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Division Of Solid & Hazardous
Utah Dept of Environmental

CLASS V LANDFILL PERMIT APPLICATION
CARBON COUNTY, UTAH

ECDC Environmental, L.C.
Landfill Facility

February 2001

Prepared by

EARTHFAX ENGINEERING, INC.
Engineers/Scientists
Midvale, Utah

EarthFax

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF SOLID AND HAZARDOUS WASTE

APPLICATION FOR A PERMIT TO OPERATE A CLASS I OR CLASS V LANDFILL
The applicant shall submit, in duplicate, an original permit application, a general report, and a technical report to:

Dennis R. Downs, Director
Division of Solid and Hazardous Waste
Utah Department of Environmental Quality
PO Box 144880
Salt Lake City, Utah 84114 - 4880

PART I - GENERAL INFORMATION

1. Name of Facility ECDC Environmental, L.C.
2. Site Location East Carbon, Utah
3. Facility Owner Allied Waste Services
4. Facility Operator ECDC Environmental, L.C.
5. Contact Person Kirk Treece
   Address 1111 West Highway 123
   P.O. Box 69
   East Carbon, Utah 84520
   Telephone 435-888-4418 Ext. 25

6. Type of Facility:

☐ Class I Landfill

☒ Class V Landfill

7. Type of Application:

☐ Initial Application

☒ Permit Renewal (Original Permit #9422)

8. Property Ownership

[X] Presently owned by applicant

[ ] To be purchased by applicant

[ ] To be leased by applicant

Property owner (if different from applicant)

Name _____

_____

Address _____

_____

_____

_____

Telephone _____

9. Certification of submitted information.

Kirk Treece, Facility Manager
(Name of Official) (Title)

I certify under penalty of law that this document and all Appendixs were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____ Date 2/20/01

SUBSCRIBED AND SWORN to before This 20th day of February, ~~19~~ 2001.

My commission expires on the 14th day of April, ~~19~~ 2003.

_____
Notary Public in and for

(SEAL) Carbon County, Utah.

TINA I. VOGRINEC
NOTARY PUBLIC • STATE of UTAH
833 WEST 1400 NORTH
PRICE, UTAH 84501
COMM. EXP. 4-14-2003

Item #1 General description of the facility (R315-310-3(1)(b))

The ECDC Environmental, L. C. (ECDC) landfill is located within the boundaries of East Carbon City, Carbon County, Utah adjacent to State Highway 123. The site encompasses approximately 2,400 acres excluding the Denver and Rio Grande (D&RG) Railroad right-of-way. The ECDC facility is an existing municipal and non-hazardous solid waste disposal facility. The facility consists of office buildings, support buildings, and active landfill cells. The initial cell was fully approved and operational in September 1992 and currently operates under permit number 9422 issued by the Utah Division of Solid and Hazardous Waste in 1996.

Whenever the facility is open and operational, ECDC will provide personnel trained in landfill operations to ensure safe and proper handling of waste. The facility accepts a wide range of wastes for disposal, including all wastes as defined in UAC R315-2-2. The facility does not except hazardous waste as defined in UAC R313-2-3, PCBs as defined in UAC R315-301-2, or radioactive materials as defined in UAC R315-12-3. Since the beginning of landfill operations at the site, the landfill waste stream has consisted of municipal solid waste and other non-hazardous municipal and industrial wastes, including green wastes and construction and demolition materials. This general waste stream will continue through the upcoming permit period. As a Class V Landfill facility, ECDC is not limited by quantities of acceptable waste and may accept non-hazardous solid waste from any origin.

This permit will regulate the operation of the existing and future landfill cells. ECDC will continue to submit detailed construction plans for each construction phase to the Executive Secretary for approval prior to construction. The work which has been completed at ECDC indicates that the present landfill property can be designed and operated so as to meet all Subtitle "D " criteria as administered by the State of Utah. Facility components which are not regulated by this permit include but are not limited to:

1. Management office, bathhouse;
2. Maintenance building;
3. Railroad car rotary dump;
4. Heat/thawing building;
5. Wash facility;
6. Railroad car bottom dump and washout facility;
7. Intermodal yard;
8. Container heat shed;
9. Solidification facility and drum dock; and
10. Truck and rail scales.

In the future, additional unloading and material handling facilities may be constructed at ECDC. Facility plans and drawings are in Appendix #1 of this permit renewal application.

Item #2 ***Legal description; proof of ownership, lease agreement, or other mechanism; latitude and longitude of the site; and land use and zoning of surrounding area (R315-310-3(1)(c))***

Proof of ownership is included in Appendix #2 of this permit renewal application. Land use and zoning are shown on drawings in Appendix #7 of this permit renewal application. The latitude of the facility is 39°31'40" with the longitude being 110°28'33". Following is a legal description of the ECDC site:

PARCEL I:

Township 15 South, Range 13 East, Salt Lake Base and Meridian

Section 7: South one-half;
Section 8: South one-half;
Section 18: North one-half; Northwest Quarter Southwest Quarter;
Section 17: Southwest Quarter Northwest Quarter;
Section 32: Southwest Quarter Southwest Quarter;

EXCEPTING THEREFROM, A strip of land 100 feet wide, being 50 feet each side of the center line of track of the Denver & Rio Grande Western Railroad Sunnyside Branch within the South one-half of Section 7 and 8, Township 15 South, Range 13 East, Salt Lake Base and Merdian, conveyed by Warranty Deed from Joseph R. Sharp, filed for recording o January 26, 1907 in the office of the Carbon County Recorder, recorded in Book 2 of Deeds at Page 395.

Township 15 South, Range 12 East, Salt Lake Base and Meridian.

Section 24: Southwest Quarter Northeast Quarter; West one-half Southeast Quarter; Southeast Quarter Southwest Quarter
Section 25: Lots 1, 2 and 3; Northeast Quarter Northwest Quarter;Northwest Quarter Northeast Quarter

EXCEPTING, therefrom all coal, oil, gas and other minerals in said lands, and the right to prospect for, mine, and remove the same.

PARCEL II:

That portion of Section 9, Township 15 South, Range 13 East, Salt Lake Base and Meridian, lying South of State Highway No. 123.

ALSO, the West one-half of the Southwest Quarter, and that portion of the Southwest Quarter of the Northwest Quarter of Section 10, Township 15 South, Range 13 East, Salt Lake Base and Meridian, lying South of State Highway No. 123.

EXCEPTING from the above land, the 200 foot wide tract of land owned by the Denver & Rio Grande Western Railroad Company through and across the North one-half of South one-half of Section 9, and the Northwest Quarter of Southwest Quarter of Section 10.

EXCEPTING therfrom all oil, gas and other mineral rights, together with the right to prospect for, mine and remove the same.

PARCEL III:

The Northeast Quarter; East one-half Northwest Quarter; Northwest Quarter Northwest Quarter, Section 17, Township 15 South, Range 13 East, Salt Lake Base and Meridian

EXCEPTING therefrom all oil, gas and other mineral rights, together with the right to enter upon, prospect for, and remove the same.

PARCEL IV:

All of Section 16, Township 15 South, Range 13 East, Salt Lake Base and Meridian

EXCEPTING therefrom all coal, oil gas and other minerals within said land, with the right to prospect for, mine and remove the same.

Item #3 The types of waste and area served by the facility (R315-310-3(1)(d))

The facility accepts a wide range of wastes for disposal. The facility accepts all wastes as defined in UAC R315-2-2, except hazardous waste as defined in UAC R315-2-3, PCBs as defined in UAC R315-301-2, and radioactive materials which equal or exceed classification as low level radioactive waste as defined in UAC R315-12-3. Since the beginning of landfill operations at the site, the landfill waste stream has consisted of municipal solid waste and other non-hazardous municipal and industrial wastes, including green wastes and construction and

demolition materials. This general waste stream will continue through the upcoming permit period. As a Class V Landfill facility, ECDC is not limited by quantities of acceptable waste and may accept non-hazardous solid waste from any origin.

PLAN OF OPERATION (R315-310-3(1)(e))

Item #4 ***An intended schedule of construction (R315-302-2(2)(a))***

ECDC intends to construct additional landfill cells as air space is needed. It is anticipated that construction will take place every other year. Each of these constructed portions will have the air space capacity to contain approximately 2,500,000 cubic yards (approximately 2,000,000 tons). ECDC reserves the right to modify this schedule upon changes of waste stream quantities. Appendix #1 of this permit renewal application provides layout plans and typical sections of the proposed development of the ECDC landfill site.

Item #5 ***A description of on-site waste handling procedures and an example of the form that will be used to record the weights or volumes of waste received (R315-302-2(2)(b) and R315-310-3(1)(f))***

ECDC accepts waste from a variety of waste-transfer mechanisms. They include, but are not limited to, commercial haulers, waste containers, and rail cars. All waste that enters the ECDC facility is weighed with state-certified scales. All weights are recorded electronically; therefore, there are no weight tickets. Volumes are tracked by surveying the active landfill cells yearly or as needed to ensure proper compaction, correct grades, and to track landfill cell life.

All commercial haulers hauling solid wastes are required to stop at the main office and be accounted for. Commercial haulers will cross a truck scale located adjacent to the main office. Once the vehicles are weighed, the commercial haulers are directed into the active landfill cell to deposit the hauled waste. The commercial haulers cross the scale once again when exiting the facility to get a tare weight. The difference between these two weights becomes the tonage placed into the landfill by the commercial hauler.

Twenty and forty foot waste containers are transported onto the ECDC property by rail. The railed waste containers are off loaded and placed onto container haul vehicles. The container haul vehicles stop at the one of two landfill scales to be weighed. A set of scales are located southeast of Cell #7 and a set of scales is located west of the existing Super Cell #1. The container haul vehicles then enter the active landfill cell to unload the containers. After unloading is complete, the haul vehicles return the containers to the rail cars.

Bulk waste streams are also brought onto the property by rail cars. These rail cars are taken into the rotary dump building, weighed, and then dumped. A front end loader then places the waste material into waste haul trucks. The waste haul trucks then enter the active landfill cell to place the load on the working face.

ECDC also accepts liquid waste material. The wastes are brought onto the facility by tank containers, either by rail or commercial hauler for solidification. Any solidification method may be employed depending on available absorbent materials. These solidified wastes are then placed at the working face and used as cover material.

Once waste is inside the cell, earth moving and compaction equipment is utilized for the placement and compaction of waste and placement of daily cover. All waste material placed in the active landfill is compacted to minimize air space usage and maximize unit weight. The waste materials are spread in lifts and compacted. At the end of each production day, MSW (Municipal Solid Waste) is covered with six inches of soil cover or an approved Alternative Daily Cover (ADC). The ADC used by ECDC is hydromulch. The hydromulch is a cellulose fiber product manufactured using fiber stock. It is provided in easy-to-handle bags. Pre-measured, water soluble dye packets are inserted into each bag, which provide a consistent dying of the material. The material mixes rapidly with water to form a homogeneous slurry. The specifications are as follows:

Moisture Content	7.1%
Organic Matter	94.6%
Moisture Holding Capacity	1,107%
pH	6.1

ECDC reserves the right to change the ADC used upon approval from the Executive Secretary.

If an area of the working landfill will not receive waste for a period longer that 30 days, ECDC will cover the area with a minimum of 12 inches of soil as an intermediate cover or an alterative intermediate cover as approved by the Executive Secretary.

If it becomes necessary to control dust emissions from the landfill activities, it will be performed in essential accordance with the ECDC Fugitive Dust Emissions Control Plan which is included in Appendix #3 of this permit renewal application.

Item #6 ***A schedule for conducting inspections and monitoring, and examples of the forms that will be used to record the results of the inspections and monitoring (R315-302-2(2)(c) and R315-310-3(1)(g))***

Inspections of the facility will be conducted quarterly by ECDC personnel or a representative of ECDC. Training of the landfill personnel for these inspections will be performed by ECDC. The purpose of these inspections is to prevent any problems with the facility and to identify any deterioration of the facility and operator errors or malfunctions which may cause a release of wastes to the environment or threaten human health. The inspection logs will be kept at the facility in the field office. In Appendix #4 of this permit renewal application is an example of the quarterly inspection log. All inspections will conform to subsection R315-302-2(5)(a) of the Solid Waste Permitting and Management Rules. The ECDC inspection plan will consist of a summary of the following information:

1. Wash Water Sump - Inspection of the integrity of the concrete sump walls will take place. If a problem is detected, remedial action will take place in a timely manner under the direction ECDC personnel. The depth of sediment and fluid will also be inspected and dealt with as needed.

2. Solidification Facility - Inspection of concrete dividing walls, back walls, and floor of the mixing and storage sump sections cracks and broken sections. Any deficiencies detected will be corrected in a timely manner under the direction ECDC personnel.

3. Run-on/Run-off Drainage for Cell #7 - Run-on/run-off protection will be inspected to ensure that no pooling occurs at the outside toe of the perimeter embankments. If a ponded area is detected, grading or pumping will take place to correct the problem. The run-off drainage collection areas will be inspected for erosion, overfilling, and blockage. Any deficiencies detected will be corrected in a timely manner under the direction ECDC personnel.

4. Run-on/Run-off Drainage for Cell #10 - Inspection of this area will occur as outlined above for Cell #7.

5. Run-on/Run-off Drainage for Super Cell #1 - Run-on/run-off protection will be inspected to ensure that no pooling occurs at the outside toe of the perimeter embankments or at the outside toe of the Run-on Diversion Safety Berms. If a ponded area is detected, grading or pumping will take place to correct the problem. The Run-on Diversion Safety Berms will also be inspected for erosion

or disturbance. If a problem is detected with the Run-on Diversion Safety Berms, the appropriate remedy will be implemented in a timely manner. The run-off drainage collection areas, including the sump, will be inspected for erosion, overfilling, and blockage. Any deficiencies detected will be corrected in a timely manner under the direction ECDC personnel.

6. Leachate Collection System for Cell #7 - The landfill leachate system, including primary and secondary piping, will be inspected for broken pipe, covers, and correctly working pumps. Leachate will be pumped out and placed on the landfill surface for evaporation and dust control. Leachate placed on a landfill surface to be evaporated will be placed into evaporation ponds located within the lined portions of landfill cells. Leachate may be placed onto lined portions of landfill cells other than the cell that it was extracted from. Any deficiencies that are discovered will be corrected in a timely manner.

7. Leachate Collection System for Cell #10 - Inspection of this leachate collection system, and handling of the collected leachate, will occur as outlined above for Cell #7.

8. Leachate Collection System for Super Cell #1 - Inspection of this leachate collection system, and handling of the collected leachate, will occur as outlined above for Cell #7.

9. Perimeter Fencing and Access Gates - Inspection of fencing for breach of security or litter accumulation, as per the ECDC litter control plan, will take place. Also, inspection of gates and other points of access for security and restriction of unauthorized access will occur. The perimeter fencing will ensure that no unauthorized access or scavenging on the landfill cells takes place. Scattered and accumulated litter will be removed in essential accordance with the ECDC Environmental Liter Control Plan which is included in Appendix #5 of this permit renewal application. If a problem with the fencing or access points, it will be corrected in a timely manner under the direction of ECDC personnel.

10. Landfill Cell #7 - The active landfill face will be inspected for proper placement and compaction of the imported waste stream. The daily cover will be inspected to ensure that all waste is being covered in essential accordance with State regulations. The access haul roads will be checked for excessive settlement, erosion, and stability. Inspection of covered (intermediate, final) portions of the landfill cell will take place. This inspection will focus on

erosion and excessive settlement. The perimeter embankments will be inspected for excessive erosion and stability of perimeter access roads. The fencing on the landfill cell will be inspected for control of blowing litter, collected litter, broken fence, and placement. Scattered and accumulated litter will be removed in essential accordance with the ECDC Environmental Liter Control Plan which is included in Appendix #5 of this permit renewal application. Any other deficiencies that are discovered will be corrected in a timely manner.

11. Landfill Cell #10 - The active landfill face will be inspected for proper placement and compaction of the imported waste stream. The access haul roads will be checked for excessive settlement, erosion, and stability. The perimeter embankments will be inspected for excessive erosion and stability of perimeter access roads. The fencing on the landfill cell will be inspected for control of blowing litter, collected litter, broken fence, and placement. Scattered and accumulated litter will be removed in essential accordance with the ECDC Environmental Liter Control Plan which is included in Appendix #5 of this permit renewal application. Any other deficiencies that are discovered will be corrected in a timely manner.

12. Super Cell #1 - Inspection of this cell will occur as outlined above for Cell #7.

Item #7 Contingency plans in the event of a fire or explosion (R315-302-2(2)(d))

ECDC will implement the Fire Prevention and Control Plan (February 2000) that has previously been submitted to the Executive Secretary. If necessary, the ECDC Environmental Emergency Evacuation Plan will be implemented (August 2000). A copy of both plans are contained in Appendix #5 of this permit renewal application.

Item #8 Corrective action programs to be initiated if ground water is contaminated (R315-302-2(2)(e))

In the event ground water contamination is detected, an appropriate remediation plan will be developed and submitted to the Utah Division of Solid and Hazardous Waste for approval.

Item #9 ***Contingency plans for other releases, e.g. explosive gases or failure of run-off collection system (R315-302-2(2)(f))***

ECDC will implement various procedures, including the ECDC Environmental Emergency Evacuation Plan (August 2000), to minimize the release of explosive gases or the failure of the run-off collection system. A copy of the ECDC Environmental Emergency Evacuation Plan is contained in Appendix #5 of this permit renewal application. ECDC will provide a Emergency Coordinator (EC) for any emergency. This person will be Jeff Green. In the case of Jeff Green being unavailable, Grant Laws will become the EC. Training for facility operations personnel and the local fire department will be provided. In the event of a explosive gas release, the procedures for taking corrective action will include:

1. ECDC will provide necessary training to facility employees regarding landfill emergency procedures.

2. All supervisory personnel will maintain radio communication with personnel in the main office, field office and the field vehicles. If required, ECDC will contact the Wellington City Fire Department and Carbon County personnel for emergency assistance.

3. Landfill earth moving equipment will be available to move earth material as necessary to contain an emergency.

4. Notify facility personnel using facility radio system and account for all personnel.

5. The EC will immediately take all necessary steps to ensure protection of human health and safety. If evacuation of the local area is advised, the EC will immediately notify local authorities and assist them in determining if evacuation of the local area is necessary.

6. Within 24 hours or the next business day, the EC will notify the Executive Secretary and local authorities. The EC will also contact other agencies if their help is needed. Telephone numbers for these agencies are listed in Table 1.

7. Within 7 days of detection, ECDC will place in the operating record the explosive gas levels detected and a description of the steps taken to protect human health and safety.

8. Within 60 days of detection, ECDC will implement a remediation plan that has

been approved by the Executive Secretary for the explosive gas release. ECDC will place a copy of the plan in the operating record and notify the Executive Secretary that the plan has been implemented.

9. If the incident involves a release of a reportable quantity of any hazardous substance (including a CERCLA hazardous substance), the community emergency coordinator or the local emergency planning committee of any area likely to be affected by the release will be notified (40 CFR 355). This notice will include:

   a. The chemical name or identity of any substance involved in the release;

   b. An indication of whether the substance is an extremely hazardous substance;

   c. An estimate of the quantity of any such substance that was released into the environment;

   d. The time and duration of the release;

   e. The medium or media into which the release occurred;

   f. Any known or anticipated acute or chronic health risks associated with the emergency and, where appropriate, advice regarding medical attention necessary for exposed individuals;

   g. Proper precautions to take as a result of the release, including evacuation; and

   h. The names and telephone numbers of the person or persons to be contacted for further information.

10. As soon as practicable after the release, ECDC will provide a written follow-up emergency notice setting forth and updating the above listed information and including action taken to respond to and contain the release.

TABLE 1.

Telephone List for Emergency Notification

Identification	Phone Number	
	Carbon County	Wellington City
Fire and Police Departments, Ambulance	911	911
Clinic/Hospital	(435) 888-4411	(435) 637-4800
Carbon County Sheriff's Department		911
Utah Dept. Of Env. Quality Div. Of Env. Response and Remediation		(801) 536-4100
Utah Dept. Of Env. Quality, Div. of Solid and Haz. Waste		(801) 538-6170
Utah Dept. Of Env. Quality, Southeastern Utah District Engineer		(801) 637-3671
National Response Center		(800) 424-8802
ECDC Environmental L.C. (office)		(435) 888-4418
Facility Manager (home) Kirk Treece		(435) 613-9196
Operations Supervisor (home) Jeff Green		(435) 472-5102
Facility Engineer (home) Darin Olson		(435) 472-8332
Shop Supervisor (home) Grant Laws		(435) 637-1529

If a failure of the run-off collection system occurs in any of the active or closed landfill cells, appropriate operations will take place in a timely manner to correct these failures. While the corrections are taking place, equipment (trash pumps, water trucks, etc.) that is available at the facility will be utilized to limit the effect of release of surface landfill water.

Following is a list of current emergency equipment that ECDC has at the facility that may be used in the event of a failure of a run-off collection system:

- Two-way Radios
- Pressurized water sources
- Assorted vacuum, Trash and Sludge Pumps
- Safety Shower and Eye Wash Stations
- First Aid Stations
- First-Aid Kits
- Respirators and Safety Equipment
- Fire Extinguishers
- Tank Truck
- Site vehicles
- Front End Loaders
- Pressure Washer
- Track Dozers
- Dump Trucks
- Excavator

Item #10 ***A plan to control fugitive dust generated from roads, construction, general operations, and covering the waste (R315-302-2(2)(g))***

A plan to control fugitive dust emissions at the ECDC facility is included in Appendix #3 of this permit renewal application.

Item #11 ***Description of maintenance of installed equipment (R315-302-2(2)(h))***

Maintenance of all equipment will be performed in essential accordance with the manufacturers recommended procedures. Following is the list of landfill equipment that will be maintained regularly or as required by the manufacturers.

1. Gas Collection System - The facility does not presently operate a gas collection system. The facility will install an active gas collection system upon closure of a landfill cell unless examination of the gas production of the waste indicates that a gas collection system is not necessary. Upon installation and operation of a gas collection system, the system will be inspected and monitored quarterly. Maintenance activities will be initiated as necessary per the manufacturer's recommended procedures.

2. Groundwater Monitoring Systems - Groundwater monitoring wells used at the facility are equipped with dedicated sampling systems. These include Teflon bladder sampling pumps, Teflon pump tubing, inlet screens and well caps. The equipment installed in each groundwater monitoring well was designed based on the specific dimensions of the well.

3. Leachate Collection System - The secondary and primary leachate collection systems consist of collection and withdrawal pipes, dedicated pumps, and a leachate tank truck. Leachate is removed, recirculated within the lined portion of the cell, utilized for dust suppression within the lined portion of the cell, or transported to a POTW.

4. Methane Gas Monitor - Methane gas monitoring will be performed quarterly using a hand-held probe. The hand-held probe will be calibrated prior to each use by the gas sample collector. This will be done in conformance with the manufacturer's recommendations. The calibration of the probe will then be documented on the landfill gas quarterly monitoring results form. Any required maintenance or repair, other than calibration, will be performed by the manufacturer of the probe or a licensed representative of the manufacturer.

Operation and maintenance of all installed equipment is performed in essential accordance with the manufacturer's recommended operation and maintenance procedures.

Prior to closure of the entire facility, the existing facility and facility structures will be maintained as part of daily operations. After closure of the entire facility, it is anticipated that the facility office will remain. The facility and facility structures will be inspected semi-annually and maintained as necessary .

Item #12 ***Procedures for excluding the receipt of regulated hazardous or PCB containing waste (R315-302-2(2)(i))***

ECDC has established strict acceptance standards for non-hazardous solid waste streams. Facility employees will supervise the unloading of waste into cells or unloading areas. Industrial solid waste classified as non-hazardous solid waste will be accepted only if the following conditions are fulfilled:

1. The generator shall be notified as to which waste streams are acceptable for disposal at the facility. No wastes listed as hazardous in 40 CFR 261.31 - 261.33 will be accepted for disposal.

2. The generator shall collect a representative sample from the waste stream and arrange for testing by a laboratory prior to shipment of the waste. The sample shall be appropriately tested for corrosivity, ignitability, reactivity, and/or the TCLP compounds as necessary. Table 2 identifies the analytical test methods and acceptance criteria for each analysis.

3. If the generator's knowledge of the waste is determined to be adequate, the generator may submit a chemical and/or physical description of the waste and a signed certification that the waste stream is not hazardous waste prior to shipment of the waste instead of the testing as discussed in Item 2.

4. ECDC personnel will examine the Generator's waste profile to determine if the waste stream is acceptable for management and disposal at the facility. The test results of Item 2 above must satisfy the acceptance criteria identified in Table 2. ECDC personnel will notify the generator of acceptance or rejection of the waste.

5. ECDC personnel will visually inspect all incoming loads for physical conformance with the waste profile.

6. Any load that does not comply with these conditions will be rejected and returned to the generator or stored on-site while the nonconformance is resolved.

TABLE 2.

Test Methods and Acceptance Criteria for Waste Samples

Parameter	Acceptance Criteria
Corrosivity	non-corrosive as defined by 40 CFR 261.22
Ignitability	non-ignitable as defined by 40 CFR 261.21
Reactivity	non-reactive as defined by 40 CFR 261.23
TCLP	does not fail the criteria listed in 40 CFR 261.24 Table 1

Notes:

1. Acceptable test methods shall be as defined by the Utah Hazardous Waste Management Regulations, R315.
2. Sulfide reactivity testing will not be conducted on refinery wastes since these wastes routinely contain more than 500 ppm sulfide and are not reactive.

Various waste streams are excluded as hazardous wastes by the Utah Hazardous Waste Management Regulations, R315-2-4. Such waste streams are acceptable for disposal at the facility. Excluded waste streams will be accepted only if the following conditions are fulfilled:

1. The generator shall be notified as to which wastestreams are acceptable for disposal at the facility.

2. The generator shall submit a signed certification that the waste stream is an excluded waste.

3. ECDC personnel will examine the generator's waste profile to determine if the waste stream is acceptable for disposal at the facility . ECDC will notify the generator of acceptance or rejection of the waste.

4. ECDC personnel will visually inspect all incoming loads for physical conformance with the waste profile. Any load which does not comply with these conditions shall be rejected and returned to the generator or stored on-site while the nonconformance is resolved.

If the receipt of prohibited hazardous waste or waste containing PCBs is discovered, ECDC will notify the Executive Secretary, the hauler, and the generator within 24 hours. The area containing prohibited waste will be controlled to restrict access by the public and facility personnel. ECDC will then ensure that proper cleanup, transport, and disposal of the waste takes place.

Item #13 Procedures for controlling disease vectors (R315-302-2(2)(j))

Various procedures are incorporated into the operation of the landfill to prevent the transmittal of disease through vector control. ECDC landfill operating procedures are intended to control disease vectors such as rodents, insects and air borne particulates.

It is ECDC policy to keep the working face exposure to a minimum. In so doing, compaction efforts are maximized which also conserves the use of daily cover material. Proper compacting procedures help ensure not only the most effective use of available landfill space but also reduces the likelihood of a rodent infestation.

To prevent an infestation of insects at the landfill, it is the policy of ECDC to cover all odoriferous wastes with a soil cover or an ADC.

Any air borne contaminants, including disease vectors, will be minimized by the ECDC Fugitive Dust Emissions Control Plan which is included in Appendix #3 of this permit renewal application. Vectors have not been observed to be a problem at the ECDC facility.

Item #14 A plan for alternative waste handling (R315-302-2(2)(k))

In the event that normal landfilling operations are impeded or all together terminated through equipment breakdown or any other unforeseen event, an alternative location within the landfill boundaries will be designated as a temporary handling and stockpiling facility. This alternative location will be as nearly adjacent to the existing working face as possible but maintaining sufficient distance for safety of the landfill personnel. It is intended to use the ground which is currently approved for disposal of solid waste as a temporary stockpiling area first. However, should it become necessary to move off the approved site for the safety and general welfare of the public, a temporary stockpiling facility would then be located on ground that is proposed for future landfill contruction. As there are approximately 2,400 acres, excluding the Denver and Rio Grande (D&RG) Railroad right-of-way, within the sanitary landfill boundaries, it is unlikely that an occasion would arise that would require the complete closure

of the landfill facility. In the event that the entire landfill facility were closed to access due to a major catastrophe, then an alternate site would need to be located for the temporary solid waste handling and stockpile facility as an emergency measure.

A temporary solid waste handling and stockpile facility would of necessity have to be versatile and mobile yet be conducive to securing the temporarily stockpiled solid waste from wind, salvagers, and animal scavengers. To construct such a facility, temporary fencing would be placed along the perimeter of the proposed temporary stockpiling area. These fenced in areas could easily be enlarged or reduced in size as necessary to accommodate the expanding or reducing stockpile size. Sizing each individual stockpile area would be important in combating the effects of wind. In addition to securing the stockpiling area with fencing, it would also be necessary to channel and berm completely around the solid waste stockpiling area to protect the facility and surrounding area from run-on/run-off water and leachate.

After the working face of the existing landfill unit is re-established and it is deemed safe to resume standard landfill operating practices, the solid waste which had previously been stockpiled at the temporary solid waste handling and stockpiling facility will then be transported to the landfill unit and deposited at the working face for compaction and burial. Upon completing the removal of all the solid waste from the temporary stockpiling facility, the fencing will then also be removed. Any impacted native soil will be removed and used as daily cover at the active landfill face. All run-on/run-off waters and leachate collected in the stockpiling area perimeter channel will then be pumped out and used as dust control at the landfill facility. All channels will then be backfilled, all berms will be leveled, and the entire temporary stockpiling area will be scarified, contoured to its original condition, and re-seeded.

In the event that the rail system were to break down or be stopped through equipment breakdown or any other unforeseen event, necessary actions will take place to ensure that the waste is hauled to the active landfill cell. This would happen by using facility waste hauling vehicles, contracting with other waste haulers, and alternate landfills.

Item #15 A general training and safety plan for site operations (R315-302-2(2)(n))

The facility manager of ECDC will ensure that the required safety and training programs are conducted for the employees. The topics to be taught will be taken from the Allied Waste Services Safety and Training Manual, a copy of which will be on file at the field office of the ECDC facility. The order of training may change to suit the needs of the facility. All safety meetings and training will be documented by indicating the topic covered and main points discussed. Employees will be required to sign and date the appropriate forms. Following is a list of the required safety and training topics:

MONTH	TRAINING TOPIC
January	Employee Right to Know
February	Respirator Training
March	Emergency Response and Spill Procedures, Company Work/Safety Rules
April	Identification of Unacceptable/Hazardous Waste; Load Inspection
May	Lock-out - Tag Out
June	Forklift Training
July	Confined Spaces
August	Asbestos Management
September	Blood Borne Pathogens
October	Electrical Safety
November	Drug and Alcohol Awareness
December	Personal Protective Equipment

Item #16 Any recycling programs planned at the facility (R315-303-4(6))

Currently, there are no recycling programs planned at the ECDC facility. ECDC does not accept waste from the general public; therefore, ECDC does not provide containers in which the general public may place recyclable materials.

Item #17 Any other site specific information pertaining to the plan of operation required by the Executive Secretary (R315-302-2(2)(o))

At the time of this permit application, no other site specific information pertaining to the plan of operation has been requested by the Executive Secretary. If any additional information is requested or required, ECDC will respond in a timely manner.

SPECIAL REQUIREMENTS FOR A CLASS V LANDFILL (R315-310-3(2))

Item #18 Submit information required by the Utah Solid and Hazardous Waste Act Subsections 19-6-108(9) and 19-6-108(10) (R315-310-3(2)(a))

The majority of the elements required by this item have been met by information contained in this permit renewal application. Other required information will be discussed in the following paragraphs.

There are many sources that supply the ECDC facility. Some of them include Utah County, Salt Lake County, Weber County, General Motors, and many private industries. ECDC markets the landfill in all areas of the country and in all markets. The waste handling procedures and quantities received have been addressed previously. ECDC charges $18 to $40 per ton of waste accepted and placed at the facility, depending on the type of waste ant the negotiated cost with each client.

ECDC has existed for the past 10 years. The facility has been profitable and has shown that there is a market and a need in the area for a commercial non-hazardous solid waste facility. ECDC has been beneficial to the local area by accepting household waste from various counties and cities. This removes the need for local municipalities to construct and operate their own landfill, there by limiting impact on the environment at various locations throughout the State. ECDC expects to continue to be beneficial to the local economy, various counties, municipalities, private industries, and the environment for at least the next two centuries.

Note: After the receipt of a solid waste permit, a Class V Landfill must receive approval from the local government, the Legislature, and the governor prior to the start of construction and operation (R315-310-3(2)(b))

PART III TECHNICAL REPORT

MAPS

Item #19 ***Topographic map drawn to the required scale with contours showing the boundaries of the landfill unit, ground water monitoring well locations, gas monitoring points, and the borrow and fill areas (R315-310-4(2)(a)(i))***

A topographic map drawn to the required scale with contours showing the boundaries of the landfill unit, ground water monitoring well locations, gas monitoring points, and the borrow and fill areas is included in Appendix #6 of this permit renewal application.

Item #20 ***Most recent U.S. Geological Survey topographic map, 7-1/2 minute series, showing the waste facility boundary; the property boundary; surface drainage channels; any existing utilities and structures within one-fourth mile of the site; and the direction of the prevailing winds (R315-310-4(2)(a)(ii))***

The most recent U.S. Geological Survey topographic map, 7-1/2 minute series, showing the waste facility boundary; the property boundary; surface drainage channels; any existing utilities and structures within one-fourth mile of the site; and the direction of the prevailing winds is included in Appendix #7 of this permit renewal application.

GEOHYDROLOGICAL ASSESSMENT (R315-310-4(2)(b))

Item #21 ***Local and regional geology and hydrology including faults, unstable slopes and subsidence areas on site (R315-310-4(2)(b)(i))***

A detailed description of the local and regional geology and hydrology of the facility was presented with the original facility permit application in a report entitled Preliminary Geologic Report of Proposed Solid Waste Disposal Site for East Carbon Development Corporation, July 11, 1989 (Appendix #8 of this permit renewal application). The following assessment summarizes and supplements the original report based on additional geologic well logs, groundwater elevation data, and groundwater chemistry data.

As described in the preliminary geologic report, the facility is located on Quaternary alluvial fan deposits consisting primarily of silt, sand, cobbles, and some boulders. These deposits

vary in thickness from approximately 0 to 50 feet while the saturated thickness of the alluvium varies from approximately 0 to 20 feet. These saturated alluvial deposits are of sufficient extent to be defined as the "uppermost aquifer."

Geologic logs from monitoring wells drilled subsequent to the preliminary geologic report are consistent with descriptions in the earlier geologic investigation. Geologic logs from monitoring wells drilled for Cell #7 indicate approximately 30 to 40 feet of alluvium (clayey gravel). Based upon a review of these geologic logs, no significant reinterpretations of the geology or hydrogeology are warranted.

According to the preliminary geologic report, no evidence of Holocene (within the last 10,000 years) faulting occurs within 3,000 feet of the site. This satisfies the requirement that a minimum 200-foot separation be maintained between Holocene faults and the facility. In addition, no faulting within 200 feet of the facility has occurred since the facility began accepting waste.

Based upon the initial geologic investigation, subsequent monitor well drilling and waste cell construction, there is no evidence of geologically unstable areas that could present a threat to the integrity of the structural components of the facility. Furthermore, there has been no earth movement events such as landslides, mudslides, sinkholes, subsidence areas, etc. within the facility boundary.

Item #22 Evaluation of bedrock and soil types and properties including permeability rates (R315-310-4(2)(b)(ii))

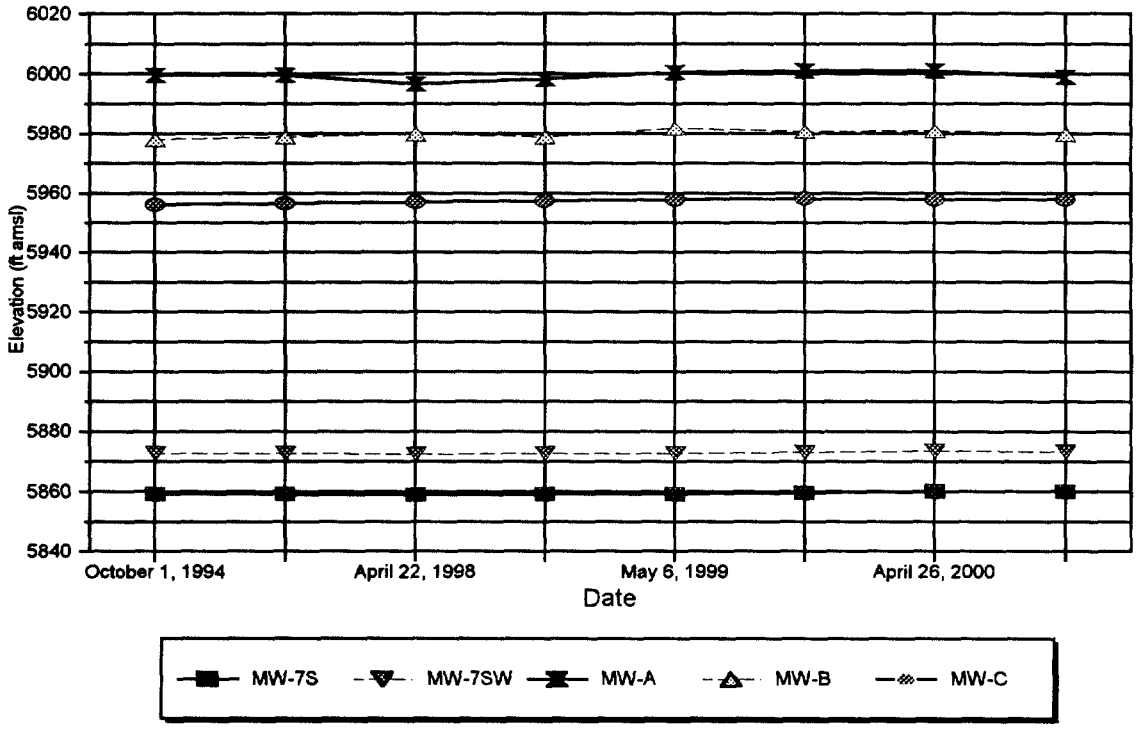
Underlying the alluvial fan materials is the Mancos Shale. The Mancos Shale is characterized as a gray clayey siltstone and silty shale which weathers at its contact with the overlying alluvial material to a tight clay, forming a permeability barrier to downward moving groundwater from the alluvial material (Lines, 1985).

Item #23 Depth to ground water (R315-310-4(2)(b)(iii))

In accordance with permit requirements, groundwater elevation data have been collected from on-site monitoring wells in conjunction with groundwater sampling since 1992. In addition, groundwater elevation data has also been periodically collected from over 40 piezometers since December, 1990. Over time, many of the piezometers have been broken or damaged. Approximately 18 piezometers remain from the original 40. These remaining piezometers were used to prepare the most recent (1Q2000) potentiometric surface map. The most complete and current site-wide potentiometric surface map is included in Appendix #18 of this permit renewal application.

Groundwater elevation data from the upgradient monitoring wells and newer Cell #7 monitoring wells were reviewed and compared to the historic groundwater elevations, gradients and flow directions. This review indicated no significant changes in the potentiometric surface

Figure 1
Monitoring Well Hydrograph



have occurred since landfill operations began.

A groundwater hydrograph for each of the up- and downgradient monitoring wells is presented in Figure 1. These hydrographs indicate very little change has occurred in the potentiometric surface across the site since 1994.

Item #24 Direction and flow rate of ground water (R315-310-4(2)(b)(iv))

Groundwater generally flows east-northeast to west-southwest across the site. Calculated groundwater gradients range from approximately 0.020 to 0.06 foot/foot.

Item #25 ***Quantity, location, and construction of any private or public wells on-site or within 2,000 feet of the facility boundary (R315-310-4(2)(b)(v))***

Table 3 presents a tabulation of private wells on-site and within a 2,000-foot radius of the facility as provided by the Utah Division of Water Rights. Three private wells were found in Sections 8 and 9 of Township 15 South, Range 13 East. No other private or public wells were found in the remaining sections (7, 10, 12, 13, 15, 21, and 22) surrounding the facility.

TABLE 3

Groundwater Rights

Location	Owner	Construction	Quantity of Right	Well Use
S 1360' W 350' N4 of Sec 8, T15S, R13E	George Porter PO Box 461 East Carbon, UT 84520	8 in. Diameter pipe to 53 ft. Bentonite grout to 26 ft.	0.015 cfs	Irrigation Domestic Stockwatering
S 1440' W 820' NE of Sec 8 T15S, R13E	George Biggs Dragerton, UT	10 in. Diameter to 50 ft.	0.0300 cfs	Irrigation Domestic Stockwatering
S 700' E 3000' NW of Sec 9 T15S, R13E	Martinez Cattle Co.	4 in. Diameter to 130 ft.	4.73 acre feet	Irrigation Domestic Stockwatering

Item #26 ***Tabulation of all water rights for ground water and surface water on-site and within 2,000 feet of the facility boundary (R315-310-4(2)(b)(vi))***

Table 4 lists all surface water rights identified within one mile of the facility boundary. This information was collected from the Division of Water Rights. Appendix #9 of this permit renewal application contains a listing of all ground water and surface water rights located on the site and with 2,000 feet of the facility boundary.

TABLE 4

Surface Water Rights

Location	Owner	Owner's Address	Source Description	Point of Diversion (distance from corner)
T15S, R12E, Sec 13	USA Bureau of Land Management	P.O. Box 970 Moab, UT 84532	Trib.to Grassy Trail	(NE 1/4 of NE 1/4)
T15S, R12E, Sec 13	USA Bureau of Land Management	P.O. Box 970 Moab, UT 84532	Trib. To Mud Spring	(NE 1/4 of SW 1/4)
T15S, R12E, Sec 13	USA Bureau of Land Management	P.O. Box 970 Moab, UT 84532	Mud Spring	(NW 1/4 of SW 1/4)
T15S, R12E, Sec 13	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Stream	(SE 1/4 of SW 1/4)
T15S, R13E, Sec 8	Paul B. Martinez	95 South 100 East Price, UT 84501	Grassy Trail Creek	(NE 1/4 of NE 1/4)
T15S, R13E, Sec 9	East Carbon City	East Carbon, UT 84520	Grassy Trail Creek	S 566,E 4323 of NW
T15S, R13E, Sec 9	Sunnyside Cogeneration Associates	P.O. Box 58087 Salt Lake City, UT 84158-0087	Grassy Trail Creek	S 566,E 4323 of NW
T15S, R13E, Sec 9	Paul B. Martinez	95 South 100 East Price, UT 84501	Grassy Trail Creek	(NE 1/4 of NE 1/4)
T15S, R13E, Sec 9	East Carbon City	East Carbon, UT 84520	Grassy Trail Creek	S 1149,E 1320 of NW
T15S, R13E, Sec 9	Sunnyside Cogeneration Associates	P.O. Box 58087 Salt Lake City, UT 84158-0087	Grassy Trail Creek	S 1149,E 1320 of NW
T15S, R13E, Sec 10	Magnificant Seven LLC Penta Creek LLC	136 So Main Salt Lake City, UT 84101	Grassy Trail Creek	NE 1/4 of NW 1/4
T15S, R13 E, Sec 10	East Carbon City	East Carbon City, UT	Unnamed Spring	N 525 W 208 SE Cor Sec 10
T15S, R13E, Sec 15	Bonnie Lynn Gleave	150 Grassy Trail East Carbon City, UT 84520	Unnamed Spring	S 840, W 860 of NE

T15S, R13E, Sec 15	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Icelander Creek and Trib to creek	(SE 1/4 of NE 1/4)
T15S, R13E, Sec 15	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Spring Area	(NW 1/4 of SE 1/4)
T15S, R13E, Sec 15	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Icelander Creek	(SW 1/4 of SE 1/4)
T15S, R13E, Sec 15	Jensen Brothers	190 North Carbon Ave. Price, UT 84501	Icelander Creek	(SE 1/4 of SW 1/4)
T15S, R13E, Sec 17	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Spring Area	(NW 1/4 of SW 1/4)
T15S, R13E, Sec 17	ECDC L.C.	124 South 500 East, Ste 675 Salt Lake City, UT 84102	East Spring	N 875, W 640 of SW
T15S, R13E, Sec 17	George Orfanakis	446 East 2nd South Price, UT 84501	Georges Spring Area and Stream	(SW 1/4 of SW 1/4)
T15S, R13E, Sec 17	Pilling, Woodrow & Ema	East Carbon City, UT	East Spring Area	(SE 1/4 of SW 1/4)
T15S, R13E, Sec 18	Sunnyside Cogeneration Associates	P.O. Box 58087 Salt Lake City, UT 84158-0087	Big Springs Spring Area	S 2450, E 2770 and S 2651, E 2316 of NW
T15S, R13E, Sec 20	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Unnamed Spring	(SW 1/4 of SW 1/4)
T15S, R13E, Sec 22	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Icelander Creek	(NW 1/4 of NW 1/4)
T15S, R13E, Sec 22	USA Bureau of Land Management	P.O. Box 45155 Salt Lake City, UT 84145	Icelander Creek	(SW 1/4 of SW 1/4)
T15S, R13E, Sec 22	Bonnie Jensen	Utah	Icelander Creek	(NE 1/4 of NW 1/4)

Note: Point of Diversions listed in parentheses are approximate locations.

Item #27 ***Identification and description of all surface waters on-site and within one mile of the facility boundary (R315-310-4(2)(b)(vii))***

The East Carbon sewage treatment and evaporation lagoons are located east of the site. The intermittent Grassy Trail Creek is located north of the site. Icelander Creek (also an intermediate stream) is located east of the site. There are several springs located southwest and southeast of the site. Appendix #6 of this permit renewal application identifies the FEMA flood plain associated with the Grassy Trail Creek. This plateau contains no naturally occurring streams, rivers, ponds, lakes, marshes, bogs, or other wetlands within the facility boundary.

Item #28 ***Background ground water and surface water quality assessment and, for an existing facility, identification of impacts upon the ground water and surface water from leachate discharges (R315-310-4(2)(b)(viii))***

Background groundwater quality has been determined through monitoring well sampling prior to cell construction and waste placement. Subsequent quarterly and semi-annual detection groundwater sampling has also contributed to a thorough description of the groundwater chemistry beneath the facility.

Groundwater data analysis consists of comparing current downgradient groundwater concentrations with the groundwater quality standards and the calculated historic means and variances from the background upgradient wells. These historic means and variances were developed from background data collected prior to waste placement (fall of 1992). The most recent quarterly sampling results and statistical analyses cover the 1st quarter of 2001 and have been submitted to the Utah Division of Solid and Hazardous Waste in essential accordance with permit requirements. This report summarizes water quality in the area based on the monitoring results.

Item #29 ***Calculation of site water balance (R315-310-4(2)(b)(ix))***

The ECDC facility is located in a generally warm arid environment with a significant negative annual water balance. The average annual precipitation for the nearby town of Sunnyside over the period 1951 to 1980 was 11.98 inches. The average annual pan evaporation for the same period and location was 46.63 inches.

As a further evaluation of this arid environment, ECDC has performed water balance calculations using the Hydrologic Evaluation of Landfill Performance (HELP) model developed for the U.S. EPA. The model was developed to estimate water movement across, into, through, and out of landfills and to simulate the effects of hydrologic processes including precipitation, surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and

lateral drainage. Specifically, the model may be used to estimate the magnitudes of various components of the water budget, including the volume of leachate produced and the thickness of water saturated soil (head) above the barrier layers.

Detailed model results have previously been submitted to the Division for review. A summary of results are presented in Table 5 and 6 below. An explanation of model assumptions and parameters is included in Appendix #10 of this permit renewal application. Model simulations included both open and closed landfill conditions. As expected, leachate production was predicted to be highest under open conditions and less under closed conditions. In each case, leachate production was predicted to be low relative to evaporation due to the low annual precipitation and high evapotranspiration rate (i.e., note the consistent negative "change in water storage"). Importantly, regardless of the climatological or physical conditions simulated, the model never predicted more than four inches of water accumulation on either the cap, secondary or primary liners (peak daily accumulation).

TABLE 5

HELP Model Water Balance
Open Cell Matrix

Run	Cell Parameters			Peak Daily Values		Average Annual Totals for 5 Years			
	Waste Depth (ft)	Floor Slope (%)	Drainage Length (ft)	Head on Primary Liner (in.)	Head on Secondary Liner (in.)	Pptn. (in.)	Leachate from Primary Collection (gal)	Leachate from Secondary Collection (gal)	Change in Water Storage (gal)
1	10	2.5	407	0	0	9.76	578,453	0	(287,687)
2	10	2.5	690	0	0	9.76	911,610	0	(773,340)
3	50	2.5	407	0	0	9.76	1,417,245	0	(1,126,493)
4	50	2.5	690	0	0	9.76	1,614,300	0	(1,476,045)
5	102	2.5	407	0	0	9.76	1,703,557	0	(1,412,805)
6	102	2.5	690	0	0	9.76	1,829,040	0	(1,690,793)
7	10	2.0	550	0	0	11.79	670,538	0	(360,608)
8	10	2.0	550	0	0	15.79	3,928,500	0	(110,865)

Notes: Run 8 was simulated for only one year, 1974. All values are for 1974 only.

TABLE 6

HELP Model Water Balance
Closed Cell Matrix

Run	Cell Parameters			Peak Daily Values		Average Annual Totals for 5 Years			
	Waste Depth (ft)	Floor Slope (%)	Drainage Length (ft)	Head on Primary Liner (in.)	Head on Secondary Liner (in.)	Pptn. (in.)	Leachate from Primary Collection (gal)	Leachate from Secondary Collection (gal)	Change in Water Storage (gal)
1	407	4	0	0	9.76	135	1,771,815	0	(1,645,193)
2	690	4	0	0	9.76	135	1,771,815	0	(1,645,193)

ENGINEERING REPORT - PLANS, SPECIFICATIONS, AND CALCULATIONS

Item #30 ***How the facility meets the location standards of R315-302-1 including documentation of any demonstration made with respect to any location standard (R315-310-4(2)(c)(i))***

The existing ECDC facility structures and waste cells presently meet all location standards under R315-302-1. In addition, all future cells and facilities will be designed and constructed to meet these criteria.

Airports - The ECDC facility is located approximately 15 miles from the nearest airport. This satisfies the airport location criteria per R315-302-1(2)(a)(v) requiring a separation distance of as much as 10,000 feet to the nearest airport runway.

Flood Plains - According to the East Carbon City and Carbon County FEMA Floodplain map as shown in Appendix #6 of this permit renewal application, none of the facility lies within the 100-year flood plain. In addition, the facility landfill units and other structures will not restrict the flow of a 100-year flood. No washout of waste material will be transported into any streams, rivers, or off-site. This satisfies the floodplain location criteria defined by R315-302-1(2)(c).

Wetlands - The ECDC facility is located on a elevated plateau or bench that gently slopes to the west. This plateau contains no naturally occurring streams, rivers, ponds, lakes, marshes, bogs, or other wetlands within the facility boundary. In addition, no vegetation that is "adapted for life in saturated soil conditions" is known to exist within any areas of the site. The low annual

precipitation (less than 12 inches) and high evapotranspiration rate (over 46 inches per year) contribute to a negative water balance, thereby creating an environment that is not conducive to the development of wetlands. This satisfies the wetlands location criteria define by R315-302-1(2)(d).

Seismic Impact Zone - The facility is located in an area rated as Seismic Zone 2. The existing landfill cells have been designed to meet this seismic criteria. Future landfill cells will also be designed to meet this criteria.

Fault Areas - Based upon a thorough geologic investigation and review, no evidence of Holocene faulting was found within 3,000 feet of the site. This satisfies the requirement that a minimum 200 foot separation be maintained between Holocene faults and the facility. In addition, no faulting within 200 feet of the facility has occurred since the facility began accepting waste.

Unstable Areas - Based upon the initial geologic investigation, subsequent monitor well drilling, and waste cell construction, there is no evidence of geologically unstable areas that could present a threat to the integrity of the structural components of the facility . Furthermore, there have been no earth movement events (landslides, mudslides, sinkholes, subsidence areas, etc.) within the facility boundary.

Item #31 The basis for calculating the facility's life (R315-310-4(2)(c)(ii))

The existing active landfill cells have recently been surveyed. The landfill cells are surveyed on an as-needed basis. The data from the surveying activities are needed to track the remaining air space and grade of each landfill cell. The data are used to establish a computer-generated existing surface topography map. For the purpose of volume calculations, this surface is then compared to the designed final surface. The difference of these two surfaces is the remaining air space. The site has approximately 374,400,000 cubic yards of air space remaining. Knowing the density range of the placed waste/cover material and the average tonnage of waste received each year, the life of the facility can be estimated. With an estimated in-place density range of 1,500 to 2,500 pounds per cubic yard, the remaining tonnage would range from 280,800,000 to 468,000,000 tons. The ECDC facility receives an average 1,000,000 tons per year. The estimated life of the facility therefore ranges from 281 to 468 years.

Item #32 ***Cell design to include liner design, cover design, fill methods, elevation of final cover including plans and drawings signed and sealed by a professional engineer registered in the State of Utah (R315-310-3(1)(b) and R315-310-4(2)(c)(iii))***

A detailed description of the ECDC facility is contained in Item #1 of this permit renewal application. The facility has three active landfill cells at the time of this application. Each landfill cell is designed to meet the requirements of the State of Utah and to protect human health and safety. The landfill cell design drawings are attached as Appendix #1 to this document.

In the future ECDC will place waste on the embankment between Cell #7 and Super Cell 1-A. Drawings showing this waste placement area are contained in Appendix #11 of this permit renewal application.

Item #33 ***Equipment requirements and availability (R315-310-4(2)(c)(iii))***

ECDC will ensure that operational equipment will be available to meet the standards for maintenance and operation of the facility. Following is a list of the equipment currently at the ECDC facility:

- Leachate Tank Truck
- Fuel Truck
- Mechanic Truck
- Two Ton Flatbed Truck
- Sweeper Truck
- Ford Service Truck
- Cat 988B Front End Loader
- Cat 988F Front End Loader
- Cat 836 Compactors (2)
- Cat 146 Motor Grader
- Cat D7H Bulldozer
- Cat D8N Bulldozer
- Kobelco 120 Track Excavator
- Columbia Tipper
- Cat 769 Water Truck
- Cat 773D End Dump Trucks (3)
- Container Lift Hist
- Cat Container Lift
- Scat Track
- Daewoo Fork Lift

- ADC Distributor
- Cat 768D Power Unit
- Cat 768B Power Unit
- Commander Scissor Lift
- Cat D8R Bulldozer
- Simon Man Lift
- International Snow Plow

Item #34 ***Identification of borrow sources for daily and final cover and for soil liners (R315-310-4(2)(c)(iv))***

All municipal solid waste will be covered intermittently , after compaction, with a minimum of six inches of soil, ash, or other non-municipal solid waste to control vectors, fires, odors, blowing litter, and scavenging animals. When waste soil materials are available from an imported waste stream, they will be utilized as daily cover; otherwise, daily cover will be excavated from an on-site borrow source. The borrow areas for daily cover, intermediate cover, final cover, and soil liners are identified on the drawing contained in Appendix #6 of this permit renewal application.

Item #35 ***Run-off or leachate collection, treatment, and disposal and documentation to show that any treatment system is being or has been reviewed by the Division of Water Quality (R315-310-4(2)(c)(v) and R315-310-3(1)(i))***

The secondary and primary leachate collection systems in each landfill cell consist of collection and withdrawal pipes, a dedicated pump installed in each withdrawal pipe, and a leachate tank truck. The leachate collection systems are designed using accepted engineering practices and to prevent no more than one foot depth of leachate developing at any point in the bottom of each landfill cell. Leachate is removed and recirculated within the composite lined portion of the landfill cells. It is utilized for dust suppression, stored in a pond, or spread out to facilitate evaporation. ECDC does not operate any waste water treatment facility.

Item #36 ***Ground water monitoring plan that meets the requirements of Rule R315-308 including well locations, design, and construction (R315-310-4(2)(b)(x) and R315-310-4(2)(c)(vi))***

A groundwater monitoring plan is included in Appendix #12 of this permit renewal application. A drawing showing the location of monitoring wells is included in Appendix #6 of this permit renewal application.

Item #37 Landfill gas monitoring and control plan that meets the requirements of Subsection R315- 303-3(5) (R315-310-4(2)(c)(vii))

Methane Gas Monitoring - Methane gas monitoring is performed quarterly at the facility structures and at the property boundaries closest to existing cell(s). The monitoring will be performed by ECDC personnel or an ECDC representative. A copy of the form for reporting gas monitoring results is in Appendix #13 of this permit renewal application. Maintenance of the monitoring equipment will take place in essential accordance with the manufactures recommendations. Quarterly monitoring is performed with a hand-held probe at the following locations:

1. Crawl space beneath the administrative building;
2. Southwest corner of the rotary dump area at ground level;
3. Southeast corner of the Super Cell #1 scale shack at ground level;
4. Southwest corner of the intermodal area at ground level;
7. Northwest corner of the Cell #7 scale shack at ground level;
8. North property boundary; and
9. South property boundary.

The Utah Solid Waste Rules require that facilities implement a methane monitoring program to ensure that methane concentrations do not exceed 25% of the Lower Explosive Limit (LEL) in facility structures and 100% of the LEL at the property boundary. The facility monitoring consists of a two-step process: an internal action level and the regulatory action level. The internal action level has been set at half of the regulatory limit, which is 12% of the LEL in structures and 50% of the LEL at property boundaries. If a monitoring event exceeds the internal action limit, the facility manager is notified. This first step is for internal awareness and planning only. The second level of the monitoring plan details the procedure if methane concentrations exceed the regulatory limit of 25% of the LEL at the facility structures or 100% of the LEL at the property boundary. If an exceedance is noted in a monitoring event, steps will immediately be taken to protect human health and the Executive Secretary will be notified within 24 hours or the next business day. Within 7 days of detection, ECDC will place in the operating record the explosive gas levels detected and a description of the steps taken to protect human health. After

an investigation into the exceedence, a remediation plan will be developed within 60 days. The ECDC facility shall not cause a violation of any ambient air quality standard at the property boundary or emission standard from any emission of landfill gases, combustion or any other emission associated with the facility.

Methane Gas Control - The facility does not presently operate a gas collection system. The facility will install a gas collection system upon closure of a landfill cell unless examination of the gas production of the compacted waste indicates that a gas collection system is not necessary. Plans will be provided to the Utah Division of Solid and Hazardous Waste for review prior to construction. Upon installation and operation of a gas collection system, the system will be inspected and monitored in essential accordance with the manufactures recommendations. Maintenance activities will be initiated as necessary.

Item #38 Design and location of run-on and run-off control systems (R315-310-4(2)(c)(viii))

All landfill cells at the facility are designed to preclude run-on storm water from entering the cells. Dikes and embankments exist to prevent non-contaminated storm water from running onto active portions of the active landfill cells. Drainage channels, embankments and dikes are inspected regularly. Erosion detected during the visual inspection will be repaired. Objects hindering flow will be removed.

Storm water run-off from active areas is treated as leachate and is collected, recirculated within the lined portion of the cell, placed in a storage pond, utilized for dust suppression within the lined portion of the cell, or taken to a waste water facility.

A drawing showing the location of the run-on/run-off control systems is included in Appendix #6 of this permit renewal application.

CLOSURE PLAN (R315-310-3(1)(h))

Item #39 Closure schedule (R315-310-4(2)(d)(i))

The closure of Cell #7 is expected to begin within the next 5 years. Once the cell reaches capacity , design drawings will provided for review and approval prior to construction. The layer will be placed using standard construction equipment. The closed cell will require approximately 1 to 2 years for settlement of the underlying waste. After the settlement period, the final closure of the cell will occur by placing the final cover material and constructing a gas control system. The time for complete closure of Cell #7 is anticipated to be approximately 3 - 5 years from the time closure begins.

The closure of Cell #10 is expected to begin within the next 5 years. Procedures and scheduling for the closure will be as outlined above for Cell #7.

The closure of Super Cell #1 is expected to occur within the next 100 years. At the time of closure, the final cover will be designed using current technology. If closure is required in the near future, it will be closed in a similar manner as previously closed cells.

ECDC will notify the Executive Secretary at least 60 days prior to receipt of the last waste into a cell that closure activities on that cell will be initiated. Implementation of closure activities in any landfill cell will begin within 30 days of last receipt of waste to that cell. Upon completion of closure activities in any of the landfill cells, ECDC will submit to the Executive Secretary certification that the landfill cell was closed in essential accordance with the closure plan. As part of the submittal to the Executive Secretary, ECDC will also submit as-built drawings of the landfill cell and certification that all final cover components were installed according to the closure plan and the QA/QC plan. All certifications and drawings will be sealed by a P.E. registered in the state of Utah. This submittal, including as-built drawings, will be submitted to the Executive Secretary within 90 days of completion of closure activities. Within 60 days of certification of closure, ECDC will file a notarized plat with the county recorder of deeds. A statement concerning the location and amount of waste will be recorded on the site title. Until a landfill cell closure is approved by the Executive Secretary, it will be regarded and be maintained as active.

The estimated life of the total facility ranges from 281 to 468 years. The current projection for closure of the entire landfill is estimated to be between the year 2281 and the year 2468.

Item #40 Design of final cover (R315-310-4(2)(c)(iii))

ECDC is currently researching alternate final cover designs. If after the research it is determined that an alternate final cover design is more beneficial, ECDC will submit the alternate final cover design to the Executive Secretary for approval. This design will be submitted for review and approval prior to closure of any landfill unit.

In lieu of an alternate final cover design, a 2-foot thick layer of protective cover will be placed over the waste and compacted. The partially closed cell will require approximately 1 to 2 years for settlement to take place. Upon completion of settlement, vegetation will be removed, eroded protective cover will be replaced, and the area will be re-compacted. A 40-mil V.L.D.P.E. liner will be installed over the protective cover. A composite drainage net system will be placed on top of the liner. Two feet of compacted (90% of a Standard Proctor) soil will be placed above the composite drainage net system. Six inches of topsoil placed over the compacted soil will support either a vegetation or a rock cover. Prior to closure of the landfill units the decision to

use vegetation or rock will take place. Vegetation requirements will be determined based upon recommended standards of the Utah Department of Natural Resources or the U.S. Natural Resources Conservation Service. Construction of a gas control system will then take place. Six months prior construction of the gas control system, ECDC will submit construction plans to the Executive Secretary for approval.

The closure cap will slope on a grade of 4:1 (run:rise) or flatter for approximately 20% of the width of the cap from the cell edge to an intermediate ridge line. The cap will then slope on a 3% to 15% grade from the ridge line to the crown of the cell. The most recently approved Quality Assurance and Quality Control Plan at the time of closure construction activities will be implemented. A third party will be involved in the closure activities to ensure that the design requirements are met. Local materials will be utilized for closure activities. Standard construction equipment and practices will be employed for the construction operations.

Item #41 Capacity of site in volume and tonnage (R315-310-4(2)(d)(ii))

The site has an approximate total capacity of 382,000,000 cubic yards of air space, with approximately 374,400,000 cubic yards of air space remaining. With an estimated in-place density range of 1,500 to 2,500 pounds per cubic yard, the remaining tonnage would range from 280,800,000 tons to 468,000,000 tons.

Item #42 Final inspection by regulatory agencies (R315-310-4(2)(d)(iii))

The Executive Secretary will be notified of the intent to implement the closure plan, in part or whole. Final closure of any cell may require 1 to 5 years to reach completion due to the amount of time allowed for settlement before placing the final cover. The Executive Secretary will be notified within 90 days after completion of closure activities to allow the regulatory agency to conduct a final review and closure inspection.

POST-CLOSURE CARE PLAN (R315-310-3(1)(h))

Item #43 Site monitoring of landfill gases, ground water, and surface water, if required (R315-310- 4(2)(e)(i))

Upon approval of closure activities by the Executive Secretary, the post-closure care plan will be implemented. Following are the monitoring activities that will take place during post-closure.

Landfill Gas Monitoring - During post-closure care, landfill gas monitoring will continue on a quarterly basis as described in Item #37 of this permit renewal application.

Ground Water Monitoring - During post-closure care, ground water monitoring will continue on a semi-annual basis as described in Item #36 of this permit renewal application.

Leachate Collection Monitoring - During post-closure care, leachate collection and treatment monitoring will continue on a quarterly basis as described in Item #45 of this permit renewal application.

Cover and Run-on/Run-off Monitoring - During post-closure care, cover and run-on/run-off monitoring will continue on a quarterly basis as described in Item #45 of this permit renewal application.

Records kept for all monitoring activities will be stored in the field office. At the end of the life of the ECDC facility, a new site will be chosen for storage of monitoring documents. ECDC will provide an annual report as required by UAC R315-302-2(4). Upon completion of the post-closure activities of any landfill unit at the facility, a P.E. registered in the state of Utah will certify that all post-closure activities were conducted in essential accordance with the post-closure plan. ECDC will place the post-closure completion documentation in the operating record and submit it to the Executive Secretary. Any modifications to the post-closure plan will be submitted to the Executive Secretary for approval at least 6 months prior to the implementation of the post-closure plan.

Withdrawals from the selected financial assurance mechanism for the costs incurred by ECDC for the regularly scheduled quarterly inspections and monitoring will be requested at the end of each post-closure quarter. Withdrawals for any added inspection trips, monitoring, and maintenance work performed will also be made at the end of the quarter in which the work was performed. In the event that the funds in the post-closure care account are depleted prior to the completion of post-closure care obligations, ECDC will continue their post-closure care responsibilities at their own expense to the end of the post-closure period. Upon completion of ECDC's post-closure care responsibilities, any remaining funds in the post-closure care account will be withdrawn by ECDC.

Item #44 ***Changes to record of title, land use, and zoning restrictions (R315-310-4(2)(e)(ii))***

Change of ownership of the property occurred on December 1997. There have been no additional changes to the zoning and land use restrictions. A copy of the name change is included in Appendix #2 of this permit renewal application.

Item #45 ***Maintenance activities to maintain cover and run-on/run-off control systems (R315-310-4(2)(e)(iii))***

There are no surface water sources on the landfill property. As a result, ECDC will not conduct surface water monitoring as part of the post-closure care activities.

Quarterly inspections will be made to ensure the integrity of the cover system and the run-on/run-off systems. It is understood that erosion can have an adverse effect on the landfill facility, and if left unchecked or not maintained, could become a stability problem or a public hazard. ECDC will ensure the integrity of the landfill facility and remaining structures during the post-closure period, thus protecting the public and the environment. ECDC will maintain and repair the cover system by replacing eroded areas with additional material and controlling deep rooted vegetation that could damage the landfill cell cover. Surface water drainage will also be controlled to preclude erosion of the cover material or the perimeter embankments. De-watering systems will remain in place to drain any leachate water within the landfill units. Post-closure maintenance of this system will consist of maintaining the integrity of the pumps, piping systems, and pipe covers.

Upon closure of each unit, run-on/run-off diversion channels will be constructed as needed. The rock-lined channels will be designed and constructed to control surface drainage as each closure section is completed. The channels will be designed for the 25-year rainfall event.

Item #46 ***List the name, address, and telephone number of the person or office to contact about the facility during the post-closure care period (R315-310-4(2)(e)(v))***

Following is the name, address, and telephone number of the person to contact about the ECDC facility during the post-closure period.

Name:	Kirk Treece Facility Manager
Address:	1111 West Highway 123 P.O. Box 69 East Carbon, Utah 84520
Telephone Number:	435-888-4418 Ext. 25

FINANCIAL ASSURANCE (R315-310-3(1)(j))

Item #47 ***Identification of closure costs including cost calculations (R315-310-4(2)(d)(iv))***

The closure costs, including cost calculations for Cell #7, are contained in Appendix #14 of this permit renewal application. The quantities for closure were determined using recent survey information to establish an existing surface and comparing it to the final designed surface. *AutoCad Land Development* was used to establish and compare the surfaces. Other quantities were determined using the final design drawings. Costs for closure were determined using similar projects in the area and projects at ECDC. Following is an explanation of each line item in the Appendix.

1. Engineering - This item includes, but is not limited to, inspection to identify waste disposal areas, analyze drainage and erosion protection needs, determine other site operational features that may not be in compliance with the permit, and analyze ground water samples and operational records.

2. Technical Specifications and Drawings - This item includes, but is not limited to, final cover system design and specifications, grading and drainage plans, specifications for revegetation, design of any other site improvements required, preparation of a closure schedule, contractor bidding process, and coordination of the closure plan with the Utah Division of Solid and Hazardous Waste.

3. Grading of Existing Waste - The existing waste in Cell #7 must be graded to an acceptable slope. The slope will be calculated at the time of closure. The waste material will be graded to form a base upon which the capping materials will be placed.

4. Preparation of Selected Waste - Selected waste will be screened to produce 2 feet of bedding material in Cell #7 for the geosynthetic liner. Once the material is produced, the material will be placed, moisture-conditioned, and compacted. If it is necessary to use an alternate bedding material, it will be produced from an on-site source.

5. Installation of Geosynthetic Liner - A geosynthetic liner will be installed on the selected screened waste in Cell #7 to prevent moisture from entering the landfill waste material.

6. Installation of Geonet - A geonet will be placed on top of the geosynthetic liner in Cell #7 to produce an avenue for liquids to flow from the landfill cell cap.

7. Installation of Geotextile - A geotextile will be placed on top of the geonet in Cell #7 to preclude fine material from plugging the geonet.

8. Protective Soil Cover - Cover soil material will be produced on-site and hauled to landfill Cell #7. The cover soil will be placed on top of the geotextile to a depth of 2 feet. The material will be moisture-conditioned and compacted during placement.

9. Cover Cell with Vegetation or Rock - Upon completion of the cap in Cell #7, 6 inches of top soil or rock will be placed on top of the protective soil cover. If top soil is used, the cell will be seeded for the production of a vegetation cover.

10. Drainage Control for Landfill Cell - Drainage control for Cell #7 will be designed and installed to allow precipitation to exit the landfill surface without eroding the landfill cell.

11. Surveying - During all activities of closure of Cell #7, surveying will take place to control construction of the project. Included in this item is the boundary survey.

12. Materials Testing and Reporting - During all activities of closure of Cell #7, materials testing and reporting will take place to ensure construction meets the requirements of the technical specifications of the project.

13. Oversight, Inspection and Supervision - During all activities of closure of Cell #7, management of the project will take place to oversee all phases of construction and closure.

14. Total - This line item is the total cost to close Cell #7.

The closure costs including cost calculations for Cell #10 are contained in Appendix #14 of this permit renewal application. The quantities for closure were determined using recent survey information to establish an existing surface and comparing it to the final designed surface. *AutoCad Land Development* was used to establish and compare the surfaces. Other quantities were determined using the final design drawings. Costs for closure were determined using similar projects in the area and projects at ECDC. Following is an explanation of each line item in the Appendix.

1. Engineering - As outlined above.

2. Technical Specifications and Drawings - As outlined above.

3. Grading of Existing Waste - As outlined above.

4. Removal and Excavation of Existing Dikes - The existing embankments of Cell #10 will be cut down to an elevation of 5895 feet. The excess material will then be hauled to the north end of the existing landfill cell for construction of the north dike. The removal of the top portion of the existing dikes will allow for a closure of Cell #10 without hauling soil material into the cell to complete the designed grades.

5. Construction of North Dike - An embankment will be constructed on the north end of Cell #10 to enclose the existing waste and allow for closure of the landfill cell. The dike will be constructed of material taken from existing dikes. The material will be moisture-conditioned and compacted during placement. After the dike is constructed, a liner will be constructed using clay material, geosynthetic liner, and select cover material. An anchor trench will be installed around the perimeter of the landfill cell.

6. Preparation of Selected Waste - As outlined above.

7. Installation of Geosynthetic Liner - As outlined above.

8. Installation of Geonet - As outlined above.

9. Installation of Geotextile - As outlined above.

10. Protective Soil Cover - As outlined above.

11. Cover Cell with Vegetation or Rock - As outlined above.

12. Drainage Control for Landfill Cell - As outlined above.

13. Surveying - As outlined above.

14. Materials Testing and Reporting - As outlined above.

15. Oversight, Inspection and Supervision - As outlined above.

16. Total - This line item is the total cost to close Cell #10.

The closure costs including cost calculations for Super Cell #1 are contained in Appendix #14 of this permit renewal application. The quantities for closure were determined using recent survey information to establish an existing surface and comparing it to the final designed surface. *AutoCad Land Development* was used to establish and compare the surfaces. Other quantities were determined using the final design drawings. Costs for closure were determined using similar projects in the area and projects at ECDC. Following is an explanation of each line item in the Appendix. Descriptions of each line item are similar to those presented in the discussion of Cell #7 closure.

Item #48 Identification of post-closure care costs including cost calculations (R315-310-4(2)(e)(iv))

The post-closure care costs including cost calculations for Cell #7 are contained in Appendix #15 of this permit renewal application. The post-closure care plan will be part of the permit; therefore, there is not a cost to produce it in the post-closure care costs. Following is an explanation of each line item in the Appendix.

1. Collect, Treat and Dispose of Leachate - During the post-closure care period, leachate collection and monitoring will take place as described in Item #35 of this permit renewal application.

2. Gas Collection and Monitoring - During the post-closure care period, gas collection and monitoring will take place as described in the Gas Collection and Monitoring Plan.

3. Repair and Maintain Surface Drainage Structures, Final Cover, On-Site Permanent Improvements and Equipment - During the post-closure care period, maintenance, inspection, and repair of the final cover, run-on/run-off systems, on-site permanent improvements, and equipment will take place.

4. Rework or Replace Defective Groundwater Monitoring Wells and Equipment, Install New Wells and Equipment - During the post-closure care period, maintenance, inspection, and repair of the monitoring wells will take place. If any new wells are required, they will be installed.

5. Collect Semi-Annual Groundwater Samples - During the post-closure care period, collection of the groundwater samples will take place semi-annually.

6. Analyze Semi-Annual Groundwater Samples - During the post-closure care period, analysis of the groundwater samples will take place semi-annually.

7. Maintain Site Security and Access Control - During the post-closure care period, security of the site and access to the site will be maintained and controlled.

8. Provide Administrative Overhead for Oversight and Record Keeping - During the post-closure care period, administrative oversight and record keeping of all activities of post-closure will take place.

9. Prepare Post-Closure Certificate - During the post-closure care period, preparation of post-closure certificates will take place.

10. Total - This line item is the total cost for post-closure care of Cell #7.

Appendix #16 of this permit renewal application demonstrates the investment that should be made for post-closure care for Cell #7. The starting cost is the estimated yearly cost for post-closure care. The income interest rate is estimated by ECDC to be 12% per year and the estimated inflation rate is 3.735% per year. The estimated inflation rate is the average inflation rate for the last twenty years in the state of Utah. The table illustrates the estimated cost, beginning amount and ending amount of the investment for each of the thirty years required for post-closure care.

The post-closure care costs including cost calculations for Cell #10 are contained in Appendix #15 of this permit renewal application. The post-closure care plan will be part of the permit, therefore, there is not a cost to produce it in the post-closure care costs. Line items

contained in the cost estimate are similar to those described above. Interest and inflation rates are equivalent to those described above.

The post-closure care costs including cost calculations for Super Cell #1 are contained in Appendix #15 of this permit renewal application. The post-closure care plan will be part of the permit, therefore, there is not a cost to produce it in the post-closure care costs. Line items contained in the cost estimate, together with the indicated inflation and interest rates, are similar to those described above.

Item #49 ***Identification of the financial assurance mechanism that meets the requirements of Rule R315-309 and the date that the mechanism will become effective (R315-309-1(1))***

A copy of the statement of financial assurance mechanism is included in Appendix #17 of this permit renewal application.

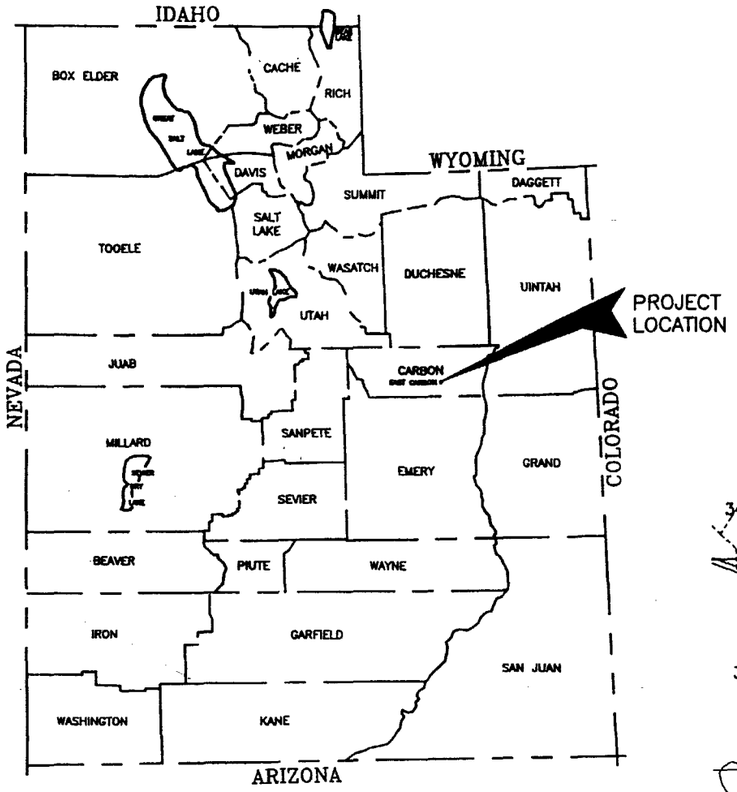
APPENDIX 1

Cell #7 Drawings

EAST CARBON DEVELOPMENT CORPORATION

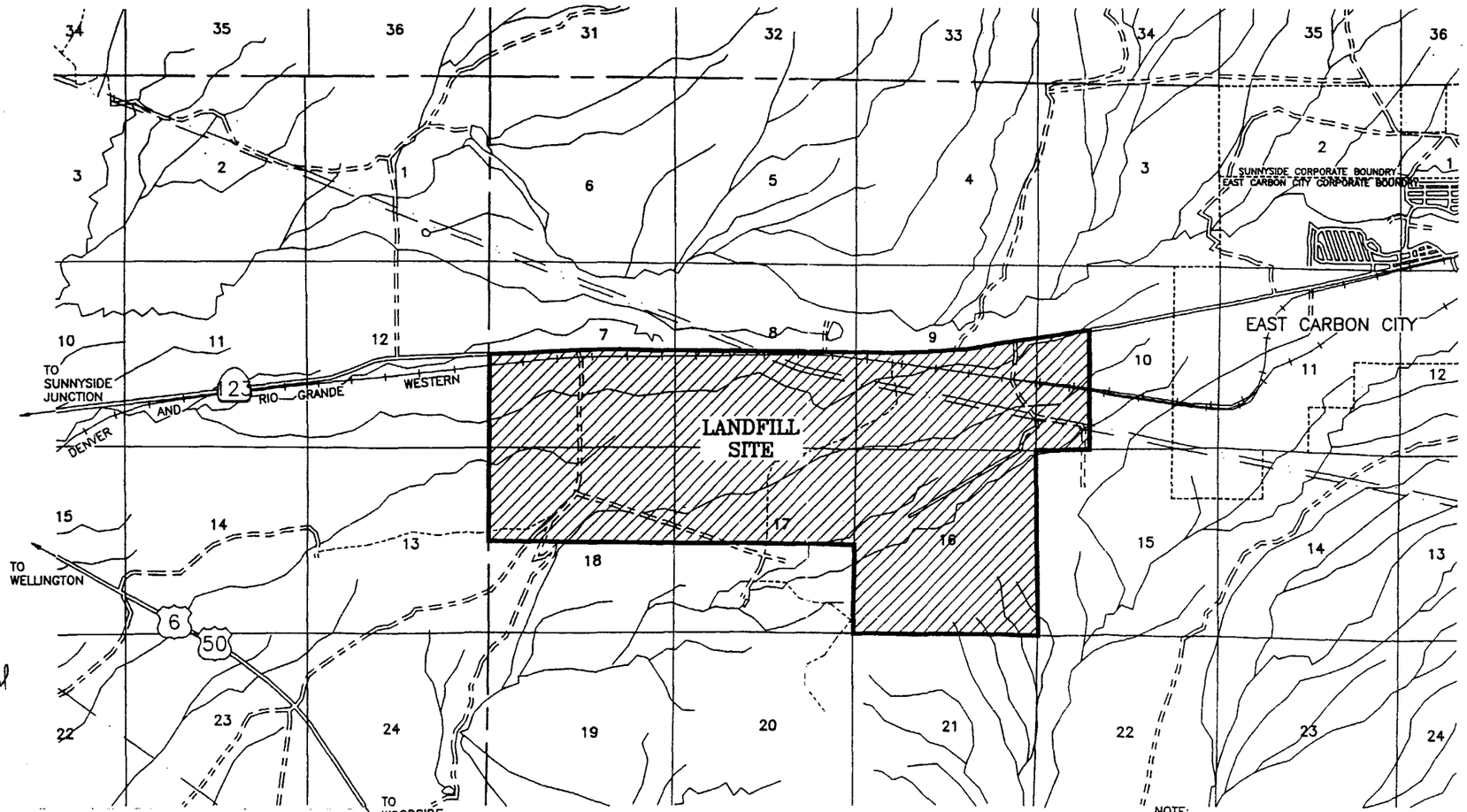
MUNICIPAL LANDFILL FACILITY

February 1990



INDEX TO SHEETS

SHEET No.	DESCRIPTION
1	COVER & INDEX TO SHEETS
2	PROJECT LOCATION MAP
3	OVERALL SITE PLAN
4	CELL 7 – PLAN VIEW
5	CELL 7 – CROSS SECTIONS
6	TYPICAL SECTIONS AND DETAILS
7	CELL LINER DETAILS
8	LEACHATE COLLECTION SYSTEM
9	LEACHATE COLLECTION SYSTEM
10	CHAIN LINK FENCE DETAILS
11	CELL CLOSURE DETAILS
12	CELL 7 – SECTION C–C



CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

NOTE:
THE CONST. PLANS ARE FOR THE ENTIRE LANDFILL SITE. DETAILS SHOWN FOR CELL 7 ARE TYPICAL FOR ALL CELLS SHOWN ON SHEET No. 3.

97-1035 Send 1035 Profile Accepted

SECTION AND DETAIL IDENTIFICATION

SECTION IDENTIFICATION

DETAIL IDENTIFICATION

NOTE:

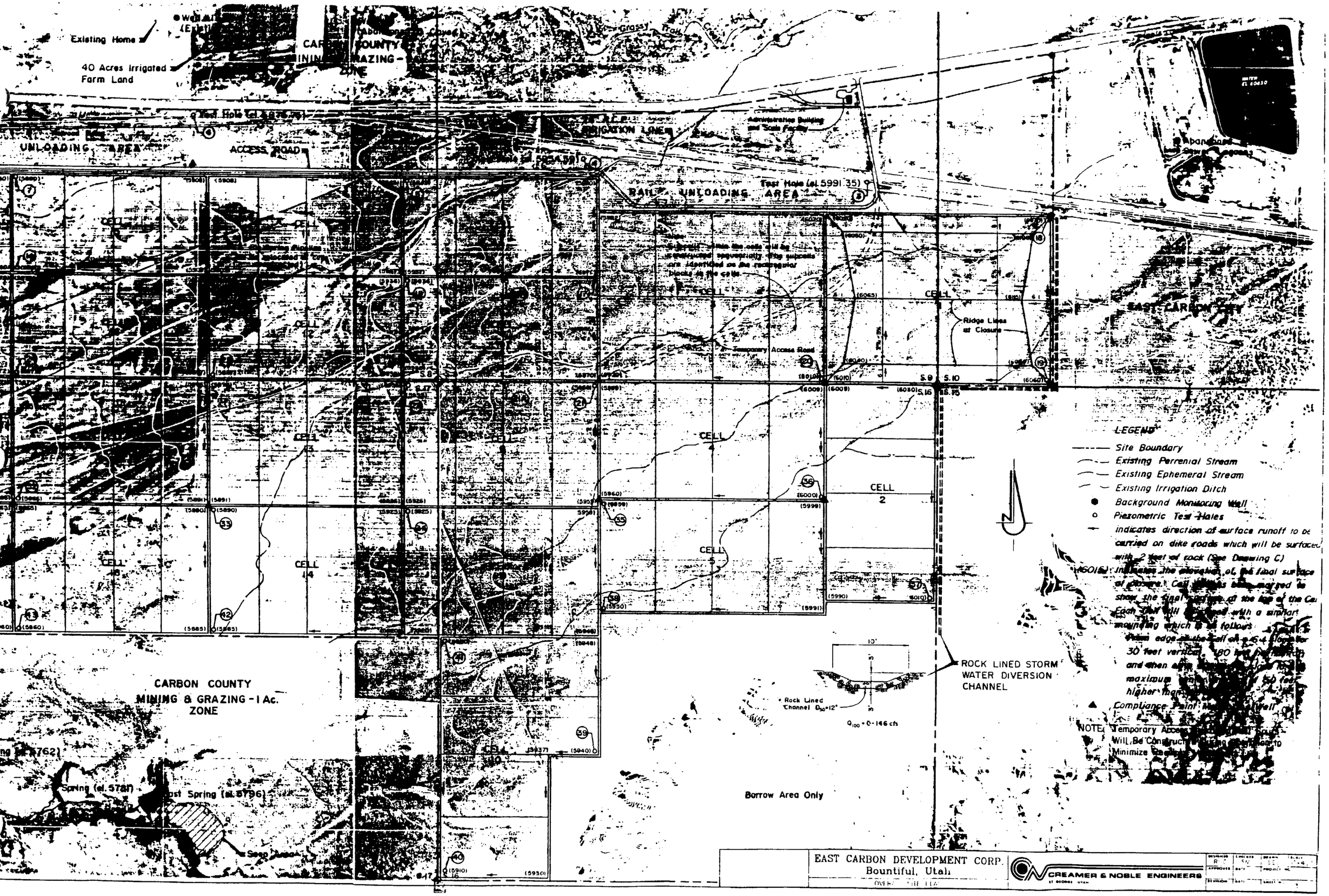
1. EMBANKMENT BORROW SHALL ALSO BE OBTAINED FROM EXCAVATION OF THE CELL. CLAY BORROW IS SHOWN
2. CONTRACTOR SHALL PROTECT EXISTING PIPELINES AND POWER LINES. A 50 FOOT BUFFER ZONE IN WHICH EXCAVATION WILL NOT BE ALLOWED SHALL BE MAINTAINED ON EACH SIDE OF EXISTING PIPELINES. ANY DAMAGE TO EXISTING PIPELINES OR POWER LINES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR, AND SHALL BE REPAIRED BY THE CONTRACTOR AT HIS EXPENSE.

EAST CARBON DEVELOPMENT CORP.
Sunnyside, Utah
PROJECT LOCATION MAP

CREAMER & NOBLE, ENGINEERS

RSC

3-37-2-14



Existing Home
40 Acres Irrigated Farm Land
CARBON COUNTY MINING & GRAZING - ZONE
UNLOADING AREA
ACCESS ROAD
IRRIGATION LINE
Administration Building and Scale Facility
RAIL UNLOADING AREA
Test Hole (el. 5991.35)
Ridge Lines at Closure
Temporary Access Road
CELL 2
CELL 4
CELL 5
CELL 14
CARBON COUNTY MINING & GRAZING - 1 Ac. ZONE
Spring (el. 5781)
East Spring (el. 5796)
Seep Area
ROCK LINED STORM WATER DIVERSION CHANNEL
Rock Lined Channel D_{50}=12"
Q_{100} = 0-146 cfs
Borrow Area Only
LEGEND
Site Boundary
Existing Perrenial Stream
Existing Ephemeral Stream
Existing Irrigation Ditch
Background Monitoring Well
Piezometric Test Holes
indicates direction of surface runoff to be carried on dike roads which will be surfaced with 2 feet of rock (See Drawing C)
Compliance Point
NOTE: Temporary Access
Will Be Construct
Minimize
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CREAMER & NOBLE ENGINEERS

Existing Home

40 Acres Irrigated Farm Land

CARBON COUNTY MINING & GRAZING - 1 Ac. ZONE

Grassy Trails Creek

24" R.C.P. IRRIGATION LINE

Test Hole (el. 5791.22)

Railroad Siding

RAIL UNLOADING AREA

ACCESS ROAD

Test Hole (el. 5934.59)

RAIL UNLOADING

CELL 26

CELL 23

CELL 19

CELL 15

CELL 27

CELL 24

CELL 20

CELL 16

CELL 28

CELL 25

CELL 21

CELL 17

CELL 29

CELL 22

CELL 18

SPRING PROTECTION AREA

Spring Area (el. 5736.3)

Spring #2 (el. 5736.6)

Spring #1 (el. 5721.5)

Spring Pit (phase 1) (el. 5702.6)

Spring #3 (el. 5711.21)

Spring #4 (el. 5711.8)

STILLING BASIN (Typical 7 Places)

Existing Home

24" R.C.P. IRRIGATION LINE

80 Acres Irrigated Farm Land

CARBON COUNTY MINING & GRAZING - 1 Ac. ZONE

Spring (el. 5762)

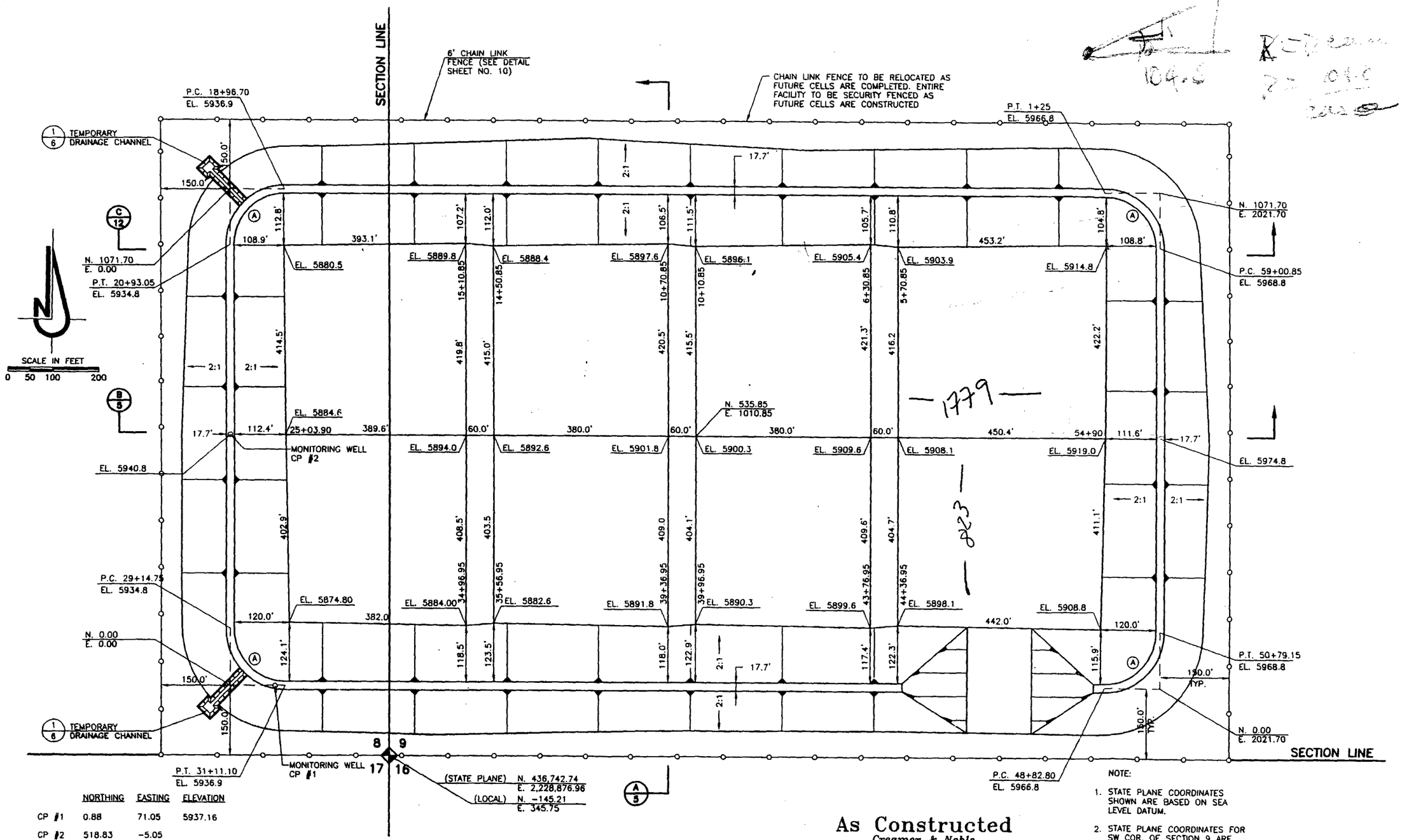
Spring (el. 5781)

Spring (el. 57961)

Seep Area

Note: Subcells within the cells constructed sequentially are identified as the rec blocks in the cells.

Temporar



	NORTHING	EASTING	ELEVATION
CP #1	0.88	71.05	5937.16
CP #2	518.83	-5.05	

CURVE DATA

(A) Δ=90°00'00"
R=125.00'
A=196.35'
C=176.78'
T=125.00'

NOTE:

1. STATE PLANE COORDINATES SHOWN ARE BASED ON SEA LEVEL DATUM.
2. STATE PLANE COORDINATES FOR SW COR. OF SECTION 9 ARE N. 436,742.74, E. 2,288,876.96
3. INDICATED ELEVATIONS ARE AT TOP OF PRIMARY LINER.

As Constructed
Creamer & Noble
CONSULTING ENGINEERS
JUNE 1995

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CELL 7 - PLAN VIEW

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	DRL	As Shown
APPROVED	DATE	PROJECT NO.	
RSC	2/90	3255	
REVISION	DATE	DRAWING NO.	
SEL	6/95	4	

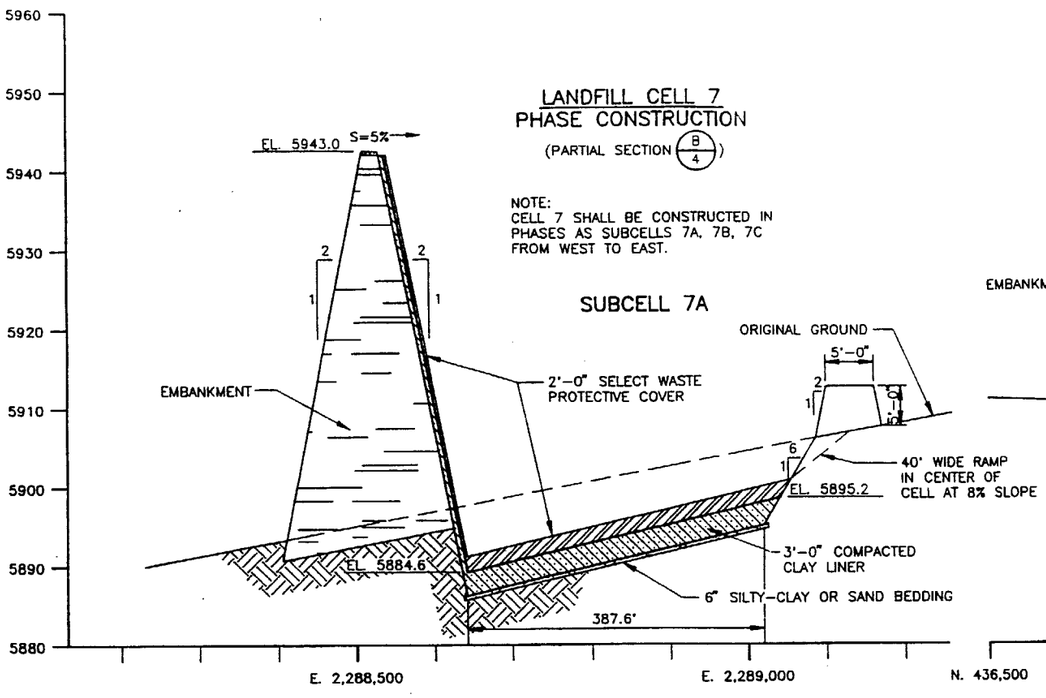
PLAN

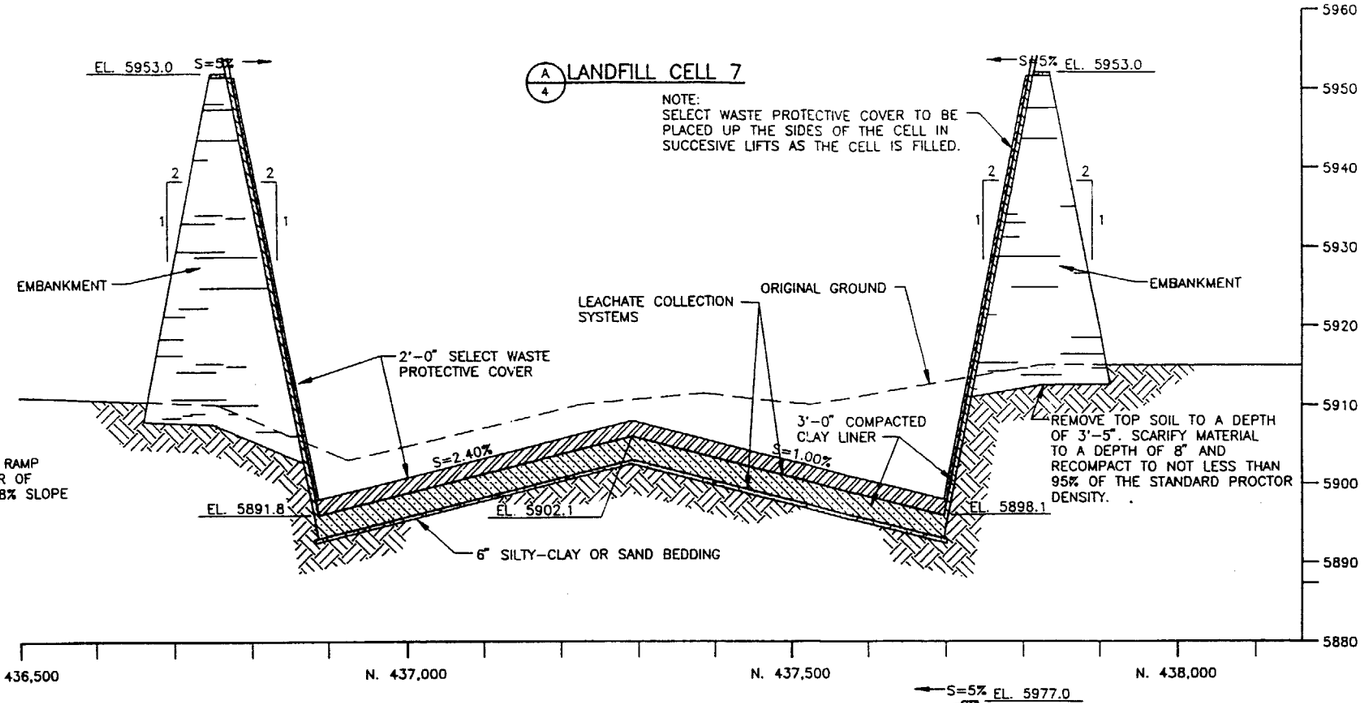
LANDFILL CELL 7
PHASE CONSTRUCTION

(PARTIAL SECTION B/4)

NOTE:
CELL 7 SHALL BE CONSTRUCTED IN PHASES AS SUBCELLS 7A, 7B, 7C FROM WEST TO EAST.

SUBCELL 7A

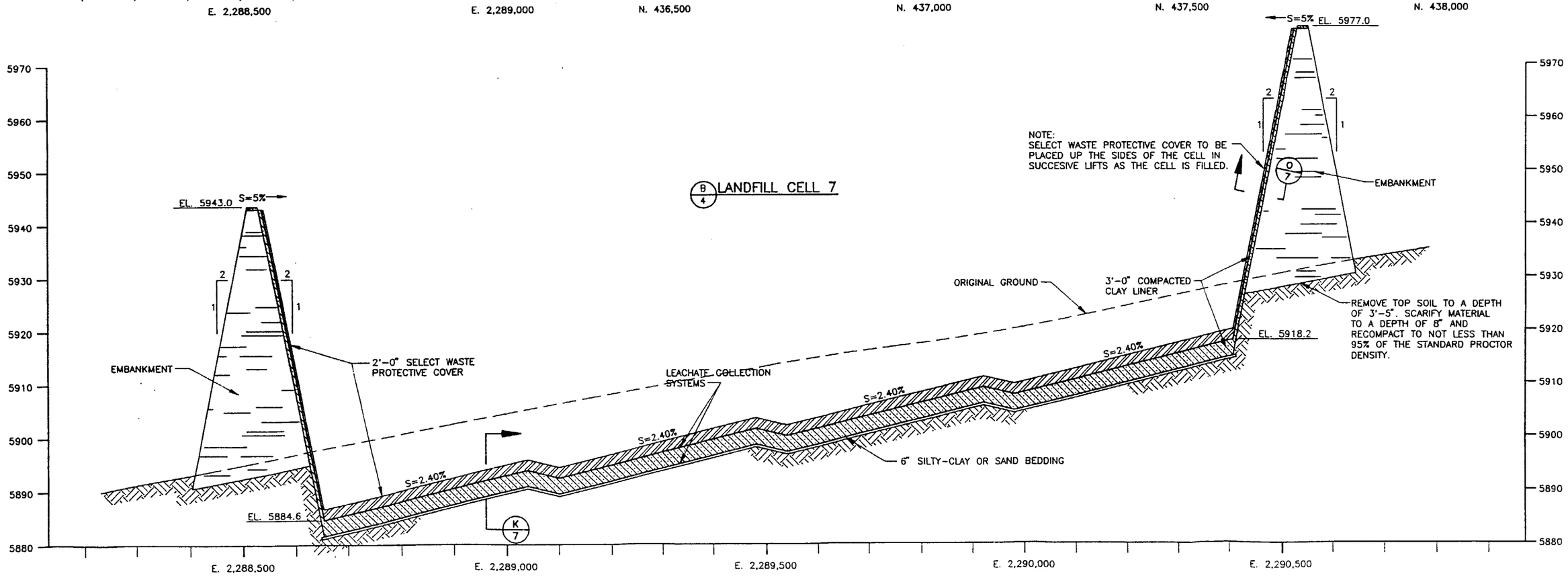




A/4 LANDFILL CELL 7

NOTE:
SELECT WASTE PROTECTIVE COVER TO BE PLACED UP THE SIDES OF THE CELL IN SUCCESIVE LIFTS AS THE CELL IS FILLED.

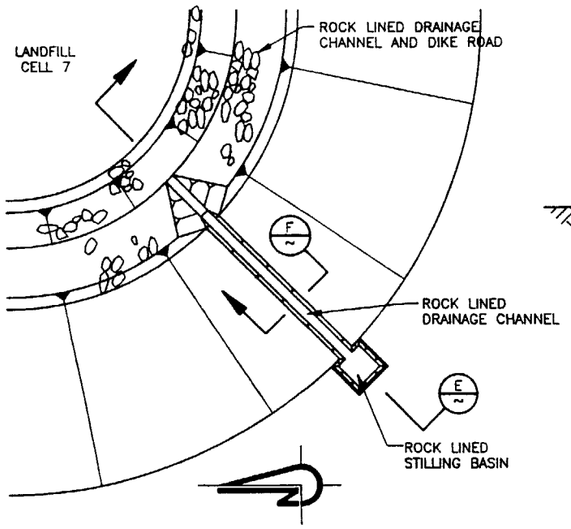
B/4 LANDFILL CELL 7



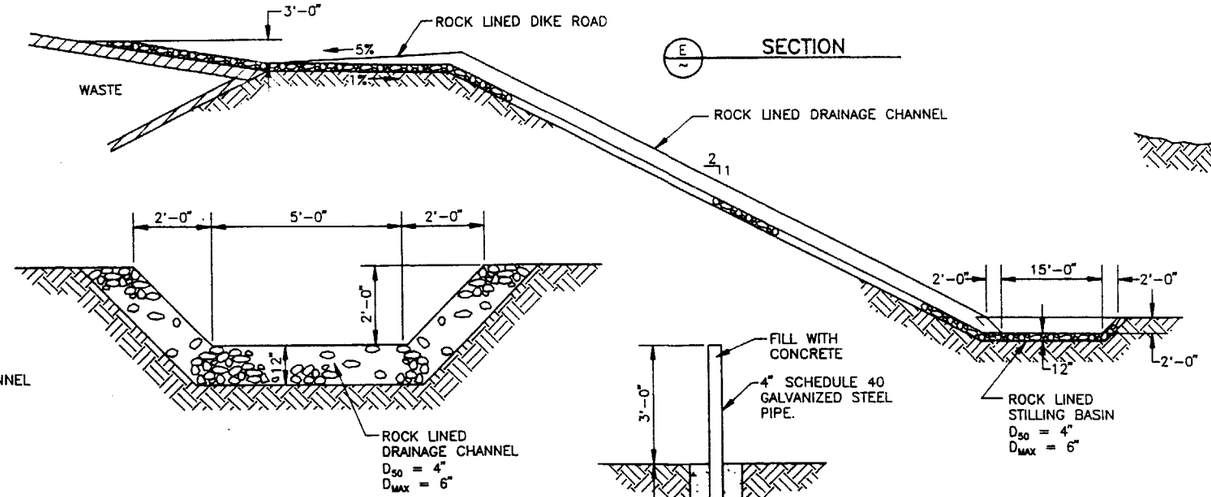
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CELL 7 CROSS SECTIONS

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	DRL	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	5

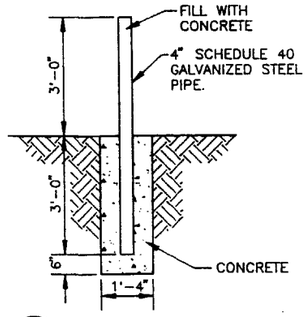


1/4 TEMPORARY DRAINAGE CHANNEL

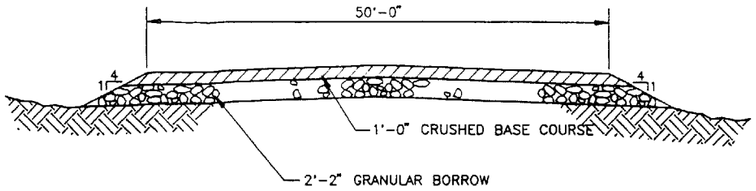


E SECTION

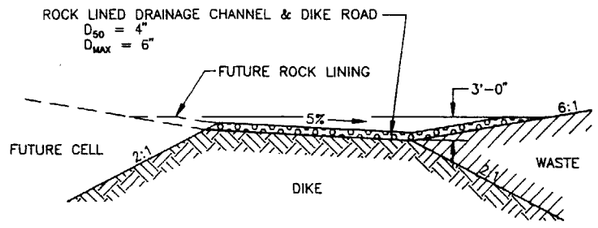
F SECTION



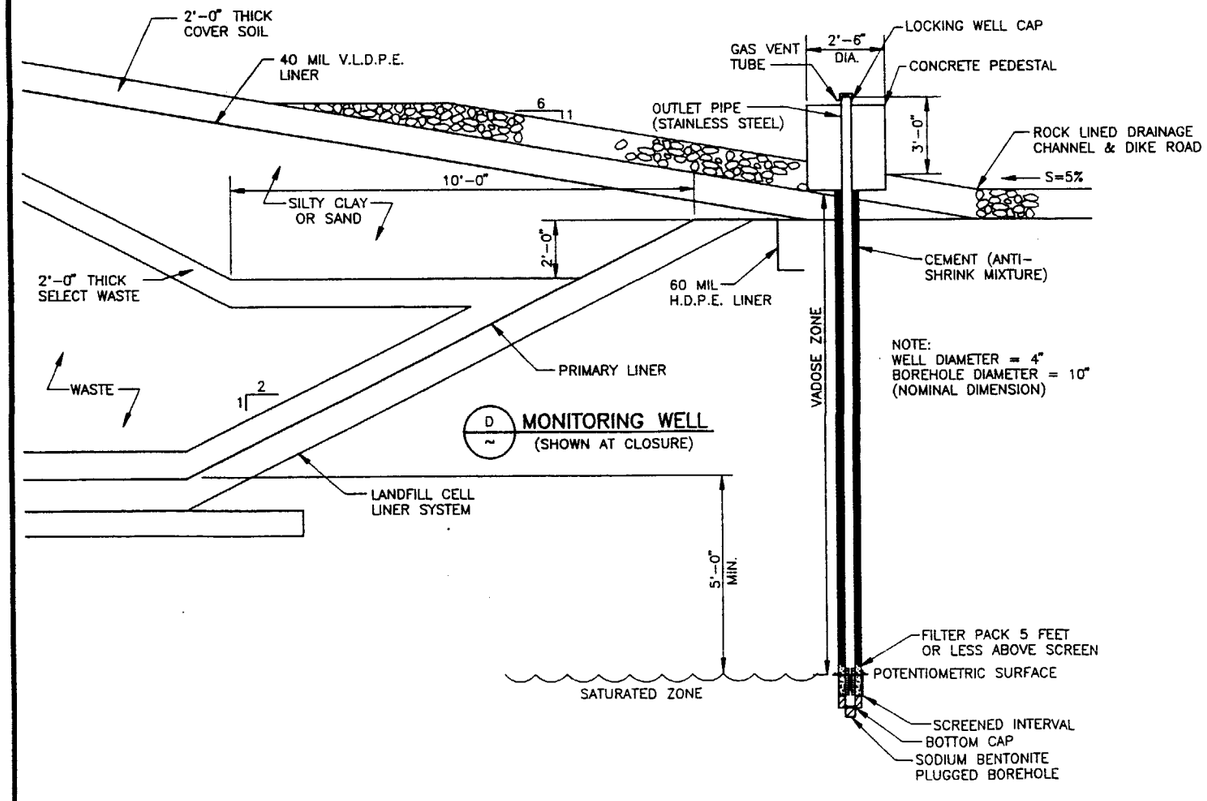
5 GUARD POST
6 REQUIRED



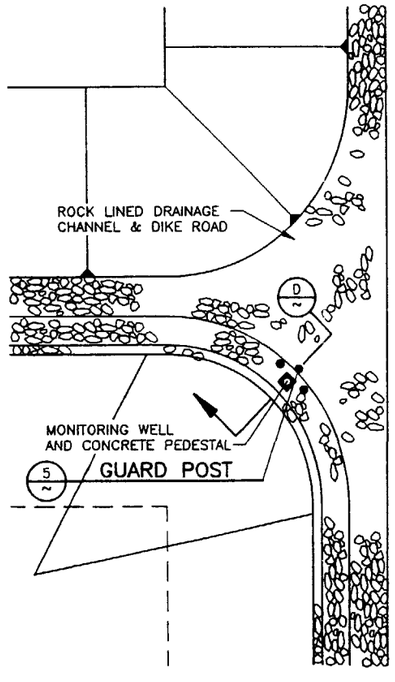
LANDFILL CELL ACCESS ROAD
TYPICAL SECTION



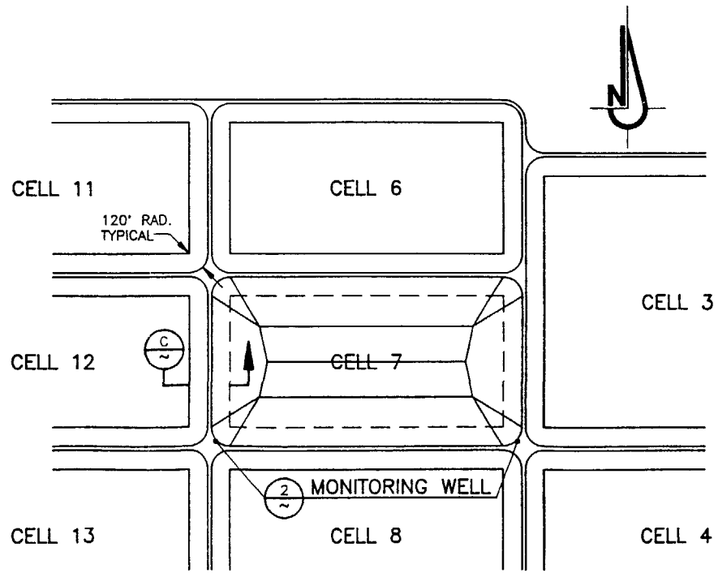
C EXTERIOR DIKE DRAINAGE DESIGN



D MONITORING WELL
(SHOWN AT CLOSURE)



2 MONITORING WELL LOCATION
(SHOWN AT CLOSURE)



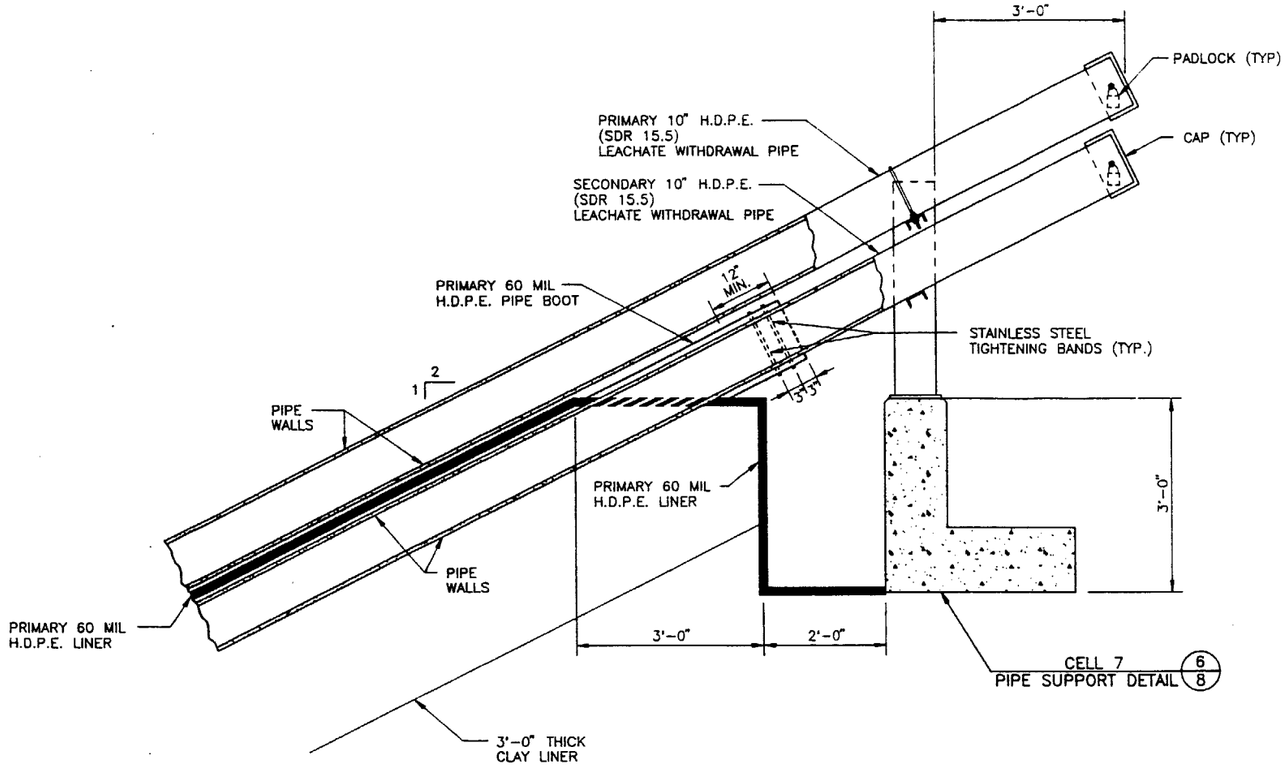
PLAN VIEW

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
TYPICAL SECTIONS AND DETAILS

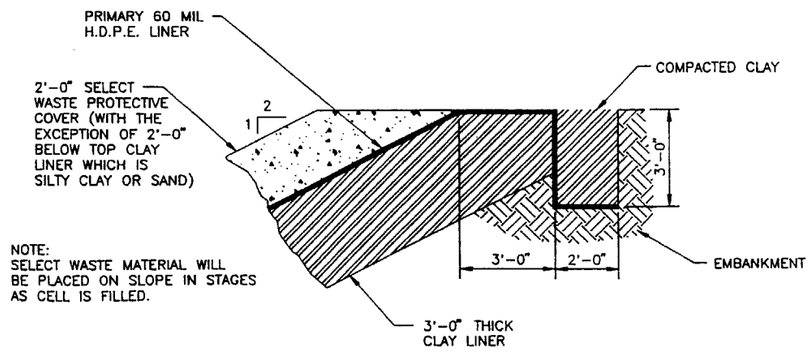
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	DRL	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	6

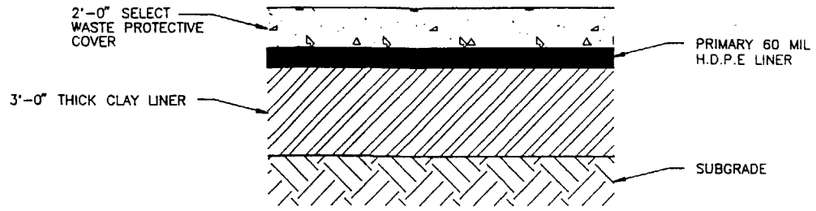
DETAIL6



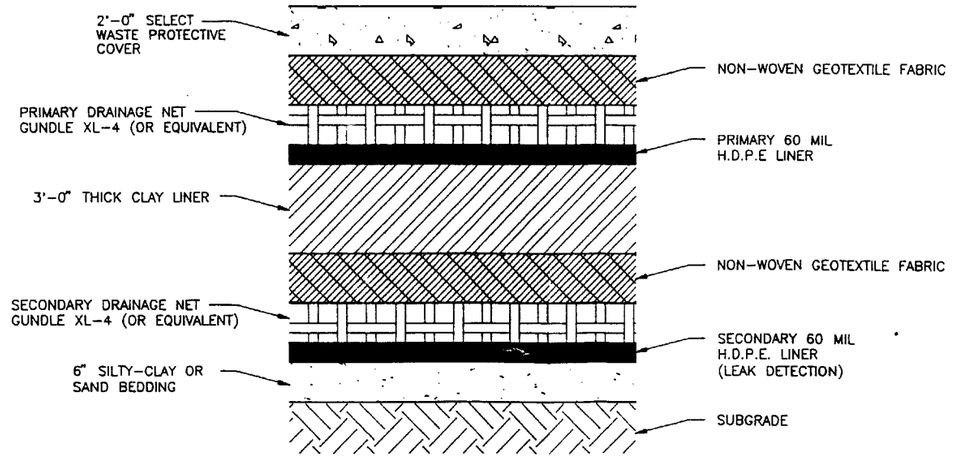
PIPE SEAL DETAIL



LINER ANCHOR DETAIL



0/11 CELL LINER SECTION



K/11 CELL LINER SECTION

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CELL LINER DETAILS

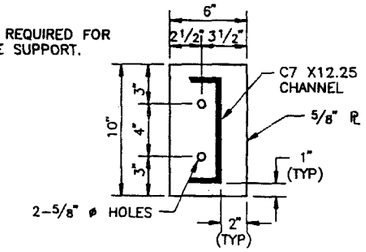
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	CLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	DRAWING NO.	7

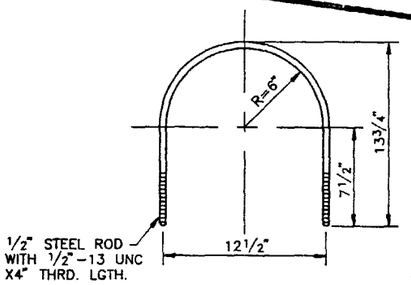
HAZARD7

NON-WOVEN GEOTEXTILE FABRIC
PRIMARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=2.42%
PRIMARY 60 MIL H.D.P.E. LINER
CLAY
SECONDARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
SECONDARY 60 MIL. H.D.P.E. LINER
3/4" MINUS GRAVEL
4" ø H.D.P.E. PIPE (SDR 15.5)
H.D.P.E. PIPE DETAIL (3/9)
1'-6"
3'-0"
1'-0" (TYP)

NOTE:
2 PLATES REQUIRED FOR EACH PIPE SUPPORT.

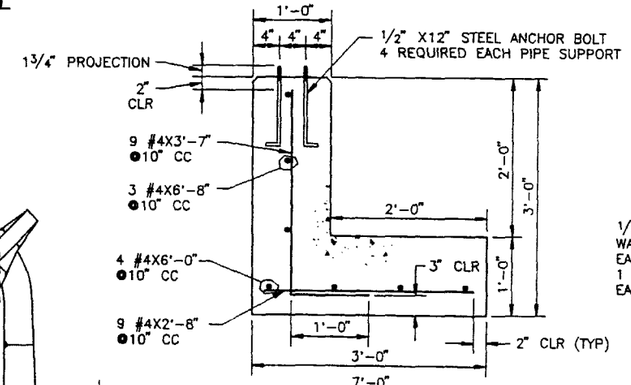


8 MOUNTING PLATE DETAIL



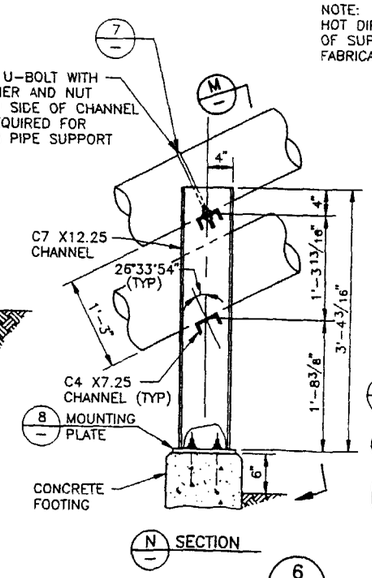
7 U-BOLT DETAIL
NTS

H SECTION

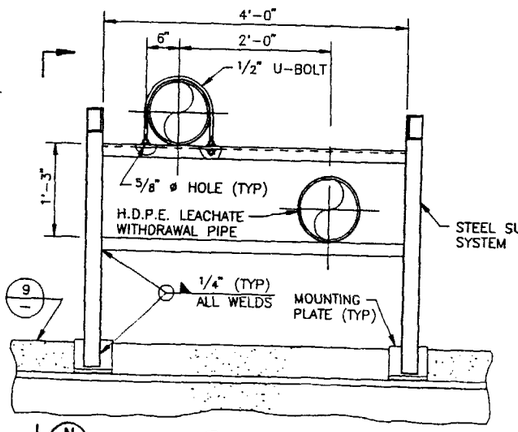


9 CONCRETE FOOTING DETAIL

NOTE:
HOT DIP GALVANIZE ALL STEEL OF SUPPORT SYSTEM AFTER FABRICATION.

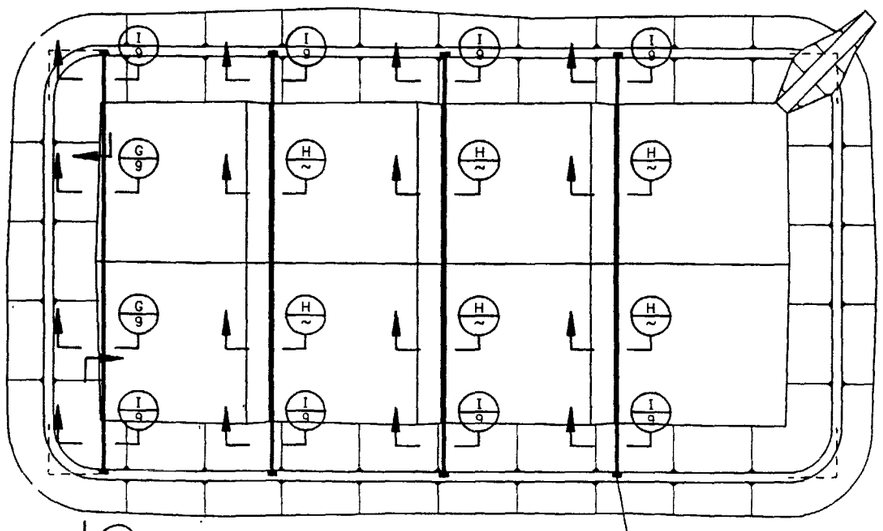


N SECTION



M SECTION

6/7 CELL 7 PIPE SUPPORT DETAIL

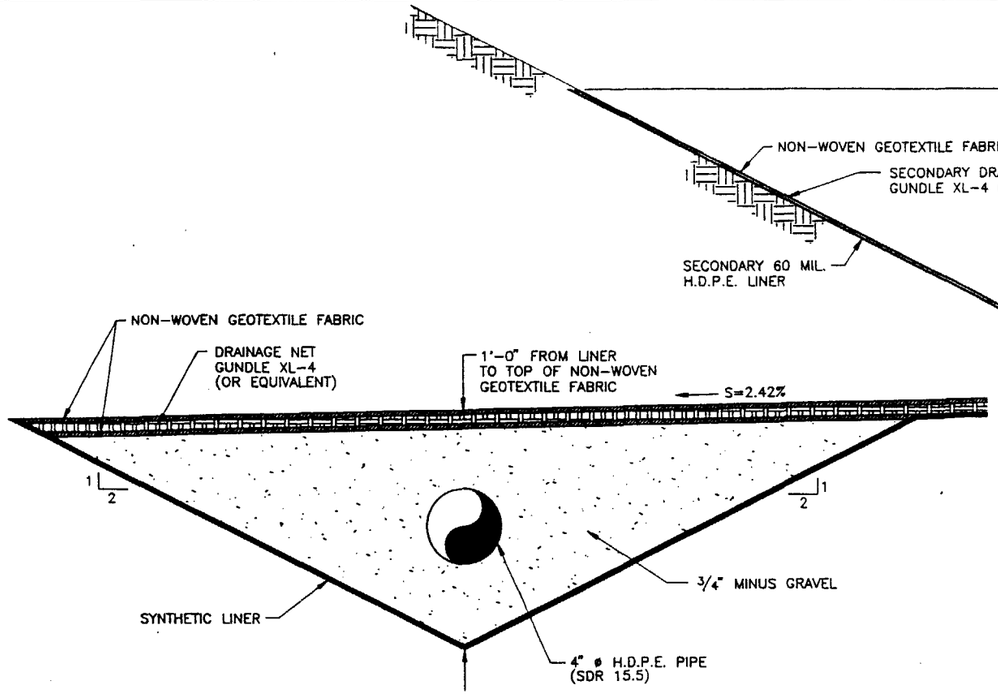


EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
LEACHATE COLLECTION SYSTEM

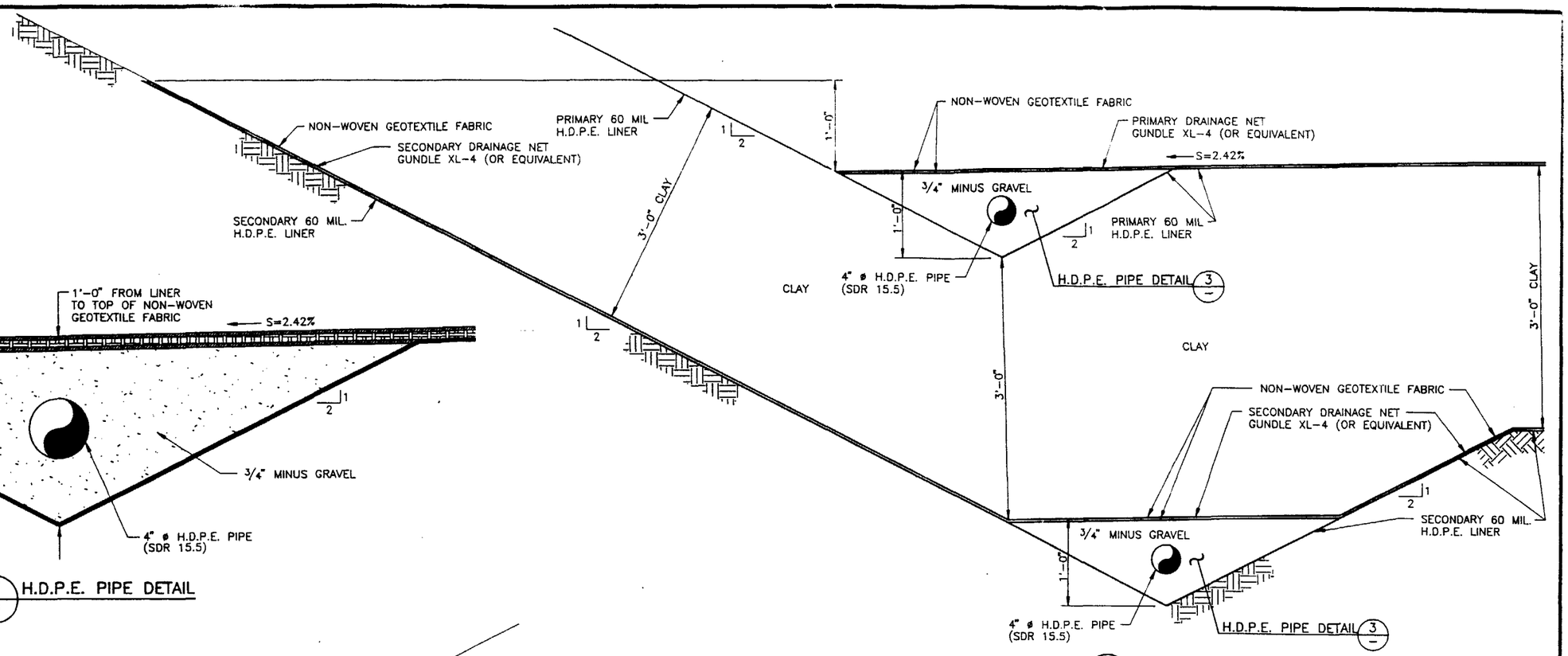
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	DRAWING NO.	8

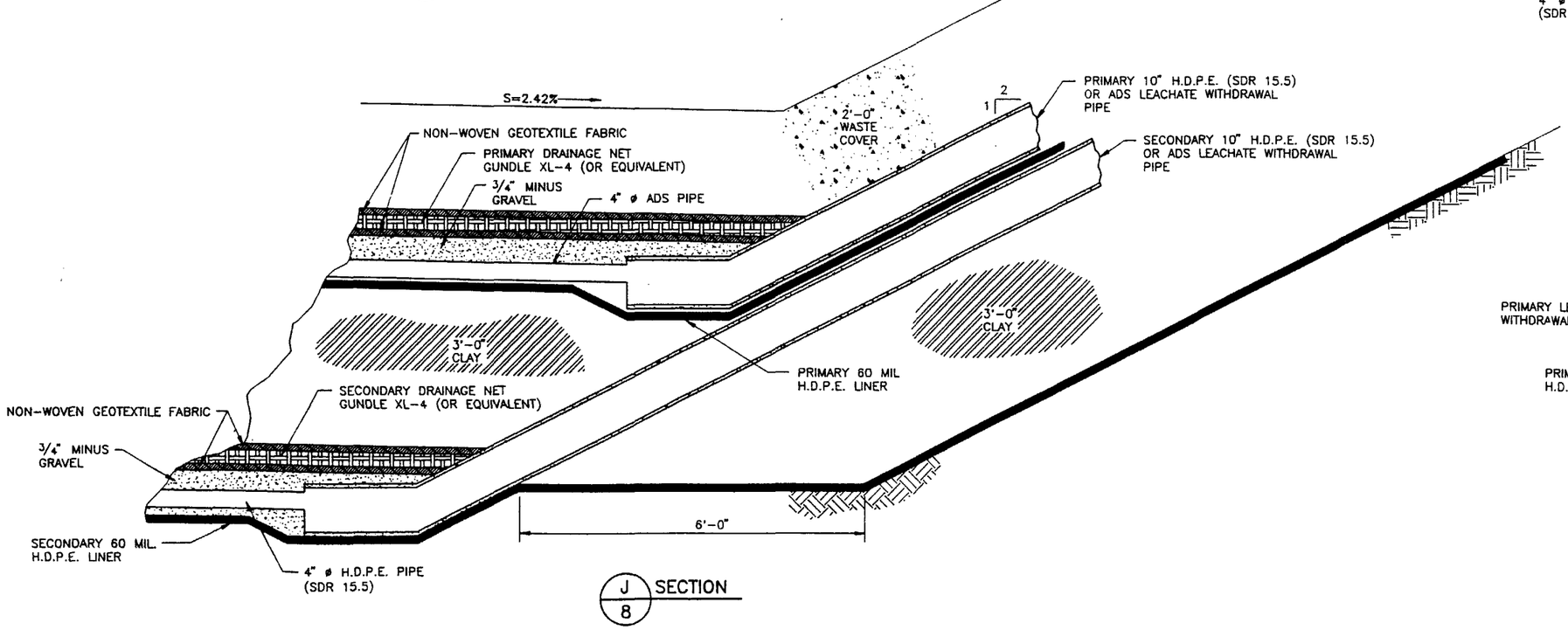
HAZARDS



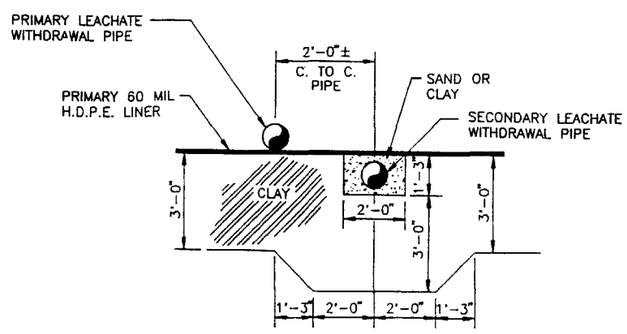
3/8 H.D.P.E. PIPE DETAIL



G 8 SECTION



J 8 SECTION



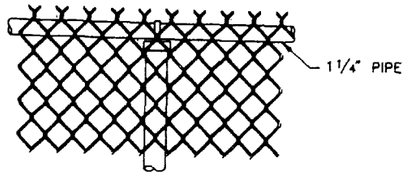
I 8 SECTION

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
LEACHATE COLLECTION SYSTEM

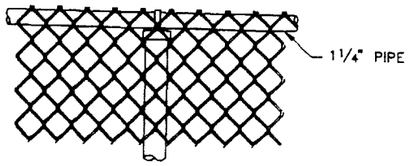
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	DRAWING NO.	9

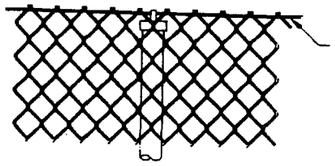
HAZARDS



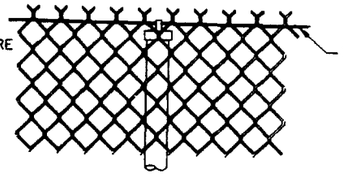
TWISTED & BARBED SELVAGE
TYPE I



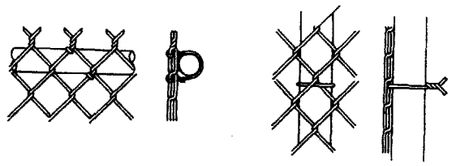
KNUCKLED SELVAGE
TYPE II



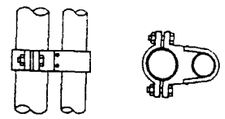
KNUCKLED SELVAGE
WITH TENSION WIRE
TYPE III



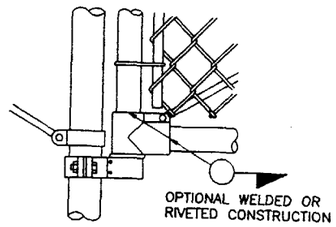
TWISTED & BARBED SELVAGE
WITH TENSION WIRE
TYPE IV



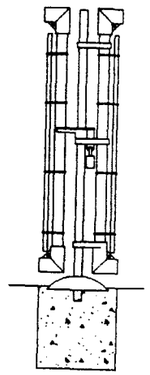
PIPE POST TIE



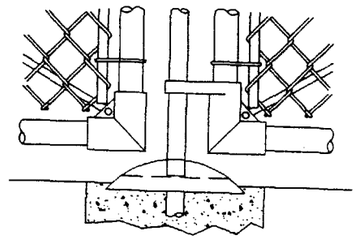
TOP GATE HINGE



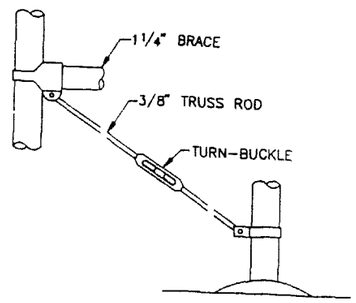
BOTTOM GATE HINGE
AND GATE DETAILS



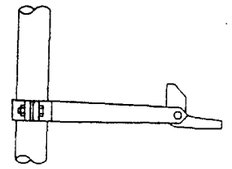
DROP ROD ASSEMBLY



CENTER GATE STOP
AND GATE DETAIL



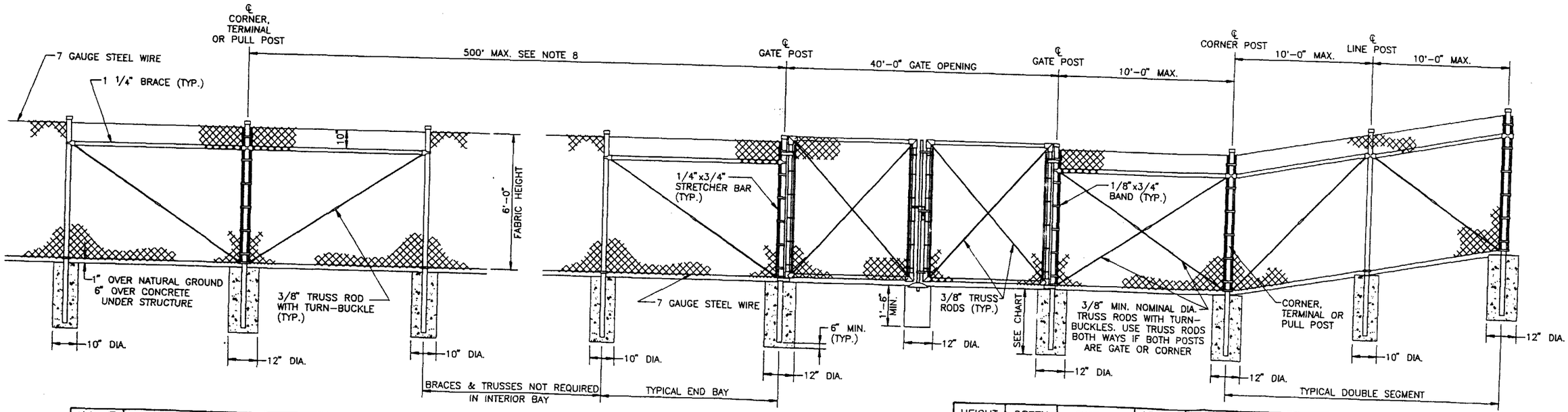
BRACE AND TRUSS CONNECTIONS



GATE HOLD BACK

NOTES:

1. MATERIALS, CONSTRUCTION AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH PROJECT STANDARD SPECIFICATIONS.
2. THE TYPE OF TOP SUPPORT IS SPECIFIED IN THE BIDDING SCHEDULE, TYPES 1 AND 2 TUBULAR RAIL, TYPES 3 AND 4 TENSION WIRE.
3. BARBED WIRE SHALL BE USED ONLY WHEN DESIGNATED ON THE PLANS OR IN THE SPECIFICATIONS.
4. TWISTED AND BARBED SELVAGE TOP AND BOTTOM SHALL BE USED ON FENCES 5 FEET HIGH OF GREATER.
5. KNUCKLED SELVAGE ON TOP AND TWISTED AND BARBED ON BOTTOM SHALL BE USED ON FENCES LESS THAN 5 FEET.
6. ALL STEEL PIPE MEMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A-120 SCHEDULE 40 HOT DIPPED ZINC COATED HIGH TENSILE STEEL PIPE OR TRIPLE COATED PIPE MADE FROM STEEL CONFORMING TO ASTM 569.
7. POSTS SHALL BE STEEL SCHEDULE 40 PIPE OR TRIPLE COATED HIGH TENSILE STEEL PIPE OF THE SIZE SHOWN IN THE CHART. WEIGHT IN POUNDS PER FOOT WITH A TOLERANCE OF 5%.
8. LINE POSTS SHALL BE LOCATED AT EQUAL SPACINGS FOR EACH SEGMENT WITH A MAXIMUM SPACING AS FOLLOWS:
   - A. TANGENT SECTIONS TO 500 FT. RADIUS NOT MORE THAN 10 FT.
   - B. UNDER 500 FT. RADIUS TO 200 FT. RADIUS NOT MORE THAN 8 FT.
   - C. UNDER 200 FT. RADIUS TO 100 FT. RADIUS NOT MORE THAN 6 FT.
   - D. UNDER 100 FT. RADIUS NOT MORE THAN 5 FT.
9. TRUSS RODS AND BRACES SHALL NOT BE REQUIRED FOR FABRIC HEIGHTS LESS THAN 5 FT.
10. TENSION WIRE SHALL BE 7 GAUGE ZINC- OR ALUMINUM-COATED COIL SPRING STEEL TENSION WIRE.



TYPICAL END, ANGLE & CORNER SECTION
NO SCALE

LINE POST	GATE OPENING	GATE POST	GATE FRAME
UNDER 6 FEET	SINGLE TO 6' OR DOUBLE TO 12'	2"	1"
	SINGLE OVER 6' TO 8' OR DOUBLE OVER 12' TO 16'	2½"	1½"
	SINGLE OVER 8' TO 12' OR DOUBLE OVER 16' TO 24'	3½"	
6 FEET AND OVER	SINGLE TO 6' OR DOUBLE TO 12'	2½"	1½"
	SINGLE OVER 6' TO 12' OR DOUBLE OVER 12' TO 24'	3½"	
	SINGLE OVER 12' TO 18' OR DOUBLE OVER 24' TO 36'	6"	
	SINGLE OVER 18' OR DOUBLE OVER 36'	8"	

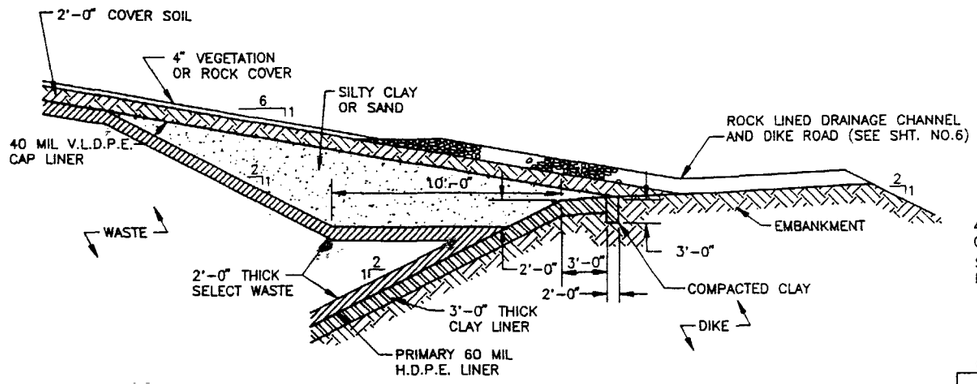
HEIGHT OF FABRIC	DEPTH OF POSTS	LENGTH OF END, CORNER OR PULL POST	LENGTH OF LINE POST HOLES	SIZE OF POSTS							
				END, CORNER & PULL POSTS				LINE POST MIN. SIZE			
				NOM. SIZE	OUTSIDE DIA.	PIPE WEIGHT ASTM A-120	PIPE WEIGHT TRIPLE COATED	NOM. SIZE	OUTSIDE DIA.	PIPE WEIGHT ASTM A-120	PIPE WEIGHT TRIPLE COATED
7'	3'	10'	9'-8"	2½"	2.875"	5.79"	4.64"	2"	2.375"	3.65"	3.11"
6'	3'	9'	8'-8"	2½"	2.875"	5.79"	4.64"	2"	2.375"	3.65"	3.11"
5'	3'	8'	7'-8"	2"	2.375"	3.65"	3.11"	1½"	1.900"	2.72"	2.23"
4'	2'	6'	5'-8"	2"	2.375"	3.65"	3.11"	1½"	1.900"	2.72"	2.23"
3'	2'	5'	4'-8"	2"	2.375"	3.65"	3.11"	1½"	1.900"	2.72"	2.23"

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CHAIN LINK FENCE DETAILS

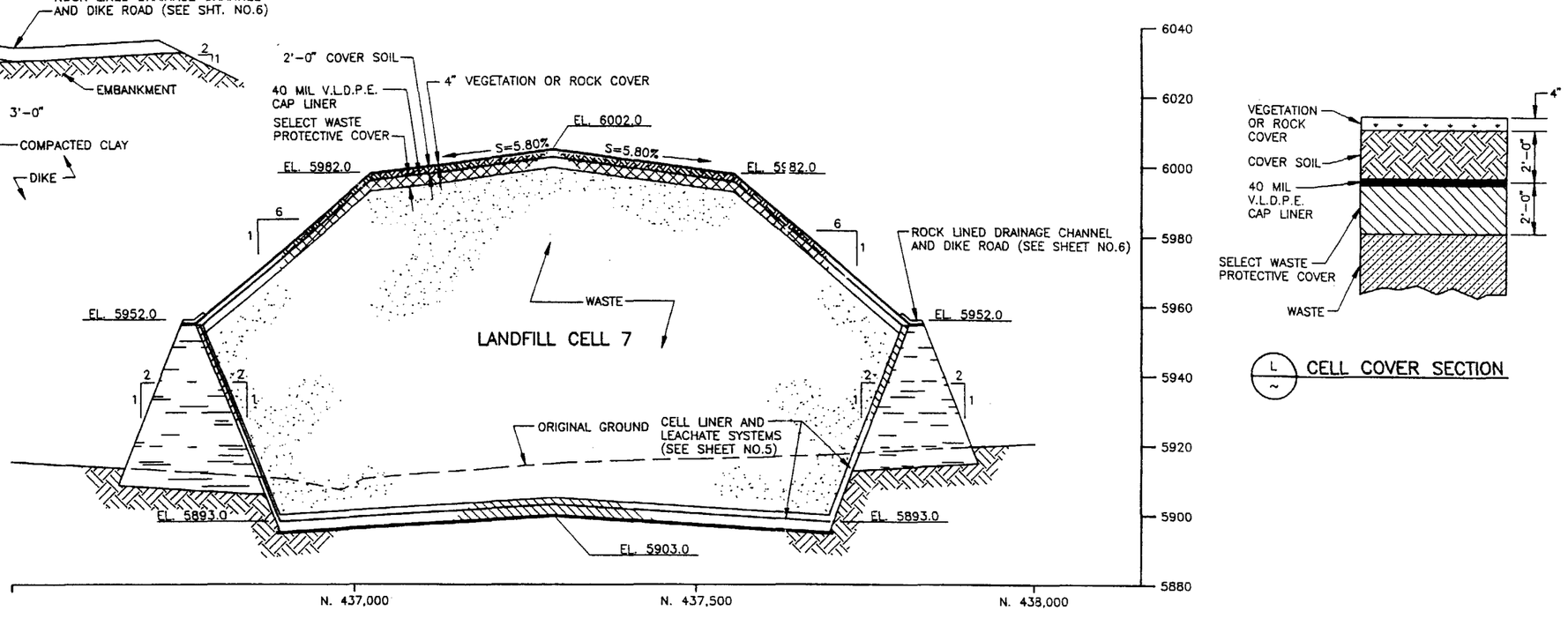
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	DRL	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	10

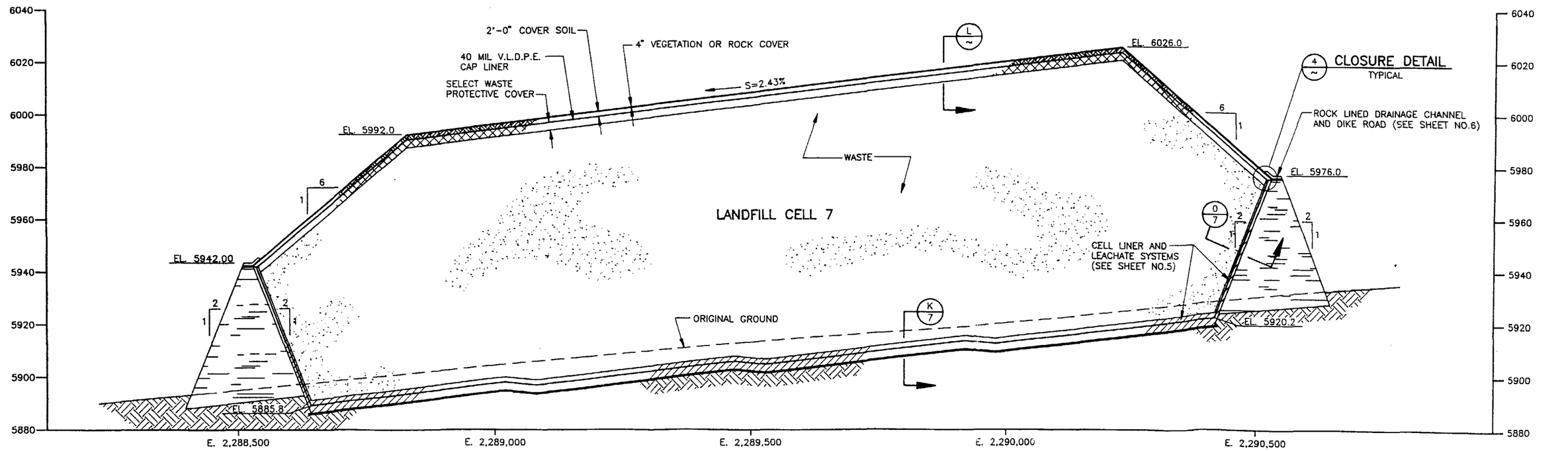
FENCE1



4 CLOSURE DETAIL



L CELL COVER SECTION

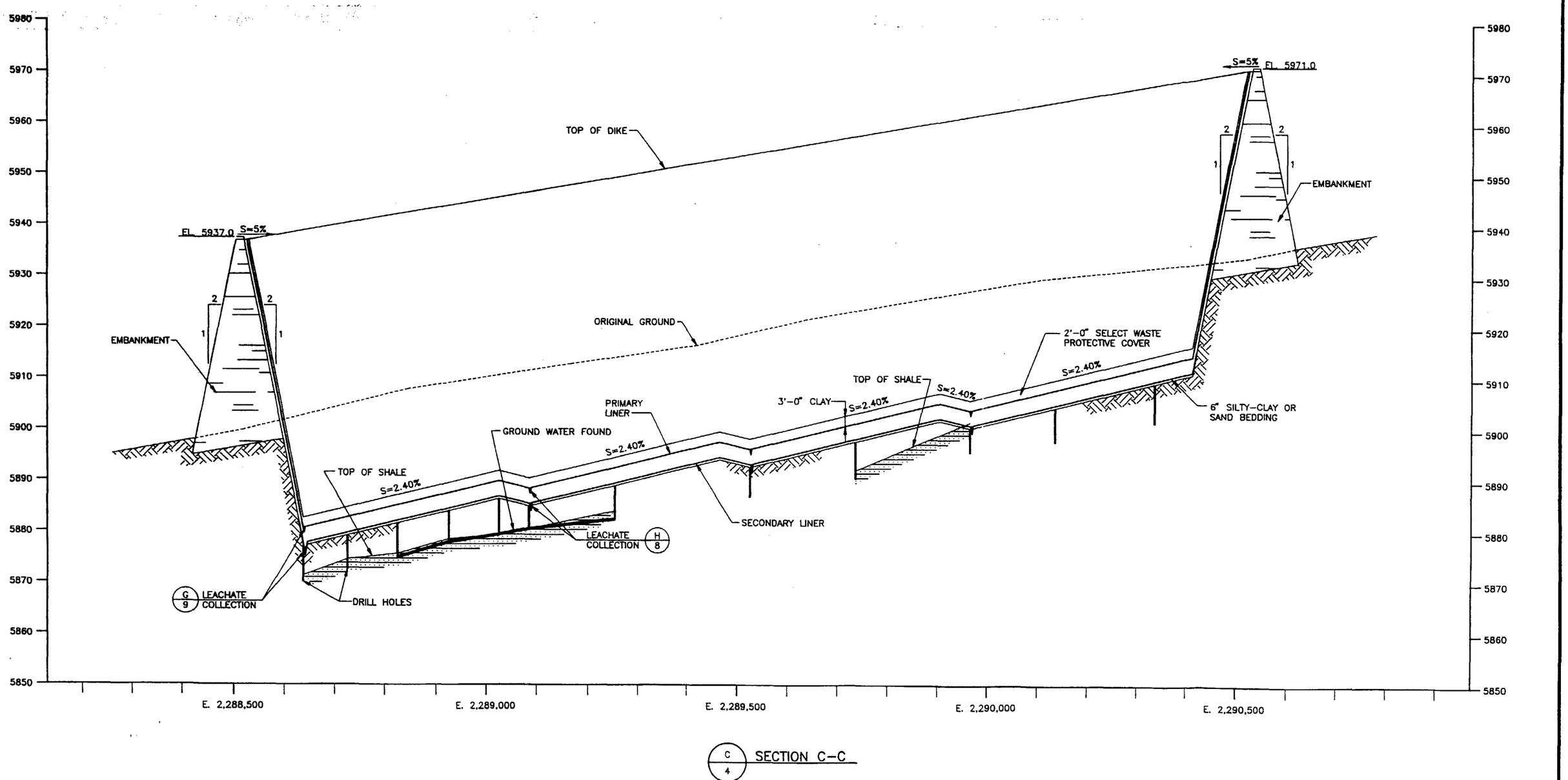


EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CELL CLOSURE DETAILS

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

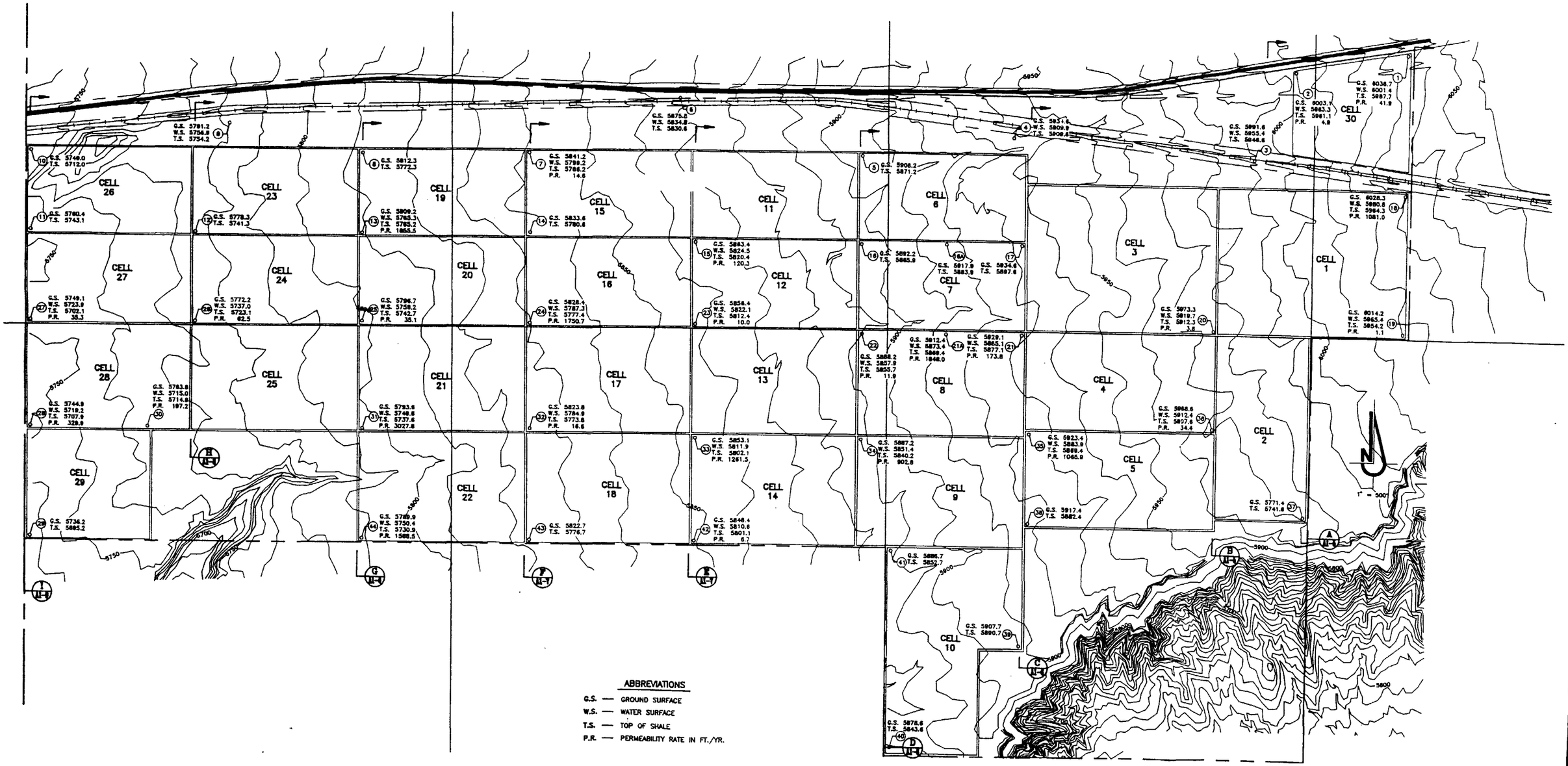
DESIGNED	CHECKED	DRAWN	SCALE
SM	RSC	DRL	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	11

SECCLOSE



C/4 SECTION C-C

EAST CARBON DEVELOPMENT CORP. Bountiful, Utah		DESIGNED SM	CHECKED RSC	DRAWN DRL	SCALE NONE
CELL 7 - SECTION C-C	CREAMER & NOBLE ENGINEERS ST. GEORGE, UTAH	APPROVED	DATE 5/92	PROJECT NO.
		REVISION	DATE	SHEET NO. 12



ABBREVIATIONS

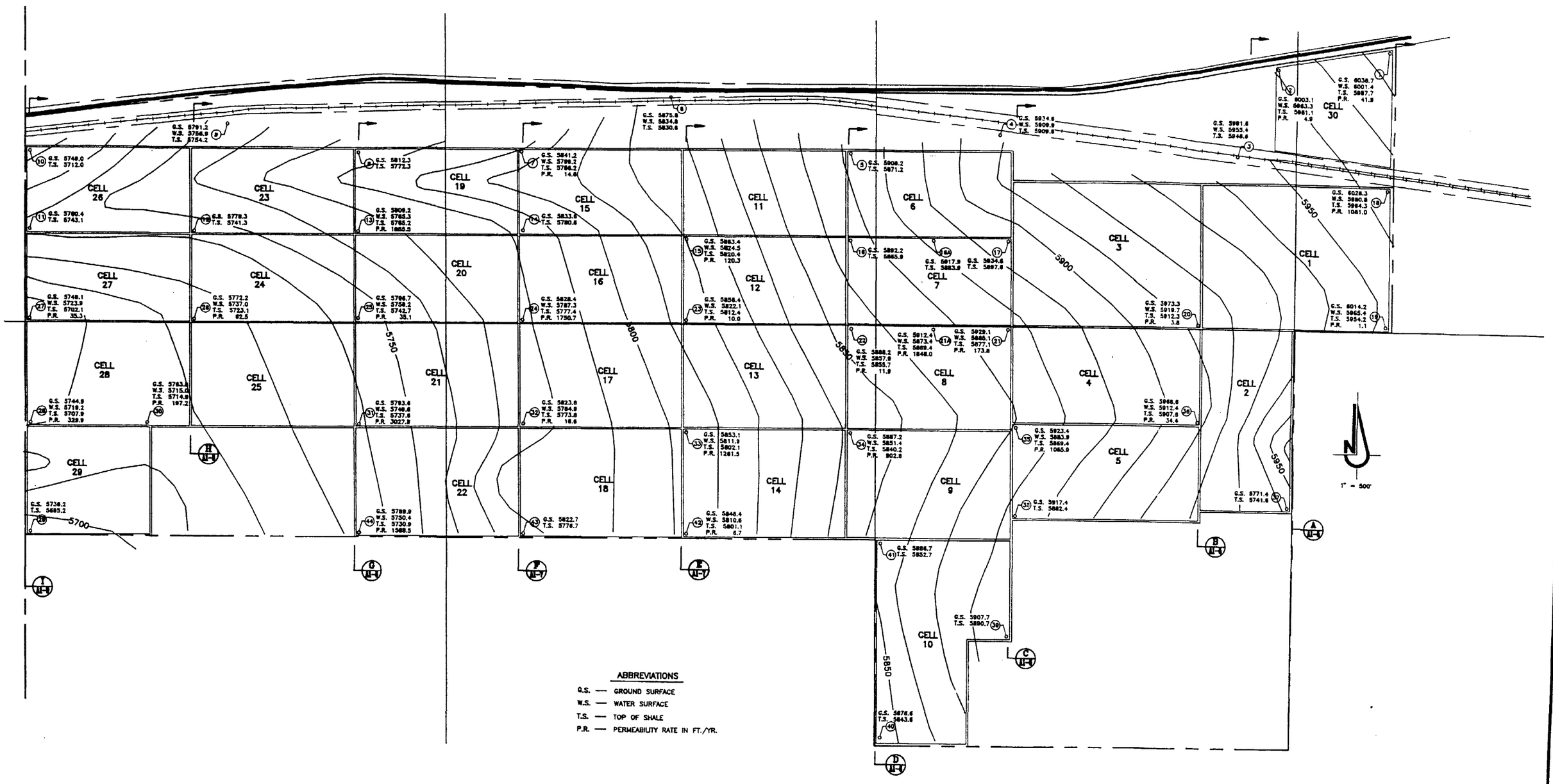
G.S. — GROUND SURFACE
W.S. — WATER SURFACE
T.S. — TOP OF SHALE
P.R. — PERMEABILITY RATE IN FT./YR.

EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
LANDFILL SITE - GROUND SURFACE CONTOUR

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	DRAWN	SCALE
RSC	GLA	NONE
CHECKED	DATE	PROJECT NO.
SM		
APPROVED	DATE	SHEET NO.
		A1-1
REVISION	DATE	

SHTNAME

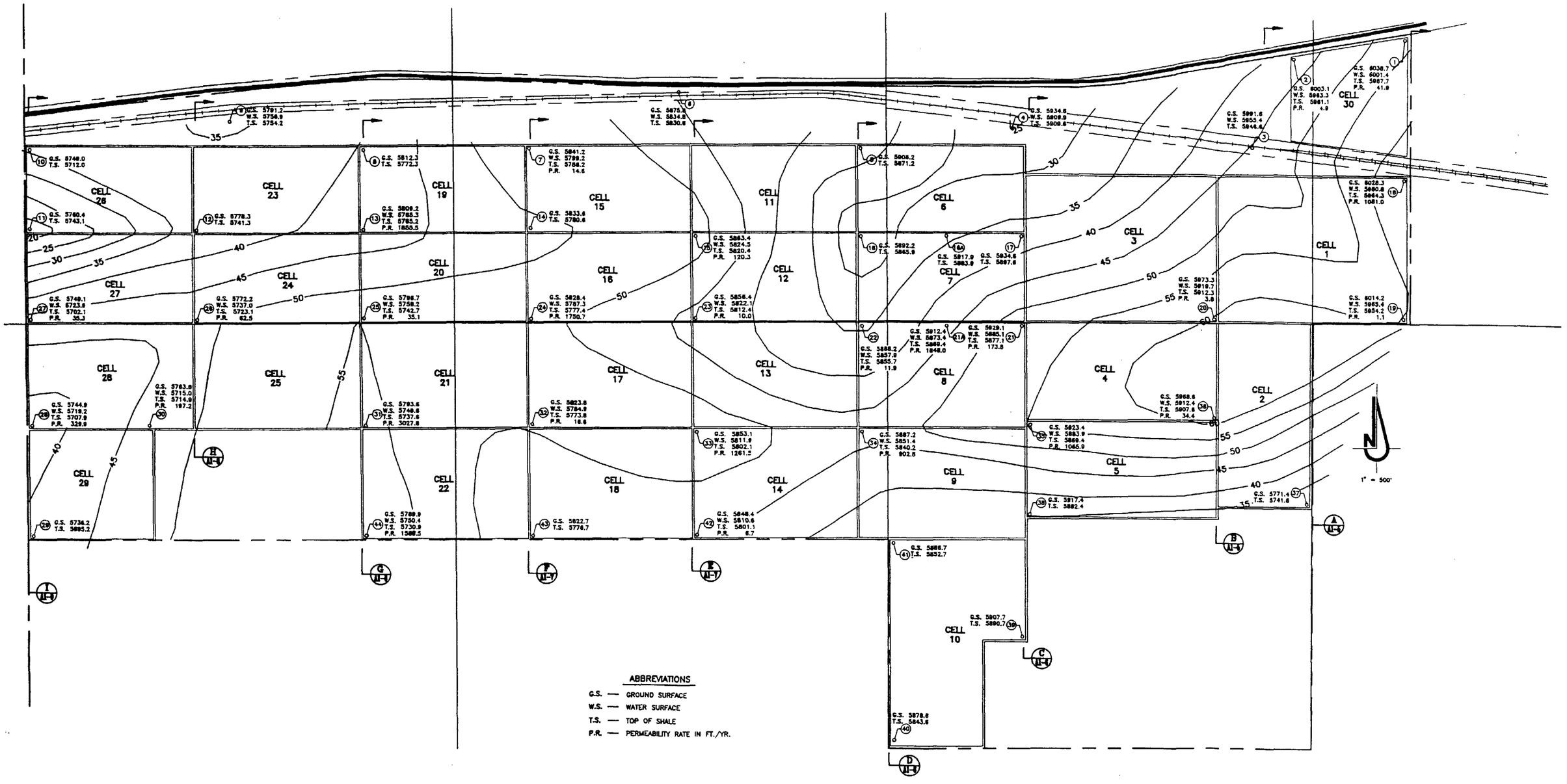


EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
LANDFILL SITE - TOP OF SHALE CONTOUR

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	DRAWN	SCALE
RSC	GLA	NONE
CHECKED	DATE	PROJECT NO.
SM		
APPROVED	DATE	SHEET NO.
		A1-2
REVISION	DATE	

SM02



ABBREVIATIONS

G.S. — GROUND SURFACE
W.S. — WATER SURFACE
T.S. — TOP OF SHALE
P.R. — PERMEABILITY RATE IN FT./YR.

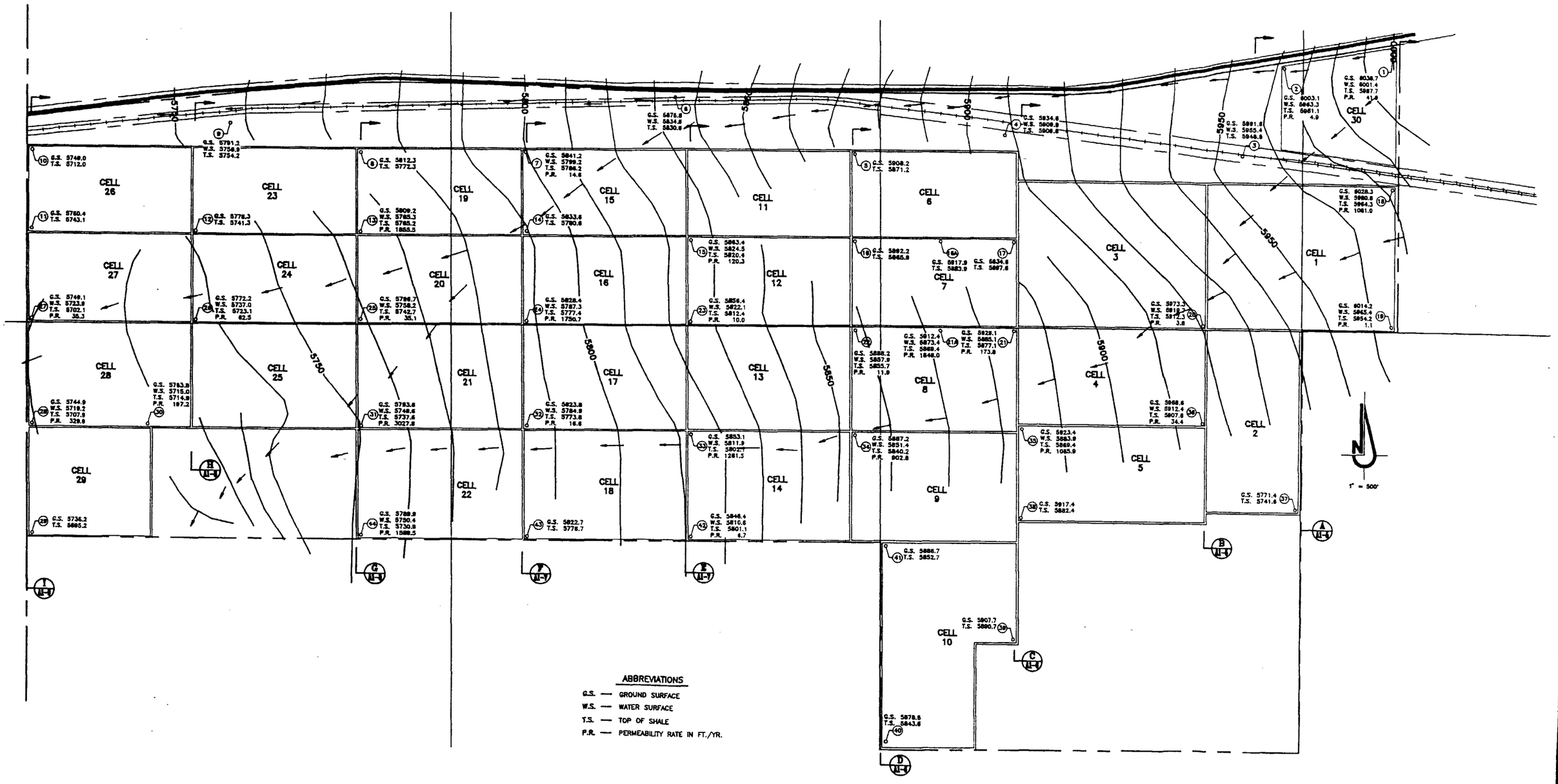
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah

LANDFILL SITE - PEDIMENT THICKNESS CONTOUR

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	DRAWN	CHECKED	SHEET
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-3

SM03



EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
LANDFILL SITE – GROUND WATER SURFACE CONTOUR

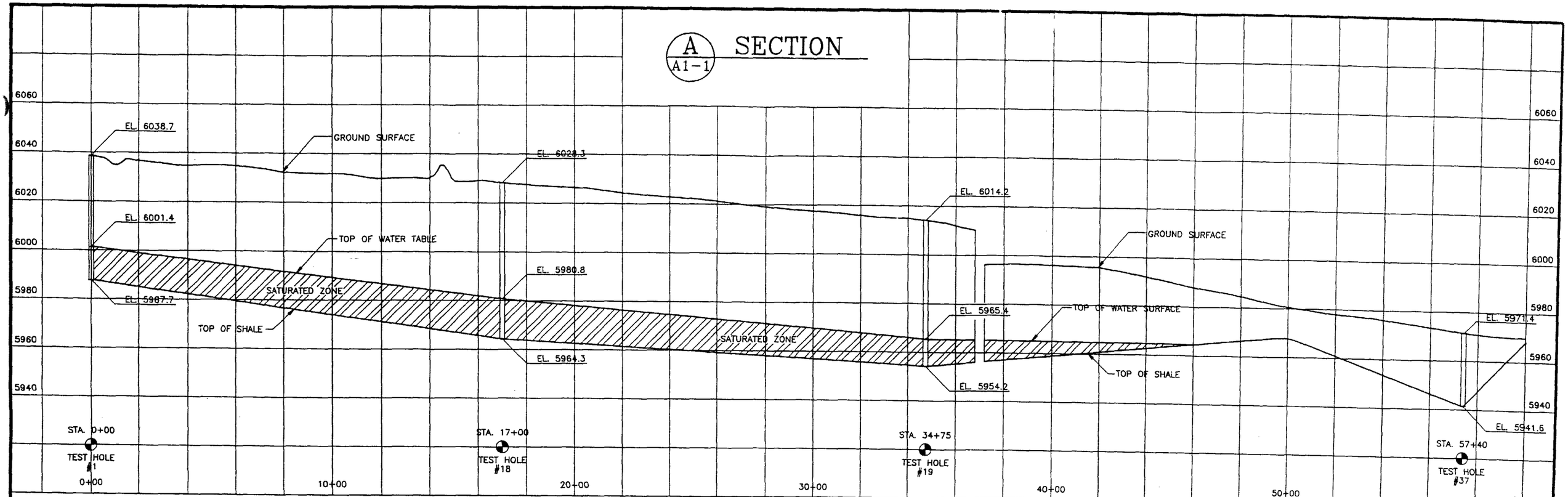
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	DRAWN	SCALE
RSC	GLA	NONE
CHECKED	DATE	PROJECT NO.
SM		
APPROVED	DATE	SHEET NO.
		A1-4

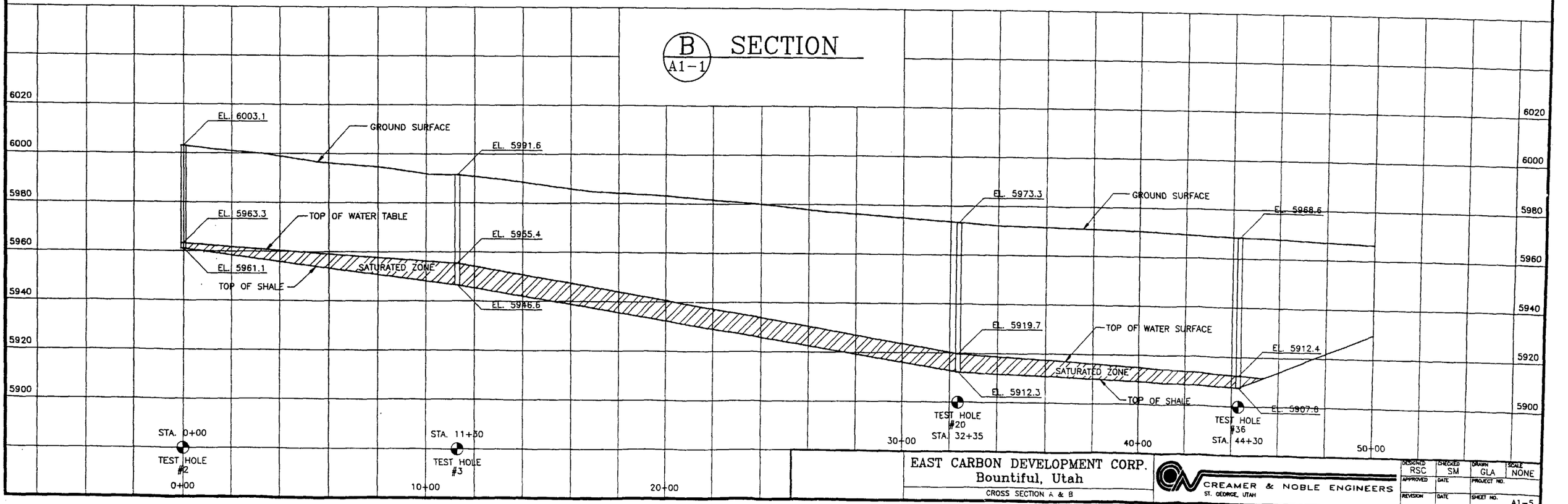
SHTNAME

Ecarbdc4

A / A1-1 SECTION



B / A1-1 SECTION



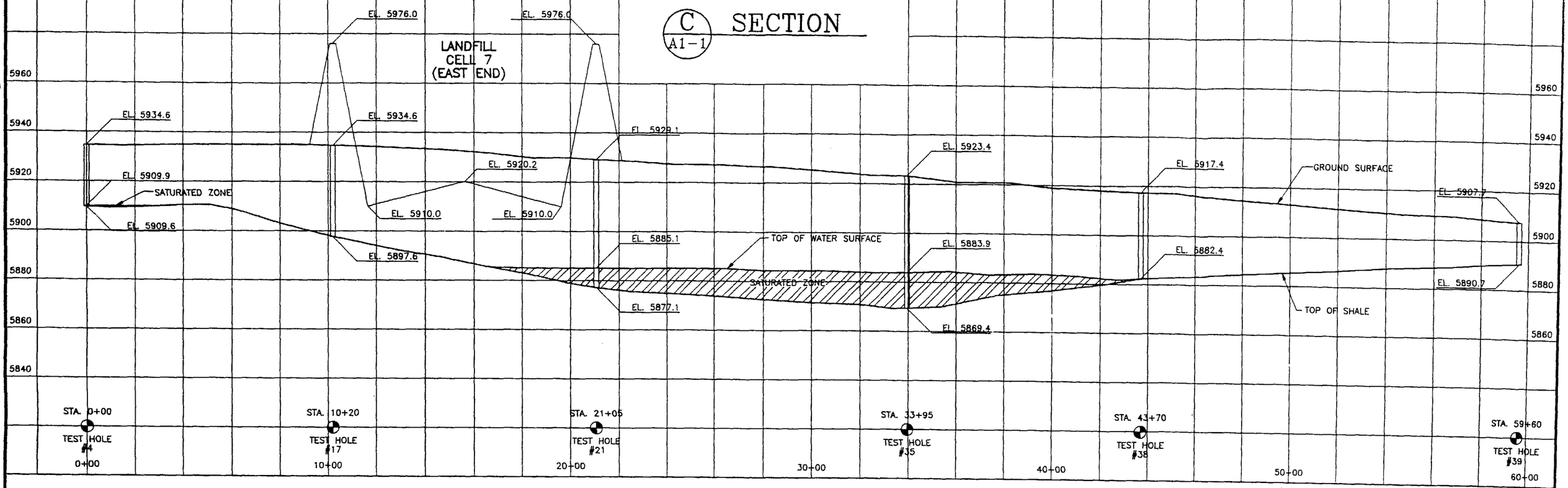
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CROSS SECTION A & B

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

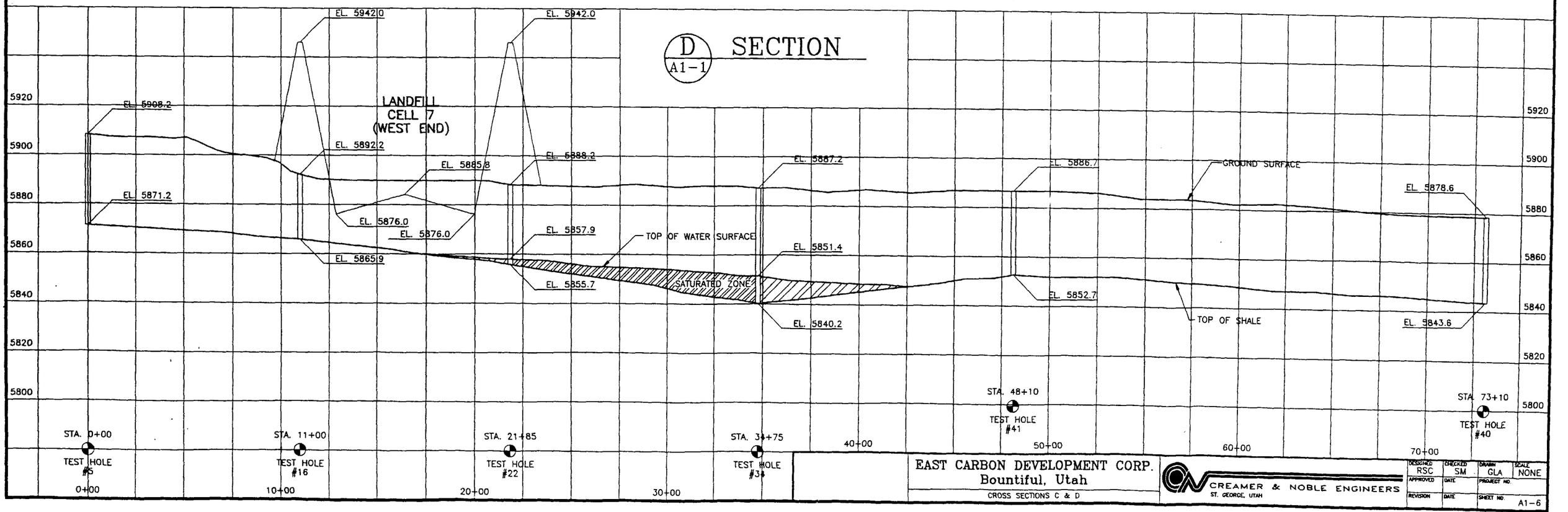
DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-5

GRAPHS

C / A1-1 SECTION



D / A1-1 SECTION



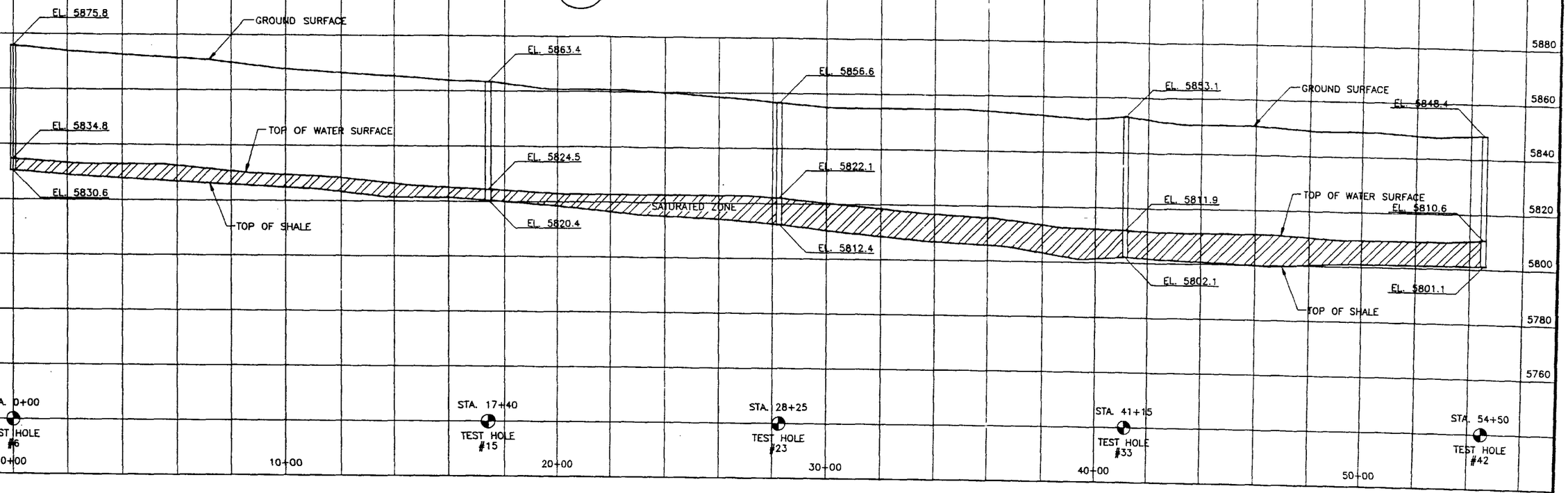
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CROSS SECTIONS C & D

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

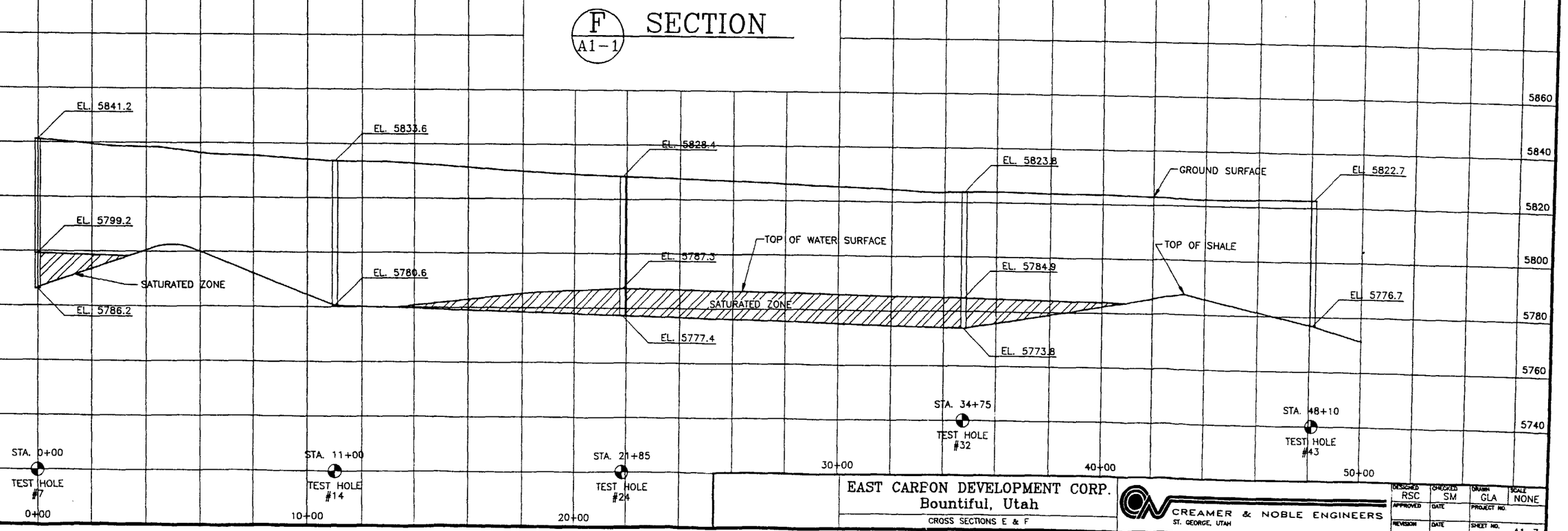
DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-6

GRAPH44

E / A1-1 SECTION



F / A1-1 SECTION



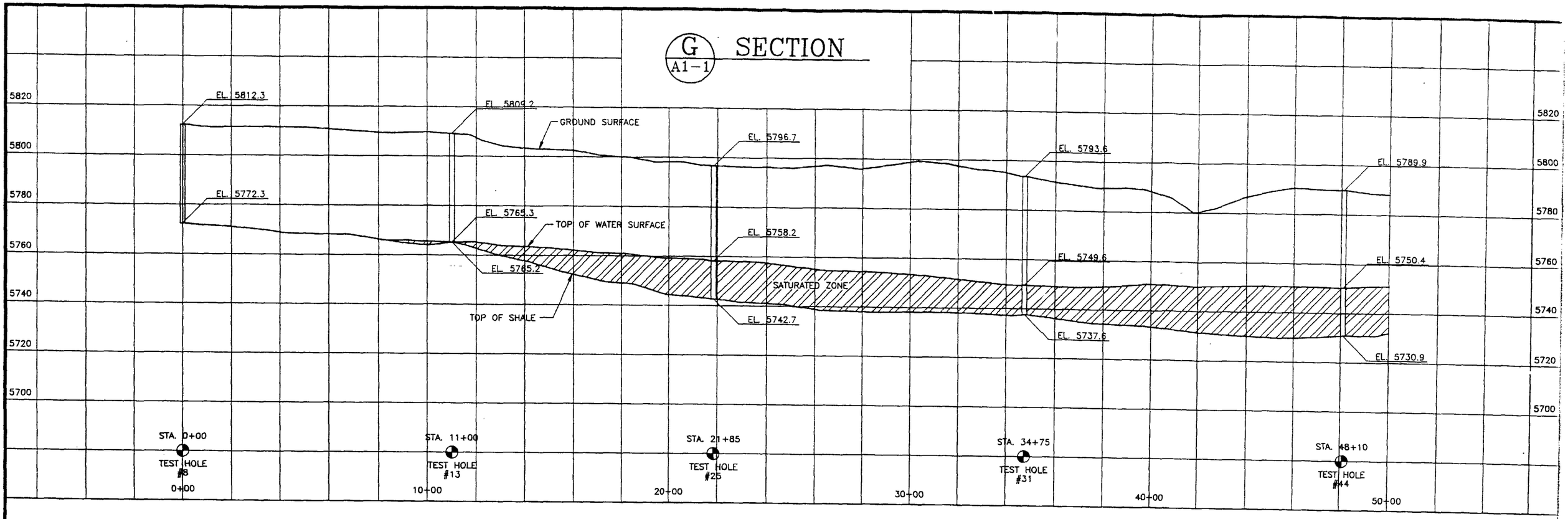
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CROSS SECTIONS E & F

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

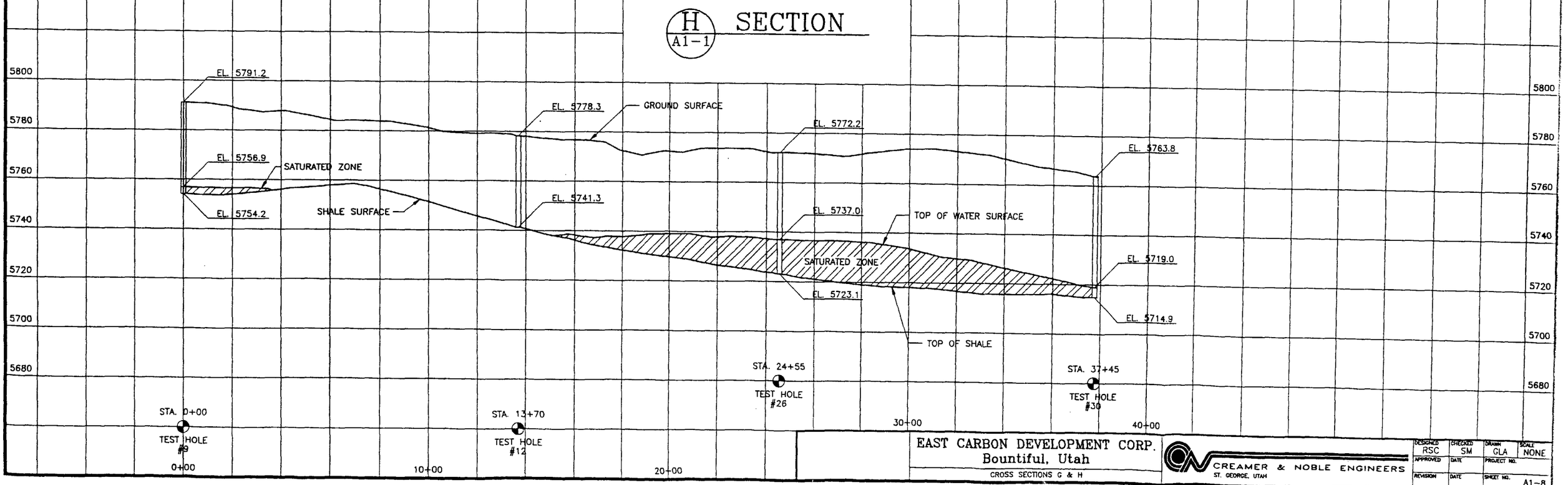
DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-7

GRAPH3

G / A1-1 SECTION



H / A1-1 SECTION



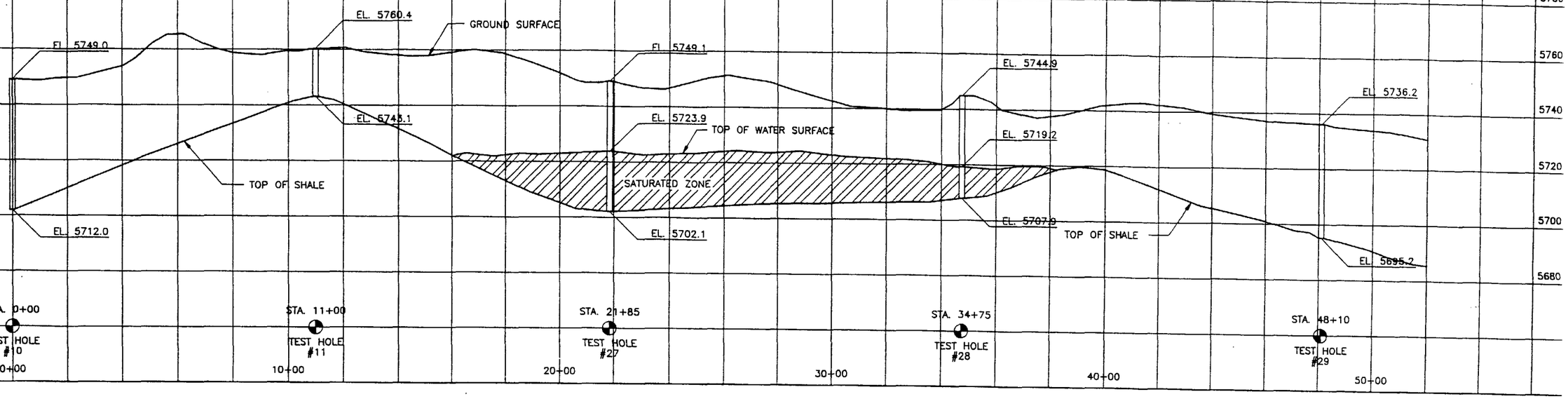
EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CROSS SECTIONS G & H

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-8

GRAPH2

I SECTION
A1-1



EAST CARBON DEVELOPMENT CORP.
Bountiful, Utah
CROSS SECTION I

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED	CHECKED	DRAWN	SCALE
RSC	SM	GLA	NONE
APPROVED	DATE	PROJECT NO.	
REVISION	DATE	SHEET NO.	A1-9

GRAPH1

Cell #10 Drawings

Construction Drawings

for

E.C.D.C. ENVIRONMENTAL, L.C.
EAST CARBON, UTAH

SOLID WASTE LANDFILL FACILITY
CELL No. 10 CONSTRUCTION PROJECT

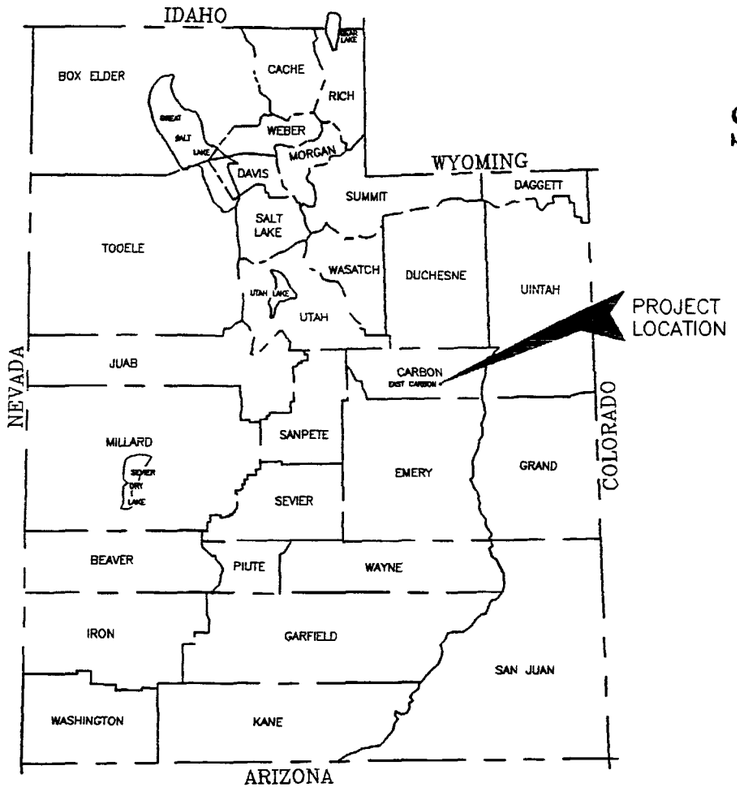
JUNE 1996

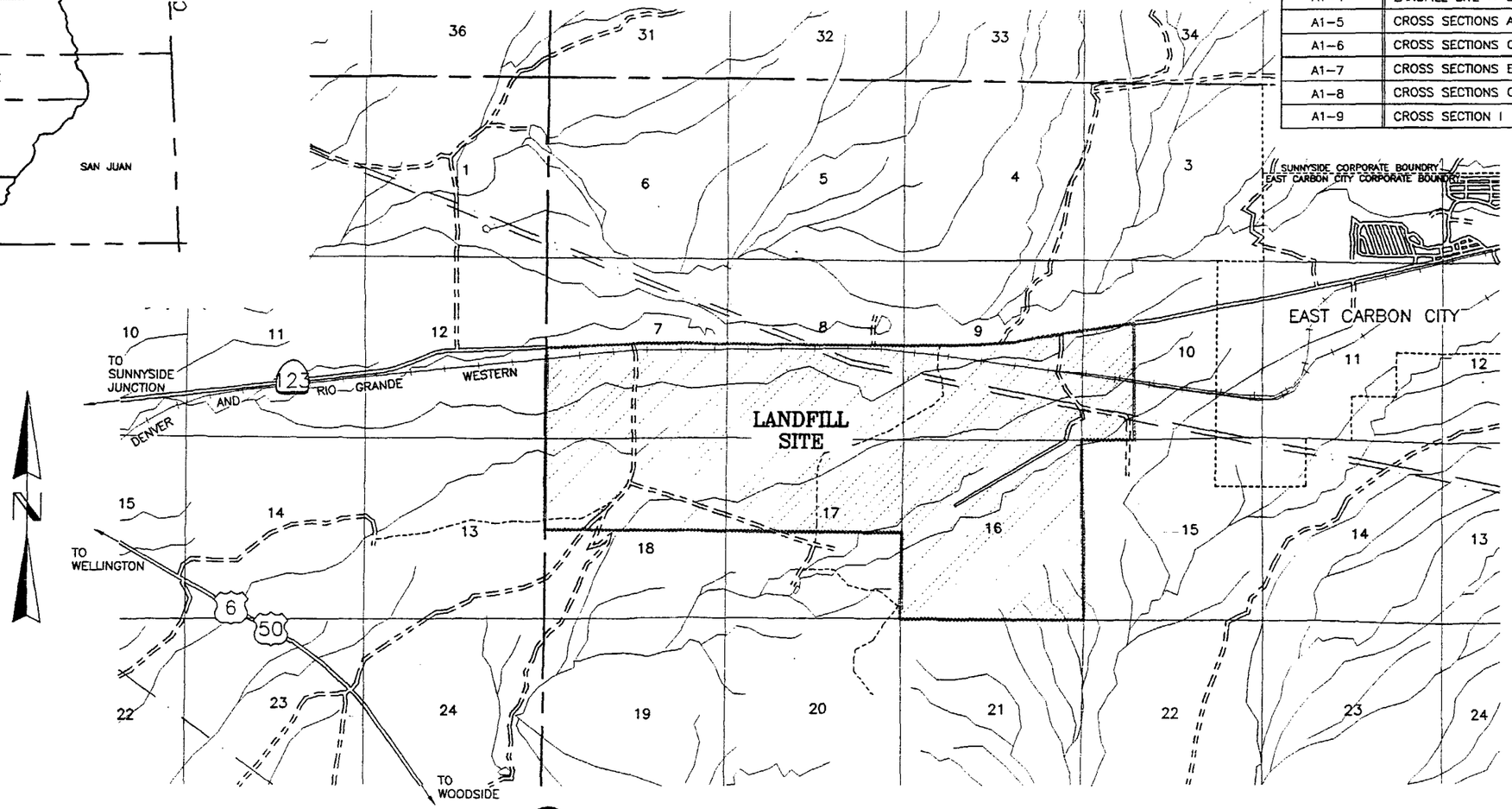
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.

SOLID WASTE LANDFILL FACILITY

May 1996





INDEX TO SHEETS

SHEET No.	DESCRIPTION
1	COVER & INDEX TO SHEETS
2	OVERALL SITE PLAN
3	PROJECT LOCATION MAP
4	CELL 10 – PLAN VIEW
5	CELL 10 – CROSS SECTIONS
6	TYPICAL SECTIONS AND DETAILS
7	CELL LINER DETAILS
8	LEACHATE COLLECTION SYSTEM
9	LEACHATE COLLECTION SYSTEM
10	FENCE DETAILS & TEST PIT LOGS
11	CELL CLOSURE DETAILS
A1–1	LANDFILL SITE – GROUND SURFACE CONTOUR
A1–2	LANDFILL SITE – TOP OF SHALE CONTOUR
A1–3	LANDFILL SITE – PEDIMENT THICKNESS CONTOUR
A1–4	LANDFILL SITE – GROUND WATER SURFACE CONTOUR
A1–5	CROSS SECTIONS A & B
A1–6	CROSS SECTIONS C & D
A1–7	CROSS SECTIONS E & F
A1–8	CROSS SECTIONS G & H
A1–9	CROSS SECTION I

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL L.C.
East Carbon, Utah

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED RSC	DATE 4/94	REVISION	DATE
CHECKED SM	PROJECT NO.	REVISION	DATE
DRAWN CFL	SCALE 1" = 500'	REVISION	DATE

LEGEND
- Existing Perimeter Fence
- Existing Ephraim Diversion Ditch
- Existing Irrigation Ditch
- Backround Monitoring Well
- Piezometric Test Holes
- Indicates direction of surface runoff to be carried on the Cell Surface
- Indicates the top of the Cell Closure. Each Cell will be graded with a similar configuration.
- Ridge Line of Closure
- Rock Lined Storm Water Diversion Channel
- Temporary Access Road and Roll Sprinkler
- Will be Constructed During Operation To Minimize Required Movements.
- Methane Gas Sampling Location
- Convenience Point Monitoring Well

NOTES:
1. Top of cell to be 50 feet vertically above the surface of the adjacent terrain.
2. Cell slopes to be 3:1 or less.
3. Cell slopes to be covered with 6 inches of soil and seeded with a mixture of grasses, forbs, and shrubs.
4. Cell slopes to be constructed with a maximum center mound of 50 feet higher than the sides.

LAT 39°39'11"N
LONG 110°27'33"W

Administration Building and Scale Facility

Test Hole (El. 5991.3')

Temporary Access Road

Note: Subcells will be constructed sequentially. The subcells are identified as the rectangular blocks in the cells.

Rock Lined Channel Detail

Q_{100} = 0-146 cfs

Borrow Area Only

Container Yard

Test Hole (El. 5931.7')

Well #1 (Existing)

Existing Home

40 Acres Irrigated Farm Land

HIGHWAY 123

CARBON COUNTY
UNZONED

CARBON COUNTY
UNZONED

CELL 10
CELL 11
CELL 12
CELL 13
CELL 14
CELL 15
CELL 16
CELL 17
CELL 18
CELL 19N
CELL 19S
CELL 20N
CELL 20S
CELL 21N
CELL 21S
CELL 22S
CELL BM

6' Bid Service Pipeline to be relocated or abandoned

Electrical Line

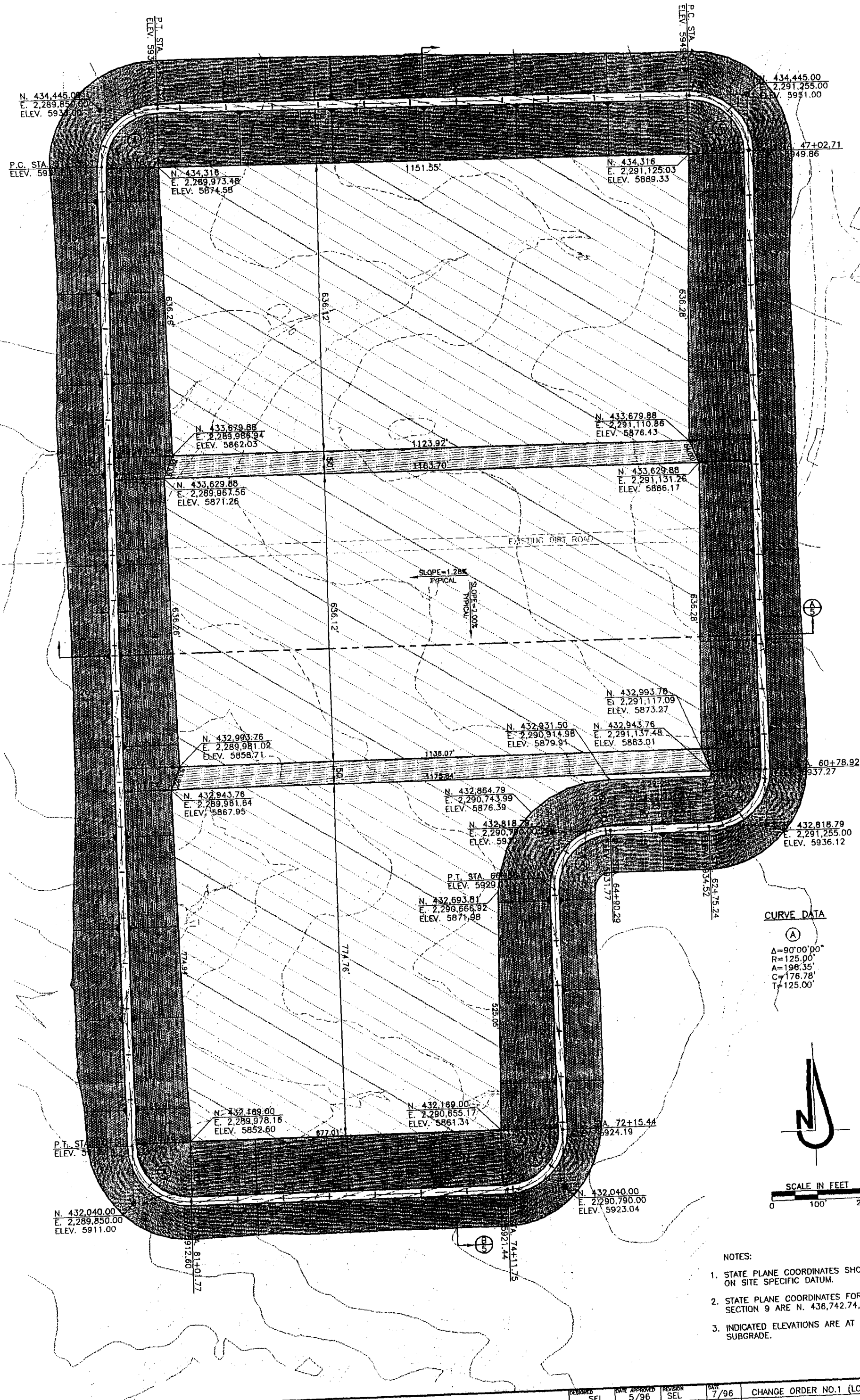
Ridge Line of Closure

Test Hole (El. 5931.7')

Grand Trail

Spring

CLARK VALLEY
CONTACT ZONE (End of Water Aquifer)
FEMA 100 YR FLOOD PLAIN
Qgs (Alluvium)
Kms (Mancos Shale)
WELL #1 and Home (Existing)
(Abandoned & Caved)
40 Acres
DENVER AND RIO GRANDE WESTERN
DRILL HOLE #4
DRILL HOLE #2
SITE BOUNDARY
WELL #3 (Abandoned)
WELL #5 (Abandoned & Caved)
WELL #6 (Caved)
WELLS #2 & #4 (Abandoned)
Dragerton
East Carbon City
Columbia Junction
SECTION AND DETAIL IDENTIFICATION
DETAIL IDENTIFICATION
SECTION LETTER
DETAIL NUMBER
DETAIL
NOTE:
1. CLAY AND EMBANKMENT BORROW SHALL BE OBTAINED FROM OFF-SITE SOURCES OR FROM WITHIN FACILITY LIMITS.
2. CONTRACTOR SHALL PROTECT EXISTING PIPELINES AND POWER LINES. A 50 FOOT BUFFER ZONE IN WHICH EXCAVATION WILL NOT BE ALLOWED SHALL BE MAINTAINED ON EACH SIDE OF EXISTING PIPELINES. ANY DAMAGE TO EXISTING PIPELINES OR POWER LINES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR, AND SHALL BE REPAIRED BY THE CONTRACTOR AT HIS EXPENSE.
STATE OF UTAH
E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
PROJECT LOCATION MAP



CURVE DATA

(A)

Δ=90°00'00"
R=125.00'
A=196.35'
C=176.78'
T=125.00'

SCALE IN FEET

0 100' 200'

NOTES:

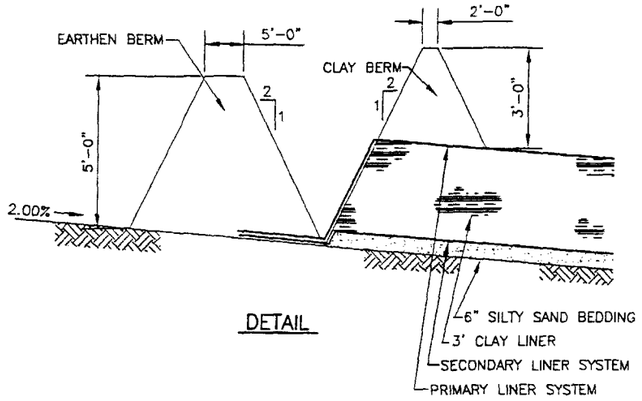
1. STATE PLANE COORDINATES SHOWN ARE BASED ON SITE SPECIFIC DATUM.
2. STATE PLANE COORDINATES FOR S.W. COR. OF SECTION 9 ARE N. 436,742.74, E. 2,288,876.96.
3. INDICATED ELEVATIONS ARE AT TOP OF SUBGRADE.

DESIGNED SEL	DATE APPROVED 5/96	REVISION SEL	DATE 7/96	CHANGE ORDER NO.1 (LOWERED 1 FOOT)		
CHECKED KRN	PROJECT NO. 3255	REVISION	DATE			
DRAWN DRL	SCALE NONE	REVISION	DATE			

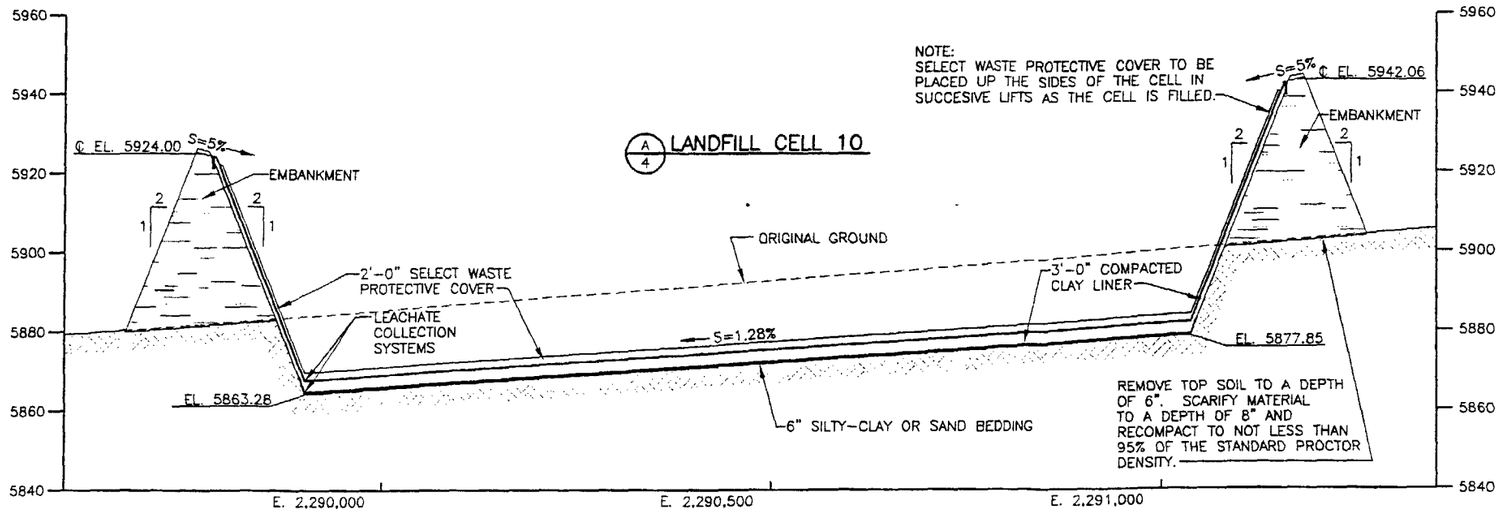
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CELL 10 - PLAN VIEW

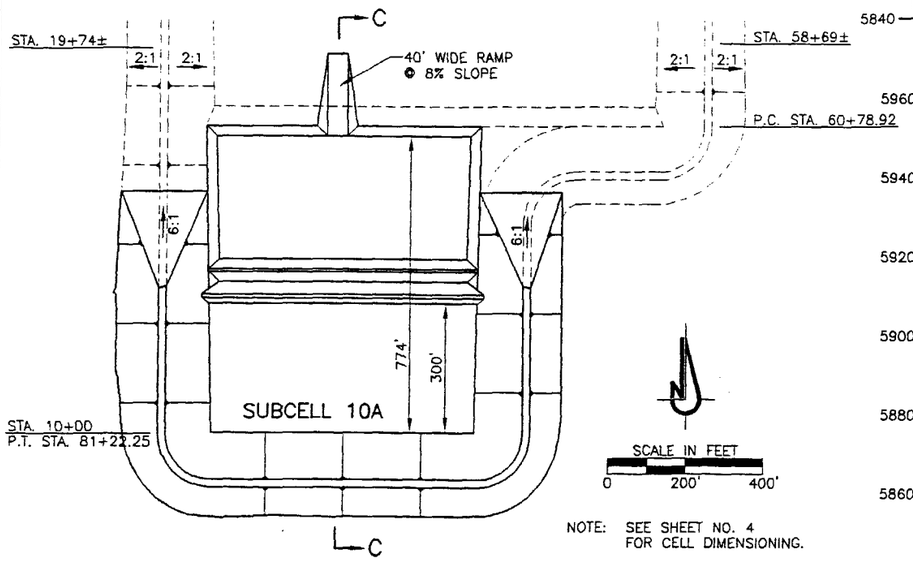
CELL 10 SHEET NO. 4



DETAIL

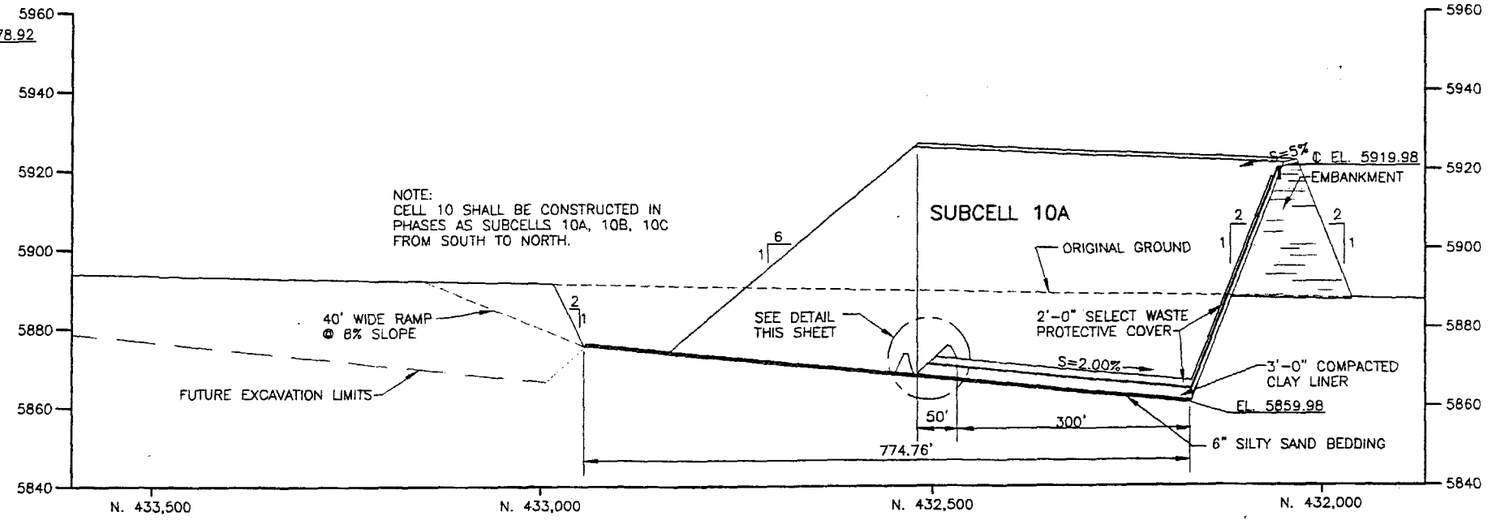


A/4 LANDFILL CELL 10

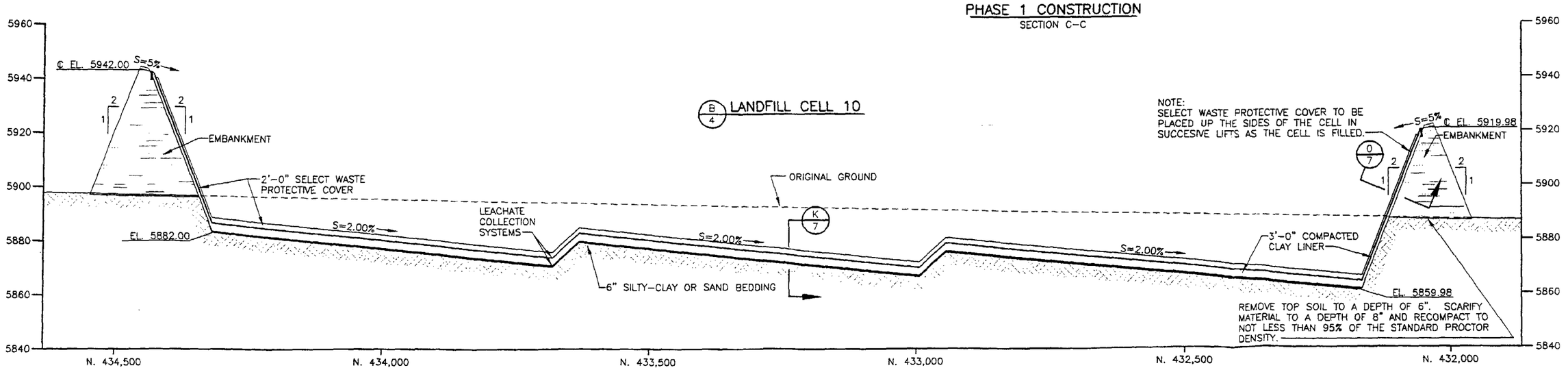


NOTE: SEE SHEET NO. 4 FOR CELL DIMENSIONING.

PHASE 1 CONSTRUCTION
PLAN



PHASE 1 CONSTRUCTION
SECTION C-C



B/4 LANDFILL CELL 10

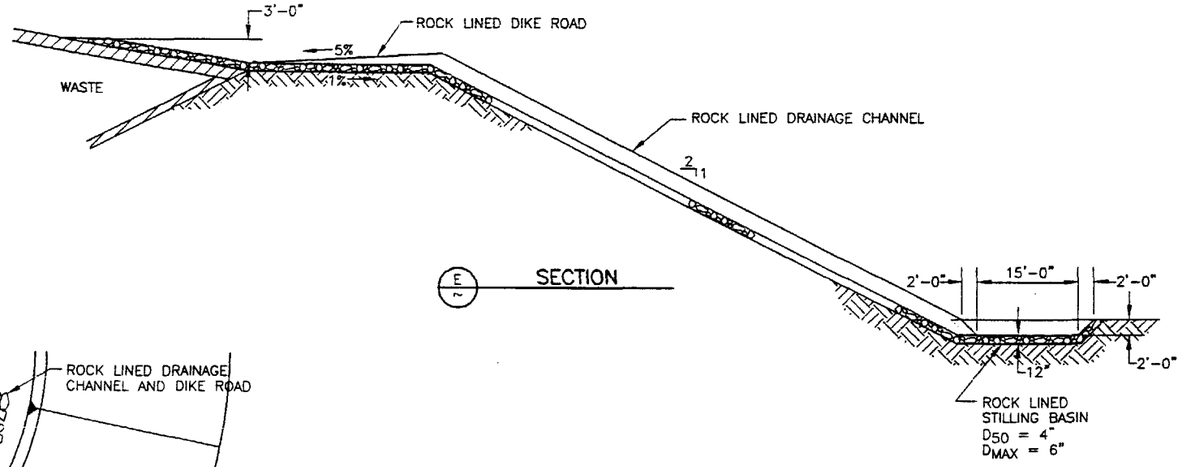
DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE APPROVED 5/96
PROJECT NO. 1255
SCALE As Shown

NO.	DATE	REVISION
1	7/96	CHANGE ORDER NO.1 (LOWERED 1 FOOT)

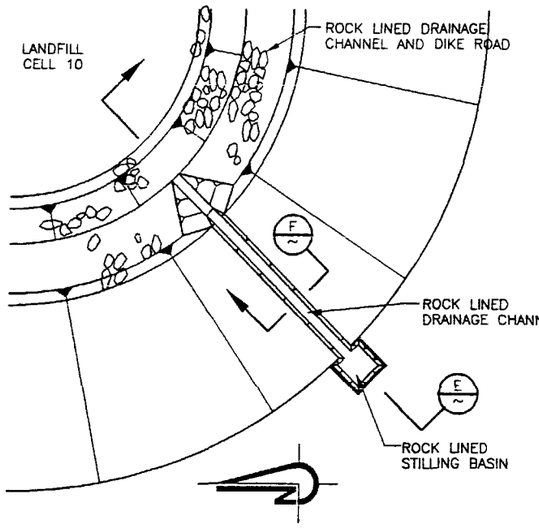
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CELL 10 CROSS SECTIONS

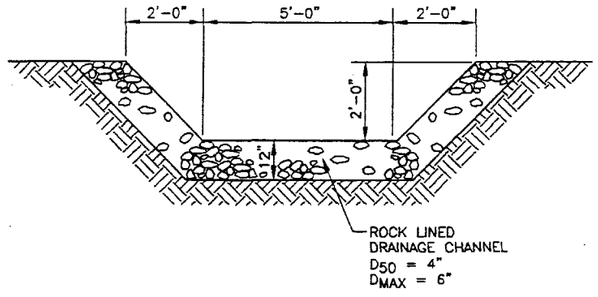
C10XSECS
SHEET NO.
5



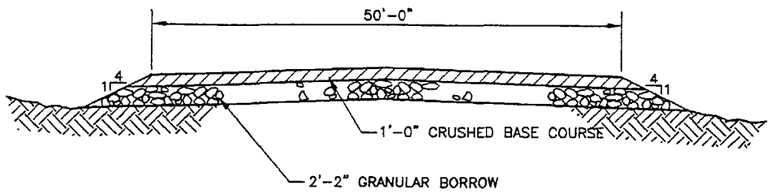
E SECTION



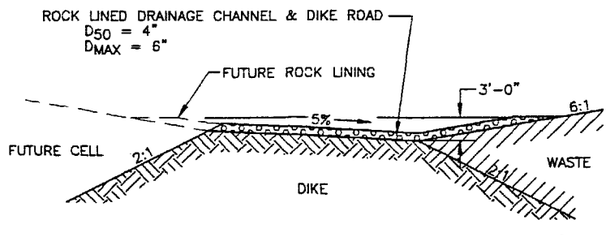
1/4 TEMPORARY DRAINAGE CHANNEL



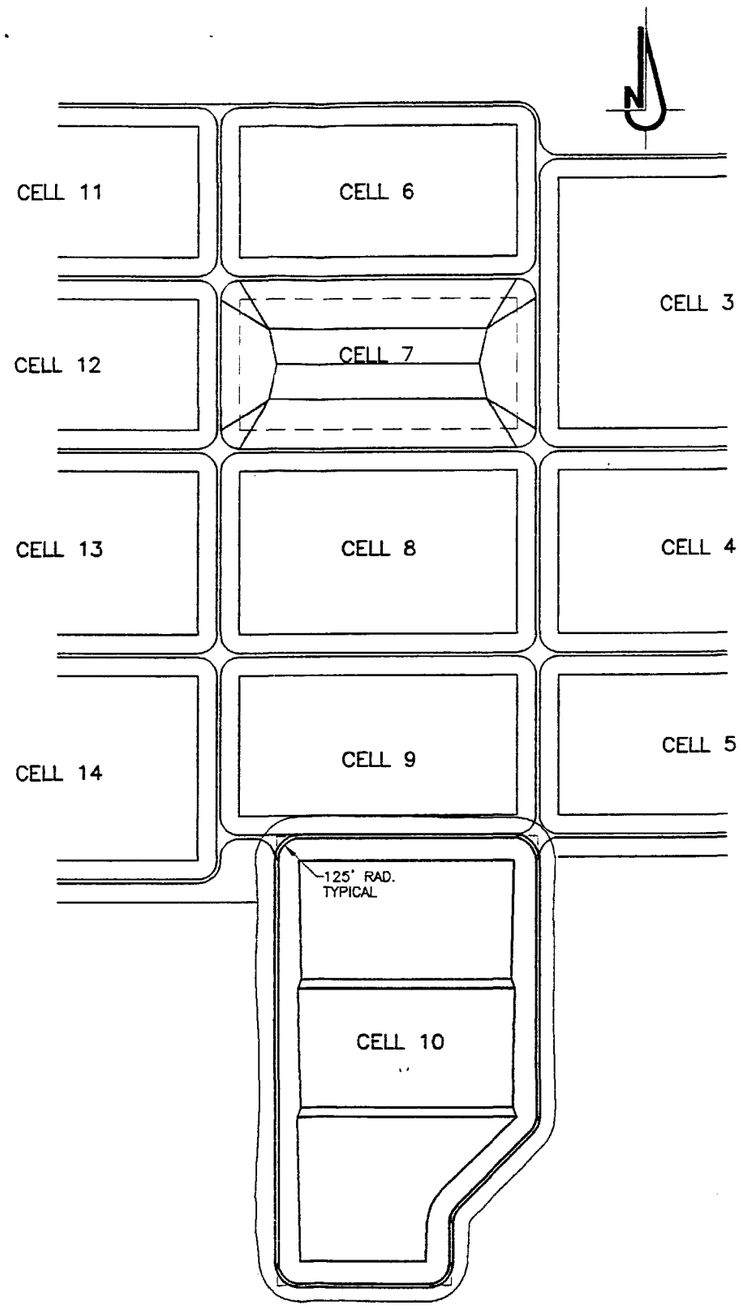
F SECTION



LANDFILL CELL ACCESS ROAD
TYPICAL SECTION



C EXTERIOR DIKE DRAINAGE DESIGN



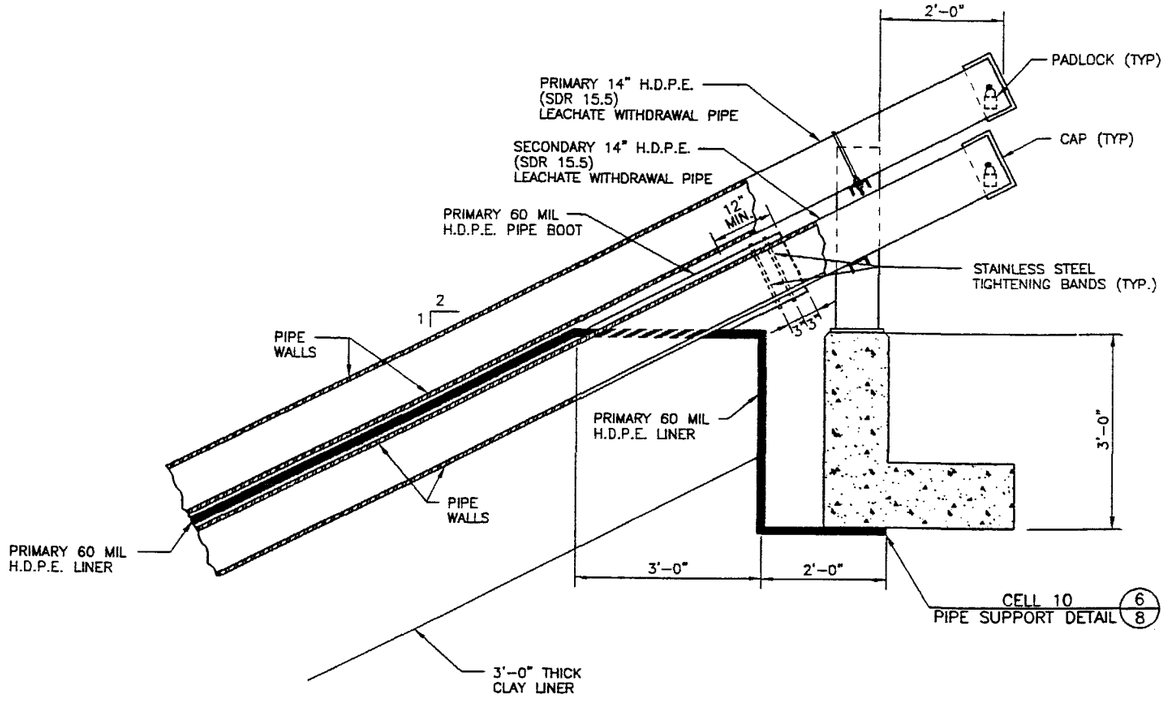
PLAN VIEW

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

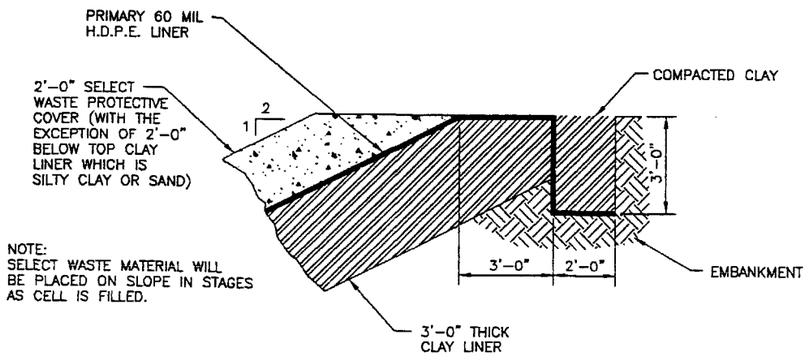
DESIGNED	DATE	APPROVED	REVISION	DATE
SEL		5/96		
CHECKED		PROJECT NO.	REVISION	DATE
KRN		3255		
DRAWN		SCALE	REVISION	DATE
DRL		NONE		

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
TYPICAL SECTIONS AND DETAILS

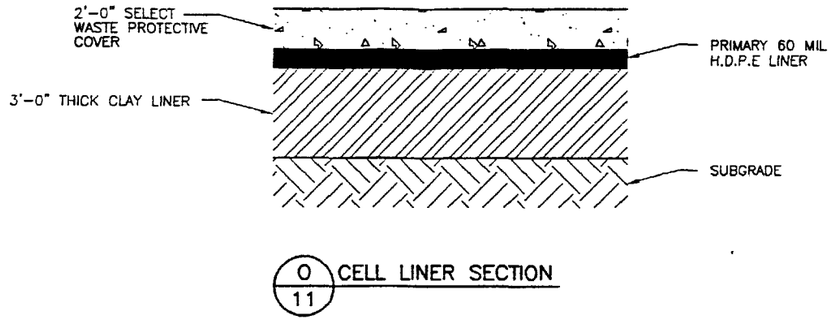
C10TYPDT
SHEET NO.
6



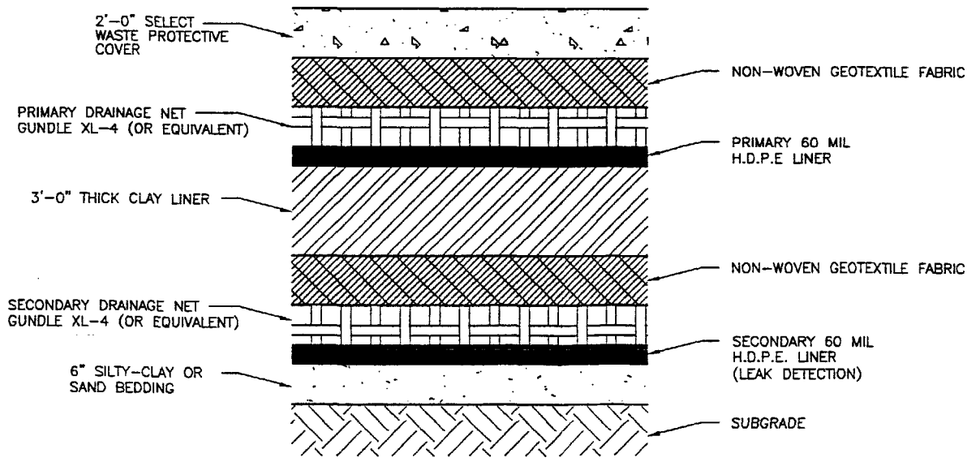
PIPE SEAL DETAIL



LINER ANCHOR DETAIL



0/11 CELL LINER SECTION



K/11 CELL LINER SECTION

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

	DATE	REVISION	DATE	REVISION	DATE
DESIGNED SEL	DATE APPROVED 5/96				
CHECKED KRN	PROJECT NO. 3255				
DRAWN DRL	SCALE NONE				

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CELL LINER DETAILS

C1CLINER
SHEET NO.
7

NON-WOVEN GEOTEXTILE FABRIC
PRIMARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=2.00%
PRIMARY 60 MIL H.D.P.E. LINER
S=18.97%
NON-WOVEN GEOTEXTILE FABRIC
PRIMARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
5'-11"
NON-WOVEN GEOTEXTILE FABRIC
PRIMARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=2.00%
3/4" MINUS GRAVEL
1 1/2
1 1/2
PRIMARY 60 MIL H.D.P.E. LINER
4" ø H.D.P.E. PIPE (SDR 15.5)
H.D.P.E. PIPE DETAIL 3/9
CLAY
CLAY
CLAY
NON-WOVEN GEOTEXTILE FABRIC
SECONDARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=2.00%
SECONDARY 60 MIL H.D.P.E. LINER
3'-0" CLAY
NON-WOVEN GEOTEXTILE FABRIC
SECONDARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=18.97%
SECONDARY 60 MIL. H.D.P.E. LINER
5'-11"
NON-WOVEN GEOTEXTILE FABRIC
SECONDARY DRAINAGE NET GUNDLE XL-4 (OR EQUIVALENT)
S=2.00%
3/4" MINUS GRAVEL
1 1/2
1 1/2
SECONDARY 60 MIL. H.D.P.E. LINER
4" ø H.D.P.E. PIPE (SDR 15.5)
1'-0" (TYP)
H.D.P.E. PIPE DETAIL 3/9

H/- SECTION

6"
2 1/2" 3 1/2"
NOTE: 2 PLATES REQUIRED FOR EACH PIPE SUPPORT.
C7 X12.25 CHANNEL
5/8" PL
10"
3"
4"
3"
1" (TYP)
2-5/8" ø HOLES
2" (TYP)

8/- MOUNTING PLATE DETAIL

R=8 1/4"
19"
10 1/4"
1/2" STEEL ROD WITH 1/2"-13 UNC X4" THRD. LGTH.
17"

7/- U-BOLT DETAIL
NTS

1'-0"
4" 4" 4"
1/2" X12" STEEL ANCHOR BOLT 4 REQUIRED EACH PIPE SUPPORT
1 3/4" PROJECTION
2" CLR
9 #4X3'-7" @10" CC
3 #4X6'-8" @10" CC
4 #4X6'-0" @10" CC
9 #4X2'-8" @10" CC
2'-0"
3'-0"
2'-0"
3" CLR
1'-0"
1'-0"
2" CLR (TYP)
3'-0"
7'-0"
1'-4 1/2"
4'-3"
1'-4 1/2"
3/4" CHAMFER ALL EXPOSED EDGES
EL. 1420.00 (TYP) TOP OF EMBANKMENT
EL. 1417.00 (TYP)

9/- CONCRETE FOOTING DETAIL

NOTE:
HOT DIP GALVANIZE ALL STEEL OF SUPPORT SYSTEM AFTER FABRICATION.

7/-
1/2" U-BOLT WITH WASHER AND NUT EACH SIDE OF CHANNEL 1 REQUIRED FOR EACH PIPE SUPPORT
M/-
4"
C7 X12.25 CHANNEL
26 1/2" (TYP)
1'-7"
4"
1'-9 1/4"
3'-3 5/8"
1'-2 3/8"
C4 X7.25 CHANNEL (TYP)
8/- MOUNTING PLATE
6"
CONCRETE FOOTING
N/- SECTION

4'-0"
8 1/4"
2'-0"
1/2" U-BOLT
5/8" ø HOLE (TYP)
H.D.P.E. LEACHATE WITHDRAWAL PIPE
STEEL SUPPORT SYSTEM
1/4" (TYP) ALL WELDS
MOUNTING PLATE (TYP)
9/-
N/-
M/- SECTION

6/7 PIPE SUPPORT DETAIL
CELL 10

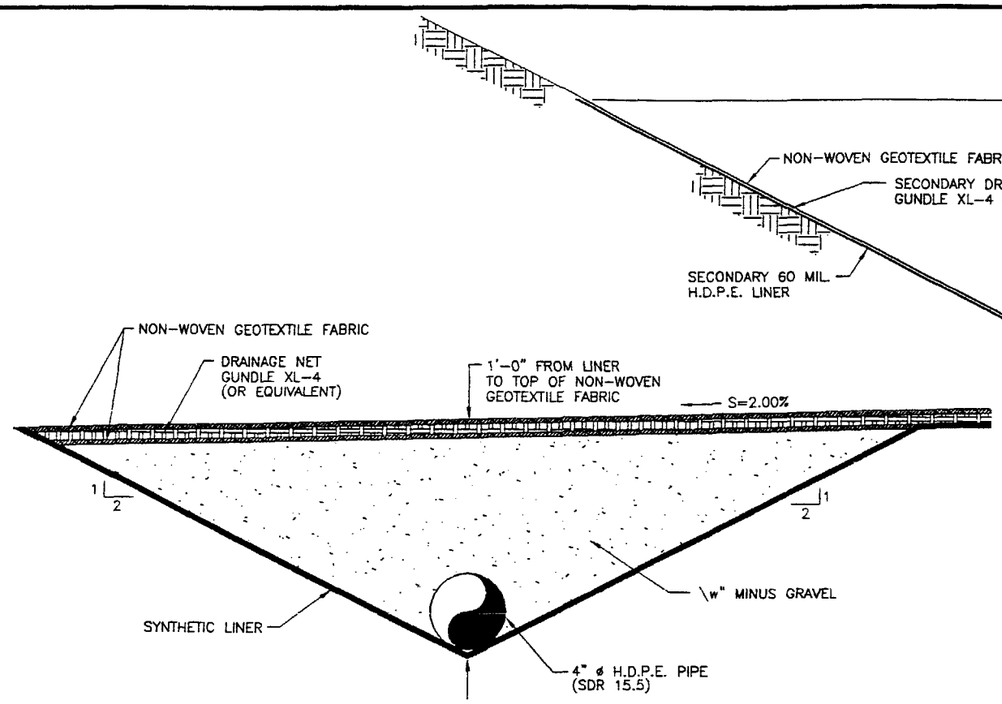
CELL 10
I/9
H/~
G/9
J/9

DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE 5/7/96
PROJECT NO. 3255
SCALE NONE
REVISION
DATE

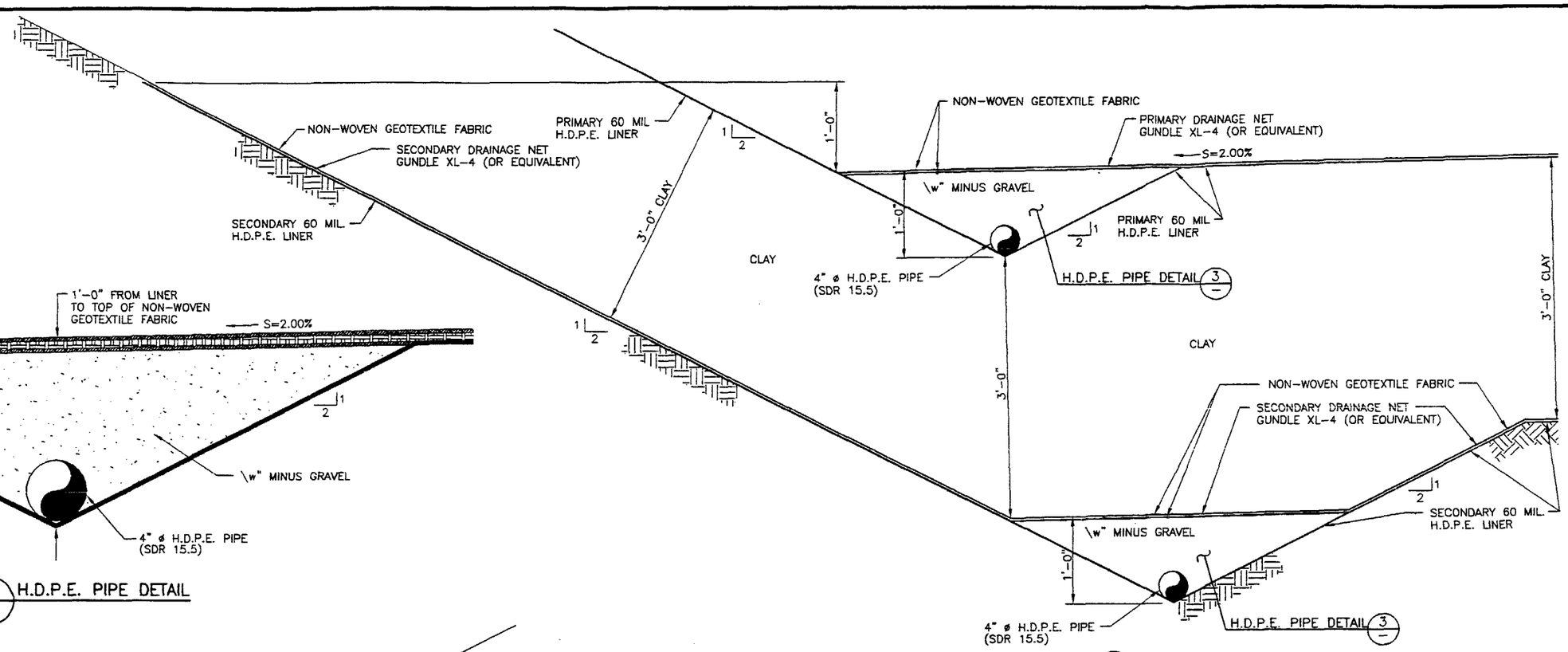
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
LEACHATE COLLECTION SYSTEM

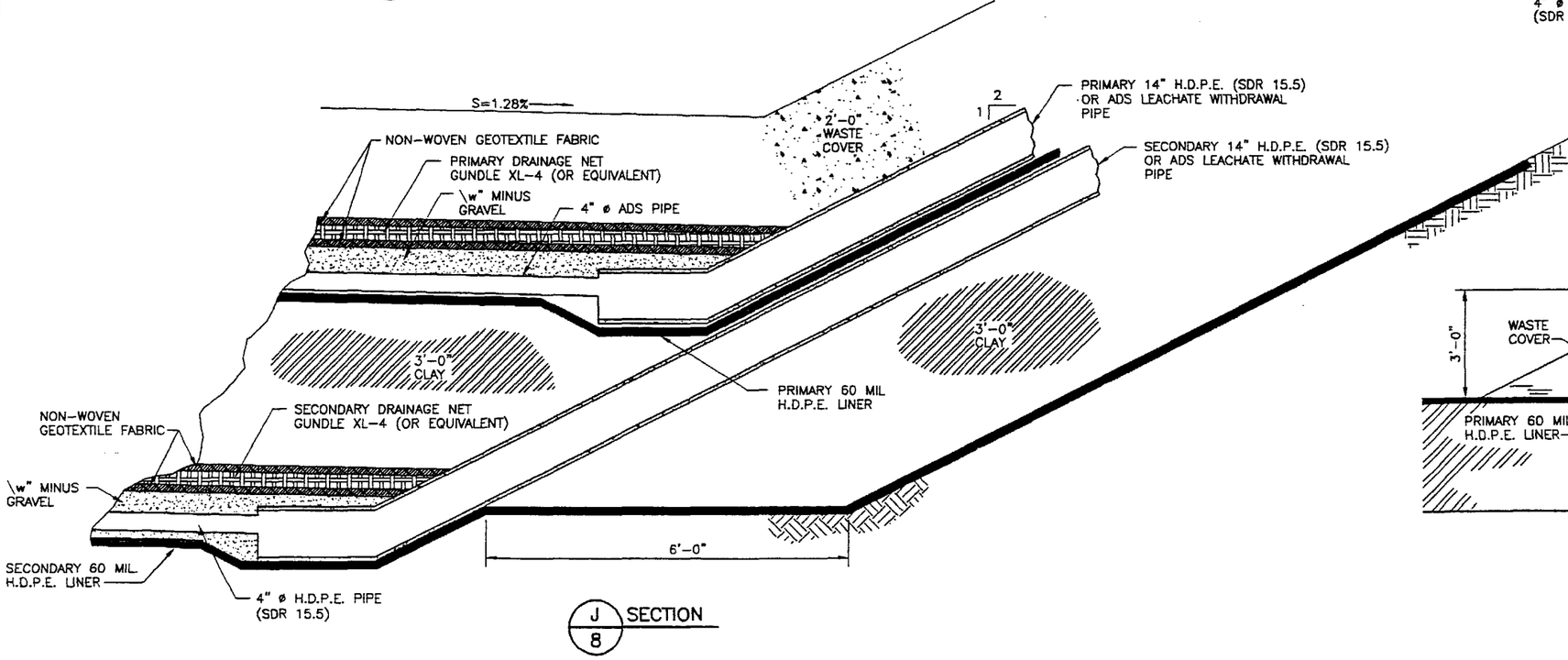
C10LEACH
SHEET NO.
8



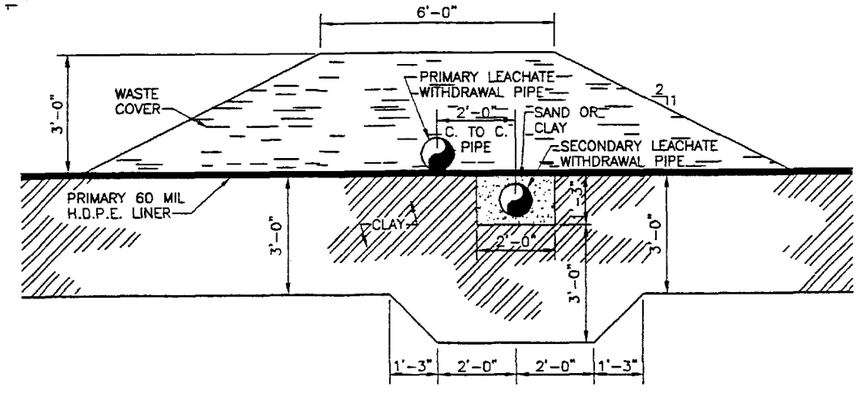
3/8 H.D.P.E. PIPE DETAIL



G/8 SECTION



J/8 SECTION



I/8 SECTION

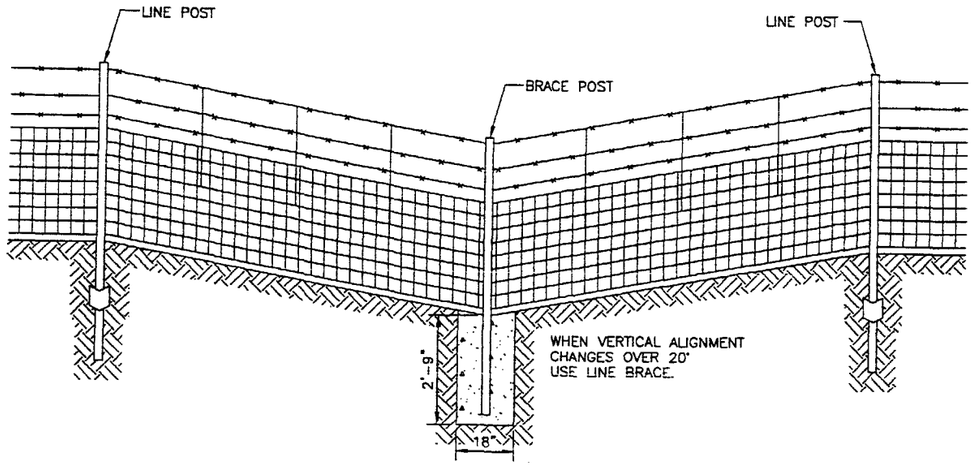
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE APPROVED 5/96
PROJECT NO. 3255
SCALE As Shown

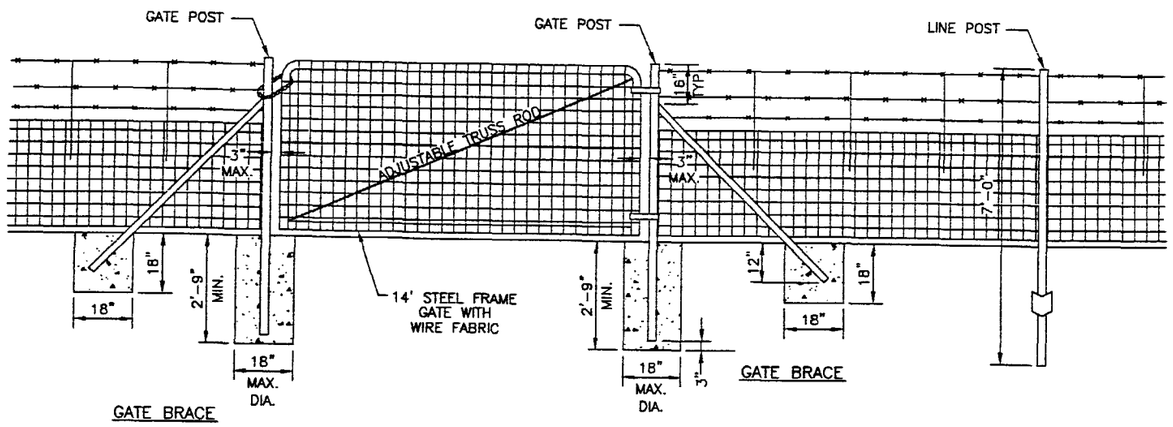
DATE / REVISION

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
LEACHATE COLLECTION SYSTEM

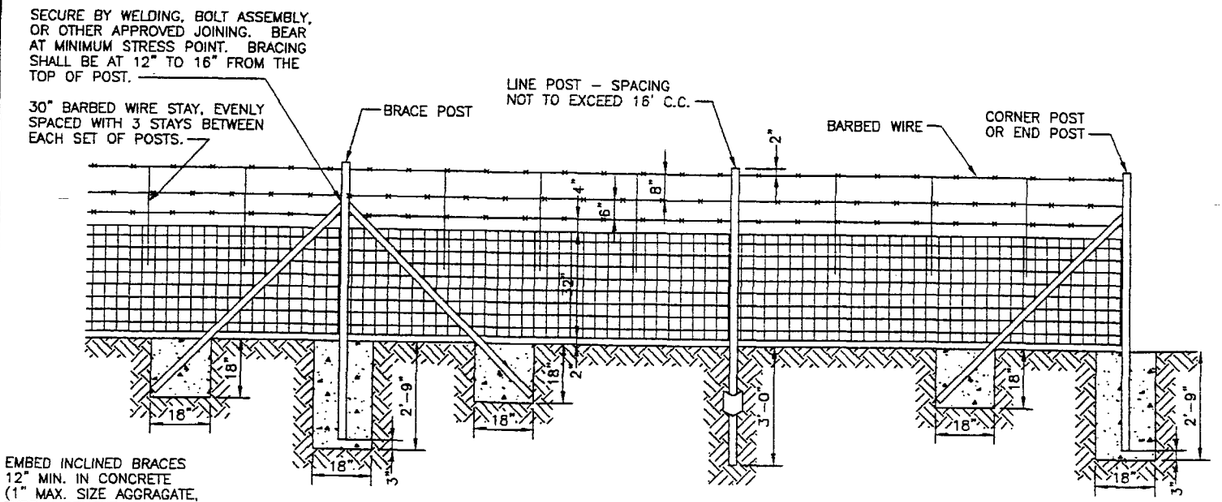
C1DLECH2
SHEET NO.
9



TYPICAL SAG OR VERTICAL ALIGNMENT CHANGE



E 14' TYPE E GATE
2 REQ'D.



EMBED INCLINED BRACES 12" MIN. IN CONCRETE (1" MAX. SIZE AGGREGATE, TYPE II CEMENT, 3000 PSI IN 28 DAYS) OR AN APPROVED HIGH STRENGTH QUICK SETTING EPOXY GROUT MIX IF BRACE IS IN SOLID ROCK.

LINE BRACE
USE FOR LINE DEVIATION TO 30° & AT INTERVALS NOT TO EXCEED 500'

E TYPE E FENCE

END, ANGLE & CORNER BRACE
USE FOR LINE DEVIATIONS GREATER TO 30° & AT ALL END POSTS.

LINE POSTS SHALL BE TEE CHANNEL OR "Y" OR "U" SECTIONS AND SHALL HAVE A MINIMUM WT. OF 1.33 LBS/FT OF LENGTH.

BRACE, CORNER AND END POSTS MAY BE 2 1/2" x 2 1/2" x 1/4" ANGLES HAVING A MINIMUM WEIGHT OF 4.10 LBS/FT INCLINED BRACES MAY BE 2" x 2" x 1/4" ANGLES HAVING A MINIMUM WEIGHT OF 3.19 LBS/FT. POSTS & BRACES SHALL CONFORM TO A-36 OR EQUAL.

AT THE CONTRACTOR'S OPTION – BRACE, CORNER, ANGLE AND END POSTS MAY BE 2 3/8" O.D. GALV. STEEL AND THE INCLINED BRACES MAY BE 1 7/8" O.D. GALV. STEEL, AS SPECIFIED IN ASTM A120, SCHEDULE 40, AND ASTM A123. THE BRACE, CORNER, ANGLE AND END POST ASSEMBLIES SHALL BE CONSTRUCTED SIMILAR TO THE APPLICABLE DETAIL. ALL ROUND POSTS SHALL BE CAPPED.

TEST PIT LOGS FOR CELL 10

A TRACK HOE WAS USED TO DIG FOURTEEN TEST PITS THROUGHOUT CELL 10. SEE THE ENCLOSED MAP FOR TEST PIT LOCATIONS. TEST PIT DEPTHS VARIED FROM 17 FEET TO 25 FEET. A NUCLEAR GAUGE WAS USED TO DETERMINE THE IN PLACE DENSITY OF THE SILTY SAND AT SOME OF THE TEST PIT LOCATIONS. MANCOS SHALE WAS ENCOUNTERED IN TEST PITS 7 AND 8.

TEST PIT 10–1 DEPTH 24 FT.
0 – .5' TOP SOIL
.5' – 7' SILTY SAND
7' – 24' GRAVEL WITH SOME BOULDERS

TEST PIT 10–2 DEPTH 25 FT.
0 – .5' TOP SOIL
.5' – 6' SILTY SAND
6' – 25' GRAVEL WITH SOME BOULDERS

TEST PIT 10–3 DEPTH 22 FT.
0 – .5' TOP SOIL
.5' – 5' SILTY SAND
5' – 22' GRAVEL WITH SOME BOULDERS

TEST PIT 10–4 DEPTH 25 FT.
0 – .5' TOP SOIL
.5' – 6' SILTY SAND
6' – 25' GRAVEL WITH SOME BOULDERS

TEST PIT 10–5 DEPTH 18 FT.
DRY DENSITY 101.3 PCF
WET DENSITY 105.7 PCF
0 – .5' TOP SOIL
.5' – 6' SILTY SAND
6' – 18' GRAVEL WITH SOME BOULDERS

TEST PIT 10–6 DEPTH 22 FT.
0 – .5' TOP SOIL
.5' – 3' SILTY SAND
3' – 22' GRAVEL WITH SOME BOULDERS

TEST PIT 10–7 DEPTH 17 FT.
DRY DENSITY 98.6 PCF
WET DENSITY 102.7 PCF
0 – .5' TOP SOIL
.5' – 5' SILTY SAND
5' – 16' GRAVEL WITH SOME BOULDERS
16' – 17' MANCOS SHALE

TEST PIT 10–8 DEPTH 21 FT.
0 – .5' TOP SOIL
.5' – 4' SILTY SAND
4' – 19' GRAVEL WITH SOME BOULDERS
19' – 21' MANCOS SHALE

TEST PIT 10–9 DEPTH 19 FT.
0 – .5' TOP SOIL
.5' – 4' SILTY SAND
4' – 19' GRAVEL WITH SOME BOULDERS

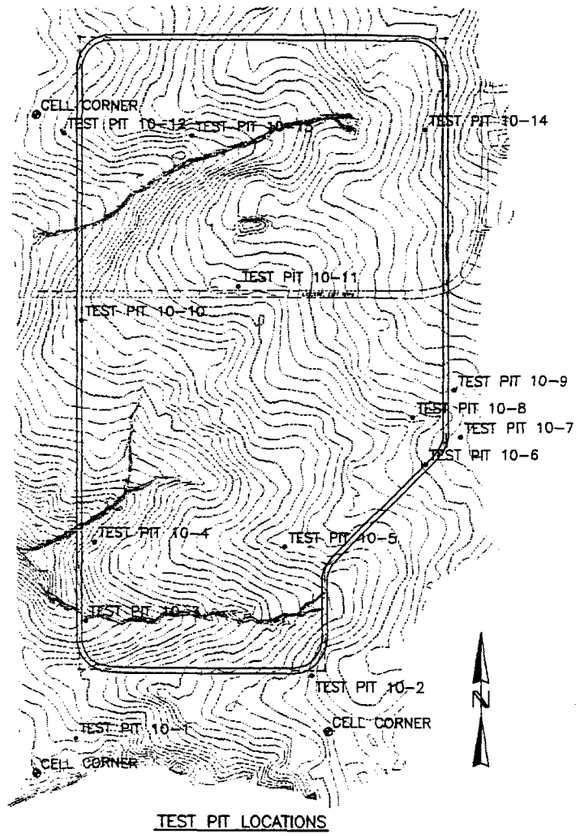
TEST PIT 10–10 DEPTH 21 FT.
0 – .5' TOP SOIL
.5' – 4' SILTY SAND
4' – 21' GRAVEL WITH SOME BOULDERS

TEST PIT 10–11 DEPTH 20 FT.
0 – .5' TOP SOIL
.5' – 5' SILTY SAND
5' – 20' GRAVEL WITH SOME BOULDERS

TEST PIT 10–12 DEPTH 20 FT.
DRY DENSITY 98.6 PCF
WET DENSITY 104.2 PCF
0 – .5' TOP SOIL
.5' – 9' SILTY SAND
9' – 20' GRAVEL WITH SOME BOULDERS

TEST PIT 10–13 DEPTH 19 FT.
0 – .5' TOP SOIL
.5' – 9' SILTY SAND
9' – 19' GRAVEL WITH SOME BOULDERS

TEST PIT 10–14 DEPTH 23 FT.
DRY DENSITY 97.2 PCF
WET DENSITY 102.5 PCF
0 – .5' TOP SOIL
.5' – 9' SILTY SAND
9' – 23' GRAVEL WITH SOME BOULDERS



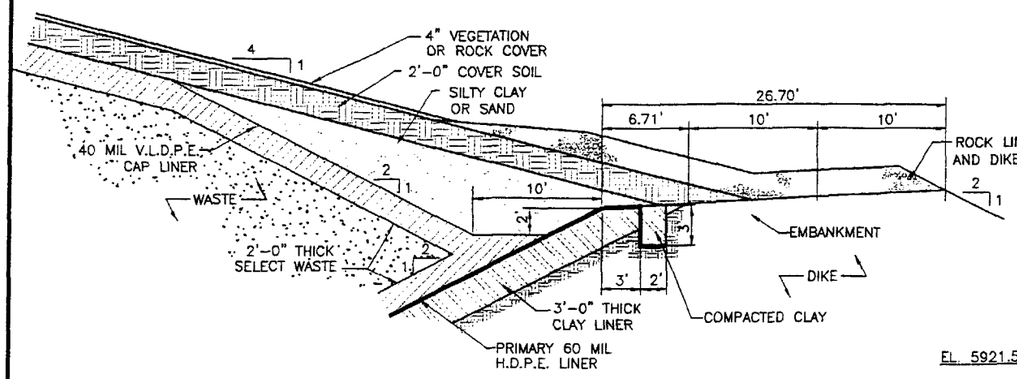
TEST PIT LOCATIONS

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

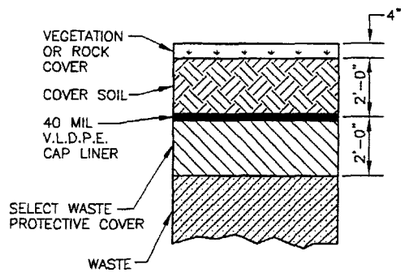
DESIGNED	DATE	REVISION	DATE	REVISION	DATE	REVISION	DATE
SEL	5/96						
CHECKED	PROJECT NO.						
KRN	3255						
DRAWN	SCALE						
DRL	As Shown						

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
FENCE DETAILS & TEST PIT LOGS

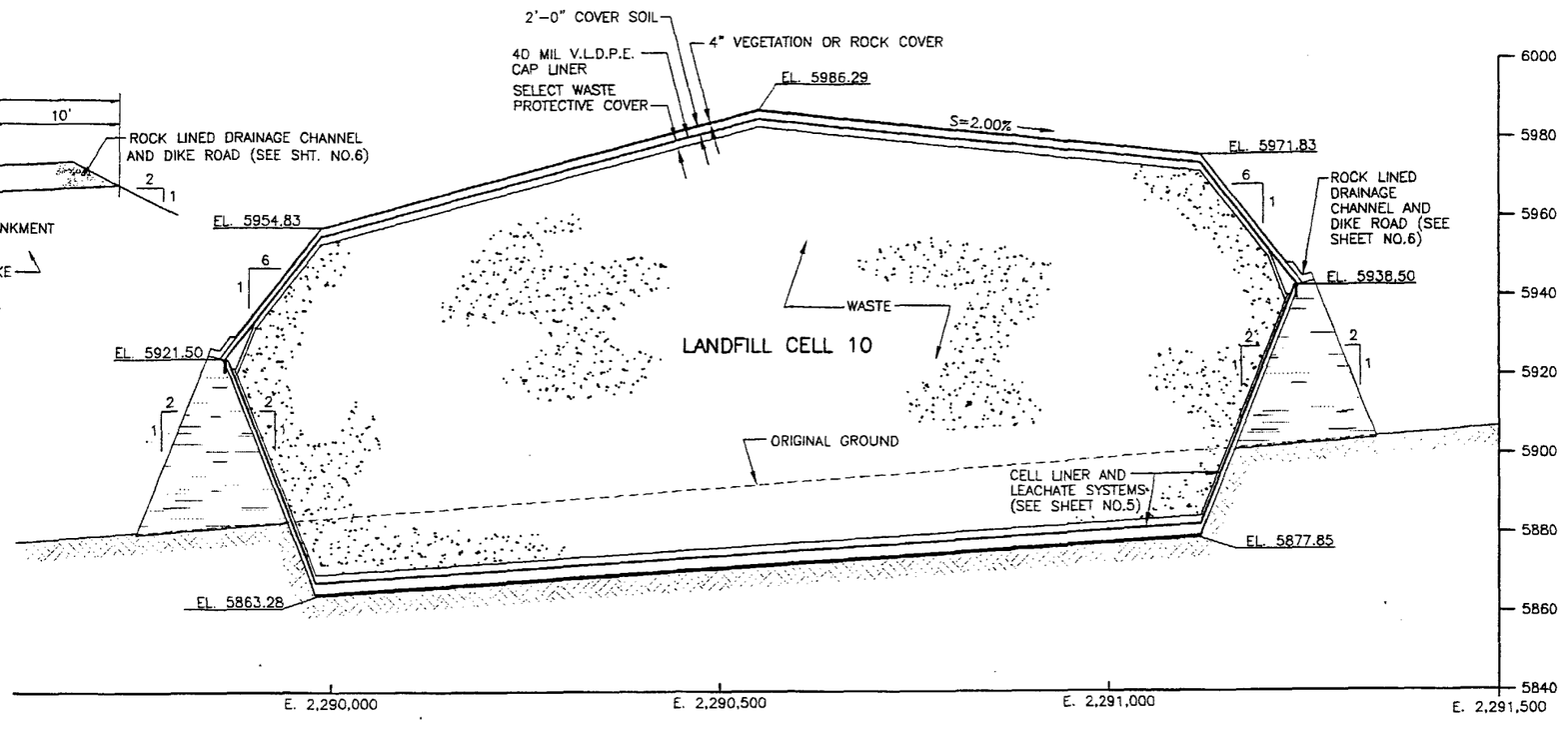
C10FENCE
SHEET NO.
10

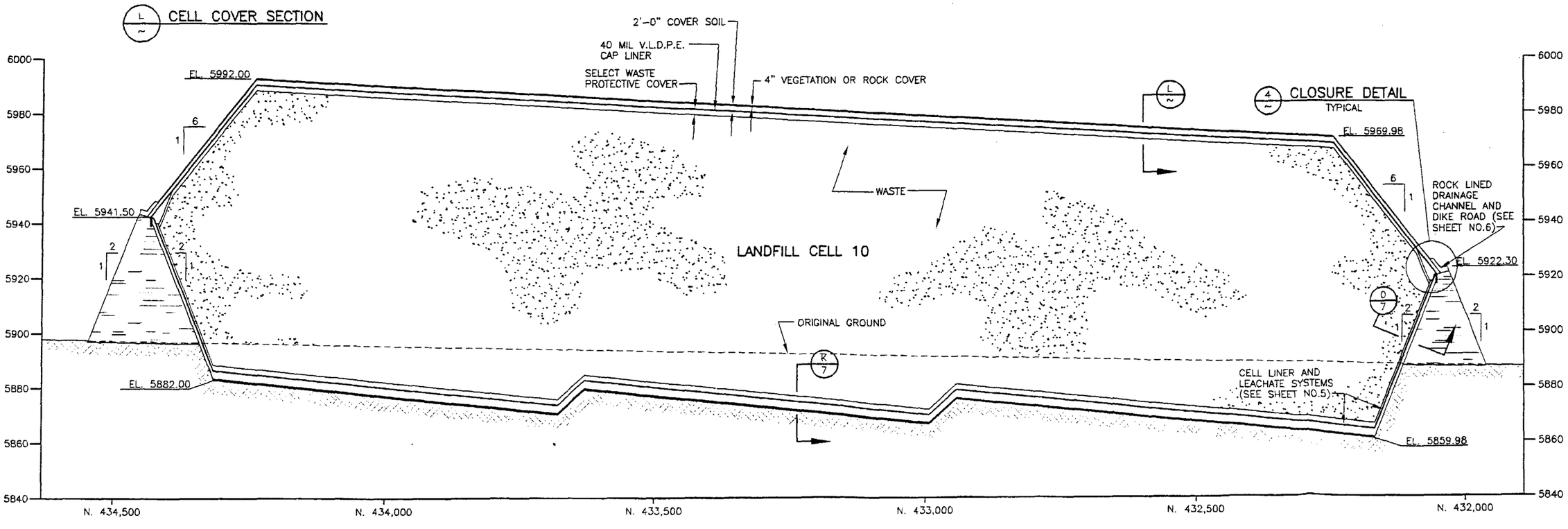


4 CLOSURE DETAIL
SCALE: 1" = 6'



L CELL COVER SECTION





DESIGNED	SEL	DATE APPROVED	5/96	DATE	7/96
CHECKED	KRN	PROJECT NO.	3255	REVISION	CHANGE ORDER NO. 1 (LOWERED 1 FOOT)
DRAWN	DRL	SCALE	As Shown	REVISION	
				REVISION	

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CELL CLOSURE DETAILS

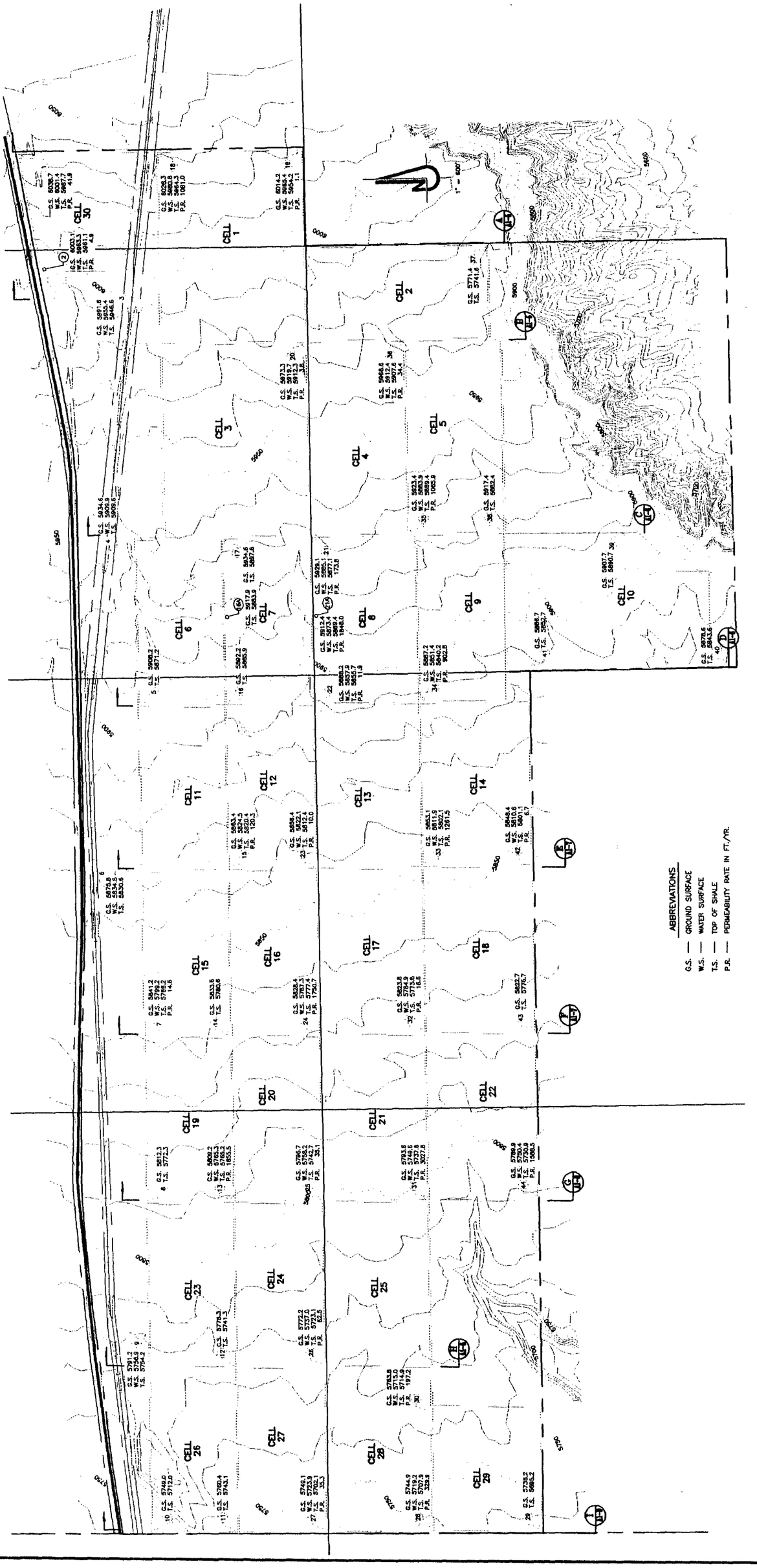
C10CLOSR
SHEET NO.
11

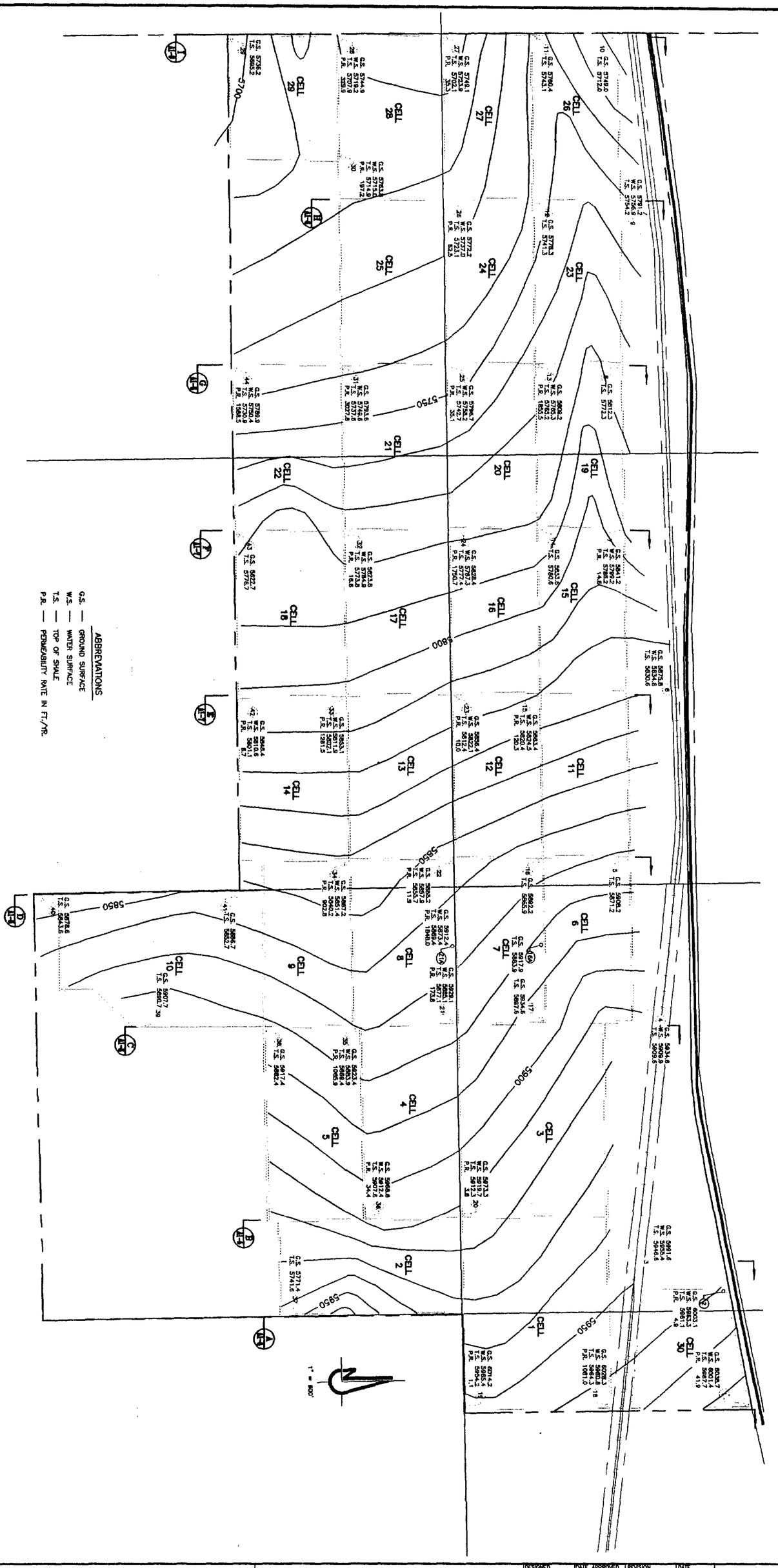
E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
LANDFILL SITE - GROUND SURFACE CONTOUR

CREAMER & NOBLE ENGINEERS
51. GEDROE, UTAH

DESIGNED	SEL	DATE APPROVED	5/86	REVISION	DATE
CHECKED	KRN	PROJECT NO.	3255	REVISION	DATE
DRAWN	DRL	SCALE	NONE	REVISION	DATE

C1705M01
SHEET NO.
A1-1





A1-2	C1GSM02 SHEET NO.	E.C.D.C. ENVIRONMENTAL, L.C. East Carbon, Utah LANDFILL SITE – TOP OF SHALE CONTOUR	CREAMER & NOBLE ENGINEERS ST. GEORGE, UTAH	DESIGNED SEL	DATE APPROVED 5/96	REVISION / DATE
				CHECKED KRN	PROJECT NO. 3255	REVISION / DATE
				DRAWN DRL	SCALE NONE	REVISION / DATE

CELL 30
CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
CELL 6
CELL 7
CELL 8
CELL 9
CELL 10
CELL 11
CELL 12
CELL 13
CELL 14
CELL 15
CELL 16
CELL 17
CELL 18
CELL 19
CELL 20
CELL 21
CELL 22
CELL 23
CELL 24
CELL 25
CELL 26
CELL 27
CELL 28
CELL 29

1 G.S. 6038.7 W.S. 6001.4 T.S. 5987.7 P.R. 41.8
2 G.S. 6003.1 W.S. 5963.3 T.S. 5961.1 P.R. 4.9
3 G.S. 5991.6 W.S. 5955.4 T.S. 5946.6
4 G.S. 5934.6 W.S. 5909.6 T.S. 5909.6
5 G.S. 5906.2 T.S. 5871.2
6 G.S. 5875.6 W.S. 5834.8 T.S. 5830.6
7 G.S. 5841.2 W.S. 5799.2 T.S. 5786.2 P.R. 14.6
8 G.S. 5812.3 T.S. 5772.3
9 G.S. 5791.2 W.S. 5756.9 T.S. 5754.2
10 G.S. 5749.0 T.S. 5712.0
11 G.S. 5780.4 T.S. 5743.1
12 G.S. 5778.3 T.S. 5741.3
13 G.S. 5809.2 W.S. 5765.3 T.S. 5765.3 P.R. 1855.5
14 G.S. 5833.6 T.S. 5780.6
15 G.S. 5863.4 W.S. 5824.5 T.S. 5820.4 P.R. 120.3
16 G.S. 5892.2 T.S. 5865.9
17 G.S. 5934.6 T.S. 5867.6
18 G.S. 6028.3 W.S. 5980.8 T.S. 5964.3 P.R. 1061.0
19 G.S. 6014.2 W.S. 5965.4 T.S. 5954.2 P.R. 1.1
20 G.S. 5973.5 W.S. 5919.7 T.S. 5912.3 P.R. 3.8
21 G.S. 5929.1 W.S. 5885.1 T.S. 5877.1 P.R. 173.8
22 G.S. 5888.2 W.S. 5857.8 T.S. 5855.7 P.R. 11.9
23 G.S. 5856.4 W.S. 5822.1 T.S. 5812.4 P.R. 10.0
24 G.S. 5828.4 W.S. 5787.3 T.S. 5777.4 P.R. 1750.7
25 G.S. 5798.7 W.S. 5758.2 T.S. 5742.7 P.R. 33.1
26 G.S. 5772.2 W.S. 5737.0 T.S. 5723.1 P.R. 62.5
27 G.S. 5749.1 W.S. 5723.9 T.S. 5702.1 P.R. 35.3
28 G.S. 5744.9 W.S. 5719.2 T.S. 5707.9 P.R. 329.9
29 G.S. 5736.2 T.S. 5685.2
30 G.S. 5763.8 W.S. 5715.0 T.S. 5714.9 P.R. 197.2
31 G.S. 5793.6 W.S. 5748.6 T.S. 5737.6 P.R. 3627.5
32 G.S. 5823.8 W.S. 5784.9 T.S. 5773.8 P.R. 16.6
33 G.S. 5853.1 W.S. 5811.9 T.S. 5802.1 P.R. 1281.5
34 G.S. 5887.2 W.S. 5851.4 T.S. 5840.2 P.R. 902.8
35 G.S. 5923.4 W.S. 5883.9 T.S. 5869.4 P.R. 1065.9
36 G.S. 5968.6 W.S. 5912.4 T.S. 5907.6 P.R. 34.4
37 G.S. 5771.4 T.S. 5741.6
38 G.S. 5817.4 T.S. 5882.4
39 G.S. 5907.7 T.S. 5890.7
40 G.S. 5878.6 T.S. 5843.6
41 G.S. 5896.7 T.S. 5852.7
42 G.S. 5848.4 W.S. 5810.6 T.S. 5801.1 P.R. 8.7
43 G.S. 5822.7 T.S. 5776.7

ABBREVIATIONS

G.S. — GROUND SURFACE
W.S. — WATER SURFACE
T.S. — TOP OF SHALE
P.R. — PERMEABILITY RATE IN FT./YR.

1" = 600'

DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE APPROVED 5/96
PROJECT NO. 3255
SCALE NONE
REVISION DATE
REVISION DATE
REVISION DATE

CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
LANDFILL SITE – PEDIMENT THICKNESS CONTOUR

C10SM03
SHEET NO.
A1-3

E.C.D.C. ENVIRONMENTAL, L.C.

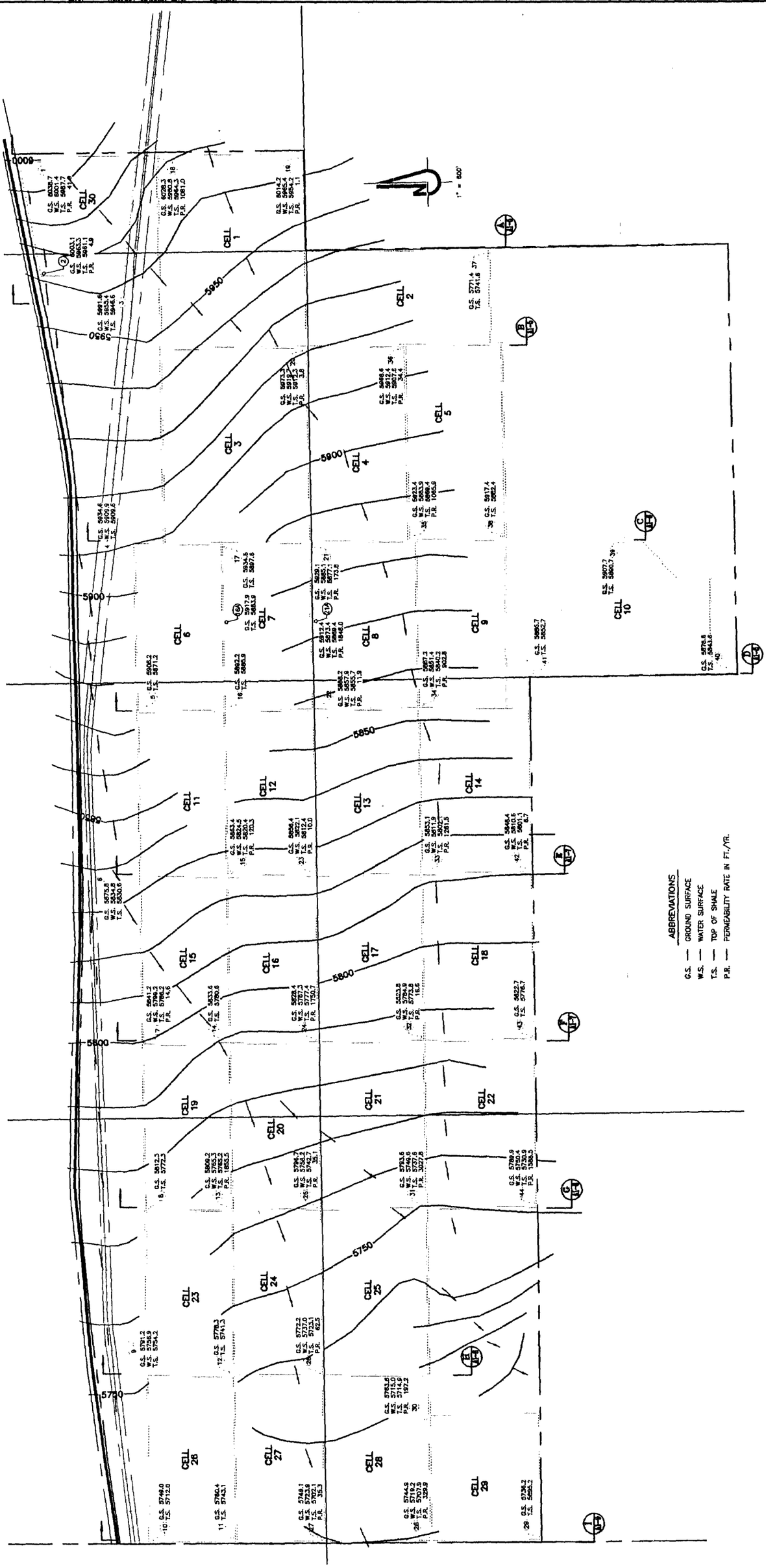
East Carbon, Utah

LANDFILL SITE – GROUND WATER SURFACE CONTOUR

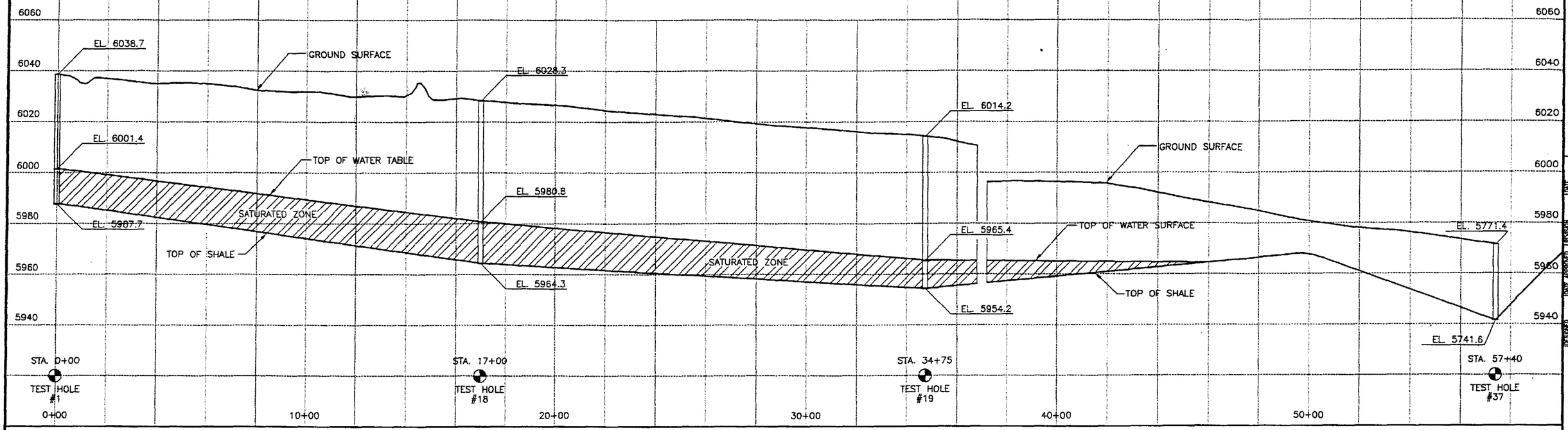
CREAMER & NOBLE ENGINEERS
SLC. GEORGE, UTAH

DESIGNED	DATE APPROVED	REVISION	DATE
SEL	5/96		
CHECKED	PROJECT NO.	REVISION	DATE
KRN	3255		
DRAWN	SCALE	REVISION	DATE
DRL	NONE		

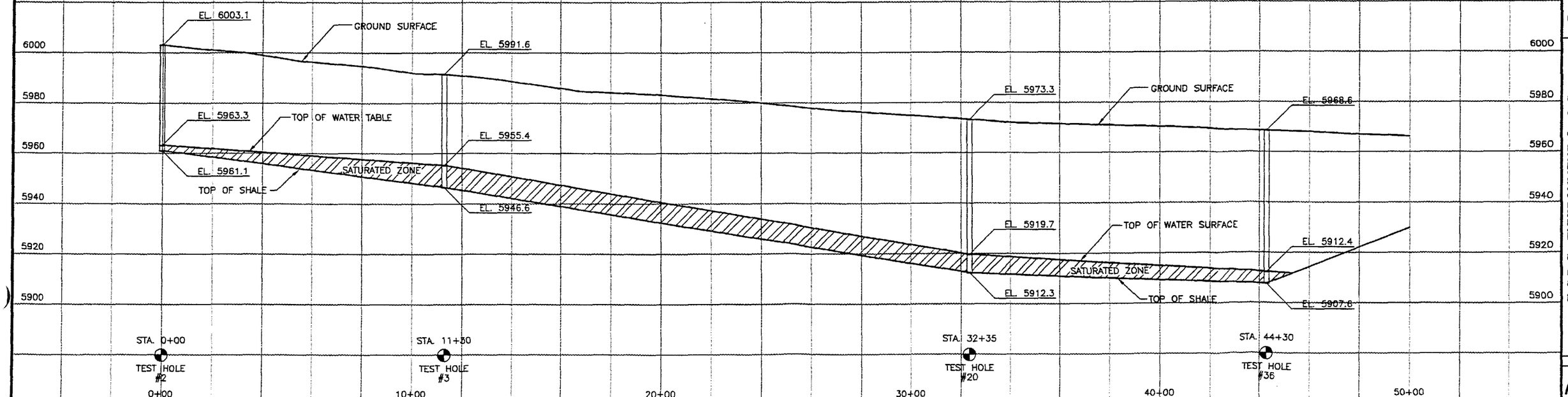
C:\DSM\04
SHEET NO.
A1-4



A / A1-1 SECTION



B / A1-1 SECTION



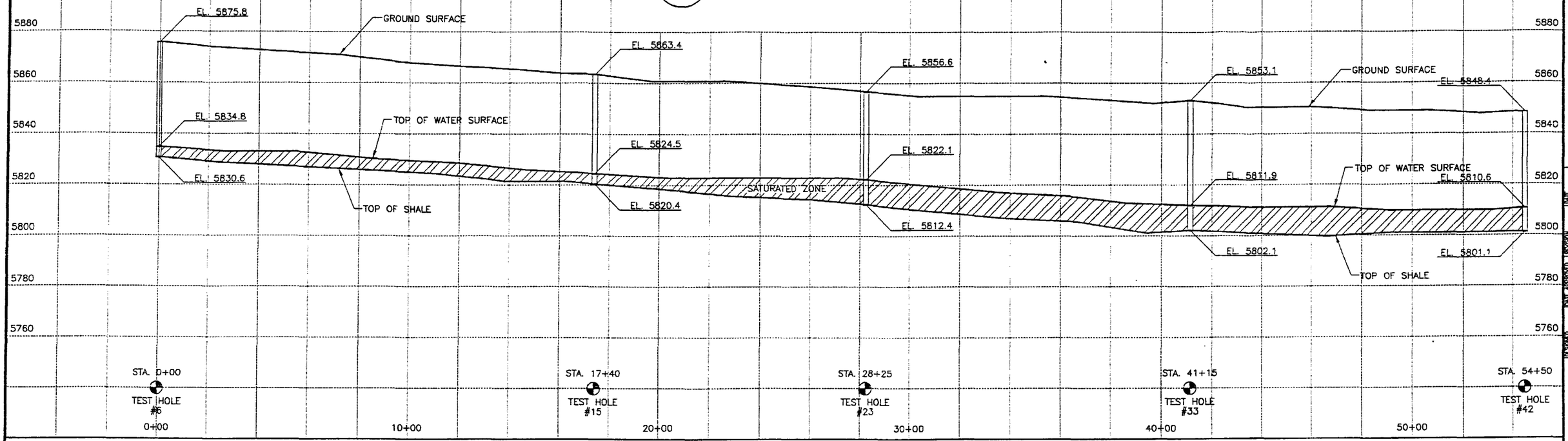
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE APPROVED 5/96
PROJECT NO. 3255
SCALE As Shown
REVISION DATE

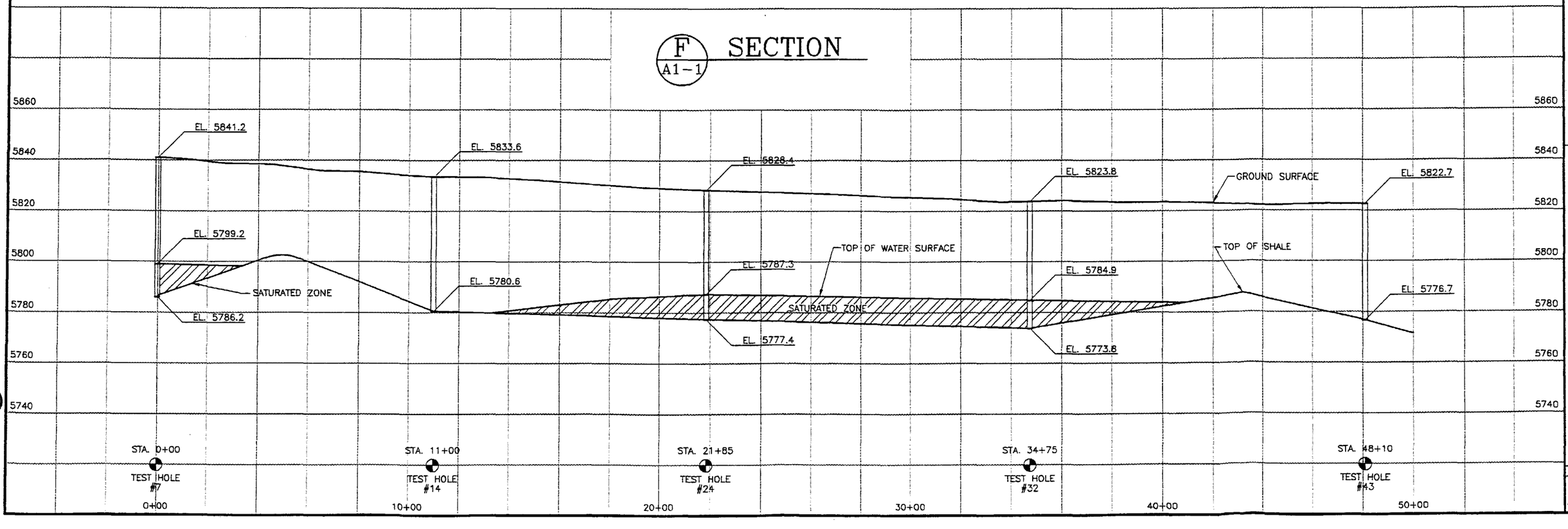
E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CROSS SECTIONS A & B

C10XSAB
SHEET NO.
A1-5

E SECTION
A1-1



F SECTION
A1-1



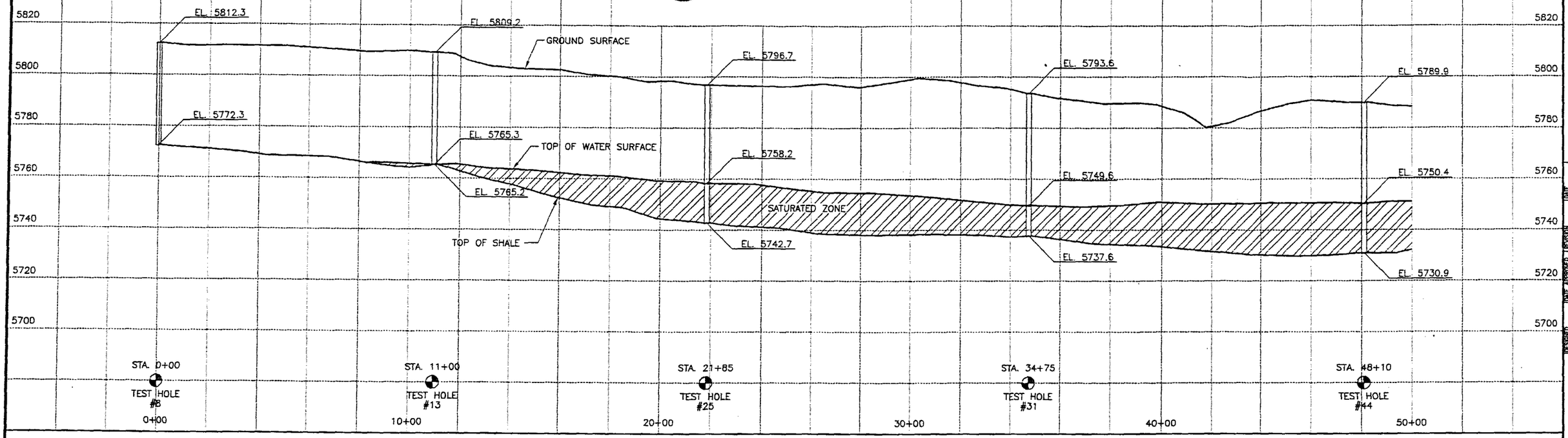
CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

DESIGNED SEL | CHECKED KRN | DRAWN DRL
DATE APPROVED 5/96 | PROJECT NO. 3255 | SCALE As Shown
REVISION | DATE

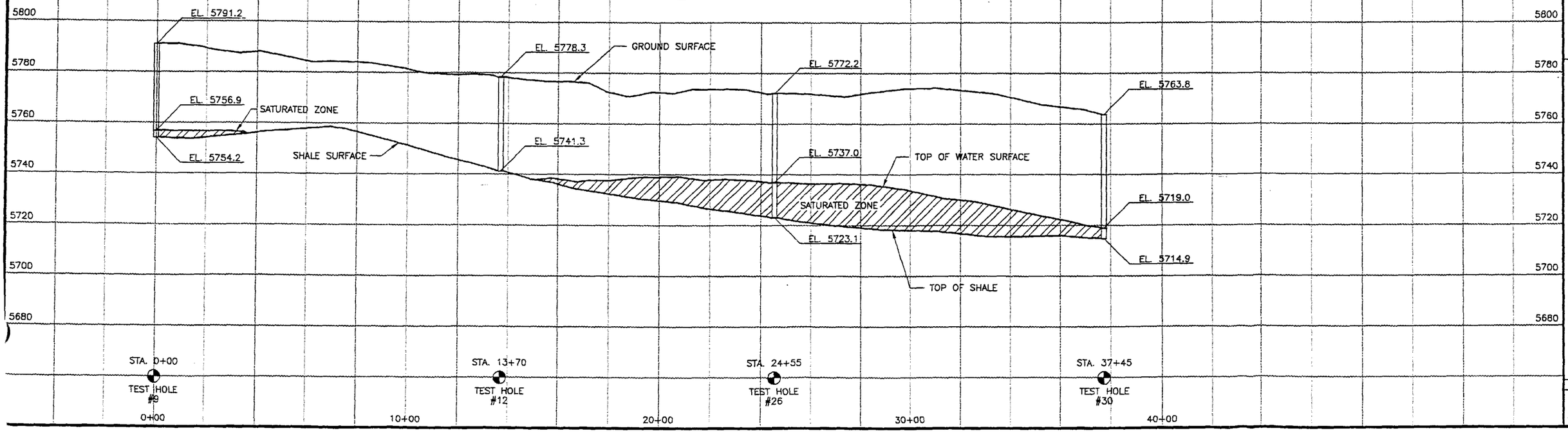
E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CROSS SECTIONS E & F

C10XSEF
SHEET NO.
A1-7

G / A1-1 SECTION



H / A1-1 SECTION



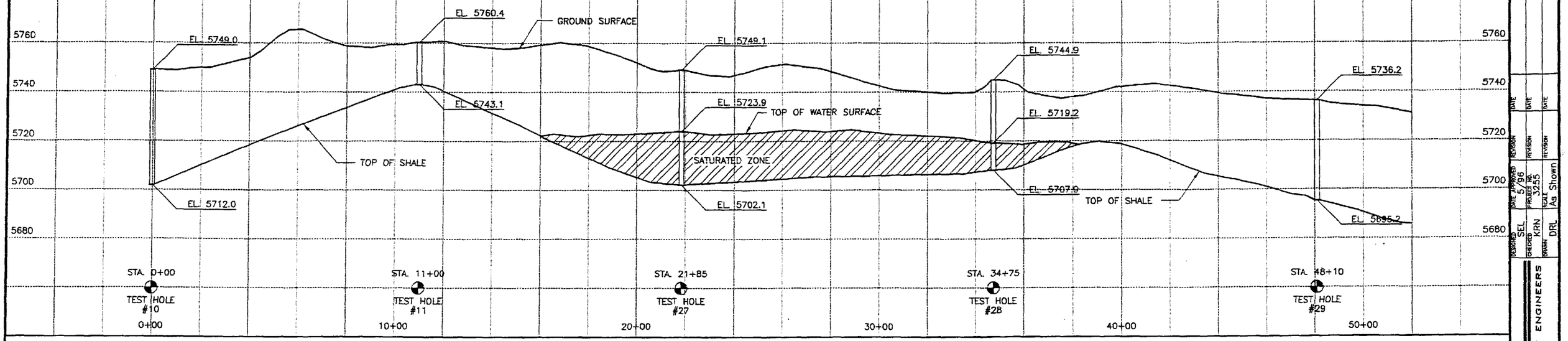
CREAMER & NOBLE ENGINEERS
St. GEORGE, UTAH

DESIGNED	DATE	REVISION	DATE
SEL			
CHECKED	DATE	REVISION	DATE
KRN			
DRAWN	DATE APPROVED	REVISION	DATE
DRL	5/96		
	PROJECT NO.		
	1255		
	SCALE		
	As Shown		

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CROSS SECTIONS G & H

C10XSGH
SHEET NO.
A1-8

I SECTION
A1-1



CREAMER & NOBLE ENGINEERS
ST. GEORGE, UTAH

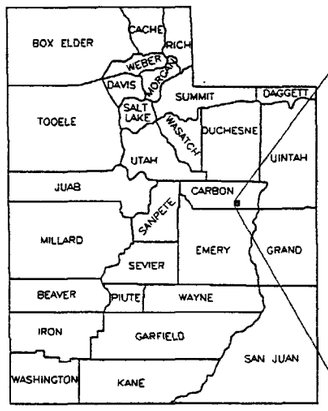
DESIGNED SEL
CHECKED KRN
DRAWN DRL
DATE APPROVED 5/96
PROJECT NO. 3255
SCALE As Shown
REVISION DATE
REVISION DATE
REVISION DATE

E.C.D.C. ENVIRONMENTAL, L.C.
East Carbon, Utah
CROSS SECTION I

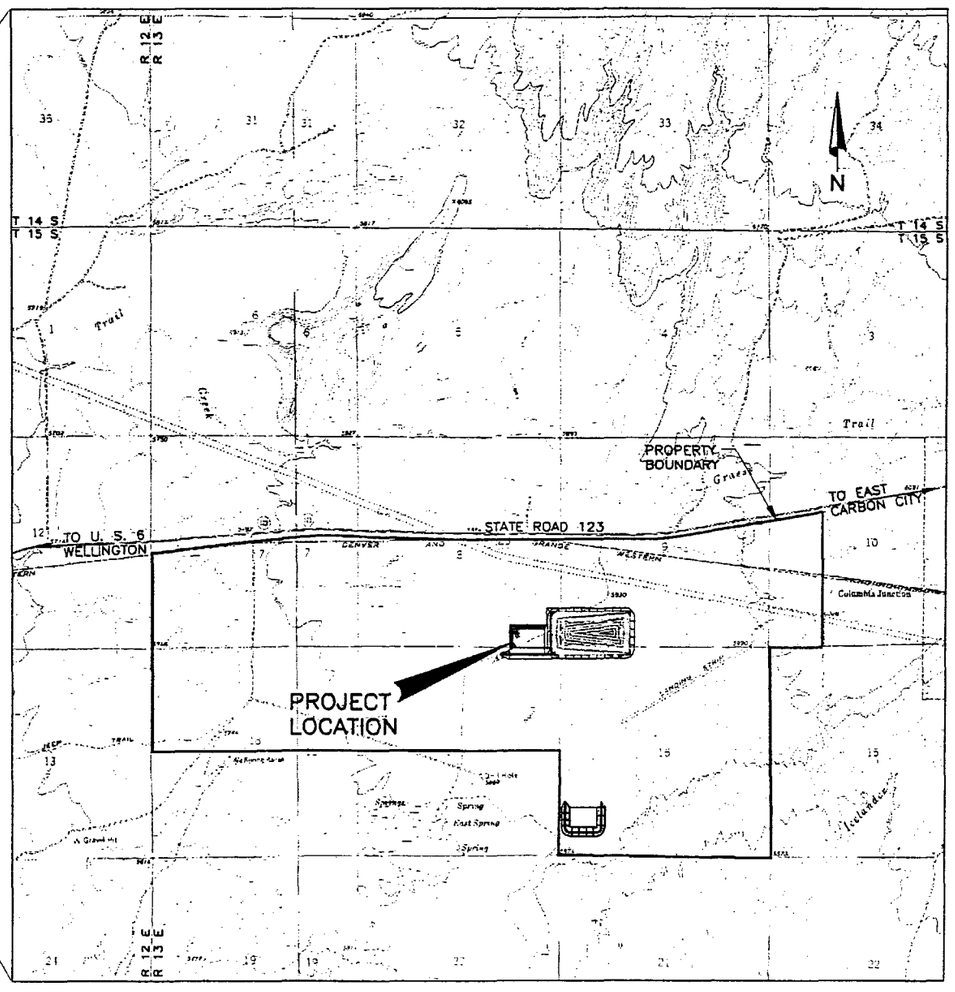
C10XSI
SHEET NO.
A1-9

Super Cell #1-A Drawings

ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE



STATE OF UTAH



PROJECT LOCATION

INDEX OF DRAWINGS

SHEET NO.	TITLE
1.	COVER SHEET
2.	GENERAL NOTES & LEGEND
3.	CLAY BORROW SITE LOCATION
4.	SITE PLAN
5.	PROJECT LOCATION
6.	PLAN VIEW – WEST
7.	PLAN VIEW – EAST
8.	CELL SECTIONS
9.	SUB-GRADE PLAN VIEW
10.	PRIMARY SUMP PLAN
11.	SECONDARY SUMP & LEACHATE PIPE PLAN
12.	TYPICAL SUMP SECTIONS
13.	LEACHATE WITHDRAWAL PIPE SECTIONS
14.	LEACHATE WITHDRAWAL SYSTEM DETAILS
15.	CELL LINER SYSTEM DETAILS
16.	PHASE BERM LINER DETAILS
17.	TYPICAL LINER SYSTEM SECTIONS & DETAILS
18.	TYPICAL SECTIONS & DETAILS
19.	MANHOLE DETAILS
20.	MANHOLE DETAILS

RECORD DRAWING

These Record Documents have been prepared based on information provided by others. Hansen, Allen & Luce, Inc. has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

HANSEN ALLEN & LUCE, INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 169141 KENT C. ISABELL

DESIGNED KCS MPW	3					
DRAFTED DRB	2					
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE 1" = 2000'

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
COVER SHEET

SHEET NO. 1 OF 20

113.05 110

FILE NAME: 113-05-110/CAD/COVER.DWG
FILE DATE: 11/16/2000 13:24:08 (CAM)
PLOT OPTIONS PLOT IN a DWG UNIT PLOT AREA
ORIGIN: DVIEW: XREF FILE NAME(S)

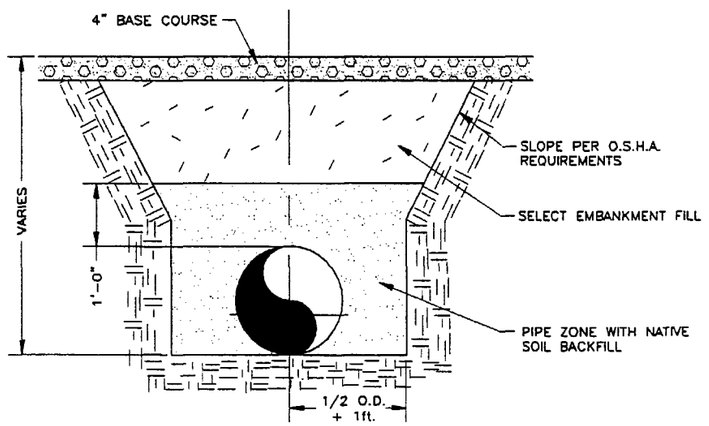
GENERAL NOTES

NOTES:

1. COORDINATES AND ELEVATIONS PROVIDED ARE BASED ON THE NAD 83 COORDINATE SYSTEM.
2. MW-1 - DENOTES MONITORING WELL LOCATION AND NUMBER.
3. PIZOM. 23 - DENOTES PIEZOMETER LOCATION AND NUMBER.
4. MONITORING WELLS, PIEZOMETERS AND LEACHATE RISERS WILL BE PROTECTED FROM DAMAGE BY CONTRACTOR DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE PROJECT ENGINEER ANY DAMAGE TO THE MONITORING WELLS, PIEZOMETERS OR LEACHATE RISERS.
5. ANY DAMAGE TO MONITORING WELLS, PIEZOMETERS OR LEACHATE RISERS WILL BE REPAIRED TO OWNERS SPECIFICATIONS AT CONTRACTOR'S EXPENSE.
6. NON-WOVEN GEOTEXTILE CUSHION LAYER - 16oz. TO BE PLACED ABOVE THE FINISH SUBGRADE.
   NON-WOVEN GEOTEXTILE PROTECTIVE LAYER - 16oz. TO BE PLACED BELOW ALL 1-INCH MINUS ROUNDED WASHED ROCK AND BELOW BACKFILL PLACED ALONG THE NORTH AND WEST PHASE EXPANSION BERMS.
   NON-WOVEN GEOTEXTILE FILTER FABRIC - 8oz. TO BE PLACED ABOVE ALL DRAINAGE NET.
7. NON-WOVEN GEOTEXTILE PROTECTIVE LAYER IS TO OVER LAP THE TOP OF THE ROCK A MINIMUM OF 2'-0".
8. NON-WOVEN GEOTEXTILE FILTER FABRIC IS TO UNDER LAP THE DRAINAGE NET ALONG THE PERIMETER OF THE CELL FLOOR A MINIMUM OF 2'-0".
9. 1-INCH MINUS ROUNDED WASHED ROCK TO CONSIST OF THE FOLLOWING GRADATION.

SIEVE SIZE	PERCENT PASSING
1"	100
3/8"	0

10. CONTRACTOR SHALL USE A VIBRATORY PLATE COMPACTOR OR SOME OTHER ACCEPTABLE METHOD TO CONSOLIDATE AND COMPACT THE 1-INCH MINUS ROUNDED WASHED ROCK.
11. THE TOP 6'-0" OF EMBANKMENT FILL ON THE EAST AND SOUTH EMBANKMENT SHALL CONSIST OF SELECT EMBANKMENT FILL.
12. STORM DRAINAGE MANHOLES AND LIDS SHALL BE MANUFACTURED TO SUPPORT HS-20 LOADINGS.
13. TYPICAL STORM DRAINAGE PIPE TRENCH SECTION IS SHOWN BELOW.

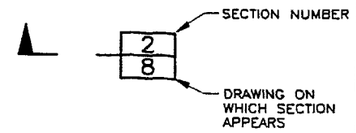


14. PRIMARY AND SECONDARY HDPE LEACHATE WITHDRAWAL PIPES SHALL BE INSTALLED AND BACKFILLED IN SECTIONS. THE FABRICATED LOWER SECTIONS OF THE PIPE SHALL BE INSTALLED AND SECURED INTO PLACE. BACKFILL SHALL THEN BE PLACED AND COMPACTED AROUND THE PIPES TO A SUFFICIENT HEIGHT TO HOLD THE PIPES PROPERLY IN PLACE. SUBSEQUENT SECTIONS OF PIPE SHALL BE INSTALLED AND BACKFILLED IN THE SAME MANNER AS THE LOWER FABRICATED SECTIONS. ALL SECTIONS OF HDPE PIPE SHALL BE JOINED IN THE TRENCH USING ELECTRO FUSION COUPLERS PER MANUFACTURES RECOMMENDATIONS.
15. PCPE PIPE IN THE PRIMARY SUMP SHALL BE EVENLY SPACED AS DESIGNATED. THE ROUNDED WASHED ROCK SHALL BE PLACED EVENLY ON BOTH SIDES OF EACH PIPE TO ENSURE THE PIPE IS NOT DISPLACED. ALL PIPE SHALL BE PLACED TO LAY FLAT ON THE UNDERLYING GEOSYNTHETIC MATERIALS.
16. ALL 60 MIL PRIMARY AND SECONDARY HDPE LINER MATERIALS SHALL BE PLACED ON THE SIDE SLOPES OF THE CELL EXTENDING FROM THE GEOSYNTHETICS ANCHOR TRENCHES TO A MINIMUM OF 5'-0" ONTO THE FLOOR OF THE CELL.
17. ALL GCL MATERIAL PLACED ABOVE THE ELEVATION OF THE COMPACTED CLAY LINER ON THE SIDE SLOPES OF THE CELL SHALL CONSIST OF BENTOMAT CL WITH A BONDED TEXTURED VAPOR BARRIER AS MANUFACTURED BY CETCO. THE GCL SHALL BE INSTALLED WITH THE VAPOR BARRIER DOWN.
18. DRAINAGE NET SHALL CONSIST OF BOTH GSE 250 MIL BI-PLANAR (250 MIL HYPER NET) AND GSE TRI-PLANAR (TP-275-08) DRAINAGE NETS. TRI-PLANAR DRAINAGE NET SHALL BE PLACED WITH THE DIRECTION OF THE FLOW PATH PERPENDICULAR TO THE FLOOR CONTOURS. LOCATIONS FOR EACH TYPE OF NET SHALL BE PROVIDED TO THE LINER INSTALLER.

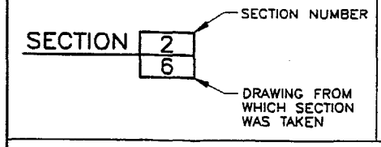
SECTION & DETAIL IDENTIFICATION

SECTION IDENTIFICATION

SECTION CUT ON DRAWING NO. 6:

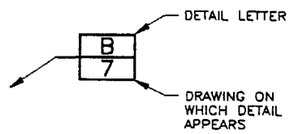


ON DRAWING NO. 8, THIS SECTION IS IDENTIFIED AS:

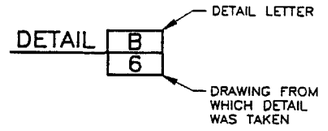


DETAIL IDENTIFICATION

DETAIL CALL-OUT ON DRAWING NO. 6:



ON DRAWING NO. 7, THIS DETAIL IS IDENTIFIED AS:



NOTES:
1. IF SECTION CUT AND SECTION OR DETAIL CALL-OUT AND DETAIL ARE SHOWN ON SAME DRAWING, DRAWING NUMBER IS REPLACED BY A LINE.
2. DETAIL LETTERS "I" AND "O" NOT USED.

TABLE OF ABBREVIATIONS

CC	CENTER TO CENTER
℄	CENTER LINE
CLR.	CLEAR
CPE	CORRUGATED POLYETHYLENE
DIA.	DIAMETER
EL.	ELEVATION
FL	FLOW LINE
GCL	GEOSYNTHETIC CLAY LINER
HDPE	HIGH DENSITY POLYETHYLENE
ID	INSIDE DIAMETER
INV EL.	INVERT ELEVATION
LW	LEACHATE WITHDRAWAL
MAX.	MAXIMUM
MH	MANHOLE
MIN.	MINIMUM
N.T.S.	NOT TO SCALE
OD	OUTSIDE DIAMETER
PC	POINT OF CURVE
PCPE	PERFORATED CORRUGATED POLYETHYLENE
PI	POINT OF INTERSECTION
PL	PLATE
PRI	PRIMARY
PT	POINT OF TANGENT
PVC	POLYVINYL CHLORIDE
SCPE	SMOOTH WALL CORRUGATED POLYETHYLENE
SDR	STANDARD DIMENSION RATIO
SEC	SECONDARY
STA.	STATION
TL	TOP OF LINER
TPS	TOP OF PRIMARY SUMP
TSS	TOP OF SECONDARY SUMP
TYP.	TYPICAL

RECORD DRAWING

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HANSEN ALLEN & LUCE, INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 169141 KENT C. FIADELL PROJECT ENGINEER

DESIGNED KCS MPW	3						
DRAFTED CAH	2						
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	11/15/2000		
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.		

SCALE AS

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
GENERAL NOTES & LEGEND

SHEET NO. 2 OF 20

113.05.110

FILE NAME: 05-110/CAD/GENERAL_NOTES.DWG
FILE DATE: 11/6/2000 14:10:20 (SDM)
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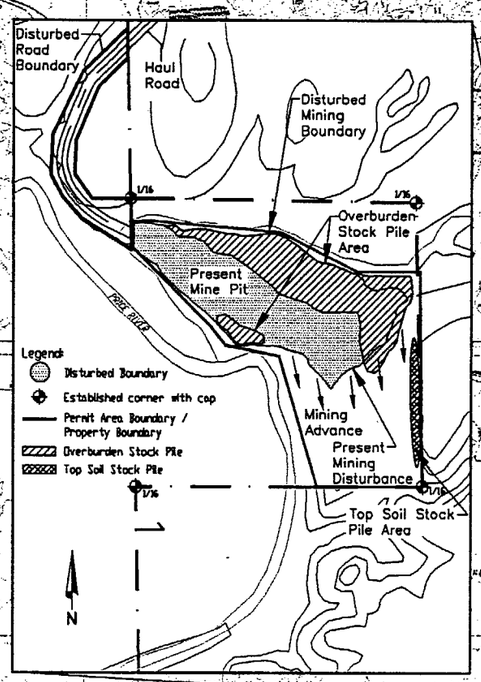
PLOT IN = DWG UNITS
PLOT AREA:
XREF FILE NAME(S)
ORIGIN: DVIEW:



WELLINGTON

EAST CARBON CITY

PROJECT LOCATION

ROAD

EXISTING CELL 7

EXISTING CELL 10

GATE

GATE

PROPERTY BOUNDARY

HAUL ROAD

CLAY BORROW SITE

ECDC PRIVATE LAND BOUNDARY

N

NOTE:
THE DISTURBED AREA OF THE CLAY BORROW WAS ENLARGED DURING CONSTRICTION OF THIS PROJECT. THESE CHANGES TO THE CLAY BORROW ARE NOT PROVIDED ON THIS DRAWING.

RECORD DRAWING

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XREF FILE NAME(S):
ORIGIN:
DWG UNITS:
PLOT OPTIONS
PLOT IN a DWG UNITS
PLOT AREA
FILE NAME: 113.05-110/CAD/CLAY_BARROW.DWG
FILE DATE: 11/07/2000 13:39:08 (CAH)

HANSEN ALLEN & LUCE INC
CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
NO. 169141
KENT C. HASELL
STATE OF UTAH

DESIGNED KCS MPW	3					
DRAFTED DRB	2					
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: 1"=3000'

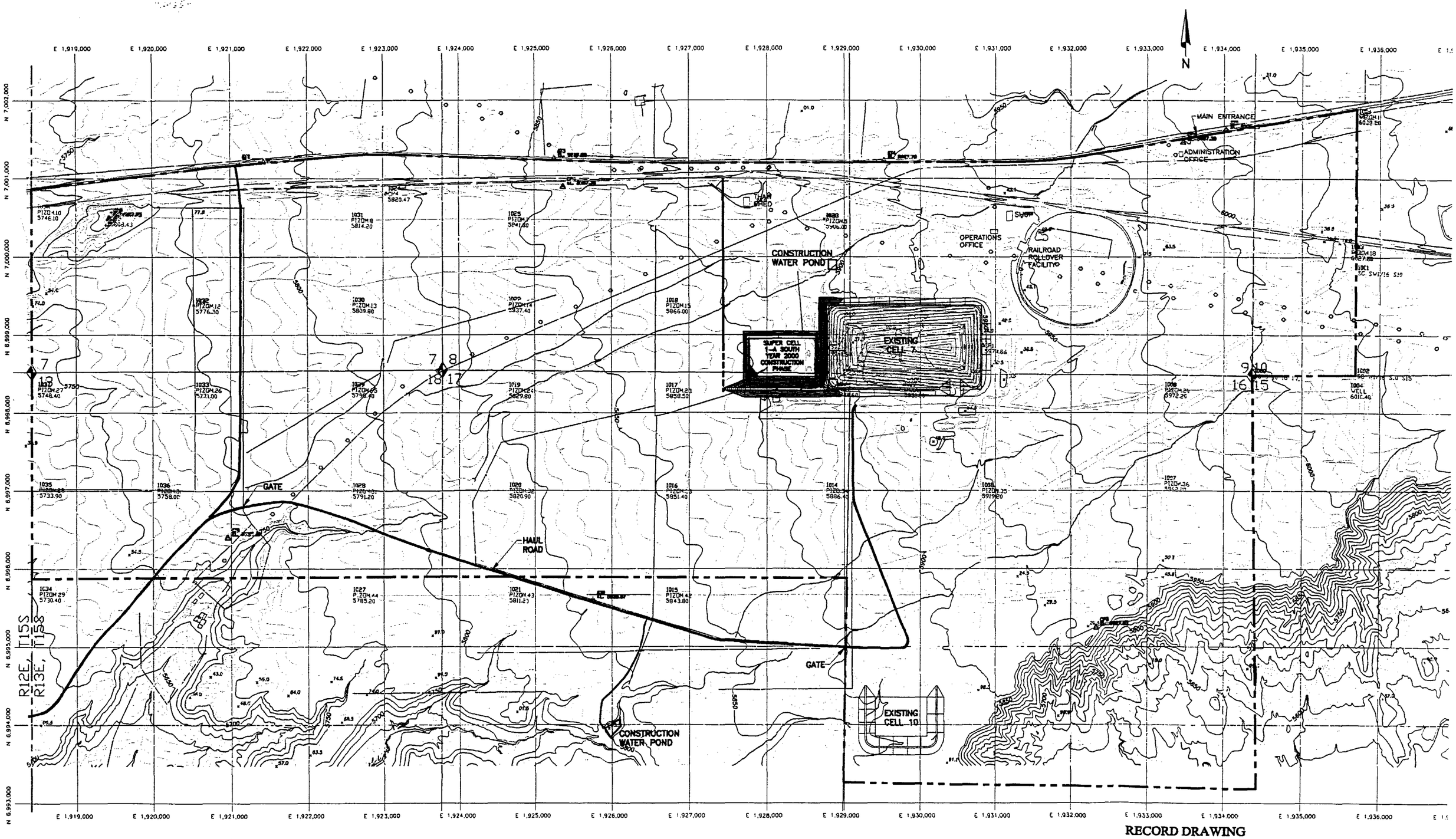
VERIFY SCALE
0" 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1–A SOUTH
YEAR 2000 CONSTRUCTION PHASE
CLAY BORROW SITE LOCATION

SHEET NO. 3 OF 20
113.05 110

3/99



RECORD DRAWING

These Record Documents have been prepared based on information provided by others. Hansen, Allen & Luce, Inc. has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

FILE NAME: 113\05-110\CAD\SITE PLAN.DWG
FILE DATE: 11/16/2000 14:31:50 (CAH)
XREF FILE NAME(S):
ORIGIN:
DVIEW:
PLOT OPTIONS
PLOT IN = DWG UNITS:
PLOT AREA:

HANSEN ALLEN & LUCE — CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — NO. 16914 — KENT C. STAHELI — PROFESSIONAL ENGINEER

DESIGNED KCS MPW	3					
DRAFTED MPW	2					
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: 1" = 600'

VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

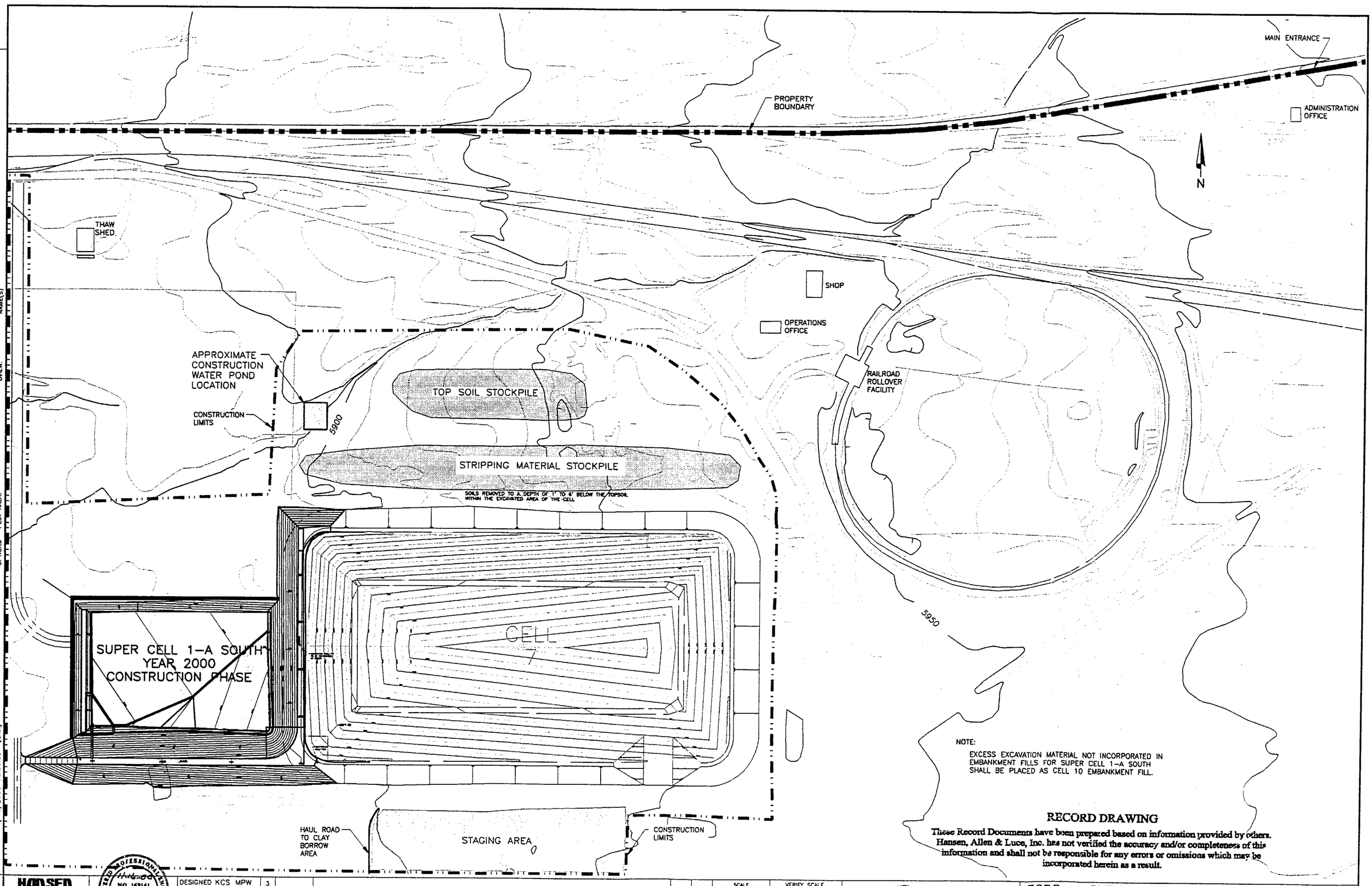
ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1–A SOUTH YEAR 2000 CONSTRUCTION PHASE SITE PLAN

SHEET NO. 4 OF 20

113.05.110

1/99



NOTE:

EXCESS EXCAVATION MATERIAL NOT INCORPORATED IN EMBANKMENT FILLS FOR SUPER CELL 1-A SOUTH SHALL BE PLACED AS CELL 10 EMBANKMENT FILL.

RECORD DRAWING

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HANSEN ALLEN & LUCE CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
NO. 169141
KENT C. ISABELL
PROJECT ENGINEER

DESIGNED KCS MPW	3				
DRAFTED MPW	2				
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE: 1" = 200'

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
PROJECT LOCATION

SHEET NO. 5 OF 20

113.05.110

FILE NAME: 05-110/CAD/PROJECT LOCATION.DWG
FILE DATE: 11/16/2000 13:56:03 (CAN)
PLOT OPTIONS
PLOT IN = DWG UNITS
PLOT AREA:
ORIGIN: DVIEW:
XREF FILE NAME(S)
5/99

RUN-ON DIVERSION SAFTEY BERM A/16

TOP OF DITCH
N. 6,998,998.94
E. 1,927,732.65
EL. 5860.59

TOP EDGE OF BENCH
N. 6,998,971.45
E. 1,927,754.01
EL. 5860.77

N. 6,998,957.06
E. 1,927,768.40
EL. 5853.58

N. 6,998,864.32
E. 1,927,435.00

ACCESS ROAD AND RAMP

N 0° E

N 90° E

S=15%

PRIMARY AND SECONDARY LEACHATE COLLECTION DITCH TO EXTEND UNDER NORTH BENCH TO NORTH EDGE OF GEOSYNTHETICS

TOP OF DITCH
N. 6,998,998.94
E. 1,927,997.14
EL. 5860.59

NORTH EXPANSION PHASE BERM

TOP EDGE OF BENCH
N. 6,998,973.46
E. 1,927,992.23
EL. 5860.77

N. 6,998,963.46
E. 1,927,992.23
EL. 5856.78

10" DIA. CPE PIPE (INVERT ELEVATIONS AT TOP OF 2-FOOT PROTECTIVE SOIL COVER)

TWO FEET OF PROTECTIVE SOIL COVER OVER ENTIRE FLOOR AND 10 FEET VERTICALLY UP SIDES SLOPES.

TRUCK TRUN AROUND

50.00'
100.00'
50.00'
146.00'

THREE FEET OF ADDITIONAL SOIL PROTECTIVE COVER FOR TRUCK TURN AROUND.

GEOSYNTHETICS INSTALLATION LIMITS.

PRIMARY LEACHATE COLLECTION DITCH (TOE OF SLOPE DRAIN)

S=1%

S=1.72%

S=1.72%
S=1.00%
S=1.40%

WEST EXPANSION PHASE BERM

2:1

5/16

COORDINATE NOTE:

COORDINATES AND ELEVATIONS PROVIDED ON THE CELL FLOOR DESIGNATE THE INTERSECTION BETWEEN THE PLANE OF THE FLOOR SURFACE AND THE CELL SIDE SLOPES. (TOP OF CLAY)

N. 6,998,603.49
E. 1,928,265.77
EL. 5857.00

S=1.714%

N. 6,998,602.18
E. 1,928,266.53
EL. 5856.50

N. 6,998,600.89
E. 1,928,267.32
EL. 5857.00

S=3.41%

RADIUS POINT
N. 6,998,463.48
E. 1,928,615.43
SEE COORDINATE NOTE THIS SHEET

N. 6,998,463.67
E. 1,928,635.24
EL. 5870.40

N. 6,998,444.50
E. 1,928,616.00
EL. 5870.00

N. 6,998,451.84
E. 1,927,778.03
EL. 5848.76
SEE COORDINATE NOTE THIS SHEET

SEE SHEET 10 FOR PRIMARY SUMP DETAILS

N. 6,998,467.32
E. 1,927,942.85
EL. 5851.12

N. 6,998,464.15
E. 1,927,935.25
EL. 5849.96

PRIMARY LEACHATE COLLECTION DITCH

S=1.68%
S=4.10%
S=2.04%

S=1.40%

N. 6,998,465.76
E. 1,927,943.02
EL. 5850.61

N. 6,998,456.76
E. 1,928,107.18
EL. 5856.23

N. 6,998,456.37
E. 1,928,278.42
EL. 5859.00

TOP EDGE OF BENCH
N. 6,998,437.08
E. 1,927,754.01
EL. 5860.77

TOP OF DITCH
N. 6,998,436.82
E. 1,927,732.65
EL. 5860.59

N. 6,998,462.15
E. 1,927,938.32
EL. 5851.01

TOP OF DITCH
N. 6,998,998.94
E. 1,928,628.31
EL. 5869.41

TOP EDGE OF BENCH
N. 6,998,971.46
E. 1,928,628.97
EL. 5869.60

N. 6,998,963.47
E. 1,928,621.00
EL. 5865.58

N. 6,998,902.54
E. 1,928,619.29
EL. 5864.45

N. 6,998,905.39
E. 1,928,620.35
EL. 5864.99

N. 6,998,901.43
E. 1,928,620.31
EL. 5864.95

GEOSYNTHETICS INSTALLATION LIMITS.

S=1.72%

MONITORING WELL-7W ABANDONED

MONITORING WELL-7SW

N. 6,998,464.88
E. 1,928,766.00
EL. 5935.78

NEW MONITORING WELL

GUARD POSTS DETAIL F/18

31.00' TYP.

S=20%
RAMP

N. 6,998,304.00
E. 1,927,712.82
EL. 5918.92

MH A-6
N. 6,998,304.00
E. 1,927,741.16
GRATE EL. 5918.94
DETAIL D/19

30" DIA. SCPE PIPE

MH A-5
N. 6,998,304.00
E. 1,928,261.58
GRATE EL. 5926.75
DETAIL C/19

N. 6,998,319.50
E. 1,928,619.76
EL. 5932.52

S=1.5%

30" DIA. SCPE PIPE

MH A-4
N. 6,998,304.00
E. 1,928,782.00
GRATE EL. 5934.60
DETAIL E/20

RECORD DRAWING

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XREF FILE NAME(S):
ORIGIN:
DVIEW:
PLOT IN = DWG UNITS:
PLOT AREA:
PLOT OPTIONS:
FILE NAME: T:\05-110\CAD\PLAN_VIEW_WEST_R1.DWG
FILE DATE: 11/16/2000 14:37:55 (CAH)

HANSEN ALLEN & LUCE CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
NO. 169141
KENT C. ISABELL
PROJECT ENGINEER

DESIGNED KCS MPW	3				SDM	KCS
DRAFTED CAH	2	11-08-00	RECORD DRAWING		MPW	KCS
CHECKED MEA	1	8-29-00	MODIFIED FLOOR GRADE & SLOPES IN THE SE AREA			
DATE APRIL 2000	NO.	DATE	REVISIONS		BY	APVD.

SCALE: 1" = 50'

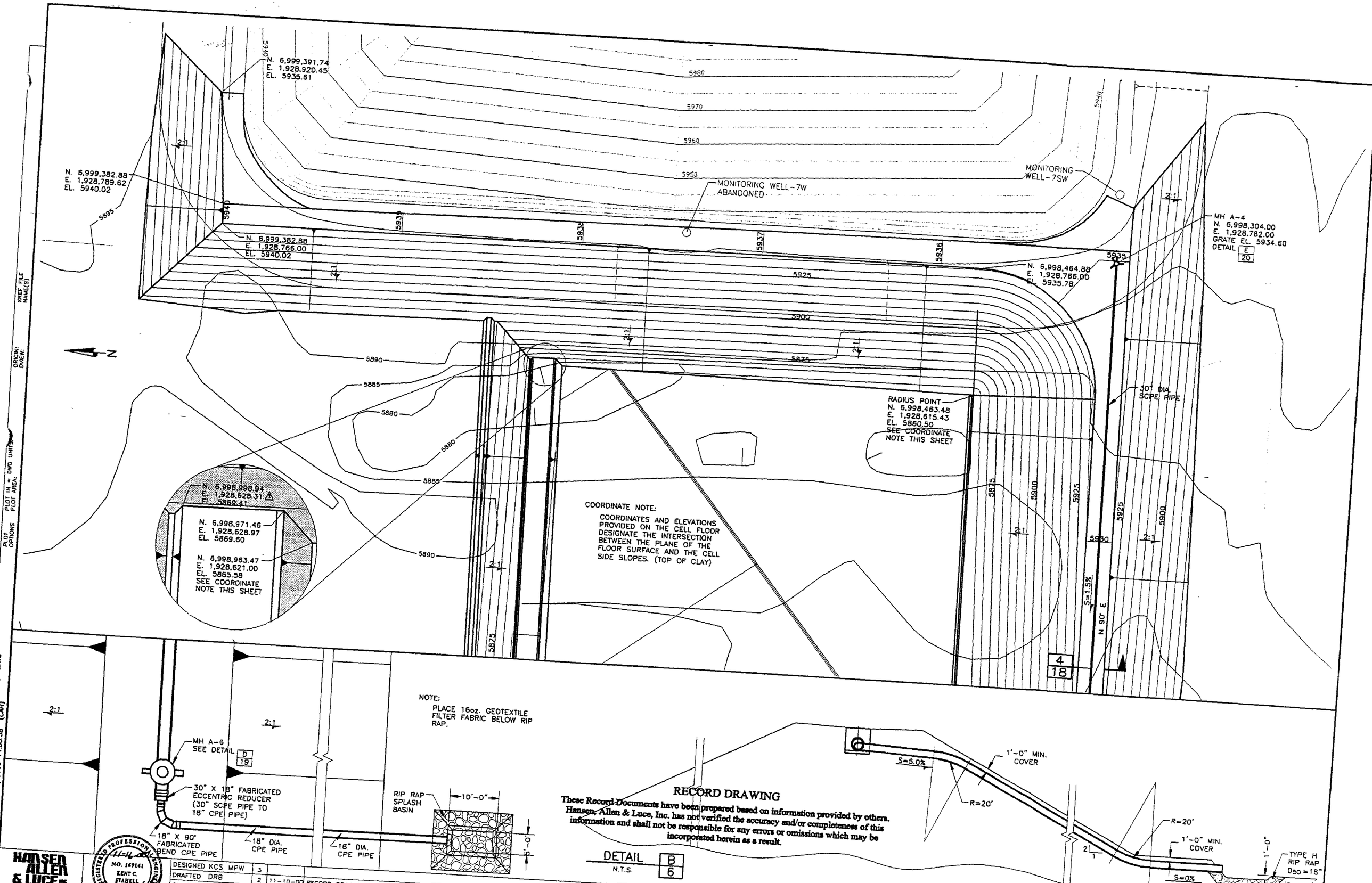
VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

ECDC - SUPER CELL 1-A SOUTH YEAR 2000 CONSTRUCTION PHASE PLAN VIEW - WEST

SHEET NO. 6 OF 20

113.05.110



RECORD DRAWING

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DETAIL B 6
N.T.S.

HANSEN ALLEN & LUCE INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 169141 KENT C. STAHELL

DESIGNED KCS MPW	3		
DRAFTED DRB	2	11-10-00	RECORD DRAWING
CHECKED MEA	1	5-23-00	REVISED COORDINATE NUMBER
DATE APRIL 2000	NO.	DATE	REVISIONS

SDM KCS
CAH MPW
BY APVD.

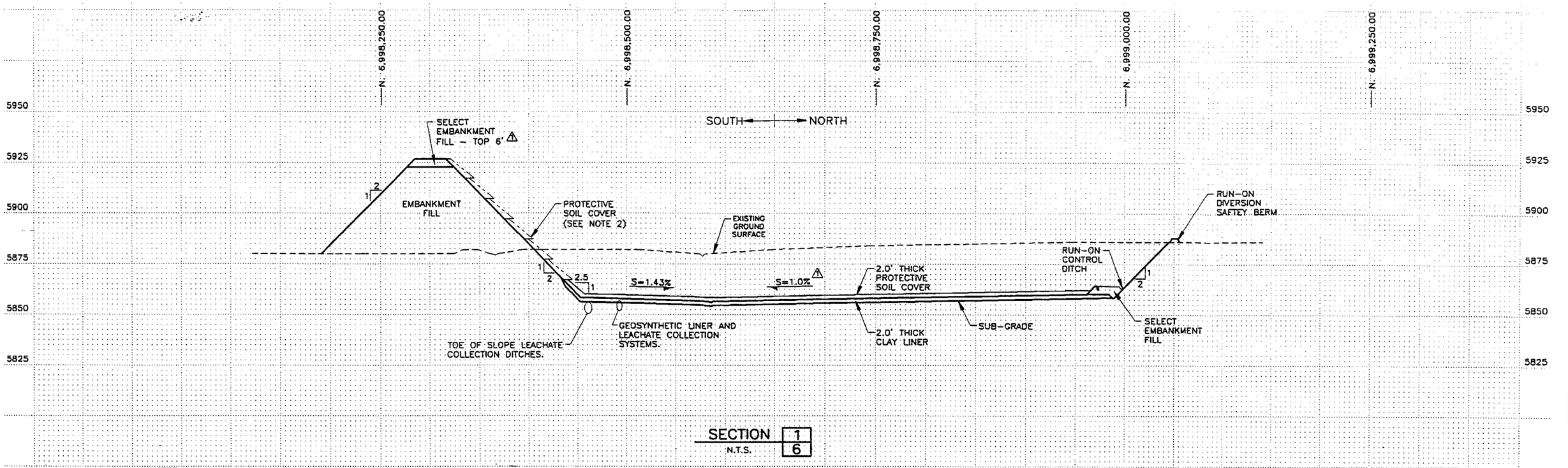
SCALE 1" = 50'

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
PLAN VIEW – EAST

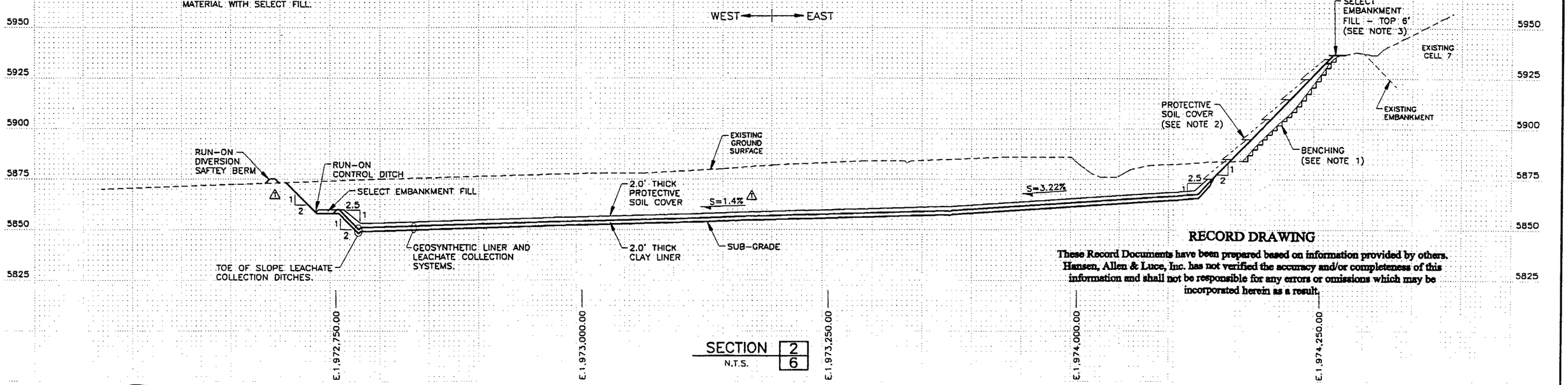
SHEET NO. 7 OF 20



SECTION 1
N.T.S. 6

NOTES:

1. EACH LIFT OF EXPANDED EMBANKMENT SHALL BE BENCHED INTO THE SIDE SLOPE OF THE EXISTING EMBANKMENT A MINIMUM HORIZONTAL DISTANCE OF 1'–0" PER LIFT.
2. PROTECTIVE SOIL COVER SHALL BE PLACED ON SIDE SLOPES WITH THE EXPOSED SLOPE OF THE PROTECTIVE SOIL COVER AT 2.5:1 SLOPE OR FLATTER. THE FIRST 10'–0" OF HEIGHT SHALL BE PLACED BY CONTRACTOR DURING CONSTRUCTION USING SELECT SOIL WASTE STOCKPILED WITHIN CELL 7 UNLESS OTHERWISE DIRECTED BY OWNER.
3. ⚠ ONLY THE TOP 6 FEET OF NEW EMBANKMENT PLACED SHALL CONSIST OF SELECT FILL. CONTRACTOR IS NOT REQUIRED TO REMOVE AND REPLACE EXISTING CELL 7 EMBANKMENT MATERIAL WITH SELECT FILL.



SECTION 2
N.T.S. 6

RECORD DRAWING

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HANSEN ALLEN & LUCE – CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 16914 KENT C. ITABELL

DESIGNED KCS MPW	3					
DRAFTED DRB	2	11-10-00	RECORD DRAWING	SDM	KCS
CHECKED MEA	⚠1	6-15-00	MODIFIED SECTION 2 BENCH & SELECT FILL, MODIFIED SELECT FILL NOTES, ADDED SLOPE ARROWS & NOTE 3.	CAH	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE 1" = 50'

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

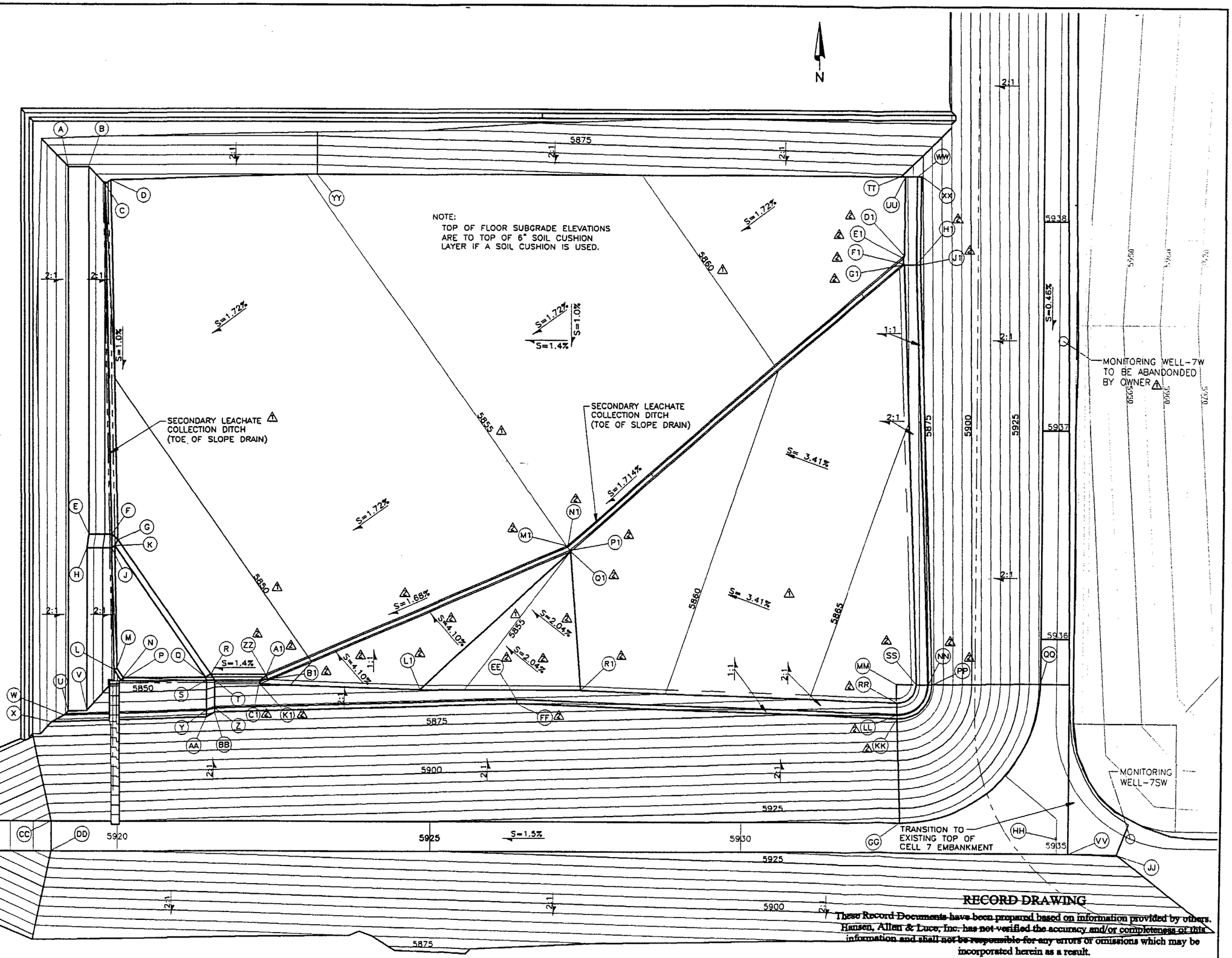
ECDC – SUPER CELL 1–A SOUTH
YEAR 2000 CONSTRUCTION PHASE
CELL SECTIONS

SHEET NO. 8 OF 20
113.05.110

FILE NAME: T:\113.05.110\CAD\CELL_SECTION_R1.DWG
FILE DATE: 11/7/2000 08:05:44 (DRB)
PLOT OPTIONS
PLOT IN = DWG UNITS:
PLOT AREA:
ORIGIN: DWG:
XREF FILE NAME(S):

COORDINATE TABLE ⚠

POINT NO.	NORTHING	EASTING	ELEVATION
A	6,999,000.45	1,927,731.02	5858.77
B	6,999,000.45	1,927,753.55	5858.77
C	6,998,982.56	1,927,771.44	5849.83
D	6,998,986.92	1,927,777.78	5852.00
E	6,998,617.97	1,927,753.55	5858.77
F	6,998,617.97	1,927,778.55	5846.27
G	6,998,612.33	1,927,785.06	5848.36
H	6,998,603.66	1,927,751.32	5858.77
J	6,998,603.66	1,927,778.58	5845.14
K	6,998,605.89	1,927,781.88	5846.25
L	6,998,476.66	1,927,781.09	5843.88
M	6,998,477.82	1,927,784.42	5845.01
N	6,998,468.53	1,927,791.05	5845.01
P	6,998,465.22	1,927,789.26	5843.88
Q	6,998,468.72	1,927,879.87	5846.25
R	6,998,471.87	1,927,885.39	5848.36
S	6,998,465.41	1,927,880.67	5845.16
T	6,998,465.58	1,927,889.55	5846.32
U	6,998,433.68	1,927,731.02	5858.77
V	6,998,434.29	1,927,751.32	5858.77
W	6,998,429.56	1,927,727.02	5860.77
X	6,998,422.45	1,927,713.62	5867.48
Y	6,998,434.17	1,927,880.67	5860.77
Z	6,998,436.68	1,927,889.55	5860.77
AA	6,998,427.46	1,927,880.67	5867.48
BB	6,998,432.20	1,927,889.55	5865.24
CC	6,998,319.50	1,927,712.82	5918.92
DD	6,998,288.50	1,927,712.82	5918.92
⚠ EE	6,998,446.31	1,928,210.49	5860.76
⚠ FF	6,998,441.84	1,928,210.48	5865.24
GG	6,998,319.50	1,928,619.76	5932.52
HH	6,998,304.00	1,928,783.58	5934.98
JJ	6,998,287.61	1,928,848.40	5935.18
⚠ KK	6,998,427.56	1,928,616.51	5878.46
⚠ LL	6,998,432.03	1,928,616.38	5873.99
MM	6,998,463.48	1,928,615.44	5858.26
⚠ NN	6,998,463.78	1,928,647.71	5874.40
⚠ PP	6,998,463.82	1,928,652.18	5878.87
QQ	6,998,464.88	1,928,766.00	5935.78
⚠ RR	6,998,444.03	1,928,616.02	5867.99
⚠ SS	6,998,463.67	1,928,635.72	5868.40
TT	6,998,993.23	1,928,617.21	5863.82
UU	6,998,993.23	1,928,621.81	5863.89
VV	6,998,288.50	1,928,796.75	5935.18
WW	6,998,993.23	1,928,633.97	5869.49
XX	6,998,993.23	1,928,638.45	5873.67
YY	6,998,993.23	1,927,998.44	5855.16
⚠ ZZ	6,998,471.99	1,927,944.35	5849.19
⚠ A1	6,998,470.41	1,927,944.67	5848.68
⚠ B1	6,998,466.72	1,927,946.23	5848.65
⚠ C1	6,998,465.68	1,927,938.14	5847.00
⚠ D1	6,998,910.68	1,928,620.90	5863.05
⚠ E1	6,998,907.82	1,928,619.83	5862.50
⚠ F1	6,998,902.51	1,928,619.76	5862.44
⚠ G1	6,998,901.38	1,928,620.79	5862.96
⚠ H1	6,998,901.52	1,928,632.78	5868.95
⚠ J1	6,998,901.57	1,928,637.25	5873.42
⚠ K1	6,998,461.69	1,927,938.14	5849.00
⚠ L1	6,998,456.29	1,928,107.19	5854.23
⚠ M1	6,998,606.75	1,928,263.94	5855.01
⚠ N1	6,998,605.27	1,928,264.49	5854.50
⚠ P1	6,998,601.82	1,928,266.61	5854.49
⚠ Q1	6,998,600.58	1,928,267.51	5855.00
⚠ R1	6,998,455.90	1,928,278.61	5857.00



RECORD DRAWING

These Record Documents have been prepared based on information provided by others. Hansen, Allen & Luce, Inc. has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

DESIGNED KCS MPW	3	11-08-00	RECORD DRAWING
DRAFTED MPW	⚠	8-28-00	REVISED COORDINATE TABLE. ADDED ELEVATIONS ON WEDGE AREA.
CHECKED MEA	⚠	5-23-00	REVISED COORDINATE TABLE. ADDED ELEVATIONS AND NOTES.
DATE APRIL 2000	NO.	DATE	REVISIONS

SDM	KCS
CAH	MPW
CAH	MPW
BY	APVD.

SCALE: 1" = 50'

VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

HANSEN ALLEN & LUCE — CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — 11-16-00 — NO. 16914 — KENT C. STAHELI — STATE OF IDAHO

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH YEAR 2000 CONSTRUCTION PHASE SUB-GRADE PLAN VIEW

SHEET NO. 9 OF 20

113.05.110

FILE NAME: 113.05-110/CAD/SUB-GRADE_PLAN_R2.DWG
FILE DATE: 11/16/2000 15:10:54 (CAH)
PLOT OPTIONS
PLOT AREA:
PLOT IN = DWG UNITS
ORIGIN: DVIEW:
XREF FILE NAME(S)

N

COORDINATE NOTE:

COORDINATES AND ELEVATIONS PROVIDED ON THE CELL FLOOR DESIGNATE THE INTERSECTION BETWEEN THE PLANE OF THE FLOOR SURFACE AND THE CELL SIDE SLOPES. (TOP OF CLAY)

NOTE:

FILL ENTIRE SUMP AND TOE OF SLOPE DITCHES WITH 1" MINUS ROUNDED WASHED ROCK TO TOP OF SUMP GRAVEL FILL LINE.

S=1.40%

N. 6,998,462.06 ⚠
E. 1,927,888.54
EL. 5850.31

N. 6,998,467.02
E. 1,927,885.00
EL. 5850.31

N. 6,998,464.04
E. 1,927,883.48
EL. 5049.24

8" DIA. PCPE PIPE EXTEND ALONG TOE OF SLOPE DITCH

10" X 8" ECCENTRIC REDUCER

3:1

2:1

S=1.72%

6.0' TYP.

8" DIA. PCPE PIPE WITH END CAP (TYP.)

10" X 8" ECCENTRIC REDUCING TEE (TYP.)

1/12

35.96' (TYP.)

106.99' MIN.

S=1.4% AT S 90° W

10" DIA. PCPE PIPE

2:1

10.22' (TYP.)

TOP OF SUMP GRAVEL (FILL LINE)

S=1.72%

2/12

RECORD DRAWING

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N. 6,998,613.95
E. 1,927,780.05
EL. 5850.31

N. 6,998,613.03
E. 1,927,777.07
EL. 5049.24

N. 6,998,621.11
E. 1,927,774.93
EL. 5850.31

S=1.00%

S=1.0% AT S 0° E

52.21' (TYP.)

10.0' MIN. PIPE BENDING RADIUS (TYP.)

7.41'±

N. 6,998,463.83
E. 1,927,779.97
EL. 5847.79

N. 6,998,461.84
E. 1,927,778.03
EL. 5848.76
SEE COORDINATE NOTE THIS SHEET

HDPE PRIMARY LEACHATE WITHDRAWAL PIPE

7.31' (TYP.)

2'

4.13'±

N. 6,998,459.88 ⚠
E. 1,927,776.07
EL. 5849.76

8" DIA. PCPE PIPE EXTEND ALONG TOE OF SLOPE DITCH

10" X 8" ECCENTRIC REDUCER

10" DIA. PCPE PIPE

152.12'

TOP OF SUMP GRAVEL (FILL LINE)

HANSEN ALLEN & LUCE
CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
NO. 169141
KENT C. ISAKEL
PROFESSIONAL ENGINEER
STATE OF UTAH

DESIGNED KCS MPW	3			SDM	KCS
DRAFTED DRB	2	11-08-00	RECORD DRAWING	CAH	KCS
CHECKED MEA	⚠	5-8-00	MODIFIED PIPING AND GRAVEL FILL LINE COORDINATES.	BY	APVD.
DATE APRIL 2000	NO.	DATE	REVISIONS		

SCALE 1" = 6'

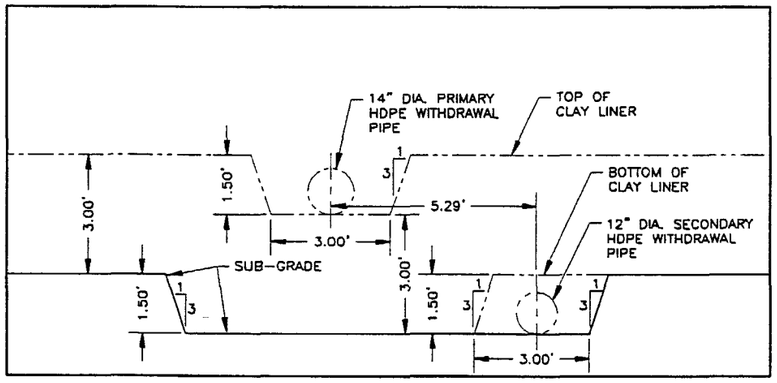
VERIFY SCALE
0" 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

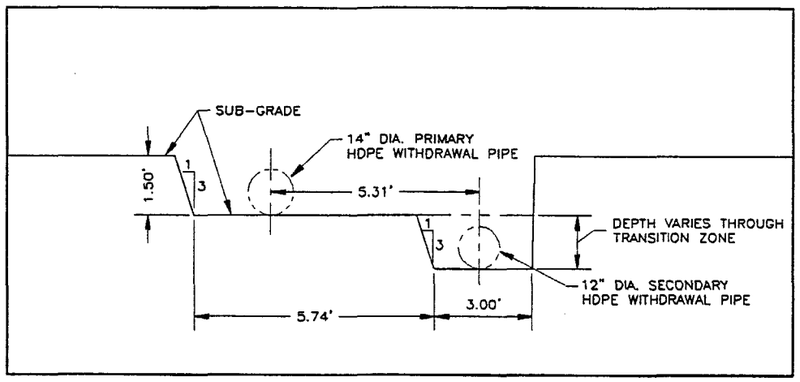
ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
PRIMARY SUMP PLAN

SHEET NO. 10 OF 20
113.05 110

XREF FILE NAME(S)
ORIGIN:
DVIEW:
PLOT OPTIONS
PLOT IN = DWG UNIT
PLOT AREA:
FILE NAME: 05-110/CAD/ADDENDUM 1/SUMPPLAN1.DWG
FILE DATE: 11/16/2000 14:25:24 (CAH)

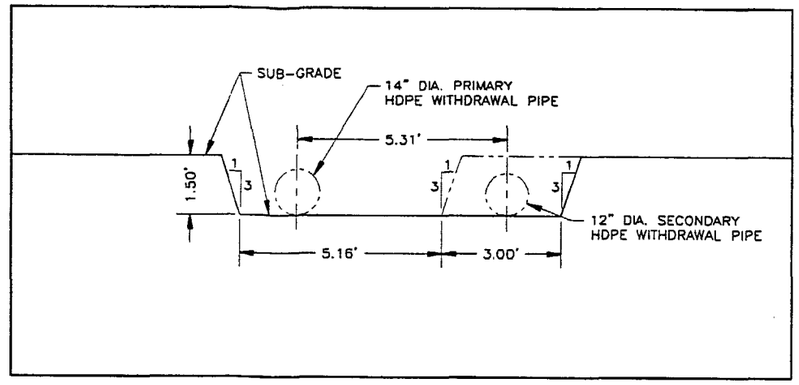


SECTION 1
N.T.S.

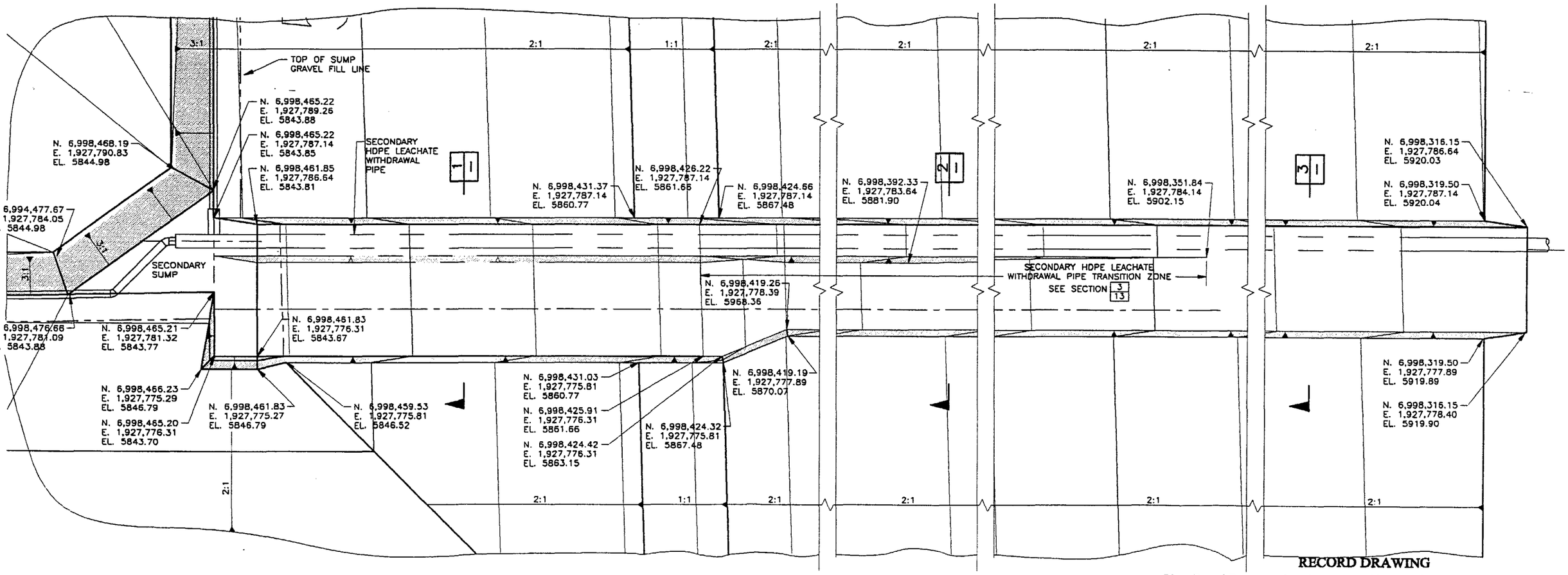


SECTION 2
N.T.S.

NOTE:
1. SURFACE SHOWN IS TOP OF EMBANKMENT, BELOW COMPACTED CLAY LINER.
2. FILL ENTIRE SUMP AND TOE OF SLOPE DITCHES WITH 1" MINUS ROUNDED WASHED ROCK TO GRAVEL FILL LINE.



SECTION 3
N.T.S.



RECORD DRAWING

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HANSEN ALLEN & LUCE INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 169141 KENT C. STAHELL 11-16-00 PROJECT ENGINEER

DESIGNED KCS MPW	3				
DRAFTED DRB	2				
CHECKED MEA	1	11-08-00	RECORD DRAWING	SDM	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE 1" = 4'

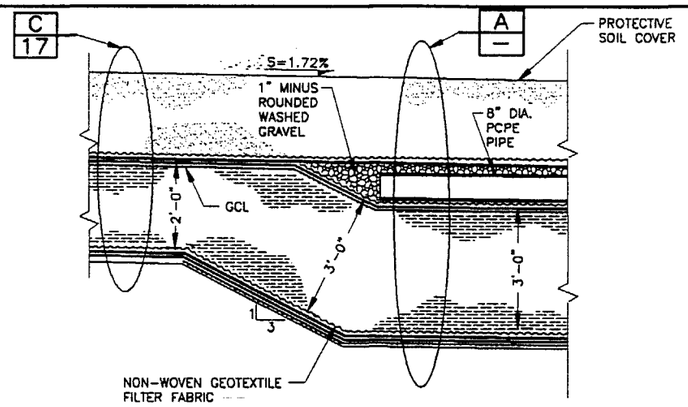
VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1–A SOUTH
YEAR 2000 CONSTRUCTION PHASE
SECONDARY SUMP & LEACHATE PIPE PLAN

SHEET NO. 11 OF 20
113.05 1

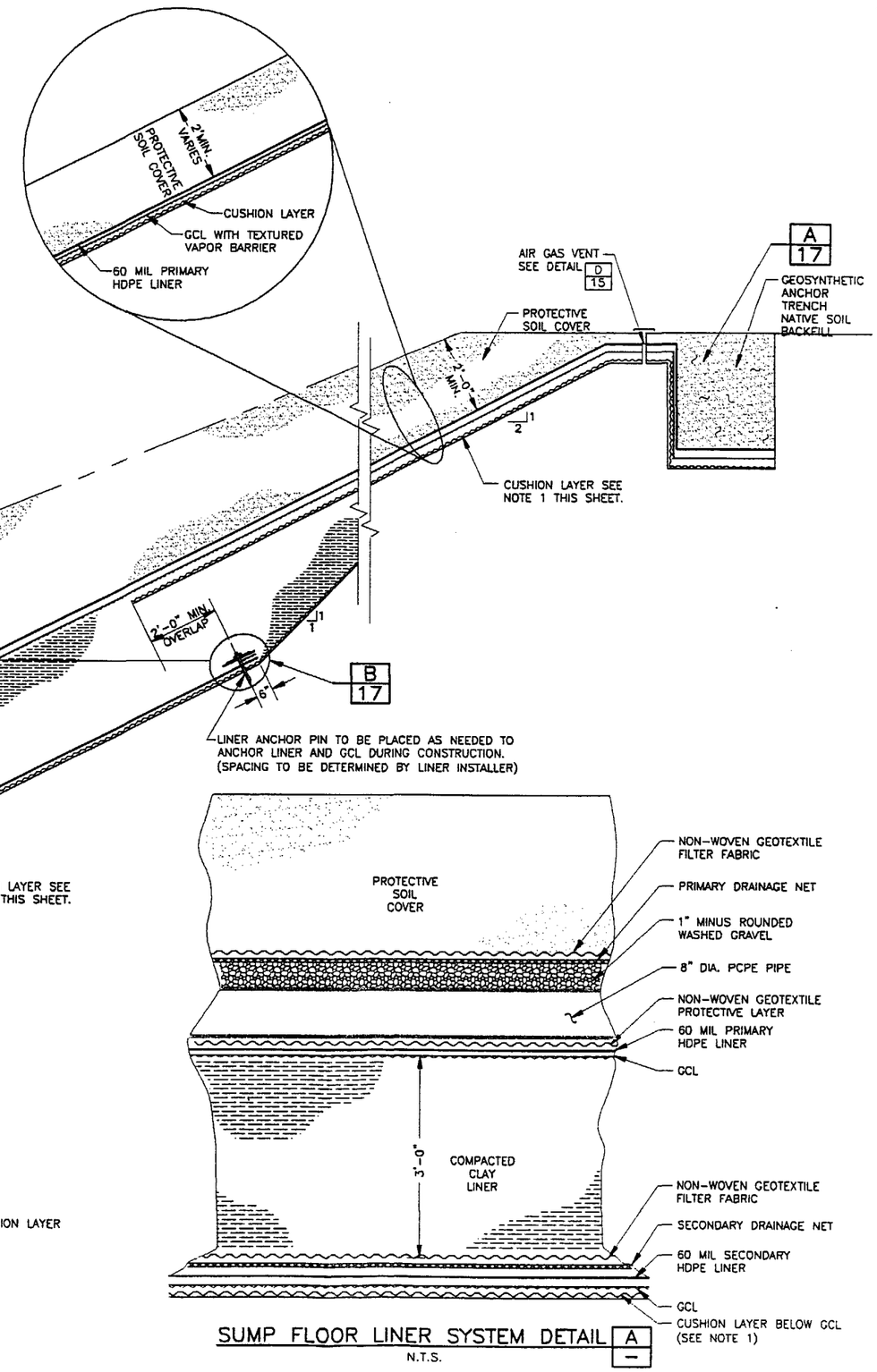
FILE NAME: /05-110/CAD/SECONDARY_SUMP_PLAN.DWG
FILE DATE: /16/2000 15:19:37 (CAH)
PLOT OPTIONS
PLOT IN = DWG UNITS
PLOT AREA:
ORIGIN:
DVIEW:
XREF FILE NAME(S)



SECTION 2 / 10
N.T.S.

NOTES:

1. CUSHION LAYER CONSISTS OF A 6-INCH THICK SILT-CLAY OR SAND TYPE SOIL MATERIAL ON THE CELL FLOOR AND CONSISTS OF NON-WOVEN GEOTEXTILE FILTER FABRIC (16 OZ. OR EQUIVALENT) ON THE SIDE SLOPES).
2. THE HEIGHT OF THE CLAY UP THE INTERIOR SIDE SLOPE VARIES MAINTAINING A CONSTANT ELEVATION OF 5860.77 UNTIL IT IS 2-FEET ABOVE THE SOIL COVER (4' ABOVE THE CLAY LINER SURFACE) ON THE CELL FLOOR. IT THEN MAINTAINS A HEIGHT 4-FEET ABOVE THE CLAY LINER SURFACE ON THE CELL FLOOR.
3. NON-WOVEN GEOTEXTILE PROTECTIVE LAYER SHALL BE 16 OZ. FABRIC. THIS PROTECTIVE LAYER SHALL BE PLACED BELOW ALL ROCK.
4. NON-WOVEN GEOTEXTILE FILTER FABRIC SHALL BE 8 OZ. FABRIC. THIS FILTER FABRIC SHALL BE PLACED ABOVE ALL DRAINAGE NET.
5. PROTECTIVE SOIL COVER ON THE FLOOR ABOVE THE PRIMARY SUMP VARIES FROM 1' THICK AT THE LOW POINT IN THE SUMP TO 2' THICK AT THE UPPER END OF THE SUMP.



SECTION 1 / 10
N.T.S.

SUMP FLOOR LINER SYSTEM DETAIL A / —
N.T.S.

RECORD DRAWING

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HANSEN ALLEN & LUCE CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — 11-16-00 — NO. 16914 — KENT C. STARELL — STATE OF IDAHO

DESIGNED KCS MPW	3					
DRAFTED DRB	2					
CHECKED MEA	1	11-09-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: AS SHOWN

VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

ECDC ENVIRONMENTAL

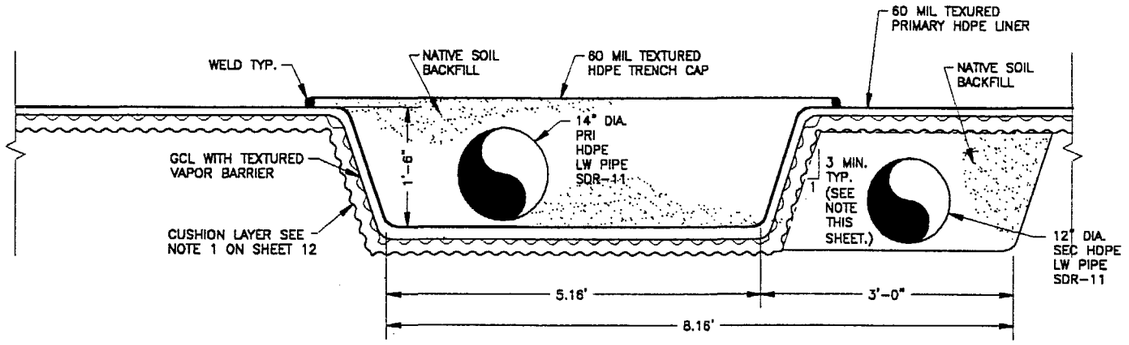
ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
TYPICAL SUMP SECTIONS

SHEET NO. 12 OF 20
113.05 11C

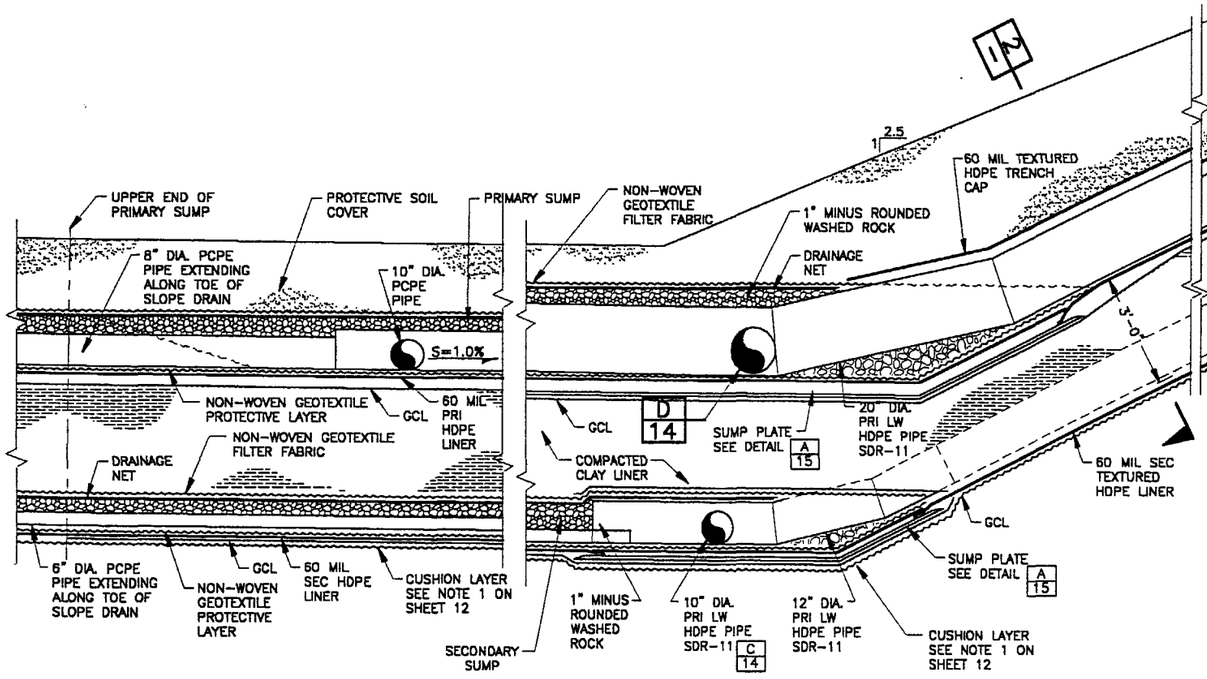
FILE NAME: 113/05-110/CAD/SUMPSECTIONS.DWG
FILE DATE: 11/16/2000 15:34:05 (CAH)
PLOT OPTIONS
PLOT IN = DWG UNITS:
PLOT AREA:
ORIGIN: D/VIEW:
XREF FILE NAME(S)
3/99

NOTES:

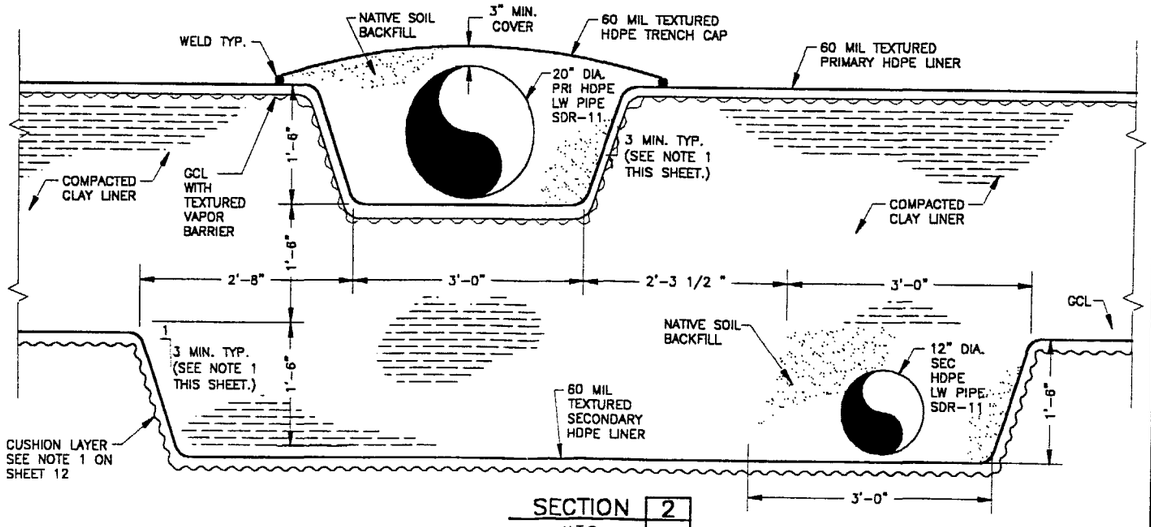
1. TRENCH SIDES TO SLOPE BETWEEN 1:3 AND 1:1. THE SIDE SLOPES OF THE TRENCH IN THE CLAY LINER SHALL NOT BE FLATTER THAN THE SIDE SLOPES OF THE SUB-GRADE TRENCH.
2. CORNERS OF TRENCHES SHALL BE ROUNDED.
3. THE 12" DIA. HDPE PIPE SHALL TRANSITION VERTICALLY BETWEEN THE END OF THE COMPACTED CLAY LINER AND THE TOP OF THE CELL EMBANKMENT SO THAT BOTH PIPES EXTEND ABOVE THE TOP OF THE CELL EMBANKMENT AT THE SAME LEVEL. THE PIPE DEFLECTION SHALL BE NO GREATER THAN 2 DEGREES THROUGH THE TRANSITION.



SECTION 3 / N.T.S.



SECTION 3 / N.T.S. 6



SECTION 2 / N.T.S.

RECORD DRAWING

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HANSEN ALLEN & LUCE CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 16914 KENT C. STARELL

DESIGNED KCS MPW	3					
DRAFTED DRB	2					
CHECKED MEA	1	11-09-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE AS SHOWN

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

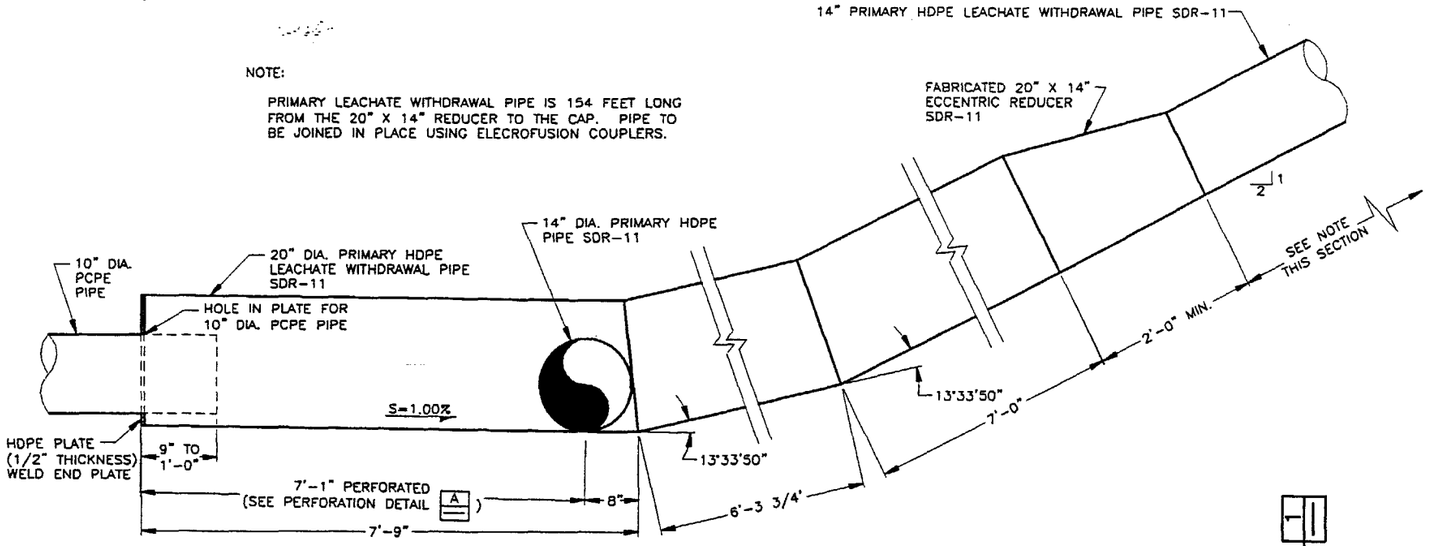
ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
LEACHATE WITHDRAWAL PIPE SECTIONS

SHEET NO. 13 OF 20
113.05.110

XREF FILE NAME(S)
ORIGIN: DVIEW:
PLOT OPTIONS
PLOT IN = DWG UNITS:
PLOT PLOT AREA:
FILE NAME: 113\05-110\CAD\SUMP_SECTION_PIPE.DWG
FILE DATE: 11/16/2000 16:34:00 (SDM)
1/93

NOTE:

PRIMARY LEACHATE WITHDRAWAL PIPE IS 154 FEET LONG FROM THE 20" X 14" REDUCER TO THE CAP. PIPE TO BE JOINED IN PLACE USING ELECROFUSION COUPLERS.

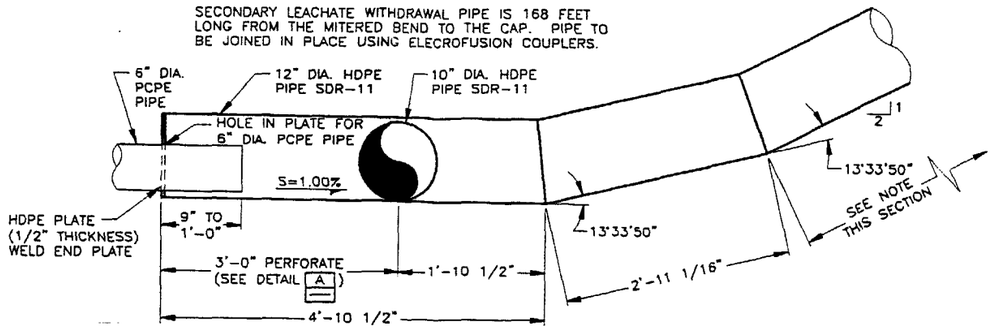


PRIMARY LEACHATE WITHDRAWAL PIPE SECTION 1

N.T.S.

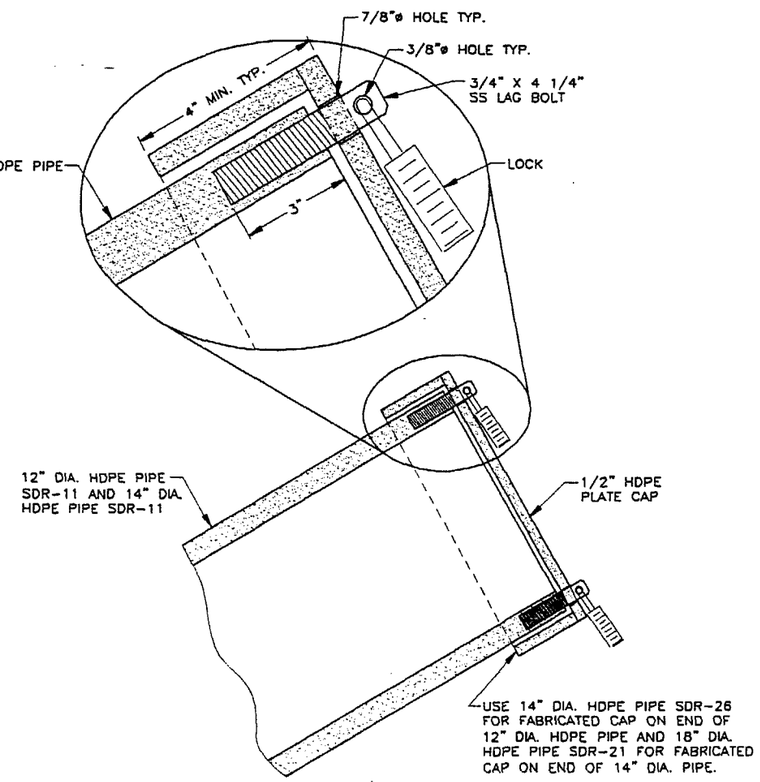
NOTE:

SECONDARY LEACHATE WITHDRAWAL PIPE IS 168 FEET LONG FROM THE MITERED BEND TO THE CAP. PIPE TO BE JOINED IN PLACE USING ELECROFUSION COUPLERS.



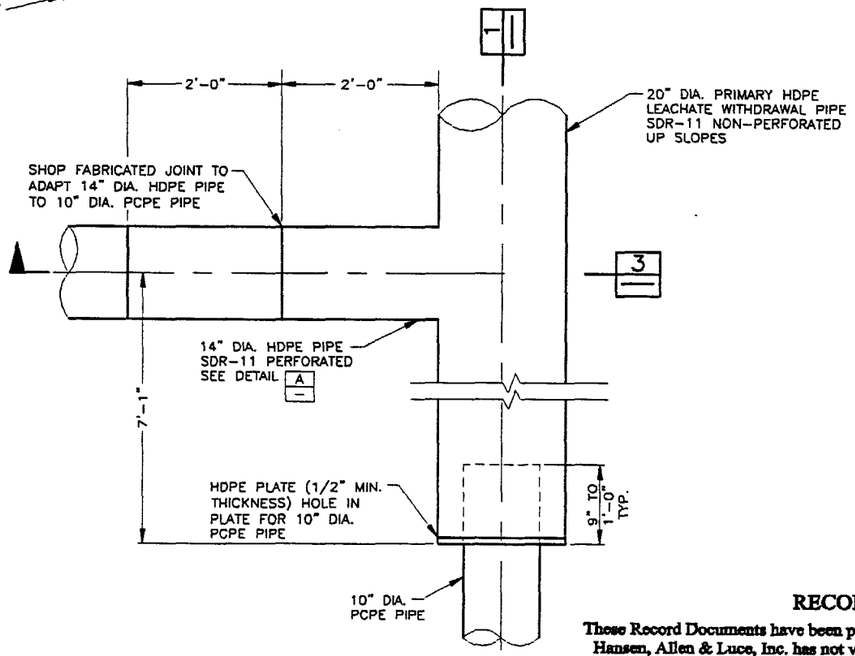
SECONDARY LEACHATE WITHDRAWAL PIPE SECTION 2

N.T.S.



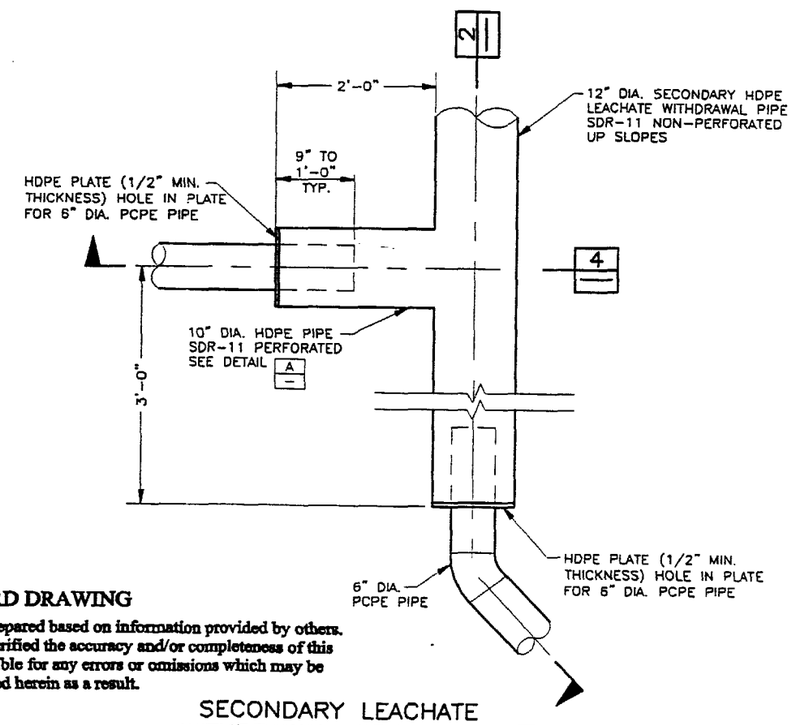
12" & 14" DIA. HDPE CAP DETAILS B/13

N.T.S.



PRIMARY LEACHATE WITHDRAWAL PIPE DETAIL D/13

N.T.S.



SECONDARY LEACHATE WITHDRAWAL PIPE DETAIL C/13

N.T.S.

RECORD DRAWING

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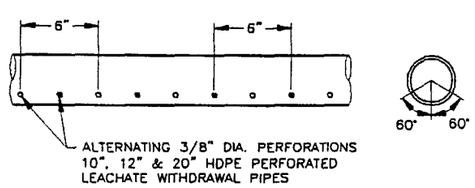
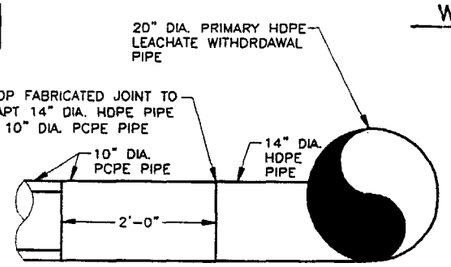


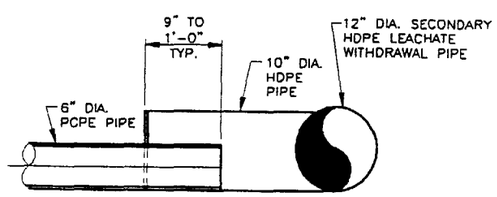
PERFORATION DETAIL A

N.T.S.



CROSS SECTION 3

N.T.S.



CROSS SECTION 4

N.T.S.

HANSEN ALLEN & LUCE — CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — NO. 169141 — KENT C. FISHELL — 11-16-00

DESIGNED KCS MPW	3					
DRAFTED	2					
CHECKED MEA	1	11-09-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: AS SHOWN

VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
LEACHATE WITHDRAWAL SYSTEM DETAILS

SHEET NO. 14 OF 20

113.05.110

FILE NAME: H:\05-110\CAD\LEACHATE_WITHDRAWAL_SYSTEM_DETAILS.DWG
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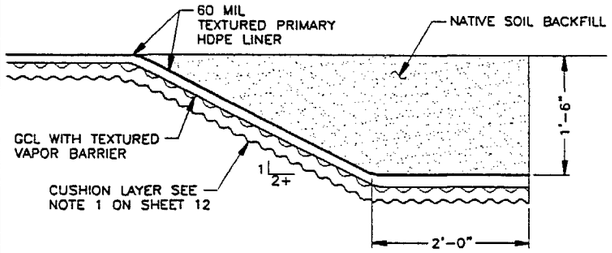
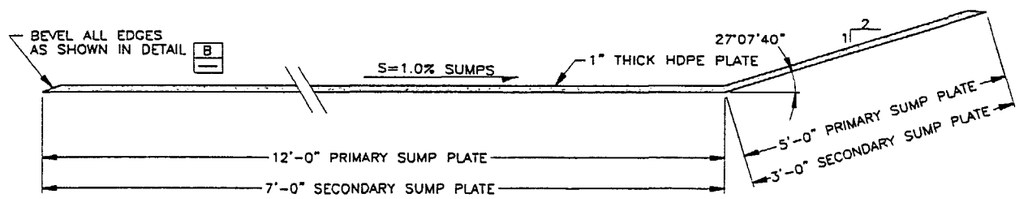
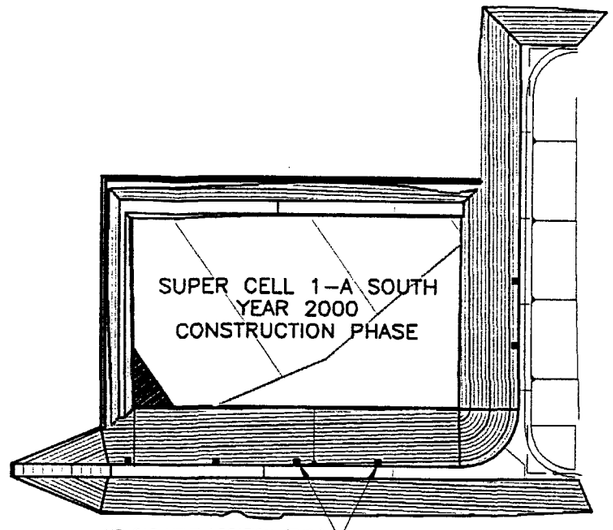


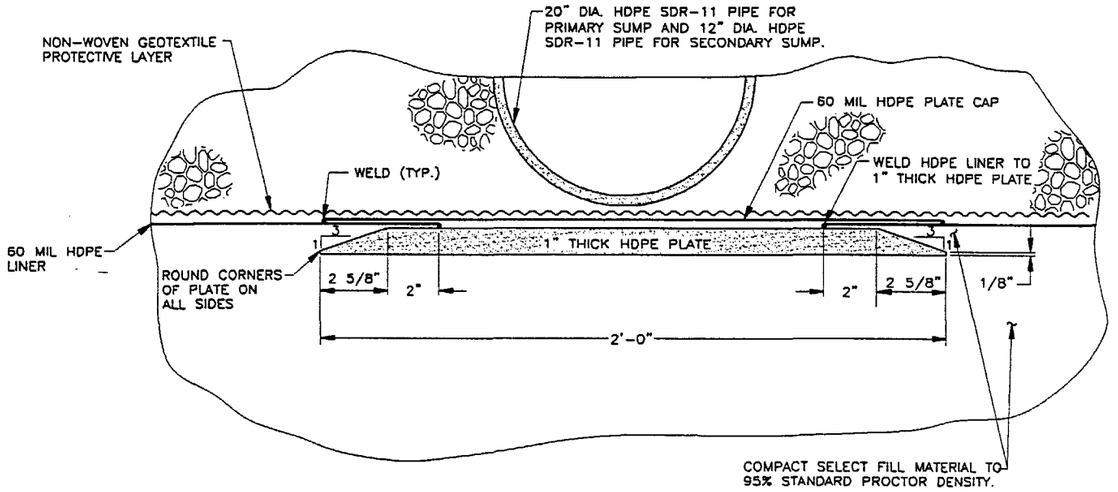
SIDE SLOPE ANCHOR TRENCH 4/6
N.T.S.



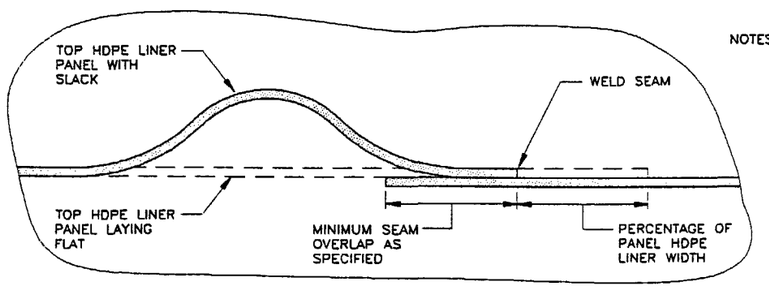
DETAIL A 13
N.T.S.



AIR GAS VENT LOCATION DETAIL D 12
N.T.S.



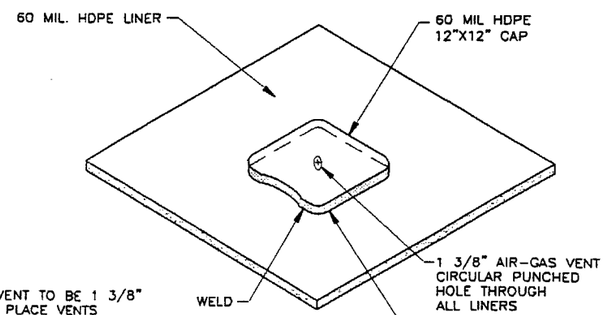
DETAIL B
4" = 1'-0"



HDPE LINER SEAMS DETAIL
N.T.S.

NOTES:

1. SLACK IN THE AMOUNT OF ONE PERCENT OF THE HDPE LINER PANEL WIDTH (UNLESS OTHERWISE DIRECTED BY THE ENGINEER FOR COLD WEATHER DEPLOYMENT) IS TO BE PROVIDED ON THE INSIDE SLOPES OF THE CELLS WHERE THE LINER WILL BE EXPOSED TO EXTREME TEMPERATURE VARIATIONS. THIS SLACK IS TO BE PROVIDED TO REDUCE STRESS CRACKING POTENTIAL AT THE SEAMS
2. SLACK IS TO BE PROVIDED BY THE FOLLOWING METHOD UNLESS ANOTHER OVERLAP METHOD IS SUBMITTED AND APPROVED BY THE ENGINEER THAT WILL PROVIDE EQUIVALENT RESULTS.
   A. OVERLAP THE SEAM OF ADJACENT LINER PANELS THE REQUIRED SEAM OVERLAP DISTANCE PLUS THE PERCENTAGE OF THE LINER PANEL WIDTH NEEDED TO PROVIDE THE REQUIRED SLACK IN THE LINER.
   B. MOVE THE EDGE OF THE TOP LINER PANEL BACK TO THE REQUIRED SEAM OVERLAP DISTANCE TO PROVIDE THE REQUIRED AMOUNT OF SLACK IN THE TOP LINER.
   C. WHILE MAINTAINING THE SLACK IN THE TOP PANEL, WELD THE TOP AND THE BOTTOM LINER PANELS TOGETHER AT THE SEAM.



NOTES:

1. AIR-GAS VENT TO BE 1 3/8" DIAMETER. PLACE VENTS AS SHOWN ON AIR GAS VENT LOCATION DETAIL.
2. AIR-GAS VENT TO BE WELDED ON LOWER SIDE AFTER THE CELL IS FILLED AND PRIOR TO CLOSURE CAP CONSTRUCTION.

AIR GAS VENT DETAIL D
N.T.S.

RECORD DRAWING

These Record Documents have been prepared based on information provided by others. Hansen, Allen & Luce, Inc. has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

HANSEN ALLEN & LUCE, INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 16914 KENT C. ISABELL PROJECT ENGINEER

DESIGNED KCS MPW	3				
DRAFTED CAH	2				
CHECKED MEA	1	11-09-00	RECORD DRAWING	SDM	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE AS SHOWN

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
CELL LINER SYSTEM DETAILS

SHEET NO. 15 OF 20
113.05.110

FILE NAME: 05-110/CAD/TYPICAL_DETAILS.DWG
FILE DATE: 11/16/2000 16:28:01 (CAH)
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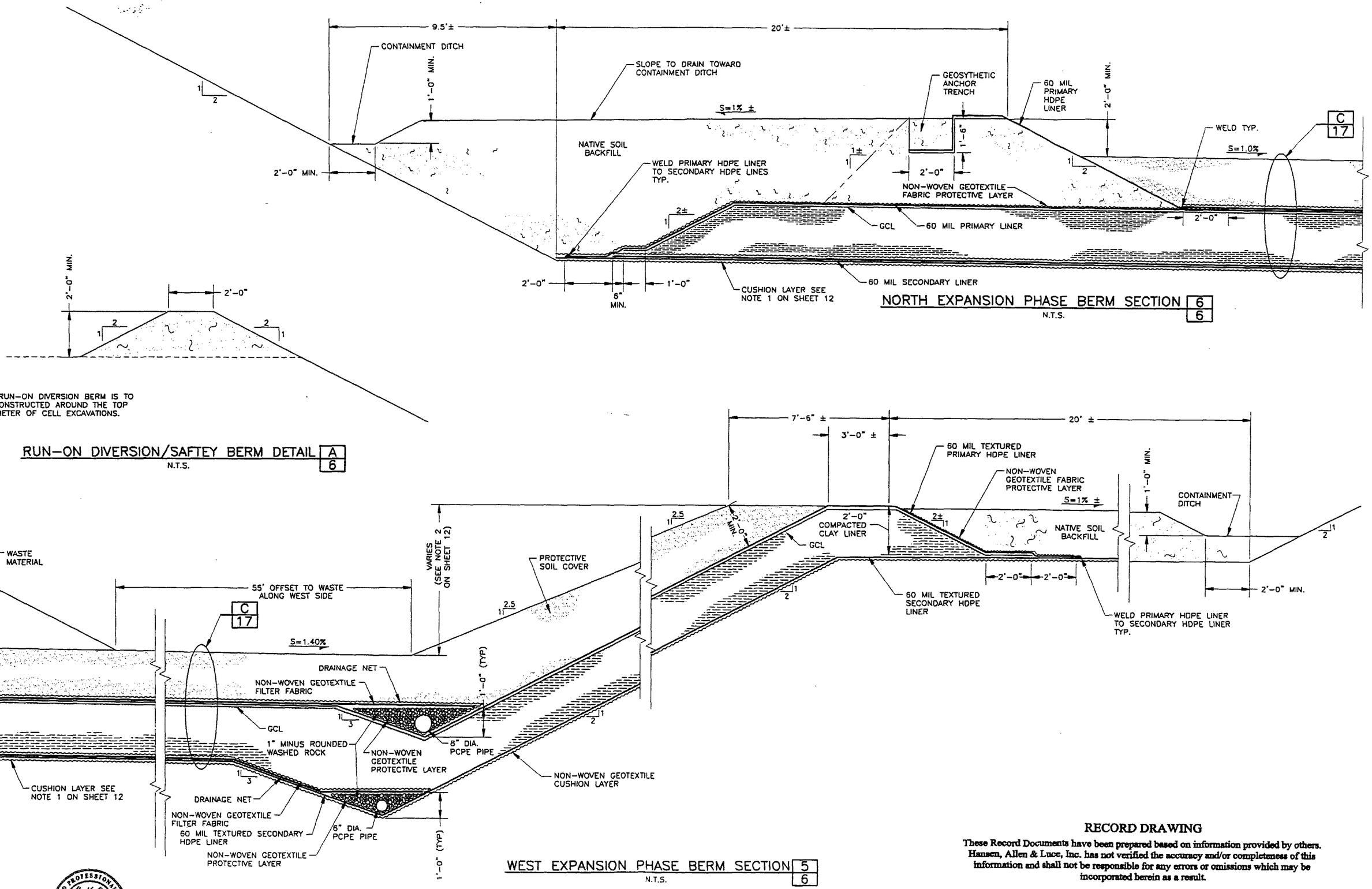
ORIGIN:
DVIEW:
XREF FILE NAME(S)



NORTH EXPANSION PHASE BERM SECTION 6/6
N.T.S.

NOTE:
THE RUN-ON DIVERSION BERM IS TO BE CONSTRUCTED AROUND THE TOP PERIMETER OF CELL EXCAVATIONS.

RUN-ON DIVERSION/SAFTEY BERM DETAIL A/6
N.T.S.

WEST EXPANSION PHASE BERM SECTION 5/6
N.T.S.

RECORD DRAWING

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HANSEN ALLEN & LUCE inc. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER NO. 16914 KENT C. STARELL PROJECT ENGINEER

DESIGNED KCS MPW	3					
DRAFTED DRB	2					
CHECKED MEA	1	11-09-00	RECORD DRAWING	SDM	KCS	
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.	

SCALE: AS SHOWN

VERIFY SCALE: 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
PHASE BERM LINER DETAILS

SHEET NO. 16 OF 20
113.05.110

FILE NAME: 113-05-110/CAD/PHASEBERMDETAILS.DWG
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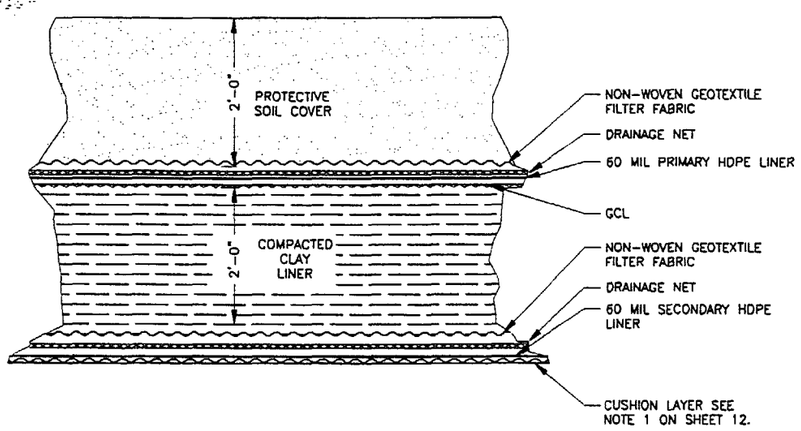
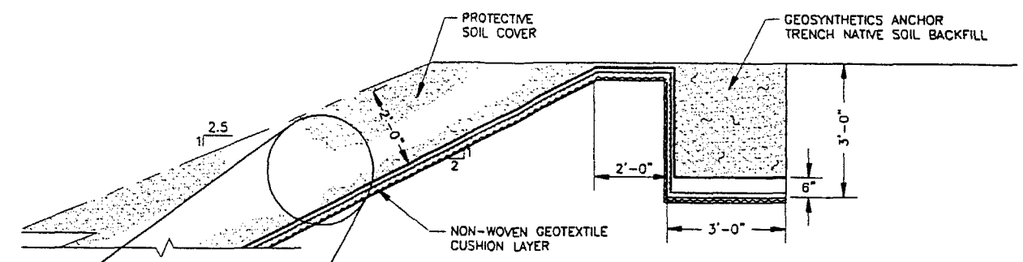
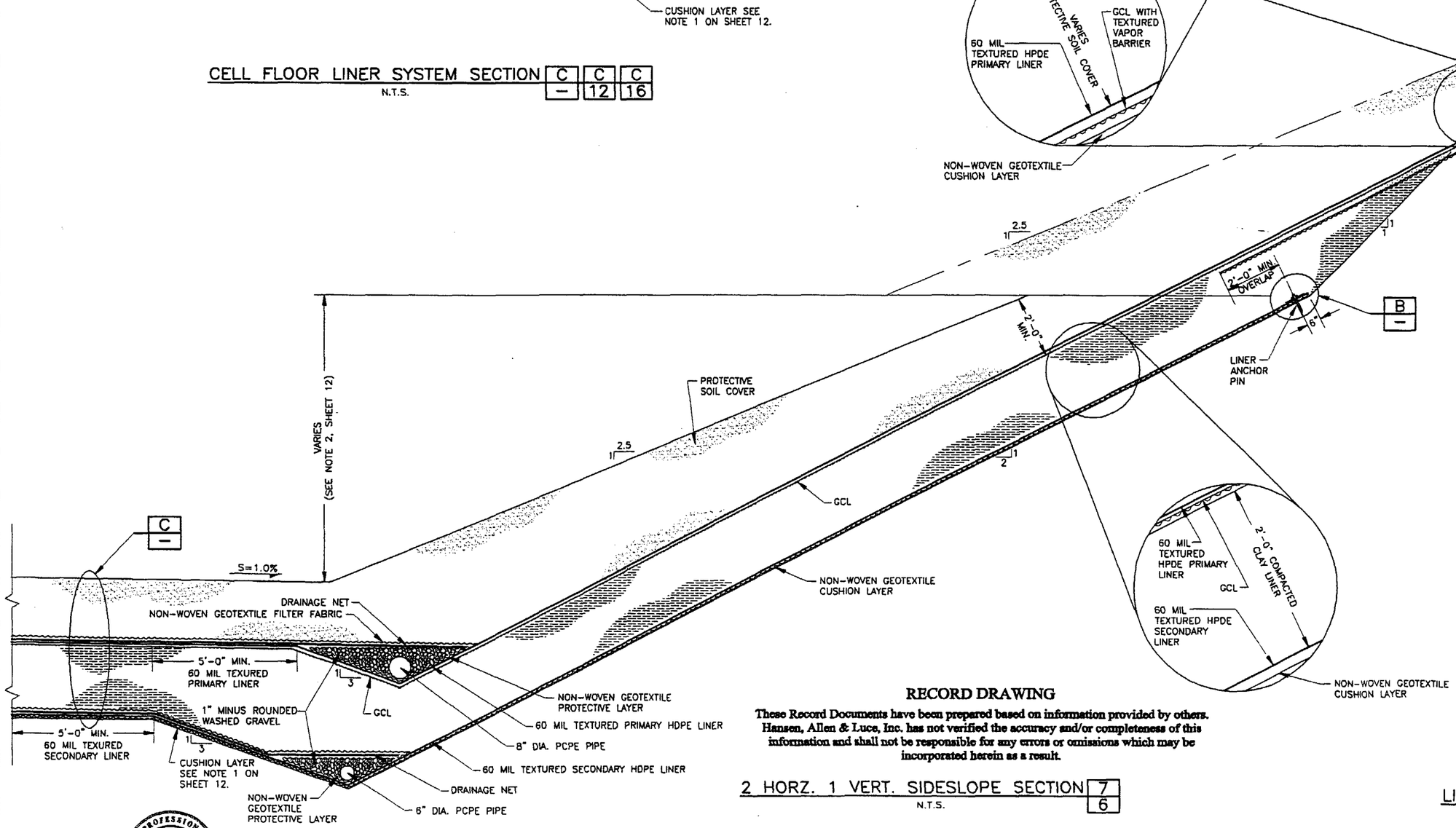
PLOT AREA:
ORIGIN:
DVIEW:
XREF FILE NAME(S)
3/99



CELL FLOOR LINER SYSTEM SECTION C/– C/12 C/16
N.T.S.



GEOSYNTHETICS ANCHOR TRENCH DETAIL A/12 C/13
N.T.S.



RECORD DRAWING

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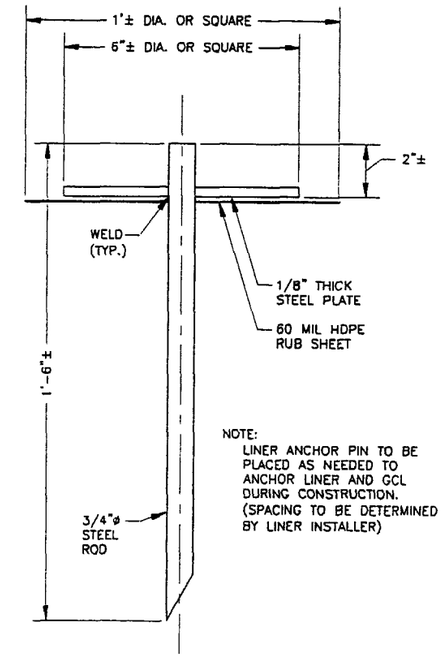
2 HORZ. 1 VERT. SIDESLOPE SECTION 7/6
N.T.S.



NOTE:
LINER ANCHOR PIN TO BE PLACED AS NEEDED TO ANCHOR LINER AND GCL DURING CONSTRUCTION. (SPACING TO BE DETERMINED BY LINER INSTALLER)

LINER ANCHOR PIN DETAIL B/– B/12
N.T.S.

HANSEN ALLEN & LUCE INC. CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER 11-16-00 NO. 169141 KENT C. STABELL PROJECT ENGINEER

DESIGNED KCS MPW	3				
DRAFTED DRB	2				
CHECKED MEA	1	11-10-00	RECORD DRAWING	SDM	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE AS SHOWN

VERIFY SCALE 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1–A SOUTH
YEAR 2000 CONSTRUCTION PHASE
TYPICAL LINER SYSTEM SECTIONS & DETAILS

SHEET NO. 17 OF 20
113.05 110

FILE NAME: 113-05-110/CAD/FLOOR_DITCH_DETAILS.DWG
FILE DATE: 11/17/2000 08:03:38 (CAH)
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PLOT AREA:
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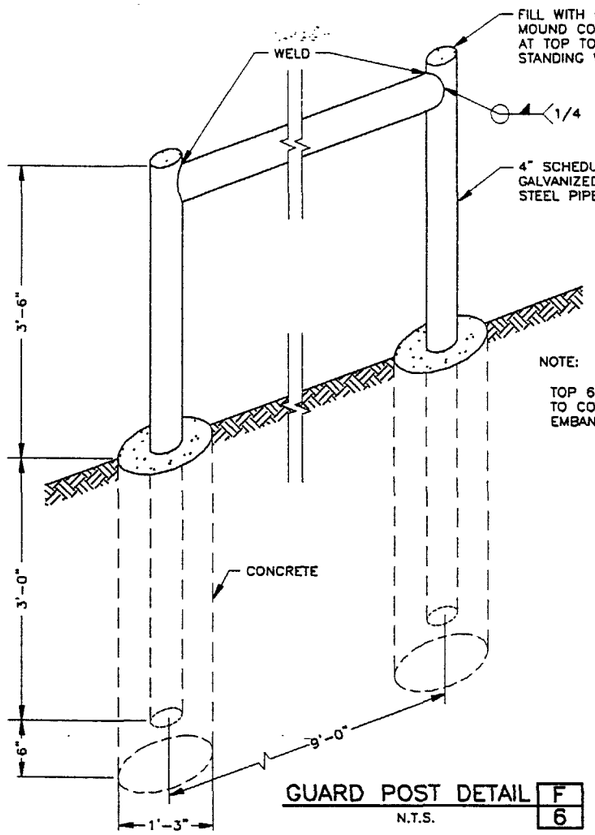
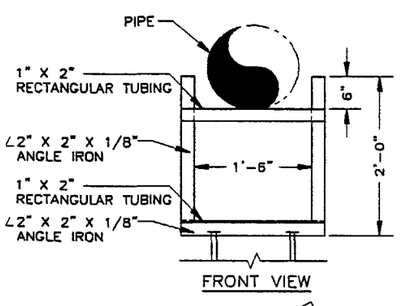
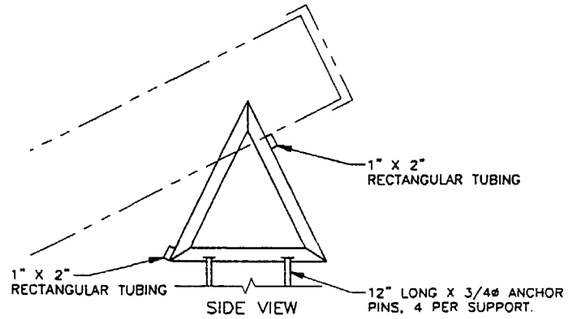


NOTE:

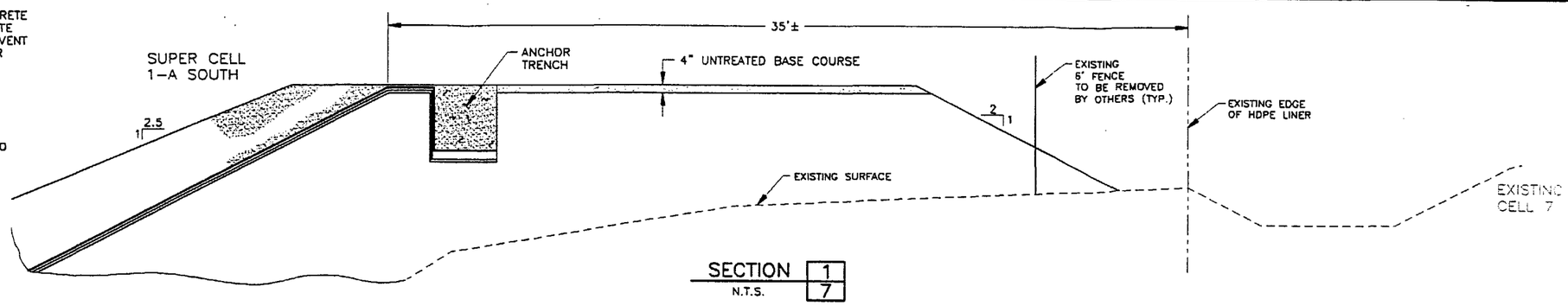
TOP 6' OF NEW FILL TO CONSIST OF SELECT EMBANKMENT FILL

GUARD POST DETAIL F 6
N.T.S.

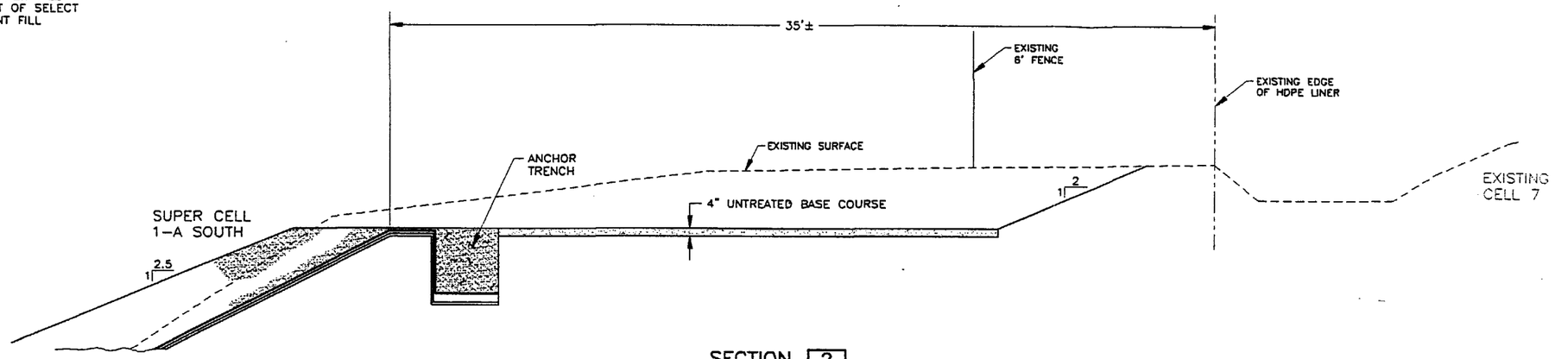




PIPE SUPPORT DETAIL D 13
N.T.S.



SECTION 1 7
N.T.S.



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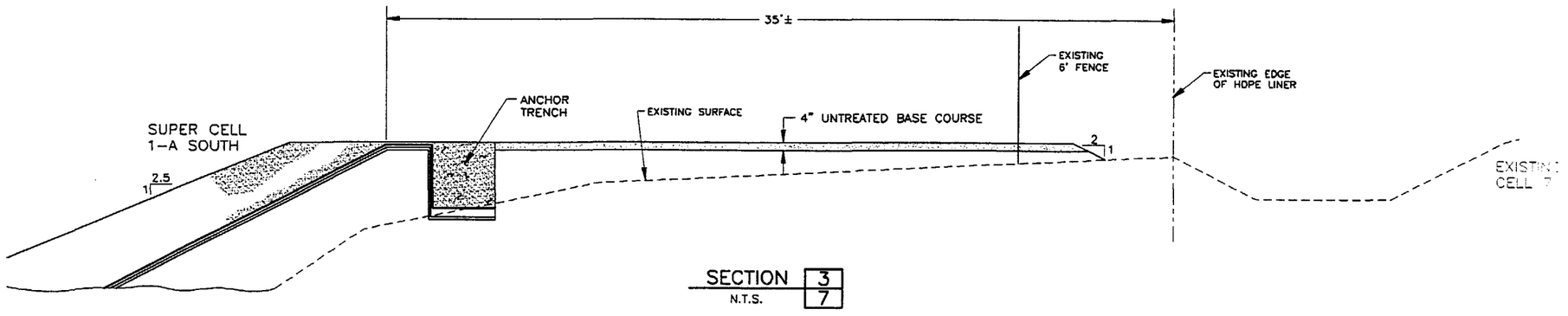

SECTION 3 7
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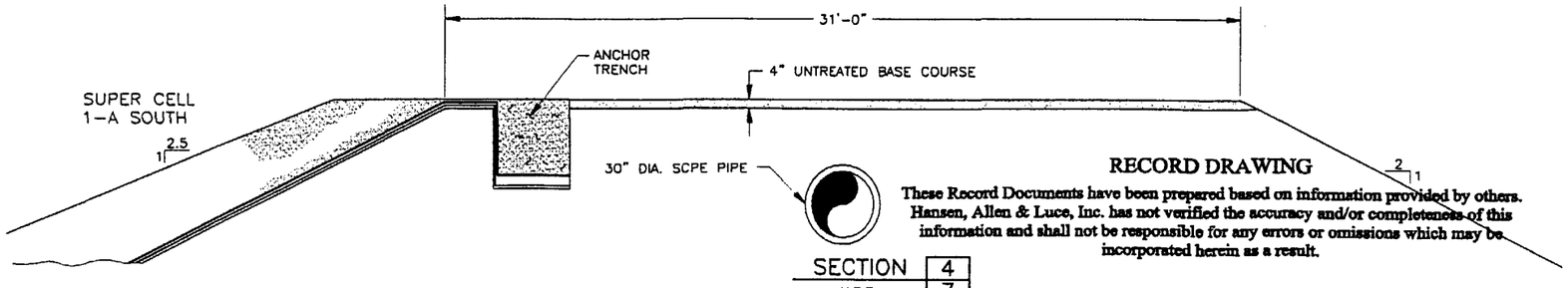

SECTION 4 7
N.T.S.

RECORD DRAWING

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HANSEN ALLEN & LUCE — CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — NO. 169141 — KENT C. STAHELI — PROJECT ENGINEER

DESIGNED KCS MPW	3				
DRAFTED DRB	2				
CHECKED MEA	1	11-10-00	RECORD DRAWING	SDM	KCS
DATE APRIL 2000	NO.	DATE	REVISIONS	BY	APVD.

SCALE: AS SHOWN

VERIFY SCALE: 0" 1" — BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
TYPICAL SECTIONS & DETAILS

SHEET NO. 18 OF 20
113.05.110

FILE NAME: 11305-110/CAD/TYPICAL_SECTIONS_&_DETAILS.DWG
FILE DATE: 11/16/2000 16:07:29 (CAH)
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DWG UNITS:
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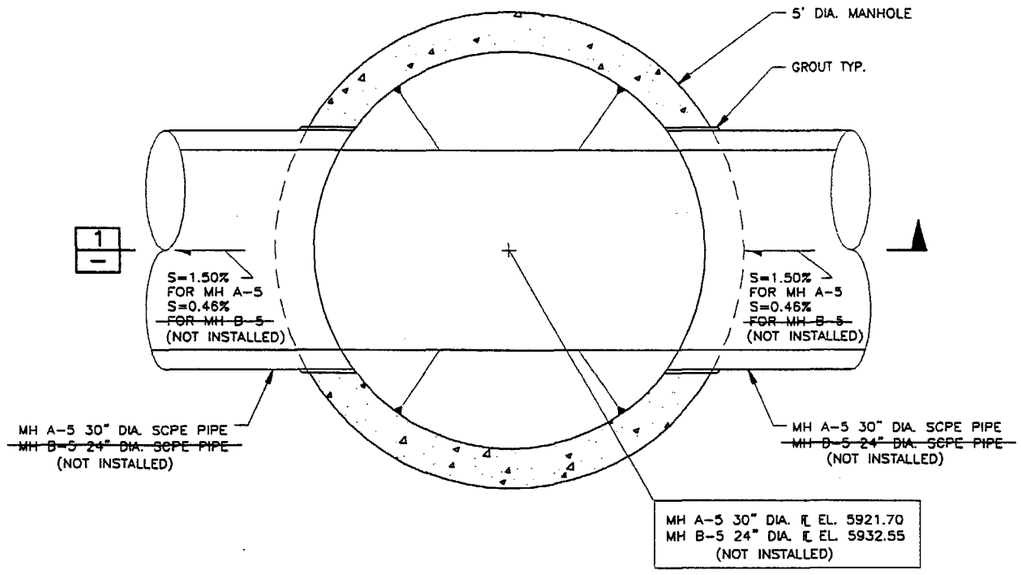
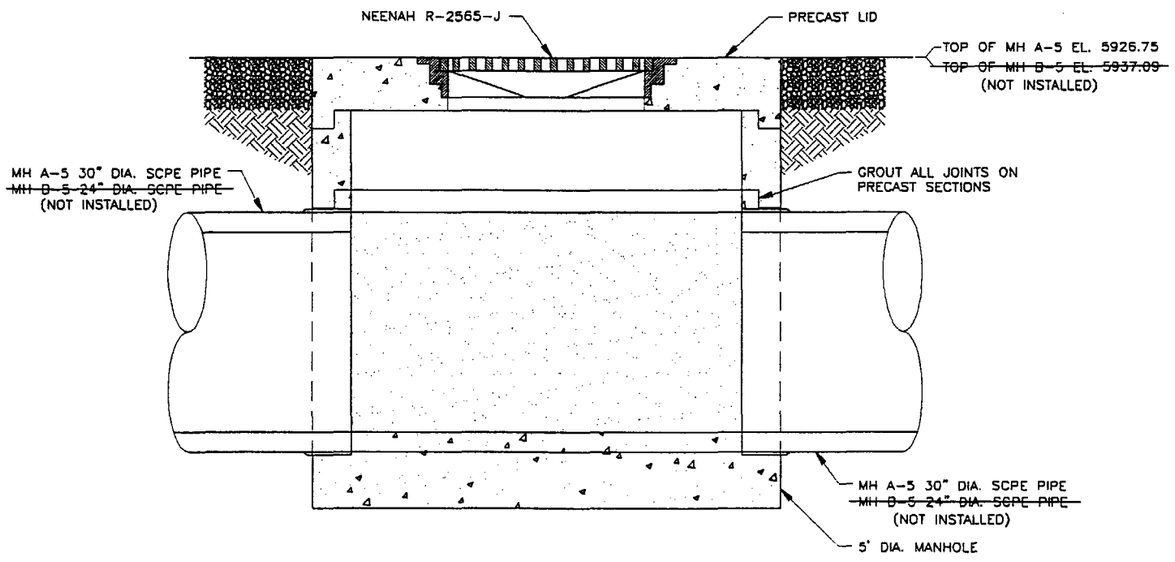
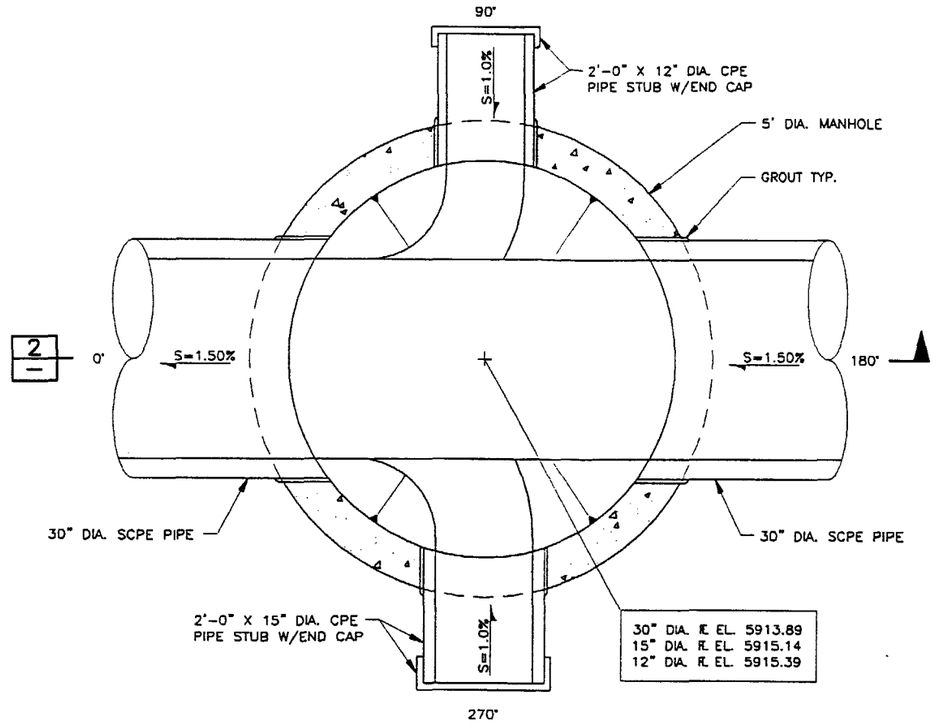


~~MANHOLE A-5 & B-5 DETAIL~~ C 6

1" = 1'-0" (NOT INSTALLED)

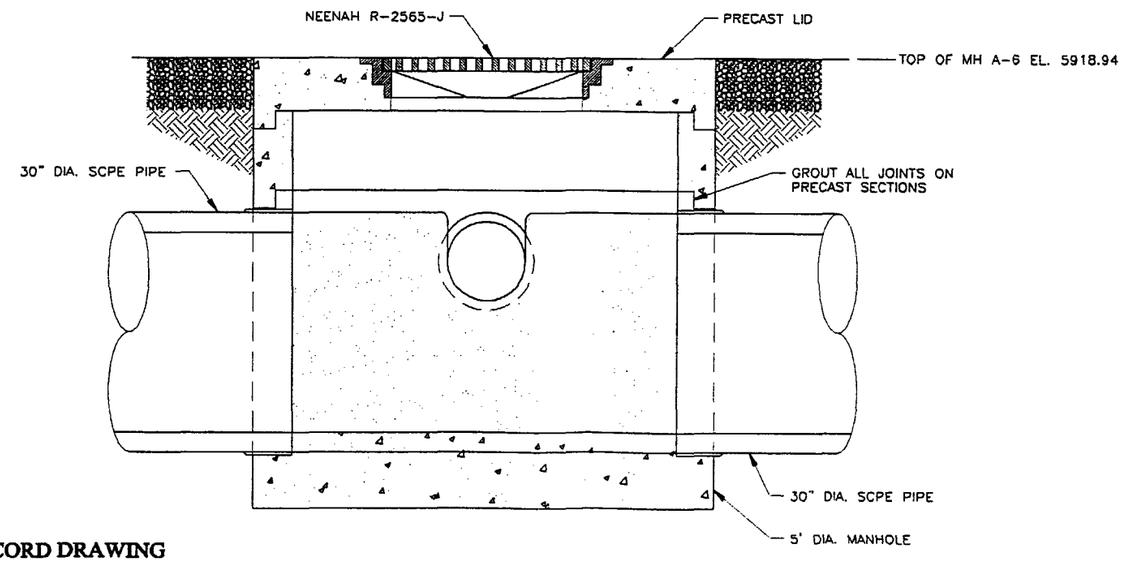


SECTION 1 —



MANHOLE A-6 DETAIL D 6

1" = 1'-0"



SECTION 2 —

RECORD DRAWING

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HANSEN ALLEN & LUCE — CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — 11-16-00 — NO. 16914 — KENT C. FISHELL — PROFESSIONAL ENGINEER

DESIGNED KCS MPW	3				SDM	KCS
DRAFTED LDT	2	11-10-00	RECORD DRAWING		DRB	KCS
CHECKED MEA	1	5-18-00	REVISED SLOPE CALLOUTS - DETAIL C			
DATE APRIL 2000	NO.	DATE	REVISIONS		BY	APVD.

SCALE: AS SHOWN

VERIFY SCALE: 0" — 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC - SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
MANHOLE DETAILS

SHEET NO. 19 OF 20
113.05 110

FILE NAME: 113.05-110/CAD/INLET & MH_R1.DWG
FILE DATE: 11/16/2000 16:32:16 (CAH)
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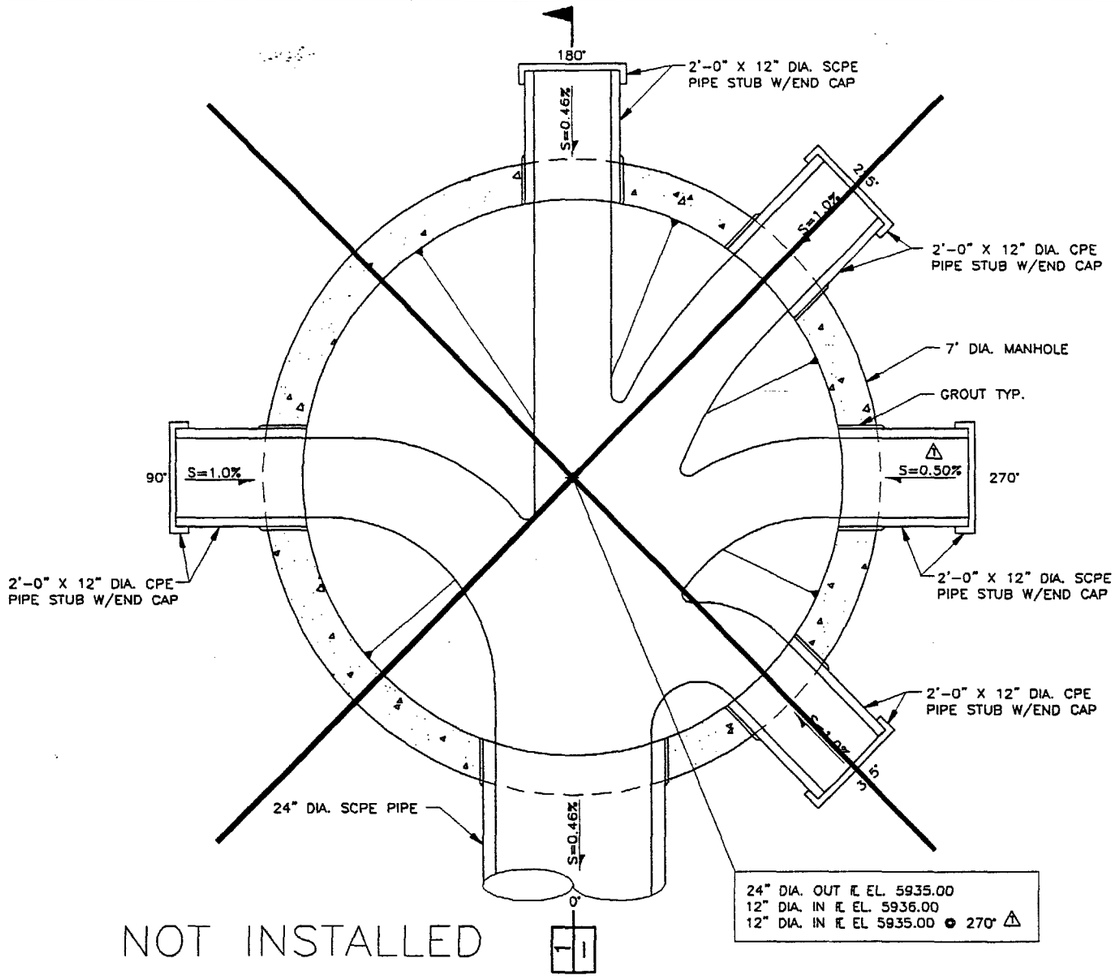
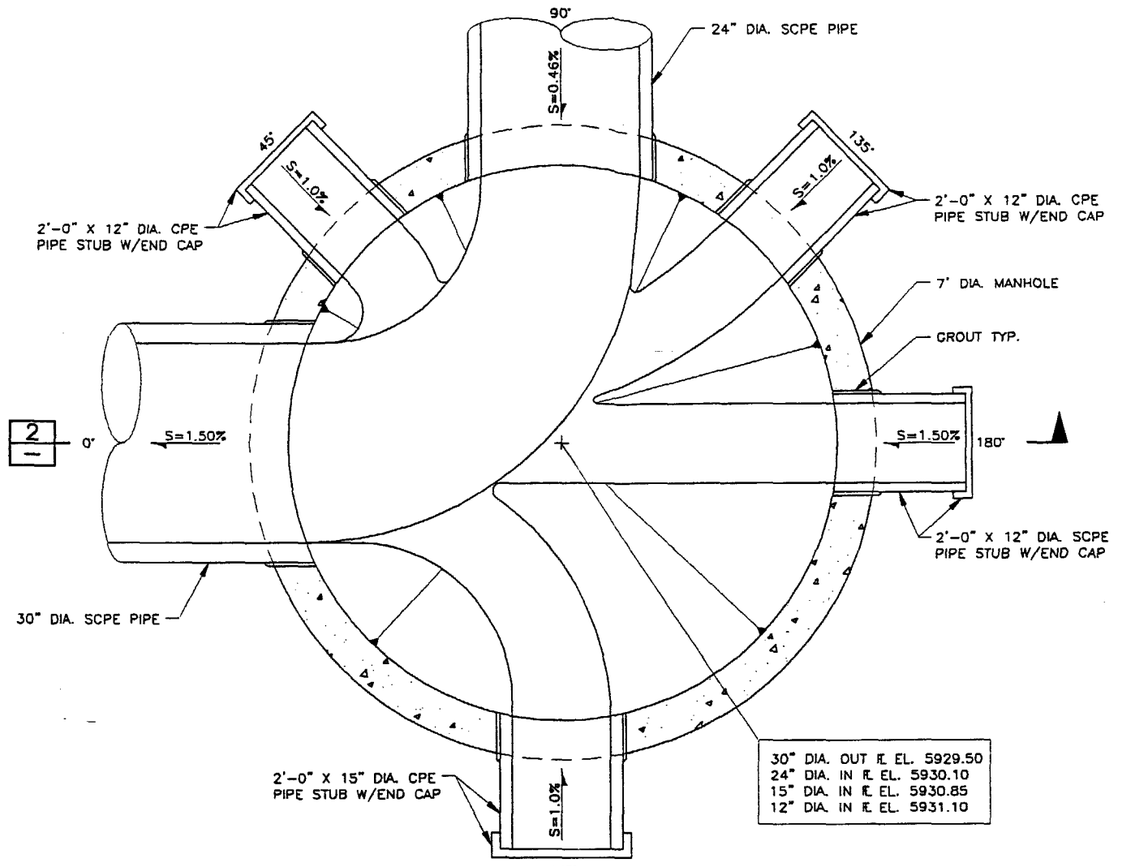
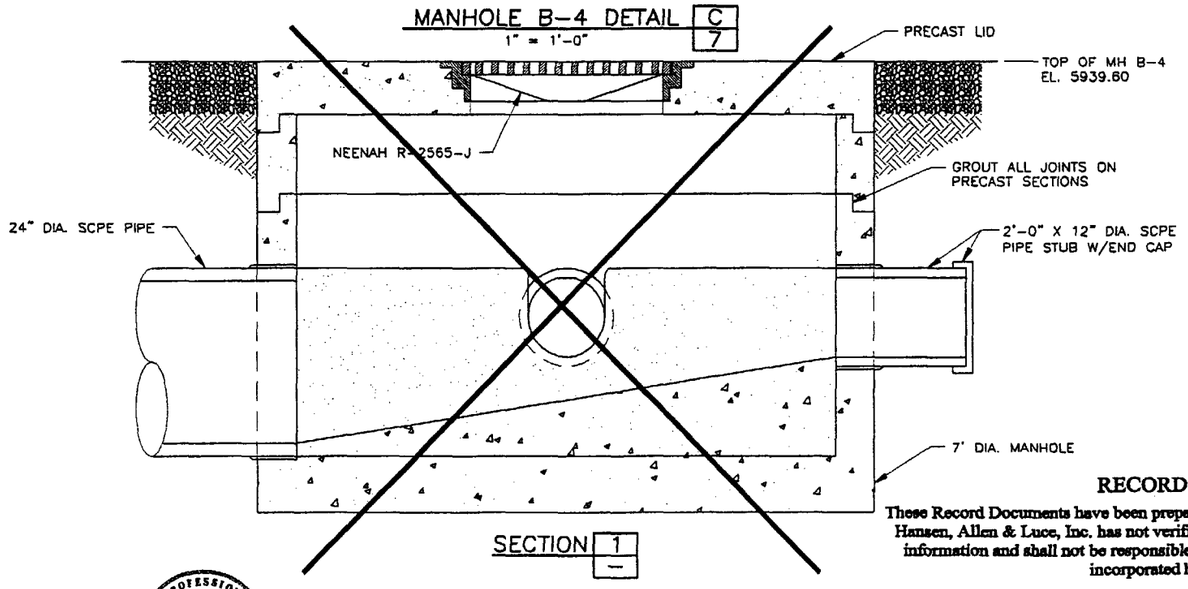
PLOT AREA:
ORIGIN: XREF. FILE NAME(S)
DVIEW:
3/99



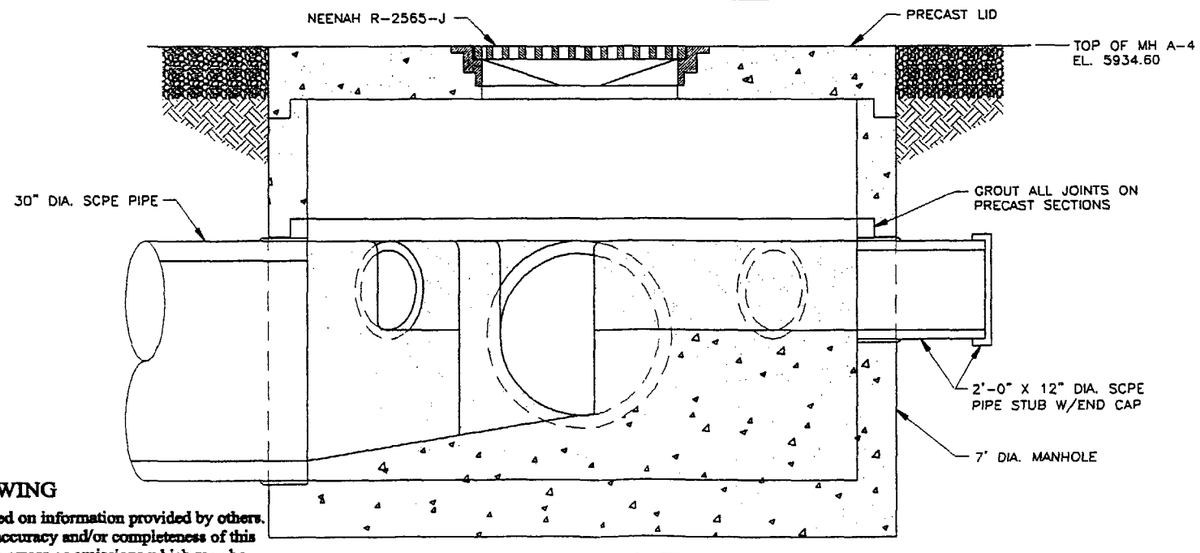


MANHOLE B-4 DETAIL C / 7
1" = 1'-0"



SECTION 1 / —

MANHOLE A-4 DETAIL E / 6
1" = 1'-0"



SECTION 2 / —

RECORD DRAWING

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HANSEN ALLEN & LUCE CONSULTING ENGINEERS

REGISTERED PROFESSIONAL ENGINEER — 11-16-00 — NO. 16914 — KENT C. ITABELL — PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS	BY	APVD.
3				
2	11-10-00	RECORD DRAWING	SDM	KCS
1	5-23-00	REVISED MANHOLE B-4 12" INLET SLOPE AND ELEVATION @ 270°	CAH	KCS

DESIGNED KCS MPW
DRAFTED LDT
CHECKED MEA
DATE APRIL 2000

SCALE: AS SHOWN

VERIFY SCALE: 0" [bar] 1" — BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH
YEAR 2000 CONSTRUCTION PHASE
MANHOLE DETAILS

SHEET NO. 20 OF 20
113.05.110

FILE NAME: 05-110/CAD/MANHOLES_R1.DWG
FILE DATE: 7/6/2000 16:35:39 (CAH)
PLOT AREA:
PLOT IN = DWG UNITS
PLOT OPTIONS
ORIGIN: DWIEW:
XREF FILE NAME(S)

APPENDIX 2

AFFIDAVIT

STATE OF ARIZONA)
) ss.
County of Maricopa)

The undersigned, being duly sworn, deposes and states as follows:

1. I am the duly elected, qualified and acting Assistant Corporate Secretary of Allied Waste Industries, Inc., a Delaware corporation and Allied Waste North America, Inc., a Delaware corporation;

2. Attached hereto as Exhibit A is a true and correct copy of the Amended and Restated Articles of Organization for ECDC Environmental, L.C. ("**ECDC LC**") filed with the State of Utah, which articles state that the sole member of ECDC LC is ECDC Holdings, Inc. ("**ECDC Holdings**");

3. ECDC Holdings is a wholly-owned subsidiary of Allied Waste North America, Inc.;

4. ECDC LC is, therefore, indirectly owned by Allied Waste Industries, Inc.; and

5. Further Affiant sayeth naught.

DATE: November 7, 2000.

Jo Lynn White

SUBSCRIBED and SWORN to before me, the undersigned notary public, on November 7, 2000.

Catherine L. Childress
Notary Public

My Commission Expires: 6/29/2004

"OFFICIAL SEAL"
Catherine Childress
Notary Public-Arizona
Maricopa County
My Commission Expires 6/29/2004

EXPEDITE

LC001147

RECEIVED
FEB 2 3 1998
Utah Div. of Corp. Comm. Co

AMENDED AND RESTATED ARTICLES OF ORGANIZATION
ECDC ENVIRONMENTAL, L.C.

Pursuant to Utah Code Ann. § 48-2b-136, these Amended and Restated Articles of Organization for ECDC Environmental, L.C., a Utah limited liability company, are hereby duly executed and filed:

1. Name. The name of the limited liability company formed by this instrument is "ECDC Environmental, L.C."

2. Duration. The latest date upon which the limited liability company is to dissolve is December 31, 2050.

3. Business Purpose. The business purpose of the Corporation is to engage in any lawful act or activity for which limited liability companies may be organized under the laws of the State of Utah.

4. Registered Office. The address of the limited liability company's registered office in Utah is 970 East Murray-Holladay Road, Suite 18, Salt Lake City, Utah 84117.

5. Registered Agent. The name and business address of the registered agent of the limited liability company in Utah are CT Corporation System, 50 West Broadway, Salt Lake City, Utah 84101.

6. Management. Management of the limited liability company is vested in its member.

7. Name and Address of Member. The name and address of the limited liability company's sole member are ECDC Holdings, Inc., 15880 N. Greenway-Hayden Loop, Suite 100, Scottsdale, Arizona 85260.

Dated as of December 19, 1997.

State of Utah
Department of Commerce
Division of Corporations and Commercial Code

I Hereby certify that the foregoing has been filed and approved on the 23 day of Feb 1998 in the office of this Division and hereby issue this Certificate thereof.

Examiner BS Date 2/24/98

Korla S. Woods
KORLA T. WOODS
Division Director

ECDC Holdings, Inc.,
a Delaware corporation

By: _____
D. W. Slager,
Executive Vice President

EXHIBIT A

PHX/CFOX/822361.1/11379.035

8054001182

APPENDIX 3

FUGITIVE DUST EMISSIONS CONTROL PLAN

DAQE 1201-95

ECDC Environmental, L.C.

February 2001

Prepared by

EARTHFAX ENGINEERING, INC.
Engineers/Scientists
Midvale, Utah

EarthFax

FUGITIVE DUST EMISSIONS CONTROL PLAN
ECDC ENVIRONMENTAL, L.C.

1. Introduction

This Fugitive Dust Emissions Control Plan has been developed by ECDC Environmental, L.C. (ECDC) to address methods of controlling on-site fugitive dust resulting from normal operations at the East Carbon landfill. It is the intent of ECDC to implement control strategies for the minimization of fugitive dust as required by Utah Code Rule R307-205 and prior negotiations between ECDC and the Utah Division of Air Quality.

2. Source Information

ECDC operates a solid waste landfill one mile west of East Carbon City, in Carbon County, Utah (UTM: 4,377,500 meters North, 548,000 meters East). This facility accepts non-hazardous solid waste as permitted by the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste. In addition to normal waste processing operations, this facility will proceed under expansion construction approximately four months per year during the expected 250-year life. The process at the facility includes acceptance and final placement of non-hazardous solid waste. During normal facility operation, many sources of fugitive dust are possible. Each of these sources are described in Section 3 of this plan. The types of materials that could emit fugitive dust at ECDC are non-hazardous waste material, imported soil material, and on-site soil materials. ECDC accepts approximately 1,000,000 tons of non-hazardous and soil waste materials per year. The waste that is accepted at ECDC is hauled to either of the two operating landfill cells for final placement. The on-site soils which are produced are used for road and landfill construction. The individuals who are responsible for the implementation and maintenance of fugitive dust control measures at the site are as follows:

Mr. Kirk Treece	Mr. Jeff Green
Site Manager	Operations Supervisor
435-888-4418	435-888-4418

3. Description of Fugitive Dust Emission Activities

ECDC will implement this Fugitive Dust Control Plan to monitor and control fugitive dust emissions from the following sources:

3.1 Railcar Rollover Facility

The Railcar Rollover Facility operates to dump the contents of railcars. The waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. The operation includes the use of a railcar rollover mechanism, railcar washout water sprayers, front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The facility is covered and enclosed on three sides with one

side open for access. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the imported waste material and loading the waste material into the waste hauling vehicles. The building that houses this activity is 110' X 126'. This fugitive dust source is identified in Attachment B.

3.2 Railcar Bottom Dump Facility

The Railcar Bottom Dump Facility operates to dump the contents of railcars. The waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. This facility is rarely used. The operation includes the use of a railcar bottom dump mechanism, front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The wastes that could be encountered at this source and could emit fugitive dust include all types of select (soils) waste. The emission of dust is possible during the dumping of the imported waste material and loading the waste material into the waste hauling vehicles. The activity site is 200 feet by 200 feet and has a maximum emission area of 0.0014 square mile (0.92 acre). This fugitive dust source is identified in Attachment A.

3.3 Paved Haul Roads

The Paved Haul Roads source consist of roadways for waste hauling vehicles, transportation vehicles, personal vehicles, and support vehicles. The operation includes the use of waste hauling vehicles, transportation vehicles, support vehicles, and a road cleaning vehicle. The average speed on the paved haul roads is 30 miles per hour. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. Such materials exist on the paved haul roads due to spillage from the waste hauling vehicles. Also, waste exist on the paved haul roads because of waste material sticking to the waste hauling vehicles tires and then falling off on the roads. The emission of fugitive dust is possible during the travel of all vehicles on the paved roads and in high wind events. The total release area of paved haul roads during this activity is 0.0361 square mile (23.08 acres). This fugitive dust source is identified in Attachment A.

3.4 Landfill Cell Haul Roads

The Landfill Cell Haul Roads source consists of roadways in the two landfill cells. The operation includes the use of waste hauling vehicles, a water truck, transportation vehicles, waste placement equipment, construction material hauling vehicles, and support vehicles. The average speed on the landfill cell haul roads is 10 miles per hour. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt

household wastes. Such materials exist on the cell haul roads due to spillage from the waste hauling vehicles and wind blown waste materials from within the landfill cells. The emission of fugitive dust is possible during the travel of all vehicles on the unpaved landfill cell haul roads and in high wind events. The total length of landfill cell haul roads in use during this activity varies from day to day but is approximately three miles with a release area of 0.0121 square mile (7.76 acres). This fugitive dust source is identified in Attachment A.

3.5 Gravel/Dirt Haul Roads

The Gravel/Dirt Haul Roads source consists of roadways on the property for construction material hauling vehicles, waste hauling vehicles, transportation vehicles, and support vehicles. The average speed on the gravel/dirt haul roads is 30 miles per hour. The operation includes the use of construction material hauling vehicles, waste hauling vehicles, a water truck, transportation vehicles, and support vehicles. The source of fugitive dust for this activity include the materials that the unpaved haul roads are constructed of, the spillage of construction and waste materials from the material hauling vehicles, and waste tracked from loading areas by the waste hauling vehicles. The emission of fugitive dust is possible during the travel of all types of vehicles on the gravel/dirt haul roads and in high wind events. The total release area length of gravel/dirt haul roads is approximately 0.0374 square mile (23.94 acres). This fugitive dust source is identified in Attachment A.

3.6 Haul Vehicle and Container Unloading

The Haul Vehicle and Container Unloading activity operates to dump the contents of waste hauling end dump vehicles and various waste containers into the landfill cells. The waste material is end-dumped from the waste hauling vehicles and the waste containers. The operation includes the use of waste and container hauling vehicles, and dust suppression water sprayers. This activity takes place at several different areas in the two landfill cells during normal operation at the facility. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the waste material from the waste hauling vehicles and the various waste containers. The size of each dumping area varies day to day but is approximately .0016 square mile (1 acre). This fugitive dust source is identified in Attachment C.

3.7 Rollover Waste Container Dumping

The Rollover Waste Container Dumping activity operates to dump the contents of large waste containers. The waste material is dumped into the landfill cell by using a large rollover mechanism. The material is then moved by dozing, placed in lifts, and compacted.

The operation includes the use of waste container hauling vehicles, rollover mechanism, track-type tractors, sheepsfoot landfill compactors, and dust suppression water sprayers. This activity takes place within the boundaries of the landfill cells. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the containers, moving, placing, and compacting the waste material. The size of each dumping area varies day to day but is approximately 0.0031 square mile (2 acres). This fugitive dust source is identified in Attachment D.

3.8 Waste Compaction

The Waste Compaction activity operates to compact the waste material within the landfill cells. The waste material is compacted by using a sheepsfoot landfill compactor. The operation includes the use of sheepsfoot landfill compactors and dust suppression water sprayers. This activity takes place within the boundaries of the landfill cell. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the compacting of the various waste materials. The size of the compaction area varies day to day but is approximately 0.0031 square mile (2 acres). This fugitive dust source is identified in Attachment E.

3.9 Soil Excavation

The Soil Excavation activity operates primarily for excavation and moisture treatment of on-site construction materials. The construction material is excavated and moisture conditioned to allow use as embankment building materials and bedding materials. The operation includes the use of construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, and support vehicles. This activity takes place on the ECDC property. The materials that could be encountered at this source and could emit fugitive dust include all types of silts, clays, and sands. The emission of dust is possible during the excavation and loading activities. The size of each excavation area is approximately 0.0313 square mile (20 acres). This fugitive dust source is identified in Attachment A.

3.10 Solidification Facility

The Solidification Facility operates to solidify liquid waste. The liquid waste material is mixed with coal ash. The mixed waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. The operation includes the use of a front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The wastes that could be encountered at this source and could emit fugitive dust include coal ash material from local power plants. The emission of dust is possible during

the dumping of the imported coal ash material, mixing of liquid waste and coal ash material, and loading the mixed waste material into the waste hauling vehicles. The activity is 70' X 100' with an area of 0.0003 square mile (0.16 acre). This fugitive dust source is identified in Attachment F.

3.11 Soil Screening and Stockpiling

The Soil Screening and Stockpiling activity operates to provide a soil cover for imported waste materials and cover for the geomembrane liner. The operation includes the use of cover material hauling vehicles, track-type tractors, track-type excavators, dust suppression water sprayers, a screen mechanism, and support vehicles. These activities take place within the landfill cell boundaries. The materials that could be encountered at this source and could emit fugitive dust include all types of silts, clays, and sands. The emission of dust is possible during screening, stockpiling, and loading activities. The size of operation area varies but is approximately 0.0078 square mile (5 acre). This fugitive dust source is identified in Attachment A.

3.12 Landfill Cell #7

Landfill Cell #7 operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0750 square mile (48 acres). This fugitive dust source is identified in Attachment A.

3.13 Landfill Cell #10

Landfill Cell #10 operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0211 square mile (13.5 acres). This fugitive dust source is identified in Attachment A.

3.14 Landfill Super Cell 1-A

Landfill Super Cell 1-A operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0188 square mile (12 acres). This fugitive dust source is identified in Attachment A.

4. Description of Fugitive Dust Emission Controls

Opacity readings will be taken randomly to ensure compliance with this plan. The results of the readings will be recorded on a log and will be available for review by representatives of the Utah Division of Air Quality. Refer to Attachment G for an example of the log sheet.

Three different levels of control are proposed for each source. Level 1 will be implemented at an estimated opacity reading of 0 - 5%. Level 2 will be implemented at an estimated opacity reading of 5 - 15%. Level 3 will be implemented at an estimated opacity reading of 15%. ECDC will apply the levels of control for each of the following identified on-site fugitive dust sources:

4.1 Railcar Rollover Facility

Level 1 — No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 — Waste material will be partially wetted with the dust suppression water sprayers during dumping operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders.

Level 3 — Material will be wetted with the dust suppression water sprayers prior to and during dumping operations. Additional water spray will be applied to the waste material after dumping as determined by the facility operator. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.2 Railcar Bottom Dump Facility

Level 1 — No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 — Waste material will be partially wetted with the dust suppression water sprayers during dumping operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders.

Level 3 — Material will be wetted with the dust suppression water sprayers prior to and during dumping operations. Additional water spray will be applied to the waste material after dumping as determined by the facility operator. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.3 Paved Haul Roads

Level 1 — No action will be required due to the conditions of the haul roads or operating weather conditions. All paved haul roads are washed and swept routinely as permitted by weather conditions.

Level 2 — All haul roads will be sprayed with water or washed and swept as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions. The operation of the water truck and sweeper vehicle will be directed by the Operations Supervisor.

Level 3 — The application rate will be increased as determined by the Site manager or his representative to a level that will minimize fugitive dust emissions without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.4 Landfill Cell Haul Roads

Level 1 No action will be required due to the condition of the haul roads or operating weather conditions. All roads within the landfill cells are routinely sprayed with water for fugitive dust control during normal operations as permitted by weather conditions. The operation of the water truck will be directed by the Operations Supervisor.

Level 2 All haul roads will be sprayed with water as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions by the Operations Supervisor.

Level 3 The application rate of water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emission without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.5 Construction Haul Roads

Level 1 No action will be required due to the condition of the haul roads or operating weather conditions. All haul roads are routinely sprayed with water for fugitive dust control during normal operations as permitted by weather conditions. The operation of the water truck will be directed by the Operations Supervisor.

Level 2 All haul roads will be sprayed with water as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions by the Operations Supervisor.

Level 3 The application rate of water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emission without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.6 Haul Vehicle and Container Unloading

Level 1 No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 Imported waste materials will be treated with dust suppression water sprayers during unloading operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the unloading activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.7 Rollover Waste Container Dumping

Level 1 No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 Imported waste materials will be treated with dust suppression water sprayers during dumping operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the dumping activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.8 Waste Compaction

Level 1 No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 Imported waste materials will be treated with dust suppression water sprayers during compaction operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor. Also, waste placement and compaction methods may be altered by the operators to minimize fugitive dust emissions.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. Waste placement and compaction methods may be altered by the operators as directed by the Operations Supervisor, Site Manager or his representative to minimize fugitive dust emissions without compromising operator safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the waste compaction activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.9 Soil Excavation

Level 1 No action will be required due to the condition of the excavated material or operating weather conditions.

Level 2 Excavated materials will be treated with dust suppression water sprayers during excavating and loading operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the excavating and loading activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.10 Solidification Facility

Level 1 No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 Ash material will be partially wetted with the dust suppression water sprayers during dumping and mixing operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders. The water application rate will be determined by the Operations Supervisor.

Level 3 Ash material will be wetted with the dust suppression water sprayers prior to and during dumping and mixing operations. The application rate of the water will be determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. Additional water spray will be applied to the waste material after dumping and mixing as determined by the facility operator, Operations Supervisor, Site Manager or his representative. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the solidification activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. The area and facility is cleaned after it has be used. Therefore, no action will be required at those times.

4.11 Soil Screening and Stockpiling

Level 1 — No action will be required due to the condition of the screened material or operating weather conditions.

Level 2 — Screened materials will be treated with dust suppression water sprayers during screening and stockpiling operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the screening and stockpiling activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.12 Landfill Cell #7

Level 1 — No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 — Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

4.13 Landfill Cell #10

Level 1 No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

4.14 Landfill Super Cell 1-A

Level 1 No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

Attachment A

LEGEND

- PAVED HAUL ROAD
- GRAVEL/DIRT ROAD
- GRAVEL/DIRT ROAD
- RAIL ROAD LINE
- SECTION LINE
- DRAINAGE CHANNEL
- ECDC PROPERTY LINE

Section 7

Section 8

Section 9

Section 10

Section 15

Section 16

Section 17

Section 18

123

MAIN OFFICE

CONTAINER HEAT SHED

SOLIDIFICATION FACILITY

RAILCAR ROLLOVER FACILITY

SOIL EXCAVATION AREA

BOTTOM DUMP FACILITY

Union Pacific Railroad

SCALES

LANDFILL SUPER CELL 1-A

Haul roads contained within Landfill Super Cell 1-A (Landfill Cell Haul Roads) vary daily in size, length, and location.

LANDFILL CELL #7

Haul roads contained within Landfill #7 (Landfill Cell Haul Roads) vary daily in size, length, and location.

SCALES

STORAGE LOT

ROCK PIT & SOIL EXCAVATION

Springs

East Spring

LANDFILL CELL #10

Haul roads contained within Landfill #10 (Landfill Cell Haul Roads) vary daily in size, length, and location.

7005000 7002500 7000000 6997500 6995000 6992500

1917500 1920000 1922500 1925000 1927500 1930000 1932500 1935000 1937500

SCALE - 1"=500'

REGISTERED PROFESSIONAL ENGINEER
GENE H. PLAYER
No. 186270
STATE OF UTAH

REVISION	
DATE	BY

EarthFax Engineering, Inc.
Engineers/Scientists

FUGITIVE DUST SOURCES
SURFACE FACILITIES AND BOUNDARY MAP

SHEET 1 OF 1

ECDC ENVIRONMENTAL, L.C.

Attachment B

RAILCAR ROLLOVER FACILITY

Attachment C

HAUL VEHICLE AND CONTAINER UNLOADING

Attachment D

ECDC Environmental, L.C.
Carbon County, Utah

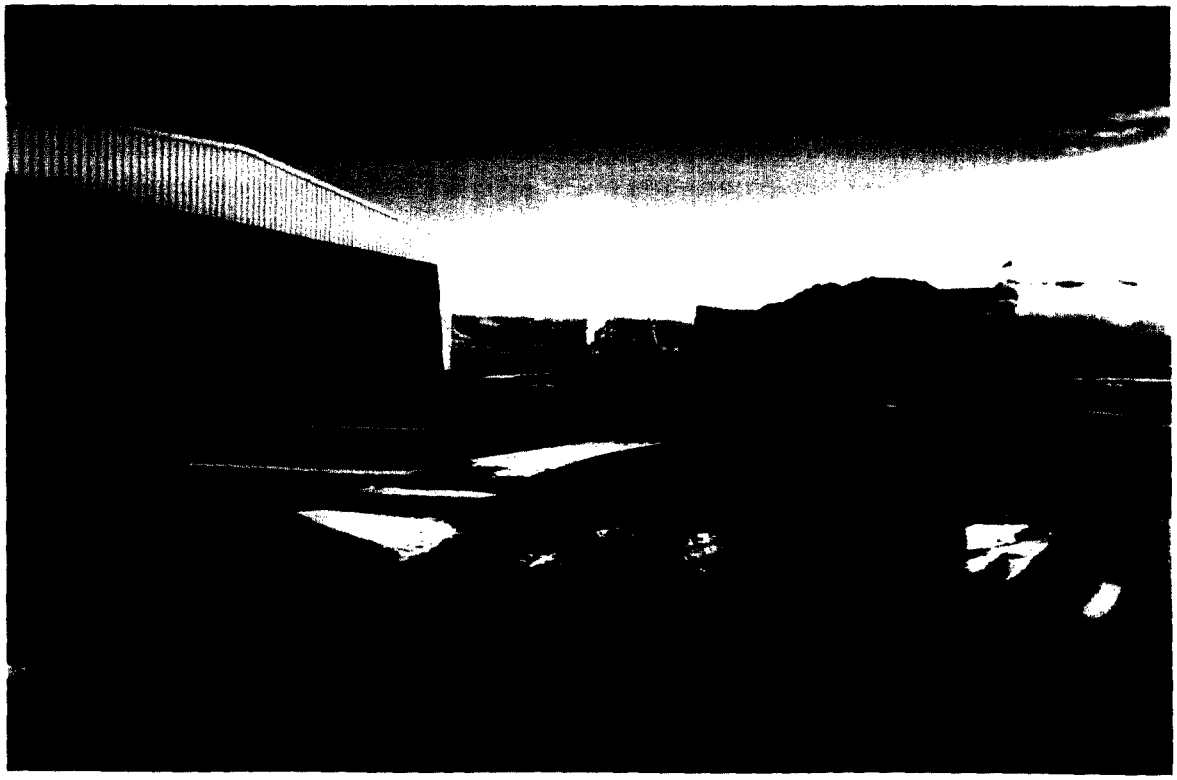
ROLLOVER WASTE CONTAINER DUMPING

Attachment E

WASTE COMPACTION

Attachment F

SOLIDIFICATION FACILITY



Attachment G

ECDC ENVIRONMENTAL, L.C.
EAST CARBON, UTAH
RANDOM OPACITY READINGS

DATE	TIME	OPACITY	LOCATION (SOURCE)	WIND SPEED	WIND DIRECTION	TEMP	HUMIDITY	BAROMETRIC PRESSURE

APPENDIX 4

QUARTERLY INSPECTION LOG
ECDC Environmental, L.C.

Area of Inspection	OK	Needs Repair	Comments
Wash Water Sump			
Solidification Facility			
Run-on/Run-off Drainage for Cell #7			
Run-on/Run-off Drainage for Cell #10			
Run-on/Run-off Drainage for Super Cell 1-A			
Leachate Collection System for Cell #7			
Leachate Collection System for Cell #10			
Leachate Collection System for Super Cell 1-A			
Perimeter Fencing and Access Gates			
Landfill Cell #7			
Landfill Cell #10			
Landfill Super Cell 1-A			
Date:	**Inspector:**		

APPENDIX 5

ECDC
Fire Prevention and Control Plan

FIRE PREVENTION AND CONTROL PLAN

ECDC Environmental, Inc.
1111 W. Highway 123
East Carbon, Ut

February 2000

ECDC Environmental
Fire Prevention and Control Plan

1.0 Introduction

Because of the nature of the material (garbage), fires will occasionally occur at landfills. This may be caused by chemical reaction, sparks from the equipment or from burning material being accidentally brought into the landfill.

If any procedure or stipulation in this procedure is inconsistent with a revision to applicable state or federal regulations, permit and regulatory revisions will take precedent.

2.0 Purpose

The purpose of this plan is to provide information to landfill employees in the event that a fire occurs at or near the landfill. Specifically, the plan establishes who is responsible for various portions of the fire control procedure.

3.0 Definitions

Fire Control Plan: The written plan which establishes the standard procedures for fighting fires.

Shop Fire: Any fire which originates in and is limited to the shop area.

Rotary Fire: Any fire which originates in and is limited to the rotary area.

Solidifer Fire: Any fire which originates in and is limited to the solidifer area.

Heatshed Fire: Any fire which originates in and is limited to the heatshed area.

Office Fire: Any fire which originates in and is limited to the office area.

Fuel Tank Fire: Any fire which originates in or spreads to the fuel tank area.

Vehicle Fire: Any fire which originates in or spreads to a vehicle.

On-site Fire: Any fire that occurs within the limits of the landfill property.

Off-site Fire: Any fire that occurs within or spreads to the land surrounding the landfill.

4.0 General

The ECDC landfill will be operated in a manner which will minimize the potential for landfill fires. This will include thoroughly compacting all refuse, applying daily cover or ADC each day. At he completion of the week all MSW will be covered with a minimum of 6" of soil.

The ECDC landfill has developed the following fire control plan to be used in the event of a landfill fire.

General Instructions

- Do not fight a fire alone!
- Contact other nearby employees.
- Summon the water truck (s) and bulldozer (s).
- Notify the site manager immediately. Follow his instructions
- Do not place yourself or others in danger while fighting a fire.
- DO NOT PANIC!

Shop Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, remove all vehicles and flammable materials from the shop.
- Turn off the main electrical breaker to the shop.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not enter any structure without the approval of the fire department.
- Be careful not to wash fuel off-site. It could spread the fire.
- Fight fires in buildings with water from water truck and/or pressurized water supply system.
- Clear the area if there is any danger of explosion.

Rotary Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, remove all vehicles and flammable materials from the rotary.
- Turn off the main electrical breaker to the rotary.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not enter any structure without the approval of the fire department.
- Be careful not to wash fuel off-site. It could spread the fire.
- Fight fires in buildings with water from water truck and/or pressurized water supply system.
- Clear the area if there is any danger of explosion

Solidifer Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, remove all vehicles and flammable materials from the solidifer.
- Turn off the main electrical breaker to the solidifer.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not enter any structure without the approval of the fire department.
- Be careful not to wash fuel off-site. It could spread the fire.
- Fight fires in buildings with water from water truck and/or pressurized water supply system.
- Clear the area if there is any danger of explosion

Heatshed Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, remove all vehicles and flammable materials from the heatshed.
- Turn off the main electrical breaker to the heatshed.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not enter any structure without the approval of the fire department.
- Be careful not to wash fuel off-site. It could spread the fire.
- Fight fires in buildings with water from water truck and/or pressurized water supply system.
- Clear the area if there is any danger of explosion

Office Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- Turn off the main electrical breaker to the office.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not enter any structure without the approval of the fire department
- Fight fires in buildings with water from water truck and/or pressurized water supply system.
- Clear the area if there is any danger of explosion

Fuel Tank Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- Turn off the main electrical breaker to the tanks.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not approach any fuel fire without the approval of the fire department.
- Do not enter any structure without the approval of the fire department.
- From a safe distance, spray fuel tanks exposed to fire with water. This helps keep them cool.
- Be careful not to wash fuel off-site. It could spread the fire.
- Erect soil berms as needed to contain spilled fuel.
- Clear the area if there is any danger of explosion.

Vehicle Fire

- Stay upwind of fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, tow the vehicle to a secure location so that the fire does not spread.
- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not approach any fuel fire without the approval of the fire department.
- From a safe distance, spray fuel, hydraulic or oil tanks which are exposed to fire with water. This helps to keep them cool.
- Be careful not to wash fuel off-site. It could spread the fire.
- Clear the area if there is any danger of explosion.

On-Site Fire

- Stay upwind of the fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If it can be done safely, use the dozer(s) to construct a fire break around the fire.
- Never drive a tractor onto burning material.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not approach any fuel fire without the approval of the fire department.
- Clear the area if there is any danger of explosion.
- Notify the surrounding land owners if there is a chance that the fire could spread beyond the landfill.

Off-Site Fire

- Stay upwind of the fire.
- Make sure that all unauthorized persons are evacuated from the area.
- If possible, remove all vehicles and flammable materials from the area.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Clear the area if there is any danger of explosion.
- Avoid causing unnecessary damage to crops or fences when fighting the fire.

Building or Office Guidelines

- Use type ABC fire extinguishers to fight electrical fires.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Make sure someone calls the Fire Department immediately. Tell them the location and type of fire and whether it looks like it will spread out of the immediate area.

Landfill Fire Guidelines

- Redirect or stop all incoming traffic going to the work face.
- D-8(dozer) or 836 will isolate fire away from working face.
- Haul trucks will respond by bringing all dirt loads to the fire until out.
- Leave alone for 12 hours or until you are positive fire is out.

Equipment Fire Guidelines

- If possible, move the machine a short distance (out of garbage) to level ground.
- Shut off machine and all master switches and fuel switches before leaving machine.
- Attempt to put out with all available fire extinguishers, if unable notify 911 or Fire Department.

General Fire-Fighting Guidelines

- If two or more water trucks are bing used, try to use them in shifts so that at least one water truck is at the fire at all times.
- Do not overuse water. Remember, most landfill fires can be controlled with a relatively small amount of water. In most cases, soil is more effective than water.
- Don't waste time trying to fight a large fire with a fire extinguisher.
- Do not approach any fire with a tractor unless a water truck is close by for backup.
- Never risk personal injury or death attempting to save a machine or building.
- SAFETY FIRST!

ECDC
Environmental Emergency Evacuation Plan

ECDC Environmental Emergency Evacuation Plan

Emergency Coordinator: Jeff Green
Emergency Coordinator Work Phone Number: 435-888-4418 ext 26
Home 435-472-5102
Cell 801-573-7533

Alternate Emergency Coordinator: Grant Laws
Alternate Coordinator Work Phone Number: 435-888-4418 ext 29
Home 435-637-1529
Cell 801-573-7504

Plan Prepared By: Jeff Green

Date: 8-17-00

ECDC Environmental, LC.
1111 West Highway 123
East Carbon, Ut
84520

Section I: Purpose and Objectives

Potential emergencies at **ECDC Environmental,** such as fire, explosion, spill, chemical releases and all other emergencies require employees to evacuate buildings, or certain areas. An Emergency Evacuation Plan (EEP) and adequate occupant familiarity with a building or area minimize threats to life and property. This plan applies to all emergencies where employees may need to evacuate for personal safety.

This EEP is intended to communicate the policies and procedures for employees to follow in an emergency situation. This written plan should be made available, upon request, to employees and their designated representatives by the Emergency Coordinator for the site.

Under this plan, employees will be informed of:

The plan's purpose,
Preferred means of reporting fires and other emergencies,
Emergency escape procedures and route assignments,
Procedures to be followed by employees who remain to control critical plant operations before they evacuate,
Procedures to account for all employees after emergency evacuation has been completed,
Rescue and medical duties for those employees who perform them.

Jeff Green is the Emergency Coordinator for this facility and has overall responsibility for the preparation and implementation of this plan.

Grant Laws is the Alternate Emergency Coordinator.

The Emergency Coordinator will review and update the plan as necessary. Copies of this plan will be maintained on the **Field Office Bulletin Board.**

Section II: General Guidelines

The following guidelines apply to this EEP:

1. All personnel must be trained in safe evacuation procedures. Refresher training is required whenever the employee's responsibilities or designated actions under the plan change, and whenever the plan itself is changed.

2. The training may include use of floor plans and workplace maps which clearly show the emergency escape routes included in the EEP. Color-coding aids employees in determining their route assignments.

3. No employee is permitted to re-enter the building or area until advised by the Emergency Coordinator , Assistant Coordinator or the Fire Department.

Section III: Responsibilities of Emergency Coordinator and Safety Monitors

The Emergency Coordinator is responsible for:

Obtaining and posting floorplans and route evacuation maps.
Overseeing the development, communication, implementation and maintenance of the overall EEP. Ensuring the training of building occupants, Safety Monitors, and Critical Operations Personnel, and notifying all personnel of changes to the plan. Maintaining up to date lists of building occupants, critical operations personnel, and any other personnel with assigned duties under this plan. Lists are included in Appendix I. In the event of a fire or other emergency, relaying applicable information to emergency personnel, occupants and Safety Monitors. Establishing Designated Meeting Sites for evacuees.

The Safety Monitors are responsible for:

Familiarizing personnel with emergency procedures. Acting as liaison between management and their work area. Ensuring that occupants have vacated the premise in the event of an evacuation, and for checking assigned areas. Knowing where their Designated Meeting Site is and for communicating this information to occupants. Having Knowledge of personnel in their area of coverage, so a head count can be made at their Designated Meeting Site. Ensuring that disabled persons and visitors are assisted in evacuating the building. Evaluating and reporting problems to the Emergency Coordinator after an emergency event. Posting the "Area Evacuation Plan" (Appendix III) in their work areas, communicating plan to occupants, and updating the plan annually.

Section IV: Alerting or Signaling Building Occupants in Case of Fire or Other Emergency

In case of a building/office fire, employees should immediately telephone the local Fire Department at 911.

Persons discovering a **fire, smoky condition, chemical reaction, or explosion** should notify the Emergency Coordinator and if needed the local Fire Department. Any pertinent fire or rescue information should be conveyed to the Fire Department. All emergency telephone numbers are listed on Appendix IV.

To report all other emergencies, employees should contact a supervisor.

Section V: Evacuation Procedures for the Landfill

When an emergency occurs, all personnel should ensure that nearby personnel are aware of the emergency and quickly shutdown operating equipment (e.g., intermodal trucks, dozers, loaders).

All occupants should proceed to their Designated Meeting Site and await further instructions from their Safety Monitor.

All personnel should know where primary and alternate exits are located, and be familiar with the various evacuation routes available. Pans with escape routes, alternate escape routes, exit locations and Designated Meeting Sites are located in Appendix II and are posted in the Field Office. Cell personnel will notify the Main Office and close all traffic into the facility. No unauthorized personnel shall enter the facility while an emergency or evacuation is in progress.

Notes and Precautions:

Small fires can be extinguished **only if you are trained to use a fire extinguisher.** However, an immediate readiness to evacuate is essential. **All fires, even those that have been extinguished, must be reported to Management or the Emergency Coordinator.**

Section VI: Disabled Occupants

If a disabled occupant is unable to exit the building unassisted, the Safety Monitor must notify the emergency response personnel of the person's location. Transporting of disabled individuals up or down stairwells should be avoided until emergency response personnel have arrived. Unless imminent life-threatening conditions exist in the immediate area occupied by a non-ambulatory or disabled person, relocation of the individual should be limited to a safe area on the same floor, in close proximity to an evacuation stairwell.

Section VII: Critical Operations Shutdown

Critical Operation Shutdown: Critical operations (e.g, electrical and gas), including equipment that must be shut off and persons designated to complete these actions are identified below. Procedures for rapid shutdown should be predetermined for life safety and loss control purposes, as well as ensuring complete evacuations in a timely manner.

The Critical Operations Shutdown procedure to be followed by those employees who have been assigned to care for essential area operations include:

Operation	Primary	Secondary
Intermodal & Heatshed	Rex McCourt	Walt Eyre
Cell Operations	Bill Gentry	Wayne Anderson
Rotary Operations	Gilbert Palacios	Darrell Porter
Shop & Washbay	Grant Laws	Jay Keel & Dave Maggio
Field Office	Kirk Treece	Darin Olson
Solidifer	Cory Bigelow	Rick Albert
Main Office	Tina Vogrinec	Kristy Candelaria

Persons involved in the Critical Operations Shutdown listed above shall be notified by management of this responsibility in advance, identified in the EEP, and will be appropriately trained for the particular situation.

Section VIII: Accountability Procedures for Emergency Evacuation

Designated Meeting Sites: Groups working together on or in the same area should meet outside the building in the prearranged Designated Meeting Site. A list of the primary and alternate Designated Meeting Sites are listed on the floor plans in the Appendix II.

Safety Monitors are designated by the Emergency Coordinator and will conduct head counts once evacuation has been completed. There is at least one Safety Monitor per twenty employees to provide adequate guidance and instruction at the time of an emergency.

The employees selected as Safety Monitors are to be trained in the complete workplace layout and the various primary and alternate escape routes from the workplace. All trained personnel are made aware of employees with disabilities that may need extra assistance, and of hazardous areas to be avoided during emergencies. Before leaving, the Safety Monitors are to check the area and other enclosed spaces in the workplace for other employees who may be trapped or otherwise unable to evacuate the area, and convey this information to emergency personnel.

Once each evacuated group of employees have reached their Designated Meeting Site, each Safety Monitor:

Assembles his/her group in the Designated Meeting Site. Takes head count of his or her group. Assumes role of department contact to answer questions. Reports status to Emergency Coordinator or Alternate Coordinator. Instructs personnel to remain at Designated Meeting Site until further notice.

Section IX: Rescue and Medical Duties

The Fire Department, East Carbon Police or Emergency Medical Technicians (EMT) will conduct all rescue and medical duties.

Do not move injured personnel. Keep the person lying down, covered and warm.

Section X: Resource and Responsibilities Lists

EEP Organization: The lists in Appendix I include the names of employees, managers, staff or other personnel and their job titles, job positions and relative EEP collateral duties. The purposes served by the lists are:

To tell employees who to see for additional information on the EEP.

To provide emergency response personnel with a list of department personnel which may be needed in order to provide additional information about the fire, a chemical reaction, a hazardous waste location, a shipment of chemicals, etc.

The lists should be updated by the Emergency Coordinator on an as-needed basis.

Section XI: Training and Communications

Each employee should know that evacuation is necessary and what his/her role is in carrying out the plan. Employees should also know what is expected of them during an emergency to assure their safety.

A method of training facility personnel in the requirements of the emergency evacuation plan is to give all employees a thorough briefing and demonstration. The department will have all managers and supervisors present this plan to their staffs in staff meetings. Annual practice drills are to be implemented and documented by the Emergency Coordinator.

Appendix 1

Emergency Evacuation Plan Responsibilities List

Title	Name	Location	Home Telephone	WorkTelephone
Emergency Coordinator	Jeff Green	Field Office	472-5102 Cell 801-573-7533	888-4418 ext 26
Alternate Emergency Coordinator	Grant Laws	Field Office	637-1529 Cell 801-573-1529	888-4418 ext 29
Safety Monitors	Bill Gentry, Gilbert Palacios, Rex MCcourt, Grant Laws, Stanley Hersh, Darin Olson, Todd McFarland, Tina Volgrinec.	Intermodal, Shop, Rotary, Litter Control, 3rd Party Cont., ITS, Main Office		888-4418
Alternate Safety Monitors	Wayne Anderson, Darrell Porter, Walt Eyre, Jay Keel, Joe Manley, Brian Russel, Kristy Candelaria	Intermodal, Shop, Rotary, Litter Control, 3rd Party Cont., ITS, Main Office		888-4418

Personnel Assigned to Critical Operations Responsibilities

Location	Required Shutdown	Name	Job Position	Work Area
Intermodal Scalehouse Heatshed	Shutdown Electrical power, Gas	Rex McCourt Walt Eyre	Lead Intermodal Driver Intermodal Driver	Intermodal Grade, Cell
Shop Washbay	Shutdown Electrical power, Gas	Grant Laws Jay Keel Dave Maggio	Shop Manager Mechanic Washbay Laborer	Shop Shop Washbay
Rotary	Shutdown Electrical power, Gas	Gilbert Palacios Darrell Porter	Rotary Leadman 773 Driver	Rotary Rotary
Field Office	Shutdown Electrical power, Gas	Kirk Treece Darin Olson	General Manager Facility Engineer	Field Office Field Office
Main Office	Shutdown Electrical power, Gas	Tina Vogrinec Kristy Candelaria	Controller Job Cost Analyist	Main Office Main Office

Appendix III

ECDC Environmental Area Evacuation Plan Intermodal

Department/Area: Intermodal

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees should evacuate to the Field Office parking lot between the shop and field office depending on the smoke, fumes or fire.

Secondary Evacuation Route:
Best established route.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:

Rex McCourt

Alternate Safety Monitor:

Walt Eyre

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

ECDC Environmental Area Evacuation Plan Field Office

Department/Area: Field Office

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees evacuate out the Northeast door of the field office to the parking lot between shop and field office

Secondary Evacuation Route:
Employees should evacuate out the Northwest door of the field office to the parking lot between the shop and field office.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:
Kirk Treece

Safety Monitor:
Darin Olson

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

ECDC Environmental Area Evacuation Plan Shop

Department/Area: Shop

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees should turn off all equipment and power down hand tools and evacuate out the Southwest door of the shop.

Secondary Evacuation Route:
Employees should turn off all equipment and power down hand tools and evacuate out the Southeast door of the shop.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:
Grant Laws

Alternate Safety Monitor:
Jay Keel

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

ECDC Environmental Area Evacuation Plan Cell 7

Department/Area: Cell 7

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees should turn off all equipment and meet at the van for transport out of cell. Then proceed to the Field Office parking lot between the ship and Field Office.

Secondary Evacuation Route:
If the main haul road is blocked, employees should then evacuate on foot away from fire, smoke or fumes. They should evacuate in a safe manner down the embankment towards the field office parking lot, using gates provided on the Northeast and Northwest sides of the slope.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:
Bill Gentry

Alternate Safety Monitor:
Wayne Anderson

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

ECDC Environmental Area Evacuation Plan Rotary

Department/Area: Rotary

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees should evacuate the door on the Southwest side of the Rotary building. Employees should then proceed to the parking lot between Field Office and shop.

Secondary Evacuation Route:
If Primary Evacuation route is blocked, employees should then exit rotary through back door, or through roll up door. Employees should then move to the North side of the rotary over the railroad tracks to the center of the parking lot between Fild Office and shop.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:
Gilbert Palacios

Alternate Safety Monitor:
Darrell Porter

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

ECDC Environmental Area Evacuation Plan Main Office

Department/Area: Main Office

Date: 8-17-00

Completed By: Jeff W. Green

Each work area should establish, in advance, a primary and a secondary evacuation route (in case the primary route is blocked) in the event of fire, flood, blackout, earthquake, etc.

Primary Evacuation Route:
Employees should evacuate out the West door of the main office. Employees should then proceed to the North parking lot.

Secondary Evacuation Route:
Employees should evacuate out the East door of the main office. Employees should then proceed to the North parking lot.

Establish an outdoor meeting place where evacuees, out of harm's way, can account for all staff and visitors. A short distance from the building.

Designated Meeting Site:
Between the Shop and Field Office, in the Parking Lot.

Designate a position/alternate who will take charge in the event of fire or another emergency.

Safety Monitor:
Tina Volgrinec

Alternate Safety Monitor:
Kristy Candelaria

Check list of Responsibilities for the Safety Monitor:

Ensure that R.A.C.E. is followed if smoke or flame are discovered in your work area: rescue, alarm, close all doors, evacuate. "Sweep" every room in your area to make sure that everyone has evacuated. Ensure that people follow the appropriate evacuation route, and that they are directed to a safe, post-evacuation meeting place. Account for all staff and visitors at the Designated Meeting Site. Identify yourself as the Safety Monitor for your work area to the Emergency Coordinator and emergency responders. Notify Emergency Coordinator and emergency responders of any personnel who remain trapped in the building, are performing critical operations shutdown, or are unaccounted for.

Appendix IV

OSHA REGULATIONS

OSHA 29 CFR 1910.38 - Employee emergency plans and fire prevention plans

(a) Emergency action plan-- (1) Scope and application. This paragraph (a) appliesto all emergency action plans required by a particular OSHA standard. The emergency action plan shall be in writing (except as provided in the last sentence of paragraph (a)(5)(iii) of this section) and shall cover those designated actions employers and employees must take to ensure employee safety from fire and other emergencies.

(a)(2) Elements. The following elements, at a minimum, shall be included in the plan:

(a)(2)(i) Emergency escape procedures and emergency escape route assignments;

(a)(2)(ii) Procedures to be followed by employees who remain to operate critical plant operations before they evacuate;

(a)(2)(iii) Procedures to account for all employees after emergency evacuation has been completed;

(a)(2)(iv) Rescue and medical duties for those employees who are to perform them;

(a)(2)(v) The preferred means of reporting fires and other emergencies; and

(a)(2)(vi) Names or regular job titles of persons or departments who can be contacted for further information or explanation of duties under the plan.

(a)(3) Alarm system. (i) The employer shall establish an employee alarm system which complies with 1910.165.

(a)(3)(ii) If the employee alarm system is used for alerting fire brigade members, or for other purposes, a distinctive signal for each purpose shall be used.

(a)(4) Evacuation. The employer shall establish in the emergency action plan the types of evacuation to be used in emergency circumstances.

(a)(5) Training. (i) Before implementing the emergency action plan, the employer shall designate and train a sufficient number of persons to assist in the safe and orderly emergency evacuation of employees.

(a)(5)(ii) The employer shall review the plan with each employee covered by the plan at the following times:

(a)(5)(ii)(A) Initially when the plan is developed,

(a)(5)(ii)(B) Whenever the employee's responsibilities or designated actions under the plan change, and

(a)(5)(ii)(C) Whenever the plan is changed.

(a)(5)(iii) The employer shall review with each employee upon initial assignment those

parts of the plan which the employee must know to protect the employee in the event of an emergency. The written plan shall be kept at the workplace and made available for employee review. For those employers with 10 or fewer employees the plan may be communicated orally to employees and the employer need not maintain a written plan.

(b) Fire prevention plan–(1) Scope and application. This paragraph (b) applies to all fire prevention plans required by a particular OSHA standard. The fire prevention plan shall be in writing, except as provided in the last sentence of paragraph (b)(4)(ii) of this section.

(b)(2) Elements. The following elements, at a minimum, shall be included in the fire prevention plan:

(b)(2)(i) A list of the major workplace fire hazards and their proper handling and storage procedures, potential ignition sources (such as welding, smoking and others) and their control procedures, and the type of fire protection equipment or systems which can control a fire involving them;

(b)(2)(ii) Names or regular job titles of those personnel responsible for maintenance of equipment and systems installed to prevent or control ignitions or fires; and

(b)(2)(iii) Names or regular job titles of those personnel responsible for control of fuel source hazards.

(b)(3) Housekeeping. The employer shall control accumulations of flammable and combustible waste materials and residues so that they do not contribute to a fire emergency. The housekeeping procedures shall be included in the written fire prevention plan.

(b)(4) Training. (i) The employer shall apprise employees of the fire hazards of the materials and processes to which they are exposed.

(b)(4)(ii) The employer shall review with each employee upon initial assignm ent those parts of the fire prevention plan which the employee must know to protect the employee in the event of an emergency. The written plan shall be kept in the workplace and made available for employee review. For those employers with 10 or fewer employees, the plan may be communicated orally to employees and the employer need not maintain a written plan.

(b)(5) Maintenance. The employer shall regularly and properly maintain, according to established procedures, equipment and systems installed on heat producing equipment to prevent accidental ignition of combustible materials. The maintenance procedures shall be included in the written fire prevention plan

ECDC
Liter Control Plan

ECDC Environmental
Litter Control Plan

Litter Control

The facility management will make every effort to clean the entire site, access and entrance roads as well as the geographic area around the site, of any windblown litter by sundown of each operating day. If this is not possible, litter pickup will begin immediately the following day and continue until the geographic area and the facility have been completely cleared of litter. Facility management will continue to evaluate the litter until such time as the facility is clean. All plastic bags that are filled with litter will be picked up and properly disposed of at the end of the day. Bags of litter should not be allowed to sit on or around the facility overnight.

To insure that all sections of the facility are receiving the proper litter control, the attached diagram (Appendix A) should be completed daily. This diagram will reflect the areas cleaned that day along with identifying sections requiring attention the next day. Management will use this report to evaluate problem areas along with defining the proper quantity of litter pickers required for the next day. As in the past management will also continue to drive the facility daily to monitor litter.

High Wind Situations

If high wind situations are encountered, facility management will reduce the size of the tipping face as much as possible. Operational considerations, such as reduction of the tipping face, reduction of the number of vehicles allowed to discharge their loads at one time and discharge of loads into the wind will also be used. Facility management will monitor the number of trucks which are allowed to discharge their loads at one time in order to allow compaction equipment to compact the waste streams faster and more efficiently. Third party companies will be required to untarp their loads only when they are arrive at the tipping face. In addition, if at all possible the tipping face will be reconfigured so that discharging vehicles are dumping their loads into the oncoming high winds, vehicles will not be allowed to discharge their loads down wind. Should the high winds present situations that the windblown litter cannot be controlled, then facility management will evaluate the options of closing the landfill for the day. Facility closings should be requested only in extreme high wind situations.

Temporary Fencing

Temporary woven wire, woven plastic or wooden fencing to surround general disposal operations will be used as needed. All temporary fencing should be cleaned of litter daily. The need for temporary fencing will be evaluated by facility management daily based on weather conditions and current, future cell operations.

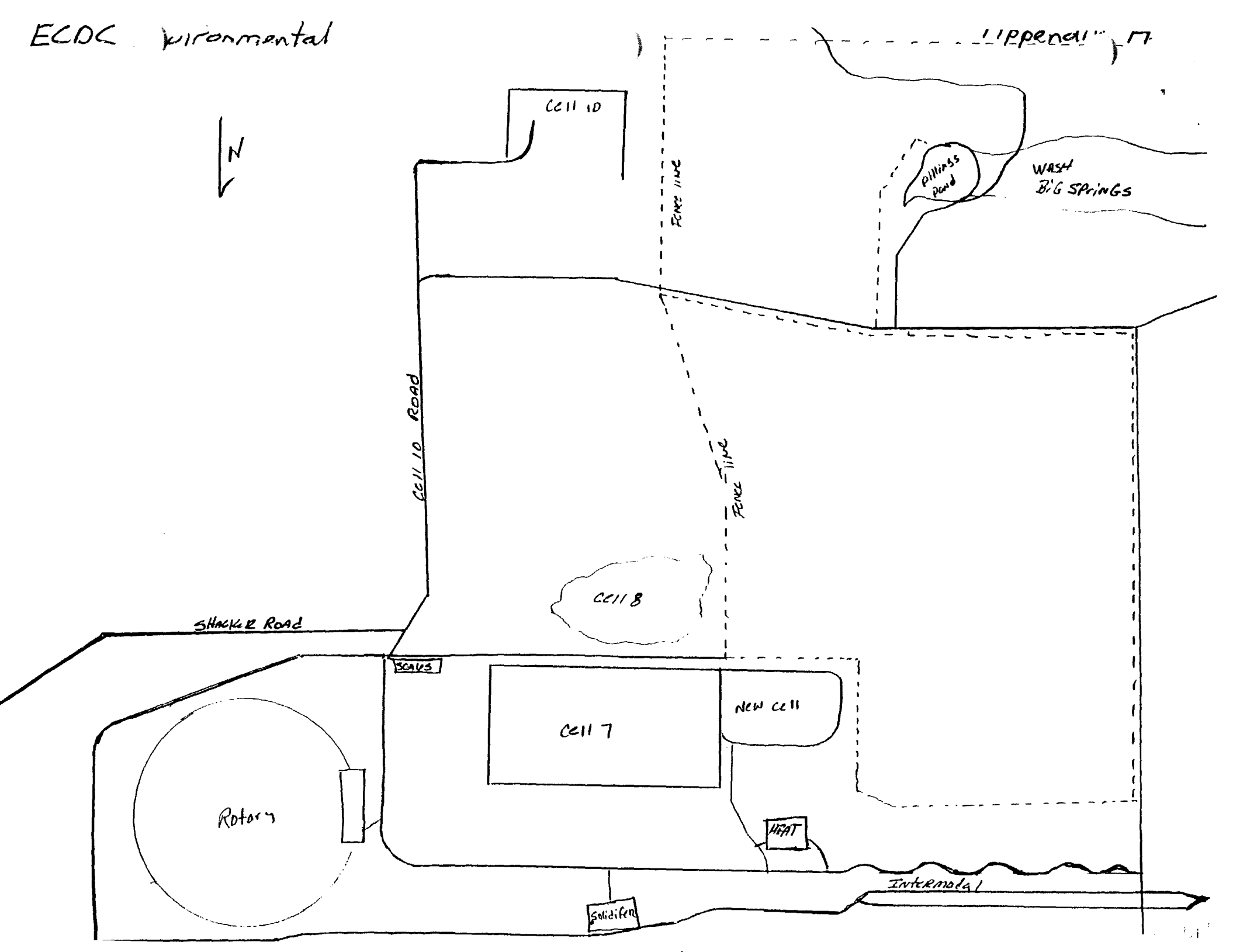
Litter Pickers

Weather reports should be monitored daily and if high winds are expected, the temporary service company should be contacted the prior day to allow them reasonable time to find workers. Do not wait until midday when you have a wind problem to begin ordering temporary service workers. The number of workers should be closely evaluated by facility management to assure that the windblown trash will be picked within a reasonable time frame.

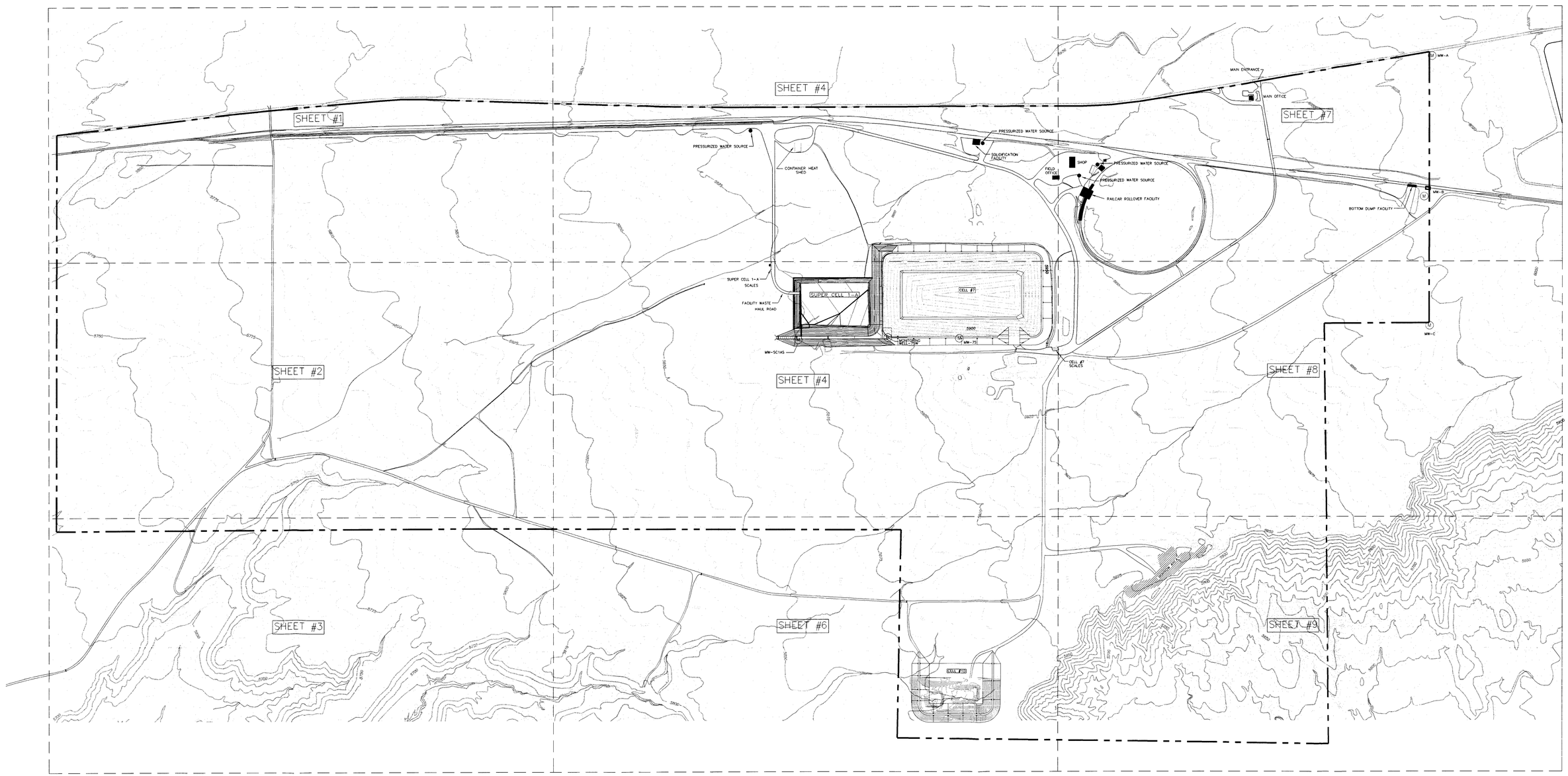
Temporary service workers will be managed and directed by facility personnel. Always keep temporary service workers far away from the active tipping face and high traffic areas. Do not let temporary workers within 10 feet of the windscreens. Use only facility personnel to clean windscreens and never let temporary workers operate Company equipment.

Work the temporary service workers in one section of the facility at a time. When that section has been adequately cleaned, move them to a second section. Do not disburse temporary service workers randomly across the facility on their own.

The basis of this plan will be to insure that the facility continues to monitor windblown trash throughout the day and that appropriate action is taken to reasonable maintain the facility.


ECDC kironmental
Cell 10
N
FENCE LINE
Pillings Road
WASH
Big Springs
Cell 10 ROAD
FENCE LINE
Cell 8
SHACKLER Road
SCALES
Cell 7
NEW Cell
Rotary
HEAT
Intermodal
Solidifier

APPENDIX 6

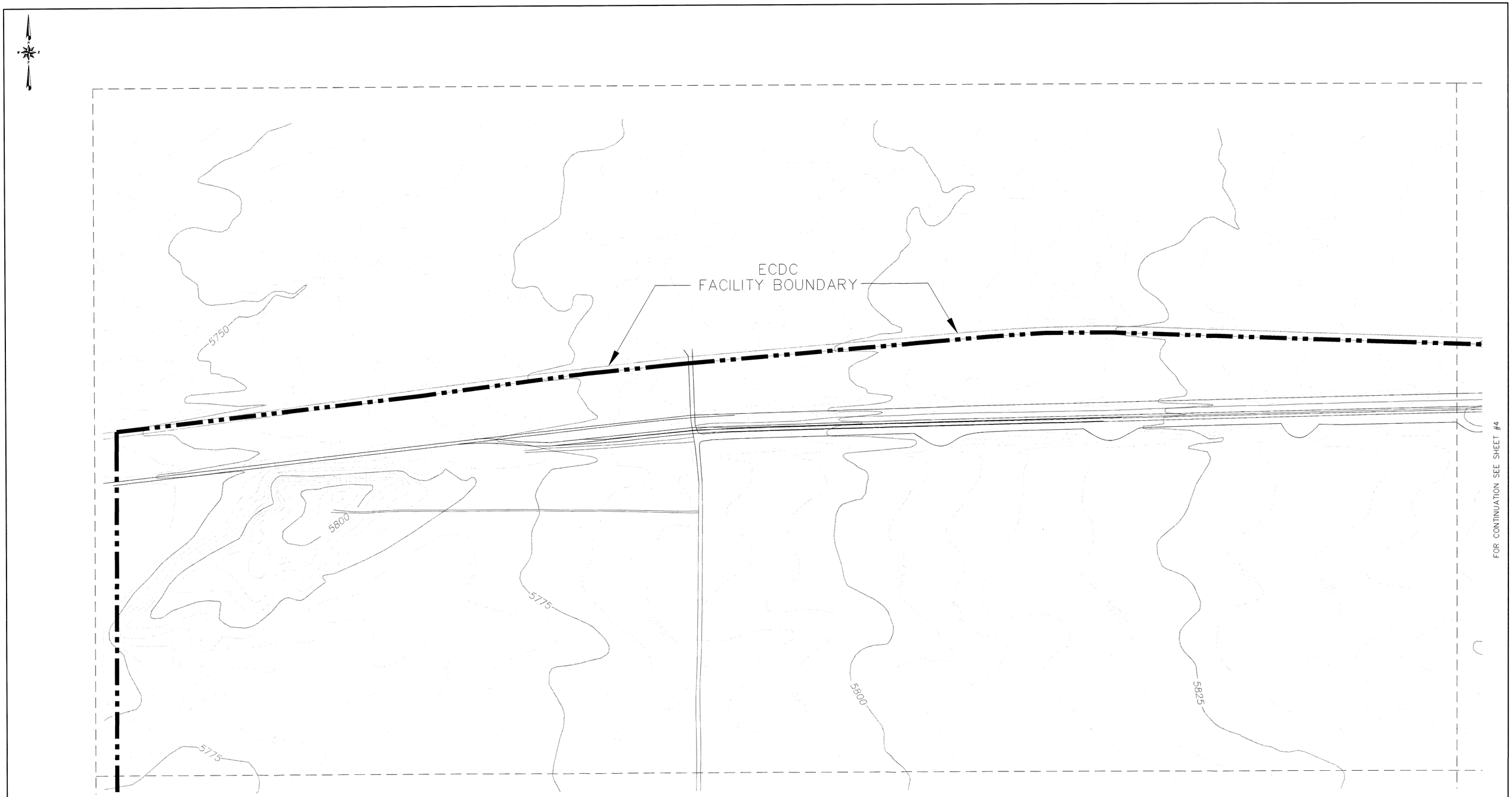


REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
Feb 2001
STATE OF UTAH

EarthFax Engineering, Inc. Engineers/Scientists	0' 600'	BASE MAP:	REVISION'S	DATE	BY	DATE	BY	DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001	ECDC ENVIRONMENTAL L.C. EAST CARBON, UTAH
EarthFax		COMPUTER FILE: G:\UC726\04\200_SCALE.DWG						APPROVED BY: GHP	PROJ. NUMBER: UC726-04		

SHEET LAYOUT
1" = 200' SCALE DRAWINGS
ECDC FACILITY

SHEET 1 OF 10



REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
STATE OF UTAH

EarthFax Engineering, Inc. Engineers/Scientists	0' 200'	BASE MAP:	REVISION'S	DATE	BY	DATE	BY	DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001	ECDC ENVIRONMENTAL L.C. EAST CARBON, UTAH
EarthFax		COMPUTER FILE: 200_SCALE.DWG						APPROVED BY: GHP	PROJECT NUMBER: UC726-04		SHEET #1 1" = 200 ' SCALE DRAWING ECDC FACILITY SHEET 2 OF 10

FOR CONTINUATION SEE SHEET #1

FOR CONTINUATION SEE SHEET #5

FOR CONTINUATION SEE SHEET #3

REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
STATE OF UTAH

EarthFax Engineering, Inc.
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EarthFax

0' 200'

BASE MAP:

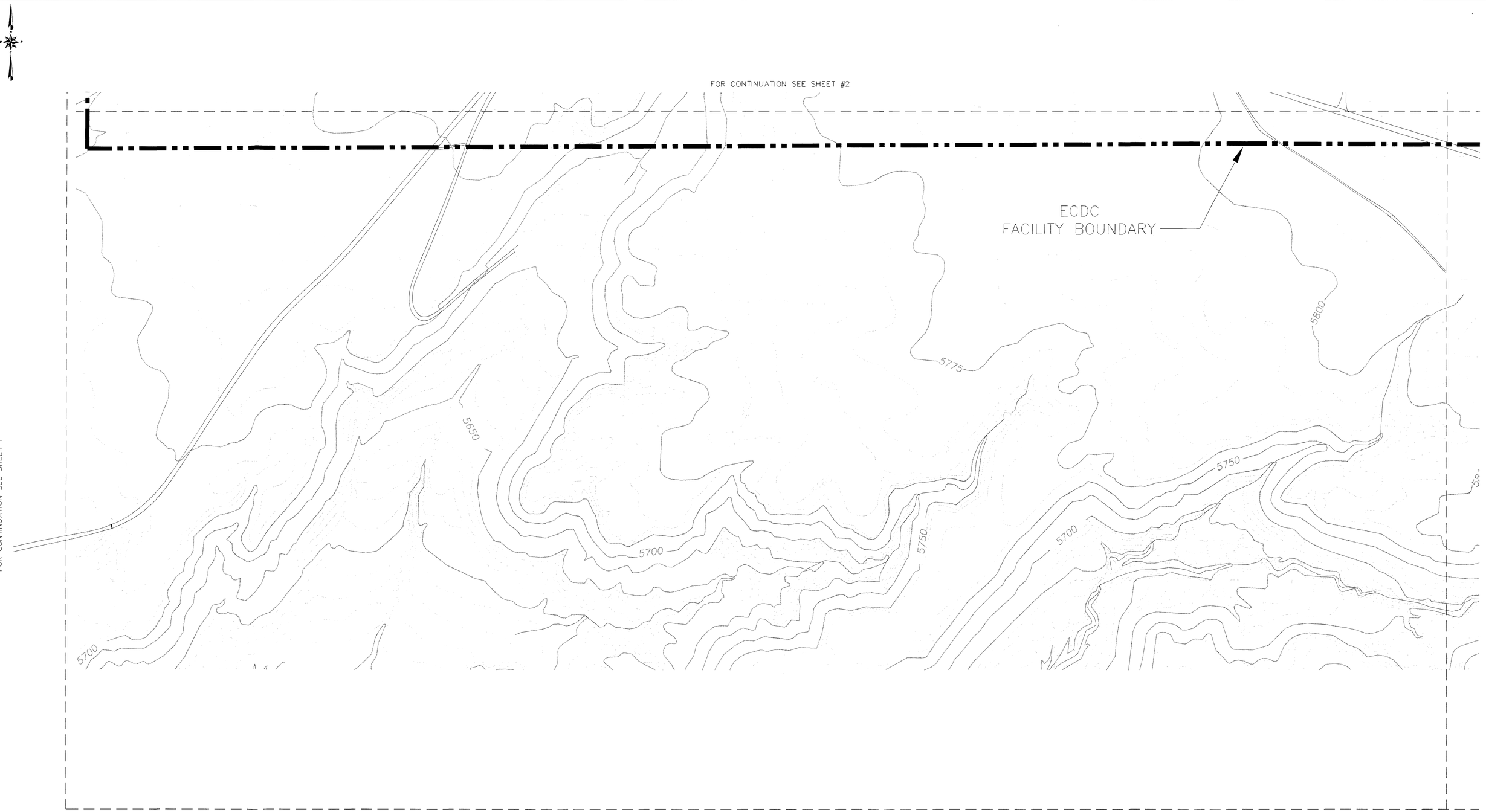
COMPUTER FILE: 200_SCALE.DWG

REVISIONS	DATE	BY	DATE	BY

DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001
APPROVED BY: GHP	PROJECT NUMBER: UC726-04	

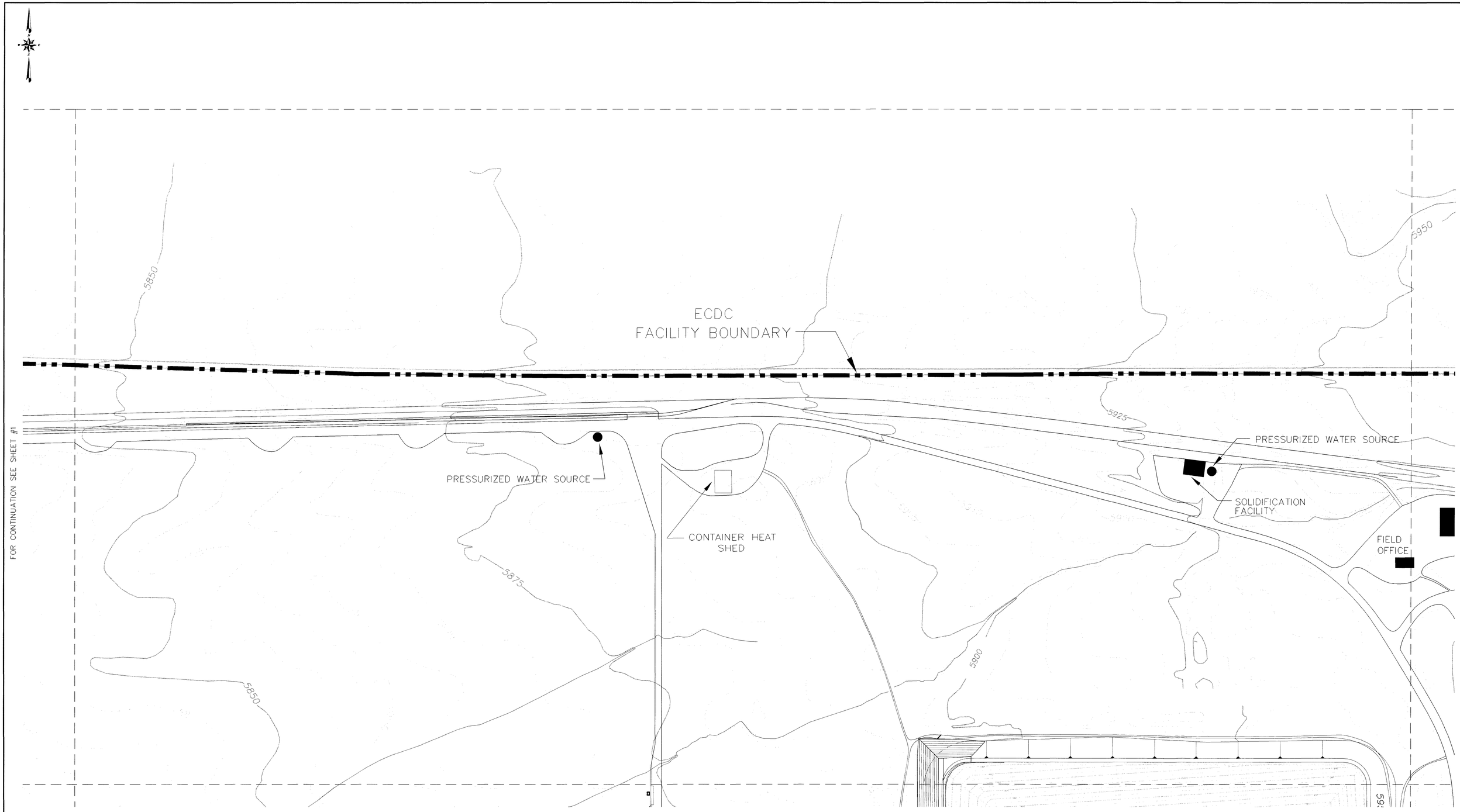
ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

SHEET#2
1" = 200' SCALE DRAWING
ECDC FACILITY



REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H.
PLAYER
Feb 2001
STATE OF UTAH

EarthFax Engineering, Inc. Engineers/Scientists	0' 200'	BASE MAP:	REVISION'S	DATE	BY	DATE	BY	DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001	ECDC ENVIRONMENTAL L.C. EAST CARBON, UTAH	SHEET #3 1" = 200' SCALE DRAWING ECDC FACILITY
		COMPUTER FILE: 200_SCALE.DWG						APPROVED BY: GHP	PROJECT NUMBER: UC726-04			SHEET 4 OF 10



REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H.
PLAYER
STATE OF UTAH

EarthFax Engineering, Inc.
Engineers/Scientists

0' 200'

BASE MAP:

COMPUTER FILE: 200_SCALE.DWG

REVISION'S	DATE	BY	DATE	BY

DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001
APPROVED BY: GHP	PROJECT NUMBER: UC726-04	

ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

SHEET#4
1" = 200' SCALE DRAWING
ECDC FACILITY

FOR CONTINUATION SEE SHEET #4

SUPER CELL 1-A
SCALES

FACILITY WASTE
HAUL ROAD

SUPER CELL 1-A

CELL #7

MONITORING
WELL-7SW

MW-7S

MW-SC1AS

5850
5875
5900
5925
5950

FOR CONTINUATION SEE SHEET #2

FOR CONTINUATION SEE SHEET #8

FOR CONTINUATION SEE SHEET #6

REGISTERED PROFESSIONAL ENGINEER
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GENE H.
PLAYER
STATE OF UTAH

EarthFax Engineering, Inc.
Engineers/Scientists
EarthFax

0' 200'

BASE MAP:

COMPUTER FILE: 200_SCALE.DWG

REVISION'S	DATE	BY	DATE	BY

DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001
APPROVED BY: GHP	PROJECT INFORMATION: UC726-04	

ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

SHEET #5
1" = 200' SCALE DRAWING
ECDC FACILITY

FOR CONTINUATION SEE SHEET #5

FOR CONTINUATION SEE SHEET #3

ECDC
FACILITY BOUNDARY

5825

5810

5800

5850

5875

5900

CELL #10

FOR CONTINUATION SEE SHEET #9

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GENE H.
PLAYER
STATE OF UTAH

EarthFax Engineering, Inc.
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0' 200'

BASE MAP:

COMPUTER FILE: 200_SCALE.DWG

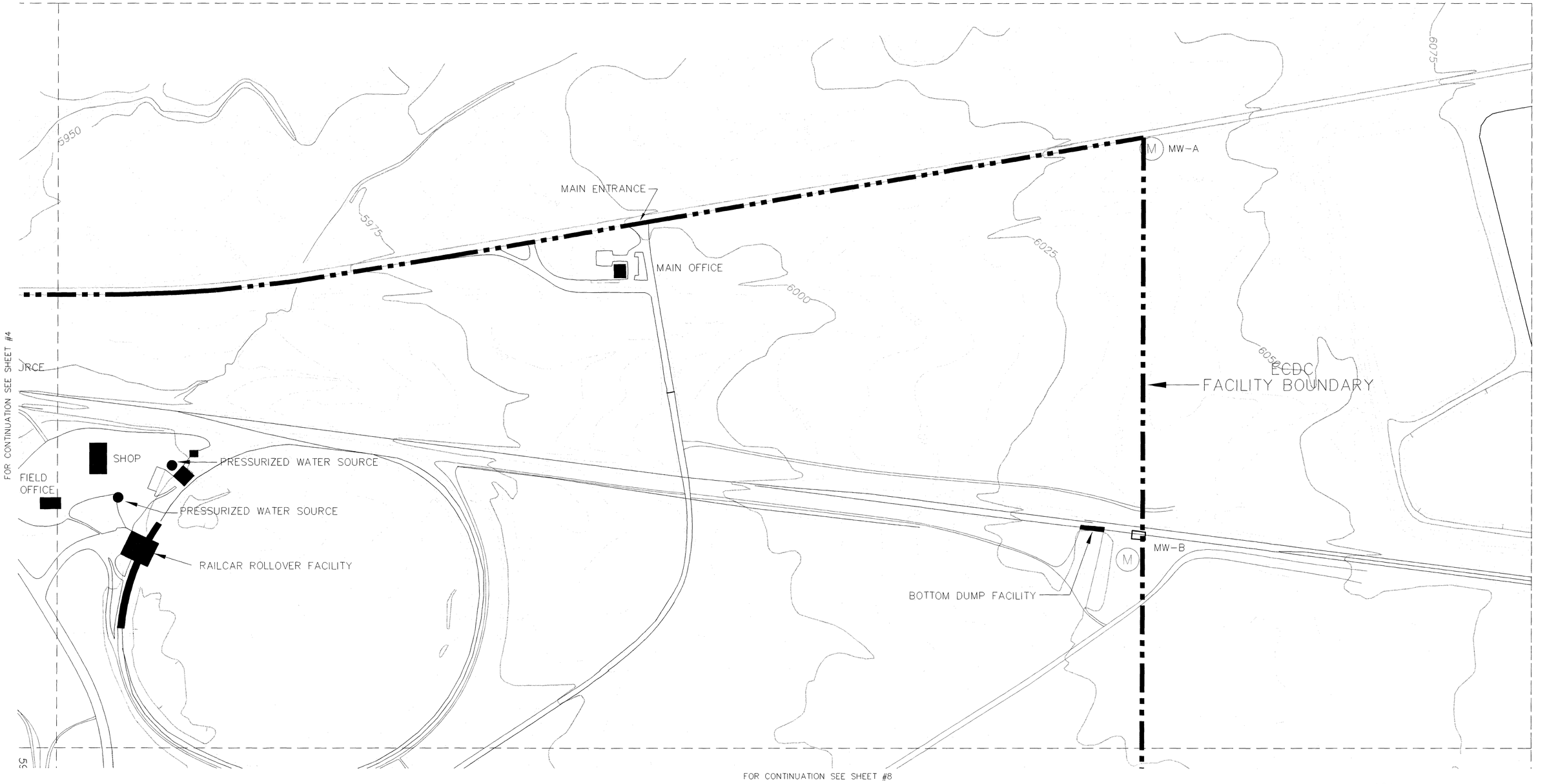
REVISIONS	DATE	BY	DATE	BY

DRAWN BY: KHB | CHECKED BY: GHP | DATE: FEB 2001

APPROVED BY: GHP | PROJECT NUMBER: UC726-04

ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

SHEET #6
1" = 200' SCALE DRAWING
ECDC FACILITY

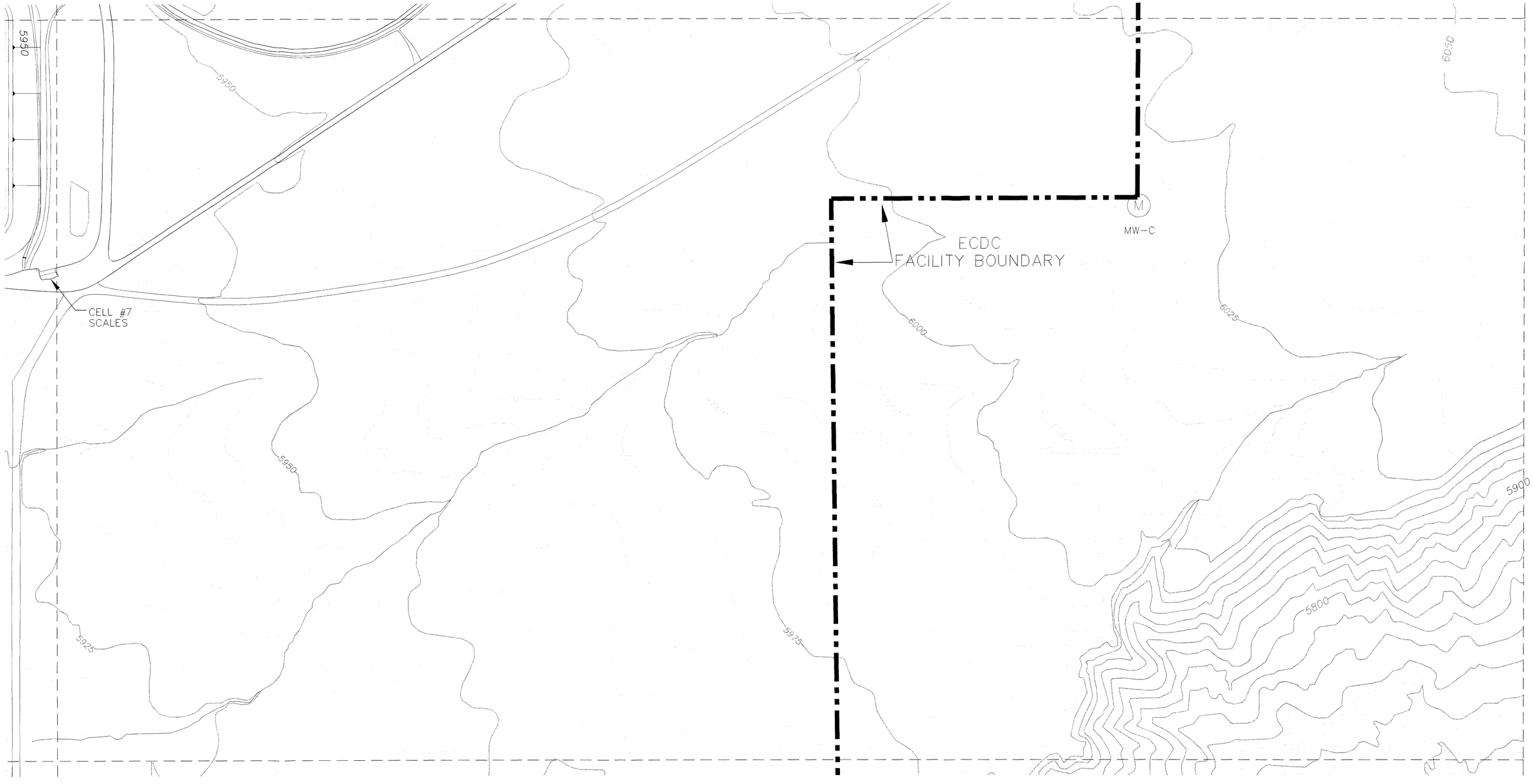


REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
Feb. 2001
STATE OF UTAH

EarthFax Engineering, Inc. Engineers/Scientists	0' 200'	BASE MAP:	REVISION'S	DATE	BY	DATE	BY	DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001	ECDC ENVIRONMENTAL L.C. EAST CARBON, UTAH	SHEET #7 1" = 200' SCALE DRAWING ECDC FACILITY
		COMPUTER FILE: 200_SCALE.DWG						APPROVED BY: GHP	PROJECT NUMBER: UC726-04			SHEET 8 OF 10

FOR CONTINUATION SEE SHEET #7

FOR CONTINUATION SEE SHEET #5



FOR CONTINUATION SEE SHEET #9

REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H.
PLAYER
STATE OF UTAH

EarthFax Engineering, Inc.
Engineers/Scientists

EarthFax

0' 200'

BASE MAP:

COMPUTER FILE: 200_SCALE.DWG

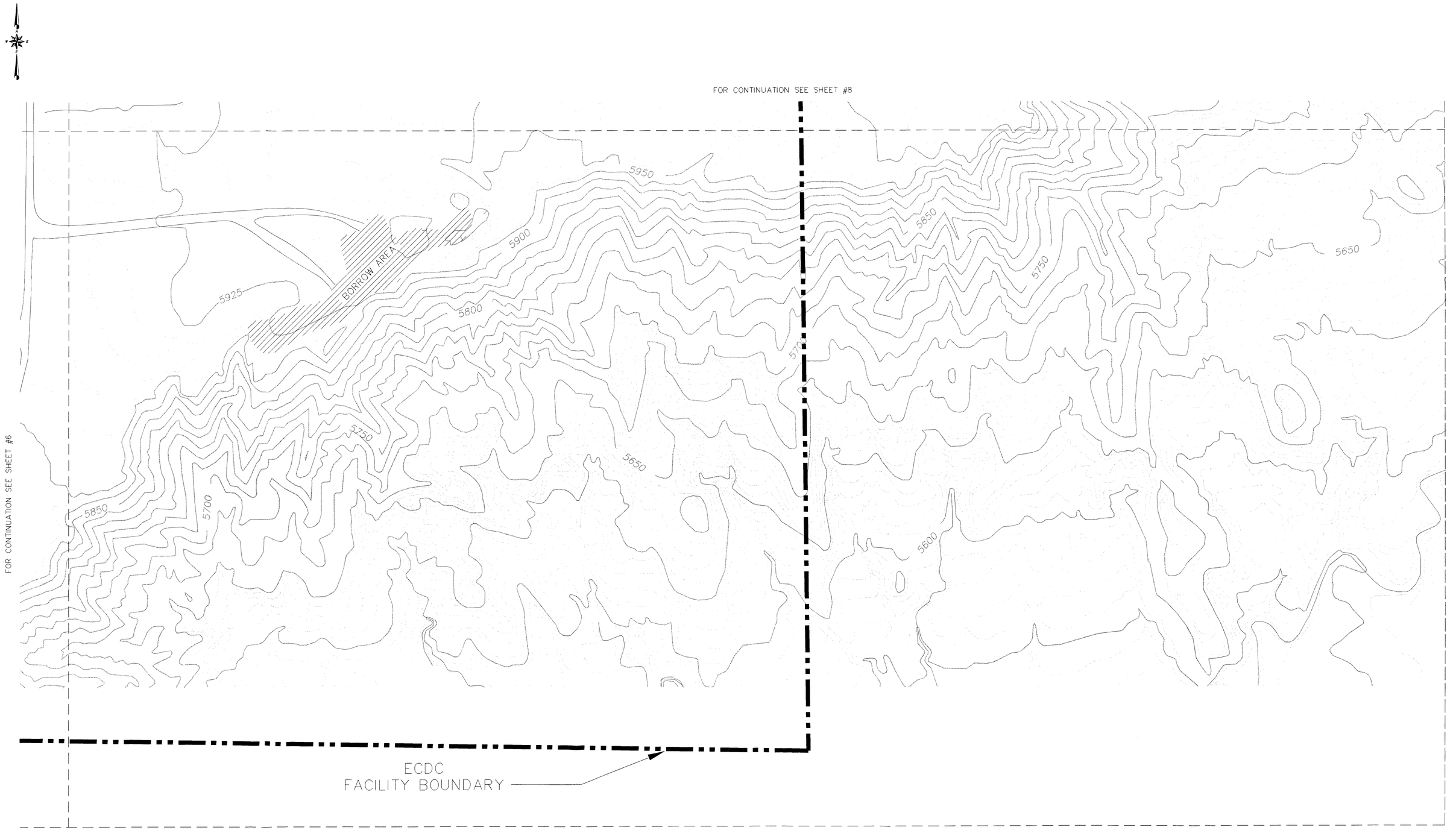
REVISION'S	DATE	BY	DATE	BY

DRAWN BY: KHB | CHECKED BY: GHP | DATE: FEB 2001

APPROVED BY: GHP | PROJECT NUMBER: UC726-04

ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

SHEET #8
1" = 200' SCALE DRAWING
ECDC FACILITY



REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
STATE OF UTAH

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EarthFax

0' 200'

BASE MAP:

COMPUTER FILE: 200_SCALE.DWG

REVISION'S	DATE	BY	DATE	BY

DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001
APPROVED BY: GHP	PROJECT NUMBER: UC726-04	

ECDC ENVIRONMENTAL L.C.
EAST CARBON, UTAH

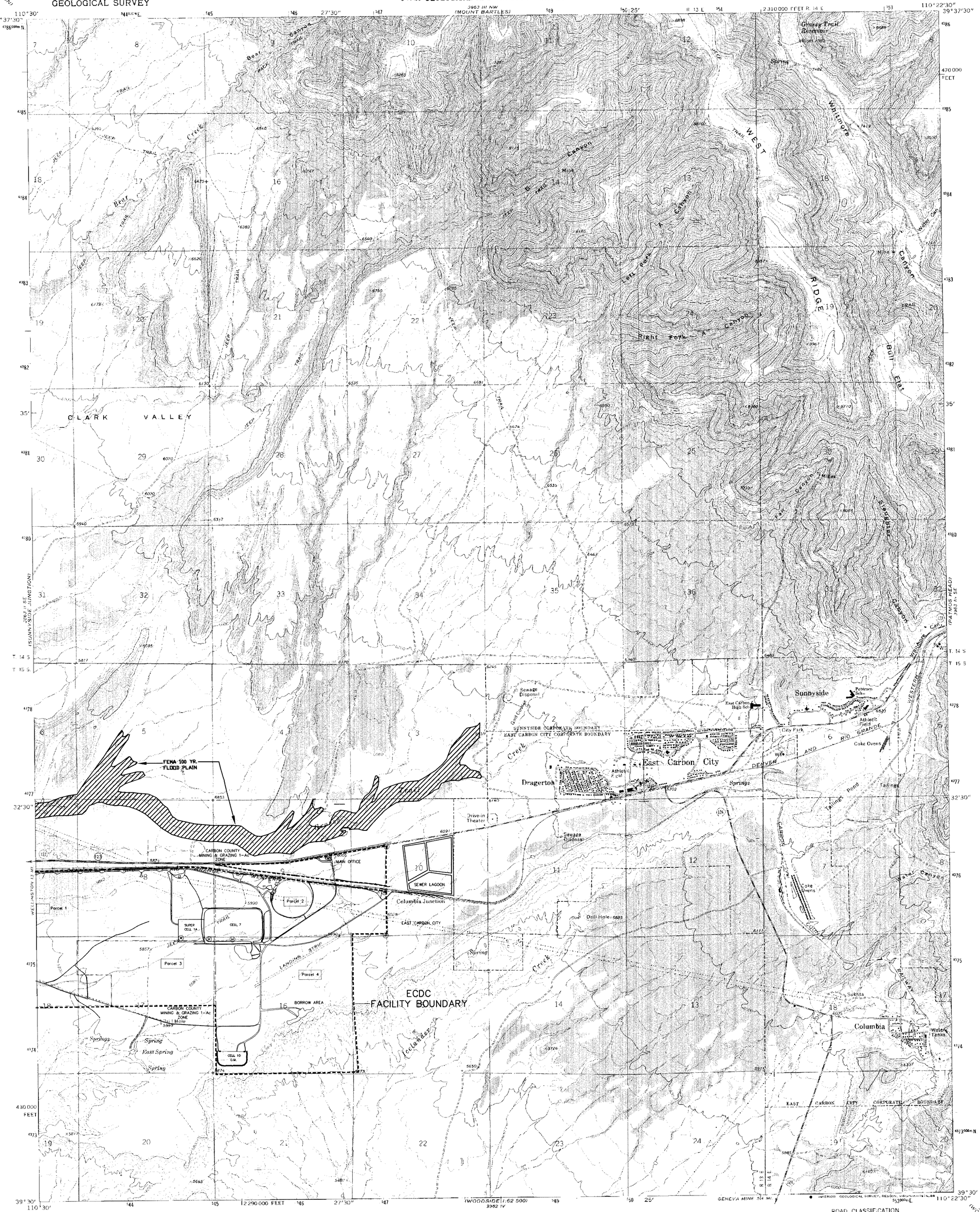
SHEET #9
1" = 200' SCALE DRAWING
ECDC FACILITY

APPENDIX 7

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF UTAH
UTAH GEOLOGICAL AND MINERAL SURVEY

SUNNYSIDE QUADRANGLE
UTAH—CARBON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 SUNNYSIDE 15' QUADRANGLE



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1972. Field checked 1972

Projection and 10,000-foot grid ticks: Utah coordinate system, central zone (Lambert conformal conic) 1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETRE

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTAH
QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface	Light-duty road, hard or improved surface
Secondary highway, hard surface	Unimproved road
Interstate Route / U. S. Route / State Route	

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

SUNNYSIDE, UTAH
SW/4 SUNNYSIDE 15' QUADRANGLE
N3930—W11022.5/7.5

1972

AMS 3963 III SW—SERIES V897

LEGEND

═══	OIL ROAD
═══	GRAVEL ROAD
– – –	DIRT ROAD
———	RAIL ROAD
-----	PROPERTY LINE

Wind Rose Report
Elno Reporting Station
Data From Utah Climate Center

REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
Feb 2001
STATE OF UTAH

0' 2000'

SCALE: 1"=2000'

REVISION	
DATE	BY

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Engineers/Scientists

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ECDC
LANDFILL FACILITY
SITE LOCATION MAP

SHEET 1 OF 2

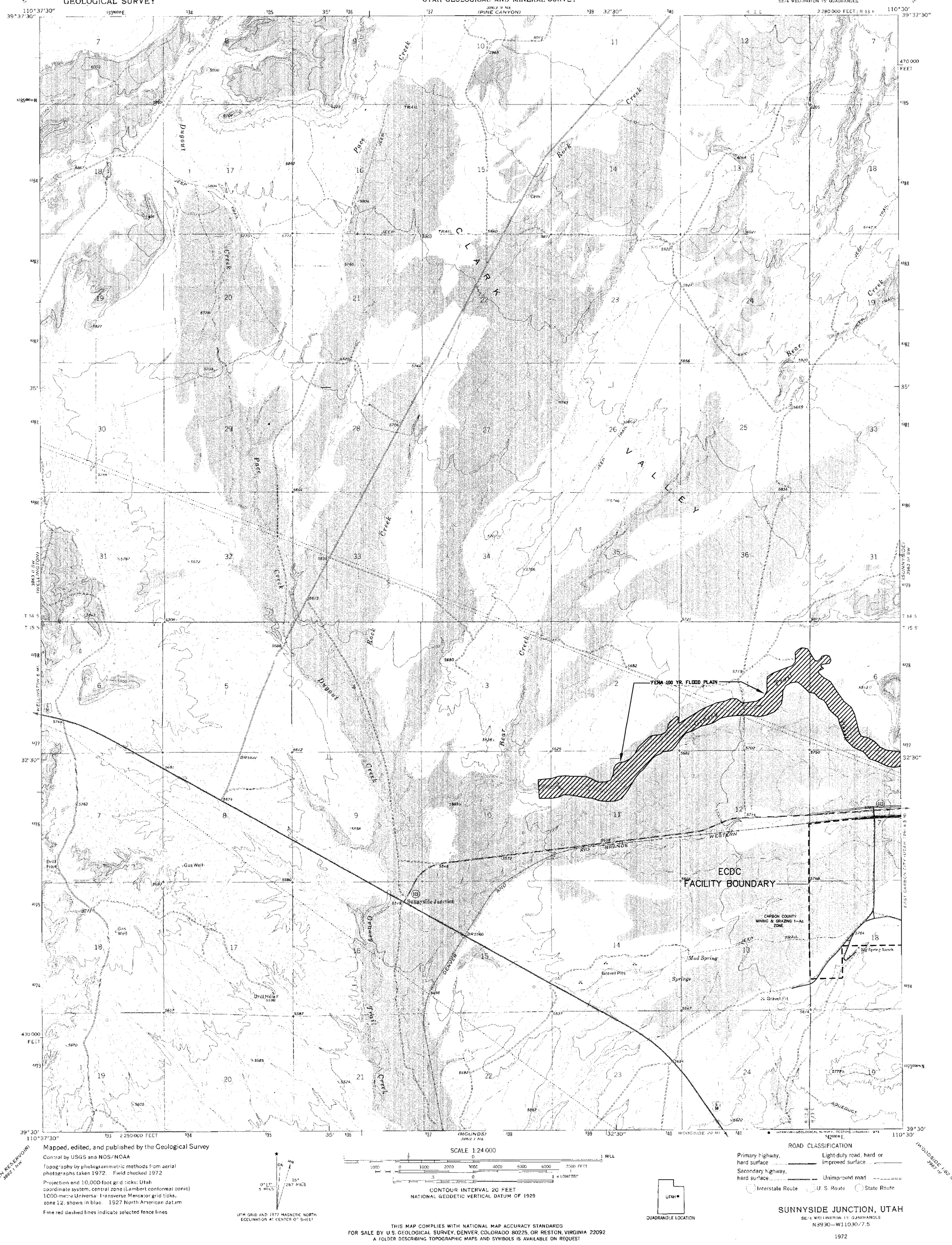
ECDC ENVIRONMENTAL L.C.

DRAWN BY: KHB	CHECKED BY: GHP	DATE: FEB 2001
APPROVED BY: GHP	DWG DATA: UC726-04 USGS SHEET 1.DWG	

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF UTAH
UTAH GEOLOGICAL AND MINERAL SURVEY

SUNNYSIDE JUNCTION QUADRANGLE
UTAH—CARBON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 WELLINGTON 15' QUADRANGLE



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1972. Field checked 1972

Projection and 10,000-foot grid ticks: Utah coordinate system, central zone (Lambert conformal conic) 1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

GN 0°17' 5 MILS; MN 15° 267 MILS

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 MILE; 1000 0 1000 2000 3000 4000 5000 6000 7000 FEET; 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

UTAH — QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route; U. S. Route; State Route

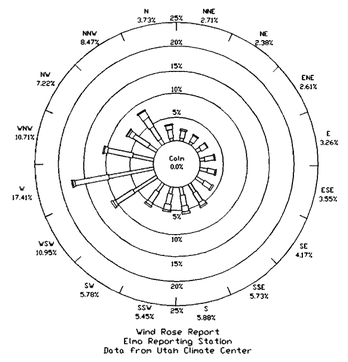
SUNNYSIDE JUNCTION, UTAH
SE/4 WELLINGTON 15' QUADRANGLE
N3930—W11030/7.5

1972

AMS 3863 II SE SERIES V697

LEGEND

	OIL ROAD
	GRAVEL ROAD
	DIRT ROAD
	RAIL ROAD
	PROPERTY LINE



Wind Rose Report
Elmo Reporting Station
Data from Utah Climate Center

0' 2000'

REGISTERED PROFESSIONAL ENGINEER
No. 186210
GENE H. PLAYER
Feb 2001
STATE OF UTAH

REVISION	
DATE	BY

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LANDFILL FACILITY SITE LOCATION MAP

SHEET 2 OF 2

ECDC ENVIRONMENTAL L.C.

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APPROVED BY: GHP	DWG DATA: UC726-04 USGS SHEET 2.DWG	

APPENDIX 8

PRELIMINARY GEOLOGIC REPORT OF PROPOSED SOLID WASTE DISPOSAL SITE for East Carbon Development Corporation

by

S. Bryce Montgomery, Geologist

July 11, 1989

PRELIMINARY GEOLOGIC REPORT OF PROPOSED SOLID WASTE DISPOSAL SITE for East Carbon Development Corporation

INTRODUCTION: The proposed solid waste disposal site is within Carbon County, Utah, west of East Carbon City, In Sections 7, 8, 9, 10, 16, 17 and 18, T15S, R13E, SLB&M; and is outlined on the attached geologic map. It is adjacent to the Denver and Rio Grande Railroad and paved, State Highway 123 which are the north boundary.

In addition to previous field work conducted in the region regarding exploration work, the author made a specific field examination of the site area on June 29-30, 1989. This included inquiries with local residents and professionals who have had direct involvement with the area.

In addition, reference has been made to F. R. Clark (1928), Economic Geology of the Castlegate Wellington, and Sunnyside Quadrangles, Carbon County, Utah, U. S. Geological Bulletin 793; F. W. Osterwald and J. O. Maberry (1974), Engineering Geologic Map of the Woodside Quadrangle, Emery and Carbon Counties, Utah, U. S. Geological Survey Map I-798; J. W. Hood and D. J. Patterson (1984), Bedrock Aquifers in the Northern San Rafael Swell Area, Utah, U. S. Geological Survey in cooperation with Utah Department of Natural Resources and Energy, Technical Publication No. 78; W. L. Stokes and J. H. Madsen, Jr. (1961), Geologic Map of Utah, Northeast Quarter, College of Mines and Mineral Industries, University of Utah; U. S. Department of Agriculture stereoscopic pairs of aerial photography (1974); U. S. Geological Survey Topographic 7.5 Minute Quadrangles, Sunnyside, Sunnyside Junction, and Patmos Head, Utah; E. H. Jensen and J. W. Borchert (1988), Soil Survey of Carbon Area, Utah, U. S. Department of Agriculture, Soil Conservation Service; and Project area topographic-aerial photo map prepared by Olympus Aerial Surveys Inc. for East Carbon Development Corporation.

Four test drill holes were drilled in the area June 12-13, 1989, by Zimmerman Well Service, at the request of East Carbon Development Corporation, and left cased for later water measurements. The author examined the drill cuttings therefrom and conducted later ground water measurements therein. The prepared logs are a part of this report. In addition a driller's log for the Porter water well located north of the subject area was obtained from the State Engineer's Area Office in Price, Utah, and is included in this report.

GEOLOGY, TOPOGRAPHY, SOILS, AND HYDROLOGY: The site is situated on the westward-sloping alluvial fan of Whitmore Canyon of the Book Cliffs, at elevations between 5740 and 6030 feet. Underlying, sedimentary bedrock is the Mancos Shale of upper Cretaceous age which has been warped with a gentle dip to the north-northeast of 3-5 degrees from horizontal. The large and prominent San Rafael Swell (uplift) is located immediately to the south and its northern end is plunging beneath the subject area. Subsequent erosion of this great uplift has stripped thousands of feet of sedimentary rock strata off from its top and sides, with the eroded materials being transported away by the Colorado River system via the Green River drainage.

Consequently, the subject bench area has been preserved as a dissected, arcuate-shaped, strike-valley between the Book Cliffs escarpment to the north, northeast and east, and the San Rafael Swell to the south. Later erosion of this valley has formed another steep escarpment which bounds the subject area

on the immediate south and southwest. This has created the present-day, gently, westward-sloping, elevated plateau or bench upon which the proposed solid waste disposal site rests.

During late (Quaternary) geologic time as the Book Cliffs continued to erode, unusually high water flows have periodically discharged from Whitmore Canyon (Sunnyside), depositing a thick blanket of sand, silt, gravel, cobbles, boulders and some large sandstone blocks (up to 20x20 feet) on the eroded surface of the Mancos Shale. Subsequent erosion has inturn removed part of this alluvial fan deposit.

From eroded exposures along the escarpment at the south edge of the subject area, within road, railroad and ravine-wash cuts, and from test holes drilled, the underlying soil profile is well revealed. This soil consists mainly of silt and sand with some clay, cobbles, boulders and widely-scattered large blocks of sandstone within the upper five feet. This is in-part weakly cemented with lime-caliche in some areas. In other areas such as the irrigated field in the NW/4 NW/4 Sec. 16, T15S, R13E, the top-soil of silt and sand soil contains small, entrapped air-voids which causes soil collapsing upon wetting, creating small sinks and subsidences.

Areas with scattered, large sandstone blocks from 6-20 feet in diameter are within the S/2 SW/4 and SW/4 NW/4 Sec. 9, NW/4 SE/4 Sec. 8, center of S/2 and S/2 SW/4 Sec. 7, and NW/4 NW/4 Sec. 18, all T15S, R13E. The largest of these are seen in the center of S/2 Section 7, and evidence the principal, major stream channel locations of ancient times. These ancient sediment-laden stream flows, sufficient to transport such large masses of rock from the mountains on the east, have deposited a continuous blanket of permeable alluvium, extending from the bottom of Whitmore Canyon throughout the subject area.

Although, generally the alluvial fan deposits beneath the subject area have low-moderate permeability, there were apparently some ancient stream channels of relatively, clean washed gravels with higher permeabilities. This is evidenced by the large-flowing Big Spring which exists within a ravine-cut through the alluvial fan materials, in the center of Section 18, T15S, R13E. This Big Spring along with other smaller springs found in Sections 17 and 18 are formed similarly.

The Big Springs was measured in 1975 (Hood and Patterson) to have a flow of 168 gpm of water. The total dissolved mineral solids were reported to be 1080 milligrams/liter (ppm) with sulfate being 480 mg/l and bicarbonate being 395 mg/l of the total. At the time of my examination June 30, 1989, I estimated a flow of 150 gpm from the Big Spring, and about 15 gpm flowing from the East Spring, located within the Ne/4 SE/4 SW/4 Sec. 17, T15S, R13E. Other small springs in Sections 17 and 18 had estimated flows from 2-10 gpm. Mr. Woodrow Pilling who has operated the Big Spring Ranch since 1942 believed the present flow from Big Spring to be close to 450 gpm based on how many furrows he is able to irrigate with the water.

As shown on the attached geologic map, geologic sections and drill hole logs, the preserved thickness of the alluvial fan materials blanketing the subject area is 0-50 feet. Likely within some ancient stream channels eroded into the

eroded surface of the underlying Mancos Shale, it may be thicker than 50 feet. Below the top 5 feet of mainly gravelly silt and sand, the alluvial fan materials consist of silty and sandy gravels, cobbles and boulders, lensing into gravelly silt and sand with some clay. Variable lime caliche weak cementation exists throughout the section. Permeability is low to moderate, with some localized high, such as east of the Big Spring. Woodrow Pilling related to me some small sink holes in the irrigated field within the NW/4 Section 16 which have captured applied irrigation water at times in the past. He further stated that when he has water available to him from Grassy Trail Creek to irrigate these bench fields and does so, he has noticed an increase in the flow from Big Spring.

Thus, underlying the capping, alluvial fan materials is the Mancos Shale of gray, clayey siltstone and silty shale which weathers at its contact to a tight clay, forming a permeability bearier to downward moving ground water. This serves as a floor to the perched groundwater aquifer within the overlying alluvium. The fact that drill cutting samples recovered from the Mancos Shale below its upper, weathered, clay contact surface were dry, evidences the effectiveness of the clay seal at its top. The remaining section of the Mancos Shale is 1770 feet thick in the oil-test well drilled by Mountain Fuel Supply Company within the NW/4 SE/4 Sec. 17, T15S, R13E, to total depth of 9165 feet in the year 1971.

In outcrop the Mancos Shale weathers to a silty clay at its contact with the atmosphere. Upon digging beneath this clay, or from exposures studied in the lower part of the steep excarpment at the south edge of the subject area, it was observed that the shale contains much jointing, inpart filled with thin coatings of gypsum. Generally these joints are near vertical and strike northwest and northeast. The chemical analysis of water from Big Spring evidences that some gypsum from the top of the Mancos Shale has been taken into solution.

The groundwater potentiometric surface is shown on the geologic map by separate contour lines. The difference between these contours and the ground surface elevation is the depth to the unconfined, perched aquifer. The saturated thickness of the aquifer is generally thin, 3-20 feet; although local areas not tested may be thicker due to ancient channeling into the top of the Mancos Shale. The difference between the depth to ground water and the isopacn (thickness) contours of the alluvium, shown on the geologic map, sections and test hole logs, illustrates the saturated thickness of alluvium.

Thus, the recharge water for the Big Spring and other nearby springs originates from precipitation in the higher elevations of Whitmore Canyon of the Book Cliffs and moves almost in a straight line, within the subsurface alluvium, from Sunnyside at the mouth of Whitmore Canyon to Big Spring. Supplemental recharge would be any infiltrating water applied to the bench above and east of the Big Springs.

From examination of stereoscopic aerial photographs of the area, which provides 3-dimensional viewing, from field examination of rock outcrops and physiographic features on the bench surface of the subject area, and from research of geologic maps done by the U. S. Geological Survey of the area, no Holocene (within the last 10,000 years) faulting or like-lineations were found in or adjacent (within 3000 feet) to the subject area.

Five prepared geologic sections along with logs of test drill holes and outcrops within ravines, road-cuts and escarpment faces illustrate and project the sub-surface beneath the subject area.

Besides the Big Spring which is used for potable water along with its other uses, there is an existing culinary-stockwatering well located immediately north of the intended use area at a point S. 1320 feet and West 800 feet from the N/4 Cor. Sec. 8, T15S, R13E. It was drilled for George Porter in 1982 to a total depth of 60 feet and is producing from open-ended, 8-inch diameter casing, from the alluvial aquifer. Mancos Shale was reported at a depth of 56 feet and the static water level was reported to be at a depth of 35 feet on October 29, 1982. A copy of the driller's log is attached to this report.

Three sewage lagoons have been constructed for East Carbon City within the central part of Section 10, T15S, R13W, immediately northeast of the subject area. Only the northeast one is presently being used. Upon talking to a local resident who was involved in the actual construction of these, I learned that no pre-compaction was done of the excavated bottoms and a liner of excavated Mancos Shale was placed within the bottom and side slopes to a thickness of about 14 inches. However, the fractured shale liner was placed without an optimum moisture content and specific compaction work. Thus, it is likely that some seepage from the operating lagoon is infiltrating into the alluvial aquifer as is seepage from Grassy Trail Creek immediately north of the intended use area. I was informed by a retired engineer in Price, Utah, that some years ago there was a flourescent dye placed in Grassy Trail Creek west of East Carbon City to determine if it was supply to the Big Springs. The dye test proved positive and it is part of a court record relative to a lawsuit on the matter.

CONCLUSIONS AND RECOMMENDATIONS: The subject area appears suitable for the intended solid-waste disposal site providing an adequate seal is provided to prevent any leachate from entering the existing alluvial aquifer. The depth (22-36') to the top of the alluvial aquifer is a limiting factor to the depth and thickness of the proposed disposal cells, below ground level.

As the project progresses, additional test holes extended to the Mancos Shale will provide added and needed control for design, construction and operation of the proposed solid waste disposal facility.

I recommend that monitoring be initiated now and continued into the future on the water within existing springs, well and test holes as to yields, water quality and static water levels.

Respectfully submitted,

S. Bryce Montgomery, Geologist

Attachments:
Geologic map and sections,
drill hole logs

845 South Main, Suite 204B
Bountiful, Utah 84010

Telephone (801) 298-9108 office
(801) 295-8592 home

July 11, 1989

TEST DRILL HOLE NO. 1, PROPOSED SOLID-WASTE SITE

East Carbon Development Corporation

LOCATION: Approx. W. 775 ft. & N. 1925 ft. from SE Cor. Sec. 9, T15S, R13E, SLB&M; at an interpolated elevation of 5995 feet.

DATE DRILLED: June 12, 1989. TOTAL DEPTH: 60 feet

DRILLING CONTRACTOR: Simmerman Well Service, using air-rotary tools.

CASING: 53 feet of 6-inch diameter, steel casing left in hole.

STATIC WATER LEVEL: 36 feet(5959 ft. elevation) measured 6/29/89; on 6/12/89 driller reported water at 38 feet.

SAMPLE DESCRIPTION AND WATER MEASUREMENTS: by S. Bryce Montgomery, Geologist

Depth in feet	Description
0-10	Silt and sand with gravel: lt. gray, buff-brown, in-part lime caliche; gravel clasts are soft-hard, gray and brown, calcareous siltstone and sandstone with some gray limestone; sand is fine-medium grained; (SM-GM)
10-35	Gravel-boulders: lt. - dark brown with silt; clasts are of pisolitic dolomite and limestone with calcareous sandstone and siltstone; generally hard; damp at 20-35 feet; (GM-SM)
35-45	Gravel with sand, silt and clay: wet, light tan-brown; est. 70 % gravel of angular, calcareous sandstone, siltstone and limestone; likely cobbles and boulders included; (GM)
45-50	Silty clay: lt. gray-brown, wet, sticky; (ML-CL)
50-60	Shale: Medium gray; weathered, silty, tight, damp and soft in top (CL); grading downward into light-dark gray, fissile-platy, silty, dry, compact and dense; Mancos Shale of Cretaceous age.

TEST DRILL HOLE NO. 2. PROPOSED SOLID WASTE SITE

East Carbon Development Corporation

LOCATION: Approx. N. 2050 ft. & E. 1400 ft. from SW Cor. Sec. 9, T15S, R13E, SLB&M; at an interpolated elevation of 5929 feet.

DATE DRILLED: June 12, 1989. TOTAL DEPTH: 30 feet.

DRILLING CONTRACTOR: Zimmerman Well Service, using air-rotary tools.

CASING: 26 feet of 6-inch diameter, steel casing left in hole.

STATIC WATER LEVEL: 22 feet (5907 ft. elevation) measured 6/30/89; on 6/12/89 driller reported water at 20 feet.

SAMPLE DESCRIPTION AND WATER MEASUREMENTS: S. Bryce Montgomery, Geologist

Depth in feet	Description
0-5	Silt and fine sand: lt. rust-brown, angular, soft, dry, with trace of lt. brown gravel; (SM)
5-20	Gravel with silt and sand: lt. rust-brown, dry; est. 50% gravel with clasts of clayey limestone, sandstone and siltstone; at 15-20 feet material is damp; (GM)
20-25	Gravel with sand, silt and clay: light-medium brown, est. 70% gravel with clasts of calcareous sandstone, siltstone and limestone; wet with low permeability; (GM-GC)
25-30	Clay and weathered shale: with some gravel estimated at 20-30%; wet with low porosity and permeability; light-medium gray; (CL); weathered Mancos Shale.

TEST DRILL HOLE NO. 3, PROPOSED SOLID-WASTE SITE

East Carbon Development Corporation

LOCATION: Approx. N. 2600 ft. & E. 2630 ft. from SW Cor. Sec. 8, T15S, R13E, SLB&M; at an interpolated elevation of 5868 feet.

DATE DRILLED: June 13, 1989. TOTAL DEPTH: 51 feet.

DRILLING CONTRACTOR: Zimmerman Well Service, using air-rotary tools.

CASING: 6-inch diameter, steel to feet depth left in hole.

STATIC WATER LEVEL: 40 feet (5828 ft. elevation) measured 6/29/89; on 6/13/89 driller reported water level at 39 feet.

SAMPLE DESCRIPTION AND WATER MEASUREMENTS: S. Bryce Montgomery, Geologist.

Depth in feet	Description
0-5	Silt and fine sand: compact, in-part lime caliche; lt. buff-brown with some buff-white; soft; dry; (SM)
5-20	Gravel: light buff-rust brown; with silt and fine sand; est. 80% gravel with clasts of calcareous sandstone, siltstone, and gray limestone; dry; (GM)
20-25	Gravel with silt and fine sand: est. 90% gravel of subrounded clasts of calcareous sandstone, siltstone and limestone; permeable; lt. gray-brown; dry; (GM)
25-30	Sand and silt: lt. gray-brown; subangular, dry; with trace of gravel with clasts of shaley sandstone; (SM)
30-35	Gravel with sand and silt: Lt. gray-brown, fine sand; est. 70% gravel with clasts of limestone, calcareous and clayey siltstone and sandstone; dry; (GM)
35-45	Sand with some gravel: light-medium brown; damp 35-40 ft. and wet 40-45 ft.; sand is fine-coarse, subangular grained; est 20% gravel with clasts of calcareous and clayey sandstone, siltstone, and limestone; (SP)
45-50	Shale: weathered, light-dark brown-gray, damp, fissile-platy; partly clay (CL); Mancos Shale of Cretaceous age.

TEST DRILL HOLE NO. 4, PROPOSED SOLID WASTE SITE

East Carbon Development Corporation

LOCATION: Approx. N. 2500 ft. & E. 2500 ft. from SW Cor. Sec. 7, T15S, R13E, SLB&M; at an interpolated elevation of 5784 feet.

DATE DRILLED: June 13, 1989. TOTAL DEPTH: 50 feet.

DRILLING CONTRACTOR: Zimmerman Well Service, using air-rotary tools.

CASING: 6-inch diameter, steel to 41 feet depth left in hole.

STATIC WATER LEVEL: 33 feet (5751 ft. elevation) measured 6/29/89; on 6/13/89 driller reported "wet" at 38 feet.

SAMPLE DESCRIPTION AND WATER MEASUREMENTS: S. Bryce Montgomery, Geologist

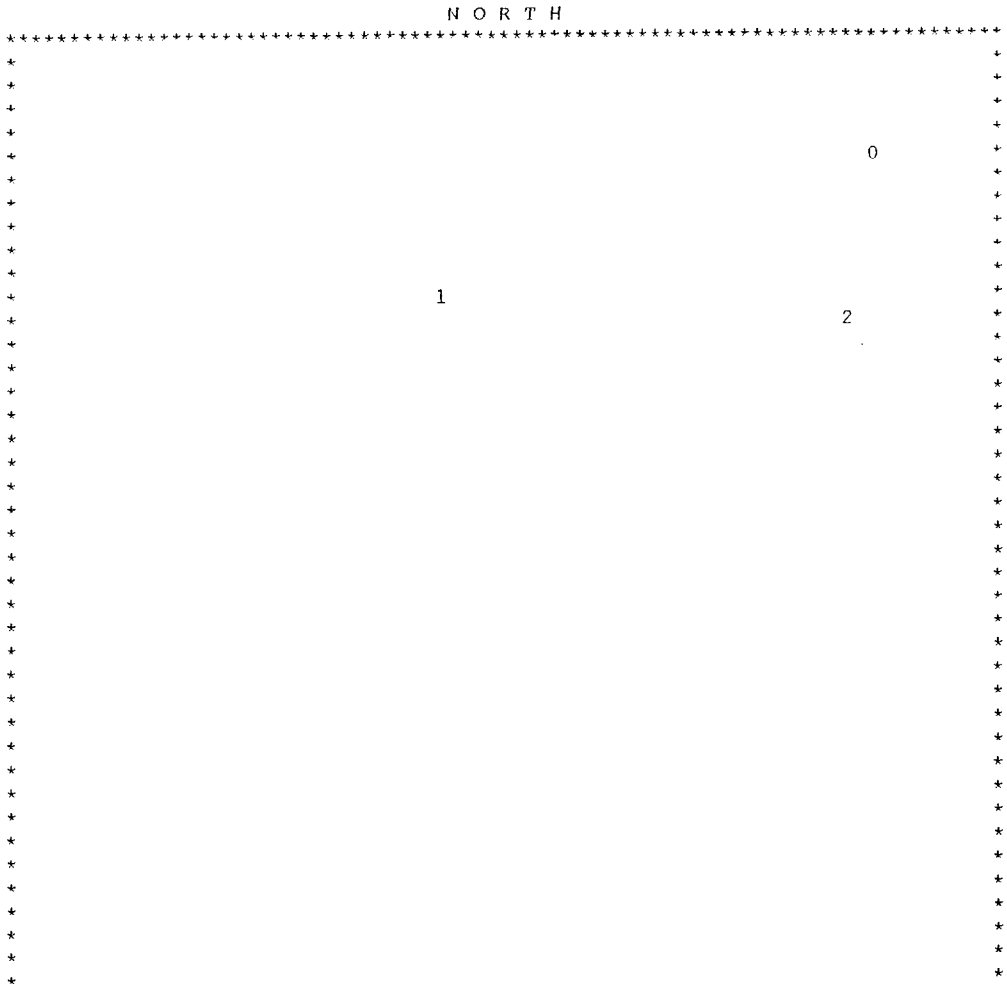
Depth in feet	Description
0-5	Silt, sand and some gravel: lt. buff-brown; calcareous; dry; est. 30% calcareous gravel with clasts of limestone, calcareous sandstone and siltstone; (SM)
5-15	Sand and silt with 20-30% gravel: lt. rust-brown, calcareous, dry; sand is fine-coarse, subangular grained; (SM)
15-20	Gravel; lt. brown-gray; with est. 30% silt and fine sand; dry; gravel clasts of subangular-subrounded calcareous sandstone, siltstone, limestone, and clayey siltstone; (GM)
20-30	Sand with some silt and gravel; rust gray-brown; subangular, fine-coarse grained; est. 15% gravel; damp in bottom 5 feet; (SM)
30-35	Sand with some rounded gravel: dark gray-brown; slightly organic, fine-coarse, subangular grained; dirty-silty in part; damp; (SM)
35-45	Very clayey and silty sand with trace of gravel: lt. buff-brown, wet, sticky, low permeability; (SC-SM)
45-50	Clay and weathered shale: lt. medium-brown-gray; silty; wet; sticky; partly (CL); tight; Mancos Shale of Cretaceous age.

APPENDIX 9

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:31 PM
PLOT SHOWS LOCATION OF 6 POINTS OF DIVERSION

PLOT OF ALL QUARTER(S) IN SECTION 8 TOWNSHIP 15S RANGE 13E SL BASE AND MERIDIAN

PLOT SCALE IS APPROXIMATELY 1 INCH = 1000 FEET



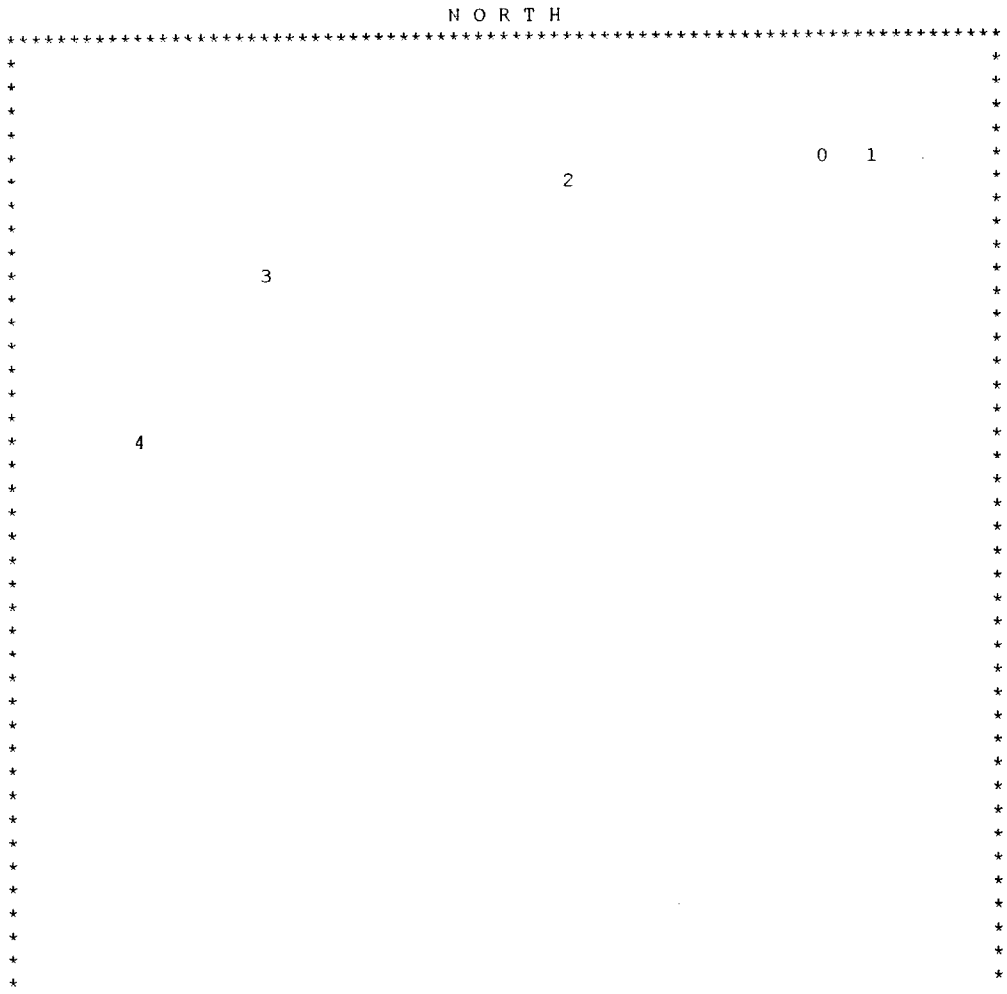
UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

MAP CHAR	WATER RIGHT	QUANTITY CFS	AND/OR AC-FT	SOURCE DESCRIPTION or WELL INFO DIAMETER	DEPTH	YEAR LOG	POINT OF DIVERSION DESCRIPTION NORTH	EAST	CNR	SEC	TWN	RNG	B&M	U N	A P	P E	T R	S R	U W	P G	R T	E D
0	91 3537	.0000	.00	Grassy Trail Creek												X		X		X		
	WATER USE(S):													PRIORITY DATE: 00/00/1869								
	Martinez, Paul B.			95 South 100 East							Price			UT 84501								
0	91 3537	.0000	.00	Grassy Trail Creek												X		X		X		
	WATER USE(S):													PRIORITY DATE: 00/00/1869								
	Martinez, Paul B.			95 South 100 East							Price			UT 84501								
0	91 3536	.0000	.00	Grassy Trail Creek												X		X		X		
	WATER USE(S):													PRIORITY DATE: 00/00/1869								
	Martinez, Paul B.			95 South 100 East							Price			UT 84501								
0	91 3536	.0000	.00	Grassy Trail Creek												X		X		X		
	WATER USE(S):													PRIORITY DATE: 00/00/1869								
	Martinez, Paul B.			95 South 100 East							Price			UT 84501								
1	91 4283	.0150	.00	8	60		N S 1360 W 350		N4	8	15S	13E	SL			X			X			
	WATER USE(S): IRRIGATION DOMESTIC STOCKWATERING													PRIORITY DATE: 05/04/1982								
	Porter, George K.			P.O. Box 461							East Carbon			UT 84520								
2	91 182	.0300	.00	Underground Water Well			S 1440 W 820		NE	8	15S	13E	SL			X			X			
	WATER USE(S): IRRIGATION DOMESTIC STOCKWATERING													PRIORITY DATE: 06/08/1949								
	Biggs, George										Dragerton			UT								

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:30 PM
PLOT SHOWS LOCATION OF 49 POINTS OF DIVERSION

PLOT OF ALL QUARTER(S) IN SECTION 9 TOWNSHIP 15S RANGE 13E SL BASE AND MERIDIAN

PLOT SCALE IS APPROXIMATELY 1 INCH = 1000 FEET



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UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

MAP CHAR	WATER RIGHT	QUANTITY CFS	QUANTITY AND/OR AC-FT	SOURCE DESCRIPTION or WELL INFO DIAMETER	DEPTH	YEAR LOG	NORTH		EAST		POINT OF DIVERSION DESCRIPTION CNR	SEC	TWN	RNG	B&M	U N	A P	P E	T E	S U	U G	P T	R E	D
0	91 158	.0000	65.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 08/19/1947													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 361	.5000	.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 00/00/1878													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 118	5.0000	.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 11/05/1937													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 143	.0000	16.67	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 12/18/1943													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 159	5.0000	.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): IRRIGATION DOMESTIC MINING										PRIORITY DATE: 09/24/1947													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 145	.0000	16.67	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 12/18/1943													
	Sunnyside Cogeneration Associates			P.O. Box 10							East Carbon				UT 84520									
0	91 363	1.5000	.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 00/00/1878													
	East Carbon City			P.O. Box 70							East Carbon				UT 84520									
0	91 360	2.0000	.00	Grassy Trail Creek			S	566	E	4323	NW	9	15S	13E	SL			X		X				
	WATER USE(S): DOMESTIC MUNICIPAL MINING										PRIORITY DATE: 00/00/1878													
	East Carbon City			P.O. Box 70							East Carbon				UT 84520									
0	91 141	5.0000	.00	Grassy Trail Creek			S	567	E	4324	NW	9	15S	13E	SL			X		X				
	WATER USE(S): DOMESTIC										PRIORITY DATE: 12/18/1943													
	East Carbon City			P.O. Box 70							East Carbon				UT 84520									

0 91 362 1.0000 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1878
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 367 .8750 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1888
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 368 .6250 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1888
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 369 .2500 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1888
East Carbon City 300 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 28 2.2000 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 06/10/1913
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 84 2.0000 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 01/31/1924
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 114 1.8000 .00 Grassy Trail S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 07/05/1935
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 125 5.0000 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 02/13/1940
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 146 .0000 33.33 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING PRIORITY DATE: 12/18/1943
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 178 .0000 916.00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MINING PRIORITY DATE: 12/19/1951
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

0 91 372 5.5750 .00 Grassy Trail Creek S 566 E 4323 NW 09 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1885
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

0 a18518 .5000 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION MUNICIPAL MINING POWER OTHER PRIORITY DATE: 00/00/1878
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

0 a18520 5.5750 .00 Grassy Trail Creek S 566 E 4323 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION MUNICIPAL MINING POWER OTHER PRIORITY DATE: 00/00/1885

Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

1 91 3535 .0000 .00 Grassy Trail Creek X X X
WATER USE(S):
PRIORITY DATE: 00/00/1869
Martinez, Paul B. 95 South 100 East Price UT 84501

1 91 3534 .0000 .00 Grassy Trail Creek X X X
WATER USE(S):
PRIORITY DATE: 00/00/1869
Martinez, Paul B. 95 South 100 East Price UT 84501

2 91 5003 .0000 4.73 4 130 S 700 E 3000 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC STOCKWATERING OTHER
PRIORITY DATE: 07/31/1997
Martinez Cattle Co. 95 South 100 East Price UT 84501

3 91 158 .0000 65.00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 08/19/1947
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 361 .5000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 00/00/1878
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 118 5.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 11/05/1937
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 143 .0000 16.67 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 12/18/1943
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 159 5.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MINING
PRIORITY DATE: 09/24/1947
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 145 .0000 16.67 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 12/18/1943
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 91 363 1.5000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 00/00/1878
East Carbon City P.O. Box 70 East Carbon UT 84520

3 91 360 2.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 00/00/1878
East Carbon City P.O. Box 70 East Carbon UT 84520

3 91 141 5.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC
PRIORITY DATE: 12/18/1943
East Carbon City P.O. Box 70 East Carbon UT 84520

3 91 362 1.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 00/00/1878
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 367 .8750 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING
PRIORITY DATE: 00/00/1888
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 368 .6250 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1888
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 369 .2500 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1888
East Carbon City 300 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 28 2.2000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 06/10/1913
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 84 2.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 01/31/1924
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 114 1.8000 .00 Grassy Trail S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 07/05/1935
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 125 5.0000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MUNICIPAL MINING PRIORITY DATE: 02/13/1940
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 146 .0000 33.33 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING PRIORITY DATE: 12/18/1943
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 178 .0000 916.00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): DOMESTIC MINING PRIORITY DATE: 12/19/1951
East Carbon City 200 East Park Place East Carbon UT 84520
Sunnyside City P.O. Box 69 Sunnyside UT 84539

3 91 372 5.5750 .00 Grassy Trail Creek S 1149 E 1320 NW 09 15S 13E SL X X
WATER USE(S): IRRIGATION DOMESTIC MUNICIPAL MINING PRIORITY DATE: 00/00/1885
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 a18518 .5000 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION MUNICIPAL MINING POWER OTHER PRIORITY DATE: 00/00/1878
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

3 a18520 5.5750 .00 Grassy Trail Creek S 1149 E 1320 NW 9 15S 13E SL X X
WATER USE(S): IRRIGATION MUNICIPAL MINING POWER OTHER PRIORITY DATE: 00/00/1885
Sunnyside Cogeneration Associates P.O. Box 10 East Carbon UT 84520

4 91 3535 .0000 .00 Grassy Trail Creek X X X
WATER USE(S): PRIORITY DATE: 00/00/1869
Martinez, Paul B. 95 South 100 East Price UT 84501

4 91 3534 .0000 .00 Grassy Trail Creek X X X
WATER USE(S): PRIORITY DATE: 00/00/1869

Martinez, Paul B.	95 South 100 East	Price	UT 84501

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:33 PM
PLOT SHOWS LOCATION OF 3 POINTS OF DIVERSION

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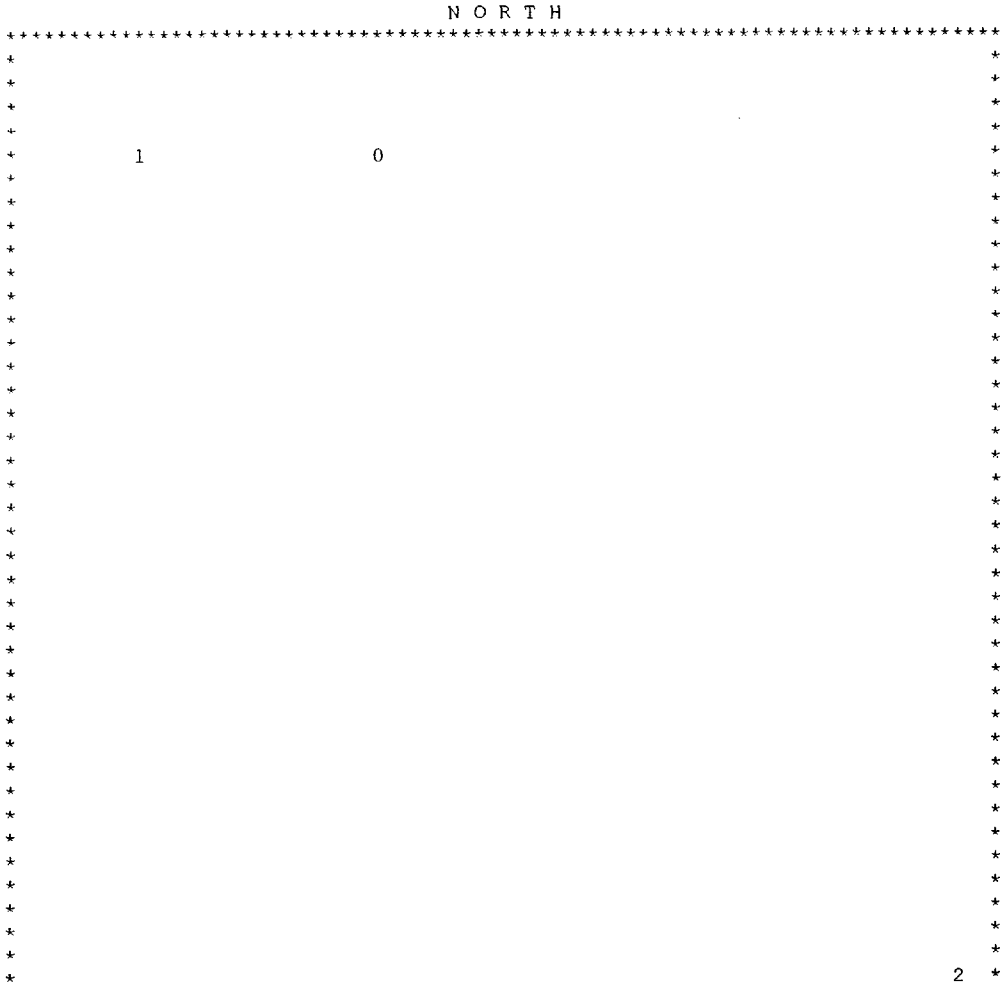

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UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

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0	91 3533	.0000	.00	Grassy Trail Creek												X		X		X	
	WATER USE(S):													PRIORITY DATE: 00/00/1869							
	Magnificent Seven L.L.C.				136 South Main, Suite 1000						Salt Lake City		UT	84101							
	Penta Creek L.L.C.				136 South Main, Suite 1000						Salt Lake City		UT	84101							
1	91 3533	.0000	.00	Grassy Trail Creek												X		X		X	
	WATER USE(S):													PRIORITY DATE: 00/00/1869							
	Magnificent Seven L.L.C.				136 South Main, Suite 1000						Salt Lake City		UT	84101							
	Penta Creek L.L.C.				136 South Main, Suite 1000						Salt Lake City		UT	84101							
2	91 124	.0026	.00	Unnamed Spring			N 525	W 208	SE	10	15S	13E	SL			X		X			
	WATER USE(S): DOMESTIC													PRIORITY DATE: 01/02/1940							
	East Carbon City										East Carbon		UT	84520							

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:35 PM
PLOT SHOWS LOCATION OF 8 POINTS OF DIVERSION

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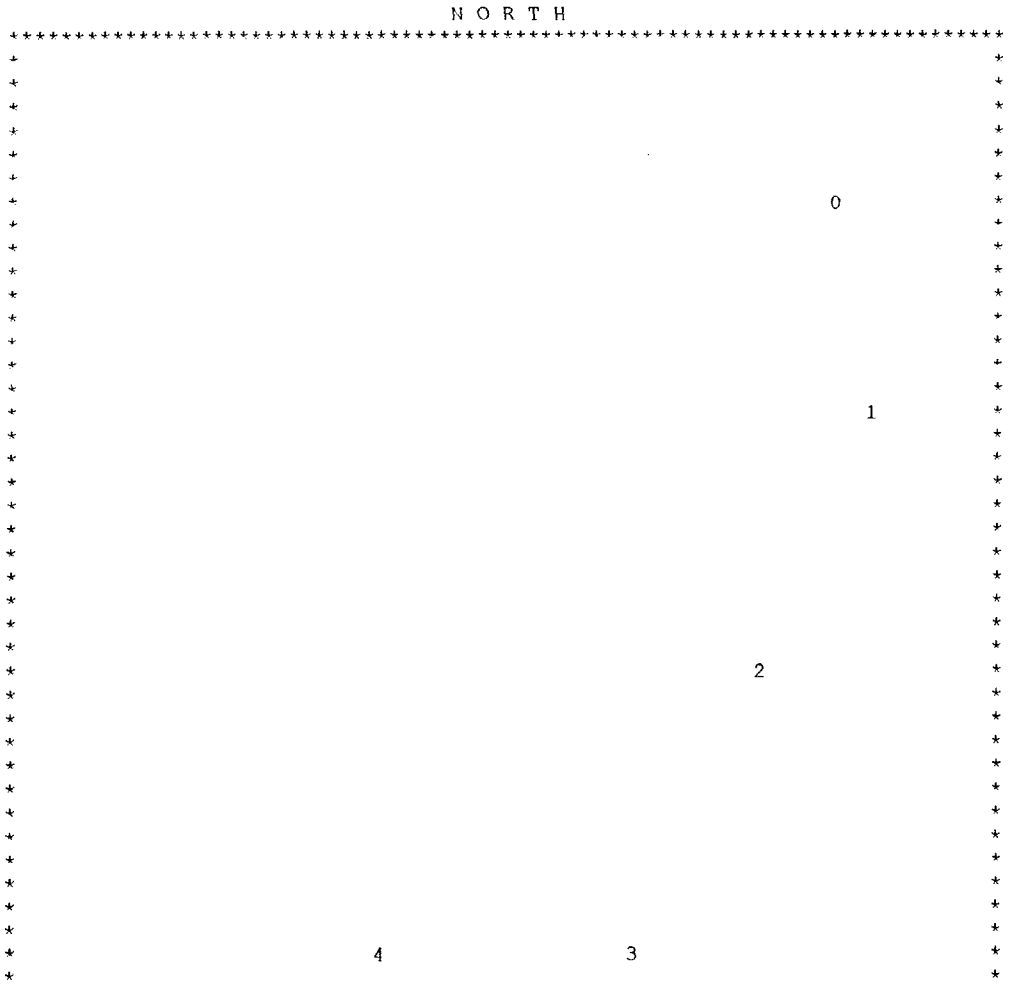

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UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

MAP CHAR	WATER RIGHT	CFS	QUANTITY AND/OR	AC-FT	SOURCE DESCRIPTION or WELL INFO DIAMETER	DEPTH	YEAR LOG	POINT OF DIVERSION DESCRIPTION NORTH	EAST	CNR	SEC	TWN	RNG	B&M	UNN	APP	PER	TER	SUR	UGW	PTP	RED
0	91 3602	.0110		.00	Unnamed Spring			S 840	W 860	NE	15	15S	13E	SL			X		X			
	WATER USE(S):									PRIORITY DATE: 00/00/1902												
	Gleave, Bonnie Lynn					150 Grassy Trail				East Carbon City					UT 84520							
1	91 3322	.0000		.00	Icelander Creek												X		X		X	
	WATER USE(S): STOCKWATERING									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price					UT 84501							
1	91 4774	.0000		.00	Unnamed Trib. to Icelander Cre												X		X		X	
	WATER USE(S): STOCKWATERING OTHER									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price					UT 84501							
1	91 4774	.0000		.00	Unnamed Trib. to Icelander Cre												X		X		X	
	WATER USE(S): STOCKWATERING OTHER									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price					UT 84501							
2	91 1824	.0110		.00	Spring Area												X		X		X	
	WATER USE(S):									PRIORITY DATE: 00/00/1902												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price					UT 84501							
3	91 3322	.0000		.00	Icelander Creek												X		X		X	
	WATER USE(S): STOCKWATERING									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price					UT 84501							
4	91 3323	.0000		.00	Icelander Creek												X		X		X	
	WATER USE(S): STOCKWATERING									PRIORITY DATE: 00/00/1869												
	Jensen Brothers					190 North Carbon Avenue				Price					UT 84501							
4	91 3323	.0000		.00	Icelander Creek												X		X		X	
	WATER USE(S): STOCKWATERING									PRIORITY DATE: 00/00/1869												
	Jensen Brothers					190 North Carbon Avenue				Price					UT 84501							

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:37 PM
PLOT SHOWS LOCATION OF 4 POINTS OF DIVERSION

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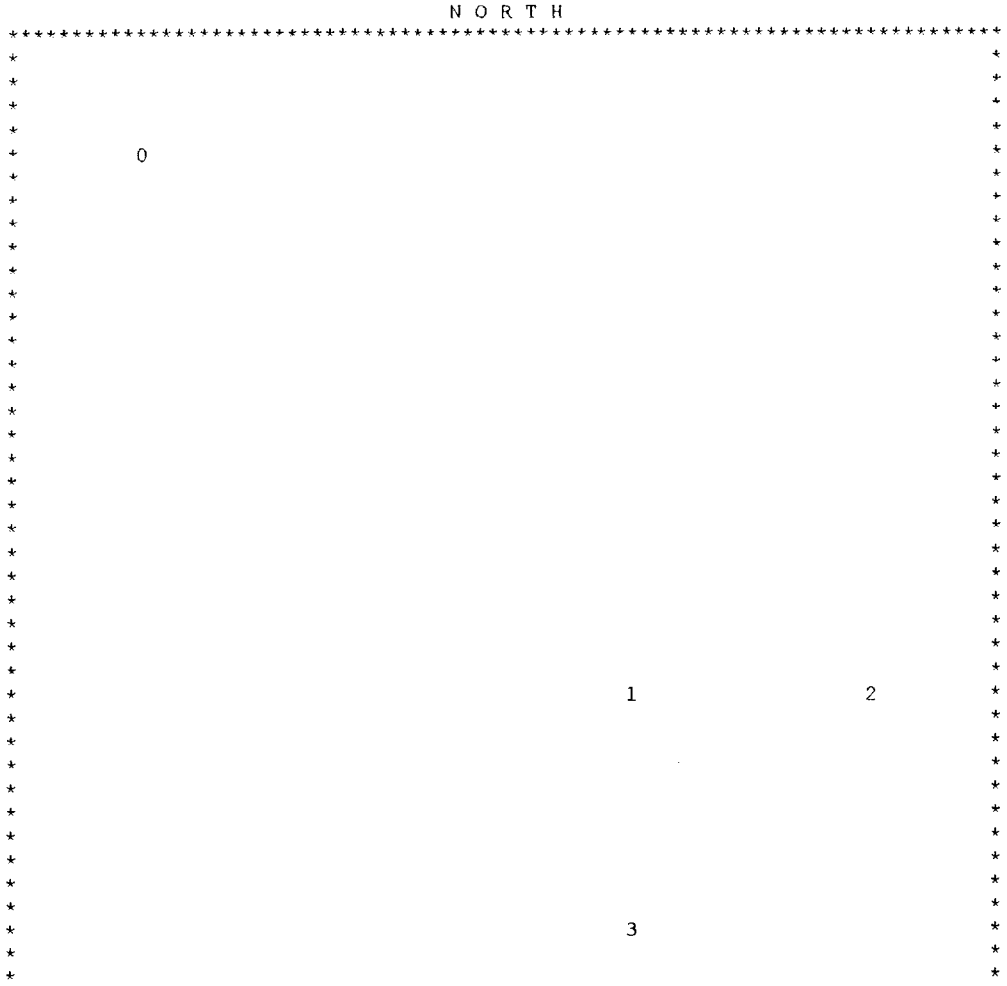

UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

MAP CHAR	WATER RIGHT	CFS	QUANTITY AND/OR	AC-FT	SOURCE DESCRIPTION or WELL INFO DIAMETER	DEPTH	YEAR LOG	NORTH	EAST	POINT OF DIVERSION DESCRIPTION CNR	SEC	TWN	RNG	B&M	U N N	A P P	P E R	T E R	S U R	U G W	P T P	R E D
0	91 3331	.0000			.00 Unnamed Stream												X		X		X	
	WATER USE(S):									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price				UT 84501								
1	91 2536	.0120			.00 Seep Spring												X		X		X	
	WATER USE(S):									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price				UT 84501								
2	91 4662	.0000			.00 Unnamed Trib. to Grassy Trail												X		X		X	
	WATER USE(S): STOCKWATERING OTHER									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price				UT 84501								
3	91 4662	.0000			.00 Unnamed Trib. to Grassy Trail												X		X		X	
	WATER USE(S): STOCKWATERING OTHER									PRIORITY DATE: 00/00/1869												
	USA Bureau of Land Management (Price Fie 125 South 600 West									Price				UT 84501								

UTAH DIVISION OF WATER RIGHTS
WATER RIGHT POINT OF DIVERSION PLOT CREATED THU, FEB 1, 2001, 4:56 PM
PLOT SHOWS LOCATION OF 4 POINTS OF DIVERSION

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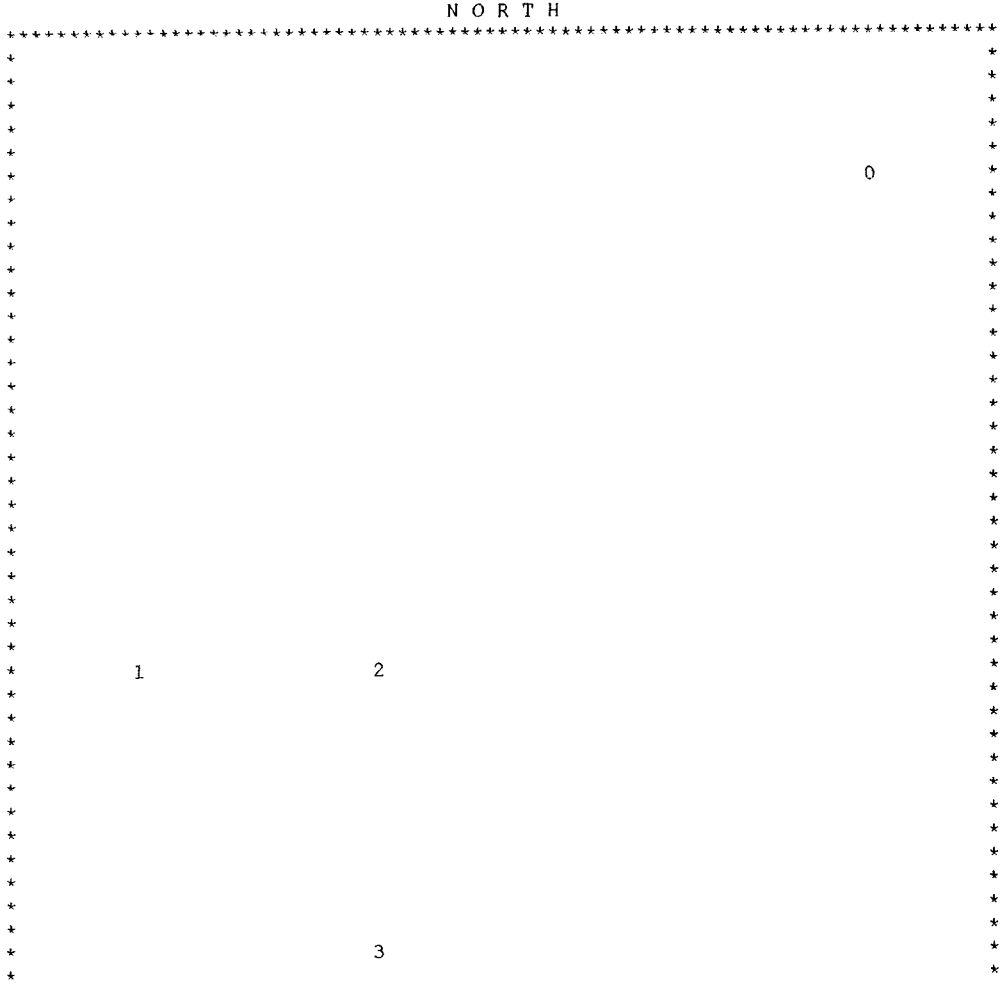
PLOT SCALE IS APPROXIMATELY 1 INCH = 1000 FEET



UTAH DIVISION OF WATER RIGHTS
NWPLAT POINT OF DIVERSION LOCATION PROGRAM

MAP CHAR	WATER RIGHT	QUANTITY CFS	AND/OR AC-FT	SOURCE DESCRIPTION or WELL INFO DIAMETER	DEPTH	YEAR LOG	NORTH	EAST	POINT OF DIVERSION DESCRIPTION CNR	SEC	TWN	RNG	B&M	UNN	APR	PTR	SUR	UWR	PTP	RED
0	91 4658	.0000		.00 Unnamed Trib. to Grassy Trail												X		X		X
	WATER USE(S): STOCKWATERING OTHER								PRIORITY DATE: 00/00/1869											
	USA Bureau of Land Management (Price Fie 125 South 600 West								Price				UT 84501							
1	91 4464	.0150		.00 Mud Spring												X		X		X
	WATER USE(S): STOCKWATERING OTHER								PRIORITY DATE: 00/00/1869											
	USA Bureau of Land Management (Price Fie 125 South 600 West								Price				UT 84501							
2	91 4786	.0000		.00 Unnamed Tributary to Mud Sprin												X		X		X
	WATER USE(S): STOCKWATERING OTHER								PRIORITY DATE: 00/00/1869											
	USA Bureau of Land Management (Price Fie 125 South 600 West								Price				UT 84501							
3	91 2606	.0000		.00 Stream												X		X		X
	WATER USE(S):								PRIORITY DATE: 00/00/1902											
	USA Bureau of Land Management (Price Fie 125 South 600 West								Price				UT 84501							

APPENDIX 10

HELP MODEL ASSUMPTIONS

USPCI
A Subsidiary of
Union Pacific Corporation

MEMORANDUM

TO: Chris Dacey

FROM: Roger Schimmel RS cc:

DATE: June 22, 1994

RE: ECDC Landfill - Water Balance/HELP Model Results

The following information summarizes the results of the water balance calculations utilizing EPA's Hydrologic Evaluation of Landfill Performance (HELP) model. The HELP model was run to evaluate the following:

- Determine the estimated net change in water storage (gain or loss) during operating conditions (i.e. landfill cell open) at various points throughout the facility life;
- Determine the estimated maximum head on both the primary and secondary liners under operating conditions, using current design criteria;
- Determine the estimated net change in water storage (gain or loss) following cell closure; and
- Examine the estimated effects of design changes on water storage and liner head.

Accordingly, several model runs were completed using different input criteria. Different operating periods in the life of a landfill cell were simulated by varying the height of the waste layer. The basic design criteria for the cell were taken from the plans and specifications available (East Carbon Development Incorporated, Municipal Landfill, Revised February, 1990). From these specifications the following construction sequence was determined:

- Four inches of rock or vegetative layer;
- Two feet of soil (undetermined classification) underlain by geomembrane;
- Waste layer;
- Synthetic drainage net overlain by geotextile fabric;
- Geomembrane underlain by 3 feet of clay;
- Synthetic drainage net overlain by geotextile fabric; and

- Geomembrane underlain by 6 inches of soil (sand or clay).

The HELP model requires the input of various climatological information. These include precipitation, evapotranspiration rates, temperature values, and solar insolation values. In general, the default data available in the model data base for Cedar, Utah were used.

In addition, the model requires input of certain design criteria, including layer thickness, soil classification, hydraulic conductivities, floor slope, and drainage length. Review of the plans showed that the floor area of the cell is approximately 1,450,000 square feet. The maximum depth of the waste layer is approximately 102 feet. The maximum drainage length to a leachate collection pipe is 407 feet with a maximum floor slope of 2.5%. In order to model the cell at different periods, simulations were run at three different waste depths, 10 feet, 50 feet, and 102 feet. The default soil characteristics (i.e. porosity, wilting point, and field capacity) were used from the model data base. The HELP model does not permit the entry of a variable thickness waste layer (i.e. a sloped layer above the top of the berm) as shown in the plan drawings. Therefore, the simulation assumed a consistent depth across the cell for each waste layer.

In order to simplify the process, several layers were combined. Where a geomembrane was indicated on the drawing, it was combined with the adjacent soil layer to form a barrier soil layer with Flexible Membrane Liner (FML) and input into the model. Therefore, the cap consisted of two layers, the 4 inch vegetative or rock layer, and a two foot barrier soil and FML layer. The bottom liner was modeled as a drainage layer (net plus fabric), an FML and 3 foot barrier soil (clay) layer, a drainage layer, and a FML with a 6 inch barrier soil (clay or sand) layer.

There is no input available in the model to simulate a synthetic drainage layer. Synthetic drainage nets have much higher transmissivities than typical sand layers and utilize less landfill space, thus allowing more waste volume. In order to correctly model the use of a geonet, the transmissivity supplied by the manufacturer was divided by the thickness of the net to derive a hydraulic conductivity. The following calculation demonstrates the procedure:

Gundle XL-14 Transmissivity: $T = 2 \times 10^{-3}$ m^2/sec;
Thickness (b) range 5.0-6.5 mm; assume 6.0 mm;
Transmissivity (T) = Kb, where K = hydraulic conductivity; therefore,

0.002 m^2/sec $= K \times 6.0$ mm $\times$ (1 m/1000 mm)
$K = 0.3333$ m/sec; or 33.3333 cm/sec

Comparatively, typical hydraulic conductivities for sand range between .01 and .001 cm/sec. Therefore, to achieve equivalent transmissivities, a sand thickness several orders of magnitude

greater would be required.

Table 1 (Open Cell Matrix) summarizes the modeling results for the cell's active period. All simulations were for five years, although the waste depth would be expected to vary over such a period. In addition to utilizing the permit design criteria, one variation was also modeled. The drainage length was increased to 690 feet. Significant results to be noted are as follows:

- All simulations showed a peak daily value of 0 inches of head on both the primary and secondary liner for the five year period, as compared to the regulatory requirement of less than 12 inches;
- The evapotranspiration rate exceeds the precipitation rate to the extent that a net loss in average annual water storage is estimated during the life of the cell. The greater the depth of waste, the greater the moisture loss; and
- No change in results is expected by varying the drainage length of the cell.

It should be noted that the open cell was conservatively modeled as having no runoff, where in actuality, typical operations would slope the working face of the waste to allow some of the precipitation to drain naturally.

Table 2 (Closed Cell Matrix) summarizes the modeling results for the time period following closure of the cell. The closed cell simulation was run under two scenarios. The first included the design criteria found in the specifications, the second varied drainage length as described above. The significant results for these runs are:

- The peak daily head on the synthetic cap liner is estimated to be 4 inches. The peak daily head on the primary and secondary liner is estimated to be 0 inches;
- Percolation through the cap is estimated to average 135 gallons per year;
- The net average annual water storage (water balance) for the cell is estimated to decrease over the five year simulation period; and
- Drainage through both the primary and secondary leachate collection systems is estimated to be zero.

In addition to the above described simulations, two additional runs were completed to estimate the impact of increased precipitation on an open cell. The default precipitation value for 1974 is 7.86 inches. This value was increased to 11.79 inches and 15.79 inches respectively. In the

first case, the peak daily head on either liner was zero inches for the year. In the second case, the peak daily head on either liner was also zero.

ECDC LANDFILL
HELP MODEL WATER BALANCE

TABLE 1

OPEN CELL MATRIX

Run	Cell Parameters			Peak Daily Values for 5 Years		Average Annual Totals for 5 Years			
	Waste Depth (ft)	Floor Slope (%)	Drainage Length (ft)	Head on Primary Liner (in.)	Head on Secondary Liner (in.)	Precip. (in.)	Leachate from Primary Collec. (gal)	Leachate from Secondary Collec. (gal)	Change in Water Storage (gal)
1	10	2.5	407	0	0	9.76	578,453	0	(287,687)
2	10	2.5	690	0	0	9.76	911,610	0	(773,340)
3	50	2.5	407	0	0	9.76	1,417,245	0	(1,126,493)
4	50	2.5	690	0	0	9.76	1,614,300	0	(1,476,045)
5	102	2.5	407	0	0	9.76	1,703,557	0	(1,412,805)
6	102	2.5	690	0	0	9.76	1,829,040	0	(1,690,793)
7	10	2.0	550	0	0	11.79	670,538	0	(360,608)
8*	10	2.0	550	0	0	15.79	3,928,500	0	(110,865)

NOTES:

* Run 8 was simulated for only 1 year, 1974. All values are for that year only.

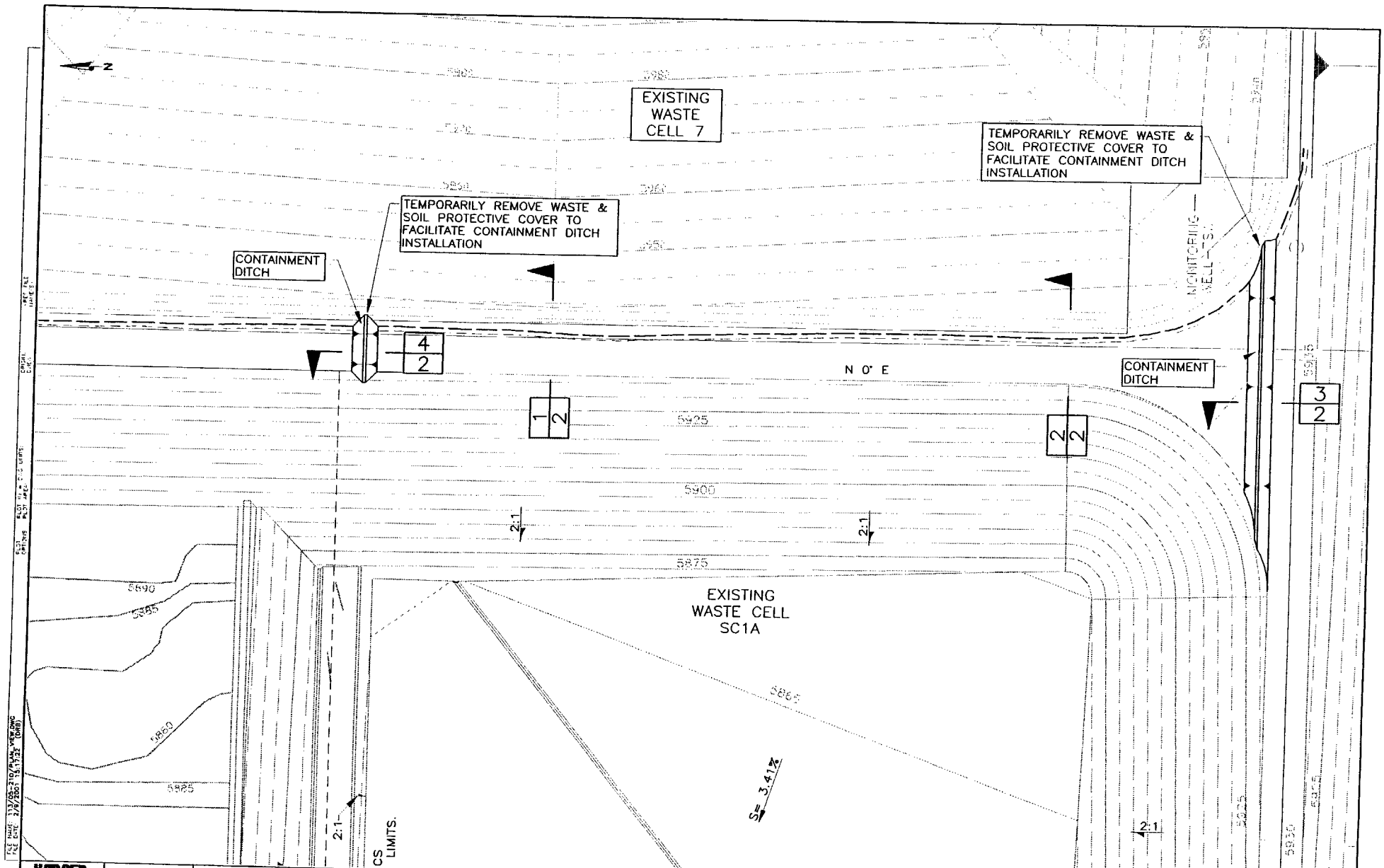
ECDC LANDFILL
HELP MODEL WATER BALANCE

TABLE 2

CLOSED CELL MATRIX

Run	Cell Parameters	Peak Daily Values for 5 Years			Average Annual Totals for 5 Years				
	Drainage Length (ft)	Head on Cap (in.)	Head on Primary Liner (in.)	Head on Secondary Liner (in.)	Precip. (in.)	Perc. thru cap (gal)	Leachate from Primary Collec. (gal)	Leachate from Secondary Collec. (gal)	Change in Water Storage (gal)
1	407	4	0	0	9.76	135	1,771,815	0	(1,645,193)
2	690	4	0	0	9.76	135	1,771,815	0	(1,645,193)

APPENDIX 11



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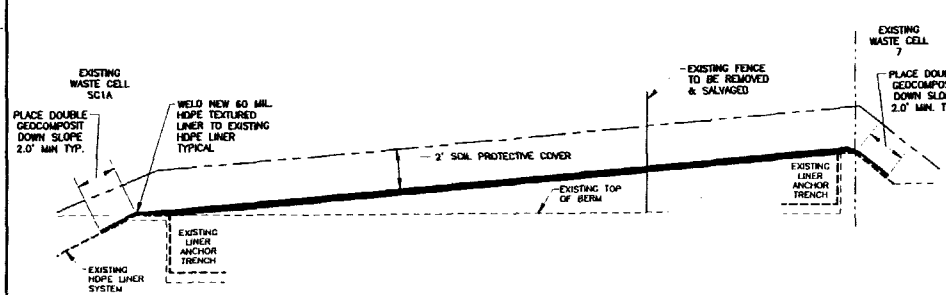
		CHECKED MEA	1	8-29-00	MODIFIED FLOOR GRADE & SLOPES IN THE SE AREA	BY	APVD		
		DATE APRIL 2000	NO.	DATE	REVISIONS				

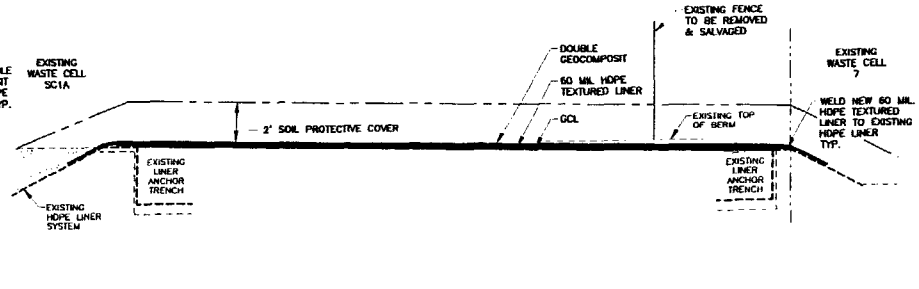
ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1–A SOUTH
CELL 7 TO SC1A CONNECTION
PLAN VIEW

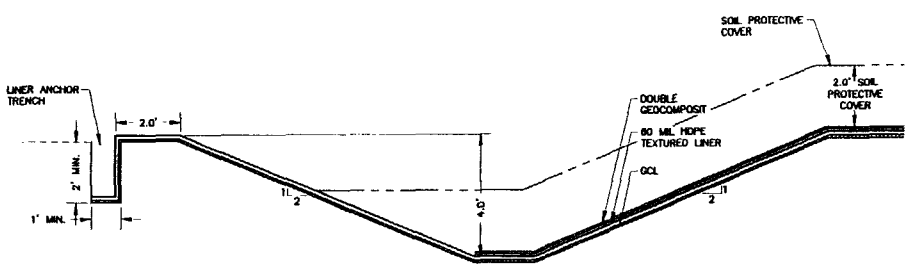
SHEET NO. 1 OF 2
113.05.210



SECTION 1/1
NTS



SECTION 2/1
NTS



SECTION 3/1
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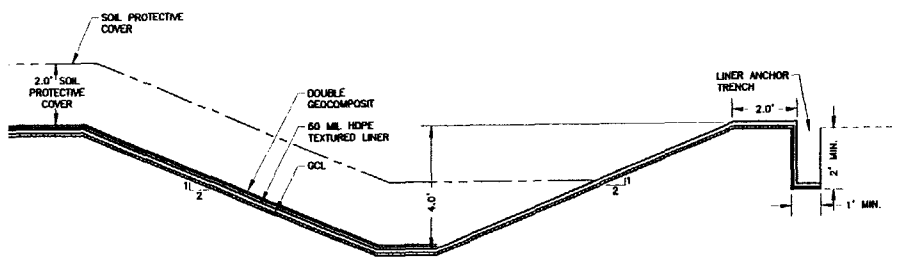

SECTION 4/1
NTS

HANSEN ALLEN & LUCE, INC. CONSULTING ENGINEERS

PROJECT ENGINEER

DESIGNED	KCS MPW	3
DRAFTED		2
CHECKED	MEA	1
DATE	APRIL 2000	NO.

DATE | REVISIONS | BY | APVD.

SCALE

VERIFY SCALE
0" 1" 2"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.

ECDC ENVIRONMENTAL

ECDC – SUPER CELL 1-A SOUTH CELL 7 TO SC1A CONNECTION TYPICAL SECTIONS

SHEET NO. 2 OF 2
113 05 210

APPENDIX 12

ECDC ENVIRONMENTAL GROUNDWATER MONITORING PLAN

February 2001

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1. Introduction 1

2. Proposed Groundwater Monitoring Plan 2

3. Proposed Statistical Analyses. 5

4. Groundwater Response Plan 7

5. Additional Requirements 8

LIST OF APPENDICES

Appendix A Standard Operating Procedures

DRAFT
ECDC GROUNDWATER MONITORING PLAN

1. Introduction

The facility groundwater monitoring system presently consists of three upgradient (background) and three downgradient (detection) monitoring wells. The three downgradient wells serve as detection monitoring wells for landfill Cell 7 and Super Cell 1A. The location of these wells are presented on Sheet 1 of the ECDC Permit Renewal Application. The geologic logs and construction details for these monitoring wells were previously submitted.

The background monitoring well network includes three wells (MW-A, MW-B, and MW-C). These wells were originally installed as piezometers during November and December, 1990 and are located to the east (upgradient) from the existing landfill Cell 7. All three wells are screened in the uppermost aquifer and range in depth from 56 feet to 68 feet below land surface.

The detection monitoring well network includes three downgradient wells (MW-7S, MW-7SW, and MW-SC1A). These wells are located along the western and southern berms of landfill Cell 7 and the southwest berm of Super Cell 1A. Wells MW-7S and MW-7SW were installed during September, 1992 and range in depth from approximately 77 feet to 84 feet from the top of the cell berm. MW-SC1A was installed in the fall of 2000. All three wells are screened in the uppermost aquifer. A former detection well, MW-7W, has been dry since installation and was plugged and abandoned by a licensed Utah Water Well Driller 2000.

All monitoring wells were constructed to standards that meet or exceed the current requirements of R315-308-2(1) and (2). Each of these wells have been sampled since their installation for all organic and inorganic parameters required by permit and are sampled by means of dedicated bladder pumps.

2. Proposed Groundwater Monitoring Plan

ECDC proposes the continued use and sampling of existing detection monitoring wells MW-7S, MW-7SW, and MW-SC1A located adjacent to Cells 7 and 1A . Additional monitoring wells may be installed as needed depending upon additional waste cell construction and/or changes in ground water flow directions. These downgradient monitoring wells will generally be located nearest the most likely point(s) of a release to ground water (for example, downgradient of leachate collection sumps).

ECDC proposes to continue the use of three upgradient monitoring wells for background ground water quality monitoring.

Any new wells will be constructed to monitor the uppermost aquifer following the guidelines required under R315-308-2. In addition, ECDC proposes to use the U.S. EPA publication RCRA Ground water Monitoring: Technical Guidance Document as a general guidance document to assure compliance with R315-308-2. ECDC will monitor for all inorganic and organic parameters as required by R315-308-4(1 through 3). In addition, ECDC has developed Standard Operating Procedures (SOPs) that specifically address ground water sampling procedures and techniques (Appendix A).

ECDC presently has a State of Utah certified laboratory perform analyses on all ground water detection monitoring samples (per R315-308-2(4)). ECDC will continue to use a Utah certified laboratory and approved analytical methods for these analyses.

ECDC proposes to define and permit each landfill cell (current and future) as separate WMAs or units. Specifically, each waste cell or unit will generally rely upon dedicated monitoring wells for groundwater detection monitoring. Detection monitoring wells will be located nearest the most likely point(s) of contaminant release. This approach allows for the more immediate detection, isolation and investigation of potential sources of groundwater contamination should a possible release to ground water be indicated. All monitoring wells will be operated and maintained so that they perform to design specifications throughout the life of the monitoring program (per R315-308- 2(2)).

After sampling all new wells quarterly for one year, ECDC proposes to sample all up- and downgradient ground water monitoring wells semi-annually. Well samples will be analyzed for all parameters listed in R315-304-2(4) (as required by R315-308-2(4)(b)). Heavy metal and organic analyses (as required by R315-304-(4)) will be performed on unfiltered samples per R315-308-2(4)(d). In addition, field measured pH, water temperature, and water conductivity will accompany each ground water sample collected.

All up- and downgradient monitoring wells have been sampled quarterly since September, 1992 (prior to waste placement) and semi-annually thereafter, and have not shown evidence of groundwater contamination. Based upon historical ground water sampling results, background ground water concentrations are below the protection standards as referenced in R317-6-2. As a result, the standards in R317-6-2 shall serve as the ground water protection standards (per R315-308-2(5)(a)). ECDC does not propose to change these established values.

3. Proposed Statistical Analyses

In accordance with R315-308-2(7) ECDC will perform statistical analyses on the ground water sample analytical results each time the monitoring wells are sampled during semi-annual detection monitoring. ECDC identified the need to provide for additional statistical testing procedures while examining the historical ground water data (upgradient and downgradient) with respect to frequency of detections, range of concentrations, analytes of concern, and results and limitations

of previously employed statistical testing procedures to determine the most appropriate statistical testing method. Therefore, ECDC proposes additional statistical testing procedures as a means of determining whether or not a "'statistically significant change in ground water has occurred with respect to background" to supplement the comparisons to the fixed ground water protection standards.

A variety of statistical testing procedures were examined. As an aid in this examination, ECDC used the U.S. EPA publication Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance, April 1989. Although the ECDC landfill is not a RCRA facility, this publication provides a complete overview of statistical method specific to ground water data evaluation. Based on a review of available methods and preliminary data analysis, ECDC has determined that the most appropriate testing procedure is the development of tolerance limit intervals. The aforementioned guidance document provides a complete description of the tolerance limit method.

The tolerance limit approach defines a concentration range from the background data, within which a large proportion of the background data population should fall with high probability. Once the range, or limit, is established, downgradient concentrations can be compared against the tolerance limit. If the data falls outside of (exceeds) the established tolerance limit, this is considered statistically significant. Tolerance limits can be calculated for both inter-well and intra-well comparisons. This allows for the monitoring and evaluation of changes in ground water quality in both up- and down-gradient monitoring wells.

ECDC proposes to calculate tolerance limits for each up- and down-gradient monitoring well for each of the ten indicator metals described in R315-308-4. Intra-well tolerance limit comparisons will be performed on each well to monitor for changes in ground water quality in each well over time. An intra-well comparison on up-gradient wells will provide for important monitoring of potential changes in background ground water quality. This is an important addition to the fixed ground water quality protection standards in R317-6-2. ECDC also proposes to calculate tolerance limits for inter-well comparisons between up-gradient and down-gradient wells. This test will also take into consideration possible changes in background ground water quality.

ECDC proposes that a "statistically significant" change in ground water quality has occurred when a parameter exceeds the ground water quality protection standards in R317-6-2 and also exceeds the inter- and intra-well tolerance limits calculated for that well. In addition, ECDC will consider any detection of an organic parameter as grounds for confirmatory resampling. Regular statistical analyses of organic constituents will not be needed unless background concentrations warrant.

ECDC believes that applying both the calculation of tolerance limits and comparisons to the ground water protection standards will provide for a comprehensive evaluation of whether a statistically significant" change in ground water quality has occurred that may be indicative of a

potential release to ground water.

4. Groundwater Response Plan

Within 14 days of discovering a statistically significant ground water quality deviation as determined by evaluation of laboratory results from a routine ground water detection monitoring event, written notification of the deviation will be submitted to the Executive Secretary. Within 30 days of the initial discovery, the suspect well(s) will be resampled for the constituent(s) of concern (R315-308-2-(10)(b)). The DSHW will be offered the opportunity to be present during re-sampling activities. The results of the resampling event will be submitted to the Executive Secretary within seven days of receipt of resample results. In lieu of ground water re-sampling, ECDC may also declare intent to provide an alternate source demonstration within 90 days (R315-308-2-(10)(a and c)).

If statistically significant concentrations are confirmed, ECDC shall submit a corrective action or assessment plan within 30 days to the Executive Secretary for approval. The corrective action or assessment plan shall include additional sampling, characterization, investigation and notification activities.

5. Additional Requirements

Per R315-308-2(6), ECDC will measure and determine the ground water surface elevation each time a well is sampled. Procedures to collect this information are thoroughly described in the ground water sampling SOP.

Per R315-308-2(9), ECDC will determine the ground water flow rate and direction each time the ground water is sampled during semi-annual detection monitoring sampling events. ECDC proposes to construct a potentiometric surface map showing ground water flow directions based upon the ground water elevation information collected from these sampling events. Ground water gradients will be calculated and combined with data from field and/or laboratory hydraulic testing of the underlying formation material to calculate a ground water flow rate. Formation testing will be performed on each new monitor well following well construction and development.

Surface water monitoring occurs as part of the UPDES General Permit for Storm water Discharges Associated with Industrial Activity administered by the Utah Department of Environmental Quality which is not part of this permit renewal.

APPENDIX A
Standard Operating Procedures

ECDC Facility
Ground-Water Sampling
Standard Operating Procedure

Revised June 23, 1994

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DRAFT
ECDC FACILITY GROUNDWATER SAMPLING
STANDARD OPERATING PROCEDURE

i. INTRODUCTION

It is the goal of this Standard Operating Procedure (SOP) document to provide for efficient, accurate, and representative sampling of the groundwater at the ECDC Facility and the subsequent analysis of those samples. This document will serve as a procedural guide for groundwater sampling during baseline, detection, and compliance monitoring events. Other non-routine sampling events may also be covered by this document.

Throughout this document, the term "The Laboratory" will be used. "The Laboratory" is expressly stated to mean a Utah certified lab.

A. Responsibilities of Key Personnel

Management of the ground-water monitoring program at this facility will be a coordinated effort between the ECDC Facility staff, ECDC management staff, consultants and The Laboratory. The actual sampling team(s) may be composed of representatives from any or all of these entities.

The sampling and/or purging team(s) are responsible for conducting the field activities of the sampling episode. The team coordinator and/or leader for the sampling event will be determined prior to sampling. Team members may come from the Facility staff, the Laboratory, consultants, or other qualified designees. The sampling team will be comprised of a minimum of two members.

Purging may be done by a single team member. Routine water level measurements may also be conducted by a single team member.

Each team member will have read this ECDC Groundwater Sampling and Field Analysis SOP before sampling is undertaken.

B. Quality Assurance/Quality Control (QA/QC)

Detailed QA/QC procedures are continuously monitored and addressed by the ECDC facility and are a significant part of sample collection, sample preservation, sample shipment, analytical procedures and chain-of-custody control.

II. SAMPLING EVENT PLANNING

A. Preparation

1. Scheduling: The final sampling event schedule will be approved by the Facility Project

Manager in charge of facility monitoring. The following tasks will be accomplished:

a. Appropriate sample containers for the sampling event will be ordered, inspected, labeled, and packaged as per the analytical protocol. Coolers and/or other sample shipping containers will also be included.

b. Prior to the sampling event all required instrumentation needed for the collection of field analytical data will be ordered, and/or gathered. These instruments will usually include:

- Electronic Water Level Indicator;
- Field pH meter;
- Field conductivity meter.
- Field thermometer.

As the field instrumentation is gathered, each instrument will be confirmed to be operational. Calibration and testing procedures as outlined by manufacturers specifications will be followed. Any equipment needing repair, battery recharging or replacement will be evaluated and corrected.

c. Following receipt of sample containers at the Facility, the sample containers will be inventoried and inspected to assure that all they have been received in acceptable condition. Missing or broken containers will be reordered or replaced.

d. Other needed equipment will be ordered and/or collected:

- Safety equipment such as protective gloves, safety glasses, or other personal protective equipment (PPE) for each team member, as required by facility health and safety policy.
- Graduated wastewater buckets, graduated cylinder or beaker, and timing device capable of measuring to the nearest second.
- Sample containers for field analytical determinations.
- Deionized/distilled water will be available from the Laboratory or other source for cleaning purposes and the collection of QA/QC blank samples.
- Well controller(s) for dedicated well pumps. All units will be confirmed to be working as per the manufacturer's specifications.

- Tarpaulin, plastic sheets, or other nonporous material (ground cloth) for use as at each sample location.

e. Documentation will be maintained by each team describing performance of all procedures and tasks. Notes are to be taken during all purging and sampling related activities describing the sequence of events. This documentation will be maintained in a combination of field notebooks, field data sheets, field forms, and/or checklists. At a minimum, each team will maintain a field notebook. Field notebooks are to be constructed of bound, water-resistant pages. Notes are to be entered using non-erasable ink. Data may be transferred from field notebooks to other required field data sheets and forms at a later time and date. Information may be recorded in more than one location. Information recorded during purging and sampling related activities shall include, but not be limited to the following:

- Identification of sampling location or monitoring well, condition of well, whether locked or not, any evidence of tampering, and the presence of standing water in the vicinity.

- General meteorological information (if available) including temperature, wind direction and velocity , and general weather conditions. These measurements will be recorded at least twice daily, once in the morning and once in the afternoon.

- Identification of all sample team members and observers-

- Depth to water information-

- W ell purging information and calculations.

- Order of sampling collection-

- Instrument calibration information-

- Variations from the SOP and the reasons for the variations.

B. Day of Sampling Preparation

1. Field Instrumentation: Field instrumentation will be validated for use daily prior to use in the field. Manufacturer's specifications will be followed for the calibration and maintenance of all field instruments. Instrument preparation protocols include the following:

- pH Meter: The pH meter will be calibrated daily using a two buffer system. The two primary calibration buffers should bracket the range of anticipated values. The

calibration shall be conducted outside of facility buildings at ambient temperatures.

- Conductivity Meter: The conductivity meter will be calibrated daily following manufacturer's specifications.

- Electronic Water Level Meter: The water level meter will be confirmed to be working as per manufacturer's specifications-

- Field Thermometer. Use of the thermocouple in the pH meter can suffice as a temperature measuring device, or a laboratory grade bulb thermometer may also be used.

2. *Health and Safety:*

- Sampling team members will adhere to all facility specific health and safety requirements.

- Gloves will be worn by all team members participating directly in sample collection and preservation tasks. As a minimum, disposable latex gloves or equivalent will be worn. Gloves will be changed as required to prevent cross contamination and maintain cleanliness. Gloves will be changed between wells and if they become soiled.

3. *Sample Containers and Coolers:*

Ice, or other cooling agents, will be added to the coolers prior to their use for sample storage. Following sample collection and inventory, and prior to sample shipment, additional ice or cooling agents may be added to the shipping containers to ensure a cool environment during shipping.

4. *Documentation Package*: The following documentation will be maintained by each team:

- Field notebook(s);

- Field data sheets (if used);

- Chain-of-custody forms

Appropriate writing tools, such as ballpoint pens and indelible markers, will be available.

III. SAMPLING ROUTE AND QA/QC SAMPLES

A. Sampling Route

The sampling route will be based on first sampling of the wells with the least potential for contamination and proceeding to the wells with the highest potential for contamination. The basic strategy is that upgradient wells are to be sampled prior to downgradient wells and that wells outside of the controlled area be sampled prior to wells inside the controlled area. If leachate sumps are to be sampled, they will be sampled last on the schedule. w ells known to be slow to recover will be purged at an appropriate time to assure timely completion of the sampling event. The route may change based upon facility operational and/or construction requirements.

B. QA/QC Samples

Sample duplicates, field blanks, equipment blanks, and trip blanks will be collected during sampling events as QA/QC samples. All QA/QC samples will be collected with the same care and treated as regular samples.

Duplicate samples will be collected from a minimum of ten percent (10%) of the sampled wells. Each duplicate sample will be analyzed for the same parameters as the original sample. Duplicates will be collected by alternating the filling of bottles between the sample and the duplicate sets. Each duplicate will be labeled to disguise the sample location from the laboratory. The location and identity of each duplicate sample will be maintained in the field documentation.

A least one complete field blank will be collected during each week of sampling. A complete bottle blank will collected using the deionized water used for cleaning and decontamination. In addition, one VOC field blank will be collected daily. Field blanks will be collected at a sample location (i.e. wellhead) or in the immediate vicinity of facility activity (such as near an active cell).

Trip blanks will originate at the Laboratory, will remain with a shipment cooler, and will be submitted to the laboratory with sample shipments for analysis. At a minimum of one trip blank for each day of shipping will be submitted for voc analysis.

IV. WATER LEVELS AND WELL PURGING

A. Water-level Readings

Water-level readings for each well shall be taken using an electronic depth meter. Water levels will be measured during each sampling event prior to well purging/sampling activities. Gloves (latex or equivalent) will be worn to minimize the potential for contamination. water-level readings are taken as follows:

- The well lock will be removed and the steel top opened. The plastic plug in the well cap will be removed, taking care that no dirt or foreign matter is dropped into the well. The probe of the electronic depth meter will be rinsed with deionized/distilled water. The probe will be slowly lowered into the well until the meter indicates that water has been reached. The depth at which the water was encountered will be measured from a surveyed datum and recorded. The probe will be raised until it is no longer in the water. Lower the probe again until the meter indicates that water has been reached and record the second value in the field log book. If the values do not agree within 0.02 ft., repeat the steps as above until the two readings agree within 0.02 ft. (record all values).

- The probe will be raised from the well, cleaning the immersed portion of the cable and rinsing the probe thoroughly with deionized/distilled water.

B. Well Purging

At a minimum, three well casing volumes will be purged prior to obtaining a sample. w ells with low rate of recovery will require special procedures. w ells will be defined as being dry when less than 75 ml/minute is obtained during pumping. Wells too slow to recover will be purged dry and allowed to recover for about 24-hours (or less if the water level has recovered sufficiently).

Following this recharge cycle, as much sample as possible will be obtained. The well will be allowed to recover an additional 24-hours (or less if the water level has recovered sufficiently) should additional water be needed for sample collection. All wells except low recovery wells will be sampled the same day they are purged.

C. Well-volume Calculations

The volume of water to be removed from the well for purging can be calculated from the following formula:

Water volume to be purged (gal) = (Casing Length in Ft - Depth to Water in Ft) * X * 3

Where: X = 0.147 for 2 inch wells
X = 0.650 for 4 inch wells
X = 1.569 for 6 inch wells

Values for additional casing sizes are available and values may change as construction materials vary. Following is a description of the well purging procedure:

- Connect the well pump control unit to each well (if nested).

- Start the pump and remove as much water from the well as required based on the well-volume calculation. Collect purge water in an appropriate container to validate purge volumes.

- Record the amount removed from the well-

- Cap and re-lock the well and proceed to the next well according to the schedule or proceed with sampling.

V. WELL SAMPLING

Well sampling can proceed following purging. All wells, except low recovery wells, will be sampled the same day they are purged.

A. Field Analytical Protocol

1. After arrival at the well, note all required environmental and site information.

2. Place a clean ground cloth on the ground near the well.

3. Separate samples for temperature, pH, and specific conductance may be collected or these analysis may be performed from the same sample. The first measurement to be taken will be for water temperature. Start the pump and flush the sampling tube into a beaker, then discard this sample in the waste container. Collect a sample in a beaker, place the "thermometer" in the sample, and record. Discard the sample in the waste container, rinse the thermometer device with deionized/distilled water and replace in the protective sheath.

4. pH is the next sample measurement. Take a sample from the well, place the pH probe into the sample, let the reading stabilize, and record. Remove the probe from the water and re-immerse the probe into the sample to obtain a second reading. Continue this process until consistent values are obtained and record all readings. Wash the probe with deionized/distilled water.

5. The final field analysis will be specific conductance. Take a sample from the well and immerse the conductivity probe into the sample. Measure and record the value. Discard sample in the waste container, wash probe with deionized/distilled water. In the event of specific conductivity greater than 100,000 umhos/cm, specific conductance will also be analyzed by the Laboratory.

B. Laboratory Analyses

Required analytes will be sampled in the order listed below. Table I provides a summary of holding time limits and preservation methods, and analytical methods. The information in these tables is subject to change based upon changes in analytical method requirements per EPA report SW -846.

Group I:

- Volatiles
- TOC

Group II:

- Semi-volatile organics
- Total Metals
- Dissolved Metals
- General Parameters - TDS, Anions, etc.
- Ammonia

Group I analyses are flow-sensitive and will be collected first. Group II samples are not flow sensitive. Generally, the safest method of preserving with an acid or base is to add the preservative once the bottle is full. All battles will be filled such that sufficient headspace remains for the addition of any required preservatives.

1. Sampling Group I analyses:

- The pump discharge rate will be adjusted and timed until flow is less than or equal to 100 ml/minute. If the flow rate is adjusted before all flow sensitive samples have been taken, the flow rate must be rechecked before collecting additional flow sensitive samples.
- All flow sensitive samples should be collected so that no air is trapped within the sample bottle after the cap is placed on each bottle. Each sample bottle should be inverted to check for air bubbles. If there is air in the sample, open the bottle and

add additional sample water to displace the air. Recheck until there is no trapped air as determined by inspection. Sample preservative, if required, may be added to the sample bottle during or prior to sample collection.

2. *Sampling Group II analytes:*

- Because group II analytes are not flow sensitive they may be sampled at higher pump discharge rate. The bottles do not need to be checked for trapped air. Sample preservatives, if required, may be added to the sample bottles during, prior to, or following sample collection.

C. Completion of well sampling

When the final sample has been collected, the following procedure is used to secure the well and prepare to move to the next sampling location:

- Remove the pump controller hose from the well pump.
- Secure the well by replacing the cap and putting the lock in place. Make sure any protective covers or caps have been put in place and secured.
- Clean the surface of the ground cloth and place in sampling vehicle or carefully dispose.
- Secure all excess ground water and rinses in a waste container for disposal.
- Dispose of used gloves.
- Proceed to the next sampling site.

D. Ending the Sampling Episode

After the final sample has been taken for a given sampling day, the following protocol is used to complete the documentation and send the samples to the Laboratory for analyses:

- Each cooler should be checked to make sure that all samples have been collected and are packed securely on ice. Packaged ice, "blue ice" or other cold preservative is acceptable as a coolant. Coolers filled during the day may be left in a secure (locked) area until the end of the day.

- A sampling team member shall review and sign the chain-of-custody forms and make sure they are placed in the cooler with the samples. Each cooler shall be sealed with "chain-of-custody" tape or equivalent.

- The bill of lading and documentation will be prepared to send the samples to The Laboratory using an overnight delivery service (within a time frame to assure that the samples will arrive at the laboratory the next day). As an option, the samples may be escorted to The Laboratory.

E. Well Re-sampling

During sampling handling, shipments, and analysis sampling bottles may be broken. In addition sample holding times may be exceeded. As a result, additional well re-sampling may be required to obtain new samples. Usually , this additional sampling will require a limited number of samples to be collected for analysis.

If re-sampling is required, the re-sampling will be scheduled for within 14 days of discovery for missing analyses. All of the procedures presented in this document will apply, including well purging and sampling. All re-sampling efforts will follow all applicable documentation guidelines.

VI. DOCUMENTATION AND DOCUMENT CONTROL

Management of the documentation package is a critical aspect of the sampling, as it provides assurance that all requirements of the operational permit in relation to facility ground-water sampling and analysis are being followed, as well as providing a complete record of activities prior to and during the event. Documentation must be processed completely and accurately.

VII. MALFUNCTIONING MONITORING WELLS

Wells with dedicated pumps may sometimes need to be sampled with a bailer. The procedures are as follows:

- A well may be sampled with a dedicated bailer, or a previously cleaned bailer using the steps identified in the procedure describing the cleaning of a used bailer. An alternate method is to use a disposable bailer.

- Purging and sampling will be conducted by lowering the bailer down the well until it fully immerses in water and then returning it to the surface. Discard the water into a waste container, if it is being purged, or into the appropriate sample container, if the well is ready to be sampled. The bailer may be manipulated by hand or a power winch, using a monofilament rope, PTFE coated wire, or single strand stainless steel wire.

- During purging and sampling the bailer and associated sampling cord should not be allowed to touch the bare ground or any potentially contaminated surface. Should this happen, the bailer and/or cord must be decontaminated or replaced prior to use.

- Bailers will be kept wrapped in clean plastic or similar material and stored in a clean plastic bag, when not in use. Alternately, bailers may be stored in the well to which they are dedicated.

- If a bailer is to be reused, the following procedure is used to clean it:

  a) If the bailer is heavily contaminated, the bailer will be thoroughly washed with a strong laboratory soap such as Alconox or Hexane/ Acetone. Hexane/ Acetone are not desired as rinses. Mechanical action with a cloth or brush may be needed to remove stubborn contamination.

  b) Thoroughly rinse the bailer with tap water.

  c) Triple rinse the bailer with deionized/distilled water.

  d) The bailer is allowed to air dry or wiped dry using a clean and dry laboratory grade disposable wipe such as a Kimwipe (TM) or equivalent.

  e) The same cleaning procedures will be followed for the cord utilized in the activity. As an alternative, the cord may be disposed.

TABLE 1
SAMPLE PRESERVATION AND HOLDING TIME LIMITS

Subject to change based upon changes in analytical method requirements per EPA report SW -846.

Parameter (if required)	Analysis Method	Preservation Method	Holding Time Limit (1)
Anions			
Chloride	EPA 300.0	Cool to 4 C	28 days
Nitrate - N	EPA 300.0	Cool to 4 C	48 hours
Nitrate - N	EPA 300.0	Cool to 4 C	48 hours
Ortho-Phosphate-P	EPA 300.0	Cool to 4 C	48 hours
Sulfate	EPA 300.0	Cool to 4 C	28 days
Alkalinity	EPA 310.1	Cool to 4 C	14 days
Ammonia	EPA 350.2	Cool to 4 C pH<2 H2S04	28 days
Conductivity	EPA 120.1/ SW9050	Cool to 4 C	28 days
Flouride	EPA 340.2	Cool to 4 C	28 days
Hardness	EPA 130.2	HN03 or H2S04 to pH<2	6 months
Nitrogen -			
Total Kjeldahl	EPA 351.3	Cool to 4 C H2S04 to pH<2	28 days
pH	EPA 150.1/ SW 9040	Cool to 4 C	48 hours or immediately
Phosphorus, Total	EPA 365.2	Cool to 4 C H2S04 pH<2	28 days
Sulfide	EPA SW 9030	Cool to 4 C Zinc Acetate + NaOH to pH>9	7 days
TOC	EPA 415.1/ SW 9060	Cool to 4 C HC1 or H2S04 to pH<2	28 days
Total Dissolved Solids	EPA 160.1	Cool to 4C	7 days
Organics			
Purgeables	SW 8240	Cool to 4 C, pH<2 with H2S0[4], HCL, or NaHS04	14 days
Base Neutrals	SW 8270	Cool to 4 C	7 days/40 days
Acids	SW 8270	Cool to 4 C	7 days/40 days
Metals			
Total Metals (ICP) months	SW 6010	HN03 pH<2	6
Total Metals (GFAA)	SW 7000 series	HN03 pH<2	
Dissolved Metals	SW 6010	Filter at sampling then HN03 to pH<2	6 months
Mercury	SW 7470	HN03 to pH<2	28 days

(1) EPA Update may be substituted.

APPENDIX 13

ECDC Environmental, LC
Landfill Gas Quarterly Montoring Results
Year _____ Quarter _____

Date: _____ Time: _____

Name of Gas Sample Collector _____

Temperature _____ Weather _____

Monitoring device should be calibrated prior to initiating sampling.
Accomplished? Yes No

Methane Monitoring Location	Measured % LEL	Internal Action Limit: Half of Regulatory Limit (% LEL)	Regulatory Action Limit (% LEL)
1. Administrative Building		12	25
2. SW Corner of Rotary Dump		12	25
3. SW Corner of Bottom Dump Area		12	25
4. SE Corner of Intermodal Area		12	25
5. NW Corner of the Scale House		12	25
6. North Boundary		50	100
7. South Boundary		50	100

- **Gas Sample Collector:** If measured % LEL equals or exceeds internal action limit, contact the facility manager.
- **Facility Manager:** If measured % LEL equals or exceeds regulatory action limit, notify the State Director in compliance with 40 CFR 258.23(c).

Comments:

_____
_____
_____
_____
_____
_____
_____

_____
Gas Sample Collector

APPENDIX 14

Closure of Cell #7

#	Description	Unit	Quantity	Cost	Total
1.	Engineering	Job	1	$10,000.00	$10,000
2.	Technical Specifications and Drawings	Job	1	$45,000.00	$45,000
3.	Grading of Existing Waste	Acre	48	$850.00	$40,800
4.	Preparation of Selected Waste				
	2a) Screen and Produce Material	CY	155,555	$1.20	$186,666
	2b) Placement and Compaction of Screened Material	CY	155,555	$2.20	$342,221
5.	Installation of Geosynthetic Liner	SF	2,100,000	$0.31	$651,000
6.	Installation of Geonet	SF	2,100,000	$0.29	$609,000
7.	Installation of Geotextile	SF	2,100,000	$0.17	$357,000
8.	Protective Soil Cover				
	6a) Production of Material	CY	155,555	$1.20	$186,666
	6b) Placement and Compaction of Material	CY	155,555	$2.20	$342,221
9.	Cover Cell with Vegatation or Rock	SY	232,320	$3.87	$899,078
10.	Drainage Control for Cell	Cell	1	$20,000.00	$20,000
11.	Surveying	Acre	48	$767.00	$36,816
12.	Materials Testing and Reporting	Acre	48	$2,000.00	$96,000
13.	Oversight and Supervision	Job	1	6.00%	$229,348
14.	**TOTAL**				**$4,051,817**

Closure of Cell #10

#	Description	Unit	Quantity	Cost	Total
1.	Engineering	Job	1	$10,000.00	$10,000
2.	Technical Specifications and Drawings	Job	1	$45,000.00	$45,000
3.	Grading of existing waste to acceptable grades	Acre	8	$850.00	$6,800
4.	Removal and Excavation of Existing Dikes	CY	165,000	$2.91	$480,150
5.	Construction of north dike				
	3a) Placement and Compaction of Material	CY	165,000	$2.20	$363,000
	3b) Clay Liner Placement	CY	3,280	$15.50	$50,840
	3c) Installation of Geosynthetic Liner	SF	42,150	$0.31	$13,067
	3d) Construction of Anchor Trench	LF	2,850	$10.23	$29,156
6.	Preparation of Selected Waste				
	4a) Screen and Produce Material	CY	25,825	$1.20	$30,990
	4b) Placement and Compaction of Screened Material	CY	25,825	$2.20	$56,815
7.	Installation of Geosynthetic Liner	SF	348,500	$0.31	$108,035
8.	Installation of Geonet	SF	348,500	$0.29	$101,065
9.	Installation of Geotextile	SF	348,500	$0.17	$59,245
10.	Protective Soil Cover				
	8a) Production of Material	CY	25,825	$1.20	$30,990
	8b) Placement and Compaction of Material	CY	25,825	$2.20	$56,815
11.	Cover Cell with Vegatation	SY	38,720	$3.87	$149,846
12.	Drainage Control for Cell	Cell	1	$15,000.00	$15,000
13.	Surveying	Acre	8	$767.00	$6,136
14.	Materials Testing and Reporting	Acre	8	$2,000.00	$16,000
15.	Oversight and Supervision	Job	1	6.00%	$97,737
16.	**TOTAL**				**$1,726,686**

Closure of Super Cell 1-A

#	Description	Unit	Quantity	Cost	Total
1	Engineering	Job	1	$10,000.00	$10,000
2	Technical Specifications and Drawings	Job	1	$45,000.00	$45,000
3	Grading of Existing Waste	Acre	13	$850.00	$11,050
4	Preparation of Selected Waste				
	2a) Screen and Produce Material	CY	33,400	$1.20	$40,080
	2b) Placement and Compaction of Screened Material	CY	33,400	$2.20	$73,480
5	Construction of Embankments	CY	158,444	$3.20	$507,021
6	Installation of Geosynthetic Liner	SF	450,900	$0.31	$139,779
7	Installation of Geonet	SF	450,900	$0.29	$130,761
8	Installation of Geotextile	SF	450,900	$0.17	$76,653
9	Protective Soil Cover				
	6a) Production of Material	CY	33,400	$1.20	$40,080
	6b) Placement and Compaction of Material	CY	33,400	$2.20	$73,480
10	Cover Cell with Vegatation or Rock	SY	50,094	$3.87	$193,864
11	Drainage Control for Cell	Cell	1	$20,000.00	$20,000
12	Surveying	Acre	13	$767.00	$9,971
13	Materials Testing and Reporting	Acre	13	$2,000.00	$26,000
14	Oversight and Supervision	Job	1	6.00%	$83,833
15	**TOTAL**				**$1,481,052**

APPENDIX 15

Cell #7 Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate	LS	1	$7,500.00	$7,500
2.	Gas Collection and Monitoring	HOUR	40	$60	$2,400
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipmen	ACRE	5	$1,000.00	$5,000
4.	Rework or Replace Defective Groundwater Monitoring				
	Wells and Equipment, Install New Wells and Equipment	EACH	3	$2,700.00	$8,100
5.	Collect Semi-Annual Groundwater Samples	HOUR	60	$65.00	$3,900
6.	Analyze Semi-Annual Groundwater Samples	EACH	6	$1,000.00	$6,000
7.	Maintain Site Security and Access Control	LS	1	$1,500.00	$1,500
8.	Provide Administrative Overhead for Oversight and				
	Record Keeping	HOUR	60	$75.00	$4,500
9.	Prepare Post-Closure Certificate	HOUR	30	$75.00	$2,250
10.	**TOTAL**				**$41,150**

Cell #10 Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate	LS	1	$7,500.00	$7,500
2.	Gas Collection and Monitoring	HOUR	20	$60	$1,200
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipmen	ACRE	1	$1,000.00	$1,000
4.	Rework or Replace Defective Groundwater Monitoring				
	Wells and Equipment, Install New Wells and Equipment	EACH	3	$2,700.00	$8,100
5.	Collect Semi-Annual Groundwater Samples	HOUR	60	$65.00	$3,900
6.	Analyze Semi-Annual Groundwater Samples	EACH	6	$1,000.00	$6,000
7.	Maintain Site Security and Access Control	LS	1	$1,500.00	$1,500
8.	Provide Administrative Overhead for Oversight and				
	Record Keeping	HOUR	60	$75.00	$4,500
9.	Prepare Post-Closure Certificate	HOUR	30	$75.00	$2,250
10.	**TOTAL**				**$35,950**

Super Cell 1-A Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate	LS	1	$7,500.00	$7,500
2.	Gas Collection and Monitoring	HOUR	20	$60	$1,200
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipmen	ACRE	1	$1,000.00	$1,000
4.	Rework or Replace Defective Groundwater Monitoring				
	Wells and Equipment, Install New Wells and Equipment	EACH	3	$2,700.00	$8,100
5.	Collect Semi-Annual Groundwater Samples	HOUR	60	$65.00	$3,900
6.	Analyze Semi-Annual Groundwater Samples	EACH	6	$1,000.00	$6,000
7.	Maintain Site Security and Access Control	LS	1	$1,500.00	$1,500
8.	Provide Administrative Overhead for Oversight and				
	Record Keeping	HOUR	60	$75.00	$4,500
9.	Prepare Post-Closure Certificate	HOUR	30	$75.00	$2,250
10.	**TOTAL**				**$35,950**

APPENDIX 16

Cell #7 Post-Closure Investment

Starting Cost	$41,150
Income interest per year	12.00%
Income interest per month	1.00%
Cost increase per year	3.74%
Post-Closure Investment	***$474,930***

Interest Income and Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$41,150	$474,930	$433,780
2	$42,687	$488,794	$446,107
3	$44,281	$502,685	$458,403
4	$45,935	$516,540	$470,605
5	$47,651	$530,290	$482,639
6	$49,431	$543,850	$494,419
7	$51,277	$557,124	$505,847
8	$53,192	$570,001	$516,809
9	$55,179	$582,353	$527,174
10	$57,240	$594,033	$536,793
11	$59,378	$604,872	$545,494
12	$61,595	$614,677	$553,081
13	$63,896	$623,226	$559,330
14	$66,283	$630,267	$563,985
15	$68,758	$635,512	$566,754
16	$71,326	$638,632	$567,306
17	$73,990	$639,255	$565,264
18	$76,754	$636,954	$560,200
19	$79,621	$631,248	$551,627
20	$82,594	$621,587	$538,993
21	$85,679	$607,350	$521,671
22	$88,879	$587,832	$498,953
23	$92,199	$562,232	$470,033
24	$95,643	$529,645	$434,002
25	$99,215	$489,045	$389,830
26	$102,921	$439,270	$336,349
27	$106,765	$379,007	$272,242
28	$110,752	$306,769	$196,017
29	$114,889	$220,877	$105,988
30	$119,180	$119,429	$249

Cell #10 Post-Closure Investment

Starting Cost	$35,950
Income interest per year	12.00%
Income interest per month	1.00%
Cost increase per year	3.74%
Post-Closure Investment	***$414,930***

Interest Income and Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$35,950	$414,930	$378,980
2	$37,293	$427,044	$389,751
3	$38,686	$439,182	$400,496
4	$40,131	$451,289	$411,158
5	$41,629	$463,304	$421,674
6	$43,184	$475,153	$431,969
7	$44,797	$486,753	$441,956
8	$46,470	$498,007	$451,537
9	$48,206	$508,803	$460,597
10	$50,007	$519,012	$469,006
11	$51,874	$528,487	$476,613
12	$53,812	$537,059	$483,248
13	$55,822	$544,536	$488,714
14	$57,907	$550,695	$492,789
15	$60,069	$555,286	$495,217
16	$62,313	$558,023	$495,710
17	$64,640	$558,578	$493,938
18	$67,055	$556,582	$489,527
19	$69,559	$551,611	$482,052
20	$72,157	$543,188	$471,031
21	$74,852	$530,770	$455,917
22	$77,648	$513,739	$436,091
23	$80,548	$491,398	$410,850
24	$83,557	$462,956	$379,400
25	$86,677	$427,517	$340,840
26	$89,915	$384,067	$294,152
27	$93,273	$331,458	$238,184
28	$96,757	$268,392	$171,635
29	$100,371	$193,403	$93,032
30	$104,120	$104,831	$711

Super Cell 1-A Post-Closure Investment

Starting Cost	$35,950
Income interest per year	12.00%
Income interest per month	1.00%
Cost increase per year	3.74%
Post-Closure Investment	***$414,920***

Interest Income and Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$35,950	$414,920	$378,970
2	$37,293	$427,033	$389,740
3	$38,686	$439,169	$400,483
4	$40,131	$451,275	$411,144
5	$41,629	$463,287	$421,658
6	$43,184	$475,135	$431,951
7	$44,797	$486,733	$441,936
8	$46,470	$497,984	$451,514
9	$48,206	$508,777	$460,571
10	$50,007	$518,983	$468,976
11	$51,874	$528,454	$476,580
12	$53,812	$537,022	$483,211
13	$55,822	$544,494	$488,672
14	$57,907	$550,648	$492,741
15	$60,069	$555,233	$495,164
16	$62,313	$557,963	$495,650
17	$64,640	$558,511	$493,870
18	$67,055	$556,506	$489,451
19	$69,559	$551,526	$481,966
20	$72,157	$543,092	$470,935
21	$74,852	$530,661	$455,809
22	$77,648	$513,616	$435,968
23	$80,548	$491,260	$410,712
24	$83,557	$462,801	$379,244
25	$86,677	$427,342	$340,664
26	$89,915	$383,869	$293,954
27	$93,273	$331,235	$237,961
28	$96,757	$268,141	$171,384
29	$100,371	$193,120	$92,749
30	$104,120	$104,512	$392

APPENDIX 17

usbank.

TO: Darren Olsen
ECDC Environmental, L.C.
FROM: Kim R. Galbraith

DATE: February 5, 2001

RE: Closure Fund Balance

Dear Darren:

As you have requested, I have determined that the current balance in the ECDC/Closure Fund, Account Number 94306680, as of February 5, 2001 is $8,575,342.47.

Should you have any further questions, please let me know.

Kim R. Galbraith
801-534-6083

HAND DELIVERED

MAY 17 2005
05.01852
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

ALTERNATIVE FINAL COVER DEMONSTRATION
ECDC LANDFILL
EAST CARBON CITY, UTAH
CLASS V LANDFILL PERMIT NO. 9422

Prepared for:

ECDC Environmental, L.C.
P.O. Box 69
East Carbon, Utah 84520

Prepared by:

SCS ENGINEERS
2702 N. 44th Street, Ste. 105B
Phoenix, Arizona 85008

April 1, 2004
File No. 10203050.00

ALTERNATIVE FINAL COVER DEMONSTRATION

ECDC LANDFILL
EAST CARBON CITY, UTAH

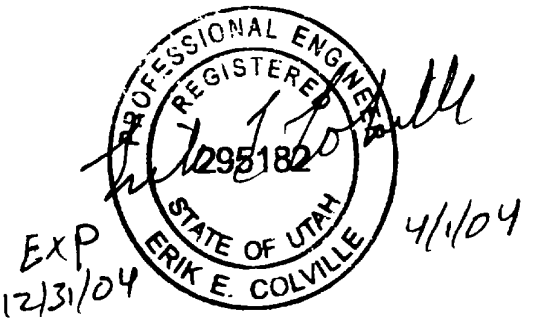
APRIL 2004

The following report has been prepared by SCS Engineers on behalf of ECDC Environmental, L.C. The various analyses and evaluations described in the report are based on sound engineering principles and represent state of the practice for alternative landfill final cover demonstrations.

The analyses demonstrate that the alternative final cover, as proposed in this report, is equivalent to the standard Subtitle D (40 CFR 258) final cover system and thus satisfies applicable federal and Utah solid waste regulatory requirements for alternative final cover approval.

Prepared Under the Direct Supervision of:

Erik Colville, P.E.
SCS Engineers



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EXECUTIVE SUMMARY

ECDC Environmental L.C. (ECDC), an Allied Waste Company, proposes to use an alternative final cover over all disposal areas at the ECDC Landfill (Landfill). All current disposal areas at the Landfill are currently composite-lined. The Landfill is located within the City limits of East Carbon City, Utah, in Carbon County, at 1111 West Highway 123.

The Landfill is regulated by Utah Department of Environmental Quality (UDEQ) and applicable federal (Subtitle D) requirements. The Landfill's currently approved final cover design includes a geomembrane that is both overlain and underlain by earthen material and exceeds minimum federal and Utah requirements. An alternative final cover design is permissible under federal and Utah regulations (R315-303-3 (4)(b)) provided it can be demonstrated that it has equivalent flow-through percolation properties to the standard design set forth in Subsection R315-303-3 (4)(a)(i) and provides equivalent protection from wind and water erosion. Based upon discussions with UDEQ personnel, the accepted percolation rate standard for demonstrating percolation equivalency is 3 mm/year or less.

The proposed alternative final cover design consists of a single two-foot thick monolithic soil layer to be constructed from on-site soils with the top six inches consisting of a topsoil layer. On-site soil samples were obtained that are typical of soil that will be used for the construction of the proposed alternative final cover. The proposed final cover design functions as a monolithic, evapotranspiration cover since it relies on the moisture retention characteristics of the soil and high evaporation potential due to climatic conditions at the Landfill to achieve the performance goal (i.e., minimize flow-through percolation).

The proposed alternative final cover will be constructed in lifts not to exceed 12 inches. It is recommended that inspections of the cover be performed quarterly for the first year after cover placement and repairs made as necessary. A full Quality Assurance/Quality Control (QA/QC) Plan will be prepared and submitted for UDEQ approval prior to the construction of any alternative final cover at the Landfill.

On behalf of ECDC, SCS Engineers has completed the required performance/equivalency demonstration for the proposed alternative final cover system. Specifically, the cover performance was determined by the computer model UNSAT-H (version 3.00). The model is commonly used for evaluating alternative covers and is generally regarded as the most accurate tool available for predicting unsaturated flow in arid environments (less than 25 inches of precipitation per year). The model input data included up to 30 years of daily climatic information which is detailed in the report and site-specific soil properties from the two on-site soil samples. The modeled configuration conservatively assumed no vegetation on the cover (i.e., bare ground) even though seeding and revegetation are planned upon final cover installation.

Based on the soil testing and modeling results, the proposed alternative final cover system will achieve flow-through percolation of less than 3 mm/year. Consequently, it is concluded that the proposed cover configuration has an equivalent level of performance with respect to percolation as the standard final cover described in R315-303-3 (4)(b). Additionally, since the topsoil layer in the alternative configuration is identical to that in the standard

configuration, the alternative final cover will also have equivalent performance against wind and water erosion.

Unlike the standard final cover, the proposed alternative final cover system will take advantage of the favorable, arid conditions at the Landfill. The advantages of using the proposed alternative final cover system include the use of on-site soils, reduced long-term care and maintenance, and better compatibility with native vegetation. Based on the equivalency demonstration and overall benefits, SCS recommends approval of the alternative final cover design.

1.0 INTRODUCTION

1.1 GENERAL OVERVIEW

ECDC operates the ECDC Landfill under a Class V Landfill Permit (No. 9422) from the UDEQ. The Landfill is located within the City limits of East Carbon City, Utah, in Carbon County, at 1111 West Highway 123 (See Figure 1). Road access is by Highway 123, which intersects with Highway 6, which connects to major interstate highways.

The Landfill opened for receipt of waste in September 1992 under a former owner/operator. The site was purchased by Allied Waste in December 1997, and as noted above, the ownership and operation are vested in the Allied subsidiary, ECDC Environmental, L.C.

The Landfill comprises 3,500 acres. Site zoning is industrial, and surrounding land use is mining and grazing. A Union Pacific Railroad rail line exists by the site with a spur directly into the site. The permitted disposal area is 2,400 acres, with an overall permitted site capacity of approximately 376,000,000 cubic yards, and a remaining capacity as of January 1, 2003 of over 366.7 million cubic yards.

The current final cover design for the Landfill exceeds the minimum requirements for a composite-lined landfill. It includes a low permeability soil layer and geosynthetic membrane. Whereas the intent of state and federal regulations is to protect the environment by providing minimum design criteria for final cover systems, it is recognized that the standard final cover design may not be the most environmentally sound or cost-effective design for every climatic setting. With this in mind, regulations allowing alternative final cover design (R315-303-3 (4)(b)) were established, provided it can be demonstrated that the alternative configuration is equivalent to the standard design set forth in Subsection R315-303-3 (4)(a)(i) and provides equivalent protection from wind and water erosion. ECDC proposes an alternative cover design at the Landfill that is equivalent to the standard configuration in both infiltration performance and with respect to wind and water erosion.

1.2 OBJECTIVE AND APPROACH

The proposed alternative cover configuration consists of a single two-foot layer of on-site soil with the top six inches consisting of protective topsoil. This proposed final cover system is an alternative since it differs from the standard design prescribed in R315-303-3 (4)(b) and contains no geosynthetic component. The objective of this demonstration is to show that the proposed alternative cover has an equivalent percolation rate through the final cover system compared to the performance of the standard cover design as well as equivalent performance with respect to wind and water erosion. Based on UDEQ criteria for equivalency, the flow-through percolation rate for the proposed alternative must be less than or equal to that of the standard cover, or the flow-through percolation rates between the two cover systems must differ by less than 3 mm/year.

The computer model UNSAT-H (version 3.00) was used to estimate the amount of percolation through the two-foot thick alternative cover configuration. The model input data include detailed climate data and soil properties.

2.0 SITE CONDITIONS

2.1 SURFACE CONDITIONS

The ECDC Landfill consists of 3,500 acres of generally flat terrain. The Landfill is reasonably isolated, with the nearest residence being approximately one mile to the northeast. The surrounding land use is mostly mining or grazing. Surface drainage is typically from northeast to southwest at a gentile slope of about two percent. The topography at the southern boundary of the site drops off steeply for several hundred feet to the desert floor.

2.2 REGIONAL AND SITE GEOLOGY

The Landfill is situated on the westward-sloping alluvial fan of Whitmore Canyon of the Book Cliffs, at elevations between 5,740 and 6,030 feet. Underlying, sedimentary bedrock is the Mancos Shale of upper Cretaceous age which has been warped with a gentile dip to the north-northeast of three to five degrees from horizontal. The alluvial fan varies in thickness from 20 to 60 feet with the underlying shale extending approximately 1,700 feet. The thickness of the alluvial deposit decreases south and west of the Landfill.

The large and prominent San Rafael Swell (uplift) is located immediately to the south and its northern end plunges beneath the subject area. Subsequent erosion of this great uplift has stripped thousands of feet of sedimentary rock strata off from its top and sides, with the eroded materials being transported away by the Colorado River system via the Green River.

Consequently, the subject bench area has been preserved as a dissected, arcuate-shaped, strike-valley between the Book Cliffs escarpment to the north, northeast and east, and the San Rafael Swell to the south. Later erosion of this valley has formed another steep escarpment which bounds the subject area on the immediate south and southwest. This has created the present-day, gently, westward-sloping, elevated plateau or bench upon which the landfill rests.

During late (Quaternary) geologic time as the Book Cliffs continued to erode, unusually high water flows have periodically discharged from Whitmore Canyon (Sunnyside), depositing a thick blanket of sand, silt, gravel, cobbles, boulders, and some large sandstone blocks (up to twenty by twenty feet) on the surface of the Mancos Shale. Subsequent erosion has in turn removed part of this alluvial fan deposit.

From eroded exposures along the escarpment at the south edge of the subject area, within road, railroad, and ravine-wash cuts, and from test holes previously drilled, the underlying soil profile is well revealed. This soil consists of mainly silt and sand with some clay within the upper seven feet. This is in part weakly cemented with lime-caliche in some areas. In other areas such as the irrigated field in the NW ¼ NW ¼ Section 16, T15S, R13E, the topsoil of silt and sand contains small, entrapped air voids which cause soil collapsing upon wetting, creating small sinks and subsidences.

Areas with scattered, large sandstone blocks from six to twenty feet in diameter are within the S ½ SW ¼ and SW ¼ Section 9, NW ¼ SE ¼ Section 8, center of S ½ and S ½ SW ¼ of Section 7, and evidence the principal, major stream channel locations of ancient times. These ancient sediment-laden stream flows, sufficient to transport such masses of rock from the mountains on the east, have deposited a continuous blanket of alluvium, extending from the bottom of Whitmore Canyon throughout the subject area.

Unconfined groundwater exists within the weathered shale at the bottom of the alluvial deposits in which the Landfill is situated. The groundwater monitoring system consists of three up-gradient and three down-gradient wells, which are sampled semi-annually.

2.3 CLIMATE

The climate of the East Carbon area is temperate and semi-arid, with a typical frost-free season from May to September. The normal annual precipitation is approximately 13.5 inches, with precipitation increasing in the mountains to the north and decreasing in the arid valleys to the south. The mean annual temperature is about 44° F with average maximums and minimums of 58 and 33.4° F, respectively. This dry climate is ideal for consideration of a monolithic, evapotranspiration cover. Refer to Section 6.2 of this demonstration for a detailed discussion of the climate inputs used in the modeling effort.

3.0 LANDFILL DESIGN AND CONFIGURATION

3.1 GENERAL OVERVIEW

The permitted disposal area of the Landfill is 2,400 acres. Excavated soils will be utilized for daily cover, intermediate cover, construction berms, final cover, roadways, liner, and final cover systems. Refer to Figure 2 for a map showing the soil sample location as well as the general facility layout.

3.2 BASE LINER SYSTEM

The Landfill is a lined, leachate-controlled facility meeting or exceeding both state and federal Subtitle D requirements. Each landfill cell is lined and contains at minimum, a protective cover layer, a leachate collection layer, a geosynthetic liner component, and a soil liner component (compacted soil or geosynthetic clay liner (GCL)).

3.3 STANDARD FINAL COVER DESIGN

Utah regulations (R315-303-3 (4)(a)(i)(A)) and federal requirements relate the required standard final cover design to the bottom liner system. The standard final cover requirement is that it must include an infiltration layer consisting of eighteen inches of earthen material with a permeability less than the bottom liner or natural subsoils, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less; and a six-inch erosion layer that is capable of sustaining native vegetation. Based upon the requirement that the standard final cover have a permeability less than the bottom liner, and since the bottom liner here includes both a geomembrane and GCL, the standard final cover at this Landfill must also include a geomembrane underlain by eighteen inches of low permeability soil to match the high-density polyethylene (HDPE) liner and GCL. The standard design which meets this regulatory criterion and has been approved for the Landfill is illustrated on Figure 3.

4.0 PROPOSED ALTERNATIVE FINAL COVER

4.1 GENERAL

Based upon prior site characterizations and discussions with Landfill personnel, on-site soils are generally uniform in nature and consist of sandy silts with some clays and minimal gravel in the top 5 to 7 feet across the entire site. On-site topsoil, although having slightly more organic matter, is essentially the same in character as the immediate 5 to 7 feet below (although the topsoil is stockpiled separately). The fine-grained, silty nature of the on-site soils is favorable for use as a monolithic, evapotranspiration cover since these types of soil have relatively high water holding capacity and are resistant to cracking. Soil samples for modeling were taken from a blend of the soils in the top 5 to 7 feet from virgin ground in the area shown on Figure 2.

The factors that will control the performance of the proposed cover include precipitation, evaporation potential, plant transpiration, surface infiltration rate, construction methods, and total thickness. Based upon the potential difficulty in relying on plant transpiration, especially upon initial construction, it is assumed that the alternative cover should be able to function by relying solely on the other factors mentioned. The currently approved and proposed alternative cover system configurations are shown on Figure 3.

4.2 ON-SITE SOIL CHARACTERIZATION

Certain soil properties need to be defined in order to properly analyze the performance of the proposed alternative final cover. These defined properties must be either representative or more critical than a majority of the soil type that will be used to construct the cover. To accomplish this, two bulk soil samples for modeling were taken from a blend of the soils in the top 5 to 7 feet from virgin ground in the area shown on Figure 2. As previously mentioned, discussions with facility personnel indicate that these samples are typical of soils found in the top 5 to 7 feet across the Landfill and are typical of soils that will be used in the construction of the final cover.

Both bulk soil samples were shipped to Daniel B. Stephens and Associates, Inc., Albuquerque, New Mexico, (D.B. Stephens) for analysis. Full results are provided in Appendix A of this evaluation. The testing included an analysis for grain-size characteristics. The purpose of the grain-size testing was to classify the soil based on the Unified Soil Classification System (USCS) and to broadly assess the material properties. Another purpose was to evaluate the homogeneity of the two samples. Based upon the results as summarized below, both samples were classified as sandy silts (ML).

Sample	A	B
USCS	ML	ML
% Passing 3/8" Sieve	99.93	99.75
% Passing #60 (0.250 mm) Sieve	90.33	90.88
% Passing #200 (0.075 mm) Sieve	61.65	62.03

Standard Proctor compaction tests were also performed on each sample. The maximum standard Proctor bulk densities were determined to be 1.70 and 1.71 g/cm^3 for samples A and B, respectively. The optimum moisture contents were determined to be 17.3 and 16.5 percent for samples A and B, respectively. Complete results can be found in Appendix A.

As can be seen from the previous table, the soils proposed for use as the alternative final cover are relatively homogeneous and are very fine with over half passing the number 200 sieve. Additionally, the fines are mostly silts which are preferable to clays which may crack and provide preferential flow paths when used in soil-only covers.

4.3 HYDRAULIC PROPERTIES

Certain hydraulic properties strongly influence soil moisture evaporation and infiltration rates. Definition of these properties, as listed below, is critical in estimating the percolation characteristics of the proposed cover.

- Saturated hydraulic conductivity;
- Relationship between suction head[1] and moisture content; and
- Relationship between unsaturated hydraulic conductivity and suction head.

[1] Soil suction head is an indication of the soil's ability to hold and attract moisture.

Both samples were compacted to ninety percent of optimum density with standard compaction prior to testing for hydraulic properties. This compaction represents a relatively minimal effort since over-compaction of a monolithic, evapotranspirative cover could result in the loss of water storage capacity.

Saturated Hydraulic Conductivity

After lab preparation, including recompaction, both soil samples were tested to determine their saturated hydraulic conductivity. The hydraulic conductivities were 6.4×10^{-6} and 6.0×10^{-6} cm/sec for samples A and B, respectively. Although several parameters describing unsaturated hydraulic conductivity are input into the UNSAT-H model, the saturated hydraulic conductivity is directly entered. No difference in the values was yielded when a gravel correction was applied due to the pre-processing that the proposed final cover soil is subjected to which removes most gravel greater than 3/8 inch. Therefore, for final cover construction in the future, no screening or materials processing should be necessary if the soils are similar to those utilized for this demonstration, as is expected.

Suction Head vs. Moisture Content

The relationship between soil suction head and moisture content was obtained for each soil sample from a soil-water characteristic curve generated by D.B. Stephens. The curve was developed by measuring the matric suction head within each remolded specimen at various

volumetric moisture contents. The resulting data points were fitted with the following numerical expression that relates soil moisture and suction head (van Genuchten, 1980):

$$\theta = \theta_r + (\theta_s - \theta_r)[1 + (\alpha h)^n]^{-m}$$

Where: θ = volumetric moisture content (volume/volume, vol/vol);
θ_r = residual volumetric moisture content (vol/vol);
θ_s = saturated volumetric moisture content (vol/vol);
α = coefficient of van Genuchten's function (centimeters^{-1}, cm^{-1});
h = matric suction head (cm); and
n and m = curve fitting parameters.

The values used in this report for the parameters θ_r, θ_s, α, and n were obtained from laboratory testing (Klute, 1986) of on-site soils. The parameter m is calculated by the UNSAT-H model and is a function of the parameter n. In typical applications, and in all the UNSAT-H analyses for this project, m is set to 1-1/n.

A copy of the results for each of these parameters for each soil analyzed is included in Appendix A.

Unsaturated Hydraulic Conductivity vs. Suction Head

The relationship between unsaturated permeability and soil suction head was defined from the soil-water characteristic curve using the van Genuchten-Mualem model (van Genuchten 1980, Mualem 1976). This numerical relationship is provided below.

$$K_L = K_S \frac{[1-(\alpha h)^{nm}[1+(\alpha h)^n]^{-m}]^2}{[1+(\alpha h)^n]^{lm}}$$

Where: α, h, n, and m are as noted above;
l = exponent of the pore interaction term (standard value of 0.5 assumed);
K_L = unsaturated permeability (centimeters per second, cm/sec); and
K_S = saturated permeability (cm/sec).

The values used in this demonstration for the parameter K_S were obtained from laboratory testing as previously discussed.

4.4 COVER PLACEMENT

Performance of the alternative final cover system will rely heavily on the arid climate and moisture holding capacity of the soil. The soil should be placed in a fairly loose to moderately dense soil structure that will maximize the water holding capacity of the soil, minimize cracking, and not overly inhibit any plant growth in the topsoil layer. The maximum lift thickness shall be 12 inches, which should create a fairly homogeneous density/soil texture within the cover. No compaction or processing should be necessary for the cover as long as the soils utilized are similar to those represented in this demonstration.

It is recommended that inspections of the cover be performed quarterly for the first year after cover placement and repairs made as necessary.

A full Quality Assurance/Quality Control (QA/QC) Plan will be prepared and submitted for UDEQ approval prior to the construction of any alternative final cover at the Landfill.

5.0 PERFORMANCE MODELING TECHNIQUES

5.1 PERFORMANCE MODEL SELECTION

Reviews of unsaturated flow models to predict percolation through a soil-only final cover have consistently indicated that the computer program UNSAT-H (Fayer, 2000) has the most complete list of features to adequately simulate unsaturated vertical flow through a soil-only final cover.

5.2 UNSAT-H MODEL DESCRIPTION

The majority of the information presented in this section is taken from the latest UNSAT-H User Manual (Fayer, 2000). Please refer to the User Manual for a much more detailed description of the model's underlying theory.

UNSAT-H (version 3.00) is a numerical finite difference model designed to simulate one-dimensional, vertical flow of water in unsaturated media. The hydrologic water balance is initially expressed in the UNSAT-H model according to the general soil-water budget formula as follows:

$$0 = P - I - R_{off}$$

Where: P = precipitation;
I = infiltration; and
R_{off} = runoff.

It should be noted that because the model is one-dimensional, run-on is not considered. Also, runoff is not computed explicitly. Instead, the model equates runoff to the precipitation amount that is in excess of the infiltration rate.

Once water has infiltrated the soil, the soil water balance equation that forms the basis of the UNSAT-H conceptual model is:

$$\in S_w = I - E - T - D$$

Where $\in S_w$ = Change in soil-water storage during an interval of time;
I = infiltration;
E = evaporation;
T = transpiration; and
D = drainage from the bottom of the system.

The water balance equation simply states that the change in the amount of water stored in the soil profile is equal to the total infiltration minus the amount of water that is lost to evaporation, E; transpiration, T; and drainage, D.

The UNSAT-H model applies the conceptual model to incremental spacings within the soil profile, commonly referred to as nodes. The nodes essentially provide different depths in the

profile, dividing it into discreet subsections for a more detailed analysis. The user can set the spatial detail of the solution by specifying the node spacing for the profile in the input file. Up to 250 nodes can be specified for analysis. Similarly, the user can also set the temporal resolution by specifying the minimum and maximum time step size. The user can also control the solution accuracy by specifying the acceptance criteria for the solution to a particular time step. The available criteria include change in water content, mass balance error, absolute change in head, relative change in head, and heat balance error.

The UNSAT-H model simulates infiltration in a two-step process. First, infiltration is set equal to the precipitation rate during each time step. Second, if the surface saturates, the solution of that time step is repeated using a Dirichlet (Fayer, 2000) boundary condition (with the surface node saturated). The resulting flux from the surface into the profile (next node) is the infiltration rate.

The UNSAT-H model simulates liquid water flow using the Richards equation, water vapor diffusion using Fick's law, and sensible heat flow using the Fourier equation. Options for describing soil water retention used in the simulation of liquid water flow include linked polynomials, the Haverkamp function, the Brooks and Corey function, the van Genuchten function coupled with the Mualem model, and several special functions that account for water retention of very dry soils (Fayer, 2000).

The van Genuchten function coupled with the Mualem model is utilized in this report to describe soil water retention properties and unsaturated hydraulic conductivity. The van Genuchten function is the most widely used closed-form analytical solution describing unsaturated hydraulic conductivity based upon Mualem's theoretical formulation of pore distribution and continuity. As described above, other options are available in the UNSAT-H model, but the other options are encountered infrequently in research or in engineering practice. As discussed in Section 4.3 of this evaluation, the van Genuchten numerical expression describing soil water retention is as follows:

$$\theta = \theta_r + (\theta_s - \theta_r)[1 + (\alpha h)^n]^{-m}$$

Where: θ = volumetric moisture content (volume/volume, vol/vol);
θ_r = residual volumetric moisture content (vol/vol);
θ_s = saturated volumetric moisture content (vol/vol);
α = coefficient of van Genuchten's function (centimeters^{-1}, cm^{-1});
h = matric suction head (cm); and
n and m = curve fitting parameters.

The values used in this report for the parameters θ_r, θ_s, α, and n were obtained from laboratory testing (Klute, 1986) of on-site soils. The parameter m is calculated by the UNSAT-H model and is a function of the parameter n. In typical application and in all the UNSAT-H analyses for this project, m is set to $1\text{-}1/n$.

When the van Genuchten function is combined with the Mualem conductivity model the following numerical expression results (also discussed in Section 4.3 of this evaluation):

$$K_L = K_S \frac{[1-(\alpha h)^{nm}[1+(\alpha h)^n]^{-m}]^2}{[1+(\alpha h)^n]^{lm}}$$

Where: α, h, n, and m are as noted above;
l = exponent of the pore interaction term (Standard value of 0.5 assumed);
K_L = unsaturated permeability (centimeters per second, cm/sec); and
K_S = saturated permeability (cm/sec).

The values used in this report for the parameter K_S were obtained from laboratory testing (ASTM D2434/D5084) of on-site soils.

The UNSAT-H model has several options for the boundary conditions. For water flow, the user can specify Dirichlet or Neumann conditions, or a unit hydraulic gradient condition (Fayer, 2000). Dirichlet boundary conditions were assumed in this report for water flow, as this is the most widely accepted practice. The only exception to Dirichlet conditions on a boundary is at the bottom of the soil profile, where it was assumed to have a unit hydraulic gradient condition. This assumption overstates the gradient encountered at the bottom of the soil profile and results in a slight overestimation of percolation at this boundary. For heat flow boundary conditions, the model uses weather and soil parameters to compute heat flow at the soil profile's upper boundary (Fayer, 2000).

The UNSAT-H model simulates evaporation in two ways. The first method is for the user to input hourly potential evapotranspiration (PET) values. These data are not available for this Site. The second method is to input daily climatic data in the isothermal mode (assumed in this report), and then the UNSAT-H model calculates the daily PET values using the Penman equation. Hourly PET values are generated with a sine wave function for the hours between 0600 and 1800, while the remaining hourly values are set equal to 0.01 (Fayer, 2000).

During each time step, the program attempts to apply the respective calculated hourly PET. If the soil surface dries to or above the user-defined matric potential limit, the time step is re-solved using a Dirichlet condition at the surface. In this situation, the surface potential is held constant at the matric potential limit and evaporation is set equal to flux from below. Please refer to the User Manual (Fayer, 2000) for a discussion of the isothermal mode for calculation of evaporation.

No plant cover and thus no transpiration is assumed in this analysis for conservativeness. Therefore, although UNSAT-H can model transpiration, it is not considered to be a factor in this report. However, even minimal vegetation can have a major effect on percolation in arid systems, and native vegetation may be reestablished on the Landfill cover over time.

Climate data are critical input parameters to the UNSAT-H model. Input information includes daily values of precipitation, temperature, dew point, cloud cover, wind speed, and solar radiation. The model has the ability to be run for multiple years as was performed in this report. The next section of this evaluation discusses the climate data utilized specific to the Landfill.

6.0 PERFORMANCE ANALYSIS

6.1 STANDARD FINAL COVER

Based upon Utah regulatory requirements and federal Subtitle D requirements, the standard final cover configuration would consist of (at a minimum):

- Six inches of erosion material capable of supporting native vegetation;
- A geomembrane; and
- An eighteen-inch compacted soil layer below the geomembrane.

Based on state requirements, any alternative final cover system proposed must have an equivalent reduction in the amount of percolation that flows through the bottom of the cover as compared to the standard final cover and must also meet equivalent protection from wind and water erosion. However, the amount of percolation through the aforementioned standard final cover is largely controlled by the number of pinholes and defects that would be in the standard cover's geomembrane, which is difficult to quantify. Although different literature sources provide different values, UDEQ personnel have indicated that, if an alternative final cover allows less than 3 mm/year of flow-through percolation, its performance can be considered equivalent to a standard final cover.

The top six inches of the proposed alternative final cover system will consist of topsoil which will have the same wind and water erosion properties as would be used with the same layer on a standard final cover system, thereby providing equivalent wind and water erosion protection.

6.2 PROPOSED ALTERNATIVE COVER

The UNSAT-H program was used to model the amount of precipitation that will percolate through the bottom of the proposed 2-foot thick alternative final cover. The model simulations and results are discussed below.

Climate

The UNSAT-H model requires the following daily inputs in its climate files: maximum and minimum temperature; dew point temperature; solar radiation; average wind speed; average cloud cover; and precipitation. Based upon a search of climate stations near the Landfill in East Carbon, Utah, the Sunnyside, Utah climate station was the closest; however this station only records temperature and precipitation readings. An expanded search was made for a station with all of the necessary data.

Upon further research, the solar radiation values were discovered to be the limiting factor to finding a complete climate data set for UNSAT-H. A national solar radiation database developed by the National Climatic Data Center (NCDC) was found which provided a complete data set for the years 1961 through 1990. The closest stations for this data base,

however, were Grand Junction, Colorado and Salt Lake City, Utah. East Carbon is located approximately halfway between these two cities.

In order to assess whether Salt Lake City or Grand Junction was a more viable candidate for use in the modeling effort, the monthly average precipitation was compared for Salt Lake City, Sunnyside, and Grand Junction. The results are shown in Appendix B, Table 1. Although the annual precipitation was closer between Sunnyside and Salt Lake City, the seasonal rainfall patterns matched more closely between Sunnyside and Grand Junction (see the graph below the aforementioned table). Based upon these seasonal patterns, it is likely that besides the lower precipitation in Grand Junction, that the weather in Sunnyside is likely to be more closely approximated by Grand Junction than Salt Lake City.

Since the Grand Junction, Colorado weather station was the closest and most similar to Sunnyside and has the complete data set needed for application of the UNSAT-H model, it was determined that data from this station should be used. The average annual rainfall in Grand Junction, however, is 8.9 inches compared with 13.4 inches in Sunnyside. To compensate for this discrepancy it was determined that each precipitation event in the Grand Junction data set should be doubled, thereby effectively using Grand Junction climate data but increasing the average annual precipitation from 8.9 inches to 17.8 inches. This figure is well in excess of the 13.4 inches per year at Sunnyside. It is assumed that this excess will compensate for any other inconsistencies between the locations. Also, in this way no data have to be fabricated in an attempt to artificially complete a Sunnyside data set, and a data set is created that will most closely mimic the general weather patterns at the ECDC Landfill.

Appendix B also contains Tables 2 and 3 which show the precipitation data between 1961 and 1990 for both Sunnyside and Grand Junction. Please note that there are some data gaps in the Sunnyside precipitation data. A column was added into Table 3 to show the doubled precipitation totals for Grand Junction.

The years 1964 and 1983 are highlighted in Table 3. The year 1964 represents a year close to the Sunnyside average annual precipitation rate. This year was repeated 20 times to initialize all modeling runs. The year 1983 is highlighted because it represents an extremely wet year (over twice the annual average for Sunnyside). At an annual total precipitation of 29.64 inches, the year 1983 represents more than 9 additional inches of precipitation than the wettest year observed for Sunnyside between 1961 and 1990. An UNSAT-H model simulation was performed for each soil using thirty consecutive years of typical climate data (1961 through 1990 run consecutively). The flow-through percolation was then examined for each soil sample for the wettest year (1983) and the final year of the 30-year simulation (1990).

Initialization is required for each run because initial suction head values are set to a relatively wet and uniform value (1.0×10^3 cm for this report) for all nodes in the initial conditions section at the beginning of each modeling run. The suction head values at each node at the end of an evaluated year serve as the initial conditions for the next year's evaluation. Twenty consecutive years of typical (1964) climate data are run through the soil profile prior to the actual model run so that the suction head values can proceed towards steady-state values prior to applying climate data for performance evaluation. Results from these

initialization years are not reported since they are not considered to be initialized output values.

Runoff

The UNSAT-H program determines runoff indirectly by subtracting the computed surface infiltration rate from the precipitation rate (cm/hour). The surface infiltration rate is equivalent to the unsaturated conductivity of the near surface soils, which is a function of the moisture content of the soil.

Hydraulic Properties

Several hydraulic properties were required as input for each soil evaluated including the following (each for A and B, respectively):

- Saturated hydraulic conductivity = 0.02304 and 0.0216 cm/hour
- Residual moisture content = 0 vol/vol for each sample (typically at or near 0)
- Saturated moisture content = 0.3867 and 0.3870 vol/vol
- Initial suction head = 1000 cm (from soil-water characteristic curve, this value will be adjusted through the initialization process by subjecting the profile to twenty years of typical climate data prior to the actual run).

All of the above data except for initial suction head, were obtained from the laboratory results provided in Appendix A. Curve fitting parameters "alpha" and "N" which help define the unsaturated hydraulic conductivity curve were also taken form the laboratory results for each soil and input directly into the UNSAT-H model. All values represent gravel-corrected values that compensate for the small amount of 3/8-inch gravel that was in each sample which was removed prior to final analyses.

Results

Based on the input data, the UNSAT-H model predicts that less than one third of a millimeter of water would flow through the alternative final cover on both the wettest (1983) and last (1990) years of the thirty-year (1961-1990) simulation. The results are summarized in the following table. Appendix C contains the input files for each of the modeling runs as well as the output for each of the cases shown the table.

	Soil Sample A		Soil Sample B	
	Wettest Year (1983)	**End of Simulation (1990)**	**Wettest Year (1983)**	**End of Simulation (1990)**
Precipitation (cm)	74.7	41.9	74.7	41.9
Runoff (cm)	48.5	22.8	48.9	23.1
Infiltration (cm)	26.2	19.1	25.8	18.9
Transpiration (cm)	0.0	0.0	0.0	0.0
Evaporation (cm)	25.0	17.9	24.6	17.6
Percolation (mm) [1]	**0.27**	**0.23**	**0.23**	**0.22**

[1] Results in this table represent flow-through percolation for the year mentioned.

7.0 EQUIVALENCY COMPARISON

7.1 REQUIREMENTS

Whereas the intent of state and federal regulations is to protect the environment by providing minimum design criteria, it is recognized that the standard final cover design may not be the most environmentally sound or cost-effective design for every climatic setting. With this in mind, Utah regulations allow for state approval of an alternative final cover (R315-303-3 (4)(b)). This regulation states that an alternative final cover can be approved if it achieves an equivalent reduction in flow-through percolation as the standard final cover system and provides equivalent wind and water erosion protection. Based on these requirements, approval of an alternative final cover involves the following steps:

- Determine an expected percolation rate through a standard final cover (SFC);
- Determine the estimated percolation rate through the proposed alternative final cover (AFC); and
- Compare the percolation rates and wind and water erosion properties of the SFC and AFC.

The AFC is considered equivalent if:

1. The computed flow-through percolation of the AFC is less than or equal to the computed flow-through percolation rate of the SFC, and
2. The AFC provides equivalent wind and water erosion protection as the SFC.

7.2 EQUIVALENCY EVALUATION

Step 1: Determine an expected percolation rate through an SFC

Based upon conversations with UDEQ personnel, an accepted target percolation rate through an SFC is 3 mm/year.

Step 2: Determine the estimated percolation rate through the proposed AFC

Percolation rates for the proposed alternative final cover system were estimated using the UNSAT-H model. Based upon the model simulations, the percolation rate for the proposed alternative final cover system at the Landfill was under 3 mm/year for all cases.

Step 3: Compare SFC and AFC percolation rates and wind and water erosion properties

The flow-through percolation for the AFC was under the accepted SFC value of 3 mm/year for all cases. In addition, an identical topsoil layer is proposed for the top of the AFC that would be equivalent to the wind and water erosion protection afforded by the same topsoil layer in the SFC.

7.3 CONCLUSIONS

The UNSAT-H percolation analyses performed on the proposed alternative final cover are based on sound engineering practice and judgements. The resulting percolation rates are extremely small, which is certainly a reflection of the overall climate and soils available at the Landfill which are ideal for use as a monolithic, evapotranspiration cover. The proposed alternative final cover will provide significant economic and operational benefits which will include: 1) utilization of on-site soils; 2) elimination of expensive synthetic cover components; 3) easier phased construction of the final cover; and 4) reduced post-closure maintenance. In conclusion, the proposed alternative final cover system is both economically beneficial and environmentally sound. Therefore, ECDC Environmental, L.C. proposes to use the alternative final cover design and requests approval of its use at the ECDC Landfill, per R315-303-3 (4)(b).

8.0 REFERENCES

1. Fayer, M.J., "UNSAT-H Version 3.0: Unsaturated Soil Water and Heat Model Flow, Theory, User Manual, and Examples", Pacific Northwest National Laboratory, June 2000.

2. Klute, A., "Water Retention: Laboratory Methods, Methods of Soil Analysis", *Soil Society in America*, Madison, WI, Ch.26, p.635-662, 1986.

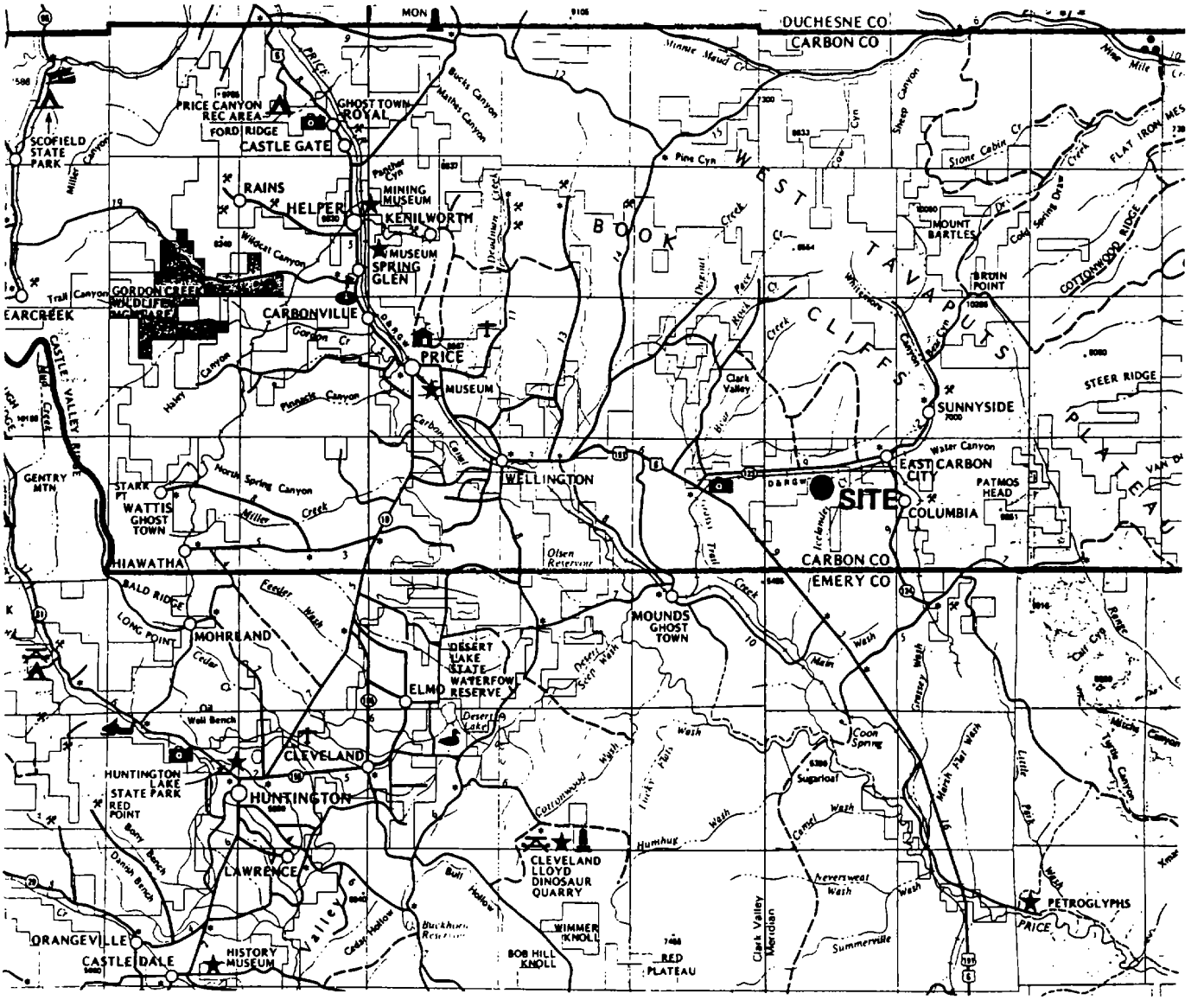
3. Koerner, R., "Designing with Geosynthetics", Prentice Hall, Second Edition, p.365, 1990.

4. Rust, "Alternative Final Cover Study, Vegetated Test Cover, Glendale Landfill", prepared for the City of Glendale, Arizona, p. 2-3, 1998.

5. Van Genuchten, M., "A Closed-Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils", Soil Science Society of America Journal, 44, 892-898, 1980.

FIGURE 1

SITE LOCATION MAP



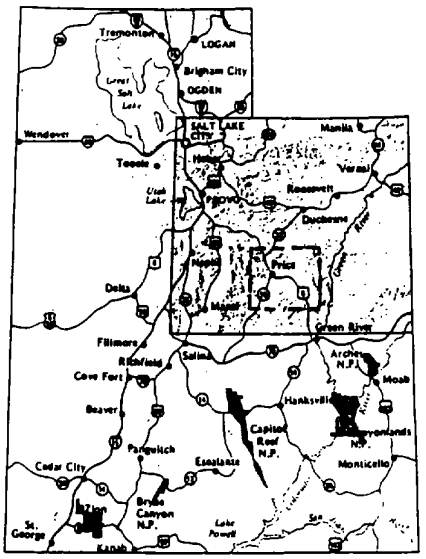


Figure 1

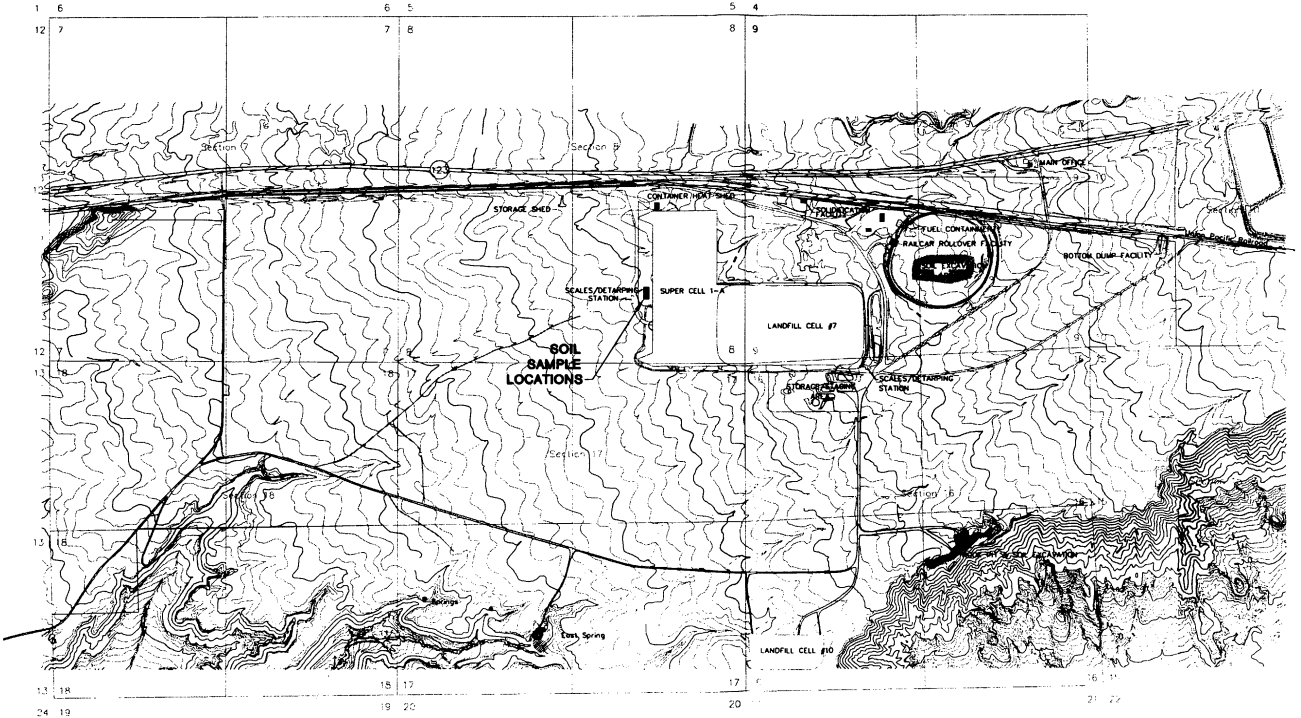
VICINITY MAP

ECDC ENVIRONMENTAL, L.C., LANDFILL
Carbon County, Utah

RB&G ENGINEERING, INC.

FIGURE 2

SAMPLE LOCATION MAP



N

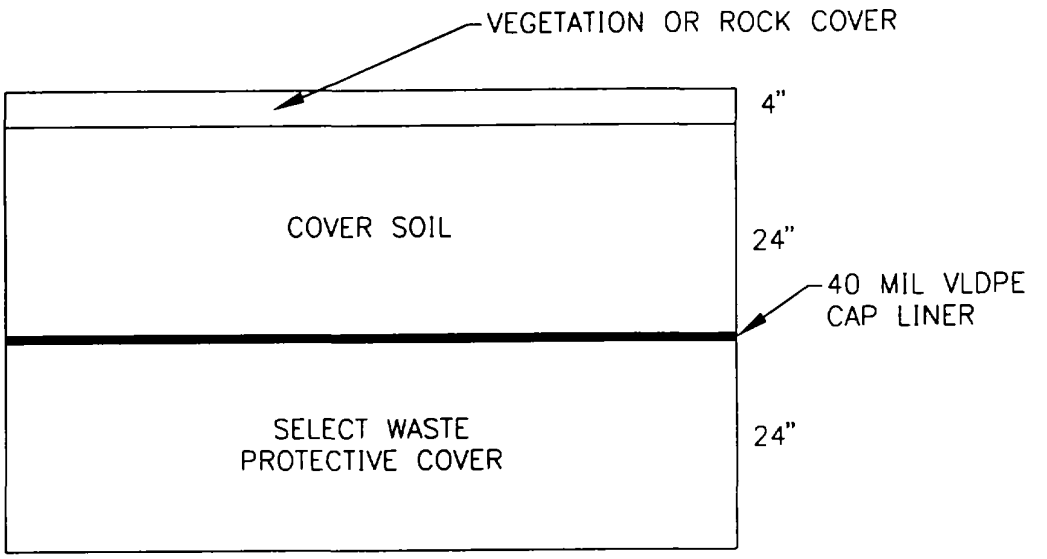
0 1,500' 3,000'

SCALE IN FEET
1" = 1,500'

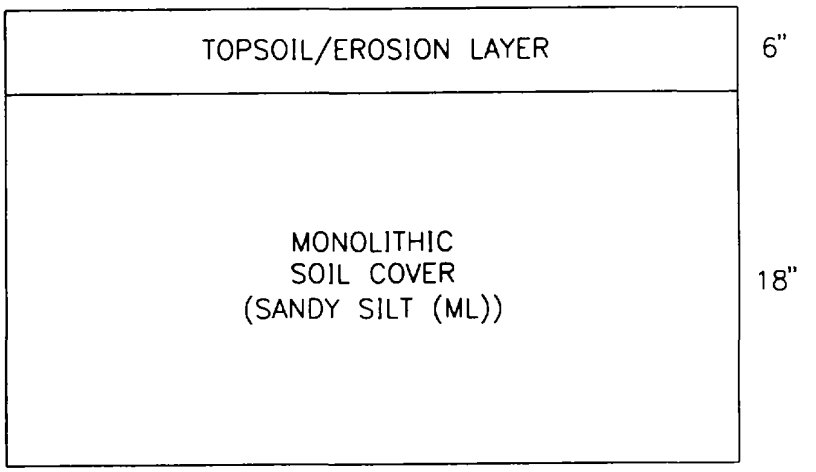
SCS ENGINEERS *"Superior Customer Service"*	*Sample Location Map* **ECDC LANDFILL** **EAST CARBON, UTAH**	**Project Number:** 10.203050.00 **Scale: As Shown** **Figure 2**

FIGURE 3

LANDFILL FINAL COVERS



CURRENTLY APPROVED COVER



PROPOSED ALTERNATIVE COVER

Not To Scale

SCS ENGINEERS *"Superior Customer Service"*	***LANDFILL FINAL COVERS*** ***ECDC LANDFILL*** ***EAST CARBON, UTAH***	**Project Number:** 10.203050.00 **Figure 3**

APPENDIX A

SOIL TESTING RESULTS

February 9, 2004

Mr. David Mezzacappa, P.E.
SCS Engineers
2702 N. 44th St., Ste. 105B
Phoenix, AZ 85008
602-840-2596

Dear Mr. Mezzacappa:

Enclosed is the final report for the SCS Engineers ECDC Landfill job. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

We are pleased to provide this service to SCS and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Daniel O'Dowd
Enclosure

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100 505-822-9400
Albuquerque, NM 87109 FAX 505-822-8877

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1] (θ, ρ_d, ϕ)	Saturated Hydraulic Conductivity[2]		Moisture Characteristics[3]					Unsaturated Hydraulic Conductivity	Particle Size[4]			Effective Porosity	Particle Density	Air Permeability	1/3, 15 Bar Points and Water Holding Capacity	Atterberg Limits	Proctor Compaction
		CH	FH	HC	PP	TH	WP	RH		DS	WS	H						
Soil A	X	X		X	X		X	X	X		X	X					X	X
Soil B	X	X		X	X		X	X	X		X	X					X	X

[1] θ = Initial moisture content, ρ_d = Dry bulk density, ϕ = Calculated porosity

[2] CH = Constant head, FH = falling head

[3] HC = Hanging column, PP = Pressure plate, TH = Thermocouple psychrometer, WP = Water activity meter, RH = Relative humidity box

[4] DS = Dry sieve, WS = Wet sieve, H = Hydrometer

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Initial Moisture Content		Dry Bulk Density	Wet Bulk Density	Calculated Porosity
	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	(g/cm^3)	(g/cm^3)	(%)
Soil A	16.5	25.4	1.54	1.79	41.9
Soil B	16.1	24.7	1.53	1.78	42.1

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
Soil A	6.4E-06	X	
Soil B	6.0E-06	X	

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
Soil A	0	39.2
	23	38.5
	125	32.2
	510	28.0
	4793	17.5
	14583	14.1
	851293	2.0
Soil B	0	39.5
	23	38.4
	125	32.8
	510	28.0
	6017	16.1
	15297	14.4
	851293	2.1

Summary of Calculated Unsaturated Hydraulic Properties with Gravel Corrections

Sample Number	α (cm^{-1})	**N** (dimensionless)	θ_r	θ_s
Soil A	0.0075	1.2359	0.0000	0.3881
Soil B	0.0075	1.2369	0.0000	0.3898

Gravel Corrections

Sample Number	**Ksat**	θ_i	θ_r	θ_s
Soil A	6.4E-06	0.2531	0.0000	0.3867
Soil B	6.0E-06	0.2452	0.0000	0.3870

Summary of Particle Size Characteristics

Sample Number	d_{10} (mm)	d_{50} (mm)	d_{60} (mm)	C_u	C_c	Method	ASTM Classification	USDA Classification	
Soil A	0.00073	0.053	0.071	97	1.7	WS/H	Sandy silt	Loam	(Est)
Soil B	0.00064	0.056	0.071	111	2.7	WS/H	Sandy silt	Loam	(Est)

d_{50} = Median particle diameter

Est = Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

$$C_u = \frac{d_{60}}{d_{10}}$$

$$C_c = \frac{(d_{30})^2}{(d_{10})(d_{60})}$$

DS = Dry sieve

H = Hydrometer

WS = Wet sieve

Summary of Atterberg Tests

Sample Number	Liquid Limit	Plastic Limit	Plasticity Index	Classification
Soil A	29	23	6	ML
Soil B	29	24	5	ML

--- = Soil requires visual-manual classification due to non-plasticity

Summary of Proctor Compaction Tests

Sample Number	Optimum Moisture Content (% g/g)	Maximum Dry Bulk Density (g/cm^3)
Soil A	17.3	1.70
Soil B	16.5	1.71

Raw Laboratory Data and Graphical Plots

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Initial Moisture Content		Dry Bulk Density	Wet Bulk Density	Calculated Porosity
	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	(g/cm^3)	(g/cm^3)	(%)
Soil A	16.5	25.4	1.54	1.79	41.9
Soil B	16.1	24.7	1.53	1.78	42.1

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil A
Ring Number: NA
Depth: NA

Test Date: 19-Jan-04

Field weight of sample* (g): 512.24
Tare weight, ring (g): 101.26
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 352.70
Sample volume (cm^3): 229.25
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 25.4

Initial Gravimetric Moisture Content (% g/g): 16.5

Dry bulk density (g/cm^3): 1.54

Wet bulk density (g/cm^3): 1.79

Calculated Porosity (% vol): 41.9

Percent Saturation: 60.6

Comments:

* Weight including tares

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil B
Ring Number: NA
Depth: NA
Test Date: 19-Jan-04

Field weight of sample* (g): 538.06
Tare weight, ring (g): 134.62
Tare weight, cap/plate/epoxy (g): 0.00

Dry weight of sample (g): 347.55
Sample volume (cm^3): 226.43
Assumed particle density: 2.65

Initial Volumetric Moisture Content (% vol): 24.7
Initial Gravimetric Moisture Content (% g/g): 16.1
Dry bulk density (g/cm^3): 1.53
Wet bulk density (g/cm^3): 1.78
Calculated Porosity (% vol): 42.1
Percent Saturation: 58.7

Comments:

* Weight including tares

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Method of Analysis	
		Constant Head	Falling Head
Soil A	6.4E-06	X	
Soil B	6.0E-06	X	

Saturated Hydraulic Conductivity
Constant Head Method

Job name: SCS-ECDC Landfill
Job number: WR04.0005.00
Sample number: Soil A
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g): 4.60
Sample length (cm): 7.58
Sample diameter (cm): 6.21
Sample x-sectional area (cm^2): 30.24

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
22-Jan-04	10:26:30	18.5	64.7	15.4	10.8	6969	6.0E-06	6.2E-06
22-Jan-04	12:22:39							
Test # 2:								
22-Jan-04	15:26:08	19.0	64.7	6.0	1.4	772	6.8E-06	6.9E-06
22-Jan-04	15:39:00							
Test # 3:								
23-Jan-04	09:52:33	18.0	64.7	6.2	1.6	1030	6.0E-06	6.3E-06
23-Jan-04	10:09:43							

***Average Ksat* (cm/sec):** **6.4E-06**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Saturated Hydraulic Conductivity
Constant Head Method

Job name: SCS-ECDC Landfill
Job number: WR04.0005.00
Sample number: Soil B
Ring number: NA
Depth: NA

Type of water used: TAP
Collection vessel tare (g)*:* 4.68
Sample length (cm)*:* 7.63
Sample diameter (cm)*:* 6.15
Sample x-sectional area (cm^2)*:* 29.68

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
22-Jan-04	10:26:33	18.5	64.9	14.9	10.3	6986	5.8E-06	6.0E-06
22-Jan-04	12:22:59							
Test # 2:								
22-Jan-04	15:27:08	19.0	64.9	5.7	1.1	694	6.1E-06	6.2E-06
22-Jan-04	15:38:42							
Test # 3:								
23-Jan-04	09:52:22	18.0	64.9	6.2	1.5	1046	5.8E-06	6.0E-06
23-Jan-04	10:09:48							

Average Ksat* (cm/sec)*: **6.0E-06**

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
Soil A	0	39.2
	23	38.5
	125	32.2
	510	28.0
	4793	17.5
	14583	14.1
	851293	2.0
Soil B	0	39.5
	23	38.4
	125	32.8
	510	28.0
	6017	16.1
	15297	14.4
	851293	2.1

Summary of Calculated Unsaturated Hydraulic Properties with Gravel Corrections

Sample Number	α (cm^{-1})	**N** (dimensionless)	θ_r	θ_s
Soil A	0.0075	1.2359	0.0000	0.3881
Soil B	0.0075	1.2369	0.0000	0.3898

Gravel Corrections

Sample Number	**Ksat**	θ_i	θ_r	θ_s
Soil A	6.4E-06	0.2531	0.0000	0.3867
Soil B	6.0E-06	0.2452	0.0000	0.3870

Gravel Correction

Sample name

Soil A

#4 Sieve Split

Inputs

Mass(coarse)	0.63
Mass(fines)	99.37
Dry bulk density(fines)	1.54
Density(coarse)	2.65
Ksat value(fines)	6.4E-06
Theta saturated(fines)	0.3881
Theta initial (fines)	0.2540
Theta residual(fines)	0.0000
Theta saturated(coarse)*	0
Theta initial (coarse)*	0
Theta residual(coarse)*	0

Volumetric fraction of fines in composite	Volumetric fraction of coarse in composite	Volumetric fraction of voids in composite
0.996	0.004	0.000

Outputs

Density (composite)	1.5441	0
Ksat composite	6.4E-06	
Theta saturated composite	0.3867	
Theta initial composite	0.2531	
Theta residual composite	0.0000	

V(coarse)	0.24
V(fines)	64.53
V(composite)	64.76
V(voids)	

* starred values to the left for coarse fraction should be set to zero if the coarse fraction is assumed to hold no water in pores

Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name:	SCS-ECDC Landfill	*Dry wt. of sample* (g):	352.70
Job Number:	WR04.0005.00	*Tare wt., screen & clamp* (g):	25.55
Sample Number:	Soil A	*Tare wt., ring* (g):	101.26
Ring Number:	NA	*Tare wt., epoxy* (g):	0.00
Depth:	NA	*Sample volume* (cm^3):	229.25

Saturated weight at 0 cm tension* (g): 569.40
Volume of water† in saturated sample (cm^3): 89.89
Saturated moisture content (% vol): 39.21
Sample bulk density (g/cm^3): 1.54

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	26-Jan-04 / 07:40	569.40	0.00	39.21
	29-Jan-04 / 12:30	567.87	23.00	38.54
	02-Feb-04 / 07:30	553.32	125.00	32.20
Pressure plate:	05-Feb-04 / 12:30	543.77	509.90	28.03

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil A
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 141.85
Tare weight, jar (g): 112.74
Sample bulk density (g/cm^3): 1.54

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	03-Feb-04 / 09:00	145.17	4793.1	17.55
	03-Feb-04 / 15:20	144.51	14583.1	14.06

Dry weight of relative humidity box sample* (g): 67.89
Tare weight (g): 40.05
Sample bulk density (g/cm^3): 1.54

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	06-Feb-04 / 08:00	68.25	851293	1.97

Comments:

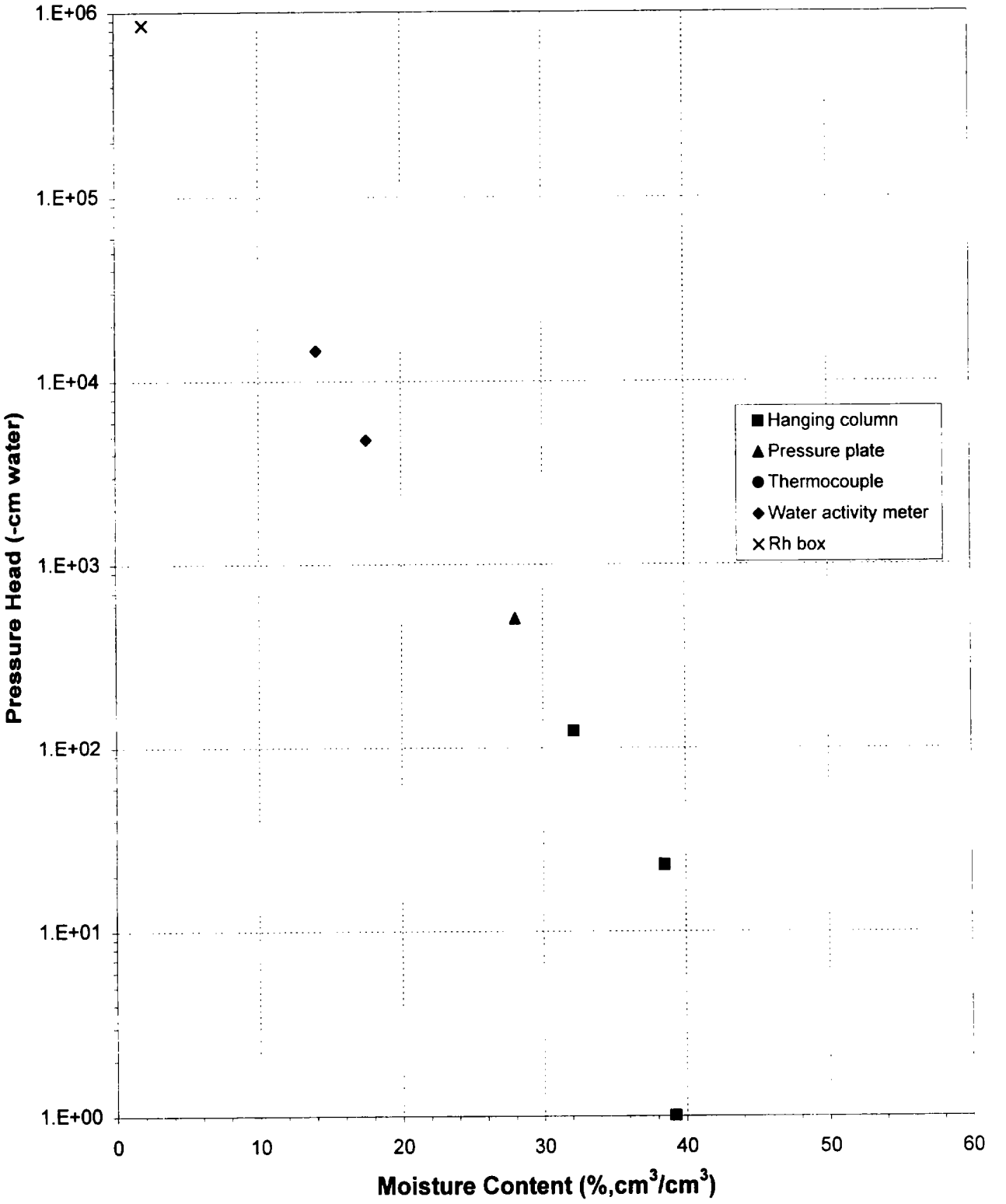
* Weight including tares

† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: M. Devine/D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

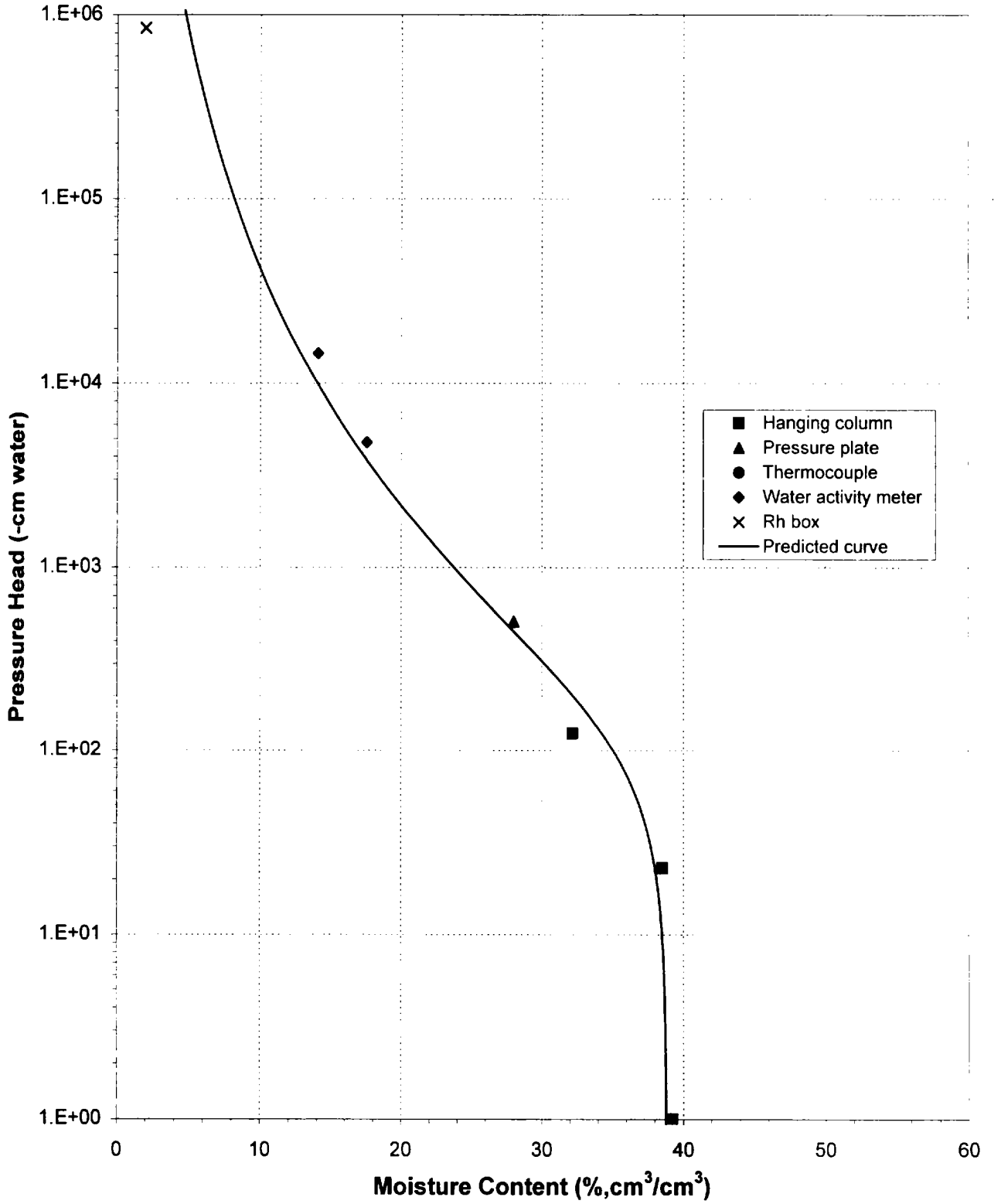
Water Retention Data Points

Sample Number: Soil A



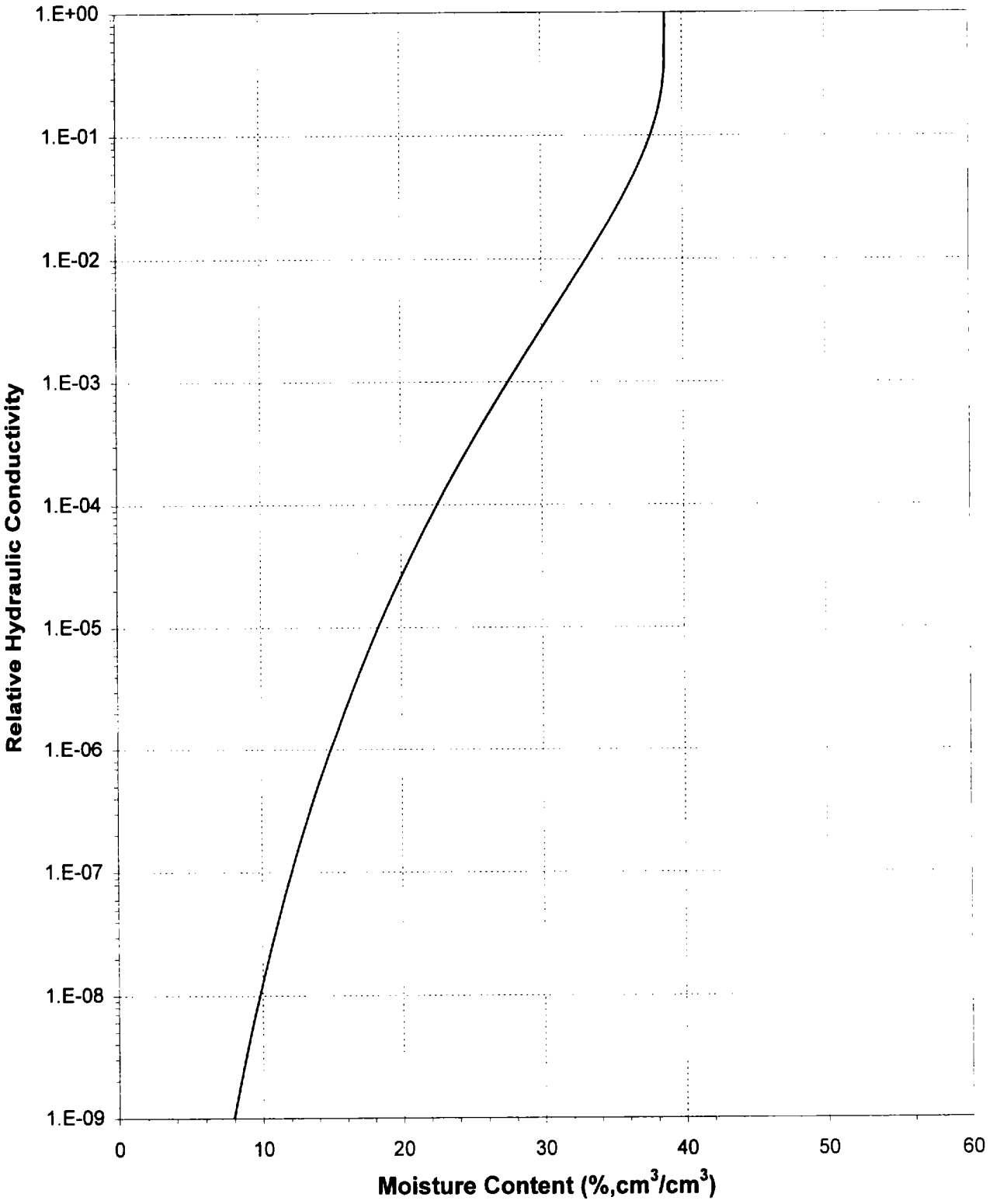
Predicted Water Retention Curve and Data Points

Sample Number: Soil A



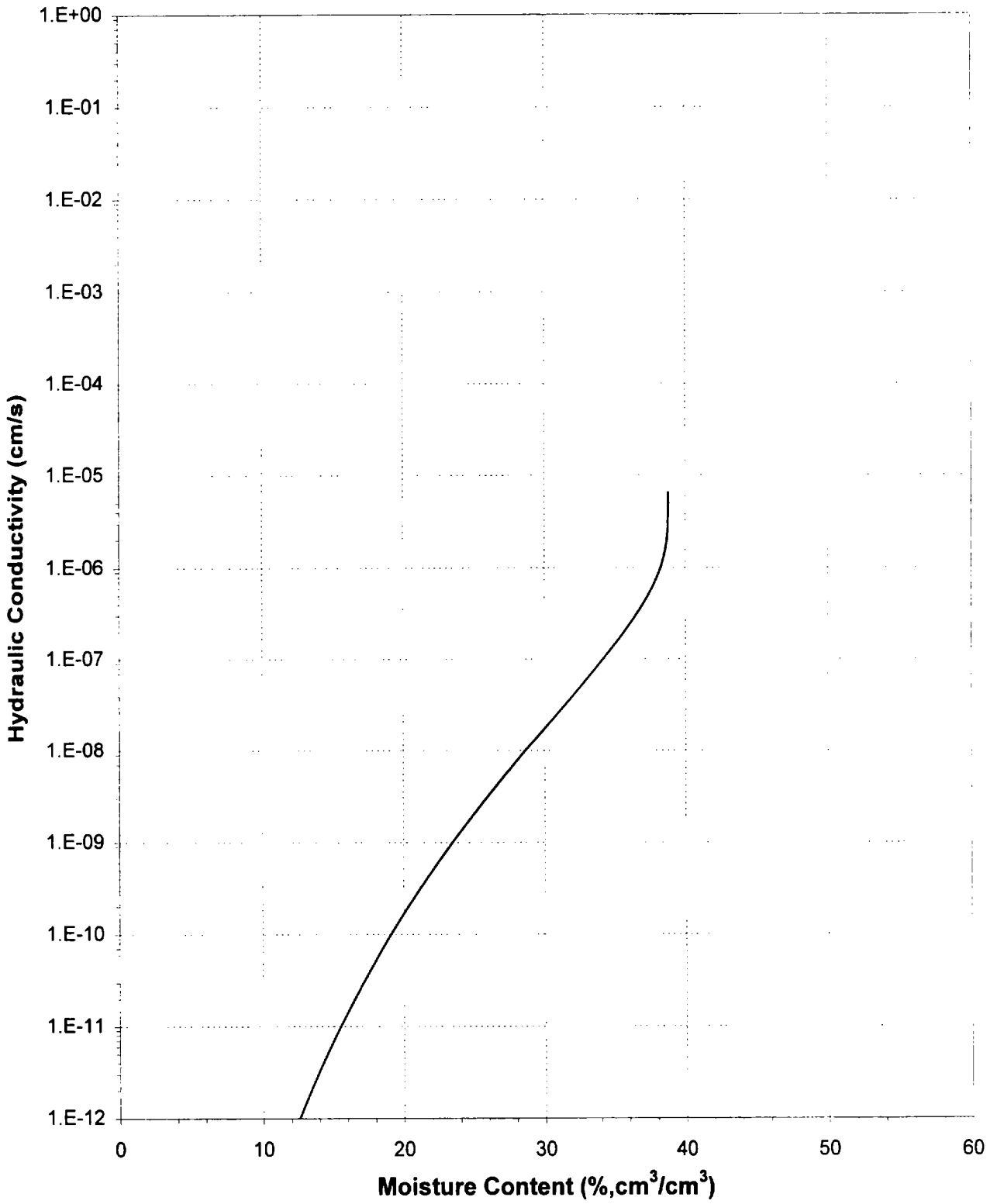
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: Soil A



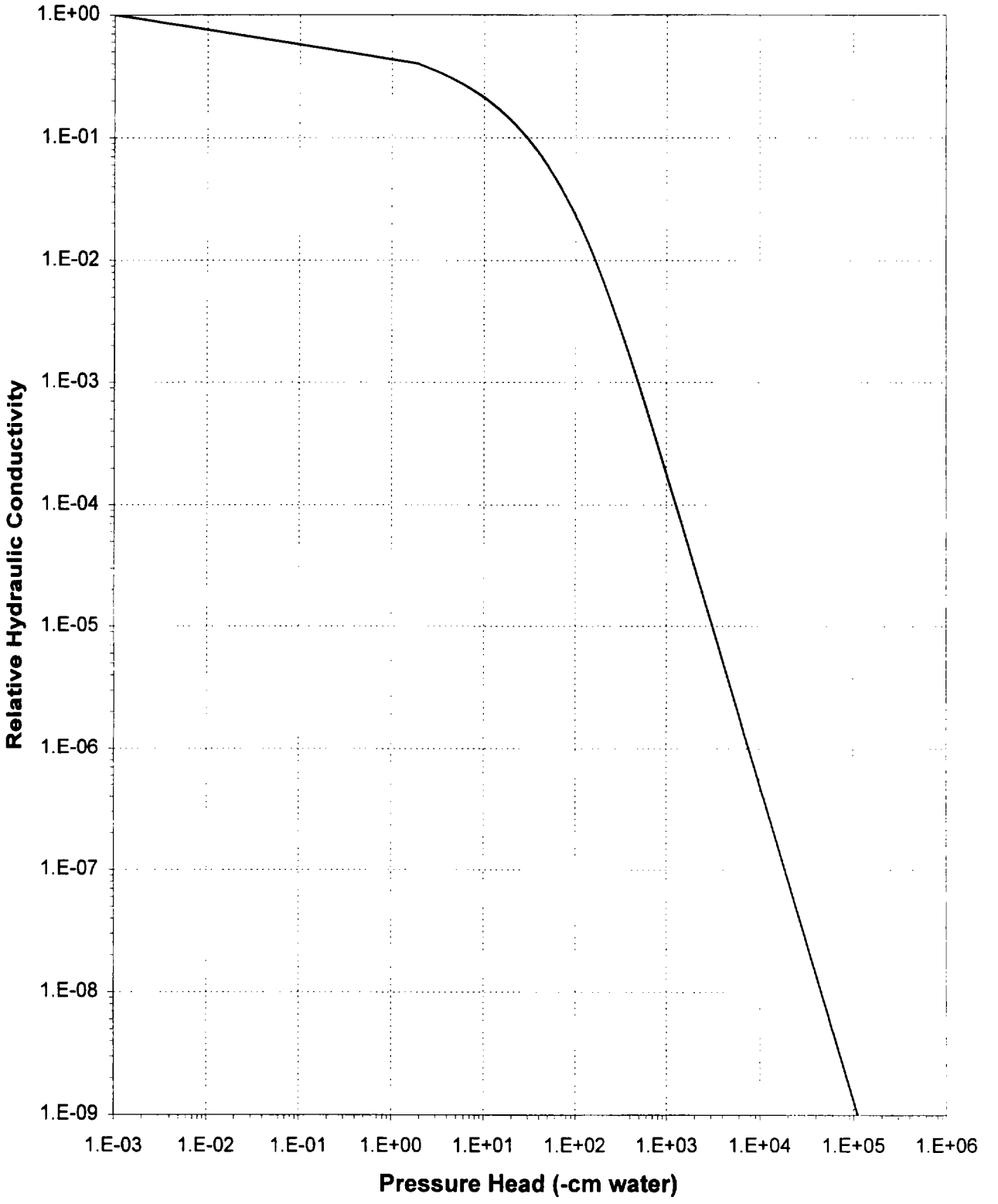
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: Soil A



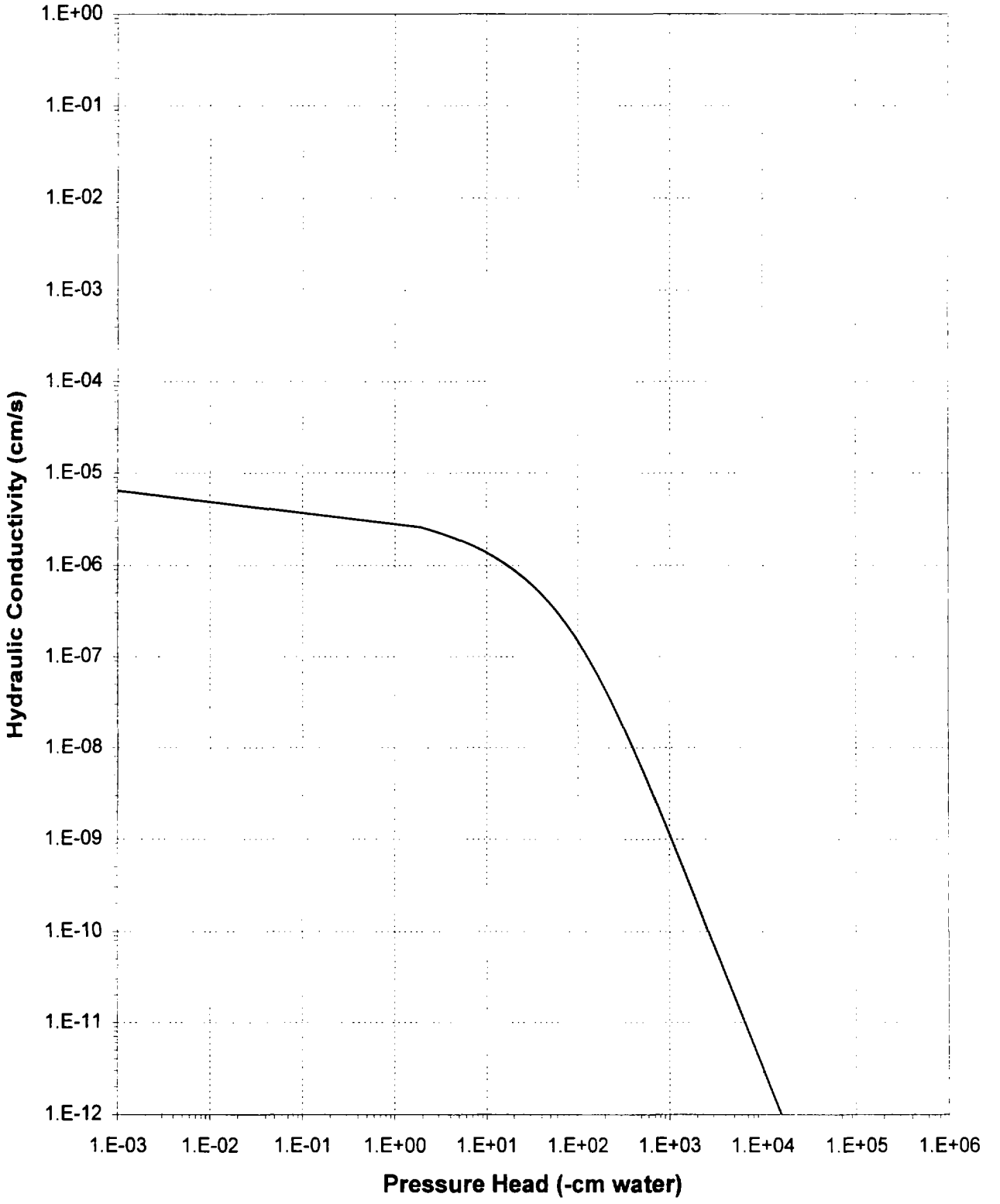
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: Soil A



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: Soil A



Gravel Correction

Sample name

Soil B

#4 Sieve Split

Inputs

Mass(coarse)	1.23
Mass(fines)	98.77
Dry bulk density(fines)	1.53
Density(coarse)	2.65
Ksat value(fines)	6.0E-06
Theta saturated(fines)	0.3898
Theta initial (fines)	0.2470
Theta residual(fines)	0.0000
Theta saturated(coarse)*	0
Theta initial (coarse)*	0
Theta residual(coarse)*	0

Volumetric fraction of fines in composite	Volumetric fraction of coarse in composite	Volumetric fraction of voids in composite	V(coarse)
0.993	0.007	0.000	0.46
			V(fines)
			64.56
			V(composite)
	Outputs		65.02
			V(voids)
Density (composite)		1.5380	0
Ksat composite		6.0E-06	
Theta saturated composite		0.3870	
Theta initial composite		0.2452	
Theta residual composite		0.0000	

* starred values to the left for coarse fraction should be set to zero if the coarse fraction is assumed to hold no water in pores

Moisture Retention Data

Hanging Column/Pressure Plate/Thermocouple

(Main Drainage Curve)

Job Name:	SCS-ECDC Landfill	*Dry wt. of sample* (g):	347.55
Job Number:	WR04.0005.00	*Tare wt., screen & clamp* (g):	26.49
Sample Number:	Soil B	*Tare wt., ring* (g):	134.62
Ring Number:	NA	*Tare wt., epoxy* (g):	0.00
Depth:	NA	*Sample volume* (cm^3):	226.43

Saturated weight at 0 cm tension* (g): 598.07
Volume of water† in saturated sample (cm^3): 89.41
Saturated moisture content (% vol): 39.49
Sample bulk density (g/cm^3): 1.53

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Hanging column:	26-Jan-04 / 07:40	598.07	0.00	39.49
	29-Jan-04 / 12:30	595.52	23.00	38.36
	02-Feb-04 / 07:30	582.86	125.00	32.77
Pressure plate:	05-Feb-04 / 12:30	572.14	509.90	28.03

Comments:

* Weight including tares
† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: M. Devine
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

Moisture Retention Data

Water Activity Meter/Relative Humidity Box

(Main Drainage Curve)

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil B
Ring Number: NA
Depth: NA

Dry weight of water activity meter sample* (g): 136.80
Tare weight, jar (g): 113.60
Sample bulk density (g/cm^3): 1.53

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Water Activity Meter:	29-Jan-04 / 15:11	139.23	6016.8	16.08
	03-Feb-04 / 15:15	138.97	15297.0	14.36

Dry weight of relative humidity box sample* (g): 76.64
Tare weight (g): 41.91
Sample bulk density (g/cm^3): 1.53

	Date/Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)
Relative humidity box:	06-Feb-04 / 08:00	77.11	851293	2.09

Comments:

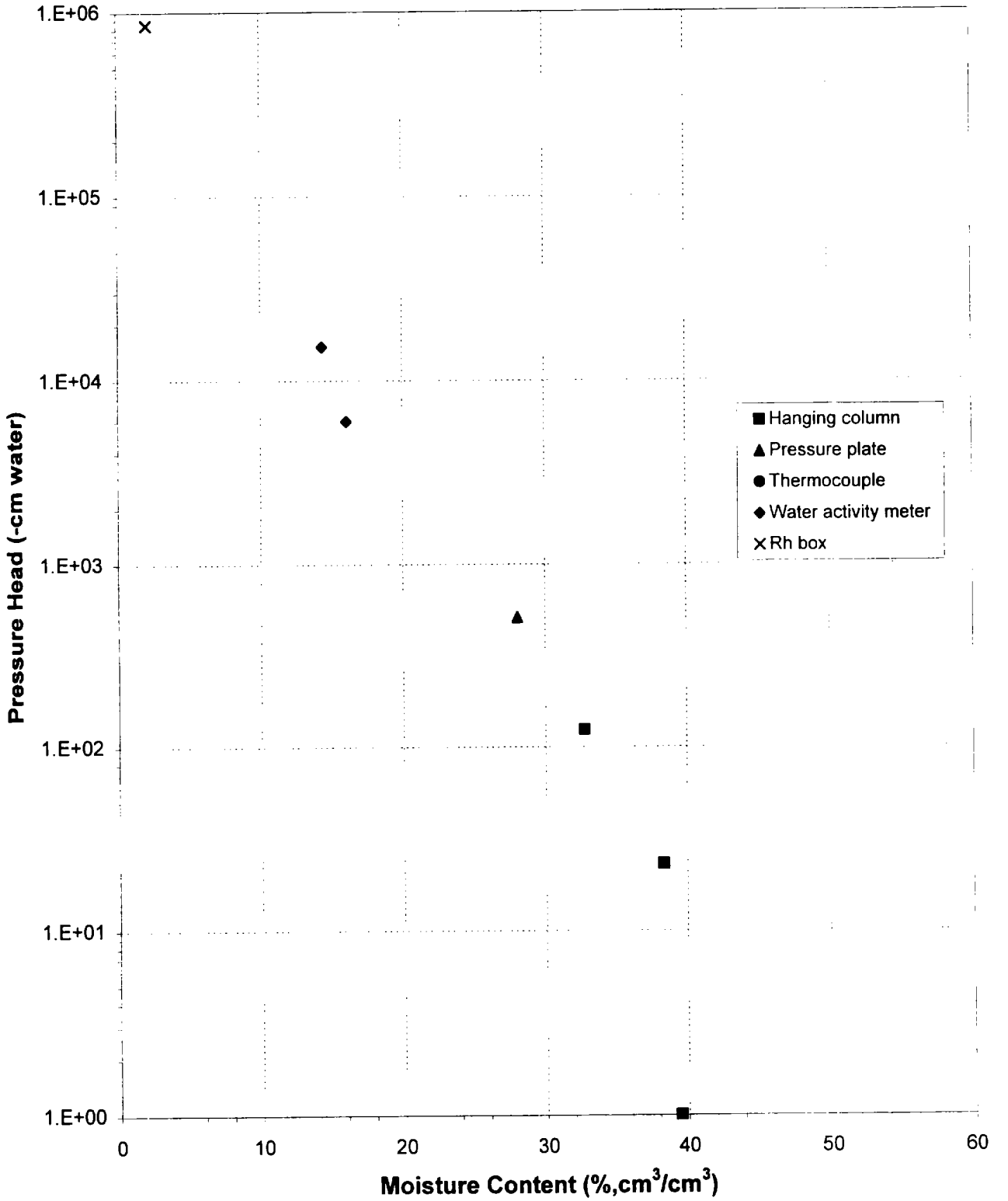
* Weight including tares

† Assumed density of water is 1.0 g/cm^3

Laboratory analysis by: M. Devine/D. O'Dowd
Data entered by: D. O'Dowd
Checked by: D. O'Dowd

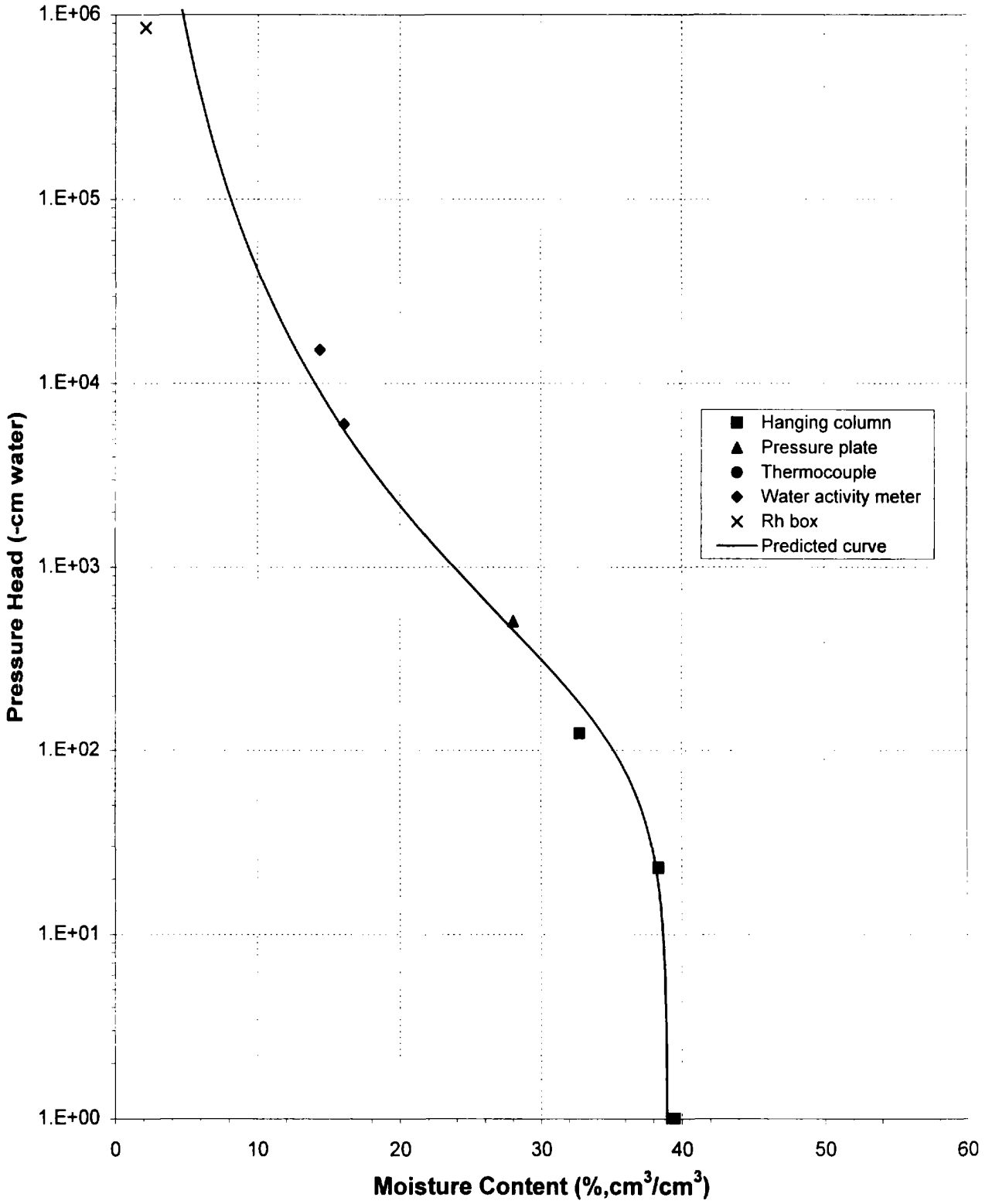
Water Retention Data Points

Sample Number: Soil B



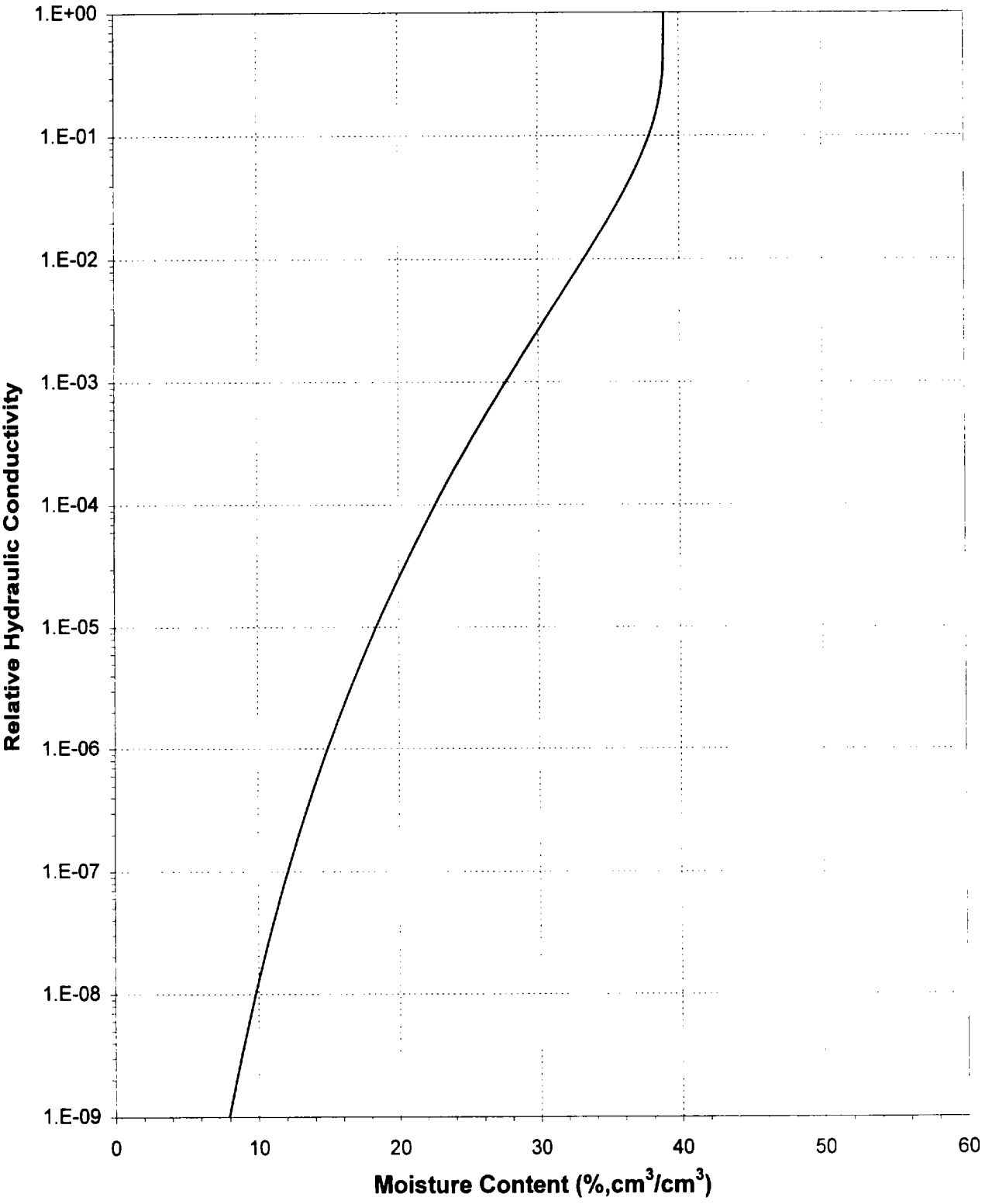
Predicted Water Retention Curve and Data Points

Sample Number: Soil B



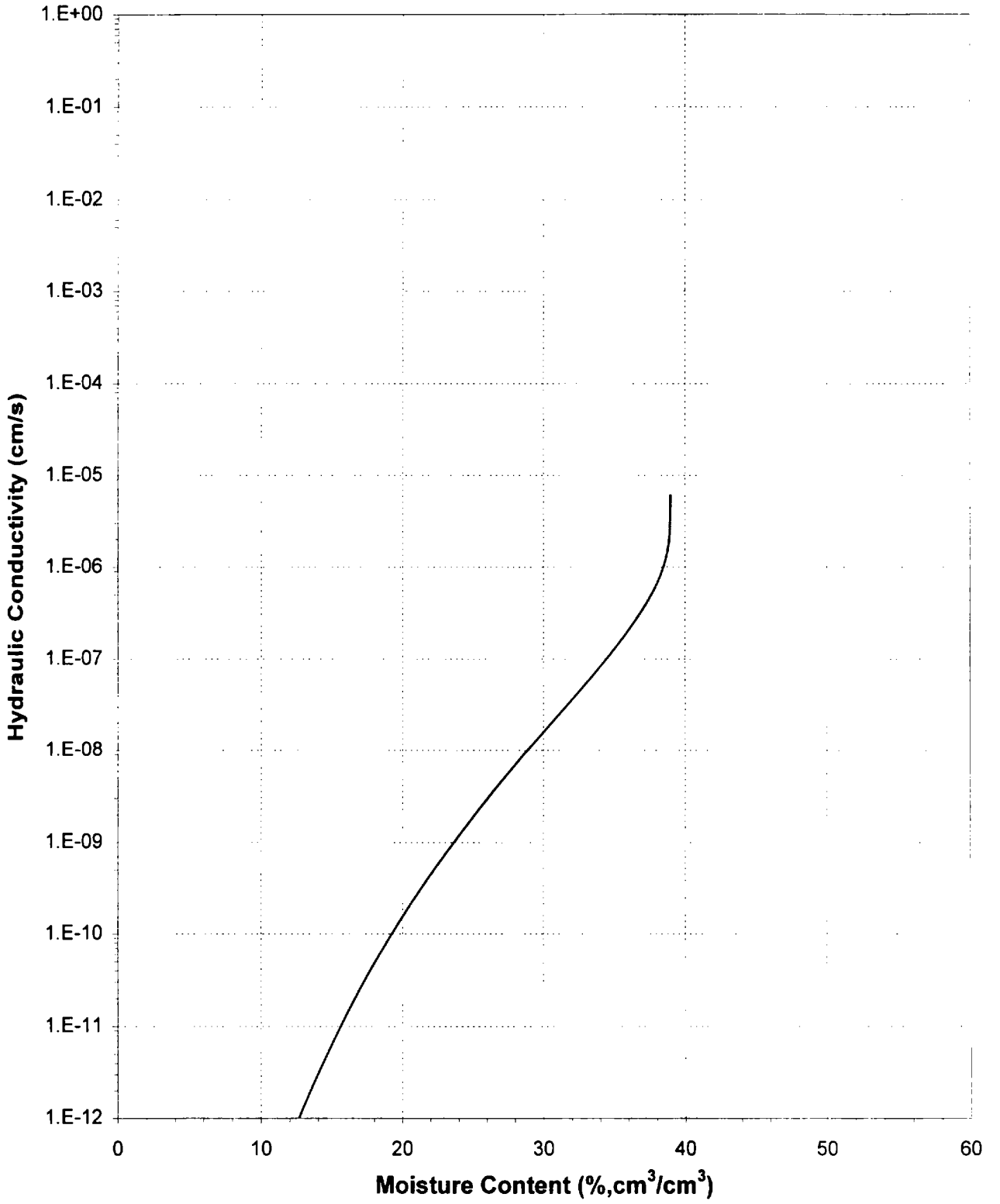
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: Soil B



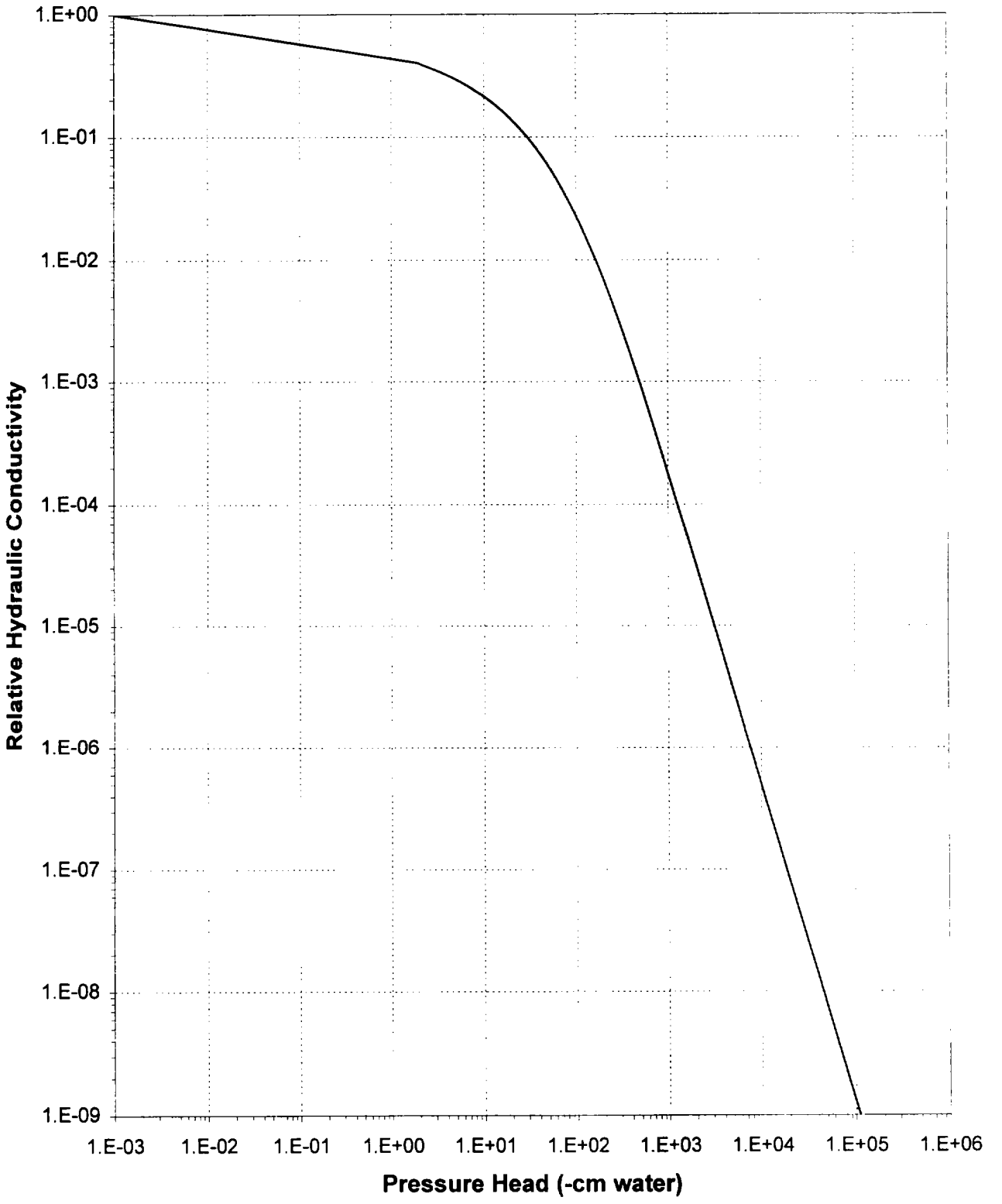
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: Soil B



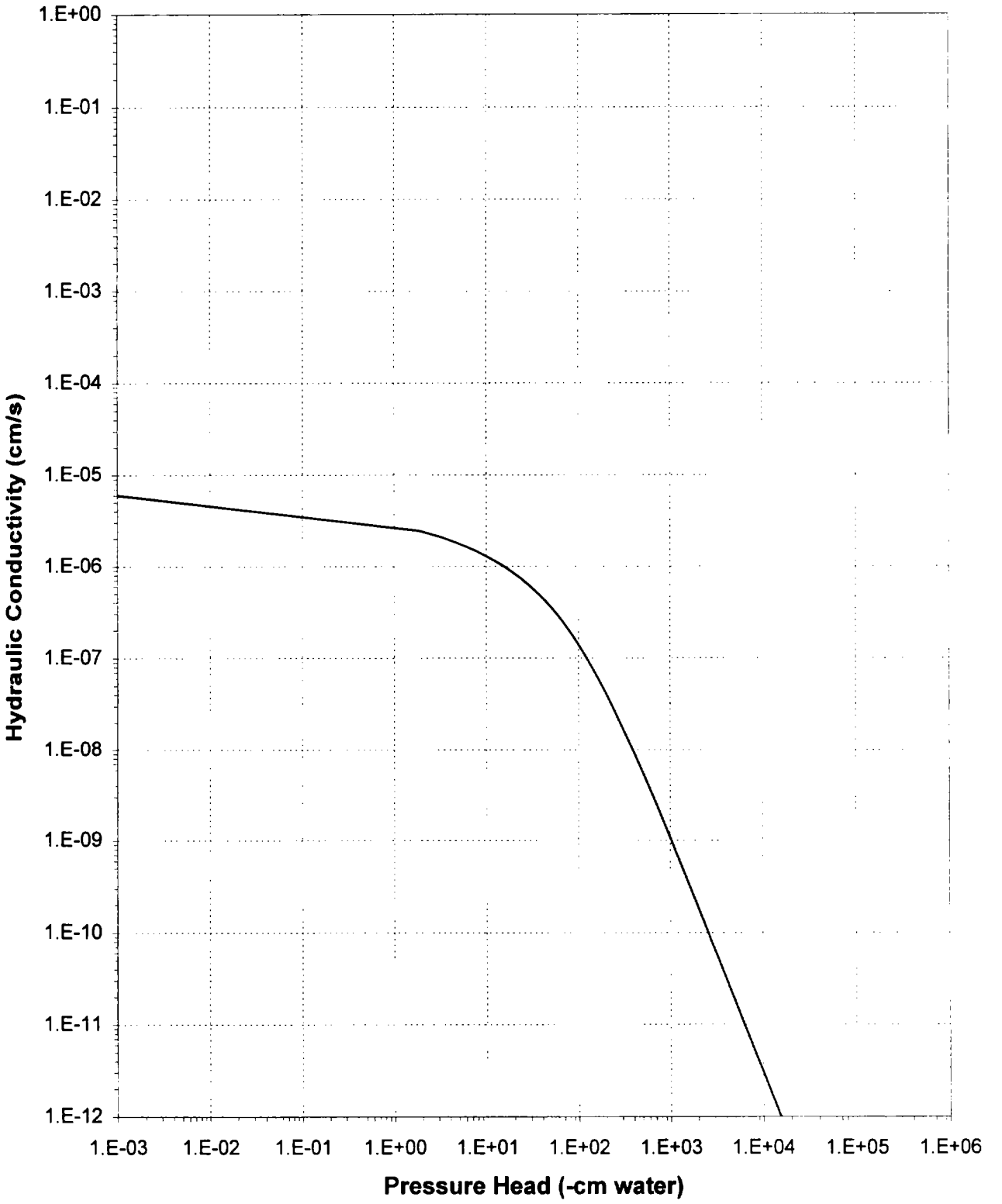
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: Soil B



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: Soil B



Summary of Particle Size Characteristics

Sample Number	d_{10} (mm)	d_{50} (mm)	d_{60} (mm)	C_u	C_c	Method	ASTM Classification	USDA Classification	
Soil A	0.00073	0.053	0.071	97	1.7	WS/H	Sandy silt	Loam	(Est)
Soil B	0.00064	0.056	0.071	111	2.7	WS/H	Sandy silt	Loam	(Est)

d_{50} = Median particle diameter

Est = Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

$$C_u = \frac{d_{60}}{d_{10}}$$

$$C_c = \frac{(d_{30})^2}{(d_{10})(d_{60})}$$

DS = Dry sieve

H = Hydrometer

WS = Wet sieve

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Particle Size Analysis
Wet Sieve Data (#10 Split)

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil A
Ring Number: NA
Depth: NA
Test Date: 16-Jan-04

Initial Dry Weight of Sample (g): 1122.00
Weight Passing #10 (g): 1097.03
Weight Retained #10 (g): 24.97
Weight of Hydrometer Sample (g): 50.16
Calculated Weight of Sieve Sample (g): 51.30

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	1122.00	100.00
	1.5"	38.1	0.00	0.00	1122.00	100.00
	3/4"	19.0	0.00	0.00	1122.00	100.00
	3/8"	9.5	0.77	0.77	1121.23	99.93
	4	4.75	6.27	7.04	1114.96	99.37
	10	2.00	17.93	24.97	1097.03	97.77
-10			(Based on calculated sieve wt.)			
	20	0.85	0.86	2.00	49.30	96.10
	40	0.425	1.10	3.10	48.20	93.95
	60	0.250	1.86	4.96	46.34	90.33
	140	0.106	8.86	13.82	37.48	73.06
	200	0.075	5.85	19.67	31.63	61.65
	dry pan		1.87	21.54	29.76	
	wet pan			29.76	0.00	

d_{10} (mm): 0.00073
d_{16} (mm): 0.0014
d_{30} (mm): 0.0094
d_{50} (mm): 0.053
d_{60} (mm): 0.071
d_{84} (mm): 0.18

Median Particle Diameter--d_{50} (mm): 0.053
Uniformity Coefficient, Cu--$[d_{60}/d_{10}]$ (mm): 97
Coefficient of Curvature, Cc--$[(d_{30})^2/(d_{10}*d_{60})]$ (mm): 1.7
Mean Particle Diameter--$[(d_{16}+d_{50}+d_{84})/3]$ (mm): 0.078

Note: Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

Classification of fines: ML

ASTM Soil Classification: Sandy silt
USDA Soil Classification: Loam

Laboratory analysis by: D. O'Dowd/J. Calvert
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Particle Size Analysis
Hydrometer Data

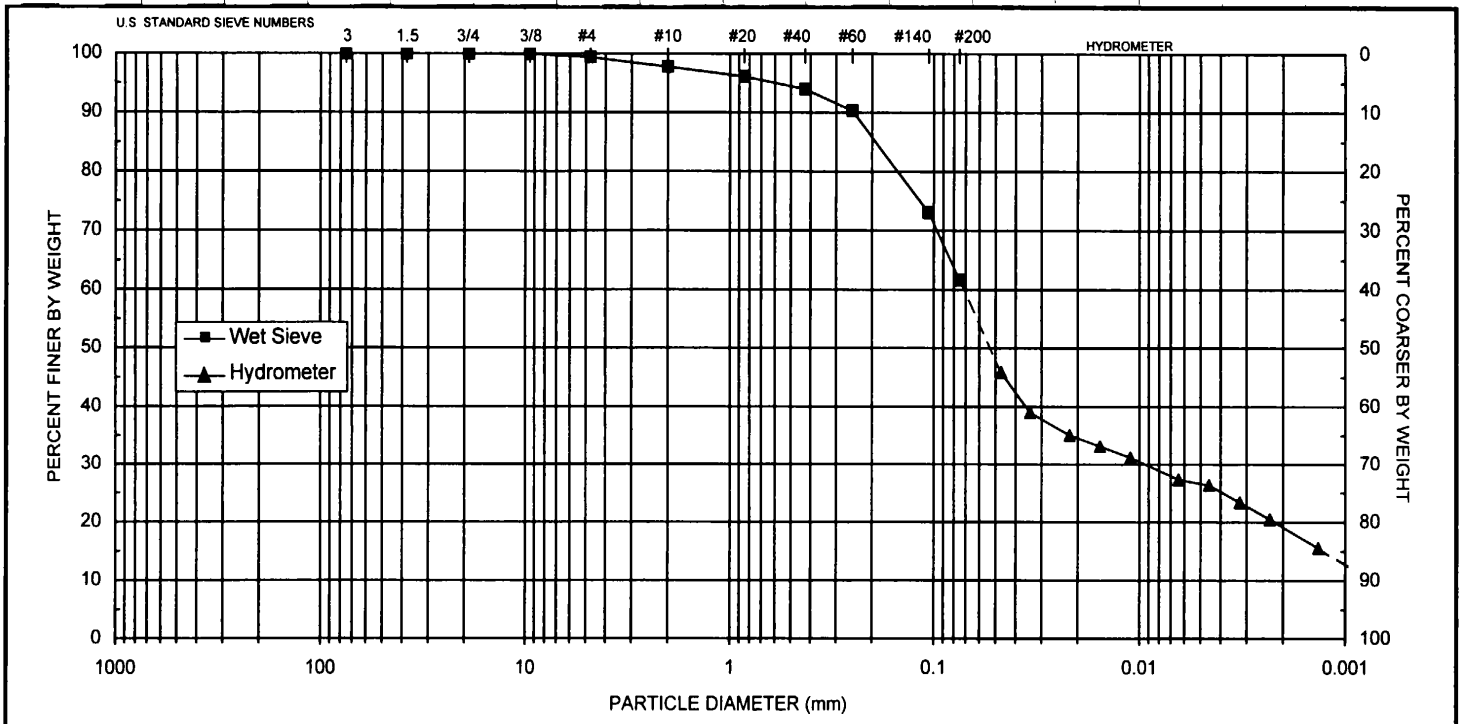
Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil A
Ring Number: NA
Depth: NA
Test Date: 21-Jan-04
Start Time: 8:00

Type of Water Used: DISTILLED
Reaction with H_2O_2*:* Moderate
Dispersant: $(NaPO_3)_6$
Assumed particle density: 2.65
Initial Wt. (g)*:* 50.16
Total Sample Wt. (g)*:* 1122.00
Wt. Passing #10 (g): 1097.03

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	L (cm)	D (mm)	P (%)	% Finer
21-Jan-04	1	18.4	29.5	6.0	23.5	11.5	0.04709	46.9	45.8
	2	18.4	26.0	6.0	20.0	12.0	0.03412	39.9	39.0
	5	18.4	24.0	6.0	18.0	12.4	0.02187	35.9	35.1
	10	18.4	23.0	6.0	17.0	12.5	0.01557	33.9	33.1
	20	18.4	22.0	6.0	16.0	12.7	0.01108	31.9	31.2
	60	19.1	20.0	6.0	14.0	13.0	0.00642	27.9	27.3
	120	19.4	19.0	5.5	13.5	13.2	0.00455	26.9	26.3
	240	19.6	17.5	5.5	12.0	13.4	0.00324	23.9	23.4
	480	19.6	16.0	5.5	10.5	13.7	0.00231	20.9	20.5
22-Jan-04	1454	19.0	14.0	6.0	8.0	14.0	0.00135	15.9	15.6

Comments:

Laboratory analysis by: J. Hines
Data entered by: D. O'Dowd
Checked by: J. Kelsey



UNIFIED	COBBLES	GRAVEL		SAND			SILT OR CLAY			
		Coarse	Fine	Coarse	Medium	Fine				
USDA	COBBLES	GRAVEL		SAND				SILT	CLAY	
				Very coarse	Coarse	Medium	Fine	Very fine		

d_{10} = **0.00073**	d_{30} = **0.0094**	d_{50} = **0.053**	d_{60} = **0.071**	C_u = **97**	C_c = **1.7**

SAMPLE NUMBER	DEPTH	ASTM CLASSIFICATION	USDA CLASSIFICATION
Soil A	**NA**	**Sandy silt**	**Loam**

Note: Reported values for d_{10}, C_u, C_c, and ASTM classification are estimates, since extrapolation was required to obtain the d_{10} diameter

Particle Size Analysis
Wet Sieve Data (#10 Split)

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil B
Ring Number: NA
Depth: NA
Test Date: 16-Jan-04

Initial Dry Weight of Sample (g): 1055.95
Weight Passing #10 (g): 1026.74
Weight Retained #10 (g): 29.21
Weight of Hydrometer Sample (g): 50.07
Calculated Weight of Sieve Sample (g): 51.49

Test Fraction	Sieve Number	Diameter (mm)	Wt. Retained	Cum Wt. Retained	Wt. Passing	% Passing
+10						
	3"	75	0.00	0.00	1055.95	100.00
	1.5"	38.1	0.00	0.00	1055.95	100.00
	3/4"	19.0	0.00	0.00	1055.95	100.00
	3/8"	9.5	2.60	2.60	1053.35	99.75
	4	4.75	10.44	13.04	1042.91	98.77
	10	2.00	16.17	29.21	1026.74	97.23
-10			(Based on calculated sieve wt.)			
	20	0.85	0.62	2.04	49.45	96.03
	40	0.425	0.95	2.99	48.50	94.18
	60	0.250	1.70	4.69	46.80	90.88
	140	0.106	8.88	13.57	37.92	73.64
	200	0.075	5.98	19.55	31.94	62.03
	dry pan		1.11	20.66	30.83	
	wet pan			30.83	0.00	

d_{10} (mm): 0.00064
d_{16} (mm): 0.0014
d_{30} (mm): 0.011
d_{50} (mm): 0.056
d_{60} (mm): 0.071
d_{84} (mm): 0.18

Median Particle Diameter --d_{50} (mm): 0.056
Uniformity Coefficient, Cu --[d_{60}/d_{10}] (mm): 111
Coefficient of Curvature, Cc --[$(d_{30})^2/(d_{10}*d_{60})$] (mm): 2.7
Mean Particle Diameter --[$(d_{16}+d_{50}+d_{84})/3$] (mm): 0.079

Note: Reported values for d_{10}, C_u, C_c, and soil classification are estimates, since extrapolation was required to obtain the d_{10} diameter

Classification of fines: ML

ASTM Soil Classification: Sandy silt
USDA Soil Classification: Loam

Laboratory analysis by: J. Calvert
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Daniel B. Stephens & Associates, Inc.

Particle Size Analysis
Hydrometer Data

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil B
Ring Number: NA
Depth: NA

Test Date: 21-Jan-04
Start Time: 8:06

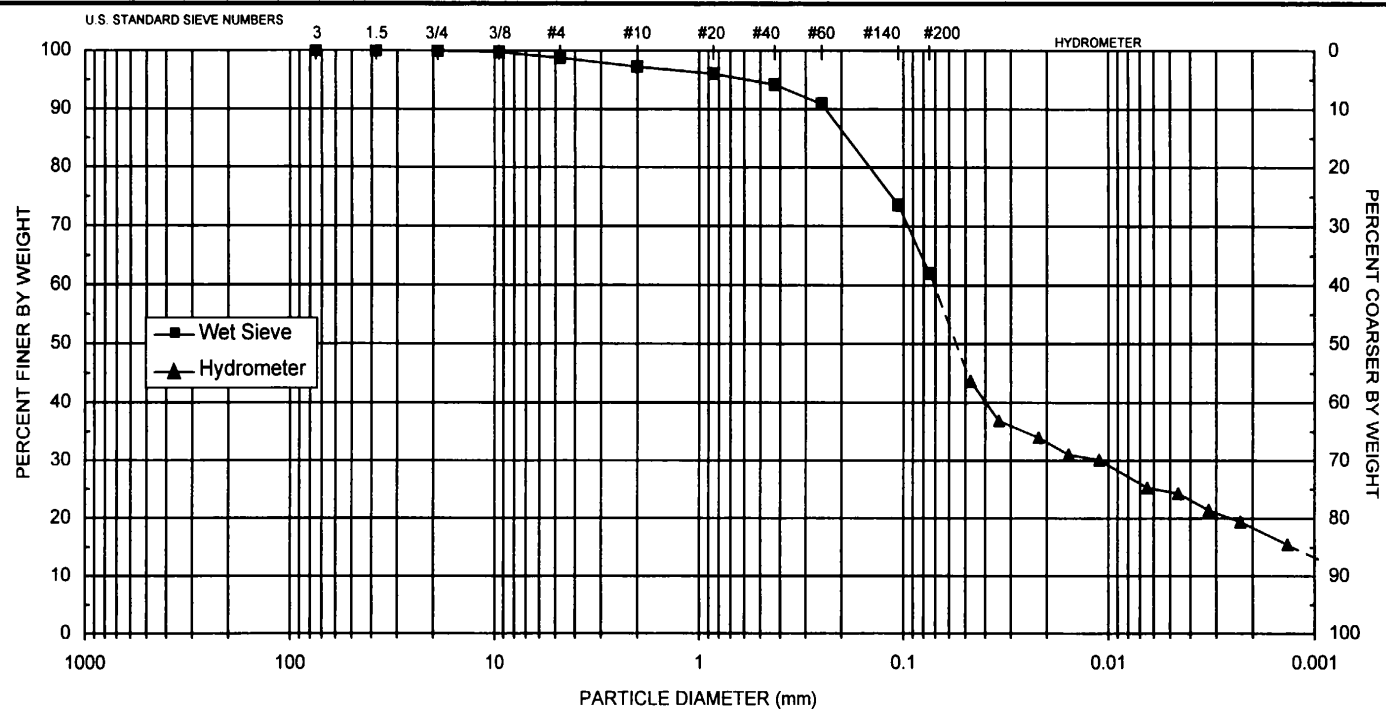
Type of Water Used: DISTILLED
Reaction with H_2O_2*:* Moderate
Dispersant: $(NaPO_3)_6$
Assumed particle density: 2.65

Initial Wt. (g): 50.07
Total Sample Wt. (g): 1055.95
Wt. Passing #10 (g): 1026.74

Date	Time (min)	Temp (°C)	R (g/L)	R_L (g/L)	R_{corr} (g/L)	L (cm)	D (mm)	P (%)	% Finer
21-Jan-04	1	18.4	28.5	6.0	22.5	11.6	0.04743	44.9	43.7
	2	18.4	25.0	6.0	19.0	12.2	0.03435	37.9	36.9
	5	18.4	23.5	6.0	17.5	12.4	0.02195	35.0	34.0
	10	18.4	22.0	6.0	16.0	12.7	0.01567	32.0	31.1
	20	18.4	21.5	6.0	15.5	12.8	0.01112	31.0	30.1
	60	19.1	19.0	6.0	13.0	13.2	0.00646	26.0	25.2
	120	19.4	18.0	5.5	12.5	13.3	0.00458	25.0	24.3
	240	19.6	16.5	5.5	11.0	13.6	0.00326	22.0	21.4
	490	19.6	15.5	5.5	10.0	13.8	0.00230	20.0	19.4
22-Jan-04	1450	19.0	14.0	6.0	8.0	14.0	0.00136	16.0	15.5

Comments:

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey



UNIFIED	COBBLES	GRAVEL: Coarse, Fine	SAND: Coarse	SAND: Medium	SAND: Fine	SILT OR CLAY
USDA	COBBLES	GRAVEL	SAND: Very coarse	SAND: Coarse	SAND: Medium	SAND: Fine	SAND: Very fine	SILT	CLAY

d_{10} = **0.00064**	d_{30} = **0.011**	d_{50} = **0.056**	d_{60} = **0.071**	C_u = **111**	C_c = **2.7**

SAMPLE NUMBER	DEPTH	ASTM CLASSIFICATION	USDA CLASSIFICATION
Soil B	**NA**	**Sandy silt**	**Loam**

Note: Reported values for d_{10}, C_u, C_c, and ASTM classification are estimates, since extrapolation was required to obtain the d_{10} diameter

Summary of Atterberg Tests

Sample Number	Liquid Limit	Plastic Limit	Plasticity Index	Classification
Soil A	29	23	6	ML
Soil B	29	24	5	ML

--- = Soil requires visual-manual classification due to non-plasticity

Atterberg Limits

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil A
Ring Number: NA
Depth: NA

Test Date: 16-Jan-04

Liquid Limit

	Trial 1	Trial 2	Trial 3
Number of drops:	34	27	15
Pan number:	LL1	LL2	LL3
Weight of pan plus moist soil (g):	133.07	131.96	130.70
Weight of pan plus dry soil (g)	128.87	127.88	127.11
Weight of pan (g):	113.77	113.59	114.93
Gravimetric moisture content (% g/g):	27.78	28.55	29.52
Liquid Limit:	29		

Plastic Limit

	Trial 1	Trial 2
Pan number:	PL1	PL3
Weight of pan plus moist soil (g):	116.67	121.64
Weight of pan plus dry soil (g)	115.79	120.74
Weight of pan (g):	112.04	116.80
Gravimetric moisture content (% g/g):	23.33	22.85
Plastic Limit:	23	

Results

Percent of Sample Retained on #40 Sieve: NA

Liquid Limit: 29
Plastic Limit: 23
Plasticity Index: 6

Classification: ML

Comments:

--- = Soil requires visual-manual classification due to non-plasticity

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Atterberg Limits

Job Name: SCS-ECDC Landfill
Job Number: WR04.0005.00
Sample Number: Soil B
Ring Number: NA
Depth: NA

Test Date: 16-Jan-04

Liquid Limit

	Trial 1	Trial 2	Trial 3
Number of drops:	33	27	16
Pan number:	LL1	LL3	LL2
Weight of pan plus moist soil (g):	128.31	133.46	129.43
Weight of pan plus dry soil (g)	124.71	129.83	125.55
Weight of pan (g):	112.18	117.36	112.51
Gravimetric moisture content (% g/g):	28.70	29.07	29.76
Liquid Limit:	29		

Plastic Limit

	Trial 1	Trial 2
Pan number:	PL1	PL2
Weight of pan plus moist soil (g):	119.93	120.03
Weight of pan plus dry soil (g)	118.72	118.97
Weight of pan (g):	113.60	114.47
Gravimetric moisture content (% g/g):	23.72	23.69
Plastic Limit:	24	

Results

Percent of Sample Retained on #40 Sieve: NA

Liquid Limit: 29
Plastic Limit: 24
Plasticity Index: 5

Classification: ML

Comments:

--- = Soil requires visual-manual classification due to non-plasticity

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Summary of Proctor Compaction Tests

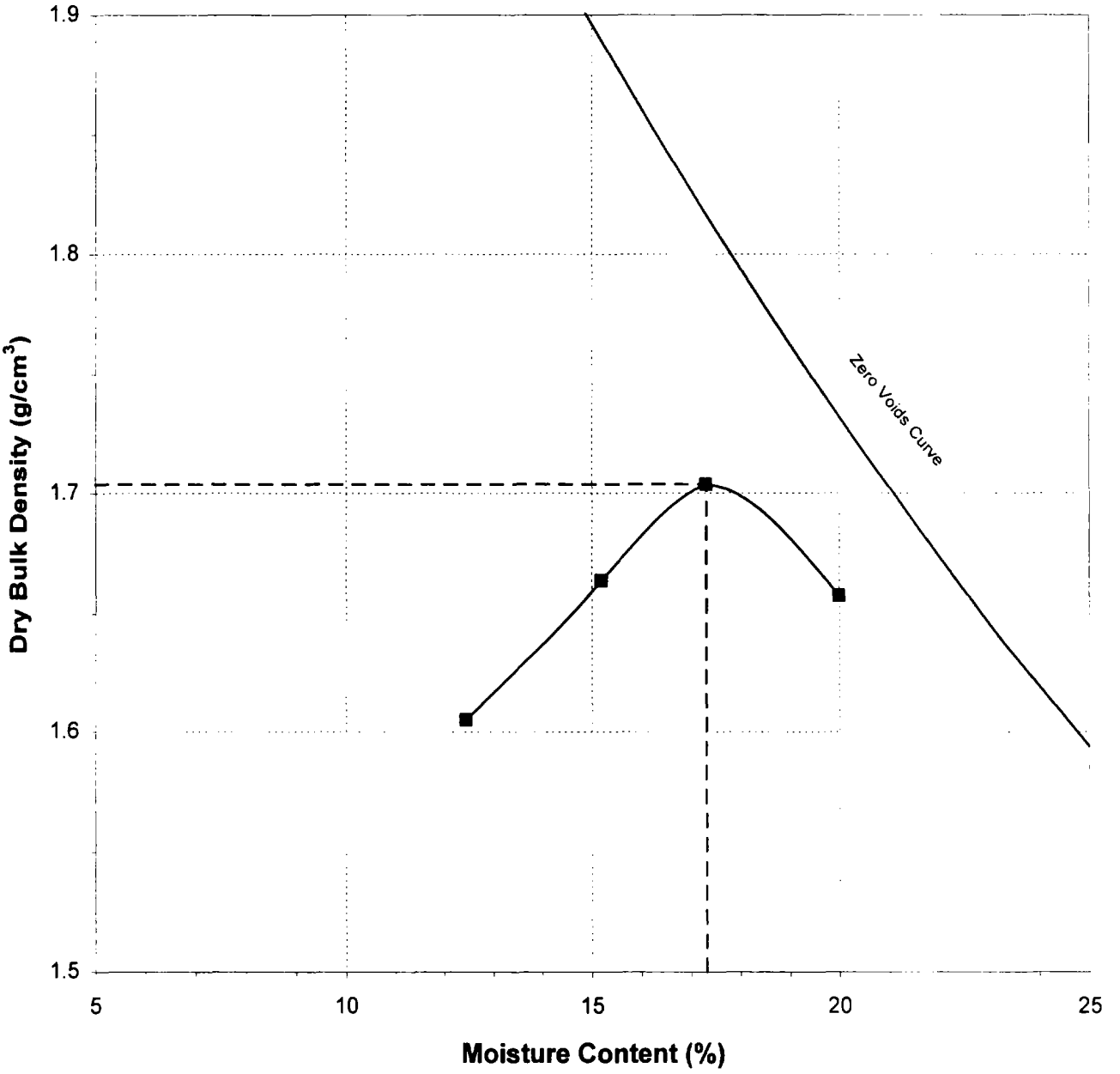
Sample Number	Optimum Moisture Content (% g/g)	Maximum Dry Bulk Density (g/cm^3)
Soil A	17.3	1.70
Soil B	16.5	1.71

Proctor Compaction Data Points with Fitted Curve

Sample Number: Soil A

Optimum Moisture Content (%):	17.3
Maximum Dry Bulk Density (g/cm^3):	1.70
Assumed particle density (g/cm^3):	2.65

Test Date: 16-Jan-04



Compaction method: Standard A

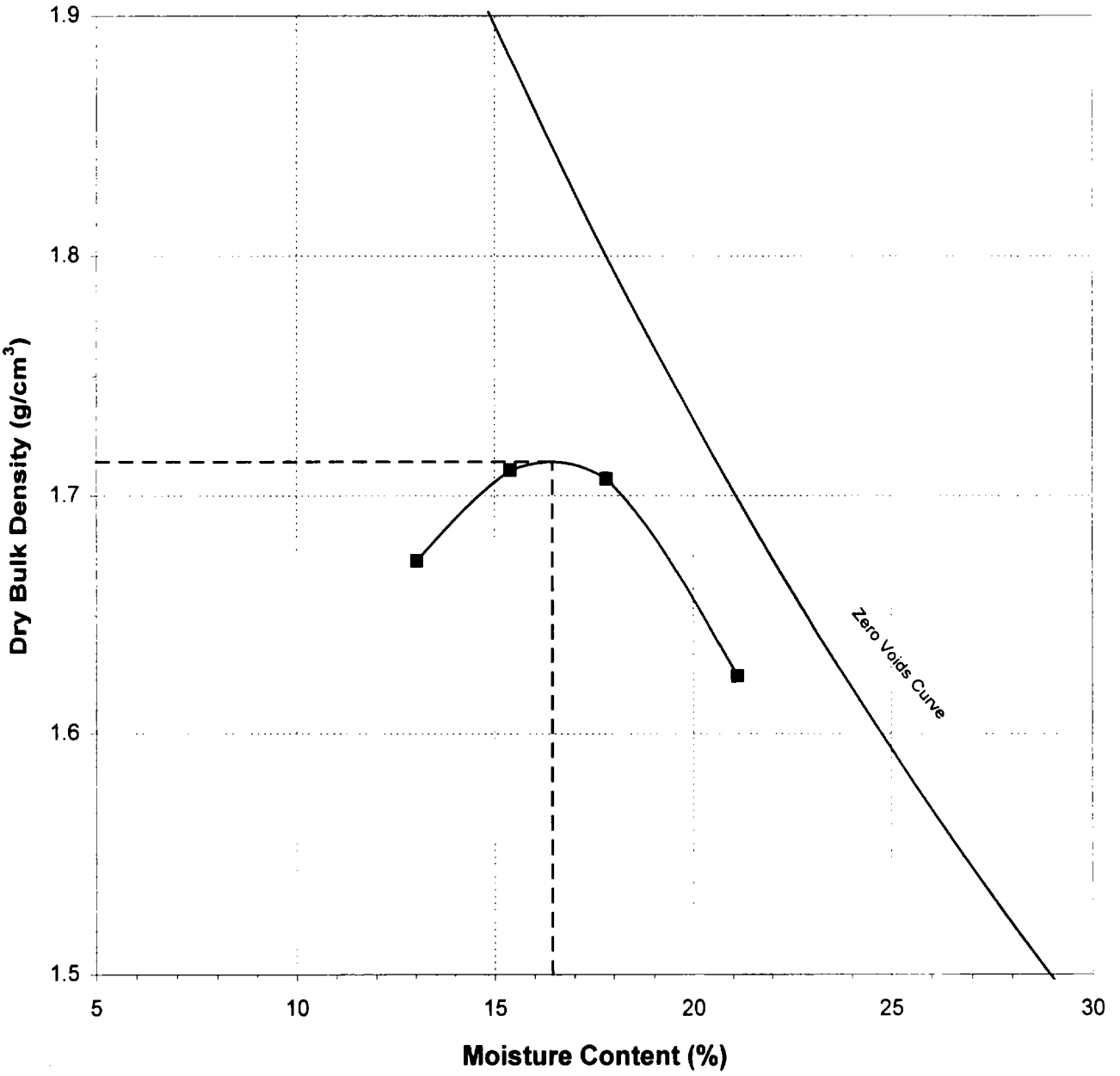
Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Proctor Compaction Data Points with Fitted Curve

Sample Number: Soil B

Optimum Moisture Content (%):	16.5
Maximum Dry Bulk Density (g/cm^3):	1.71
Assumed particle density (g/cm^3):	2.65

Test Date: 16-Jan-04



Compaction method: Standard A

Laboratory analysis by: D. O'Dowd
Data entered by: D. O'Dowd
Checked by: J. Kelsey

Laboratory Tests and Methods

Tests and Methods

Dry Bulk Density:	ASTM D 4531-91
Moisture Content:	ASTM D 2216-92
Calculated Porosity	Klute, A. 1986. Porosty. Chp.18-2.1, pp. 444-445, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Ksat:	
Constant Head:	ASTM D 2434-68 (93)
Hanging Column Method	Klute, A. 1986. Porosty. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Pressure Plate Method	ASTM D 2325-65 (94)
Water Potential Method	Dane, H. Jacob and G. Clark Topp. 2002. Chp.3. pp. 663-665, in J. H. Dane and G. C. Topp (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Relative Humidity Box	Karathanasis & Hajek. 1982. Quantitative Evaluation of Water Adsorption on Soil Clays. SSA Journal 46:1321-1325
Calc. Kunsat	Soil Sci. Soc. Am. J. 1980 44:892-898
Particle Size Analysis	ASTM D 422-63 (90)
Atterberg Limits	ASTM D 4318
Proctor Compaction Test	ASTM D 698-91

APPENDIX B

CLIMATE DATA

TABLE 1

Average Total Precipitation for Different Stations

Month	Sunnyside, UT	Salt Lake City, UT	Grand Jct., CO
	13.4	15.7	8.9
Jan	0.82	1.35	0.47
Feb	1.05	1.28	0.46
Mar	1.17	1.77	0.91
Apr	1.13	2.07	0.79
May	1.23	1.76	1
June	0.77	0.9	0.48
July	1.21	0.72	0.76
Aug	1.35	0.8	0.87
Sept	1.8	1.06	0.87
Oct	1.39	1.31	0.94
Nov	0.83	1.35	0.75
Dec	0.66	1.31	0.57

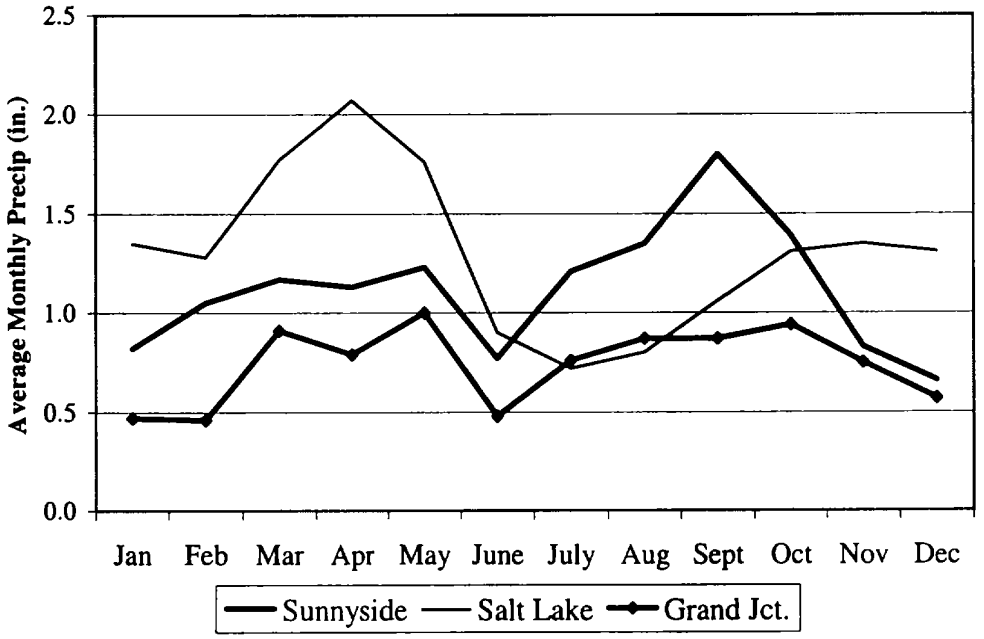


TABLE 2 - SUNNYSIDE, UTAH

Monthly Total Precipitation (inches)

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1961	0	0.19	1.97	0.66	1	0 z	0.45	2.79	3.78	0.69	1.45	0.5	13.48
1962	0.62	3.75	0 z	0	0.07	0.19	0.9	0.74	2.23	1.41	0.46	0.1	10.47
1963	0.25	0.28	0.54	0.94 i	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	1.07
1964	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0
1965	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0 z	0
1966	0 z	0 z	0 z	0.8 u	0.85	0.51	1.21	1.7	1.05	0.7	0.3	1.27	7.59
1967	1.23	0	0.15	0.45	2.61	2.24	1.75	0.92	0.98	0	0.2	1.42	11.95
1968	0.11	0.26	1.68	2.76	1.35	1.43	0.85	3.34	0.56	1.4	0.5	0.72	14.96
1969	3.32	3.41	1	1.26	1.31	2.99	0.97	1.09	1.58	1.68	0.55	0	19.16
1970	0.57	0.11	1.61	0.75	0	2.86	0.58	1.24	0.56	0.72	0.97	0.26	10.23
1971	0.2	0.69	0.32	1.27	1.71	0 z	0 z	0 z	0 z	0 z	0.1	1.46	5.75
1972	0 z	0 z	0 z	0 z	0 b	1.09	0.14	0.98	1.98	4.31	1.34	1.17	11.01
1973	0.62	0.41	1.51	0.84	0 z	1.4	1.97	1.17	0 z	0 z	0 z	0 z	7.92
1974	0 z	0 z	0 n	0.56	0	0.04	2.12	0.35	0.21	4.08	0.22	0.53	8.11
1975	0.76	0.59	2.22	0.61	1.84	1.44	3.05	0.06	0.32	0.4	0.51	0.66	12.46
1976	0.07	1.21	0.75	2.02	2.08	0.1	0.43	0.53	1.67	0	0	0	8.86
1977	0.58	0.13	0.06	0.05	1.49	0.5	2.09	1.4	0.64	1.58	0.67	0.43	9.62
1978	2.07	1.55	2.8	1.79	0.91	0.17	0.89	1.01	0.59	0.9	3.95	1.53	18.16
1979	1.05	0 z	2.9	0.58 a	0.83	0	0	1.68	0.03	0.65	0.1	0.57	8.39
1980	1.67	4.41	1.25	0.4	1.5	0	2.49	0.64	3.58	1.99	1.08	0.01	19.02
1981	0.1	0.63	1.55	1.85	2.95	0.33	1.46	2.47	2.21	3.07	0.46	0.56	17.64
1982	1.23 c	0.14	2.46	0.02	1.35	0.66 b	0.73	3.07 c	4.55 d	0.92	2.07	0.74	17.94
1983	1.14	1.04	0.76	1.1	1.57	0.58	3.07	2.28	3.22	1.46	2.13 d	1.93 b	20.28
1984	0.41 a	0.51	0.71	0.64 a	0.26	2.34 f	1.84	1.6 b	0.96 e	1.46	0.64	1.41	10.44
1985	0.71	0.18	1.74 d	1.52 c	2.24	1.27 b	2.13	0	4.45 d	0.84	1.18 d	0.52 c	16.78
1986	0.28	0.84 b	0.7 d	2.57 a	0.79	0.61	1.99	1.11	2.03	1.58 e	0.47	0.2	13.17
1987	0.52	1.36 b	1.7 b	0.47	1.9 c	0.27	2.67 f	3.25 b	0.14	1.8	2.42 b	1.16 a	14.99
1988	0.79 b	0.03	0.98	3.08	1.01	1.23	0.26 e	0 z	0 z	0.58	0.46	0.8 z	
1989	0.44 a	0.42	1.21	0.01	0.46	0.28	0.96	1.84	0.45	0.51	0.06	0.01	6.65
1990	0.67	0.42	1.32	1.21	0.54	1.28	1.48	0.58	2.44	0.82	0.05	0.51	11.32

a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present

TABLE 3 - GRAND JUNCTION WALKER, COLORADO

Monthly Total Precipitation (inches)

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN	Doubled
1961	0	0.18	1.47	0.85	1.11	0	0.03	1.63	2.22	0.7	0.66	0.63	9.48	**18.96**
1962	0.39	1.09	0.28	0.97	0.17	0.3	0.08	0.15	1.41	0.46	0.36	0.36	6.02	**12.04**
1963	0.99	0.47	0.55	0.12	0.01	0.61	0.93	1.75	0.48	0.6	0.36	0.45	7.32	**14.64**
1964	0.47	0.02	0.07	1.57	0.71	0.15	0.55	1.16	0.25	0	0.5	1.28	6.73	**13.46**
1965	0.66	0.94	0.87	1.95	1.35	1.33	0.89	0.67	2.52	1.4	0.82	0.76	14.16	**28.32**
1966	0.65	0.44	0.04	0.83	0.71	0.13	0.31	0.52	0.26	1.23	0.62	1.78	7.52	**15.04**
1967	0.25	0.22	0.18	0.08	1.52	1.34	1.03	0.59	0.37	0.63	0.33	1.14	7.68	**15.36**
1968	0.26	1.13	0.44	0.67	1.14	0.05	0.49	1.37	0.07	0.94	0.42	0.47	7.45	**14.9**
1969	1.03	0.4	0.67	0.33	0.45	2.07	0.21	0.88	1.45	2.01	0.45	0.36	10.31	**20.62**
1970	0.52	0.05	1.75	0.76	0	0.91	0.6	0.44	0.78	1.56	0.54	0.39	8.3	**16.6**
1971	0.19	0.13	0.02	0.42	1.1	0.03	0.15	1.02	0.58	1.13	0.56	0.67	6	**12**
1972	0.2	0	0.02	0.11	0.44	0.64	0.03	0.29	0.72	3.45	0.69	0.74	7.33	**14.66**
1973	0.79	0.12	0.65	0.86	1.45	0.87	0.52	0.62	0.33	0.2	0.91	0.62	7.94	**15.88**
1974	1.2	0.4	0.81	1.03	0.01	0.14	1.53	0.48	0.38	0.72	1.18	0.32	8.2	**16.4**
1975	0.53	0.49	1.74	1.38	1.23	0.43	1.39	0.09	0.16	0.85	0.39	0.5	9.18	**18.36**
1976	0.13	0.81	0.75	0.4	1.49	0.14	0.2	0.31	0.67	0.32	0.04	0.01	5.27	**10.54**
1977	0.37	0.06	0.5	0.54	0.59	0.04	0.89	0.59	0.52	0.5	0.7	0.38	5.68	**11.36**
1978	1.08	0.64	1.19	1.19	0.55	0.01	0.25	0.54	0.49	0.03	0.62	1.3	7.89	**15.78**
1979	1.36	0.63	2.02	0.42	1.45	0.78	0.08	0.61	0.01	0.25	1.02	0.27	8.9	**17.8**
1980	0.57	1.1	1.77	0.53	1.17	0	0.96	1.39	0.58	1.31	0.52	0.24	10.14	**20.28**
1981	0.44	0.16	1.35	0.56	1.49	0.17	0.41	0.82	0.25	2.06	0.47	0.6	8.78	**17.56**
1982	0.29	0.41	0.79	0.09	0.75	0.21	0.35	0.94	2.81	0.83	0.48	0.27	8.22	**16.44**
1983	0.57	0.54	1.39	0.9	1.66	1.52	1.02	0.73	1.11	0.36	2	1.65	12.45	**24.9**
1984	0.28	0.11	1.57	1.21	0.55	1.68	0.62	1.77	0.34	2.65	0.38	0.43	11.59	**23.18**
1985	0.51	0.26	0.92	1.78	1.09	0.39	1.21	0.24	1.67	2.32	1.1	0.73	12.22	**24.44**
1986	0.13	0.33	0.25	0.71	1.15	0.15	0.94	0.97	1.52	1.22	1.02	0.47	8.86	**17.72**
1987	0.3	1.21	1.95	0.46	1.51	0.23	1.51	0.83	0.13	0.65	1.92	0.83	11.53	**23.06**
1988	1.07	0.21	0.72	0.99	1.1	0.21	0.18	1.37	0.76	0.02	1.02	0.2	7.85	**15.7**
1989	0.98	1.33	0.51	0.23	0.39	0.24	0.27	1.01	0.33	0.14	0	0.08	5.51	**11.02**
1990	0.59	0.55	1.07	0.71	0.05	0.26	0.96	0.49	1.23	0.95	0.57	0.98	8.41	**16.82**

a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present

APPENDIX C

UNSAT-H MODEL RESUL

Soil A - Typical (1961 through 1
UNSAT-H Input File

```
ECDC Soil A, 2.0' Cover,                "Avg" Precip.
0,1,                                     IPLANT,NGRAV
365,1,365,                               IFDEND,IDTBEG,IDTEND
1,50,0,1,50,                             IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24.0,                                  NPRINT,STOPHR
0,10,1,1.0d-5,                           ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                         DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                 RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                 KOPT,KEST,WTF
0,1,2,1,                                 ITOPBC,IEVOPT,NFHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                    HIRRI,HDRY,HTOP,RHA
1,1,1,                                   IETOPT,ICLOUD,ISHOPT
1,0.10,                                  IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,               IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                   IHEAT,ICONVH,DMAXHE
0,0,0,0,                                 UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                               LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                       IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                 MATN,NPT
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
1,0.80,1,0.90,1,1.00,1,1.10,
1,1.20,1,1.30,1,1.40,1,1.50,
1,1.60,1,1.70,1,1.80,1,1.90,
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Soil Properties for Soil A
0.3867, 0.0000, 0.0075, 1.2359,           THES,THER,ALPHA,N
SOIL CONDUCTIVITY DATA
2.0d+0, 0.02304, 0.0075, 1.2359, 0.5,     KMOD,KSAT,ALPHA,N,EPIT
SOIL HYSTERESIS PARAMETERS
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year
dat
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Soil A - Typical (1961 through 1[redacted]
UNSAT-H Output File for end of Wette[redacted] - 1983

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\A_2.0_Avg\input.inp
Results File: F:\DATA\PROJECTS\203050 - Allied - ECDC AFC\Modeling\A_2.0_Avg\in
Date of Run: 23 Feb 2004
Time of Run: 09:02:17.42
Title:
ECDC Soil A, 2.0' Cover, "Avg" Precip.

		Initial Conditions					Initial Conditions		
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.639E+03	0.2122	290.00	2	1.000E-01	1.639E+03	0.2122	290.00
3	2.000E-01	1.638E+03	0.2122	290.00	4	3.000E-01	1.638E+03	0.2122	290.00
5	4.000E-01	1.637E+03	0.2122	290.00	6	5.000E-01	1.635E+03	0.2123	290.00
7	6.000E-01	1.634E+03	0.2123	290.00	8	7.000E-01	1.632E+03	0.2124	290.00
9	8.000E-01	1.630E+03	0.2124	290.00	10	9.000E-01	1.628E+03	0.2125	290.00
11	1.000E+00	1.625E+03	0.2126	290.00	12	1.100E+00	1.623E+03	0.2126	290.00
13	1.200E+00	1.620E+03	0.2127	290.00	14	1.300E+00	1.617E+03	0.2128	290.00
15	1.400E+00	1.613E+03	0.2129	290.00	16	1.500E+00	1.610E+03	0.2130	290.00
17	1.600E+00	1.606E+03	0.2131	290.00	18	1.700E+00	1.602E+03	0.2133	290.00
19	1.800E+00	1.598E+03	0.2134	290.00	20	1.900E+00	1.594E+03	0.2135	290.00
21	2.000E+00	1.590E+03	0.2136	290.00	22	2.250E+00	1.579E+03	0.2140	290.00
23	2.500E+00	1.567E+03	0.2143	290.00	24	2.750E+00	1.555E+03	0.2147	290.00
25	3.000E+00	1.543E+03	0.2151	290.00	26	3.250E+00	1.530E+03	0.2155	290.00
27	3.500E+00	1.518E+03	0.2159	290.00	28	3.750E+00	1.505E+03	0.2163	290.00
29	4.000E+00	1.493E+03	0.2167	290.00	30	4.250E+00	1.481E+03	0.2171	290.00
31	4.500E+00	1.469E+03	0.2175	290.00	32	4.750E+00	1.457E+03	0.2178	290.00
33	5.000E+00	1.446E+03	0.2182	290.00	34	5.250E+00	1.435E+03	0.2186	290.00
35	5.750E+00	1.414E+03	0.2193	290.00	36	6.250E+00	1.395E+03	0.2200	290.00
37	6.750E+00	1.377E+03	0.2206	290.00	38	7.250E+00	1.360E+03	0.2213	290.00
39	7.750E+00	1.343E+03	0.2219	290.00	40	8.250E+00	1.328E+03	0.2224	290.00
41	8.750E+00	1.313E+03	0.2230	290.00	42	9.250E+00	1.299E+03	0.2235	290.00
43	9.750E+00	1.285E+03	0.2241	290.00	44	1.025E+01	1.272E+03	0.2246	290.00
45	1.050E+01	1.265E+03	0.2248	290.00	46	1.075E+01	1.259E+03	0.2251	290.00
47	1.100E+01	1.253E+03	0.2253	290.00	48	1.125E+01	1.246E+03	0.2256	290.00
49	1.150E+01	1.240E+03	0.2258	290.00	50	1.175E+01	1.234E+03	0.2261	290.00
51	1.200E+01	1.228E+03	0.2263	290.00	52	1.225E+01	1.223E+03	0.2265	290.00
53	1.250E+01	1.217E+03	0.2268	290.00	54	1.275E+01	1.212E+03	0.2270	290.00
55	1.300E+01	1.206E+03	0.2272	290.00	56	1.325E+01	1.201E+03	0.2275	290.00
57	1.350E+01	1.196E+03	0.2277	290.00	58	1.360E+01	1.194E+03	0.2277	290.00
59	1.370E+01	1.192E+03	0.2278	290.00	60	1.380E+01	1.190E+03	0.2279	290.00
61	1.390E+01	1.188E+03	0.2280	290.00	62	1.400E+01	1.186E+03	0.2281	290.00
63	1.410E+01	1.184E+03	0.2282	290.00	64	1.420E+01	1.182E+03	0.2282	290.00
65	1.430E+01	1.180E+03	0.2283	290.00	66	1.440E+01	1.179E+03	0.2284	290.00
67	1.450E+01	1.177E+03	0.2285	290.00	68	1.460E+01	1.175E+03	0.2285	290.00
69	1.470E+01	1.173E+03	0.2286	290.00	70	1.480E+01	1.172E+03	0.2287	290.00
71	1.490E+01	1.170E+03	0.2288	290.00	72	1.500E+01	1.168E+03	0.2288	290.00
73	1.510E+01	1.166E+03	0.2289	290.00	74	1.520E+01	1.165E+03	0.2290	290.00
75	1.530E+01	1.163E+03	0.2291	290.00	76	1.540E+01	1.162E+03	0.2291	290.00
77	1.550E+01	1.160E+03	0.2292	290.00	78	1.560E+01	1.159E+03	0.2293	290.00
79	1.570E+01	1.157E+03	0.2293	290.00	80	1.580E+01	1.156E+03	0.2294	290.00
81	1.590E+01	1.154E+03	0.2295	290.00	82	1.600E+01	1.153E+03	0.2295	290.00
83	1.610E+01	1.151E+03	0.2296	290.00	84	1.620E+01	1.150E+03	0.2296	290.00
85	1.630E+01	1.149E+03	0.2297	290.00	86	1.640E+01	1.147E+03	0.2298	290.00
87	1.650E+01	1.146E+03	0.2298	290.00	88	1.660E+01	1.145E+03	0.2299	290.00
89	1.670E+01	1.143E+03	0.2299	290.00	90	1.680E+01	1.142E+03	0.2300	290.00
91	1.690E+01	1.141E+03	0.2300	290.00	92	1.700E+01	1.140E+03	0.2301	290.00
93	1.710E+01	1.138E+03	0.2302	290.00	94	1.735E+01	1.136E+03	0.2303	290.00

95	1.760E+01	1.133E+03	0.2304	290.00	96	1.785E+01	1.130E+03	0.2305	290.00
97	1.810E+01	1.128E+03	0.2306	290.00	98	1.835E+01	1.125E+03	0.2307	290.00
99	1.860E+01	1.123E+03	0.2308	290.00	100	1.885E+01	1.121E+03	0.2309	290.00
101	1.910E+01	1.119E+03	0.2310	290.00	102	1.935E+01	1.117E+03	0.2311	290.00
103	1.960E+01	1.116E+03	0.2312	290.00	104	2.010E+01	1.113E+03	0.2313	290.00
105	2.060E+01	1.110E+03	0.2314	290.00	106	2.110E+01	1.108E+03	0.2315	290.00
107	2.160E+01	1.106E+03	0.2316	290.00	108	2.210E+01	1.104E+03	0.2317	290.00
109	2.260E+01	1.103E+03	0.2317	290.00	110	2.310E+01	1.102E+03	0.2318	290.00
111	2.360E+01	1.102E+03	0.2318	290.00	112	2.410E+01	1.102E+03	0.2318	290.00
113	2.460E+01	1.102E+03	0.2318	290.00	114	2.510E+01	1.102E+03	0.2318	290.00
115	2.560E+01	1.102E+03	0.2318	290.00	116	2.610E+01	1.103E+03	0.2318	290.00
117	2.660E+01	1.104E+03	0.2317	290.00	118	2.710E+01	1.105E+03	0.2317	290.00
119	2.760E+01	1.106E+03	0.2316	290.00	120	2.810E+01	1.107E+03	0.2316	290.00
121	2.860E+01	1.108E+03	0.2315	290.00	122	2.910E+01	1.110E+03	0.2315	290.00
123	2.960E+01	1.111E+03	0.2314	290.00	124	3.010E+01	1.113E+03	0.2313	290.00
125	3.060E+01	1.114E+03	0.2312	290.00	126	3.110E+01	1.116E+03	0.2312	290.00
127	3.160E+01	1.118E+03	0.2311	290.00	128	3.210E+01	1.119E+03	0.2310	290.00
129	3.260E+01	1.121E+03	0.2309	290.00	130	3.310E+01	1.123E+03	0.2309	290.00
131	3.360E+01	1.124E+03	0.2308	290.00	132	3.410E+01	1.126E+03	0.2307	290.00
133	3.460E+01	1.128E+03	0.2306	290.00	134	3.510E+01	1.129E+03	0.2306	290.00
135	3.560E+01	1.131E+03	0.2305	290.00	136	3.610E+01	1.132E+03	0.2304	290.00
137	3.660E+01	1.134E+03	0.2303	290.00	138	3.710E+01	1.135E+03	0.2303	290.00
139	3.760E+01	1.137E+03	0.2302	290.00	140	3.810E+01	1.138E+03	0.2302	290.00
141	3.860E+01	1.139E+03	0.2301	290.00	142	3.910E+01	1.141E+03	0.2300	290.00
143	3.960E+01	1.142E+03	0.2300	290.00	144	4.010E+01	1.143E+03	0.2299	290.00
145	4.060E+01	1.144E+03	0.2299	290.00	146	4.110E+01	1.145E+03	0.2299	290.00
147	4.160E+01	1.146E+03	0.2298	290.00	148	4.210E+01	1.147E+03	0.2298	290.00
149	4.260E+01	1.148E+03	0.2297	290.00	150	4.310E+01	1.148E+03	0.2297	290.00
151	4.360E+01	1.149E+03	0.2297	290.00	152	4.410E+01	1.150E+03	0.2297	290.00
153	4.460E+01	1.150E+03	0.2296	290.00	154	4.510E+01	1.151E+03	0.2296	290.00
155	4.560E+01	1.151E+03	0.2296	290.00	156	4.610E+01	1.152E+03	0.2296	290.00
157	4.660E+01	1.152E+03	0.2296	290.00	158	4.710E+01	1.152E+03	0.2295	290.00
159	4.760E+01	1.153E+03	0.2295	290.00	160	4.810E+01	1.153E+03	0.2295	290.00
161	4.860E+01	1.153E+03	0.2295	290.00	162	4.910E+01	1.153E+03	0.2295	290.00
163	4.960E+01	1.153E+03	0.2295	290.00	164	5.010E+01	1.154E+03	0.2295	290.00
165	5.060E+01	1.154E+03	0.2295	290.00	166	5.110E+01	1.154E+03	0.2295	290.00
167	5.160E+01	1.154E+03	0.2295	290.00	168	5.210E+01	1.154E+03	0.2295	290.00
169	5.260E+01	1.154E+03	0.2295	290.00	170	5.310E+01	1.154E+03	0.2295	290.00
171	5.360E+01	1.154E+03	0.2295	290.00	172	5.410E+01	1.154E+03	0.2295	290.00
173	5.460E+01	1.154E+03	0.2295	290.00	174	5.510E+01	1.154E+03	0.2295	290.00
175	5.560E+01	1.154E+03	0.2295	290.00	176	5.585E+01	1.154E+03	0.2295	290.00
177	5.610E+01	1.154E+03	0.2295	290.00	178	5.635E+01	1.154E+03	0.2295	290.00
179	5.660E+01	1.154E+03	0.2295	290.00	180	5.685E+01	1.154E+03	0.2295	290.00
181	5.710E+01	1.154E+03	0.2295	290.00	182	5.735E+01	1.154E+03	0.2295	290.00
183	5.760E+01	1.154E+03	0.2295	290.00	184	5.785E+01	1.154E+03	0.2295	290.00
185	5.810E+01	1.154E+03	0.2295	290.00	186	5.835E+01	1.154E+03	0.2295	290.00
187	5.860E+01	1.154E+03	0.2295	290.00	188	5.870E+01	1.154E+03	0.2295	290.00
189	5.880E+01	1.154E+03	0.2295	290.00	190	5.890E+01	1.154E+03	0.2295	290.00
191	5.900E+01	1.154E+03	0.2295	290.00	192	5.910E+01	1.154E+03	0.2295	290.00
193	5.920E+01	1.154E+03	0.2295	290.00	194	5.930E+01	1.154E+03	0.2295	290.00
195	5.940E+01	1.154E+03	0.2295	290.00	196	5.950E+01	1.154E+03	0.2295	290.00
197	5.960E+01	1.154E+03	0.2295	290.00	198	5.970E+01	1.154E+03	0.2295	290.00
199	5.980E+01	1.154E+03	0.2295	290.00	200	5.990E+01	1.154E+03	0.2295	290.00
201	6.000E+01	1.154E+03	0.2295	290.00	202	6.010E+01	1.154E+03	0.2295	290.00
203	6.020E+01	1.154E+03	0.2295	290.00	204	6.030E+01	1.154E+03	0.2295	290.00
205	6.040E+01	1.154E+03	0.2295	290.00	206	6.050E+01	1.154E+03	0.2295	290.00
207	6.060E+01	1.154E+03	0.2295	290.00	208	6.070E+01	1.154E+03	0.2295	290.00
209	6.080E+01	1.154E+03	0.2295	290.00	210	6.090E+01	1.154E+03	0.2295	290.00
211	6.100E+01	1.154E+03	0.2295	290.00					

Initial Water Storage = 13.9083 cm

```
 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)= 2.44768E-08
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO   TRANS     DRAIN      NEWSTOR        STORAGE
  13.9083+ 0.0000+ 0.0000 - 0.0802- 0.0000-  0.0001 =    13.8280 vs.    13.8284

 Mass Balance = -3.4580E-04 cm;  Time step attempts =  114 and successes =   87
   Evaporation:  Potential =  0.1180 cm, Actual =  0.0802 cm
 RHMEAN = 52.5 %;  TMEAN = 270.1 K;  HDRY =  8.8140E+05 cm;  DAYUBC =    35

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)= 5.73485E-07
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO   TRANS     DRAIN      NEWSTOR        STORAGE
  15.0794+ 0.0000+ 0.0000 - 0.0697- 0.0000-  0.0001 =    15.0096 vs.    15.0096

 Mass Balance = -3.2335E-05 cm;  Time step attempts =  148 and successes =  110
   Evaporation:  Potential =  0.0697 cm, Actual =  0.0697 cm
 RHMEAN = 71.2 %;  TMEAN = 269.0 K;  HDRY =  4.6466E+05 cm;  DAYUBC =     0
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                            SIMULATION SUMMARY

 Title:
 ECDC Soil A, 2.0' Cover, 5-Year "Avg" Precip.
--------------------------------------------------------------------------------

 Transpiration Scheme is:            =    0
 Potential Evapotranspiration        =  1.6927E+02     [cm]
 Potential Transpiration             =  0.0000E+00     [cm]
 Actual Transpiration                =  0.0000E+00     [cm]
 Potential Evaporation               =  1.6927E+02     [cm]
 Actual Evaporation                  =  2.5040E+01     [cm]
 Evaporation during Growth           =  0.0000E+00     [cm]
 Total Runoff                        =  4.8473E+01     [cm]
 Total Infiltration                  =  2.6203E+01     [cm]
 Total Basal Liquid Flux (drainage) =  2.7112E-02     [cm]
 Total Basal Vapor Flux (temp-grad) =  0.0000E+00     [cm]
 Total Applied Water                 =  7.4676E+01     [cm]
 Actual Rainfall                     =  7.4676E+01     [cm]
 Actual Irrigation                   =  0.0000E+00     [cm]
 Total Final Moisture Storage        =  1.5010E+01     [cm]
```

Mass Balance Error	=	3.3877E-02	[cm]
Total Successful Time Steps	=	88508	
Total Attempted Time Steps	=	104366	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32791	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1623E+00	0.050	1.8053E+01	0.150	1.3901E+01
0.250	1.1526E+01	0.350	9.8490E+00	0.450	8.4923E+00
0.550	7.3376E+00	0.650	6.3710E+00	0.750	5.4927E+00
0.850	4.7565E+00	0.950	4.0803E+00	1.050	3.4866E+00
1.150	3.0330E+00	1.250	2.6540E+00	1.350	2.3119E+00
1.450	2.0372E+00	1.550	1.8461E+00	1.650	1.6967E+00
1.750	1.5586E+00	1.850	1.4462E+00	1.950	1.3582E+00
2.125	1.2521E+00	2.375	1.1272E+00	2.625	1.0751E+00
2.875	1.0583E+00	3.125	1.0454E+00	3.375	1.0328E+00
3.625	1.0203E+00	3.875	1.0078E+00	4.125	9.9521E-01
4.375	9.8240E-01	4.625	9.6952E-01	4.875	9.5649E-01
5.125	9.4344E-01	5.500	9.2363E-01	6.000	8.9704E-01
6.500	8.7033E-01	7.000	8.4365E-01	7.500	8.1706E-01
8.000	7.9070E-01	8.500	7.6458E-01	9.000	7.3882E-01
9.500	7.1353E-01	10.000	6.8874E-01	10.375	6.7057E-01
10.625	6.5860E-01	10.875	6.4678E-01	11.125	6.3509E-01
11.375	6.2357E-01	11.625	6.1222E-01	11.875	6.0103E-01
12.125	5.9000E-01	12.375	5.7915E-01	12.625	5.6847E-01
12.875	5.5798E-01	13.125	5.4769E-01	13.375	5.3757E-01
13.550	5.3062E-01	13.650	5.2668E-01	13.750	5.2276E-01
13.850	5.1888E-01	13.950	5.1503E-01	14.050	5.1121E-01
14.150	5.0743E-01	14.250	5.0368E-01	14.350	4.9996E-01
14.450	4.9627E-01	14.550	4.9261E-01	14.650	4.8897E-01
14.750	4.8537E-01	14.850	4.8180E-01	14.950	4.7826E-01
15.050	4.7476E-01	15.150	4.7128E-01	15.250	4.6784E-01
15.350	4.6443E-01	15.450	4.6106E-01	15.550	4.5771E-01
15.650	4.5440E-01	15.750	4.5111E-01	15.850	4.4786E-01
15.950	4.4465E-01	16.050	4.4147E-01	16.150	4.3831E-01
16.250	4.3520E-01	16.350	4.3212E-01	16.450	4.2907E-01
16.550	4.2605E-01	16.650	4.2306E-01	16.750	4.2010E-01
16.850	4.1718E-01	16.950	4.1429E-01	17.050	4.1144E-01
17.225	4.0649E-01	17.475	3.9964E-01	17.725	3.9298E-01
17.975	3.8652E-01	18.225	3.8026E-01	18.475	3.7420E-01
18.725	3.6833E-01	18.975	3.6265E-01	19.225	3.5714E-01
19.475	3.5182E-01	19.850	3.4409E-01	20.350	3.3447E-01
20.850	3.2548E-01	21.350	3.1708E-01	21.850	3.0922E-01
22.350	3.0185E-01	22.850	2.9492E-01	23.350	2.8840E-01
23.850	2.8224E-01	24.350	2.7640E-01	24.850	2.7086E-01
25.350	2.6558E-01	25.850	2.6051E-01	26.350	2.5564E-01
26.850	2.5094E-01	27.350	2.4639E-01	27.850	2.4196E-01
28.350	2.3763E-01	28.850	2.3340E-01	29.350	2.2925E-01
29.850	2.2516E-01	30.350	2.2113E-01	30.850	2.1715E-01
31.350	2.1322E-01	31.850	2.0931E-01	32.350	2.0543E-01
32.850	2.0158E-01	33.350	1.9775E-01	33.850	1.9393E-01
34.350	1.9014E-01	34.850	1.8636E-01	35.350	1.8260E-01
35.850	1.7884E-01	36.350	1.7511E-01	36.850	1.7138E-01
37.350	1.6766E-01	37.850	1.6396E-01	38.350	1.6028E-01
38.850	1.5660E-01	39.350	1.5294E-01	39.850	1.4930E-01
40.350	1.4567E-01	40.850	1.4205E-01	41.350	1.3845E-01
41.850	1.3487E-01	42.350	1.3131E-01	42.850	1.2776E-01

43.350	1.2425E-01	43.850	1.2081E-01	44.350	1.1743E-01
44.850	1.1412E-01	45.350	1.1088E-01	45.850	1.0769E-01
46.350	1.0456E-01	46.850	1.0148E-01	47.350	9.8451E-02
47.850	9.5472E-02	48.350	9.2538E-02	48.850	8.9648E-02
49.350	8.6797E-02	49.850	8.3985E-02	50.350	8.1208E-02
50.850	7.8465E-02	51.350	7.5753E-02	51.850	7.3070E-02
52.350	7.0415E-02	52.850	6.7785E-02	53.350	6.5178E-02
53.850	6.2594E-02	54.350	6.0029E-02	54.850	5.7483E-02
55.350	5.4954E-02	55.725	5.3069E-02	55.975	5.1816E-02
56.225	5.0566E-02	56.475	4.9319E-02	56.725	4.8076E-02
56.975	4.6835E-02	57.225	4.5597E-02	57.475	4.4362E-02
57.725	4.3129E-02	57.975	4.1898E-02	58.225	4.0669E-02
58.475	3.9441E-02	58.650	3.8583E-02	58.750	3.8094E-02
58.850	3.7604E-02	58.950	3.7114E-02	59.050	3.6625E-02
59.150	3.6136E-02	59.250	3.5647E-02	59.350	3.5158E-02
59.450	3.4670E-02	59.550	3.4181E-02	59.650	3.3693E-02
59.750	3.3205E-02	59.850	3.2717E-02	59.950	3.2229E-02
60.050	3.1742E-02	60.150	3.1254E-02	60.250	3.0767E-02
60.350	3.0279E-02	60.450	2.9792E-02	60.550	2.9304E-02
60.650	2.8817E-02	60.750	2.8330E-02	60.850	2.7843E-02
60.950	2.7355E-02	61.000	2.7112E-02		

Soil A - Typical (1961 through 1[redacted]
UNSAT-H Output File for end of Final [redacted] 1990

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\A_2.0_Avg\input.inp
Results File: F:\DATA\PROJECTS\203050 - Allied - ECDC AFC\Modeling\A_2.0_Avg\in
Date of Run: 23 Feb 2004
Time of Run: 09:02:17.42
Title:
ECDC Soil A, 2.0' Cover "Avg" Precip.

		Initial Conditions					Initial Conditions		
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.780E+05	0.0474	290.00	2	1.000E-01	9.482E+05	0.0477	290.00
3	2.000E-01	9.189E+05	0.0481	290.00	4	3.000E-01	8.904E+05	0.0484	290.00
5	4.000E-01	8.624E+05	0.0488	290.00	6	5.000E-01	8.350E+05	0.0492	290.00
7	6.000E-01	8.081E+05	0.0496	290.00	8	7.000E-01	7.819E+05	0.0499	290.00
9	8.000E-01	7.561E+05	0.0503	290.00	10	9.000E-01	7.309E+05	0.0507	290.00
11	1.000E+00	7.063E+05	0.0512	290.00	12	1.100E+00	6.821E+05	0.0516	290.00
13	1.200E+00	6.585E+05	0.0520	290.00	14	1.300E+00	6.354E+05	0.0524	290.00
15	1.400E+00	6.128E+05	0.0529	290.00	16	1.500E+00	5.907E+05	0.0534	290.00
17	1.600E+00	5.690E+05	0.0538	290.00	18	1.700E+00	5.479E+05	0.0543	290.00
19	1.800E+00	5.272E+05	0.0548	290.00	20	1.900E+00	5.069E+05	0.0553	290.00
21	2.000E+00	4.871E+05	0.0558	290.00	22	2.250E+00	4.396E+05	0.0572	290.00
23	2.500E+00	3.947E+05	0.0587	290.00	24	2.750E+00	3.522E+05	0.0603	290.00
25	3.000E+00	3.122E+05	0.0620	290.00	26	3.250E+00	2.743E+05	0.0639	290.00
27	3.500E+00	2.386E+05	0.0661	290.00	28	3.750E+00	2.048E+05	0.0685	290.00
29	4.000E+00	1.729E+05	0.0713	290.00	30	4.250E+00	1.429E+05	0.0746	290.00
31	4.500E+00	1.149E+05	0.0785	290.00	32	4.750E+00	8.881E+04	0.0834	290.00
33	5.000E+00	6.505E+04	0.0898	290.00	34	5.250E+00	4.416E+04	0.0984	290.00
35	5.750E+00	1.728E+04	0.1227	290.00	36	6.250E+00	9.278E+03	0.1420	290.00
37	6.750E+00	6.601E+03	0.1538	290.00	38	7.250E+00	5.279E+03	0.1620	290.00
39	7.750E+00	4.481E+03	0.1683	290.00	40	8.250E+00	3.944E+03	0.1734	290.00
41	8.750E+00	3.555E+03	0.1777	290.00	42	9.250E+00	3.259E+03	0.1813	290.00
43	9.750E+00	3.025E+03	0.1844	290.00	44	1.025E+01	2.836E+03	0.1872	290.00
45	1.050E+01	2.754E+03	0.1885	290.00	46	1.075E+01	2.679E+03	0.1897	290.00
47	1.100E+01	2.610E+03	0.1908	290.00	48	1.125E+01	2.546E+03	0.1919	290.00
49	1.150E+01	2.487E+03	0.1929	290.00	50	1.175E+01	2.433E+03	0.1939	290.00
51	1.200E+01	2.381E+03	0.1949	290.00	52	1.225E+01	2.334E+03	0.1958	290.00
53	1.250E+01	2.289E+03	0.1966	290.00	54	1.275E+01	2.247E+03	0.1975	290.00
55	1.300E+01	2.208E+03	0.1983	290.00	56	1.325E+01	2.171E+03	0.1990	290.00
57	1.350E+01	2.135E+03	0.1998	290.00	58	1.360E+01	2.122E+03	0.2001	290.00
59	1.370E+01	2.109E+03	0.2004	290.00	60	1.380E+01	2.096E+03	0.2006	290.00
61	1.390E+01	2.083E+03	0.2009	290.00	62	1.400E+01	2.071E+03	0.2012	290.00
63	1.410E+01	2.059E+03	0.2015	290.00	64	1.420E+01	2.047E+03	0.2017	290.00
65	1.430E+01	2.035E+03	0.2020	290.00	66	1.440E+01	2.024E+03	0.2023	290.00
67	1.450E+01	2.012E+03	0.2025	290.00	68	1.460E+01	2.001E+03	0.2028	290.00
69	1.470E+01	1.991E+03	0.2030	290.00	70	1.480E+01	1.980E+03	0.2033	290.00
71	1.490E+01	1.970E+03	0.2035	290.00	72	1.500E+01	1.959E+03	0.2038	290.00
73	1.510E+01	1.949E+03	0.2040	290.00	74	1.520E+01	1.940E+03	0.2042	290.00
75	1.530E+01	1.930E+03	0.2045	290.00	76	1.540E+01	1.920E+03	0.2047	290.00
77	1.550E+01	1.911E+03	0.2049	290.00	78	1.560E+01	1.902E+03	0.2051	290.00
79	1.570E+01	1.893E+03	0.2054	290.00	80	1.580E+01	1.884E+03	0.2056	290.00
81	1.590E+01	1.875E+03	0.2058	290.00	82	1.600E+01	1.867E+03	0.2060	290.00
83	1.610E+01	1.858E+03	0.2062	290.00	84	1.620E+01	1.850E+03	0.2064	290.00
85	1.630E+01	1.842E+03	0.2066	290.00	86	1.640E+01	1.834E+03	0.2068	290.00
87	1.650E+01	1.826E+03	0.2070	290.00	88	1.660E+01	1.819E+03	0.2072	290.00
89	1.670E+01	1.811E+03	0.2074	290.00	90	1.680E+01	1.803E+03	0.2076	290.00
91	1.690E+01	1.796E+03	0.2078	290.00	92	1.700E+01	1.789E+03	0.2080	290.00
93	1.710E+01	1.782E+03	0.2082	290.00	94	1.735E+01	1.764E+03	0.2087	290.00

95	1.760E+01	1.747E+03	0.2091	290.00	96	1.785E+01	1.731E+03	0.2096	290.00
97	1.810E+01	1.716E+03	0.2100	290.00	98	1.835E+01	1.700E+03	0.2104	290.00
99	1.860E+01	1.686E+03	0.2108	290.00	100	1.885E+01	1.672E+03	0.2112	290.00
101	1.910E+01	1.658E+03	0.2116	290.00	102	1.935E+01	1.645E+03	0.2120	290.00
103	1.960E+01	1.632E+03	0.2124	290.00	104	2.010E+01	1.608E+03	0.2131	290.00
105	2.060E+01	1.585E+03	0.2138	290.00	106	2.110E+01	1.563E+03	0.2145	290.00
107	2.160E+01	1.543E+03	0.2151	290.00	108	2.210E+01	1.523E+03	0.2157	290.00
109	2.260E+01	1.505E+03	0.2163	290.00	110	2.310E+01	1.487E+03	0.2169	290.00
111	2.360E+01	1.471E+03	0.2174	290.00	112	2.410E+01	1.455E+03	0.2179	290.00
113	2.460E+01	1.440E+03	0.2184	290.00	114	2.510E+01	1.426E+03	0.2189	290.00
115	2.560E+01	1.412E+03	0.2194	290.00	116	2.610E+01	1.399E+03	0.2198	290.00
117	2.660E+01	1.387E+03	0.2203	290.00	118	2.710E+01	1.375E+03	0.2207	290.00
119	2.760E+01	1.363E+03	0.2211	290.00	120	2.810E+01	1.352E+03	0.2215	290.00
121	2.860E+01	1.342E+03	0.2219	290.00	122	2.910E+01	1.332E+03	0.2223	290.00
123	2.960E+01	1.322E+03	0.2226	290.00	124	3.010E+01	1.313E+03	0.2230	290.00
125	3.060E+01	1.304E+03	0.2233	290.00	126	3.110E+01	1.295E+03	0.2237	290.00
127	3.160E+01	1.287E+03	0.2240	290.00	128	3.210E+01	1.279E+03	0.2243	290.00
129	3.260E+01	1.271E+03	0.2246	290.00	130	3.310E+01	1.264E+03	0.2249	290.00
131	3.360E+01	1.257E+03	0.2252	290.00	132	3.410E+01	1.250E+03	0.2254	290.00
133	3.460E+01	1.243E+03	0.2257	290.00	134	3.510E+01	1.237E+03	0.2260	290.00
135	3.560E+01	1.231E+03	0.2262	290.00	136	3.610E+01	1.225E+03	0.2265	290.00
137	3.660E+01	1.219E+03	0.2267	290.00	138	3.710E+01	1.214E+03	0.2269	290.00
139	3.760E+01	1.208E+03	0.2271	290.00	140	3.810E+01	1.203E+03	0.2274	290.00
141	3.860E+01	1.198E+03	0.2276	290.00	142	3.910E+01	1.193E+03	0.2278	290.00
143	3.960E+01	1.189E+03	0.2280	290.00	144	4.010E+01	1.184E+03	0.2282	290.00
145	4.060E+01	1.180E+03	0.2283	290.00	146	4.110E+01	1.176E+03	0.2285	290.00
147	4.160E+01	1.172E+03	0.2287	290.00	148	4.210E+01	1.168E+03	0.2289	290.00
149	4.260E+01	1.164E+03	0.2290	290.00	150	4.310E+01	1.161E+03	0.2292	290.00
151	4.360E+01	1.157E+03	0.2293	290.00	152	4.410E+01	1.154E+03	0.2295	290.00
153	4.460E+01	1.151E+03	0.2296	290.00	154	4.510E+01	1.148E+03	0.2297	290.00
155	4.560E+01	1.145E+03	0.2299	290.00	156	4.610E+01	1.142E+03	0.2300	290.00
157	4.660E+01	1.139E+03	0.2301	290.00	158	4.710E+01	1.136E+03	0.2302	290.00
159	4.760E+01	1.134E+03	0.2303	290.00	160	4.810E+01	1.132E+03	0.2305	290.00
161	4.860E+01	1.129E+03	0.2306	290.00	162	4.910E+01	1.127E+03	0.2307	290.00
163	4.960E+01	1.125E+03	0.2307	290.00	164	5.010E+01	1.123E+03	0.2308	290.00
165	5.060E+01	1.121E+03	0.2309	290.00	166	5.110E+01	1.119E+03	0.2310	290.00
167	5.160E+01	1.118E+03	0.2311	290.00	168	5.210E+01	1.116E+03	0.2312	290.00
169	5.260E+01	1.115E+03	0.2312	290.00	170	5.310E+01	1.113E+03	0.2313	290.00
171	5.360E+01	1.112E+03	0.2313	290.00	172	5.410E+01	1.111E+03	0.2314	290.00
173	5.460E+01	1.110E+03	0.2315	290.00	174	5.510E+01	1.109E+03	0.2315	290.00
175	5.560E+01	1.108E+03	0.2315	290.00	176	5.585E+01	1.107E+03	0.2316	290.00
177	5.610E+01	1.107E+03	0.2316	290.00	178	5.635E+01	1.106E+03	0.2316	290.00
179	5.660E+01	1.106E+03	0.2316	290.00	180	5.685E+01	1.106E+03	0.2316	290.00
181	5.710E+01	1.105E+03	0.2317	290.00	182	5.735E+01	1.105E+03	0.2317	290.00
183	5.760E+01	1.105E+03	0.2317	290.00	184	5.785E+01	1.104E+03	0.2317	290.00
185	5.810E+01	1.104E+03	0.2317	290.00	186	5.835E+01	1.104E+03	0.2317	290.00
187	5.860E+01	1.104E+03	0.2317	290.00	188	5.870E+01	1.104E+03	0.2317	290.00
189	5.880E+01	1.103E+03	0.2317	290.00	190	5.890E+01	1.103E+03	0.2317	290.00
191	5.900E+01	1.103E+03	0.2317	290.00	192	5.910E+01	1.103E+03	0.2317	290.00
193	5.920E+01	1.103E+03	0.2317	290.00	194	5.930E+01	1.103E+03	0.2317	290.00
195	5.940E+01	1.103E+03	0.2318	290.00	196	5.950E+01	1.103E+03	0.2318	290.00
197	5.960E+01	1.103E+03	0.2318	290.00	198	5.970E+01	1.103E+03	0.2318	290.00
199	5.980E+01	1.103E+03	0.2318	290.00	200	5.990E+01	1.103E+03	0.2318	290.00
201	6.000E+01	1.103E+03	0.2318	290.00	202	6.010E+01	1.103E+03	0.2318	290.00
203	6.020E+01	1.103E+03	0.2318	290.00	204	6.030E+01	1.103E+03	0.2318	290.00
205	6.040E+01	1.103E+03	0.2318	290.00	206	6.050E+01	1.103E+03	0.2318	290.00
207	6.060E+01	1.103E+03	0.2318	290.00	208	6.070E+01	1.103E+03	0.2318	290.00
209	6.080E+01	1.103E+03	0.2318	290.00	210	6.090E+01	1.103E+03	0.2318	290.00
211	6.100E+01	1.103E+03	0.2318	290.00					

Initial Water Storage = 12.3975 cm

```
 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)=-6.26094E-07
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO   TRANS     DRAIN      NEWSTOR        STORAGE
  12.3975+ 0.0000+ 0.0000 - 0.0066- 0.0000-   0.0001 =    12.3909 vs.    12.3909

 Mass Balance =  3.8965E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.1408 cm, Actual =  0.0066 cm
 RHMEAN = 49.4 %;  TMEAN = 270.7 K;  HDRY =  9.6397E+05 cm;  DAYUBC =    23

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)=-3.87631E-08
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO   TRANS     DRAIN      NEWSTOR        STORAGE
  13.5617+ 0.0000+ 0.0000 - 0.0474- 0.0000-   0.0001 =    13.5143 vs.    13.5144

 Mass Balance = -1.5847E-04 cm;  Time step attempts =   75 and successes =   59
   Evaporation:  Potential =  0.0502 cm, Actual =  0.0474 cm
 RHMEAN = 64.7 %;  TMEAN = 258.7 K;  HDRY =  5.9554E+05 cm;  DAYUBC =    14
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 ECDC Soil A, 2.0' Cover, 5-Year "Avg" Precip.
-------------------------------------------------------------------------------

 Transpiration Scheme is:            =    0
 Potential Evapotranspiration        =  1.8739E+02     [cm]
 Potential Transpiration             =  0.0000E+00     [cm]
 Actual Transpiration                =  0.0000E+00     [cm]
 Potential Evaporation               =  1.8739E+02     [cm]
 Actual Evaporation                  =  1.7931E+01     [cm]
 Evaporation during Growth           =  0.0000E+00     [cm]
 Total Runoff                        =  2.2798E+01     [cm]
 Total Infiltration                  =  1.9112E+01     [cm]
 Total Basal Liquid Flux (drainage)  =  2.2631E-02     [cm]
 Total Basal Vapor Flux (temp-grad)  =  0.0000E+00     [cm]
 Total Applied Water                 =  4.1910E+01     [cm]
 Actual Rainfall                     =  4.1910E+01     [cm]
 Actual Irrigation                   =  0.0000E+00     [cm]
 Total Final Moisture Storage        =  1.3514E+01     [cm]
```

Mass Balance Error	=	4.1520E-02	[cm]
Total Successful Time Steps	=	78079	
Total Attempted Time Steps	=	90623	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30561	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1810E+00	0.050	1.5012E+01	0.150	1.2672E+01
0.250	1.1124E+01	0.350	9.8540E+00	0.450	8.8970E+00
0.550	8.0933E+00	0.650	7.3960E+00	0.750	6.7454E+00
0.850	6.1253E+00	0.950	5.5440E+00	1.050	5.0285E+00
1.150	4.5750E+00	1.250	4.1515E+00	1.350	3.7677E+00
1.450	3.4245E+00	1.550	3.1142E+00	1.650	2.8278E+00
1.750	2.5565E+00	1.850	2.3081E+00	1.950	2.0915E+00
2.125	1.8517E+00	2.375	1.5941E+00	2.625	1.4080E+00
2.875	1.2488E+00	3.125	1.0971E+00	3.375	9.4598E-01
3.625	8.0517E-01	3.875	6.8342E-01	4.125	5.8474E-01
4.375	5.1287E-01	4.625	4.7003E-01	4.875	4.3581E-01
5.125	4.0421E-01	5.500	3.5413E-01	6.000	2.8711E-01
6.500	2.3705E-01	7.000	1.9641E-01	7.500	1.6074E-01
8.000	1.2855E-01	8.500	9.9046E-02	9.000	7.1778E-02
9.500	4.6431E-02	10.000	2.2805E-02	10.375	6.2347E-03
10.625	-4.4461E-03	10.875	-1.4776E-02	11.125	-2.4766E-02
11.375	-3.4426E-02	11.625	-4.3766E-02	11.875	-5.2793E-02
12.125	-6.1514E-02	12.375	-6.9936E-02	12.625	-7.8066E-02
12.875	-8.5908E-02	13.125	-9.3468E-02	13.375	-1.0075E-01
13.550	-1.0566E-01	13.650	-1.0842E-01	13.750	-1.1114E-01
13.850	-1.1381E-01	13.950	-1.1645E-01	14.050	-1.1904E-01
14.150	-1.2159E-01	14.250	-1.2410E-01	14.350	-1.2657E-01
14.450	-1.2900E-01	14.550	-1.3138E-01	14.650	-1.3373E-01
14.750	-1.3604E-01	14.850	-1.3831E-01	14.950	-1.4054E-01
15.050	-1.4273E-01	15.150	-1.4488E-01	15.250	-1.4699E-01
15.350	-1.4907E-01	15.450	-1.5110E-01	15.550	-1.5310E-01
15.650	-1.5507E-01	15.750	-1.5699E-01	15.850	-1.5888E-01
15.950	-1.6074E-01	16.050	-1.6256E-01	16.150	-1.6434E-01
16.250	-1.6609E-01	16.350	-1.6780E-01	16.450	-1.6948E-01
16.550	-1.7112E-01	16.650	-1.7274E-01	16.750	-1.7431E-01
16.850	-1.7586E-01	16.950	-1.7737E-01	17.050	-1.7885E-01
17.225	-1.8138E-01	17.475	-1.8481E-01	17.725	-1.8804E-01
17.975	-1.9109E-01	18.225	-1.9396E-01	18.475	-1.9666E-01
18.725	-1.9919E-01	18.975	-2.0156E-01	19.225	-2.0377E-01
19.475	-2.0583E-01	19.850	-2.0871E-01	20.350	-2.1199E-01
20.850	-2.1477E-01	21.350	-2.1708E-01	21.850	-2.1896E-01
22.350	-2.2044E-01	22.850	-2.2156E-01	23.350	-2.2234E-01
23.850	-2.2280E-01	24.350	-2.2297E-01	24.850	-2.2288E-01
25.350	-2.2253E-01	25.850	-2.2196E-01	26.350	-2.2116E-01
26.850	-2.2017E-01	27.350	-2.1898E-01	27.850	-2.1762E-01
28.350	-2.1608E-01	28.850	-2.1440E-01	29.350	-2.1256E-01
29.850	-2.1058E-01	30.350	-2.0847E-01	30.850	-2.0623E-01
31.350	-2.0388E-01	31.850	-2.0141E-01	32.350	-1.9884E-01
32.850	-1.9616E-01	33.350	-1.9339E-01	33.850	-1.9053E-01
34.350	-1.8759E-01	34.850	-1.8456E-01	35.350	-1.8146E-01
35.850	-1.7828E-01	36.350	-1.7504E-01	36.850	-1.7172E-01
37.350	-1.6835E-01	37.850	-1.6492E-01	38.350	-1.6144E-01
38.850	-1.5790E-01	39.350	-1.5431E-01	39.850	-1.5068E-01
40.350	-1.4701E-01	40.850	-1.4329E-01	41.350	-1.3953E-01
41.850	-1.3574E-01	42.350	-1.3192E-01	42.850	-1.2806E-01

43.350	-1.2417E-01	43.850	-1.2026E-01	44.350	-1.1631E-01
44.850	-1.1234E-01	45.350	-1.0835E-01	45.850	-1.0434E-01
46.350	-1.0031E-01	46.850	-9.6255E-02	47.350	-9.2184E-02
47.850	-8.8097E-02	48.350	-8.3995E-02	48.850	-7.9877E-02
49.350	-7.5747E-02	49.850	-7.1603E-02	50.350	-6.7448E-02
50.850	-6.3282E-02	51.350	-5.9106E-02	51.850	-5.4921E-02
52.350	-5.0727E-02	52.850	-4.6525E-02	53.350	-4.2315E-02
53.850	-3.8099E-02	54.350	-3.3877E-02	54.850	-2.9649E-02
55.350	-2.5417E-02	55.725	-2.2238E-02	55.975	-2.0119E-02
56.225	-1.7998E-02	56.475	-1.5876E-02	56.725	-1.3753E-02
56.975	-1.1630E-02	57.225	-9.5056E-03	57.475	-7.3806E-03
57.725	-5.2549E-03	57.975	-3.1286E-03	58.225	-1.0017E-03
58.475	1.1258E-03	58.650	2.6153E-03	58.750	3.4665E-03
58.850	4.3178E-03	58.950	5.1692E-03	59.050	6.0206E-03
59.150	6.8721E-03	59.250	7.7236E-03	59.350	8.5752E-03
59.450	9.4269E-03	59.550	1.0279E-02	59.650	1.1130E-02
59.750	1.1982E-02	59.850	1.2834E-02	59.950	1.3686E-02
60.050	1.4538E-02	60.150	1.5389E-02	60.250	1.6241E-02
60.350	1.7093E-02	60.450	1.7945E-02	60.550	1.8797E-02
60.650	1.9649E-02	60.750	2.0501E-02	60.850	2.1353E-02
60.950	2.2205E-02	61.000	2.2631E-02		

Soil B - Typical (1961 through 1
UNSAT-H Input File

```
ECDC Soil B, 2.0' Cover,                "Avg" Precip.
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1,50,0,1,50,                            IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24.0,                                 NPRINT,STOPHR
0,10,1,1.0d-5,                          ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                        DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                   HIRRI,HDRY,HTOP,RHA
1,1,1,                                  IETOPT,ICLOUD,ISHOPT
1,0.10,                                 IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,              IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                  IHEAT,ICONVH,DMAXHE
0,0,0,0,                                UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                MATN,NPT
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1,60.80,1,60.90,1,61.00,
Soil Properties for Soil B
0.3870, 0.0000, 0.0075, 1.2369,          THES,THER,ALPHA,N
SOIL CONDUCTIVITY DATA
2.0d+0, 0.0216, 0.0075, 1.2369, 0.5,     KMOD,KSAT,ALPHA,N,EPIT
SOIL HYSTERESIS PARAMETERS
7,0.25,2.0,1000.0,                       IPATHA,SARWA,ALFACT,HYSHPH
   0,    (TOSS.OUT file for day  3.65000E+02)          NDAY (UNSAT-H V3.03)
   1.00000E+03, 1.00000E+03, 1.00000E+03, 1.00000E+03,  negative Head Values
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year
dat
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Soil B - Typical (1961 through 1[redacted]
UNSAT-H Output File for end of Wette[redacted] 1983

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\B_2.0_Avg\input.inp
Results File: F:\DATA\PROJECTS\203050 - Allied - ECDC AFC\Modeling\B_2.0_Avg\in
Date of Run: 23 Feb 2004
Time of Run: 17:40:50.40
Title:
ECDC Soil B, 2.0' Cover, "Avg" Precip.

	Initial Conditions				Initial Conditions			
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	1.704E+03	0.2099	290.00	2	1.000E-01	1.704E+03	0.2099	290.00
3	2.000E-01	1.703E+03	0.2100	290.00	4	3.000E-01	1.702E+03	0.2100	290.00
5	4.000E-01	1.701E+03	0.2100	290.00	6	5.000E-01	1.699E+03	0.2101	290.00
7	6.000E-01	1.697E+03	0.2101	290.00	8	7.000E-01	1.695E+03	0.2102	290.00
9	8.000E-01	1.693E+03	0.2103	290.00	10	9.000E-01	1.690E+03	0.2103	290.00
11	1.000E+00	1.687E+03	0.2104	290.00	12	1.100E+00	1.683E+03	0.2105	290.00
13	1.200E+00	1.680E+03	0.2106	290.00	14	1.300E+00	1.676E+03	0.2107	290.00
15	1.400E+00	1.672E+03	0.2109	290.00	16	1.500E+00	1.667E+03	0.2110	290.00
17	1.600E+00	1.663E+03	0.2111	290.00	18	1.700E+00	1.658E+03	0.2112	290.00
19	1.800E+00	1.653E+03	0.2114	290.00	20	1.900E+00	1.648E+03	0.2115	290.00
21	2.000E+00	1.643E+03	0.2117	290.00	22	2.250E+00	1.629E+03	0.2121	290.00
23	2.500E+00	1.615E+03	0.2125	290.00	24	2.750E+00	1.601E+03	0.2129	290.00
25	3.000E+00	1.586E+03	0.2134	290.00	26	3.250E+00	1.571E+03	0.2138	290.00
27	3.500E+00	1.556E+03	0.2143	290.00	28	3.750E+00	1.542E+03	0.2147	290.00
29	4.000E+00	1.528E+03	0.2152	290.00	30	4.250E+00	1.514E+03	0.2156	290.00
31	4.500E+00	1.500E+03	0.2161	290.00	32	4.750E+00	1.487E+03	0.2165	290.00
33	5.000E+00	1.475E+03	0.2169	290.00	34	5.250E+00	1.463E+03	0.2173	290.00
35	5.750E+00	1.440E+03	0.2181	290.00	36	6.250E+00	1.418E+03	0.2188	290.00
37	6.750E+00	1.399E+03	0.2195	290.00	38	7.250E+00	1.380E+03	0.2202	290.00
39	7.750E+00	1.363E+03	0.2208	290.00	40	8.250E+00	1.346E+03	0.2214	290.00
41	8.750E+00	1.330E+03	0.2220	290.00	42	9.250E+00	1.315E+03	0.2226	290.00
43	9.750E+00	1.300E+03	0.2231	290.00	44	1.025E+01	1.286E+03	0.2237	290.00
45	1.050E+01	1.279E+03	0.2240	290.00	46	1.075E+01	1.272E+03	0.2242	290.00
47	1.100E+01	1.266E+03	0.2245	290.00	48	1.125E+01	1.259E+03	0.2247	290.00
49	1.150E+01	1.253E+03	0.2250	290.00	50	1.175E+01	1.246E+03	0.2252	290.00
51	1.200E+01	1.240E+03	0.2255	290.00	52	1.225E+01	1.235E+03	0.2257	290.00
53	1.250E+01	1.229E+03	0.2260	290.00	54	1.275E+01	1.223E+03	0.2262	290.00
55	1.300E+01	1.218E+03	0.2264	290.00	56	1.325E+01	1.213E+03	0.2266	290.00
57	1.350E+01	1.207E+03	0.2268	290.00	58	1.360E+01	1.205E+03	0.2269	290.00
59	1.370E+01	1.203E+03	0.2270	290.00	60	1.380E+01	1.202E+03	0.2271	290.00
61	1.390E+01	1.200E+03	0.2272	290.00	62	1.400E+01	1.198E+03	0.2273	290.00
63	1.410E+01	1.196E+03	0.2273	290.00	64	1.420E+01	1.194E+03	0.2274	290.00
65	1.430E+01	1.192E+03	0.2275	290.00	66	1.440E+01	1.191E+03	0.2276	290.00
67	1.450E+01	1.189E+03	0.2276	290.00	68	1.460E+01	1.187E+03	0.2277	290.00
69	1.470E+01	1.185E+03	0.2278	290.00	70	1.480E+01	1.184E+03	0.2279	290.00
71	1.490E+01	1.182E+03	0.2279	290.00	72	1.500E+01	1.180E+03	0.2280	290.00
73	1.510E+01	1.179E+03	0.2281	290.00	74	1.520E+01	1.177E+03	0.2281	290.00
75	1.530E+01	1.176E+03	0.2282	290.00	76	1.540E+01	1.174E+03	0.2283	290.00
77	1.550E+01	1.173E+03	0.2283	290.00	78	1.560E+01	1.171E+03	0.2284	290.00
79	1.570E+01	1.170E+03	0.2284	290.00	80	1.580E+01	1.169E+03	0.2285	290.00
81	1.590E+01	1.167E+03	0.2286	290.00	82	1.600E+01	1.166E+03	0.2286	290.00
83	1.610E+01	1.165E+03	0.2287	290.00	84	1.620E+01	1.163E+03	0.2287	290.00
85	1.630E+01	1.162E+03	0.2288	290.00	86	1.640E+01	1.161E+03	0.2288	290.00
87	1.650E+01	1.160E+03	0.2289	290.00	88	1.660E+01	1.159E+03	0.2289	290.00
89	1.670E+01	1.157E+03	0.2290	290.00	90	1.680E+01	1.156E+03	0.2290	290.00
91	1.690E+01	1.155E+03	0.2291	290.00	92	1.700E+01	1.154E+03	0.2291	290.00
93	1.710E+01	1.153E+03	0.2292	290.00	94	1.735E+01	1.151E+03	0.2293	290.00

95	1.760E+01	1.148E+03	0.2294	290.00	96	1.785E+01	1.146E+03	0.2295	290.00
97	1.810E+01	1.144E+03	0.2296	290.00	98	1.835E+01	1.142E+03	0.2297	290.00
99	1.860E+01	1.140E+03	0.2298	290.00	100	1.885E+01	1.138E+03	0.2298	290.00
101	1.910E+01	1.137E+03	0.2299	290.00	102	1.935E+01	1.136E+03	0.2300	290.00
103	1.960E+01	1.134E+03	0.2300	290.00	104	2.010E+01	1.132E+03	0.2301	290.00
105	2.060E+01	1.130E+03	0.2302	290.00	106	2.110E+01	1.129E+03	0.2303	290.00
107	2.160E+01	1.128E+03	0.2303	290.00	108	2.210E+01	1.127E+03	0.2303	290.00
109	2.260E+01	1.127E+03	0.2303	290.00	110	2.310E+01	1.127E+03	0.2303	290.00
111	2.360E+01	1.127E+03	0.2303	290.00	112	2.410E+01	1.128E+03	0.2303	290.00
113	2.460E+01	1.129E+03	0.2303	290.00	114	2.510E+01	1.129E+03	0.2302	290.00
115	2.560E+01	1.131E+03	0.2302	290.00	116	2.610E+01	1.132E+03	0.2301	290.00
117	2.660E+01	1.133E+03	0.2301	290.00	118	2.710E+01	1.135E+03	0.2300	290.00
119	2.760E+01	1.137E+03	0.2299	290.00	120	2.810E+01	1.139E+03	0.2298	290.00
121	2.860E+01	1.141E+03	0.2297	290.00	122	2.910E+01	1.143E+03	0.2296	290.00
123	2.960E+01	1.145E+03	0.2296	290.00	124	3.010E+01	1.147E+03	0.2295	290.00
125	3.060E+01	1.149E+03	0.2294	290.00	126	3.110E+01	1.151E+03	0.2293	290.00
127	3.160E+01	1.153E+03	0.2292	290.00	128	3.210E+01	1.155E+03	0.2291	290.00
129	3.260E+01	1.157E+03	0.2290	290.00	130	3.310E+01	1.159E+03	0.2289	290.00
131	3.360E+01	1.161E+03	0.2288	290.00	132	3.410E+01	1.163E+03	0.2288	290.00
133	3.460E+01	1.164E+03	0.2287	290.00	134	3.510E+01	1.166E+03	0.2286	290.00
135	3.560E+01	1.168E+03	0.2285	290.00	136	3.610E+01	1.170E+03	0.2285	290.00
137	3.660E+01	1.171E+03	0.2284	290.00	138	3.710E+01	1.173E+03	0.2283	290.00
139	3.760E+01	1.174E+03	0.2283	290.00	140	3.810E+01	1.175E+03	0.2282	290.00
141	3.860E+01	1.177E+03	0.2282	290.00	142	3.910E+01	1.178E+03	0.2281	290.00
143	3.960E+01	1.179E+03	0.2281	290.00	144	4.010E+01	1.180E+03	0.2280	290.00
145	4.060E+01	1.181E+03	0.2280	290.00	146	4.110E+01	1.182E+03	0.2279	290.00
147	4.160E+01	1.183E+03	0.2279	290.00	148	4.210E+01	1.183E+03	0.2279	290.00
149	4.260E+01	1.184E+03	0.2278	290.00	150	4.310E+01	1.185E+03	0.2278	290.00
151	4.360E+01	1.185E+03	0.2278	290.00	152	4.410E+01	1.186E+03	0.2278	290.00
153	4.460E+01	1.186E+03	0.2277	290.00	154	4.510E+01	1.187E+03	0.2277	290.00
155	4.560E+01	1.187E+03	0.2277	290.00	156	4.610E+01	1.187E+03	0.2277	290.00
157	4.660E+01	1.187E+03	0.2277	290.00	158	4.710E+01	1.188E+03	0.2277	290.00
159	4.760E+01	1.188E+03	0.2277	290.00	160	4.810E+01	1.188E+03	0.2277	290.00
161	4.860E+01	1.188E+03	0.2277	290.00	162	4.910E+01	1.188E+03	0.2277	290.00
163	4.960E+01	1.188E+03	0.2277	290.00	164	5.010E+01	1.188E+03	0.2277	290.00
165	5.060E+01	1.188E+03	0.2277	290.00	166	5.110E+01	1.188E+03	0.2277	290.00
167	5.160E+01	1.188E+03	0.2277	290.00	168	5.210E+01	1.188E+03	0.2277	290.00
169	5.260E+01	1.188E+03	0.2277	290.00	170	5.310E+01	1.188E+03	0.2277	290.00
171	5.360E+01	1.188E+03	0.2277	290.00	172	5.410E+01	1.188E+03	0.2277	290.00
173	5.460E+01	1.188E+03	0.2277	290.00	174	5.510E+01	1.188E+03	0.2277	290.00
175	5.560E+01	1.188E+03	0.2277	290.00	176	5.585E+01	1.188E+03	0.2277	290.00
177	5.610E+01	1.188E+03	0.2277	290.00	178	5.635E+01	1.188E+03	0.2277	290.00
179	5.660E+01	1.188E+03	0.2277	290.00	180	5.685E+01	1.187E+03	0.2277	290.00
181	5.710E+01	1.187E+03	0.2277	290.00	182	5.735E+01	1.187E+03	0.2277	290.00
183	5.760E+01	1.187E+03	0.2277	290.00	184	5.785E+01	1.187E+03	0.2277	290.00
185	5.810E+01	1.187E+03	0.2277	290.00	186	5.835E+01	1.187E+03	0.2277	290.00
187	5.860E+01	1.187E+03	0.2277	290.00	188	5.870E+01	1.187E+03	0.2277	290.00
189	5.880E+01	1.187E+03	0.2277	290.00	190	5.890E+01	1.187E+03	0.2277	290.00
191	5.900E+01	1.187E+03	0.2277	290.00	192	5.910E+01	1.187E+03	0.2277	290.00
193	5.920E+01	1.187E+03	0.2277	290.00	194	5.930E+01	1.187E+03	0.2277	290.00
195	5.940E+01	1.187E+03	0.2277	290.00	196	5.950E+01	1.187E+03	0.2277	290.00
197	5.960E+01	1.187E+03	0.2277	290.00	198	5.970E+01	1.187E+03	0.2277	290.00
199	5.980E+01	1.187E+03	0.2277	290.00	200	5.990E+01	1.187E+03	0.2277	290.00
201	6.000E+01	1.187E+03	0.2277	290.00	202	6.010E+01	1.187E+03	0.2277	290.00
203	6.020E+01	1.187E+03	0.2277	290.00	204	6.030E+01	1.187E+03	0.2277	290.00
205	6.040E+01	1.187E+03	0.2277	290.00	206	6.050E+01	1.187E+03	0.2277	290.00
207	6.060E+01	1.187E+03	0.2277	290.00	208	6.070E+01	1.187E+03	0.2277	290.00
209	6.080E+01	1.187E+03	0.2277	290.00	210	6.090E+01	1.187E+03	0.2277	290.00
211	6.100E+01	1.187E+03	0.2277	290.00					

Initial Water Storage = 13.8115 cm

```
 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 ------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)= 5.75739E-08
 IsoVapor Flow (cm)= 0.00000E+00

                                                    LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS      DRAIN      NEWSTOR        STORAGE
  13.8115+ 0.0000+ 0.0000 - 0.0791- 0.0000-   0.0001 =    13.7323 vs.    13.7327

 Mass Balance = -3.4868E-04 cm;  Time step attempts =  111 and successes =    87
   Evaporation:  Potential =  0.1180 cm, Actual =  0.0791 cm
 RHMEAN = 52.5 %;  TMEAN = 270.1 K;  HDRY =  8.8140E+05 cm;  DAYUBC =     35

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 ------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)= 5.37726E-07
 IsoVapor Flow (cm)= 0.00000E+00

                                                    LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS      DRAIN      NEWSTOR        STORAGE
  14.9667+ 0.0000+ 0.0000 - 0.0695- 0.0000-   0.0001 =    14.8971 vs.    14.8971

 Mass Balance = -3.2411E-05 cm;  Time step attempts =  135 and successes =    99
   Evaporation:  Potential =  0.0697 cm, Actual =  0.0695 cm
 RHMEAN = 71.2 %;  TMEAN = 269.0 K;  HDRY =  4.6466E+05 cm;  DAYUBC =      5
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 ECDC Soil B, 2.0' Cover, 5-Year "Avg" Precip.
-------------------------------------------------------------------------------

 Transpiration Scheme is:             =    0
 Potential Evapotranspiration         =  1.6927E+02     [cm]
 Potential Transpiration              =  0.0000E+00     [cm]
 Actual Transpiration                 =  0.0000E+00     [cm]
 Potential Evaporation                =  1.6927E+02     [cm]
 Actual Evaporation                   =  2.4641E+01     [cm]
 Evaporation during Growth            =  0.0000E+00     [cm]
 Total Runoff                         =  4.8886E+01     [cm]
 Total Infiltration                   =  2.5790E+01     [cm]
 Total Basal Liquid Flux (drainage)   =  2.3408E-02     [cm]
 Total Basal Vapor Flux (temp-grad)   =  0.0000E+00     [cm]
 Total Applied Water                  =  7.4676E+01     [cm]
 Actual Rainfall                      =  7.4676E+01     [cm]
 Actual Irrigation                    =  0.0000E+00     [cm]
 Total Final Moisture Storage         =  1.4897E+01     [cm]
```

Mass Balance Error	=	3.9277E-02	[cm]
Total Successful Time Steps	=	87881	
Total Attempted Time Steps	=	103656	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32594	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1484E+00	0.050	1.7931E+01	0.150	1.3836E+01
0.250	1.1483E+01	0.350	9.8249E+00	0.450	8.4793E+00
0.550	7.3425E+00	0.650	6.3858E+00	0.750	5.5192E+00
0.850	4.7883E+00	0.950	4.1280E+00	1.050	3.5300E+00
1.150	3.0633E+00	1.250	2.6852E+00	1.350	2.3439E+00
1.450	2.0597E+00	1.550	1.8577E+00	1.650	1.7097E+00
1.750	1.5727E+00	1.850	1.4542E+00	1.950	1.3613E+00
2.125	1.2518E+00	2.375	1.1198E+00	2.625	1.0579E+00
2.875	1.0386E+00	3.125	1.0251E+00	3.375	1.0122E+00
3.625	9.9939E-01	3.875	9.8655E-01	4.125	9.7355E-01
4.375	9.6047E-01	4.625	9.4726E-01	4.875	9.3395E-01
5.125	9.2062E-01	5.500	9.0050E-01	6.000	8.7343E-01
6.500	8.4637E-01	7.000	8.1934E-01	7.500	7.9250E-01
8.000	7.6593E-01	8.500	7.3967E-01	9.000	7.1389E-01
9.500	6.8857E-01	10.000	6.6384E-01	10.375	6.4573E-01
10.625	6.3383E-01	10.875	6.2209E-01	11.125	6.1052E-01
11.375	5.9911E-01	11.625	5.8790E-01	11.875	5.7685E-01
12.125	5.6600E-01	12.375	5.5533E-01	12.625	5.4486E-01
12.875	5.3457E-01	13.125	5.2448E-01	13.375	5.1459E-01
13.550	5.0781E-01	13.650	5.0397E-01	13.750	5.0016E-01
13.850	4.9639E-01	13.950	4.9264E-01	14.050	4.8894E-01
14.150	4.8526E-01	14.250	4.8161E-01	14.350	4.7800E-01
14.450	4.7442E-01	14.550	4.7086E-01	14.650	4.6735E-01
14.750	4.6386E-01	14.850	4.6042E-01	14.950	4.5701E-01
15.050	4.5364E-01	15.150	4.5030E-01	15.250	4.4699E-01
15.350	4.4372E-01	15.450	4.4047E-01	15.550	4.3726E-01
15.650	4.3408E-01	15.750	4.3094E-01	15.850	4.2783E-01
15.950	4.2477E-01	16.050	4.2173E-01	16.150	4.1872E-01
16.250	4.1574E-01	16.350	4.1280E-01	16.450	4.0990E-01
16.550	4.0702E-01	16.650	4.0419E-01	16.750	4.0138E-01
16.850	3.9861E-01	16.950	3.9588E-01	17.050	3.9317E-01
17.225	3.8849E-01	17.475	3.8201E-01	17.725	3.7573E-01
17.975	3.6966E-01	18.225	3.6378E-01	18.475	3.5809E-01
18.725	3.5259E-01	18.975	3.4728E-01	19.225	3.4214E-01
19.475	3.3716E-01	19.850	3.2996E-01	20.350	3.2098E-01
20.850	3.1258E-01	21.350	3.0471E-01	21.850	2.9732E-01
22.350	2.9037E-01	22.850	2.8381E-01	23.350	2.7759E-01
23.850	2.7168E-01	24.350	2.6604E-01	24.850	2.6063E-01
25.350	2.5542E-01	25.850	2.5039E-01	26.350	2.4551E-01
26.850	2.4076E-01	27.350	2.3612E-01	27.850	2.3157E-01
28.350	2.2710E-01	28.850	2.2268E-01	29.350	2.1833E-01
29.850	2.1402E-01	30.350	2.0975E-01	30.850	2.0551E-01
31.350	2.0130E-01	31.850	1.9711E-01	32.350	1.9294E-01
32.850	1.8879E-01	33.350	1.8465E-01	33.850	1.8052E-01
34.350	1.7641E-01	34.850	1.7232E-01	35.350	1.6823E-01
35.850	1.6416E-01	36.350	1.6010E-01	36.850	1.5606E-01
37.350	1.5210E-01	37.850	1.4823E-01	38.350	1.4443E-01
38.850	1.4071E-01	39.350	1.3707E-01	39.850	1.3351E-01
40.350	1.3001E-01	40.850	1.2658E-01	41.350	1.2322E-01
41.850	1.1993E-01	42.350	1.1669E-01	42.850	1.1352E-01

43.350	1.1041E-01	43.850	1.0735E-01	44.350	1.0434E-01
44.850	1.0139E-01	45.350	9.8488E-02	45.850	9.5633E-02
46.350	9.2823E-02	46.850	9.0056E-02	47.350	8.7332E-02
47.850	8.4649E-02	48.350	8.2003E-02	48.850	7.9395E-02
49.350	7.6822E-02	49.850	7.4283E-02	50.350	7.1776E-02
50.850	6.9299E-02	51.350	6.6853E-02	51.850	6.4434E-02
52.350	6.2041E-02	52.850	5.9674E-02	53.350	5.7330E-02
53.850	5.5009E-02	54.350	5.2708E-02	54.850	5.0427E-02
55.350	4.8164E-02	55.725	4.6479E-02	55.975	4.5360E-02
56.225	4.4245E-02	56.475	4.3133E-02	56.725	4.2024E-02
56.975	4.0919E-02	57.225	3.9817E-02	57.475	3.8717E-02
57.725	3.7620E-02	57.975	3.6526E-02	58.225	3.5433E-02
58.475	3.4343E-02	58.650	3.3582E-02	58.750	3.3147E-02
58.850	3.2712E-02	58.950	3.2277E-02	59.050	3.1843E-02
59.150	3.1409E-02	59.250	3.0975E-02	59.350	3.0542E-02
59.450	3.0109E-02	59.550	2.9675E-02	59.650	2.9242E-02
59.750	2.8810E-02	59.850	2.8377E-02	59.950	2.7944E-02
60.050	2.7512E-02	60.150	2.7080E-02	60.250	2.6647E-02
60.350	2.6215E-02	60.450	2.5783E-02	60.550	2.5351E-02
60.650	2.4920E-02	60.750	2.4488E-02	60.850	2.4056E-02
60.950	2.3624E-02	61.000	2.3408E-02		

Soil B - Typical (1961 through 1990
UNSAT-H Output File for end of Final - 1990

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\B_2.0_Avg\input.inp
Results File: F:\DATA\PROJECTS\203050 - Allied - ECDC AFC\Modeling\B_2.0_Avg\in
Date of Run: 23 Feb 2004
Time of Run: 17:40:50.40
Title:
ECDC Soil B, 2.0' Cover, "Avg" Precip.

		Initial Conditions					Initial Conditions		
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.780E+05	0.0470	290.00	2	1.000E-01	9.489E+05	0.0473	290.00
3	2.000E-01	9.203E+05	0.0477	290.00	4	3.000E-01	8.924E+05	0.0480	290.00
5	4.000E-01	8.650E+05	0.0484	290.00	6	5.000E-01	8.382E+05	0.0487	290.00
7	6.000E-01	8.120E+05	0.0491	290.00	8	7.000E-01	7.862E+05	0.0495	290.00
9	8.000E-01	7.611E+05	0.0499	290.00	10	9.000E-01	7.364E+05	0.0503	290.00
11	1.000E+00	7.122E+05	0.0507	290.00	12	1.100E+00	6.886E+05	0.0511	290.00
13	1.200E+00	6.654E+05	0.0515	290.00	14	1.300E+00	6.428E+05	0.0519	290.00
15	1.400E+00	6.206E+05	0.0523	290.00	16	1.500E+00	5.989E+05	0.0528	290.00
17	1.600E+00	5.776E+05	0.0532	290.00	18	1.700E+00	5.568E+05	0.0537	290.00
19	1.800E+00	5.365E+05	0.0542	290.00	20	1.900E+00	5.166E+05	0.0547	290.00
21	2.000E+00	4.972E+05	0.0552	290.00	22	2.250E+00	4.505E+05	0.0565	290.00
23	2.500E+00	4.063E+05	0.0579	290.00	24	2.750E+00	3.645E+05	0.0594	290.00
25	3.000E+00	3.251E+05	0.0610	290.00	26	3.250E+00	2.877E+05	0.0628	290.00
27	3.500E+00	2.525E+05	0.0648	290.00	28	3.750E+00	2.191E+05	0.0670	290.00
29	4.000E+00	1.875E+05	0.0695	290.00	30	4.250E+00	1.578E+05	0.0724	290.00
31	4.500E+00	1.298E+05	0.0758	290.00	32	4.750E+00	1.037E+05	0.0800	290.00
33	5.000E+00	7.953E+04	0.0851	290.00	34	5.250E+00	5.765E+04	0.0919	290.00
35	5.750E+00	2.403E+04	0.1130	290.00	36	6.250E+00	1.089E+04	0.1363	290.00
37	6.750E+00	7.175E+03	0.1503	290.00	38	7.250E+00	5.551E+03	0.1597	290.00
39	7.750E+00	4.632E+03	0.1666	290.00	40	8.250E+00	4.034E+03	0.1721	290.00
41	8.750E+00	3.612E+03	0.1766	290.00	42	9.250E+00	3.296E+03	0.1804	290.00
43	9.750E+00	3.050E+03	0.1836	290.00	44	1.025E+01	2.852E+03	0.1865	290.00
45	1.050E+01	2.767E+03	0.1878	290.00	46	1.075E+01	2.689E+03	0.1891	290.00
47	1.100E+01	2.618E+03	0.1903	290.00	48	1.125E+01	2.552E+03	0.1914	290.00
49	1.150E+01	2.492E+03	0.1924	290.00	50	1.175E+01	2.436E+03	0.1934	290.00
51	1.200E+01	2.384E+03	0.1944	290.00	52	1.225E+01	2.335E+03	0.1953	290.00
53	1.250E+01	2.289E+03	0.1962	290.00	54	1.275E+01	2.247E+03	0.1971	290.00
55	1.300E+01	2.207E+03	0.1979	290.00	56	1.325E+01	2.169E+03	0.1987	290.00
57	1.350E+01	2.133E+03	0.1994	290.00	58	1.360E+01	2.119E+03	0.1997	290.00
59	1.370E+01	2.106E+03	0.2000	290.00	60	1.380E+01	2.093E+03	0.2003	290.00
61	1.390E+01	2.080E+03	0.2006	290.00	62	1.400E+01	2.068E+03	0.2009	290.00
63	1.410E+01	2.055E+03	0.2011	290.00	64	1.420E+01	2.043E+03	0.2014	290.00
65	1.430E+01	2.031E+03	0.2017	290.00	66	1.440E+01	2.020E+03	0.2019	290.00
67	1.450E+01	2.009E+03	0.2022	290.00	68	1.460E+01	1.997E+03	0.2025	290.00
69	1.470E+01	1.987E+03	0.2027	290.00	70	1.480E+01	1.976E+03	0.2030	290.00
71	1.490E+01	1.965E+03	0.2032	290.00	72	1.500E+01	1.955E+03	0.2035	290.00
73	1.510E+01	1.945E+03	0.2037	290.00	74	1.520E+01	1.935E+03	0.2039	290.00
75	1.530E+01	1.925E+03	0.2042	290.00	76	1.540E+01	1.916E+03	0.2044	290.00
77	1.550E+01	1.906E+03	0.2046	290.00	78	1.560E+01	1.897E+03	0.2049	290.00
79	1.570E+01	1.888E+03	0.2051	290.00	80	1.580E+01	1.879E+03	0.2053	290.00
81	1.590E+01	1.871E+03	0.2055	290.00	82	1.600E+01	1.862E+03	0.2057	290.00
83	1.610E+01	1.853E+03	0.2060	290.00	84	1.620E+01	1.845E+03	0.2062	290.00
85	1.630E+01	1.837E+03	0.2064	290.00	86	1.640E+01	1.829E+03	0.2066	290.00
87	1.650E+01	1.821E+03	0.2068	290.00	88	1.660E+01	1.813E+03	0.2070	290.00
89	1.670E+01	1.806E+03	0.2072	290.00	90	1.680E+01	1.798E+03	0.2074	290.00
91	1.690E+01	1.791E+03	0.2076	290.00	92	1.700E+01	1.783E+03	0.2078	290.00
93	1.710E+01	1.776E+03	0.2080	290.00	94	1.735E+01	1.759E+03	0.2084	290.00

95	1.760E+01	1.742E+03	0.2089	290.00	96	1.785E+01	1.726E+03	0.2093	290.00
97	1.810E+01	1.710E+03	0.2098	290.00	98	1.835E+01	1.695E+03	0.2102	290.00
99	1.860E+01	1.680E+03	0.2106	290.00	100	1.885E+01	1.666E+03	0.2110	290.00
101	1.910E+01	1.652E+03	0.2114	290.00	102	1.935E+01	1.639E+03	0.2118	290.00
103	1.960E+01	1.626E+03	0.2122	290.00	104	2.010E+01	1.602E+03	0.2129	290.00
105	2.060E+01	1.579E+03	0.2136	290.00	106	2.110E+01	1.557E+03	0.2143	290.00
107	2.160E+01	1.537E+03	0.2149	290.00	108	2.210E+01	1.517E+03	0.2155	290.00
109	2.260E+01	1.499E+03	0.2161	290.00	110	2.310E+01	1.482E+03	0.2167	290.00
111	2.360E+01	1.465E+03	0.2172	290.00	112	2.410E+01	1.449E+03	0.2178	290.00
113	2.460E+01	1.434E+03	0.2183	290.00	114	2.510E+01	1.420E+03	0.2188	290.00
115	2.560E+01	1.406E+03	0.2192	290.00	116	2.610E+01	1.393E+03	0.2197	290.00
117	2.660E+01	1.381E+03	0.2201	290.00	118	2.710E+01	1.369E+03	0.2206	290.00
119	2.760E+01	1.358E+03	0.2210	290.00	120	2.810E+01	1.347E+03	0.2214	290.00
121	2.860E+01	1.336E+03	0.2218	290.00	122	2.910E+01	1.326E+03	0.2221	290.00
123	2.960E+01	1.317E+03	0.2225	290.00	124	3.010E+01	1.307E+03	0.2229	290.00
125	3.060E+01	1.298E+03	0.2232	290.00	126	3.110E+01	1.290E+03	0.2235	290.00
127	3.160E+01	1.282E+03	0.2239	290.00	128	3.210E+01	1.274E+03	0.2242	290.00
129	3.260E+01	1.266E+03	0.2245	290.00	130	3.310E+01	1.259E+03	0.2248	290.00
131	3.360E+01	1.252E+03	0.2250	290.00	132	3.410E+01	1.245E+03	0.2253	290.00
133	3.460E+01	1.238E+03	0.2256	290.00	134	3.510E+01	1.232E+03	0.2258	290.00
135	3.560E+01	1.226E+03	0.2261	290.00	136	3.610E+01	1.220E+03	0.2263	290.00
137	3.660E+01	1.214E+03	0.2266	290.00	138	3.710E+01	1.209E+03	0.2268	290.00
139	3.760E+01	1.203E+03	0.2270	290.00	140	3.810E+01	1.198E+03	0.2272	290.00
141	3.860E+01	1.193E+03	0.2274	290.00	142	3.910E+01	1.189E+03	0.2276	290.00
143	3.960E+01	1.184E+03	0.2278	290.00	144	4.010E+01	1.180E+03	0.2280	290.00
145	4.060E+01	1.175E+03	0.2282	290.00	146	4.110E+01	1.171E+03	0.2284	290.00
147	4.160E+01	1.167E+03	0.2286	290.00	148	4.210E+01	1.163E+03	0.2287	290.00
149	4.260E+01	1.160E+03	0.2289	290.00	150	4.310E+01	1.156E+03	0.2290	290.00
151	4.360E+01	1.153E+03	0.2292	290.00	152	4.410E+01	1.149E+03	0.2293	290.00
153	4.460E+01	1.146E+03	0.2295	290.00	154	4.510E+01	1.143E+03	0.2296	290.00
155	4.560E+01	1.140E+03	0.2297	290.00	156	4.610E+01	1.138E+03	0.2299	290.00
157	4.660E+01	1.135E+03	0.2300	290.00	158	4.710E+01	1.132E+03	0.2301	290.00
159	4.760E+01	1.130E+03	0.2302	290.00	160	4.810E+01	1.128E+03	0.2303	290.00
161	4.860E+01	1.125E+03	0.2304	290.00	162	4.910E+01	1.123E+03	0.2305	290.00
163	4.960E+01	1.121E+03	0.2306	290.00	164	5.010E+01	1.119E+03	0.2307	290.00
165	5.060E+01	1.117E+03	0.2308	290.00	166	5.110E+01	1.116E+03	0.2309	290.00
167	5.160E+01	1.114E+03	0.2309	290.00	168	5.210E+01	1.112E+03	0.2310	290.00
169	5.260E+01	1.111E+03	0.2311	290.00	170	5.310E+01	1.110E+03	0.2311	290.00
171	5.360E+01	1.108E+03	0.2312	290.00	172	5.410E+01	1.107E+03	0.2313	290.00
173	5.460E+01	1.106E+03	0.2313	290.00	174	5.510E+01	1.105E+03	0.2314	290.00
175	5.560E+01	1.104E+03	0.2314	290.00	176	5.585E+01	1.103E+03	0.2314	290.00
177	5.610E+01	1.103E+03	0.2314	290.00	178	5.635E+01	1.103E+03	0.2315	290.00
179	5.660E+01	1.102E+03	0.2315	290.00	180	5.685E+01	1.102E+03	0.2315	290.00
181	5.710E+01	1.102E+03	0.2315	290.00	182	5.735E+01	1.101E+03	0.2315	290.00
183	5.760E+01	1.101E+03	0.2315	290.00	184	5.785E+01	1.101E+03	0.2315	290.00
185	5.810E+01	1.100E+03	0.2316	290.00	186	5.835E+01	1.100E+03	0.2316	290.00
187	5.860E+01	1.100E+03	0.2316	290.00	188	5.870E+01	1.100E+03	0.2316	290.00
189	5.880E+01	1.100E+03	0.2316	290.00	190	5.890E+01	1.100E+03	0.2316	290.00
191	5.900E+01	1.100E+03	0.2316	290.00	192	5.910E+01	1.100E+03	0.2316	290.00
193	5.920E+01	1.100E+03	0.2316	290.00	194	5.930E+01	1.100E+03	0.2316	290.00
195	5.940E+01	1.100E+03	0.2316	290.00	196	5.950E+01	1.099E+03	0.2316	290.00
197	5.960E+01	1.099E+03	0.2316	290.00	198	5.970E+01	1.099E+03	0.2316	290.00
199	5.980E+01	1.099E+03	0.2316	290.00	200	5.990E+01	1.099E+03	0.2316	290.00
201	6.000E+01	1.099E+03	0.2316	290.00	202	6.010E+01	1.099E+03	0.2316	290.00
203	6.020E+01	1.099E+03	0.2316	290.00	204	6.030E+01	1.099E+03	0.2316	290.00
205	6.040E+01	1.099E+03	0.2316	290.00	206	6.050E+01	1.099E+03	0.2316	290.00
207	6.060E+01	1.099E+03	0.2316	290.00	208	6.070E+01	1.099E+03	0.2316	290.00
209	6.080E+01	1.099E+03	0.2316	290.00	210	6.090E+01	1.099E+03	0.2316	290.00
211	6.100E+01	1.099E+03	0.2316	290.00					

Initial Water Storage = 12.3658 cm

```
 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 ------------
 Node Number       =     211
 Depth (cm)        =    61.00000
 Water (cm3/cm3)   =     0.23160
 Head (cm)         = 1.09963E+03
 LiqWater Flow (cm)= 7.31512E-05
 IsoVapor Flow (cm)= 0.00000E+00

                                                    LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
  12.3658+ 0.0000+ 0.0000 - 0.0065- 0.0000-  0.0001 =    12.3593 vs.    12.3593

 Mass Balance =  3.7271E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.1408 cm, Actual =  0.0065 cm
 RHMEAN = 49.4 %;  TMEAN = 270.7 K;  HDRY =  9.6397E+05 cm;  DAYUBC =    23

-------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 ------------
 Node Number       =     211
 Depth (cm)        =    61.00000
 Water (cm3/cm3)   =     0.22329
 Head (cm)         = 1.29624E+03
 LiqWater Flow (cm)= 4.85437E-05
 IsoVapor Flow (cm)= 0.00000E+00

                                                    LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
  13.5050+ 0.0000+ 0.0000 - 0.0460- 0.0000-  0.0000 =    13.4590 vs.    13.4591

 Mass Balance = -1.3591E-04 cm;  Time step attempts =   78 and successes =   62
   Evaporation:  Potential =  0.0502 cm, Actual =  0.0460 cm
 RHMEAN = 64.7 %;  TMEAN = 258.7 K;  HDRY =  5.9554E+05 cm;  DAYUBC =    18
1

-------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 ECDC Soil B, 2.0' Cover, 5-Year "Avg" Precip.
-------------------------------------------------------------------------------

 Transpiration Scheme is:              =    0
 Potential Evapotranspiration          =  1.8739E+02     [cm]
 Potential Transpiration               =  0.0000E+00     [cm]
 Actual Transpiration                  =  0.0000E+00     [cm]
 Potential Evaporation                 =  1.8739E+02     [cm]
 Actual Evaporation                    =  1.7625E+01     [cm]
 Evaporation during Growth             =  0.0000E+00     [cm]
 Total Runoff                          =  2.3122E+01     [cm]
 Total Infiltration                    =  1.8788E+01     [cm]
 Total Basal Liquid Flux (drainage)    =  2.1629E-02     [cm]
 Total Basal Vapor Flux (temp-grad)    =  0.0000E+00     [cm]
 Total Applied Water                   =  4.1910E+01     [cm]
 Actual Rainfall                       =  4.1910E+01     [cm]
 Actual Irrigation                     =  0.0000E+00     [cm]
 Total Final Moisture Storage          =  1.3459E+01     [cm]
```

Mass Balance Error	=	4.7796E-02	[cm]
Total Successful Time Steps	=	77375	
Total Attempted Time Steps	=	89732	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	30227	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	1.1627E+00	0.050	1.4846E+01	0.150	1.2554E+01
0.250	1.1029E+01	0.350	9.7859E+00	0.450	8.8271E+00
0.550	8.0333E+00	0.650	7.3442E+00	0.750	6.7098E+00
0.850	6.1044E+00	0.950	5.5337E+00	1.050	5.0199E+00
1.150	4.5719E+00	1.250	4.1536E+00	1.350	3.7693E+00
1.450	3.4300E+00	1.550	3.1295E+00	1.650	2.8503E+00
1.750	2.5860E+00	1.850	2.3357E+00	1.950	2.1150E+00
2.125	1.8656E+00	2.375	1.5900E+00	2.625	1.3959E+00
2.875	1.2390E+00	3.125	1.0911E+00	3.375	9.4941E-01
3.625	8.1283E-01	3.875	6.8583E-01	4.125	5.8411E-01
4.375	4.9917E-01	4.625	4.4698E-01	4.875	4.1079E-01
5.125	3.7858E-01	5.500	3.3042E-01	6.000	2.5985E-01
6.500	2.0321E-01	7.000	1.6045E-01	7.500	1.2388E-01
8.000	9.1271E-02	8.500	6.1633E-02	9.000	3.4411E-02
9.500	9.2752E-03	10.000	-1.4028E-02	10.375	-3.0261E-02
10.625	-4.0691E-02	10.875	-5.0744E-02	11.125	-6.0433E-02
11.375	-6.9769E-02	11.625	-7.8761E-02	11.875	-8.7419E-02
12.125	-9.5750E-02	12.375	-1.0376E-01	12.625	-1.1146E-01
12.875	-1.1885E-01	13.125	-1.2595E-01	13.375	-1.3275E-01
13.550	-1.3730E-01	13.650	-1.3986E-01	13.750	-1.4238E-01
13.850	-1.4485E-01	13.950	-1.4727E-01	14.050	-1.4965E-01
14.150	-1.5199E-01	14.250	-1.5429E-01	14.350	-1.5654E-01
14.450	-1.5875E-01	14.550	-1.6091E-01	14.650	-1.6304E-01
14.750	-1.6512E-01	14.850	-1.6717E-01	14.950	-1.6917E-01
15.050	-1.7113E-01	15.150	-1.7305E-01	15.250	-1.7494E-01
15.350	-1.7678E-01	15.450	-1.7859E-01	15.550	-1.8035E-01
15.650	-1.8208E-01	15.750	-1.8378E-01	15.850	-1.8543E-01
15.950	-1.8705E-01	16.050	-1.8863E-01	16.150	-1.9018E-01
16.250	-1.9169E-01	16.350	-1.9317E-01	16.450	-1.9461E-01
16.550	-1.9602E-01	16.650	-1.9740E-01	16.750	-1.9874E-01
16.850	-2.0005E-01	16.950	-2.0132E-01	17.050	-2.0257E-01
17.225	-2.0469E-01	17.475	-2.0753E-01	17.725	-2.1019E-01
17.975	-2.1267E-01	18.225	-2.1497E-01	18.475	-2.1711E-01
18.725	-2.1909E-01	18.975	-2.2092E-01	19.225	-2.2260E-01
19.475	-2.2414E-01	19.850	-2.2625E-01	20.350	-2.2856E-01
20.850	-2.3041E-01	21.350	-2.3183E-01	21.850	-2.3286E-01
22.350	-2.3354E-01	22.850	-2.3388E-01	23.350	-2.3393E-01
23.850	-2.3370E-01	24.350	-2.3322E-01	24.850	-2.3249E-01
25.350	-2.3155E-01	25.850	-2.3039E-01	26.350	-2.2905E-01
26.850	-2.2753E-01	27.350	-2.2584E-01	27.850	-2.2400E-01
28.350	-2.2201E-01	28.850	-2.1988E-01	29.350	-2.1762E-01
29.850	-2.1524E-01	30.350	-2.1274E-01	30.850	-2.1013E-01
31.350	-2.0742E-01	31.850	-2.0462E-01	32.350	-2.0173E-01
32.850	-1.9875E-01	33.350	-1.9569E-01	33.850	-1.9255E-01
34.350	-1.8934E-01	34.850	-1.8607E-01	35.350	-1.8273E-01
35.850	-1.7934E-01	36.350	-1.7589E-01	36.850	-1.7238E-01
37.350	-1.6883E-01	37.850	-1.6523E-01	38.350	-1.6159E-01
38.850	-1.5791E-01	39.350	-1.5420E-01	39.850	-1.5044E-01
40.350	-1.4666E-01	40.850	-1.4285E-01	41.350	-1.3900E-01
41.850	-1.3513E-01	42.350	-1.3124E-01	42.850	-1.2732E-01

43.350	-1.2339E-01	43.850	-1.1943E-01	44.350	-1.1545E-01
44.850	-1.1146E-01	45.350	-1.0746E-01	45.850	-1.0343E-01
46.350	-9.9399E-02	46.850	-9.5352E-02	47.350	-9.1293E-02
47.850	-8.7224E-02	48.350	-8.3146E-02	48.850	-7.9059E-02
49.350	-7.4963E-02	49.850	-7.0861E-02	50.350	-6.6751E-02
50.850	-6.2635E-02	51.350	-5.8514E-02	51.850	-5.4387E-02
52.350	-5.0256E-02	52.850	-4.6120E-02	53.350	-4.1981E-02
53.850	-3.7838E-02	54.350	-3.3692E-02	54.850	-2.9542E-02
55.350	-2.5391E-02	55.725	-2.2275E-02	55.975	-2.0198E-02
56.225	-1.8120E-02	56.475	-1.6041E-02	56.725	-1.3962E-02
56.975	-1.1883E-02	57.225	-9.8032E-03	57.475	-7.7232E-03
57.725	-5.6428E-03	57.975	-3.5621E-03	58.225	-1.4812E-03
58.475	6.0004E-04	58.650	2.0570E-03	58.750	2.8896E-03
58.850	3.7223E-03	58.950	4.5550E-03	59.050	5.3876E-03
59.150	6.2204E-03	59.250	7.0531E-03	59.350	7.8859E-03
59.450	8.7187E-03	59.550	9.5515E-03	59.650	1.0384E-02
59.750	1.1217E-02	59.850	1.2050E-02	59.950	1.2883E-02
60.050	1.3716E-02	60.150	1.4549E-02	60.250	1.5382E-02
60.350	1.6215E-02	60.450	1.7048E-02	60.550	1.7881E-02
60.650	1.8714E-02	60.750	1.9547E-02	60.850	2.0380E-02
60.950	2.1212E-02	61.000	2.1629E-02		

HAND DELIVERED

DEC 2 2 2005
05.04064
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

ALTERNATIVE FINAL COVER DEMONSTRATION SUPPLEMENT

ECDC LANDFILL
EAST CARBON CITY, UTAH
CLASS V LANDFILL PERMIT NO. 9422

Prepared for:

ECDC Environmental, L.C.
P.O. Box 69
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Prepared by:

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December 16, 2005
File No. 10203050.00

ALTERNATIVE FINAL COVER DEMONSTRATION SUPPLEMENT

ECDC LANDFILL
EAST CARBON CITY, UTAH

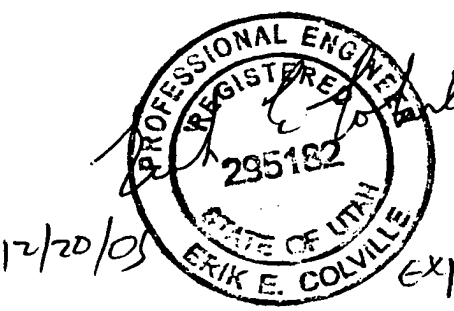
December 2005

The following supplemental report has been prepared by SCS Engineers on behalf of ECDC Environmental, L.C. The various analyses and evaluations described in the report are based on sound engineering principles and represent state of the practice for alternative landfill final cover demonstrations.

This report, along with information contained in the original alternate final cover demonstration dated April 1, 2004 demonstrate that the proposed alternative final cover, is equivalent to the standard Subtitle D (40 CFR 258) final cover system and thus satisfies applicable federal and Utah solid waste regulatory requirements for alternative final cover approval.

Prepared Under the Direct Supervision of:

Erik Colville, P.E.
SCS Engineers



12/20/05 Exp 12/31/06

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1.0 INTRODUCTION

ECDC operates the ECDC Landfill under a Class V Landfill Permit (No. 9422). The Landfill is located within the City limits of East Carbon City, Utah, in Carbon County, at 1111 West Highway 123. Road access is by Highway 123, which intersects with Highway 6, which connects to major interstate highways.

The current final cover design for the Landfill exceeds the minimum requirements for a composite-lined landfill. It includes a low permeability soil layer and geosynthetic membrane. Whereas the intent of state and federal regulations is to protect the environment by providing minimum design criteria for final cover systems, it is recognized that the standard final cover design may not be the most environmentally sound or cost-effective design for every climatic setting. With this in mind, regulations allowing alternative final cover design (R315-303-3 (4)(b)) were established, provided it can be demonstrated that the alternative configuration is equivalent to the standard design set forth in Subsection R315-303-3 (4)(a)(i) and provides equivalent protection from wind and water erosion.

On April 1, 2004, ECDC proposed an alternative cover design at the Landfill via an alternate final cover demonstration. The proposed alternate final cover is equivalent to the standard configuration in both infiltration performance and with respect to wind and water erosion. On December 6, 2005 a letter was received from the State of Utah Department of Environmental Quality (UDEQ) with comments on the originally submitted demonstration. Although this letter agreed with many of the assumptions in the original demonstration, it stated that prior to approval, two different climate scenarios needed to be run with the UNSAT-H model for each profile considered.

The two new scenarios UDEQ is requesting be run prior to approval were as follows: one "wet" scenario consisting of initializing the profile with twenty years of typical climate data and then running the five wettest years available in descending order (starting with the fifth wettest and ending with the wettest). The second scenario required, the "dry" scenario, consists of twenty initialization years through the profile, but then runs the five driest years in descending order (starting with the fifth driest year and ending with the driest). For approval, UDEQ stated that the infiltration rate through the proposed alternate final cover profile must be under 3 mm/year at the end of the wet-year analysis.

This supplemental modeling report has been written to provide the modeling runs requested in UDEQ's letter for each of the two soil profiles considered in the original demonstration (originally labeled as Soil Samples A and B). As a supplement, this report is a companion to the April 1, 2004 demonstration. As such, much of the general and background information on the Landfill, soils, and modeling is not included herein. Please refer to the original demonstration for this information.

As was done in the previous demonstration, the computer model UNSAT-H (version 3.00) was used to apply the required climate scenarios to and estimate the amount of percolation through each two-foot thick alternative cover configuration considered.

2.0 PERFORMANCE ANALYSES

General

For the original alternate final cover demonstration, two bulk soil samples (Samples A and B) were taken from a blend of the soils in the top 5 to 7 feet from virgin ground. Discussions with facility personnel indicate that these samples are typical of soils found in the top 5 to 7 feet of the Landfill property and are typical of soils that will be used in the construction of the final cover.

The UNSAT-H program was used to model the amount of precipitation that will percolate through the bottom of two different proposed 2-foot thick alternative final cover profiles. One profile was modeled as 2 feet of Soil A recompacted to 90 percent standard Proctor and the other as 2 feet of Soil B recompacted to 90 percent standard Proctor. The model simulations and results are discussed below.

The UNSAT-H model requires the following daily inputs in its climate files: maximum and minimum temperature; dew point temperature; solar radiation; average wind speed; average cloud cover; and precipitation. As set forth in the original demonstration, climate data from Grand Junction, Colorado was utilized in the modeling effort with the precipitation doubled to more closely approximate the Landfill's climate patterns.

Appendix A contains a table which shows the precipitation data set for all the years where complete data for the model was available (1961 and 1990). The right-most column shows the precipitation doubled since this was what was entered into the model. The year 1964 is highlighted in this precipitation table. The year 1964 represents a year close to the Sunnyside average annual precipitation rate. This year was repeated 20 times and applied to the profile to initialize all modeling runs.

At the bottom of the precipitation table in Appendix A the five driest and five wettest years are shown in descending order. Per UDEQ guidance, each alternate cover profile was run with artificially created "wet" and "dry" climate scenarios. For the wet scenario the five wettest years were applied to each profile in descending order and for the dry scenario the five driest years were applied to each profile in descending order.

Results

The following table shows the analysis results for alternate final cover profiles using each of the two soils from the last year of both the wet and dry climate scenarios. The results are summarized in the following table. Appendix B contains the input files for each of the modeling runs as well as the output file for the last year of each of the cases shown the table.

	Soil Sample A		Soil Sample B	
	End of Wettest Year (1983) in 5-Year Wet Cycle	**End of Driest Year (1976) in 5-Year Dry Cycle**	**End of Wettest Year (1983) in 5-Year Wet Cycle**	**End of Driest Year (1976) in 5-Year Dry Cycle**
Precipitation (cm)	74.7	26.2	74.7	26.2
Runoff (cm)	48.6	12.4	49.0	12.6
Infiltration (cm)	26.0	13.8	25.6	13.6
Transpiration (cm)	0.0	0.0	0.0	0.0
Evaporation (cm)	25.2	14.0	24.8	13.8
Percolation (mm)	**0.44**	**0.10**	**0.39**	**0.08**

As can be seen from these results, each profile under each climate condition allows under 3 mm/year of flow-through percolation. It should be noted that the flow-through percolation was also verified to be under 3 mm/year at the end of *every* year in the 5-year wet climate scenario (not just the end of the final and wettest year). Based upon these results, the proposed alternate final cover meets UDEQ performance requirements for alternate final covers.

APPENDIX A

CLIMATE DATA

GRAND JUNCTION WALKER, COLORADO
Monthly Total Precipitation (inches)
ation-53488

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN	Doubled
1961	0	0.18	1.47	0.85	1.11	0	0.03	1.63	2.22	0.7	0.66	0.63	9.48	**18.96**
1962	0.39	1.09	0.28	0.97	0.17	0.3	0.08	0.15	1.41	0.46	0.36	0.36	6.02	**12.04**
1963	0.99	0.47	0.55	0.12	0.01	0.61	0.93	1.75	0.48	0.6	0.36	0.45	7.32	**14.64**
1964	0.47	0.02	0.7	1.37	0.41	0.16	0.65	1.16	0.36	0	1.05	0.53	6.88	**13.76**
1965	0.66	0.94	0.87	1.95	1.35	1.33	0.89	0.67	2.52	1.4	0.82	0.76	14.16	**28.32**
1966	0.65	0.44	0.04	0.83	0.71	0.13	0.31	0.52	0.26	1.23	0.62	1.78	7.52	**15.04**
1967	0.25	0.22	0.18	0.08	1.52	1.34	1.03	0.59	0.37	0.63	0.33	1.14	7.68	**15.36**
1968	0.26	1.13	0.44	0.67	1.14	0.05	0.49	1.37	0.07	0.94	0.42	0.47	7.45	**14.9**
1969	1.03	0.4	0.67	0.33	0.45	2.07	0.21	0.88	1.45	2.01	0.45	0.36	10.31	**20.62**
1970	0.52	0.05	1.75	0.76	0	0.91	0.6	0.44	0.78	1.56	0.54	0.39	8.3	**16.6**
1971	0.19	0.13	0.02	0.42	1.1	0.03	0.15	1.02	0.58	1.13	0.56	0.67	6	**12**
1972	0.2	0	0.02	0.11	0.44	0.64	0.03	0.29	0.72	3.45	0.69	0.74	7.33	**14.66**
1973	0.79	0.12	0.65	0.86	1.45	0.87	0.52	0.62	0.33	0.2	0.91	0.62	7.94	**15.88**
1974	1.2	0.4	0.81	1.03	0.01	0.14	1.53	0.48	0.38	0.72	1.18	0.32	8.2	**16.4**
1975	0.53	0.49	1.74	1.38	1.23	0.43	1.39	0.09	0.16	0.85	0.39	0.5	9.18	**18.36**
1976	0.13	0.81	0.75	0.4	1.49	0.14	0.2	0.31	0.67	0.32	0.04	0.01	5.27	**10.54**
1977	0.37	0.06	0.5	0.54	0.59	0.04	0.89	0.59	0.52	0.5	0.7	0.38	5.68	**11.36**
1978	1.08	0.64	1.19	1.19	0.55	0.01	0.25	0.54	0.49	0.03	0.62	1.3	7.89	**15.78**
1979	1.36	0.63	2.02	0.42	1.45	0.78	0.08	0.61	0.01	0.25	1.02	0.27	8.9	**17.8**
1980	0.57	1.1	1.77	0.53	1.17	0	0.96	1.39	0.58	1.31	0.52	0.24	10.14	**20.28**
1981	0.44	0.16	1.35	0.56	1.49	0.17	0.41	0.82	0.25	2.06	0.47	0.6	8.78	**17.56**
1982	0.29	0.41	0.79	0.09	0.75	0.21	0.35	0.94	2.81	0.83	0.48	0.27	8.22	**16.44**
1983	0.5	0.64	1.59	0.9	1.68	1.54	1.92	0.73	1.11	0.36	2	1.85	14.82	**29.64**
1984	0.28	0.11	1.57	1.21	0.55	1.68	0.62	1.77	0.34	2.65	0.38	0.43	11.59	**23.18**
1985	0.51	0.26	0.92	1.78	1.09	0.39	1.21	0.24	1.67	2.32	1.1	0.73	12.22	**24.44**
1986	0.13	0.33	0.25	0.71	1.15	0.15	0.94	0.97	1.52	1.22	1.02	0.47	8.86	**17.72**
1987	0.3	1.21	1.95	0.46	1.51	0.23	1.51	0.83	0.13	0.65	1.92	0.83	11.53	**23.06**
1988	1.07	0.21	0.72	0.99	1.1	0.21	0.18	1.37	0.76	0.02	1.02	0.2	7.85	**15.7**
1989	0.98	1.33	0.51	0.23	0.39	0.24	0.27	1.01	0.33	0.14	0	0.08	5.51	**11.02**
1990	0.59	0.55	1.07	0.71	0.05	0.26	0.96	0.49	1.23	0.95	0.57	0.98	8.41	**16.82**

Driest Years In Descending Order

5th Driest	1962	12.04 "
4th Driest	1971	12 "
3rd Driest	1977	11.36 "
2nd Driest	1989	11.02 "
Driest	1976	10.54 "

Wettest Years In Descending Order

5th Wettest	1987	23.06 "
4th Wettest	1984	23.18 "
3rd Wettest	1985	24.44 "
2nd Wettest	1965	28.32 "
Wettest	1983	29.64 "

APPENDIX B

SUPPLEMENTAL UNSAT-H MODEL RESULTS

Soil A - End of Wettest Year (1983) in 5-Year Wet Cycle
UNSAT-H Input File

```
ECDC Soil A, 2.0' Cover, 5-Year "Wet" Precip.
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1,25,0,1,25,                            IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24.0,                                 NPRINT,STOPHR
0,10,1,1.0d-5,                          ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                        DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NPHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                   HIRRI,HDRY,HTOP,RHA
1,1,1,                                  IETOPT,ICLOUD,ISHOPT
1,0.10,                                 IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,              IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                  IHEAT,ICONVH,DMAXHE
0,0,0,0,                                UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                MATN,NPT
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
1,0.80,1,0.90,1,1.00,1,1.10,
1,1.20,1,1.30,1,1.40,1,1.50,
1,1.60,1,1.70,1,1.80,1,1.90,
1,2.00,1,2.25,1,2.50,1,2.75,
1,3.00,1,3.25,1,3.50,1,3.75,
1,4.00,1,4.25,1,4.50,1,4.75,
1,5.00,1,5.25,1,5.75,1,6.25,
1,6.75,1,7.25,1,7.75,1,8.25,
1,8.75,1,9.25,1,9.75,1,10.25,
1,10.50,1,10.75,1,11.00,1,11.25,
1,11.50,1,11.75,1,12.00,1,12.25,
1,12.50,1,12.75,1,13.00,1,13.25,
1,13.50,1,13.60,1,13.70,1,13.80,
1,13.90,1,14.00,1,14.10,1,14.20,
1,14.30,1,14.40,1,14.50,1,14.60,
1,14.70,1,14.80,1,14.90,1,15.00,
1,15.10,1,15.20,1,15.30,1,15.40,
1,15.50,1,15.60,1,15.70,1,15.80,
1,15.90,1,16.00,1,16.10,1,16.20,
1,16.30,1,16.40,1,16.50,1,16.60,
1,16.70,1,16.80,1,16.90,1,17.00,
1,17.10,1,17.35,1,17.60,1,17.85,
1,18.10,1,18.35,1,18.60,1,18.85,
1,19.10,1,19.35,1,19.60,1,20.10,
1,20.60,1,21.10,1,21.60,1,22.10,
1,22.60,1,23.10,1,23.60,1,24.10,
1,24.60,1,25.10,1,25.60,1,26.10,
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1,60.40,1,60.50,1,60.60,1,60.70,
1,60.80,1,60.90,1,61.00,
Soil Properties for Soil A
0.3867, 0.0000, 0.0075, 1.2359,             THES,THER,ALPHA,N
SOIL CONDUCTIVITY DATA
2.0d+0, 0.02304, 0.0075, 1.2359, 0.5,       KMOD,KSAT,ALPHA,N,EPIT
SOIL HYSTERESIS PARAMETERS
7,0.25,2.0,1000.0,                          IPATHA,SARWA,ALFACT,HYSHPH
    0,     (TOSS.OUT file for day  3.65000E+02)          NDAY (UNSAT-H V3.03)
   1.00000E+03, 1.00000E+03, 1.00000E+03, 1.00000E+03,  negative Head Values
   1.00000E+03, 1.00000E+03, 1.00000E+03, 1.00000E+03,
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0.3,1813.56,18.0,852.4,
c:/david/modeling/A_2.0_Wet_New/
year
dat
```

Soil A - End of Wettest Year (1983) in 5-Year Wet Cycle
UNSAT-H Output File

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\Modeling\A_2.0_Wet_New\input.inp
Results File: C:\david\Modeling\A_2.0_Wet_New\input0025.res
Date of Run: 11 Dec 2005
Time of Run: 15:59:19.92
Title:
ECDC Soil A, 2.0' Cover, 5-Year "Wet" Precip.

Initial Conditions					Initial Conditions				
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	4.157E+05	0.0580	290.00	2	1.000E-01	3.296E+05	0.0612	290.00
3	2.000E-01	2.493E+05	0.0654	290.00	4	3.000E-01	1.702E+05	0.0716	290.00
5	4.000E-01	9.209E+04	0.0827	290.00	6	5.000E-01	2.086E+04	0.1174	290.00
7	6.000E-01	6.770E+03	0.1529	290.00	8	7.000E-01	4.587E+03	0.1674	290.00
9	8.000E-01	3.645E+03	0.1766	290.00	10	9.000E-01	3.102E+03	0.1833	290.00
11	1.000E+00	2.743E+03	0.1886	290.00	12	1.100E+00	2.485E+03	0.1930	290.00
13	1.200E+00	2.289E+03	0.1966	290.00	14	1.300E+00	2.135E+03	0.1998	290.00
15	1.400E+00	2.010E+03	0.2026	290.00	16	1.500E+00	1.905E+03	0.2051	290.00
17	1.600E+00	1.817E+03	0.2073	290.00	18	1.700E+00	1.742E+03	0.2093	290.00
19	1.800E+00	1.676E+03	0.2111	290.00	20	1.900E+00	1.618E+03	0.2128	290.00
21	2.000E+00	1.567E+03	0.2143	290.00	22	2.250E+00	1.462E+03	0.2177	290.00
23	2.500E+00	1.380E+03	0.2205	290.00	24	2.750E+00	1.315E+03	0.2229	290.00
25	3.000E+00	1.261E+03	0.2250	290.00	26	3.250E+00	1.217E+03	0.2268	290.00
27	3.500E+00	1.179E+03	0.2284	290.00	28	3.750E+00	1.147E+03	0.2297	290.00
29	4.000E+00	1.120E+03	0.2310	290.00	30	4.250E+00	1.096E+03	0.2321	290.00
31	4.500E+00	1.075E+03	0.2331	290.00	32	4.750E+00	1.057E+03	0.2340	290.00
33	5.000E+00	1.040E+03	0.2348	290.00	34	5.250E+00	1.025E+03	0.2355	290.00
35	5.750E+00	9.999E+02	0.2368	290.00	36	6.250E+00	9.773E+02	0.2373	290.00
37	6.750E+00	9.562E+02	0.2378	290.00	38	7.250E+00	9.366E+02	0.2382	290.00
39	7.750E+00	9.182E+02	0.2386	290.00	40	8.250E+00	9.010E+02	0.2390	290.00
41	8.750E+00	8.848E+02	0.2394	290.00	42	9.250E+00	8.696E+02	0.2398	290.00
43	9.750E+00	8.554E+02	0.2401	290.00	44	1.025E+01	8.420E+02	0.2404	290.00
45	1.050E+01	8.357E+02	0.2406	290.00	46	1.075E+01	8.296E+02	0.2407	290.00
47	1.100E+01	8.237E+02	0.2409	290.00	48	1.125E+01	8.180E+02	0.2410	290.00
49	1.150E+01	8.126E+02	0.2412	290.00	50	1.175E+01	8.073E+02	0.2413	290.00
51	1.200E+01	8.023E+02	0.2414	290.00	52	1.225E+01	7.975E+02	0.2416	290.00
53	1.250E+01	7.929E+02	0.2417	290.00	54	1.275E+01	7.885E+02	0.2418	290.00
55	1.300E+01	7.842E+02	0.2419	290.00	56	1.325E+01	7.802E+02	0.2420	290.00
57	1.350E+01	7.764E+02	0.2421	290.00	58	1.360E+01	7.749E+02	0.2422	290.00
59	1.370E+01	7.735E+02	0.2422	290.00	60	1.380E+01	7.721E+02	0.2422	290.00
61	1.390E+01	7.707E+02	0.2423	290.00	62	1.400E+01	7.694E+02	0.2423	290.00
63	1.410E+01	7.680E+02	0.2423	290.00	64	1.420E+01	7.668E+02	0.2424	290.00
65	1.430E+01	7.655E+02	0.2424	290.00	66	1.440E+01	7.643E+02	0.2424	290.00
67	1.450E+01	7.631E+02	0.2425	290.00	68	1.460E+01	7.619E+02	0.2425	290.00
69	1.470E+01	7.608E+02	0.2425	290.00	70	1.480E+01	7.596E+02	0.2426	290.00
71	1.490E+01	7.586E+02	0.2426	290.00	72	1.500E+01	7.575E+02	0.2426	290.00
73	1.510E+01	7.565E+02	0.2427	290.00	74	1.520E+01	7.555E+02	0.2427	290.00
75	1.530E+01	7.545E+02	0.2427	290.00	76	1.540E+01	7.535E+02	0.2427	290.00
77	1.550E+01	7.526E+02	0.2428	290.00	78	1.560E+01	7.517E+02	0.2428	290.00
79	1.570E+01	7.508E+02	0.2428	290.00	80	1.580E+01	7.500E+02	0.2428	290.00
81	1.590E+01	7.492E+02	0.2428	290.00	82	1.600E+01	7.484E+02	0.2429	290.00
83	1.610E+01	7.476E+02	0.2429	290.00	84	1.620E+01	7.469E+02	0.2429	290.00
85	1.630E+01	7.462E+02	0.2429	290.00	86	1.640E+01	7.455E+02	0.2430	290.00
87	1.650E+01	7.448E+02	0.2430	290.00	88	1.660E+01	7.442E+02	0.2430	290.00
89	1.670E+01	7.435E+02	0.2430	290.00	90	1.680E+01	7.429E+02	0.2430	290.00
91	1.690E+01	7.424E+02	0.2430	290.00	92	1.700E+01	7.418E+02	0.2431	290.00
93	1.710E+01	7.413E+02	0.2431	290.00	94	1.735E+01	7.400E+02	0.2431	290.00
95	1.760E+01	7.389E+02	0.2431	290.00	96	1.785E+01	7.380E+02	0.2432	290.00
97	1.810E+01	7.371E+02	0.2432	290.00	98	1.835E+01	7.364E+02	0.2432	290.00
99	1.860E+01	7.358E+02	0.2432	290.00	100	1.885E+01	7.353E+02	0.2432	290.00
101	1.910E+01	7.349E+02	0.2432	290.00	102	1.935E+01	7.347E+02	0.2432	290.00
103	1.960E+01	7.345E+02	0.2432	290.00	104	2.010E+01	7.344E+02	0.2432	290.00
105	2.060E+01	7.347E+02	0.2432	290.00	106	2.110E+01	7.353E+02	0.2432	290.00
107	2.160E+01	7.362E+02	0.2432	290.00	108	2.210E+01	7.374E+02	0.2431	290.00
109	2.260E+01	7.389E+02	0.2431	290.00	110	2.310E+01	7.405E+02	0.2430	290.00
111	2.360E+01	7.424E+02	0.2430	290.00	112	2.410E+01	7.444E+02	0.2429	290.00
113	2.460E+01	7.466E+02	0.2429	290.00	114	2.510E+01	7.489E+02	0.2428	290.00
115	2.560E+01	7.513E+02	0.2427	290.00	116	2.610E+01	7.539E+02	0.2427	290.00
117	2.660E+01	7.565E+02	0.2426	290.00	118	2.710E+01	7.591E+02	0.2425	290.00
119	2.760E+01	7.618E+02	0.2424	290.00	120	2.810E+01	7.646E+02	0.2424	290.00
121	2.860E+01	7.674E+02	0.2423	290.00	122	2.910E+01	7.701E+02	0.2422	290.00
123	2.960E+01	7.729E+02	0.2421	290.00	124	3.010E+01	7.757E+02	0.2420	290.00
125	3.060E+01	7.784E+02	0.2420	290.00	126	3.110E+01	7.811E+02	0.2419	290.00
127	3.160E+01	7.838E+02	0.2418	290.00	128	3.210E+01	7.864E+02	0.2418	290.00
129	3.260E+01	7.890E+02	0.2417	290.00	130	3.310E+01	7.915E+02	0.2416	290.00
131	3.360E+01	7.940E+02	0.2416	290.00	132	3.410E+01	7.964E+02	0.2415	290.00
133	3.460E+01	7.987E+02	0.2414	290.00	134	3.510E+01	8.010E+02	0.2414	290.00
135	3.560E+01	8.032E+02	0.2413	290.00	136	3.610E+01	8.053E+02	0.2413	290.00
137	3.660E+01	8.074E+02	0.2412	290.00	138	3.710E+01	8.094E+02	0.2411	290.00
139	3.760E+01	8.113E+02	0.2411	290.00	140	3.810E+01	8.131E+02	0.2411	290.00
141	3.860E+01	8.149E+02	0.2410	290.00	142	3.910E+01	8.166E+02	0.2410	290.00
143	3.960E+01	8.182E+02	0.2409	290.00	144	4.010E+01	8.198E+02	0.2409	290.00
145	4.060E+01	8.213E+02	0.2408	290.00	146	4.110E+01	8.227E+02	0.2408	290.00
147	4.160E+01	8.241E+02	0.2408	290.00	148	4.210E+01	8.254E+02	0.2407	290.00
149	4.260E+01	8.267E+02	0.2407	290.00	150	4.310E+01	8.278E+02	0.2407	290.00
151	4.360E+01	8.290E+02	0.2406	290.00	152	4.410E+01	8.301E+02	0.2406	290.00
153	4.460E+01	8.311E+02	0.2406	290.00	154	4.510E+01	8.321E+02	0.2406	290.00
155	4.560E+01	8.331E+02	0.2405	290.00	156	4.610E+01	8.340E+02	0.2405	290.00
157	4.660E+01	8.348E+02	0.2405	290.00	158	4.710E+01	8.356E+02	0.2405	290.00
159	4.760E+01	8.364E+02	0.2405	290.00	160	4.810E+01	8.372E+02	0.2404	290.00
161	4.860E+01	8.379E+02	0.2404	290.00	162	4.910E+01	8.385E+02	0.2404	290.00
163	4.960E+01	8.392E+02	0.2404	290.00	164	5.010E+01	8.398E+02	0.2404	290.00
165	5.060E+01	8.403E+02	0.2404	290.00	166	5.110E+01	8.409E+02	0.2403	290.00

167	5.160E+01	8.414E+02	0.2403	290.00	168	5.210E+01	8.418E+02	0.2403	290.00
169	5.260E+01	8.423E+02	0.2403	290.00	170	5.310E+01	8.427E+02	0.2403	290.00
171	5.360E+01	8.431E+02	0.2403	290.00	172	5.410E+01	8.434E+02	0.2403	290.00
173	5.460E+01	8.438E+02	0.2403	290.00	174	5.510E+01	8.441E+02	0.2403	290.00
175	5.560E+01	8.444E+02	0.2403	290.00	176	5.585E+01	8.445E+02	0.2403	290.00
177	5.610E+01	8.446E+02	0.2403	290.00	178	5.635E+01	8.447E+02	0.2403	290.00
179	5.660E+01	8.449E+02	0.2402	290.00	180	5.685E+01	8.450E+02	0.2402	290.00
181	5.710E+01	8.451E+02	0.2402	290.00	182	5.735E+01	8.452E+02	0.2402	290.00
183	5.760E+01	8.452E+02	0.2402	290.00	184	5.785E+01	8.453E+02	0.2402	290.00
185	5.810E+01	8.454E+02	0.2402	290.00	186	5.835E+01	8.455E+02	0.2402	290.00
187	5.860E+01	8.455E+02	0.2402	290.00	188	5.870E+01	8.455E+02	0.2402	290.00
189	5.880E+01	8.456E+02	0.2402	290.00	190	5.890E+01	8.456E+02	0.2402	290.00
191	5.900E+01	8.456E+02	0.2402	290.00	192	5.910E+01	8.456E+02	0.2402	290.00
193	5.920E+01	8.456E+02	0.2402	290.00	194	5.930E+01	8.457E+02	0.2402	290.00
195	5.940E+01	8.457E+02	0.2402	290.00	196	5.950E+01	8.457E+02	0.2402	290.00
197	5.960E+01	8.457E+02	0.2402	290.00	198	5.970E+01	8.457E+02	0.2402	290.00
199	5.980E+01	8.457E+02	0.2402	290.00	200	5.990E+01	8.457E+02	0.2402	290.00
201	6.000E+01	8.458E+02	0.2402	290.00	202	6.010E+01	8.458E+02	0.2402	290.00
203	6.020E+01	8.458E+02	0.2402	290.00	204	6.030E+01	8.458E+02	0.2402	290.00
205	6.040E+01	8.458E+02	0.2402	290.00	206	6.050E+01	8.458E+02	0.2402	290.00
207	6.060E+01	8.458E+02	0.2402	290.00	208	6.070E+01	8.458E+02	0.2402	290.00
209	6.080E+01	8.458E+02	0.2402	290.00	210	6.090E+01	8.458E+02	0.2402	290.00
211	6.100E+01	8.458E+02	0.2402	290.00					

Initial Water Storage = 14.5108 cm

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)= 9.39999E-08
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
14.5108+	0.0000+	0.0000 -	0.0427-	0.0000-	0.0001 =	14.4680 vs.	14.4680

Mass Balance = -8.0122E-05 cm; Time step attempts = 34 and successes = 30
Evaporation: Potential = 0.1180 cm, Actual = 0.0427 cm
RHMEAN = 52.5 %; TMEAN = 270.1 K; HDRY = 8.8140E+05 cm; DAYUBC = 16

DAILY SUMMARY: Day = 365, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)= 4.01690E-07
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
15.3193+	0.0000+	0.0000 -	0.0697-	0.0000-	0.0001 =	15.2495 vs.	15.2495

Mass Balance = -4.3653E-05 cm; Time step attempts = 134 and successes = 101
Evaporation: Potential = 0.0697 cm, Actual = 0.0697 cm
RHMEAN = 71.2 %; TMEAN = 269.0 K; HDRY = 4.6466E+05 cm; DAYUBC = 0
1

UNSAT-H Version 3.01
SIMULATION SUMMARY

Title:
ECDC Soil A, 2.0' Cover, 5-Year "Wet" Precip.

Transpiration Scheme is:	=	0	
Potential Evapotranspiration	=	1.6927E+02	[cm]
Potential Transpiration	=	0.0000E+00	[cm]
Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	1.6927E+02	[cm]
Actual Evaporation	=	2.5232E+01	[cm]
Evaporation during Growth	=	0.0000E+00	[cm]
Total Runoff	=	4.8628E+01	[cm]
Total Infiltration	=	2.6048E+01	[cm]
Total Basal Liquid Flux (drainage)	=	4.4005E-02	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	7.4676E+01	[cm]
Actual Rainfall	=	7.4676E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	1.5249E+01	[cm]
Mass Balance Error	=	3.3321E-02	[cm]
Total Successful Time Steps	=	87583	
Total Attempted Time Steps	=	103171	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32452	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	8.1607E-01	0.050	1.7802E+01	0.150	1.3606E+01
0.250	1.1210E+01	0.350	9.5283E+00	0.450	8.1520E+00
0.550	6.9814E+00	0.650	5.9808E+00	0.750	5.0765E+00
0.850	4.3177E+00	0.950	3.6152E+00	1.050	3.0141E+00
1.150	2.5529E+00	1.250	2.1644E+00	1.350	1.8176E+00
1.450	1.5460E+00	1.550	1.3603E+00	1.650	1.2042E+00
1.750	1.0677E+00	1.850	9.6922E-01	1.950	8.8872E-01
2.125	7.8432E-01	2.375	6.6724E-01	2.625	6.2684E-01
2.875	6.1385E-01	3.125	6.0344E-01	3.375	5.9373E-01
3.625	5.8434E-01	3.875	5.7498E-01	4.125	5.6570E-01
4.375	5.5651E-01	4.625	5.4738E-01	4.875	5.3824E-01
5.125	5.2910E-01	5.500	5.1543E-01	6.000	4.9722E-01
6.500	4.7881E-01	7.000	4.6030E-01	7.500	4.4178E-01
8.000	4.2336E-01	8.500	4.0511E-01	9.000	3.8712E-01
9.500	3.6942E-01	10.000	3.5210E-01	10.375	3.3943E-01
10.625	3.3110E-01	10.875	3.2288E-01	11.125	3.1477E-01
11.375	3.0678E-01	11.625	2.9892E-01	11.875	2.9119E-01
12.125	2.8360E-01	12.375	2.7612E-01	12.625	2.6880E-01
12.875	2.6160E-01	13.125	2.5454E-01	13.375	2.4763E-01
13.550	2.4290E-01	13.650	2.4022E-01	13.750	2.3757E-01
13.850	2.3493E-01	13.950	2.3233E-01	14.050	2.2975E-01
14.150	2.2719E-01	14.250	2.2466E-01	14.350	2.2215E-01
14.450	2.1967E-01	14.550	2.1721E-01	14.650	2.1477E-01
14.750	2.1236E-01	14.850	2.0998E-01	14.950	2.0762E-01
15.050	2.0528E-01	15.150	2.0297E-01	15.250	2.0068E-01
15.350	1.9843E-01	15.450	1.9619E-01	15.550	1.9398E-01
15.650	1.9180E-01	15.750	1.8964E-01	15.850	1.8751E-01
15.950	1.8541E-01	16.050	1.8333E-01	16.150	1.8128E-01
16.250	1.7925E-01	16.350	1.7725E-01	16.450	1.7528E-01
16.550	1.7333E-01	16.650	1.7141E-01	16.750	1.6951E-01
16.850	1.6764E-01	16.950	1.6580E-01	17.050	1.6399E-01
17.225	1.6086E-01	17.475	1.5655E-01	17.725	1.5240E-01
17.975	1.4843E-01	18.225	1.4461E-01	18.475	1.4096E-01
18.725	1.3746E-01	18.975	1.3412E-01	19.225	1.3094E-01
19.475	1.2791E-01	19.850	1.2358E-01	20.350	1.1838E-01
20.850	1.1371E-01	21.350	1.0954E-01	21.850	1.0583E-01
22.350	1.0254E-01	22.850	9.9638E-02	23.350	9.7076E-02
23.850	9.4819E-02	24.350	9.2833E-02	24.850	9.1085E-02
25.350	8.9543E-02	25.850	8.8179E-02	26.350	8.6968E-02
26.850	8.5886E-02	27.350	8.4913E-02	27.850	8.4031E-02
28.350	8.3224E-02	28.850	8.2478E-02	29.350	8.1781E-02
29.850	8.1124E-02	30.350	8.0496E-02	30.850	7.9892E-02
31.350	7.9305E-02	31.850	7.8730E-02	32.350	7.8164E-02
32.850	7.7602E-02	33.350	7.7042E-02	33.850	7.6482E-02
34.350	7.5921E-02	34.850	7.5357E-02	35.350	7.4791E-02
35.850	7.4221E-02	36.350	7.3646E-02	36.850	7.3068E-02
37.350	7.2486E-02	37.850	7.1900E-02	38.350	7.1311E-02
38.850	7.0718E-02	39.350	7.0123E-02	39.850	6.9525E-02
40.350	6.8924E-02	40.850	6.8322E-02	41.350	6.7719E-02
41.850	6.7114E-02	42.350	6.6508E-02	42.850	6.5901E-02
43.350	6.5294E-02	43.850	6.4686E-02	44.350	6.4079E-02
44.850	6.3471E-02	45.350	6.2864E-02	45.850	6.2257E-02
46.350	6.1650E-02	46.850	6.1044E-02	47.350	6.0438E-02
47.850	5.9833E-02	48.350	5.9228E-02	48.850	5.8624E-02
49.350	5.8020E-02	49.850	5.7417E-02	50.350	5.6814E-02
50.850	5.6211E-02	51.350	5.5609E-02	51.850	5.5007E-02
52.350	5.4405E-02	52.850	5.3804E-02	53.350	5.3202E-02
53.850	5.2601E-02	54.350	5.2000E-02	54.850	5.1399E-02
55.350	5.0798E-02	55.725	5.0347E-02	55.975	5.0047E-02
56.225	4.9746E-02	56.475	4.9446E-02	56.725	4.9145E-02
56.975	4.8845E-02	57.225	4.8544E-02	57.475	4.8244E-02
57.725	4.7943E-02	57.975	4.7643E-02	58.225	4.7342E-02
58.475	4.7041E-02	58.650	4.6831E-02	58.750	4.6711E-02
58.850	4.6590E-02	58.950	4.6470E-02	59.050	4.6350E-02
59.150	4.6230E-02	59.250	4.6109E-02	59.350	4.5989E-02
59.450	4.5869E-02	59.550	4.5749E-02	59.650	4.5628E-02
59.750	4.5508E-02	59.850	4.5388E-02	59.950	4.5268E-02
60.050	4.5147E-02	60.150	4.5027E-02	60.250	4.4907E-02
60.350	4.4787E-02	60.450	4.4666E-02	60.550	4.4546E-02
60.650	4.4426E-02	60.750	4.4306E-02	60.850	4.4185E-02
60.950	4.4065E-02	61.000	4.4005E-02		

Soil A - End of Driest Year (1976) in 5-Year Dry Cycle
UNSAT-H Input File

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ECDC Soil A, 2.0' Cover, 5-Year "Dry" Precip.
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1,25,0,1,25,                            IYS,NYEARS,ISTEAD,IPLIST,NPLIST
0,24.0,                                 NPRINT,STOPHR
0,10,1,1.0d-5,                          ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                        DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                   HIRRI,HDRY,HTOP,RHA
1,1,1,                                  IETOPT,ICLOUD,ISHOPT
1,0.10,                                 IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,              IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                  IHEAT,ICONVH,DMAXHE
0,0,0,0,                                UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                MATN,NPT
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
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1,60.80,1,60.90,1,61.00,
Soil Properties for Soil A
0.3867, 0.0000, 0.0075, 1.2359,         THES,THER,ALPHA,N
SOIL CONDUCTIVITY DATA
2.0d+0, 0.02304, 0.0075, 1.2359, 0.5,   KMOD,KSAT,ALPHA,N,EPIT
SOIL HYSTERESIS PARAMETERS
7,0.25,2.0,1000.0,                      IPATHA,SARWA,ALFACT,HYSHPH
    0,    (TOSS.OUT file for day  3.65000E+02)          NDAY (UNSAT-H V3.03)
   1.00000E+03, 1.00000E+03, 1.00000E+03, 1.00000E+03,  negative Head Values
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year
dat
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Soil A - End of Driest Year (1976) in 5-Year Dry Cycle
UNSAT-H Output File

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\David\modeling\A_2.0_Dry_New\input.inp
Results File: N:\DATA\PROJECTS\203050 - Allied - ECDC AFC\AFC Comment Response
Date of Run: 11 Dec 2005
Time of Run: 16:38:38.34
Title:
ECDC Soil A, 2.0' Cover, 5-Year "Dry" Precip.

	Initial Conditions					Initial Conditions			
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.780E+05	0.0474	290.00	2	1.000E-01	9.513E+05	0.0477	290.00
3	2.000E-01	9.252E+05	0.0480	290.00	4	3.000E-01	8.995E+05	0.0483	290.00
5	4.000E-01	8.743E+05	0.0486	290.00	6	5.000E-01	8.496E+05	0.0490	290.00
7	6.000E-01	8.253E+05	0.0493	290.00	8	7.000E-01	8.014E+05	0.0497	290.00
9	8.000E-01	7.780E+05	0.0500	290.00	10	9.000E-01	7.550E+05	0.0504	290.00
11	1.000E+00	7.324E+05	0.0507	290.00	12	1.100E+00	7.102E+05	0.0511	290.00
13	1.200E+00	6.884E+05	0.0515	290.00	14	1.300E+00	6.669E+05	0.0518	290.00
15	1.400E+00	6.459E+05	0.0522	290.00	16	1.500E+00	6.252E+05	0.0526	290.00
17	1.600E+00	6.049E+05	0.0531	290.00	18	1.700E+00	5.850E+05	0.0535	290.00
19	1.800E+00	5.654E+05	0.0539	290.00	20	1.900E+00	5.462E+05	0.0544	290.00
21	2.000E+00	5.273E+05	0.0548	290.00	22	2.250E+00	4.816E+05	0.0560	290.00
23	2.500E+00	4.380E+05	0.0573	290.00	24	2.750E+00	3.964E+05	0.0586	290.00
25	3.000E+00	3.568E+05	0.0601	290.00	26	3.250E+00	3.191E+05	0.0617	290.00
27	3.500E+00	2.834E+05	0.0634	290.00	28	3.750E+00	2.495E+05	0.0654	290.00
29	4.000E+00	2.175E+05	0.0675	290.00	30	4.250E+00	1.872E+05	0.0700	290.00
31	4.500E+00	1.588E+05	0.0727	290.00	32	4.750E+00	1.322E+05	0.0759	290.00
33	5.000E+00	1.075E+05	0.0798	290.00	34	5.250E+00	8.462E+04	0.0844	290.00
35	5.750E+00	4.525E+04	0.0978	290.00	36	6.250E+00	1.963E+04	0.1191	290.00
37	6.750E+00	1.059E+04	0.1377	290.00	38	7.250E+00	7.498E+03	0.1493	290.00
39	7.750E+00	5.997E+03	0.1573	290.00	40	8.250E+00	5.104E+03	0.1633	290.00
41	8.750E+00	4.507E+03	0.1681	290.00	42	9.250E+00	4.078E+03	0.1721	290.00
43	9.750E+00	3.754E+03	0.1754	290.00	44	1.025E+01	3.500E+03	0.1783	290.00
45	1.050E+01	3.392E+03	0.1796	290.00	46	1.075E+01	3.294E+03	0.1808	290.00
47	1.100E+01	3.206E+03	0.1820	290.00	48	1.125E+01	3.125E+03	0.1830	290.00
49	1.150E+01	3.051E+03	0.1841	290.00	50	1.175E+01	2.982E+03	0.1850	290.00
51	1.200E+01	2.919E+03	0.1859	290.00	52	1.225E+01	2.861E+03	0.1868	290.00
53	1.250E+01	2.806E+03	0.1876	290.00	54	1.275E+01	2.756E+03	0.1884	290.00
55	1.300E+01	2.708E+03	0.1892	290.00	56	1.325E+01	2.664E+03	0.1899	290.00
57	1.350E+01	2.622E+03	0.1906	290.00	58	1.360E+01	2.606E+03	0.1909	290.00
59	1.370E+01	2.591E+03	0.1911	290.00	60	1.380E+01	2.576E+03	0.1914	290.00
61	1.390E+01	2.561E+03	0.1916	290.00	62	1.400E+01	2.546E+03	0.1919	290.00
63	1.410E+01	2.532E+03	0.1921	290.00	64	1.420E+01	2.518E+03	0.1924	290.00
65	1.430E+01	2.505E+03	0.1926	290.00	66	1.440E+01	2.491E+03	0.1929	290.00
67	1.450E+01	2.478E+03	0.1931	290.00	68	1.460E+01	2.466E+03	0.1933	290.00
69	1.470E+01	2.453E+03	0.1935	290.00	70	1.480E+01	2.441E+03	0.1938	290.00
71	1.490E+01	2.429E+03	0.1940	290.00	72	1.500E+01	2.418E+03	0.1942	290.00
73	1.510E+01	2.406E+03	0.1944	290.00	74	1.520E+01	2.395E+03	0.1946	290.00
75	1.530E+01	2.384E+03	0.1948	290.00	76	1.540E+01	2.373E+03	0.1950	290.00
77	1.550E+01	2.363E+03	0.1952	290.00	78	1.560E+01	2.353E+03	0.1954	290.00
79	1.570E+01	2.342E+03	0.1956	290.00	80	1.580E+01	2.333E+03	0.1958	290.00
81	1.590E+01	2.323E+03	0.1960	290.00	82	1.600E+01	2.313E+03	0.1962	290.00
83	1.610E+01	2.304E+03	0.1964	290.00	84	1.620E+01	2.295E+03	0.1965	290.00
85	1.630E+01	2.286E+03	0.1967	290.00	86	1.640E+01	2.277E+03	0.1969	290.00
87	1.650E+01	2.268E+03	0.1971	290.00	88	1.660E+01	2.259E+03	0.1972	290.00
89	1.670E+01	2.251E+03	0.1974	290.00	90	1.680E+01	2.243E+03	0.1976	290.00
91	1.690E+01	2.235E+03	0.1977	290.00	92	1.700E+01	2.227E+03	0.1979	290.00
93	1.710E+01	2.219E+03	0.1980	290.00	94	1.735E+01	2.200E+03	0.1984	290.00
95	1.760E+01	2.182E+03	0.1988	290.00	96	1.785E+01	2.164E+03	0.1992	290.00
97	1.810E+01	2.147E+03	0.1995	290.00	98	1.835E+01	2.131E+03	0.1999	290.00
99	1.860E+01	2.116E+03	0.2002	290.00	100	1.885E+01	2.101E+03	0.2005	290.00
101	1.910E+01	2.086E+03	0.2009	290.00	102	1.935E+01	2.072E+03	0.2012	290.00
103	1.960E+01	2.059E+03	0.2015	290.00	104	2.010E+01	2.034E+03	0.2020	290.00
105	2.060E+01	2.010E+03	0.2026	290.00	106	2.110E+01	1.988E+03	0.2031	290.00
107	2.160E+01	1.968E+03	0.2036	290.00	108	2.210E+01	1.948E+03	0.2040	290.00
109	2.260E+01	1.930E+03	0.2044	290.00	110	2.310E+01	1.913E+03	0.2049	290.00
111	2.360E+01	1.897E+03	0.2052	290.00	112	2.410E+01	1.882E+03	0.2056	290.00
113	2.460E+01	1.868E+03	0.2060	290.00	114	2.510E+01	1.855E+03	0.2063	290.00
115	2.560E+01	1.843E+03	0.2066	290.00	116	2.610E+01	1.831E+03	0.2069	290.00
117	2.660E+01	1.820E+03	0.2072	290.00	118	2.710E+01	1.809E+03	0.2075	290.00
119	2.760E+01	1.800E+03	0.2077	290.00	120	2.810E+01	1.790E+03	0.2080	290.00
121	2.860E+01	1.781E+03	0.2082	290.00	122	2.910E+01	1.773E+03	0.2084	290.00
123	2.960E+01	1.765E+03	0.2086	290.00	124	3.010E+01	1.758E+03	0.2088	290.00
125	3.060E+01	1.751E+03	0.2090	290.00	126	3.110E+01	1.744E+03	0.2092	290.00
127	3.160E+01	1.738E+03	0.2094	290.00	128	3.210E+01	1.732E+03	0.2095	290.00
129	3.260E+01	1.727E+03	0.2097	290.00	130	3.310E+01	1.722E+03	0.2098	290.00
131	3.360E+01	1.717E+03	0.2100	290.00	132	3.410E+01	1.712E+03	0.2101	290.00
133	3.460E+01	1.708E+03	0.2102	290.00	134	3.510E+01	1.704E+03	0.2103	290.00
135	3.560E+01	1.700E+03	0.2104	290.00	136	3.610E+01	1.697E+03	0.2105	290.00
137	3.660E+01	1.693E+03	0.2106	290.00	138	3.710E+01	1.690E+03	0.2107	290.00
139	3.760E+01	1.687E+03	0.2108	290.00	140	3.810E+01	1.685E+03	0.2109	290.00
141	3.860E+01	1.682E+03	0.2109	290.00	142	3.910E+01	1.680E+03	0.2110	290.00
143	3.960E+01	1.678E+03	0.2110	290.00	144	4.010E+01	1.676E+03	0.2111	290.00
145	4.060E+01	1.674E+03	0.2112	290.00	146	4.110E+01	1.672E+03	0.2112	290.00
147	4.160E+01	1.671E+03	0.2112	290.00	148	4.210E+01	1.669E+03	0.2113	290.00
149	4.260E+01	1.668E+03	0.2113	290.00	150	4.310E+01	1.667E+03	0.2114	290.00
151	4.360E+01	1.666E+03	0.2114	290.00	152	4.410E+01	1.665E+03	0.2114	290.00
153	4.460E+01	1.664E+03	0.2114	290.00	154	4.510E+01	1.663E+03	0.2115	290.00
155	4.560E+01	1.663E+03	0.2115	290.00	156	4.610E+01	1.662E+03	0.2115	290.00
157	4.660E+01	1.662E+03	0.2115	290.00	158	4.710E+01	1.661E+03	0.2115	290.00
159	4.760E+01	1.661E+03	0.2115	290.00	160	4.810E+01	1.661E+03	0.2115	290.00
161	4.860E+01	1.661E+03	0.2115	290.00	162	4.910E+01	1.660E+03	0.2115	290.00
163	4.960E+01	1.660E+03	0.2116	290.00	164	5.010E+01	1.660E+03	0.2116	290.00
165	5.060E+01	1.660E+03	0.2116	290.00	166	5.110E+01	1.660E+03	0.2116	290.00

167	5.160E+01	1.660E+03	0.2116	290.00	168	5.210E+01	1.660E+03	0.2116	290.00
169	5.260E+01	1.660E+03	0.2116	290.00	170	5.310E+01	1.660E+03	0.2116	290.00
171	5.360E+01	1.660E+03	0.2115	290.00	172	5.410E+01	1.660E+03	0.2115	290.00
173	5.460E+01	1.661E+03	0.2115	290.00	174	5.510E+01	1.661E+03	0.2115	290.00
175	5.560E+01	1.661E+03	0.2115	290.00	176	5.585E+01	1.661E+03	0.2115	290.00
177	5.610E+01	1.661E+03	0.2115	290.00	178	5.635E+01	1.661E+03	0.2115	290.00
179	5.660E+01	1.661E+03	0.2115	290.00	180	5.685E+01	1.661E+03	0.2115	290.00
181	5.710E+01	1.661E+03	0.2115	290.00	182	5.735E+01	1.661E+03	0.2115	290.00
183	5.760E+01	1.661E+03	0.2115	290.00	184	5.785E+01	1.661E+03	0.2115	290.00
185	5.810E+01	1.661E+03	0.2115	290.00	186	5.835E+01	1.661E+03	0.2115	290.00
187	5.860E+01	1.661E+03	0.2115	290.00	188	5.870E+01	1.661E+03	0.2115	290.00
189	5.880E+01	1.661E+03	0.2115	290.00	190	5.890E+01	1.661E+03	0.2115	290.00
191	5.900E+01	1.661E+03	0.2115	290.00	192	5.910E+01	1.661E+03	0.2115	290.00
193	5.920E+01	1.661E+03	0.2115	290.00	194	5.930E+01	1.661E+03	0.2115	290.00
195	5.940E+01	1.661E+03	0.2115	290.00	196	5.950E+01	1.661E+03	0.2115	290.00
197	5.960E+01	1.661E+03	0.2115	290.00	198	5.970E+01	1.661E+03	0.2115	290.00
199	5.980E+01	1.661E+03	0.2115	290.00	200	5.990E+01	1.661E+03	0.2115	290.00
201	6.000E+01	1.661E+03	0.2115	290.00	202	6.010E+01	1.661E+03	0.2115	290.00
203	6.020E+01	1.661E+03	0.2115	290.00	204	6.030E+01	1.661E+03	0.2115	290.00
205	6.040E+01	1.661E+03	0.2115	290.00	206	6.050E+01	1.661E+03	0.2115	290.00
207	6.060E+01	1.661E+03	0.2115	290.00	208	6.070E+01	1.662E+03	0.2115	290.00
209	6.080E+01	1.662E+03	0.2115	290.00	210	6.090E+01	1.662E+03	0.2115	290.00
211	6.100E+01	1.662E+03	0.2115	290.00					

Initial Water Storage = 11.5370 cm

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)=-6.08176E-07
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
11.5370+	0.0000+	0.0000	- 0.0000-	0.0000-	0.0000 =	11.5369 vs.	11.5369

Mass Balance = -9.8045E-08 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.0534 cm, Actual = 0.0000 cm
RHMEAN = 81.7 %; TMEAN = 259.0 K; HDRY = 2.7524E+05 cm; DAYUBC = 0

DAILY SUMMARY: Day = 365, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)=-7.07900E-07
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
11.2770+	0.0000+	0.0000	- 0.0085-	0.0000-	0.0000 =	11.2685 vs.	11.2685

Mass Balance = 5.6062E-08 cm; Time step attempts = 24 and successes = 24
Evaporation: Potential = 0.1293 cm, Actual = 0.0085 cm
RHMEAN = 33.5 %; TMEAN = 268.7 K; HDRY = 1.4935E+06 cm; DAYUBC = 24
1

UNSAT-H Version 3.01
SIMULATION SUMMARY

Title:
ECDC Soil A, 2.0' Cover, 5-Year "Dry" Precip.

Transpiration Scheme is:	=	0	
Potential Evapotranspiration	=	1.7757E+02	[cm]
Potential Transpiration	=	0.0000E+00	[cm]
Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	1.7757E+02	[cm]
Actual Evaporation	=	1.4035E+01	[cm]
Evaporation during Growth	=	0.0000E+00	[cm]
Total Runoff	=	1.2355E+01	[cm]
Total Infiltration	=	1.3807E+01	[cm]
Total Basal Liquid Flux (drainage)	=	9.5659E-03	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	2.6162E+01	[cm]
Actual Rainfall	=	2.6162E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	1.1268E+01	[cm]
Mass Balance Error	=	3.0569E-02	[cm]
Total Successful Time Steps	=	69244	
Total Attempted Time Steps	=	78998	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	24147	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.2837E-01	0.050	1.0980E+01	0.150	9.3076E+00
0.250	8.1817E+00	0.350	7.3192E+00	0.450	6.6407E+00
0.550	6.0533E+00	0.650	5.5260E+00	0.750	5.0571E+00
0.850	4.6347E+00	0.950	4.2449E+00	1.050	3.8940E+00
1.150	3.5589E+00	1.250	3.2204E+00	1.350	2.8710E+00
1.450	2.5708E+00	1.550	2.3444E+00	1.650	2.1740E+00
1.750	2.0320E+00	1.850	1.9077E+00	1.950	1.7926E+00
2.125	1.6261E+00	2.375	1.3809E+00	2.625	1.1616E+00
2.875	9.4907E-01	3.125	8.0089E-01	3.375	6.8327E-01
3.625	5.8381E-01	3.875	4.7601E-01	4.125	3.8060E-01
4.375	3.0494E-01	4.625	2.2915E-01	4.875	1.5360E-01
5.125	8.4320E-02	5.500	1.0199E-02	6.000	-7.3152E-02
6.500	-1.5049E-01	7.000	-1.8135E-01	7.500	-1.8989E-01
8.000	-1.9344E-01	8.500	-1.9522E-01	9.000	-1.9612E-01
9.500	-1.9647E-01	10.000	-1.9641E-01	10.375	-1.9615E-01
10.625	-1.9590E-01	10.875	-1.9559E-01	11.125	-1.9521E-01
11.375	-1.9479E-01	11.625	-1.9432E-01	11.875	-1.9380E-01
12.125	-1.9324E-01	12.375	-1.9264E-01	12.625	-1.9200E-01
12.875	-1.9132E-01	13.125	-1.9061E-01	13.375	-1.8987E-01
13.550	-1.8932E-01	13.650	-1.8901E-01	13.750	-1.8869E-01
13.850	-1.8837E-01	13.950	-1.8804E-01	14.050	-1.8770E-01
14.150	-1.8737E-01	14.250	-1.8702E-01	14.350	-1.8668E-01
14.450	-1.8633E-01	14.550	-1.8597E-01	14.650	-1.8562E-01
14.750	-1.8525E-01	14.850	-1.8489E-01	14.950	-1.8452E-01
15.050	-1.8414E-01	15.150	-1.8377E-01	15.250	-1.8338E-01
15.350	-1.8300E-01	15.450	-1.8261E-01	15.550	-1.8222E-01
15.650	-1.8183E-01	15.750	-1.8143E-01	15.850	-1.8103E-01
15.950	-1.8062E-01	16.050	-1.8021E-01	16.150	-1.7980E-01
16.250	-1.7939E-01	16.350	-1.7897E-01	16.450	-1.7855E-01
16.550	-1.7813E-01	16.650	-1.7770E-01	16.750	-1.7728E-01
16.850	-1.7685E-01	16.950	-1.7641E-01	17.050	-1.7597E-01
17.225	-1.7521E-01	17.475	-1.7409E-01	17.725	-1.7296E-01
17.975	-1.7182E-01	18.225	-1.7066E-01	18.475	-1.6949E-01
18.725	-1.6831E-01	18.975	-1.6712E-01	19.225	-1.6591E-01
19.475	-1.6469E-01	19.850	-1.6285E-01	20.350	-1.6036E-01
20.850	-1.5783E-01	21.350	-1.5527E-01	21.850	-1.5268E-01
22.350	-1.5007E-01	22.850	-1.4744E-01	23.350	-1.4479E-01
23.850	-1.4213E-01	24.350	-1.3946E-01	24.850	-1.3677E-01
25.350	-1.3408E-01	25.850	-1.3139E-01	26.350	-1.2869E-01
26.850	-1.2599E-01	27.350	-1.2330E-01	27.850	-1.2061E-01
28.350	-1.1793E-01	28.850	-1.1525E-01	29.350	-1.1259E-01
29.850	-1.0993E-01	30.350	-1.0729E-01	30.850	-1.0466E-01
31.350	-1.0204E-01	31.850	-9.9446E-02	32.350	-9.6866E-02
32.850	-9.4304E-02	33.350	-9.1762E-02	33.850	-8.9240E-02
34.350	-8.6740E-02	34.850	-8.4262E-02	35.350	-8.1807E-02
35.850	-7.9376E-02	36.350	-7.6969E-02	36.850	-7.4588E-02
37.350	-7.2233E-02	37.850	-6.9904E-02	38.350	-6.7602E-02
38.850	-6.5327E-02	39.350	-6.3080E-02	39.850	-6.0861E-02
40.350	-5.8671E-02	40.850	-5.6510E-02	41.350	-5.4377E-02
41.850	-5.2274E-02	42.350	-5.0200E-02	42.850	-4.8155E-02
43.350	-4.6140E-02	43.850	-4.4154E-02	44.350	-4.2197E-02
44.850	-4.0270E-02	45.350	-3.8372E-02	45.850	-3.6503E-02
46.350	-3.4663E-02	46.850	-3.2850E-02	47.350	-3.1066E-02
47.850	-2.9310E-02	48.350	-2.7580E-02	48.850	-2.5877E-02
49.350	-2.4200E-02	49.850	-2.2549E-02	50.350	-2.0922E-02
50.850	-1.9319E-02	51.350	-1.7740E-02	51.850	-1.6183E-02
52.350	-1.4648E-02	52.850	-1.3133E-02	53.350	-1.1638E-02
53.850	-1.0162E-02	54.350	-8.7037E-03	54.850	-7.2621E-03
55.350	-5.8360E-03	55.725	-4.7773E-03	55.975	-4.0749E-03
56.225	-3.3757E-03	56.475	-2.6797E-03	56.725	-1.9866E-03
56.975	-1.2962E-03	57.225	-6.0854E-04	57.475	7.6668E-05
57.725	7.5955E-04	57.975	1.4403E-03	58.225	2.1190E-03
58.475	2.7959E-03	58.650	3.2685E-03	58.750	3.5383E-03
58.850	3.8079E-03	58.950	4.0772E-03	59.050	4.3464E-03
59.150	4.6153E-03	59.250	4.8840E-03	59.350	5.1526E-03
59.450	5.4209E-03	59.550	5.6891E-03	59.650	5.9572E-03
59.750	6.2251E-03	59.850	6.4929E-03	59.950	6.7605E-03
60.050	7.0280E-03	60.150	7.2954E-03	60.250	7.5628E-03
60.350	7.8300E-03	60.450	8.0972E-03	60.550	8.3643E-03
60.650	8.6314E-03	60.750	8.8985E-03	60.850	9.1655E-03
60.950	9.4325E-03	61.000	9.5659E-03		

Soil B - End of Wettest Year (1983) in 5-Year Wet Cycle
UNSAT-H Input File

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ECDC Soil B, 2.0' Cover, 5-Year "Wet" Precip.
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1,25,0,1,25,                            IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24.0,                                 NPRINT,STOPHR
0,10,1,1.0d-5,                          ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                        DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                   HIRRI,HDRY,HTOP,RHA
1,1,1,                                  IETOPT,ICLOUD,ISHOPT
1,0.10,                                 IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,              IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                  IHEAT,ICONVH,DMAXHE
0,0,0,0,                                UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                MATN,NPT
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
1,0.80,1,0.90,1,1.00,1,1.10,
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Soil Properties for Soil B
0.3870, 0.0000, 0.0075, 1.2369,             THES,THER,ALPHA,N
SOIL CONDUCTIVITY DATA
2.0d+0, 0.0216, 0.0075, 1.2369, 0.5,        KMOD,KSAT,ALPHA,N,EPIT
SOIL HYSTERESIS PARAMETERS
7,0.25,2.0,1000.0,                          IPATHA,SARWA,ALFACT,HYSHPH
    0,    (TOSS.OUT file for day  3.65000E+02)            NDAY (UNSAT-H V3.03)
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0.3,1813.56,18.0,852.4,
c:/david/modeling/B_2.0_Wet_New/
year
dat
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Soil B - End of Wettest Year (1983) in 5-Year Wet Cycle
UNSAT-H Output File

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\david\Modeling\B_2.0_Wet_New\input.inp
Results File: N:\DATA\PROJECTS\203050 - Allied - ECDC AFC\AFC Comment Response
Date of Run: 11 Dec 2005
Time of Run: 15:59:40.21
Title:
ECDC Soil B, 2.0' Cover, 5-Year "Wet" Precip.

	Initial Conditions					Initial Conditions			
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	4.250E+05	0.0572	290.00	2	1.000E-01	3.383E+05	0.0604	290.00
3	2.000E-01	2.581E+05	0.0644	290.00	4	3.000E-01	1.792E+05	0.0702	290.00
5	4.000E-01	1.015E+05	0.0804	290.00	6	5.000E-01	2.789E+04	0.1091	290.00
7	6.000E-01	7.152E+03	0.1505	290.00	8	7.000E-01	4.674E+03	0.1662	290.00
9	8.000E-01	3.672E+03	0.1759	290.00	10	9.000E-01	3.109E+03	0.1828	290.00
11	1.000E+00	2.742E+03	0.1882	290.00	12	1.100E+00	2.480E+03	0.1926	290.00
13	1.200E+00	2.283E+03	0.1964	290.00	14	1.300E+00	2.128E+03	0.1996	290.00
15	1.400E+00	2.002E+03	0.2024	290.00	16	1.500E+00	1.898E+03	0.2048	290.00
17	1.600E+00	1.811E+03	0.2071	290.00	18	1.700E+00	1.736E+03	0.2091	290.00
19	1.800E+00	1.670E+03	0.2109	290.00	20	1.900E+00	1.613E+03	0.2126	290.00
21	2.000E+00	1.563E+03	0.2141	290.00	22	2.250E+00	1.460E+03	0.2174	290.00
23	2.500E+00	1.379E+03	0.2202	290.00	24	2.750E+00	1.315E+03	0.2226	290.00
25	3.000E+00	1.263E+03	0.2246	290.00	26	3.250E+00	1.220E+03	0.2263	290.00
27	3.500E+00	1.184E+03	0.2278	290.00	28	3.750E+00	1.153E+03	0.2292	290.00
29	4.000E+00	1.126E+03	0.2304	290.00	30	4.250E+00	1.103E+03	0.2314	290.00
31	4.500E+00	1.083E+03	0.2324	290.00	32	4.750E+00	1.065E+03	0.2332	290.00
33	5.000E+00	1.049E+03	0.2340	290.00	34	5.250E+00	1.034E+03	0.2347	290.00
35	5.750E+00	1.009E+03	0.2360	290.00	36	6.250E+00	9.883E+02	0.2367	290.00
37	6.750E+00	9.687E+02	0.2372	290.00	38	7.250E+00	9.503E+02	0.2376	290.00
39	7.750E+00	9.330E+02	0.2380	290.00	40	8.250E+00	9.167E+02	0.2383	290.00
41	8.750E+00	9.014E+02	0.2387	290.00	42	9.250E+00	8.870E+02	0.2390	290.00
43	9.750E+00	8.736E+02	0.2394	290.00	44	1.025E+01	8.610E+02	0.2397	290.00
45	1.050E+01	8.551E+02	0.2398	290.00	46	1.075E+01	8.494E+02	0.2399	290.00
47	1.100E+01	8.439E+02	0.2401	290.00	48	1.125E+01	8.386E+02	0.2402	290.00
49	1.150E+01	8.336E+02	0.2403	290.00	50	1.175E+01	8.288E+02	0.2404	290.00
51	1.200E+01	8.242E+02	0.2406	290.00	52	1.225E+01	8.198E+02	0.2407	290.00
53	1.250E+01	8.156E+02	0.2408	290.00	54	1.275E+01	8.117E+02	0.2409	290.00
55	1.300E+01	8.079E+02	0.2410	290.00	56	1.325E+01	8.044E+02	0.2411	290.00
57	1.350E+01	8.011E+02	0.2411	290.00	58	1.360E+01	7.998E+02	0.2412	290.00
59	1.370E+01	7.986E+02	0.2412	290.00	60	1.380E+01	7.974E+02	0.2412	290.00
61	1.390E+01	7.962E+02	0.2413	290.00	62	1.400E+01	7.950E+02	0.2413	290.00
63	1.410E+01	7.939E+02	0.2413	290.00	64	1.420E+01	7.928E+02	0.2414	290.00
65	1.430E+01	7.918E+02	0.2414	290.00	66	1.440E+01	7.907E+02	0.2414	290.00
67	1.450E+01	7.898E+02	0.2414	290.00	68	1.460E+01	7.888E+02	0.2415	290.00
69	1.470E+01	7.879E+02	0.2415	290.00	70	1.480E+01	7.869E+02	0.2415	290.00
71	1.490E+01	7.861E+02	0.2415	290.00	72	1.500E+01	7.852E+02	0.2416	290.00
73	1.510E+01	7.844E+02	0.2416	290.00	74	1.520E+01	7.836E+02	0.2416	290.00
75	1.530E+01	7.828E+02	0.2416	290.00	76	1.540E+01	7.821E+02	0.2416	290.00
77	1.550E+01	7.814E+02	0.2417	290.00	78	1.560E+01	7.807E+02	0.2417	290.00
79	1.570E+01	7.801E+02	0.2417	290.00	80	1.580E+01	7.794E+02	0.2417	290.00
81	1.590E+01	7.788E+02	0.2417	290.00	82	1.600E+01	7.783E+02	0.2417	290.00
83	1.610E+01	7.777E+02	0.2418	290.00	84	1.620E+01	7.772E+02	0.2418	290.00
85	1.630E+01	7.767E+02	0.2418	290.00	86	1.640E+01	7.762E+02	0.2418	290.00
87	1.650E+01	7.757E+02	0.2418	290.00	88	1.660E+01	7.753E+02	0.2418	290.00
89	1.670E+01	7.749E+02	0.2418	290.00	90	1.680E+01	7.745E+02	0.2418	290.00
91	1.690E+01	7.742E+02	0.2418	290.00	92	1.700E+01	7.738E+02	0.2419	290.00
93	1.710E+01	7.735E+02	0.2419	290.00	94	1.735E+01	7.728E+02	0.2419	290.00
95	1.760E+01	7.723E+02	0.2419	290.00	96	1.785E+01	7.719E+02	0.2419	290.00
97	1.810E+01	7.716E+02	0.2419	290.00	98	1.835E+01	7.714E+02	0.2419	290.00
99	1.860E+01	7.713E+02	0.2419	290.00	100	1.885E+01	7.714E+02	0.2419	290.00
101	1.910E+01	7.716E+02	0.2419	290.00	102	1.935E+01	7.718E+02	0.2419	290.00
103	1.960E+01	7.722E+02	0.2419	290.00	104	2.010E+01	7.732E+02	0.2419	290.00
105	2.060E+01	7.746E+02	0.2418	290.00	106	2.110E+01	7.762E+02	0.2418	290.00
107	2.160E+01	7.782E+02	0.2417	290.00	108	2.210E+01	7.804E+02	0.2417	290.00
109	2.260E+01	7.829E+02	0.2416	290.00	110	2.310E+01	7.855E+02	0.2415	290.00
111	2.360E+01	7.884E+02	0.2414	290.00	112	2.410E+01	7.914E+02	0.2414	290.00
113	2.460E+01	7.945E+02	0.2413	290.00	114	2.510E+01	7.978E+02	0.2412	290.00
115	2.560E+01	8.011E+02	0.2411	290.00	116	2.610E+01	8.045E+02	0.2410	290.00
117	2.660E+01	8.080E+02	0.2409	290.00	118	2.710E+01	8.115E+02	0.2408	290.00
119	2.760E+01	8.151E+02	0.2407	290.00	120	2.810E+01	8.187E+02	0.2406	290.00
121	2.860E+01	8.222E+02	0.2405	290.00	122	2.910E+01	8.258E+02	0.2404	290.00
123	2.960E+01	8.293E+02	0.2404	290.00	124	3.010E+01	8.328E+02	0.2403	290.00
125	3.060E+01	8.363E+02	0.2402	290.00	126	3.110E+01	8.397E+02	0.2401	290.00
127	3.160E+01	8.430E+02	0.2400	290.00	128	3.210E+01	8.463E+02	0.2399	290.00
129	3.260E+01	8.496E+02	0.2398	290.00	130	3.310E+01	8.527E+02	0.2398	290.00
131	3.360E+01	8.558E+02	0.2397	290.00	132	3.410E+01	8.588E+02	0.2396	290.00
133	3.460E+01	8.617E+02	0.2396	290.00	134	3.510E+01	8.646E+02	0.2395	290.00
135	3.560E+01	8.673E+02	0.2394	290.00	136	3.610E+01	8.700E+02	0.2394	290.00
137	3.660E+01	8.726E+02	0.2393	290.00	138	3.710E+01	8.751E+02	0.2392	290.00
139	3.760E+01	8.775E+02	0.2392	290.00	140	3.810E+01	8.799E+02	0.2391	290.00
141	3.860E+01	8.822E+02	0.2391	290.00	142	3.910E+01	8.844E+02	0.2390	290.00
143	3.960E+01	8.865E+02	0.2390	290.00	144	4.010E+01	8.885E+02	0.2389	290.00
145	4.060E+01	8.905E+02	0.2389	290.00	146	4.110E+01	8.924E+02	0.2388	290.00
147	4.160E+01	8.942E+02	0.2388	290.00	148	4.210E+01	8.960E+02	0.2387	290.00
149	4.260E+01	8.977E+02	0.2387	290.00	150	4.310E+01	8.993E+02	0.2387	290.00
151	4.360E+01	9.009E+02	0.2386	290.00	152	4.410E+01	9.024E+02	0.2386	290.00
153	4.460E+01	9.039E+02	0.2386	290.00	154	4.510E+01	9.053E+02	0.2385	290.00
155	4.560E+01	9.066E+02	0.2385	290.00	156	4.610E+01	9.079E+02	0.2385	290.00
157	4.660E+01	9.091E+02	0.2384	290.00	158	4.710E+01	9.103E+02	0.2384	290.00
159	4.760E+01	9.115E+02	0.2384	290.00	160	4.810E+01	9.126E+02	0.2384	290.00
161	4.860E+01	9.136E+02	0.2383	290.00	162	4.910E+01	9.146E+02	0.2383	290.00
163	4.960E+01	9.156E+02	0.2383	290.00	164	5.010E+01	9.165E+02	0.2383	290.00
165	5.060E+01	9.174E+02	0.2383	290.00	166	5.110E+01	9.182E+02	0.2382	290.00

167	5.160E+01	9.190E+02	0.2382	290.00	168	5.210E+01	9.197E+02	0.2382	290.00
169	5.260E+01	9.204E+02	0.2382	290.00	170	5.310E+01	9.211E+02	0.2382	290.00
171	5.360E+01	9.217E+02	0.2382	290.00	172	5.410E+01	9.223E+02	0.2381	290.00
173	5.460E+01	9.228E+02	0.2381	290.00	174	5.510E+01	9.233E+02	0.2381	290.00
175	5.560E+01	9.238E+02	0.2381	290.00	176	5.585E+01	9.240E+02	0.2381	290.00
177	5.610E+01	9.242E+02	0.2381	290.00	178	5.635E+01	9.244E+02	0.2381	290.00
179	5.660E+01	9.246E+02	0.2381	290.00	180	5.685E+01	9.248E+02	0.2381	290.00
181	5.710E+01	9.249E+02	0.2381	290.00	182	5.735E+01	9.251E+02	0.2381	290.00
183	5.760E+01	9.252E+02	0.2381	290.00	184	5.785E+01	9.254E+02	0.2381	290.00
185	5.810E+01	9.255E+02	0.2381	290.00	186	5.835E+01	9.256E+02	0.2381	290.00
187	5.860E+01	9.257E+02	0.2381	290.00	188	5.870E+01	9.257E+02	0.2381	290.00
189	5.880E+01	9.258E+02	0.2381	290.00	190	5.890E+01	9.258E+02	0.2381	290.00
191	5.900E+01	9.259E+02	0.2381	290.00	192	5.910E+01	9.259E+02	0.2381	290.00
193	5.920E+01	9.259E+02	0.2381	290.00	194	5.930E+01	9.259E+02	0.2381	290.00
195	5.940E+01	9.260E+02	0.2381	290.00	196	5.950E+01	9.260E+02	0.2381	290.00
197	5.960E+01	9.260E+02	0.2381	290.00	198	5.970E+01	9.260E+02	0.2381	290.00
199	5.980E+01	9.261E+02	0.2381	290.00	200	5.990E+01	9.261E+02	0.2381	290.00
201	6.000E+01	9.261E+02	0.2381	290.00	202	6.010E+01	9.261E+02	0.2381	290.00
203	6.020E+01	9.261E+02	0.2381	290.00	204	6.030E+01	9.261E+02	0.2381	290.00
205	6.040E+01	9.262E+02	0.2381	290.00	206	6.050E+01	9.262E+02	0.2381	290.00
207	6.060E+01	9.262E+02	0.2381	290.00	208	6.070E+01	9.262E+02	0.2381	290.00
209	6.080E+01	9.262E+02	0.2381	290.00	210	6.090E+01	9.262E+02	0.2381	290.00
211	6.100E+01	9.262E+02	0.2381	290.00					

Initial Water Storage = 14.4141 cm

DAILY SUMMARY: Day = 1, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)= 1.33030E-07
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
14.4141+	0.0000+	0.0000 -	0.0420-	0.0000-	0.0001 =	14.3720 vs.	14.3721

Mass Balance = -8.4226E-05 cm; Time step attempts = 36 and successes = 31
Evaporation: Potential = 0.1180 cm, Actual = 0.0420 cm
RHMEAN = 52.5 %; TMEAN = 270.1 K; HDRY = 8.8140E+05 cm; DAYUBC = 17

DAILY SUMMARY: Day = 365, Simulated Time = 24.0000 hr

Node Number = 365
Depth (cm) = 0.00000
Water (cm3/cm3) = 0.00000
Head (cm) = 0.00000E+00
LiqWater Flow (cm)= 3.57769E-07
IsoVapor Flow (cm)= 0.00000E+00

PRESTOR	INFIL	RUNOFF	EVAPO	TRANS	LIQUID DRAIN	NEWSTOR	STORAGE
15.2387+	0.0000+	0.0000 -	0.0696-	0.0000-	0.0001 =	15.1690 vs.	15.1690

Mass Balance = -1.6410E-05 cm; Time step attempts = 129 and successes = 96
Evaporation: Potential = 0.0697 cm, Actual = 0.0696 cm
RHMEAN = 71.2 %; TMEAN = 269.0 K; HDRY = 4.6466E+05 cm; DAYUBC = 3
1

UNSAT-H Version 3.01
SIMULATION SUMMARY

Title:
ECDC Soil B, 2.0' Cover, 5-Year "Wet" Precip.

Transpiration Scheme is:	=	0	
Potential Evapotranspiration	=	1.6927E+02	[cm]
Potential Transpiration	=	0.0000E+00	[cm]
Actual Transpiration	=	0.0000E+00	[cm]
Potential Evaporation	=	1.6927E+02	[cm]
Actual Evaporation	=	2.4813E+01	[cm]
Evaporation during Growth	=	0.0000E+00	[cm]
Total Runoff	=	4.9029E+01	[cm]
Total Infiltration	=	2.5647E+01	[cm]
Total Basal Liquid Flux (drainage)	=	3.8849E-02	[cm]
Total Basal Vapor Flux (temp-grad)	=	0.0000E+00	[cm]
Total Applied Water	=	7.4676E+01	[cm]
Actual Rainfall	=	7.4676E+01	[cm]
Actual Irrigation	=	0.0000E+00	[cm]
Total Final Moisture Storage	=	1.5169E+01	[cm]
Mass Balance Error	=	4.0337E-02	[cm]
Total Successful Time Steps	=	87121	
Total Attempted Time Steps	=	102416	
Total Time Step Reductions (DHMAX)	=	0	
Total Changes in Surface Boundary	=	32138	
Total Time Actually Simulated	=	3.6500E+02	[days]

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	8.3407E-01	0.050	1.7703E+01	0.150	1.3566E+01
0.250	1.1189E+01	0.350	9.5302E+00	0.450	8.1700E+00
0.550	7.0156E+00	0.650	6.0324E+00	0.750	5.1378E+00
0.850	4.3873E+00	0.950	3.7005E+00	1.050	3.0931E+00
1.150	2.6200E+00	1.250	2.2326E+00	1.350	1.8851E+00
1.450	1.6021E+00	1.550	1.4068E+00	1.650	1.2542E+00
1.750	1.1132E+00	1.850	1.0061E+00	1.950	9.2298E-01
2.125	8.1819E-01	2.375	6.9232E-01	2.625	6.4242E-01
2.875	6.2801E-01	3.125	6.1743E-01	3.375	6.0757E-01
3.625	5.9800E-01	3.875	5.8854E-01	4.125	5.7930E-01
4.375	5.6996E-01	4.625	5.6067E-01	4.875	5.5138E-01
5.125	5.4210E-01	5.500	5.2822E-01	6.000	5.0979E-01
6.500	4.9130E-01	7.000	4.7273E-01	7.500	4.5415E-01
8.000	4.3569E-01	8.500	4.1742E-01	9.000	3.9946E-01
9.500	3.8187E-01	10.000	3.6467E-01	10.375	3.5213E-01
10.625	3.4390E-01	10.875	3.3578E-01	11.125	3.2779E-01
11.375	3.1992E-01	11.625	3.1218E-01	11.875	3.0457E-01
12.125	2.9711E-01	12.375	2.8978E-01	12.625	2.8258E-01
12.875	2.7554E-01	13.125	2.6865E-01	13.375	2.6192E-01
13.550	2.5732E-01	13.650	2.5472E-01	13.750	2.5215E-01
13.850	2.4959E-01	13.950	2.4707E-01	14.050	2.4457E-01
14.150	2.4209E-01	14.250	2.3963E-01	14.350	2.3721E-01
14.450	2.3481E-01	14.550	2.3243E-01	14.650	2.3008E-01
14.750	2.2776E-01	14.850	2.2546E-01	14.950	2.2319E-01
15.050	2.2095E-01	15.150	2.1873E-01	15.250	2.1654E-01
15.350	2.1437E-01	15.450	2.1224E-01	15.550	2.1013E-01
15.650	2.0804E-01	15.750	2.0599E-01	15.850	2.0396E-01
15.950	2.0196E-01	16.050	1.9998E-01	16.150	1.9803E-01
16.250	1.9611E-01	16.350	1.9422E-01	16.450	1.9235E-01
16.550	1.9052E-01	16.650	1.8870E-01	16.750	1.8692E-01
16.850	1.8517E-01	16.950	1.8344E-01	17.050	1.8173E-01
17.225	1.7880E-01	17.475	1.7479E-01	17.725	1.7094E-01
17.975	1.6726E-01	18.225	1.6374E-01	18.475	1.6038E-01
18.725	1.5717E-01	18.975	1.5413E-01	19.225	1.5123E-01
19.475	1.4848E-01	19.850	1.4456E-01	20.350	1.3987E-01
20.850	1.3568E-01	21.350	1.3194E-01	21.850	1.2861E-01
22.350	1.2565E-01	22.850	1.2301E-01	23.350	1.2067E-01
23.850	1.1858E-01	24.350	1.1671E-01	24.850	1.1503E-01
25.350	1.1350E-01	25.850	1.1211E-01	26.350	1.1084E-01
26.850	1.0965E-01	27.350	1.0854E-01	27.850	1.0749E-01
28.350	1.0649E-01	28.850	1.0552E-01	29.350	1.0458E-01
29.850	1.0366E-01	30.350	1.0276E-01	30.850	1.0186E-01
31.350	1.0096E-01	31.850	1.0007E-01	32.350	9.9169E-02
32.850	9.8267E-02	33.350	9.7358E-02	33.850	9.6442E-02
34.350	9.5518E-02	34.850	9.4586E-02	35.350	9.3646E-02
35.850	9.2697E-02	36.350	9.1740E-02	36.850	9.0775E-02
37.350	8.9801E-02	37.850	8.8821E-02	38.350	8.7833E-02
38.850	8.6838E-02	39.350	8.5836E-02	39.850	8.4828E-02
40.350	8.3815E-02	40.850	8.2796E-02	41.350	8.1772E-02
41.850	8.0743E-02	42.350	7.9710E-02	42.850	7.8672E-02
43.350	7.7629E-02	43.850	7.6583E-02	44.350	7.5533E-02
44.850	7.4479E-02	45.350	7.3421E-02	45.850	7.2360E-02
46.350	7.1295E-02	46.850	7.0227E-02	47.350	6.9155E-02
47.850	6.8080E-02	48.350	6.7002E-02	48.850	6.5921E-02
49.350	6.4836E-02	49.850	6.3748E-02	50.350	6.2657E-02
50.850	6.1563E-02	51.350	6.0466E-02	51.850	5.9366E-02
52.350	5.8263E-02	52.850	5.7158E-02	53.350	5.6049E-02
53.850	5.4938E-02	54.350	5.3825E-02	54.850	5.2709E-02
55.350	5.1591E-02	55.725	5.0751E-02	55.975	5.0190E-02
56.225	4.9629E-02	56.475	4.9067E-02	56.725	4.8505E-02
56.975	4.7943E-02	57.225	4.7380E-02	57.475	4.6817E-02
57.725	4.6253E-02	57.975	4.5689E-02	58.225	4.5125E-02
58.475	4.4561E-02	58.650	4.4165E-02	58.750	4.3940E-02
58.850	4.3714E-02	58.950	4.3488E-02	59.050	4.3262E-02
59.150	4.3035E-02	59.250	4.2809E-02	59.350	4.2583E-02
59.450	4.2357E-02	59.550	4.2131E-02	59.650	4.1905E-02
59.750	4.1678E-02	59.850	4.1452E-02	59.950	4.1226E-02
60.050	4.1000E-02	60.150	4.0773E-02	60.250	4.0547E-02
60.350	4.0321E-02	60.450	4.0094E-02	60.550	3.9868E-02
60.650	3.9642E-02	60.750	3.9415E-02	60.850	3.9189E-02
60.950	3.8963E-02	61.000	3.8849E-02		

Soil B - End of Driest Year (1976) in 5-Year Dry Cycle
UNSAT-H Input File

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ECDC Soil B, 2.0' Cover, 5-Year "Dry" Precip.
0,1,                                    IPLANT,NGRAV
365,1,365,                              IFDEND,IDTBEG,IDTEND
1,25,0,1,25,                            IYS,NYEARS,ISTEAD,IFLIST,NFLIST
0,24.0,                                 NPRINT,STOPHR
0,10,1,1.0d-5,                          ISMETH,INMAX,ISWDIF,DMAXBA
1.0,1.0E-15,1.0,                        DELMAX,DELMIN,OUTTIM
1.2,1.0E-15,0.0,0.0,0.0,                RFACT,RAINIF,DHTOL,DHMAX,DHFACT
4,3,0.5,                                KOPT,KEST,WTF
0,1,2,1,                                ITOPBC,IEVOPT,NFHOUR,LOWER
0.0,1.0E+06,0.0,0.30,                   HIRRI,HDRY,HTOP,RHA
1,1,1,                                  IETOPT,ICLOUD,ISHOPT
1,0.10,                                 IRAIN,HPR
1,1.0E-10,1.0E-10,1000.0,,              IHYS,AIRTOL,HYSTOL,HYSMXH,HYFILE
0,0,0,                                  IHEAT,ICONVH,DMAXHE
0,0,0,0,                                UPPERH,TSMEAN,TSAMP,QHCTOP
0,0.0,0.0,                              LOWERH,QHLEAK,TGRAD
1,0.66,290.0,0.24,                      IVAPOR,TORT,TSOIL,VAPDIF
1,  211,                                MATN,NPT
1,0.00,1,0.10,1,0.20,1,0.30,
1,0.40,1,0.50,1,0.60,1,0.70,
1,0.80,1,0.90,1,1.00,1,1.10,
1,1.20,1,1.30,1,1.40,1,1.50,
1,1.60,1,1.70,1,1.80,1,1.90,
1,2.00,1,2.25,1,2.50,1,2.75,
1,3.00,1,3.25,1,3.50,1,3.75,
1,4.00,1,4.25,1,4.50,1,4.75,
1,5.00,1,5.25,1,5.75,1,6.25,
1,6.75,1,7.25,1,7.75,1,8.25,
1,8.75,1,9.25,1,9.75,1,10.25,
1,10.50,1,10.75,1,11.00,1,11.25,
1,11.50,1,11.75,1,12.00,1,12.25,
1,12.50,1,12.75,1,13.00,1,13.25,
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Soil Properties for Soil B
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year
dat
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Soil B - End of Driest Year (1976) in 5-Year Dry Cycle
UNSAT-H Output File

UNSAT-H Version 3.01
INITIAL CONDITIONS

Input File: C:\David\modeling\B_2.0_Dry_New\input.inp
Results File: N:\DATA\PROJECTS\203050 - Allied - ECDC AFC\AFC Comment Response
Date of Run: 11 Dec 2005
Time of Run: 22:44:21.79
Title:
ECDC Soil B, 2.0' Cover, 5-Year "Dry" Precip.

	Initial Conditions					Initial Conditions			
NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)	NODE	DEPTH (cm)	HEAD (cm)	THETA (vol.)	TEMP (K)
1	0.000E+00	9.780E+05	0.0470	290.00	2	1.000E-01	9.521E+05	0.0473	290.00
3	2.000E-01	9.266E+05	0.0476	290.00	4	3.000E-01	9.017E+05	0.0479	290.00
5	4.000E-01	8.772E+05	0.0482	290.00	6	5.000E-01	8.531E+05	0.0485	290.00
7	6.000E-01	8.294E+05	0.0489	290.00	8	7.000E-01	8.062E+05	0.0492	290.00
9	8.000E-01	7.833E+05	0.0495	290.00	10	9.000E-01	7.609E+05	0.0499	290.00
11	1.000E+00	7.388E+05	0.0502	290.00	12	1.100E+00	7.171E+05	0.0506	290.00
13	1.200E+00	6.958E+05	0.0509	290.00	14	1.300E+00	6.749E+05	0.0513	290.00
15	1.400E+00	6.544E+05	0.0517	290.00	16	1.500E+00	6.342E+05	0.0521	290.00
17	1.600E+00	6.143E+05	0.0525	290.00	18	1.700E+00	5.948E+05	0.0529	290.00
19	1.800E+00	5.757E+05	0.0533	290.00	20	1.900E+00	5.568E+05	0.0537	290.00
21	2.000E+00	5.384E+05	0.0541	290.00	22	2.250E+00	4.936E+05	0.0553	290.00
23	2.500E+00	4.509E+05	0.0564	290.00	24	2.750E+00	4.101E+05	0.0577	290.00
25	3.000E+00	3.712E+05	0.0591	290.00	26	3.250E+00	3.342E+05	0.0606	290.00
27	3.500E+00	2.991E+05	0.0622	290.00	28	3.750E+00	2.657E+05	0.0640	290.00
29	4.000E+00	2.342E+05	0.0659	290.00	30	4.250E+00	2.043E+05	0.0681	290.00
31	4.500E+00	1.762E+05	0.0705	290.00	32	4.750E+00	1.497E+05	0.0733	290.00
33	5.000E+00	1.250E+05	0.0765	290.00	34	5.250E+00	1.020E+05	0.0803	290.00
35	5.750E+00	6.116E+04	0.0906	290.00	36	6.250E+00	2.949E+04	0.1077	290.00
37	6.750E+00	1.356E+04	0.1294	290.00	38	7.250E+00	8.603E+03	0.1441	290.00
39	7.750E+00	6.559E+03	0.1535	290.00	40	8.250E+00	5.446E+03	0.1604	290.00
41	8.750E+00	4.741E+03	0.1657	290.00	42	9.250E+00	4.252E+03	0.1700	290.00
43	9.750E+00	3.890E+03	0.1735	290.00	44	1.025E+01	3.612E+03	0.1766	290.00
45	1.050E+01	3.495E+03	0.1779	290.00	46	1.075E+01	3.390E+03	0.1792	290.00
47	1.100E+01	3.295E+03	0.1804	290.00	48	1.125E+01	3.209E+03	0.1815	290.00
49	1.150E+01	3.130E+03	0.1825	290.00	50	1.175E+01	3.058E+03	0.1835	290.00
51	1.200E+01	2.991E+03	0.1845	290.00	52	1.225E+01	2.930E+03	0.1854	290.00
53	1.250E+01	2.873E+03	0.1862	290.00	54	1.275E+01	2.820E+03	0.1870	290.00
55	1.300E+01	2.771E+03	0.1878	290.00	56	1.325E+01	2.725E+03	0.1885	290.00
57	1.350E+01	2.681E+03	0.1892	290.00	58	1.360E+01	2.665E+03	0.1895	290.00
59	1.370E+01	2.649E+03	0.1897	290.00	60	1.380E+01	2.633E+03	0.1900	290.00
61	1.390E+01	2.618E+03	0.1903	290.00	62	1.400E+01	2.603E+03	0.1905	290.00
63	1.410E+01	2.588E+03	0.1908	290.00	64	1.420E+01	2.574E+03	0.1910	290.00
65	1.430E+01	2.560E+03	0.1912	290.00	66	1.440E+01	2.546E+03	0.1915	290.00
67	1.450E+01	2.533E+03	0.1917	290.00	68	1.460E+01	2.520E+03	0.1919	290.00
69	1.470E+01	2.507E+03	0.1922	290.00	70	1.480E+01	2.495E+03	0.1924	290.00
71	1.490E+01	2.483E+03	0.1926	290.00	72	1.500E+01	2.471E+03	0.1928	290.00
73	1.510E+01	2.459E+03	0.1930	290.00	74	1.520E+01	2.448E+03	0.1932	290.00
75	1.530E+01	2.437E+03	0.1934	290.00	76	1.540E+01	2.426E+03	0.1936	290.00
77	1.550E+01	2.415E+03	0.1938	290.00	78	1.560E+01	2.404E+03	0.1940	290.00
79	1.570E+01	2.394E+03	0.1942	290.00	80	1.580E+01	2.384E+03	0.1944	290.00
81	1.590E+01	2.374E+03	0.1946	290.00	82	1.600E+01	2.364E+03	0.1948	290.00
83	1.610E+01	2.355E+03	0.1950	290.00	84	1.620E+01	2.345E+03	0.1951	290.00
85	1.630E+01	2.336E+03	0.1953	290.00	86	1.640E+01	2.327E+03	0.1955	290.00
87	1.650E+01	2.318E+03	0.1957	290.00	88	1.660E+01	2.309E+03	0.1958	290.00
89	1.670E+01	2.301E+03	0.1960	290.00	90	1.680E+01	2.293E+03	0.1962	290.00
91	1.690E+01	2.284E+03	0.1963	290.00	92	1.700E+01	2.276E+03	0.1965	290.00
93	1.710E+01	2.268E+03	0.1966	290.00	94	1.735E+01	2.249E+03	0.1970	290.00
95	1.760E+01	2.231E+03	0.1974	290.00	96	1.785E+01	2.213E+03	0.1978	290.00
97	1.810E+01	2.196E+03	0.1981	290.00	98	1.835E+01	2.180E+03	0.1985	290.00
99	1.860E+01	2.164E+03	0.1988	290.00	100	1.885E+01	2.149E+03	0.1991	290.00
101	1.910E+01	2.134E+03	0.1994	290.00	102	1.935E+01	2.121E+03	0.1997	290.00
103	1.960E+01	2.107E+03	0.2000	290.00	104	2.010E+01	2.082E+03	0.2006	290.00
105	2.060E+01	2.058E+03	0.2011	290.00	106	2.110E+01	2.036E+03	0.2016	290.00
107	2.160E+01	2.016E+03	0.2020	290.00	108	2.210E+01	1.997E+03	0.2025	290.00
109	2.260E+01	1.979E+03	0.2029	290.00	110	2.310E+01	1.962E+03	0.2033	290.00
111	2.360E+01	1.947E+03	0.2037	290.00	112	2.410E+01	1.932E+03	0.2040	290.00
113	2.460E+01	1.918E+03	0.2043	290.00	114	2.510E+01	1.906E+03	0.2047	290.00
115	2.560E+01	1.893E+03	0.2050	290.00	116	2.610E+01	1.882E+03	0.2052	290.00
117	2.660E+01	1.871E+03	0.2055	290.00	118	2.710E+01	1.861E+03	0.2058	290.00
119	2.760E+01	1.852E+03	0.2060	290.00	120	2.810E+01	1.843E+03	0.2062	290.00
121	2.860E+01	1.835E+03	0.2064	290.00	122	2.910E+01	1.827E+03	0.2066	290.00
123	2.960E+01	1.820E+03	0.2068	290.00	124	3.010E+01	1.813E+03	0.2070	290.00
125	3.060E+01	1.807E+03	0.2072	290.00	126	3.110E+01	1.801E+03	0.2073	290.00
127	3.160E+01	1.795E+03	0.2075	290.00	128	3.210E+01	1.790E+03	0.2076	290.00
129	3.260E+01	1.785E+03	0.2077	290.00	130	3.310E+01	1.781E+03	0.2078	290.00
131	3.360E+01	1.776E+03	0.2080	290.00	132	3.410E+01	1.773E+03	0.2081	290.00
133	3.460E+01	1.769E+03	0.2082	290.00	134	3.510E+01	1.766E+03	0.2082	290.00
135	3.560E+01	1.763E+03	0.2083	290.00	136	3.610E+01	1.760E+03	0.2084	290.00
137	3.660E+01	1.757E+03	0.2085	290.00	138	3.710E+01	1.755E+03	0.2085	290.00
139	3.760E+01	1.753E+03	0.2086	290.00	140	3.810E+01	1.751E+03	0.2086	290.00
141	3.860E+01	1.749E+03	0.2087	290.00	142	3.910E+01	1.748E+03	0.2087	290.00
143	3.960E+01	1.746E+03	0.2088	290.00	144	4.010E+01	1.745E+03	0.2088	290.00
145	4.060E+01	1.744E+03	0.2088	290.00	146	4.110E+01	1.744E+03	0.2088	290.00
147	4.160E+01	1.743E+03	0.2089	290.00	148	4.210E+01	1.742E+03	0.2089	290.00
149	4.260E+01	1.742E+03	0.2089	290.00	150	4.310E+01	1.742E+03	0.2089	290.00
151	4.360E+01	1.741E+03	0.2089	290.00	152	4.410E+01	1.741E+03	0.2089	290.00
153	4.460E+01	1.741E+03	0.2089	290.00	154	4.510E+01	1.741E+03	0.2089	290.00
155	4.560E+01	1.742E+03	0.2089	290.00	156	4.610E+01	1.742E+03	0.2089	290.00
157	4.660E+01	1.742E+03	0.2089	290.00	158	4.710E+01	1.743E+03	0.2089	290.00
159	4.760E+01	1.743E+03	0.2089	290.00	160	4.810E+01	1.743E+03	0.2088	290.00
161	4.860E+01	1.744E+03	0.2088	290.00	162	4.910E+01	1.745E+03	0.2088	290.00
163	4.960E+01	1.745E+03	0.2088	290.00	164	5.010E+01	1.746E+03	0.2088	290.00
165	5.060E+01	1.746E+03	0.2088	290.00	166	5.110E+01	1.747E+03	0.2087	290.00

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   167 5.160E+01 1.748E+03 0.2087 290.00   168 5.210E+01 1.748E+03 0.2087 290.00
   169 5.260E+01 1.749E+03 0.2087 290.00   170 5.310E+01 1.750E+03 0.2087 290.00
   171 5.360E+01 1.750E+03 0.2087 290.00   172 5.410E+01 1.751E+03 0.2086 290.00
   173 5.460E+01 1.751E+03 0.2086 290.00   174 5.510E+01 1.752E+03 0.2086 290.00
   175 5.560E+01 1.753E+03 0.2086 290.00   176 5.585E+01 1.753E+03 0.2086 290.00
   177 5.610E+01 1.753E+03 0.2086 290.00   178 5.635E+01 1.753E+03 0.2086 290.00
   179 5.660E+01 1.753E+03 0.2086 290.00   180 5.685E+01 1.754E+03 0.2086 290.00
   181 5.710E+01 1.754E+03 0.2086 290.00   182 5.735E+01 1.754E+03 0.2086 290.00
   183 5.760E+01 1.754E+03 0.2086 290.00   184 5.785E+01 1.754E+03 0.2086 290.00
   185 5.810E+01 1.755E+03 0.2085 290.00   186 5.835E+01 1.755E+03 0.2085 290.00
   187 5.860E+01 1.755E+03 0.2085 290.00   188 5.870E+01 1.755E+03 0.2085 290.00
   189 5.880E+01 1.755E+03 0.2085 290.00   190 5.890E+01 1.755E+03 0.2085 290.00
   191 5.900E+01 1.755E+03 0.2085 290.00   192 5.910E+01 1.755E+03 0.2085 290.00
   193 5.920E+01 1.755E+03 0.2085 290.00   194 5.930E+01 1.755E+03 0.2085 290.00
   195 5.940E+01 1.755E+03 0.2085 290.00   196 5.950E+01 1.755E+03 0.2085 290.00
   197 5.960E+01 1.755E+03 0.2085 290.00   198 5.970E+01 1.755E+03 0.2085 290.00
   199 5.980E+01 1.755E+03 0.2085 290.00   200 5.990E+01 1.755E+03 0.2085 290.00
   201 6.000E+01 1.755E+03 0.2085 290.00   202 6.010E+01 1.755E+03 0.2085 290.00
   203 6.020E+01 1.755E+03 0.2085 290.00   204 6.030E+01 1.755E+03 0.2085 290.00
   205 6.040E+01 1.755E+03 0.2085 290.00   206 6.050E+01 1.755E+03 0.2085 290.00
   207 6.060E+01 1.755E+03 0.2085 290.00   208 6.070E+01 1.755E+03 0.2085 290.00
   209 6.080E+01 1.755E+03 0.2085 290.00   210 6.090E+01 1.755E+03 0.2085 290.00
   211 6.100E+01 1.755E+03 0.2085 290.00

 Initial Water Storage =  11.3980 cm

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day =   1, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)=-5.93963E-07
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
  11.3980+ 0.0000+ 0.0000 - 0.0000- 0.0000-  0.0000 =   11.3980 vs.   11.3980

 Mass Balance = -1.2319E-07 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.0534 cm, Actual =  0.0000 cm
 RHMEAN = 81.7 %;  TMEAN = 259.0 K;  HDRY =  2.7524E+05 cm;  DAYUBC =      0

--------------------------------------------------------------------------------


 DAILY SUMMARY:  Day = 365, Simulated Time = 24.0000 hr
 -------------
 Node Number        =     365
 Depth (cm)         =     0.00000
 Water (cm3/cm3)    =     0.00000
 Head (cm)          = 0.00000E+00
 LiqWater Flow (cm)=-7.53807E-07
 IsoVapor Flow (cm)= 0.00000E+00

                                                 LIQUID
  PRESTOR    INFIL  RUNOFF     EVAPO    TRANS     DRAIN      NEWSTOR        STORAGE
  11.1356+ 0.0000+ 0.0000 - 0.0083- 0.0000-  0.0000 =   11.1272 vs.   11.1272

 Mass Balance =  6.4783E-08 cm;  Time step attempts =   24 and successes =   24
   Evaporation:  Potential =  0.1293 cm, Actual =  0.0083 cm
 RHMEAN = 33.5 %;  TMEAN = 268.7 K;  HDRY =  1.4935E+06 cm;  DAYUBC =     24
1

--------------------------------------------------------------------------------
                            UNSAT-H Version 3.01
                             SIMULATION SUMMARY

 Title:
 ECDC Soil B, 2.0' Cover, 5-Year "Dry" Precip.
--------------------------------------------------------------------------------

 Transpiration Scheme is:              =    0
 Potential Evapotranspiration          =  1.7757E+02     [cm]
 Potential Transpiration               =  0.0000E+00     [cm]
 Actual Transpiration                  =  0.0000E+00     [cm]
 Potential Evaporation                 =  1.7757E+02     [cm]
 Actual Evaporation                    =  1.3825E+01     [cm]
 Evaporation during Growth             =  0.0000E+00     [cm]
 Total Runoff                          =  1.2564E+01     [cm]
 Total Infiltration                    =  1.3598E+01     [cm]
 Total Basal Liquid Flux (drainage)    =  8.0320E-03     [cm]
 Total Basal Vapor Flux (temp-grad)    =  0.0000E+00     [cm]
 Total Applied Water                   =  2.6162E+01     [cm]
 Actual Rainfall                       =  2.6162E+01     [cm]
 Actual Irrigation                     =  0.0000E+00     [cm]
 Total Final Moisture Storage          =  1.1127E+01     [cm]
 Mass Balance Error                    =  3.5908E-02     [cm]
 Total Successful Time Steps           =     68651
 Total Attempted Time Steps            =     78138
 Total Time Step Reductions (DHMAX)    =         0
 Total Changes in Surface Boundary     =     23485
 Total Time Actually Simulated         =  3.6500E+02     [days]
```

Total liquid water flow (cm) across different depths at the end of 3.6500E+02 days:

DEPTH	FLOW	DEPTH	FLOW	DEPTH	FLOW
0.000	-2.2682E-01	0.050	1.0847E+01	0.150	9.2011E+00
0.250	8.0797E+00	0.350	7.2217E+00	0.450	6.5470E+00
0.550	5.9674E+00	0.650	5.4441E+00	0.750	4.9775E+00
0.850	4.5590E+00	0.950	4.1753E+00	1.050	3.8232E+00
1.150	3.4858E+00	1.250	3.1384E+00	1.350	2.7875E+00
1.450	2.5035E+00	1.550	2.2982E+00	1.650	2.1410E+00
1.750	2.0067E+00	1.850	1.8875E+00	1.950	1.7790E+00
2.125	1.6207E+00	2.375	1.3743E+00	2.625	1.1710E+00
2.875	9.7647E-01	3.125	8.2785E-01	3.375	7.1186E-01
3.625	6.1741E-01	3.875	5.2024E-01	4.125	4.1589E-01
4.375	3.3599E-01	4.625	2.6883E-01	4.875	1.9963E-01
5.125	1.3150E-01	5.500	4.9076E-02	6.000	-3.8737E-02
6.500	-1.1823E-01	7.000	-1.7312E-01	7.500	-1.8887E-01
8.000	-1.9408E-01	8.500	-1.9630E-01	9.000	-1.9724E-01
9.500	-1.9746E-01	10.000	-1.9717E-01	10.375	-1.9670E-01
10.625	-1.9629E-01	10.875	-1.9581E-01	11.125	-1.9527E-01
11.375	-1.9467E-01	11.625	-1.9401E-01	11.875	-1.9331E-01
12.125	-1.9256E-01	12.375	-1.9176E-01	12.625	-1.9092E-01
12.875	-1.9005E-01	13.125	-1.8914E-01	13.375	-1.8820E-01
13.550	-1.8751E-01	13.650	-1.8712E-01	13.750	-1.8672E-01
13.850	-1.8631E-01	13.950	-1.8590E-01	14.050	-1.8549E-01
14.150	-1.8507E-01	14.250	-1.8465E-01	14.350	-1.8422E-01
14.450	-1.8379E-01	14.550	-1.8336E-01	14.650	-1.8292E-01
14.750	-1.8248E-01	14.850	-1.8203E-01	14.950	-1.8158E-01
15.050	-1.8112E-01	15.150	-1.8067E-01	15.250	-1.8021E-01
15.350	-1.7974E-01	15.450	-1.7927E-01	15.550	-1.7880E-01
15.650	-1.7833E-01	15.750	-1.7785E-01	15.850	-1.7737E-01
15.950	-1.7689E-01	16.050	-1.7640E-01	16.150	-1.7591E-01
16.250	-1.7542E-01	16.350	-1.7492E-01	16.450	-1.7443E-01
16.550	-1.7392E-01	16.650	-1.7342E-01	16.750	-1.7292E-01
16.850	-1.7241E-01	16.950	-1.7190E-01	17.050	-1.7138E-01
17.225	-1.7048E-01	17.475	-1.6918E-01	17.725	-1.6786E-01
17.975	-1.6654E-01	18.225	-1.6520E-01	18.475	-1.6385E-01
18.725	-1.6248E-01	18.975	-1.6111E-01	19.225	-1.5973E-01
19.475	-1.5834E-01	19.850	-1.5625E-01	20.350	-1.5342E-01
20.850	-1.5058E-01	21.350	-1.4771E-01	21.850	-1.4482E-01
22.350	-1.4193E-01	22.850	-1.3902E-01	23.350	-1.3610E-01
23.850	-1.3319E-01	24.350	-1.3027E-01	24.850	-1.2735E-01
25.350	-1.2444E-01	25.850	-1.2153E-01	26.350	-1.1863E-01
26.850	-1.1574E-01	27.350	-1.1287E-01	27.850	-1.1001E-01
28.350	-1.0717E-01	28.850	-1.0434E-01	29.350	-1.0153E-01
29.850	-9.8748E-02	30.350	-9.5986E-02	30.850	-9.3247E-02
31.350	-9.0534E-02	31.850	-8.7848E-02	32.350	-8.5189E-02
32.850	-8.2559E-02	33.350	-7.9959E-02	33.850	-7.7390E-02
34.350	-7.4853E-02	34.850	-7.2349E-02	35.350	-6.9879E-02
35.850	-6.7444E-02	36.350	-6.5044E-02	36.850	-6.2680E-02
37.350	-6.0354E-02	37.850	-5.8065E-02	38.350	-5.5814E-02
38.850	-5.3603E-02	39.350	-5.1430E-02	39.850	-4.9298E-02
40.350	-4.7206E-02	40.850	-4.5154E-02	41.350	-4.3143E-02
41.850	-4.1173E-02	42.350	-3.9244E-02	42.850	-3.7357E-02
43.350	-3.5511E-02	43.850	-3.3706E-02	44.350	-3.1943E-02
44.850	-3.0220E-02	45.350	-2.8539E-02	45.850	-2.6898E-02
46.350	-2.5297E-02	46.850	-2.3736E-02	47.350	-2.2214E-02
47.850	-2.0731E-02	48.350	-1.9286E-02	48.850	-1.7878E-02
49.350	-1.6506E-02	49.850	-1.5170E-02	50.350	-1.3869E-02
50.850	-1.2601E-02	51.350	-1.1366E-02	51.850	-1.0162E-02
52.350	-8.9889E-03	52.850	-7.8444E-03	53.350	-6.7275E-03
53.850	-5.6369E-03	54.350	-4.5710E-03	54.850	-3.5285E-03
55.350	-2.5078E-03	55.725	-1.7573E-03	55.975	-1.2618E-03
56.225	-7.7079E-04	56.475	-2.8411E-04	56.725	1.9846E-04
56.975	6.7713E-04	57.225	1.1521E-03	57.475	1.6237E-03
57.725	2.0919E-03	57.975	2.5572E-03	58.225	3.0197E-03
58.475	3.4796E-03	58.650	3.7998E-03	58.750	3.9825E-03
58.850	4.1648E-03	58.950	4.3469E-03	59.050	4.5286E-03
59.150	4.7100E-03	59.250	4.8911E-03	59.350	5.0720E-03
59.450	5.2526E-03	59.550	5.4330E-03	59.650	5.6132E-03
59.750	5.7932E-03	59.850	5.9730E-03	59.950	6.1526E-03
60.050	6.3321E-03	60.150	6.5114E-03	60.250	6.6906E-03
60.350	6.8697E-03	60.450	7.0486E-03	60.550	7.2275E-03
60.650	7.4064E-03	60.750	7.5852E-03	60.850	7.7639E-03
60.950	7.9426E-03	61.000	8.0320E-03		

Player Consulting, L.C.
3071 West 8900 South
West Jordan, Utah 84088
801-554-2660

March 2, 2005

HAND DELIVERED

MAY - 6 2005
05.01748
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

Mr. Darin Olson
Facility Engineer
ECDC Environmental L.C.
1111 West Highway 123
East Carbon, Utah 84520

RE: 2005 Closure, Post-Closure Care, and Post-Closure Investment Costs for the ECDC Landfill Facility.

Mr. Olson:

As per your request, I have calculated the closure, post-closure, and investment costs for the ECDC Landfill Facility. I used aerial survey information supplied to me by Olympus Aerial from the past year. Using *AutoDesk Land Desktop* with the supplied data, I established the existing topography of the landfill facility. I used this topography information and information contained in the permit application to calculate the quantities required for closure and post-closure. I used costs supplied to me from recent cell development at the facility, known costs of similar projects, contractor estimates, professional engineer estimates, and *Means CostWorks* for references to establish costs for each closure and post-closure item. Attached are the tables I used to calculate the total cost of closure, post-closure, and required investment. Following is an explanation of each of the attachments.

Attachment 1 - Closure Costs (Cell #7 and Super Cell 1-A)

1. Engineering - This item includes, but is not limited to, inspection to identify waste disposal areas, design drainage and erosion protection needs, and determine other site operational issues that need to be addressed, analyze ground water samples, and characterize operational records. The quantity of engineering has been estimated by comparison of similar projects.

2. Technical Specifications and Drawings - This item includes, but is not limited to, final cover system design and specifications, grading and drainage plans, specifications for revegetation, design of any other site improvements required, preparation of a closure schedule, contractor bidding process, and coordination of the closure plan with the Utah Division of Solid and Hazardous Waste. The quantity of time required to produce the technical specifications and drawings has been estimated by comparison of similar projects.

3. Grading of Existing Waste - The existing waste in cells must be graded to an acceptable slope. The slope will be calculated at the time of closure. The waste material will be graded to form a base upon which the capping materials will be placed. This quantity has been calculated by finding the three dimensional area of each cell at the facility that requires grading for drainage and closure. The finished grade shall be not be less than 2% on surface slopes and not greater than 33% on side slopes. Currently Cell #7 has been graded to finish grade lines; therefore the cell does not require any future grading for closure.

4. Protective Soil Cap - Material from the ECDC property will be excavated, hauled, and placed on the landfill cells. The thickness of the cap material will be 2 feet. Some cap material has already been placed on Cell #7. Therefore, when calculating the quantity of cap material for Cell #7 the variation in depth was taken into account. The depth of additional cover material varies from 0 to 1 foot in Cell #7. Additional material shall be added to complete the total designed and approved thickness. In addition to the Cell #7 quantity, Super Cell 1-A quantities are also part of this number. The Super Cell 1-A quantities were calculated by taking the three dimensional area and covering the calculated area with 1.5 feet of cap material.

5. Placement of 6" of Top Soil - Upon completion of the cap material placement on the cells, 6 inches of top soil will be placed on the protective soil cover. The quantity of top soil has been calculated by finding the three dimensional areas of Cell #7 and Super Cell 1-A then placing 0.5 feet of top soil on the total area.

6. Cover Cell with Vegetation - The cells will be seeded for the production of a vegetation cover. Seed selection will take place at the time of closure of each of the landfill cells. This quantity has been calculated by finding the three dimensional areas of Cell #7 and Super Cell 1-A.

7. Drainage Control for Landfill Cells - Drainage control for the cells will be designed and installed to allow precipitation to exit the landfill surface without eroding the landfill cells. Drainage control for Cell #7 is not needed because the cell has previously been graded and drainage controlled. The drainage control for Super Cell 1-A has been estimated by preliminary planning of run-on/fun-off control.

8. Surveying - During all activities of closure of the cells, surveying will take place to control construction of the projects. Included in this item is the boundary survey. Surveying quantity has been estimated to cover the costs of all project surveying.

9. Materials Testing and Reporting - During all activities of closure of the cells, materials testing and reporting will take place to ensure construction activities meets the requirements of the technical specifications of the projects. The quantity of testing and reporting has been estimated by comparing to similar projects.

10. Oversight, Inspection, and Supervision - During all activities of closure of the cells, management of the projects will take place to oversee all phases of construction and closure. The quantity of oversight, inspection and supervision has been estimated by comparison of similar projects.

11. Total - This line item is the total cost for closure of the cells.

Attachment 1 - Closure Costs (Cell #10)

1. Engineering - This item includes, but is not limited to, inspection to identify waste disposal areas, analyze drainage and erosion protection needs, and determine other site operational issues that need to be addressed, and analyze ground water samples and operational records. The quantity of engineering has been estimated by comparison of similar projects.

2. Technical Specifications and Drawings - This item includes, but is not limited to, final cover system design and specifications, specifications for revegetation, design of any other site improvements required by the permit, preparation of a closure schedule, contractor bidding process, and coordination of the closure plan with the Utah Division of Solid and Hazardous Waste. The quantity of time required to produce the technical specifications and drawings has been estimated by comparison of similar projects.

3. Placement of 6" of Top Soil - Upon completion of the cap material placement on the cells, 6 inches of top soil will be placed on the protective soil cover. The quantity of top soil has been calculated by finding the three dimensional area of Cell #10 then placing 0.5 feet of top soil on the total area.

4. Cover Cell with Vegetation - The cells will be seeded for the production of a vegetation cover. Seed selection will take place at the time of closure of each of the landfill cells. This quantity has been calculated by finding the three dimensional area of Cell #10.

5. Drainage Control for Landfill Cells - Drainage control for the cells will be designed and installed to allow precipitation to exit the landfill surface without eroding the landfill cells. The drainage control for Cell #10 has been estimated by preliminary planning of run-on/fun-off control.

6. Surveying - During all activities of closure of the cells, surveying will take place to control construction of the projects. Included in this item is the boundary survey. Surveying quantity has been estimated to cover the costs of all project surveying.

7. Materials Testing and Reporting - During all activities of closure of the cells, materials testing and reporting will take place to ensure construction activities meets the requirements of the technical specifications of the projects. The quantity of testing and reporting has been estimated by comparing to similar projects.

8. Oversight, Inspection and Supervision - During all activities of closure of the cells, management of the projects will take place to oversee all phases of construction and closure. The quantity of oversight, inspection and supervision has been estimated by comparison of similar projects.

9. Total - This line item is the total cost for closure of the cells.

Attachment 2 - Post-Closure Costs for the Landfill Facility

1. Collect, Treat, and Dispose of Leachate - During the post-closure care period, collection, treatment and disposal of leachate will take place. The quantity of leachate processes has been estimated by comparison of similar projects.

2. Gas Collection and Monitoring - During the post-closure care period, gas collection and monitoring will take place. The quantity of gas collection and monitoring has been estimated by comparison of similar projects.

3. Repair and maintain surface drainage structures, final cover, on-site permanent improvements and equipment - During the post-closure care period, maintenance, inspection, and repair of the final cover, run-on/run-off systems, on-site permanent improvements, and equipment will take place. The quantity of maintenance has been estimated by comparison of similar projects.

4. Rework or replace defective groundwater monitoring wells and equipment, install new wells and equipment - During the post-closure care period, maintenance, inspection, and repair of the monitoring wells will take place. If any new wells are required, they will be installed. The quantity of monitoring well maintenance has been estimated to provide quality sampling and monitoring for the life of the project.

5. Collect semi-annual groundwater samples - During the post-closure care period, collection of the groundwater samples will take place semi-annually. The quantity of groundwater samples has been estimated to comply with the post-closure requirements.

6. Analyze semi-annual groundwater samples - During the post-closure care period, analysis of the groundwater samples will take place semi-annually. The quantity of groundwater samples has been estimated to comply with the post-closure requirements.

7. Maintain site security and access control - During the post-closure care period, security of the site and access to the site will be maintained and controlled. The quantity of site security and access control has been estimated to control the site through the life of post-closure activities.

8. Provide administrative overhead for oversight and record keeping - During the post-closure care period, administrative oversight and record keeping of all activities of post-closure will take place. The quantity of oversight and record keeping has been estimated to satisfy the requirements through the life of post-closure activities.

9. Prepare post-closure certificate - During the post-closure care period, preparation of post-closure certificates by qualified personnel will take place. This has been estimated by comparison to similar projects.

10. Total - This line item is the total cost for post-closure care period for each of the landfill cells.

Attachments 3, 4, 5 - Interest Income and Yearly Costs for Post-Closure Care

Attachments 3, 4, 5 demonstrate the investment that should be made for post-closure care. The starting cost is the estimated yearly cost for post-closure care at the present time. Inserting these numbers into the table demonstrates what the initial investment should be to offset the post-closure care costs for the Washington County Landfill Facility. The table shows the estimated cost, beginning amount and ending amount of the investment for each of the thirty years required for post-closure care. In creating this attachment, it was assumed that the income interest rate would equal the inflation rate. Using this assumption, the increased costs of performing associated work at the landfill facility would be offset by the interest income from the initial investment.

The cost to close Cell #7 is $414,465. The cost to close Cell #10 is $44,459. The cost to close Super Cell 1-A is $769,462.

The investment for post-closure care of Cell #7 is $686,700. The investment for post-closure care of Cell #10 is $193,800. The investment for post-closure care of Super Cell 1-A is $719,100.

The total investment for closure and post-closure care of the ECDC Landfill Facility should be $2,827,986. If you need any additional information or have any questions, please give me a call.

Sincerely,

Gene Player

Gene Player, P.E.
Project Engineer

Attachments:

ATTACHMENT 1

2005 Closure of Cell #7

#	Description	Unit	Quantity	Cost	Total
1.	Engineering**	Job	1	$15,000	$15,000
2.	Technical Specifications and Drawings**	Job	1	$15,000	$15,000
4.	Protective Soil Cap**				
	4a) Excavation of Material**	CY	53,240	$1.34	$71,348
	4b) Haul, Placement, and Compaction of Material**	CY	53,240	$1.88	$100,289
5.	Placement of 6" of Top Soil**	CY	38,720	$2.46	$95,131
6.	Cover Cell with Vegatation*	Acre	48	$1,100	$52,800
8.	Surveying*	Acre	48	$500	$24,000
9.	Materials Testing and Reporting*	Acre	48	$500	$24,000
10.	Oversight and Supervision**	Job	1	4.25%	$16,897
11.	**TOTAL**				**$414,465**

2005 Closure of Cell #10

#	Description	Unit	Quantity	Cost	Total
1.	Engineering**	Job	1	$2,500	$2,500
2.	Technical Specifications and Drawings**	Job	1	$2,500	$2,500
3.	Placement of 6" of Top Soil**	CY	6,450	$2.46	$15,847
4.	Cover Cell with Vegatation*	Acre	8	$1,100	$8,800
5.	Drainage Control for Cell*	Cell	1	$5,000	$5,000
6.	Surveying*	Acre	8	$500	$4,000
7.	Materials Testing and Reporting*	Acre	8	$500	$4,000
8.	Oversight and Supervision**	Job	1	4.25%	$1,812
9.	**TOTAL**				**$44,459**

2005 Closure of Super Cell 1-A

#	Description	Unit	Quantity	Cost	Total
1.	Engineering**	Job	1	$11,000	$11,000
2.	Technical Specifications and Drawings**	Job	1	$11,000	$11,000
3.	Grading of Existing Waste*	Acre	26	$985	$25,610
4.	Protective Soil Cap**				
	4a) Excavation of Material**	CY	135,521	$1.34	$181,615
	4b) Haul, Placement, and Compaction of Material**	CY	135,521	$1.88	$255,282
5.	Placement of 6" of Top Soil**	CY	45,173	$2.46	$110,985
6.	Cover Cell with Vegatation*	Acre	56	$1,100	$61,600
7.	Drainage Control for Cell*	Cell	1	$25,000	$25,000
8.	Surveying*	Acre	56	$500	$28,000
9.	Materials Testing and Reporting*	Acre	56	$500	$28,000
10.	Oversight and Supervision**	Job	1	4.25%	$31,369
11.	**TOTAL**				**$769,462**

Notes:

* *Means CostWorks* was used as a reference for cost of this item.

** Known cost from a recent project or a contractor estimate was used as a reference for this item.

ATTACHMENT 2

2005 Cell #7 Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate**	JOB/YR	1	$2,400	$2,400
2.	Gas Collection and Monitoring*	HOUR	40	$60	$2,400
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipment*	JOB/YR	1	$4,320	$4,320
4.	Collect Semi-Annual Groundwater Samples*	HOURS	16	$60	$960
5.	Analyze Semi-Annual Groundwater Samples**	EACH	6	$1,655	$9,930
6.	Maintain Site Security and Access Control*	JOB/YR	1	$1,080	$1,080
7.	Provide Administrative Overhead for Oversight and				
	Record Keeping**	HOUR	16	$75	$1,200
8.	Prepare Post-Closure Certificate**	HOUR	8	$75	$600
9.	**TOTAL**				**$22,890**

2005 Cell #10 Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate**	JOB/YR	1	$1,200	$1,200
2.	Gas Collection and Monitoring*	HOUR	20	$60	$1,200
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipment*	JOB/YR	1	$2,160	$2,160
4.	Maintain Site Security and Access Control*	JOB/YR	1	$540	$700
5.	Provide Administrative Overhead for Oversight and				
	Record Keeping**	HOUR	8	$75	$600
6.	Prepare Post-Closure Certificate**	HOUR	8	$75	$600
7.	**TOTAL**				**$6,460**

2005 Super Cell 1-A Post-Closure Costs

#	Description	Unit	Quantity	Cost	Total
1.	Collect, Treat and Dispose of Leachate**	JOB/YR	1	$2,400	$2,400
2.	Gas Collection and Monitoring*	HOUR	40	$60	$2,400
3.	Repair and Maintain Surface Drainage Structures, Final				
	Cover, On-Site Permanent Improvements and Equipment*	JOB/YR	1	$5,400	$5,400
4.	Collect Semi-Annual Groundwater Samples*	HOURS	16	$60	$960
5.	Analyze Semi-Annual Groundwater Samples**	EACH	6	$1,655	$9,930
6.	Maintain Site Security and Access Control*	JOB/YR	1	$1,080	$1,080
7.	Provide Administrative Overhead for Oversight and				
	Record Keeping**	HOUR	16	$75	$1,200
8.	Prepare Post-Closure Certificate**	HOUR	8	$75	$600
9.	**TOTAL**				**$23,970**

Notes:

* *Means CostWorks* was used as a reference for cost of this item.

** Known cost from a recent project or a contractor estimate was used as a reference for this item.

ATTACHMENT 3

2005 Cell #7 Post-Closure Investment

Starting Cost	$22,890
Post-Closure Investment	***$686,700***

Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$22,890	$686,700	$663,810
2	$22,890	$663,810	$640,920
3	$22,890	$640,920	$618,030
4	$22,890	$618,030	$595,140
5	$22,890	$595,140	$572,250
6	$22,890	$572,250	$549,360
7	$22,890	$549,360	$526,470
8	$22,890	$526,470	$503,580
9	$22,890	$503,580	$480,690
10	$22,890	$480,690	$457,800
11	$22,890	$457,800	$434,910
12	$22,890	$434,910	$412,020
13	$22,890	$412,020	$389,130
14	$22,890	$389,130	$366,240
15	$22,890	$366,240	$343,350
16	$22,890	$343,350	$320,460
17	$22,890	$320,460	$297,570
18	$22,890	$297,570	$274,680
19	$22,890	$274,680	$251,790
20	$22,890	$251,790	$228,900
21	$22,890	$228,900	$206,010
22	$22,890	$206,010	$183,120
23	$22,890	$183,120	$160,230
24	$22,890	$160,230	$137,340
25	$22,890	$137,340	$114,450
26	$22,890	$114,450	$91,560
27	$22,890	$91,560	$68,670
28	$22,890	$68,670	$45,780
29	$22,890	$45,780	$22,890
30	$22,890	$22,890	$0

ATTACHMENT 4

2005 Cell #10 Post-Closure Investment

Starting Cost	$6,460
Post-Closure Investment	***$193,800***

Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$6,460	$193,800	$187,340
2	$6,460	$187,340	$180,880
3	$6,460	$180,880	$174,420
4	$6,460	$174,420	$167,960
5	$6,460	$167,960	$161,500
6	$6,460	$161,500	$155,040
7	$6,460	$155,040	$148,580
8	$6,460	$148,580	$142,120
9	$6,460	$142,120	$135,660
10	$6,460	$135,660	$129,200
11	$6,460	$129,200	$122,740
12	$6,460	$122,740	$116,280
13	$6,460	$116,280	$109,820
14	$6,460	$109,820	$103,360
15	$6,460	$103,360	$96,900
16	$6,460	$96,900	$90,440
17	$6,460	$90,440	$83,980
18	$6,460	$83,980	$77,520
19	$6,460	$77,520	$71,060
20	$6,460	$71,060	$64,600
21	$6,460	$64,600	$58,140
22	$6,460	$58,140	$51,680
23	$6,460	$51,680	$45,220
24	$6,460	$45,220	$38,760
25	$6,460	$38,760	$32,300
26	$6,460	$32,300	$25,840
27	$6,460	$25,840	$19,380
28	$6,460	$19,380	$12,920
29	$6,460	$12,920	$6,460
30	$6,460	$6,460	$0

ATTACHMENT 5

2005 Super Cell 1-A Post-Closure Investment

Starting Cost	$23,970
Post-Closure Investment	***$719,100***

Yearly Costs

Year	Yearly Cost	Beginning	Ending
1	$23,970	$719,100	$695,130
2	$23,970	$695,130	$671,160
3	$23,970	$671,160	$647,190
4	$23,970	$647,190	$623,220
5	$23,970	$623,220	$599,250
6	$23,970	$599,250	$575,280
7	$23,970	$575,280	$551,310
8	$23,970	$551,310	$527,340
9	$23,970	$527,340	$503,370
10	$23,970	$503,370	$479,400
11	$23,970	$479,400	$455,430
12	$23,970	$455,430	$431,460
13	$23,970	$431,460	$407,490
14	$23,970	$407,490	$383,520
15	$23,970	$383,520	$359,550
16	$23,970	$359,550	$335,580
17	$23,970	$335,580	$311,610
18	$23,970	$311,610	$287,640
19	$23,970	$287,640	$263,670
20	$23,970	$263,670	$239,700
21	$23,970	$239,700	$215,730
22	$23,970	$215,730	$191,760
23	$23,970	$191,760	$167,790
24	$23,970	$167,790	$143,820
25	$23,970	$143,820	$119,850
26	$23,970	$119,850	$95,880
27	$23,970	$95,880	$71,910
28	$23,970	$71,910	$47,940
29	$23,970	$47,940	$23,970
30	$23,970	$23,970	$0

EVERGREEN NATIONAL INDEMNITY COMPANY
COLUMBUS, OHIO
POWER OF ATTORNEY

PRINCIPAL ECDC Environmental, LC EFFECTIVE DATE April 14, 2005

CONTRACT AMOUNT _____ AMOUNT OF BOND $ 2,827,986.00

POWER NO. 80134

KNOW ALL MEN BY THESE PRESENTS: That the Evergreen National Indemnity Company, a corporation in the State of Ohio does hereby nominate, constitute and appoint:

*****Nicole Skedel*****

its true and lawful Attorney(s)-In-Fact to make, execute, attest, seal and deliver for and on its behalf, as Surety, and as its act and deed, where required, any and all bonds, undertakings, recognizances and written obligations in the nature thereof. PROVIDED, however, that the obligation of the Company under this Power of Attorney shall not exceed

Two Million Eight Hundred Twenty Seven Thousand Nine Hundred Eighty Six and No/100 Dollars.

This Power of Attorney is granted and is signed by facsimile pursuant to the following Resolution adopted by its Board of Directors on the 23rd day of February, 1994:

"RESOLVED, That any two officers of the Company have the authority to make, execute and deliver a Power of Attorney constituting as Attorney(s)-in-fact such persons, firms, or corporations as may be selected from time to time.
FURTHER RESOLVED, that the signatures of such officers and the Seal of the Company may be affixed to any such Power of Attorney or any certificate relating thereto by facsimile; and any such Power of Attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company; and any such powers so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with respect to any bond or undertaking to which it is attached."

IN WITNESS WHEREOF, the Evergreen National Indemnity Company has caused its corporate seal to be affixed hereunto, and these presents to be signed by its duly authorized officers this 27th day of August, 2001.

EVERGREEN NATIONAL INDEMNITY COMPANY

Roswell P. Ellis, President

Glenn D. Southwick, Treasurer

Notary Public)
State of Ohio) SS:

On this 27th day of August, 2001, before the subscriber, a Notary for the State of Ohio, duly commissioned and qualified, personally came Roswell P. Ellis and Glenn D. Southwick of the Evergreen National Indemnity Company, to me personally known to be the individuals and officers described herein, and who executed the preceding instrument and acknowledged the execution of the same and being by me duly sworn, deposed and said that they are the officers of said Company aforesaid, and that the seal affixed to the preceding instrument is the Corporate Seal of said Company, and the said Corporate Seal and signatures as officers were duly affixed and subscribed to the said instrument by the authority and direction of said Corporation, and that the resolution of said Company, referred to in the preceding instrument, is now in force.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal at Columbus, Ohio, the day and year above written.

SUE E DUFFY
NOTARY PUBLIC, STATE OF OHIO
MY COMMISSION EXPIRES AUG. 6, 2004

Notary Public State of Ohio
My Commission expires August 6, 2004

State of Ohio) SS:

I, the undersigned, Secretary of the Evergreen National Indemnity Company, a stock corporation of the State of Ohio, DO HEREBY CERTIFY that the foregoing Power of Attorney remains in full force and has not been revoked; and furthermore that the Resolution of the Board of Directors, set forth herein above, is now in force.

Signed and sealed in Columbus, Ohio this 14th day of April 2005.

John A. Marazza, Secretary

Any reproduction or facsimile of this form is void and invalid.

INCREASE RIDER TO SURETY BOND

PURPOSE: INCREASE

To be attached to Bond Number 80134 issued by Evergreen National Indemnity Company, as Surety in the amount of Two Million Four Hundred Sixty Seven Thousand Four Hundred Seventy Nine and 00/100 Dollars ($2,467,479.00), on behalf of ECDC Environmental, LC, in favor of the Utah Department of Environmental Quality.

In consideration of the premium charged for the attached bond, it is mutually understood and agreed by the Principal and the Surety that the bond shall be modified to read as follows: The above said bond amount shall be Two Million Eight Hundred Twenty Seven Thousand Nine Hundred Eighty Six and 00/100 Dollars ($2,827,986.00)(Closure: $1,228,386.00 and Post Closure: $1,599,600.00, effective the 14th day of April 2005.

All other items, limitations and conditions of said bond except as herein expressly modified shall remain unchanged.

Signed, sealed and dated this 14th day of April 2005.

Principal: ECDC Environmental, LC

By: _____
Jo Lynn White, Secretary

Surety: Evergreen National Indemnity Company

By: _____
Nicole Skedel, Attorney-In-Fact

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JAN 25 2007
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

GROUNDWATER SAMPLING AND ANALYSIS PLAN (GWSAP)

ECDC ENVIRONMENTAL FACILITY CARBON COUNTY, UTAH

Project No: 06-06-04

Prepared for

ECDC Environmental Facility

June 2006

Prepared by:

The Carel Corporation
136 Pecan Street
Keller, TX 76248

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1 Background/Detection Monitoring Parameters

Appendix A Field Data Sheet
Appendix B Recommended Containerization and Preservation of Samples
Appendix C Calibration Data Sheet
Appendix D Sample Chain-of-Custody
Appendix E Statistical Analysis Plan

1 INTRODUCTION

The following sampling and analysis plan covers the procedures for collecting representative samples from groundwater monitoring wells and the laboratory requirements for obtaining valid, defensible data. The current groundwater monitoring system consists of six groundwater monitor wells, three upgradient wells (MW-A, MW-B, and MW-C) and three downgradient wells (MW-7S, MW-7SW, and MW-SC1AS). Wells are completed into alluvial fan deposits overlying the Cretaceous age Mancos Shale, which forms a barrier to further downward groundwater migration below the up to 60 feet thick alluvium. Groundwater flow is generally to the west-southwest. The groundwater monitoring network complies with UAC R315-308-2(1)(a) and (b) based on review of the number and location of wells relative to unit boundaries and prior approved landfill design and permitting documentation. Details of site geology and hydrogeology can be found in ECDC Environmental, LC Landfill Carbon County, Utah Hydrogelogic Report (RB&G Engineering, Inc. March 1996).

The plan is a general requirement for groundwater monitoring sampling and analysis based primarily on the federal requirements in 40 CFR Part 258, current EPA guidance documents, and Utah Administrative Code (UAC) R315-308-2 Solid Waste Permitting and Management Rules.

2 FIELD PROCEDURES

2.1 Field Sampling Health and Safety Plan

A health and safety plan is required for all groundwater sampling events at the ECDC Environmental Facility. Prior to monitoring well purging and sampling, the sampling contractor's Groundwater Sampling Health and Safety Plan must be in place. Designing the site Groundwater Sampling Health and Safety Plan will be the duty of the party performing the actual work.

In addition, each laboratory facility should have their own standard laboratory health and safety plan as required by current OSHA regulations.

2.2 Sample Event Preparation and QA/QC

2.2.1 General Event Preparation

The laboratory performing the groundwater analysis shall supply all necessary coolers, pre-cleaned containers, trip blanks, chemical preservatives, labels, custody seals, and chain-of-custody and shipping forms. All field data shall be entered on a Field Data Sheet (see example provided as Appendix A) or equivalent form. Adequate instructions to the laboratory must be given in advance of each monitoring event. Details concerning any changes to the monitoring plan and/or procedures need to be given to the laboratory prior to the field sampling personnel arriving on the site. A specific contact person shall be established at both the facility and contract laboratory for communication between the two (2) parties.

2.2.2 Sample Container Selection

Sample containers need to be constructed of a material compatible and non-reactive with the material it is to contain. Consult Appendix B, *Recommended Containerization and Preservation of Samples*, to determine the number, type and volume of appropriate containers. The contract laboratory performing the analysis shall supply all the required containers. In special circumstances when the facility must obtain its own containers,

these containers will be purchased from local container distributors with the exception of the septum vials and PTFE (e.g. Teflon®) lined caps required for organic analyses which are available from laboratory supply companies. Metal lids shall not be utilized for any sample containers.

2.2.3 Container Preparation

Sample containers will be purchased as a pre-cleaned product or cleaned in the laboratory in a manner consistent with EPA protocol.

2.2.4 Sample Equipment Preparation

This section outlines the equipment preparation prior to site arrival for a specific monitoring event. This equipment preparation includes minimum decontamination procedures for water level indicator(s), pH/temperature meter, specific conductivity meter, turbidity meter, and filtration device. Operation and calibration of equipment will be as per the manufacturer's instructions. All non-dedicated equipment will be thoroughly cleaned prior to arrival at the site and between sampling points as follows:

- Water Level Indicator(s) - Water level indicator(s) will be decontaminated prior to initial site arrival by hand washing the sensor probe and entire length of tape in a non-phosphate detergent followed by rinsing with deionized water. While the tape is reeled back onto the carrying spool, the tape and probe will be wiped down with a clean dry paper towel.

- Field Parameter (Temperature, pH, Specific Conductivity, Turbidity) Measuring Device(s) – Field parameter measuring device(s) will be decontaminated by hand washing the sample cells in a non-phosphate detergent followed by rinsing with deionized water. Meters will then be checked for proper calibration and operation as per the manufacturer's instructions. Field calibration results will be recorded on a Calibration Data Sheet (Appendix C). Any malfunctioning meters will be replaced prior to packing. Field parameter measuring device(s) will be rinsed with deionized water after each measurement.

- Sampling devices associated with groundwater sampling will be cleaned in non-phosphate detergent, followed by rinsing with deionized water.

Multiple-use equipment (e.g. water level indicators and filter chambers) must be thoroughly decontaminated and cleaned as described in this section to prevent cross contamination from prior use at other facilities. All field instruments must be properly checked and calibrated prior to arrival on-site at a sampling location.

2.2.5 Field QA/QC Samples

Field QA/QC samples consist of two (2) primary areas of quality control. The first part is the quality control of sample contamination, which may occur in the field and/or shipping procedures. This is monitored in the trip blank(s), field blank(s), and the equipment (rinsate) blank(s). A basic description of each is as follows:

- Trip Blank - These samples will be prepared in the laboratory by filling the appropriate clean sample containers with organic-free water and adding the applicable chemical preservative, if any, as indicated in Appendix B for each type of sample. These containers are to be labeled "Trip Blank", the analyses to be performed on each container indicated, and then shipped in the typical transportation cooler to the field and back to the laboratory along with the other sample set containers for a given event. This blank is tested for any contamination that may occur as a result of the containers, sample coolers, cleaning procedures, or chemical preservatives used. Trip blanks shall be taken and analyzed for each sampling event or a minimum of a one (1) in twenty (20) batch per monitoring event for volatile organic compounds (VOCs).

- Field Blank - Field blank containers will be prepared in the field at a routine sample collection point during a monitoring event by filling the appropriate sample containers from the field supply of deionized water. This field supply water shall be the same water used for cleaning and decontamination of all field purge and sample equipment. This blank is tested for any contamination that may occur as a result of site ambient air conditions and serves as an additional check for contamination in the containers, sample transport coolers, cleaning procedures, and any chemical preservatives. Field blanks shall be taken and analyzed for each sampling event or a minimum of a one (1) per cooler per monitoring event for VOCs.

- Equipment (Rinsate) Blank - These blanks will be prepared in the field immediately following decontamination cleaning procedures on any non-dedicated equipment used for purging, sampling or sample filtration. Following decontamination, field supply organic-free water is passed through the non-dedicated equipment in the same procedure as a groundwater sample. This blank confirms proper field decontamination procedures on non-dedicated equipment utilized in the field. Equipment blanks shall be taken and analyzed for all applicable parameters anytime non-dedicated equipment is used or new equipment is being dedicated to a well at a batch minimum of one (1) in twenty (20) per monitoring event.

Other Field QA/QC Samples - A second area of standard field QA/QC samples are field duplicates.

- Field duplicates are an extra set of samples taken at a particular monitoring point and labeled "Field Duplicate". These are independent samples that are collected as close as possible to the same point in space and time. They are two (2) separate samples taken from the same source, stored in separate containers, and analyzed independently. Field duplicates are useful in documenting the precision of the sampling and analytical process. Samples shall be collected in proper alternating order for the sample point and field duplicate for each parameter (e.g. VOA - VOA, metals - metals, etc.) Field duplicates shall be taken and analyzed at a batch minimum of one (1) in twenty (20).

Appropriate field QA/QC documentation should be recorded in the field notes (e.g. locations where the field blank or duplicate were collected).

2.3 Well Purge

2.3.1 General Well Purge Information

Purging a monitoring well is just as important as the subsequent sampling of the well. Water standing in a monitor well over a certain period of time may become unrepresentative of formation water because of chemical and biochemical changes which may cause water quality alterations. Prior to monitoring well purge, inspection of the monitoring well integrity will be performed utilizing the Field Data Sheet (Appendix A) or equivalent form.

2.3.2 Water Level Measurement

Prior to any purge or sampling activity at each monitoring well, a water level measurement is required to be taken. Measurement of the static water level is important in determining the hydrogeologic characteristics of the subsurface (e.g. upgradient and downgradient). The water level indicator will be an electronic sensor device, which signals by audio or light indicator when the probe contacts the water.

Water level indicator equipment will be constructed of chemically inert materials and, during mobilization preparation and following each monitoring point, be decontaminated with a non-phosphate detergent followed with multiple deionized water rinses. Water levels will be measured with a precision of +/- 0.01 foot. Water level indicator devices will be periodically checked for proper calibration. Calibration shall be performed at a frequency recommended by the manufacturer. Each monitor well shall have a reference elevation point located and properly marked at the top of the riser casing established by a licensed surveyor. This reference point elevation is measured in relation to Mean Sea Level (MSL).

Ground water elevations in wells that monitor the same waste management area must be measured within a forty-eight (48) hour period to avoid temporary variations in groundwater flow, which could preclude accurate determination of groundwater flow rate and direction.

2.3.3 Purge Equipment and Procedure

Well purging will take place from hydraulically upgradient wells to hydraulically downgradient wells. If known impacts exist, purging will take place from the least impacted well to the most impacted well. Prior to purge, the sample personnel will put on clean disposable nitrile gloves and an initial water level will be taken as described in Section 2.3.2.

Groundwater wells will be purged with dedicated bladder pumps. These pumps will remain dedicated to each respective well throughout monitoring unless replacement is necessary due to damage or wear, in which case repairs will be completed or a new pump will be dedicated. Purge procedures for dedicated equipment are described in Section 2.3.3.1. Pump intakes will be located as close as possible to the middle of the screened interval.

2.3.3.1 Dedicated Equipment

Low Flow Technique

Low-flow purging is the preferred purging and sampling technique and will be employed using dedicated bladder pumps if proper pump controller and field instruments are available to the sampling personnel. Well purging will be conducted at a rate of approximately 100 milliliters per minute until a minimum of two pump and tubing volumes have been removed and stabilization of field parameters is achieved. Field parameters include temperature, specific conductivity, pH, and turbidity.

Parameter stabilization is defined as:

- Temperature = ± 10% for three (3) consecutive measurements
- pH = ± 0.1 standard pH units for three (3) consecutive measurements
- Specific Conductivity = ± 3% for three (3) consecutive measurements
- Turbidity = ± 10% for three (3) consecutive measurements

Measurements will be recorded on the field data sheet every three to five minutes. Water level measurement will also be taken every three to five minutes and recorded on the field data sheet. An initial decrease in water level may be expected due to pump and tubing

evacuation, however, minimal subsequent continuous drawdown is to be expected. Should a well repeatedly not meet one or more criteria, alternate criteria may be implemented with UDEQ approval.

Fixed Volume Technique

If Low-Flow techniques are not used, wells will be purged a minimum of three (3) well casing volumes of water or until dryness if occurring prior to removal of three well casing volumes of water. Measurements of temperature, pH, conductivity, and turbidity will be recorded at intervals of approximately three to five minutes on a Field Data Sheet (see Appendix A) during purging.

A bladder pump will be used for both well purging and sample collection.

Equipment:

- Bladder pump
- Bladder pump controller
- Compressed air source
- New disposable gloves of appropriate material (nitrile)
- Graduated pail and/or cylinder
- Field parameter measurement device/s

Procedure:

- Appropriate disposable gloves are to be worn during installation.
- Connect the compressed air source to the pump fitting at the top of the well.
- Start the air compressor.
- Replace disposable gloves after handling the compressor.
- Turn on the pump controller and adjust the discharge and refill cycles to the appropriate settings.
- Press the start button on the controller, which begins the pumping action.
- Adjust the controller to the desired flow rate (approximately 100 milliliters per minute).

Continue pumping until the necessary volume of water has been purged from the well and field parameters have stabilized.

2.3.3.2 Non-Dedicated Equipment

In the event of a non-operative dedicated pump, the pump and tubing apparatus will be removed for repairs or replacement and the well will be purged by means of either a

disposable bailer or a portable pump until such time the bladder pump is repaired/replaced and rededicated to the well. Purging will be performed by removing a minimum of three well-casing volumes of water from the well or until stabilization of field parameters (as defined in Section 2.3.3.1) occurs. Purging will be deemed complete if the well goes dry before three well-casing volumes of water have been removed. Field parameters will be measured after each well-casing volume of water removed.

Equipment:

- Non-dedicated pump/bailer
- Pump controller (if required)
- Generator or other power source/driving mechanism for pumps / appropriate disposable string or rope for bailer, downrigger (optional)
- New disposable tubing
- New disposable gloves of appropriate material (nitrile)
- Graduated pail or other appropriate container
- Field parameter measurement device(s)
- Container for laboratory grade, nonphosphate soap/reagent-grade deionized water solution
- Container for reagent-grade deionized water rinse

Procedure (Specific operating instructions vary depending on the type of portable pump used. The steps listed below are generalized procedures)

- Don a new pair of gloves.
- Cleanse portable pump/bailer with a non-phosphate, laboratory grade detergent solution followed by a reagent-grade deionized water rinse. Sufficient water should be passed through a non-dedicated pump to ensure proper cleansing.
- Remove gloves worn during cleaning and don a new pair of gloves.
- Attach new disposable tubing to pump or new disposable string to bailer.
- Insert pump and tubing/bailer into well.
- Start the portable pump by the appropriate method and adjust flow to desired rate / initiate removal of water from well with bailer. Ensure bailer and string does not touch ground during purging.

When purging with a bailer, introduce bailer into water column slowly (i.e. do not "drop" into water column) to avoid agitation of water in the well and immediate formation area.

Non-dedicated equipment will be constructed of chemically inert materials and will be decontaminated at each well with a non-phosphate detergent followed with a reagent-grade deionized water rinse. Additional cleaning procedures will be performed as deemed necessary.

Rate of discharge and volume purged will be checked periodically with a graduated bucket and/or timer. Field parameter (temperature, pH, specific conductivity, and turbidity) measurements will be recorded after each well volume of water is removed during purging.

2.3.4 Purge Water Management

If purge water is known to be historically contaminated or suspect due to prior analytical data, the water shall be stored in appropriate containers until analytical results are available. After review of these analyses, proper arrangements for disposal or treatment of the water shall be made. Otherwise, purge water will be discarded on the ground away from the monitor well area.

2.4 Monitoring Well Sample Collection

2.4.1 General Sample Collection Information

Sampling should take place as soon as purging is complete if the well has sufficient recharge. If the well was purged dry or significant drawdown of the water level exists immediately after purge, the monitor well should be sampled as soon as sufficient water is present for all analytes to be collected. The time interval between the completion of well purge and sample collection normally should not exceed forty-eight hours.

2.4.2 Sample Collection Order

Monitor well sampling at each event shall proceed from the point with the highest water level elevation to those with successively lower elevations unless contamination is known to be present. If contamination is known to be present, samples will be collected from the least to most contaminated wells, to minimize the potential for any cross-contamination. Samples will be collected and containerized according of the volatility of the requested analyses. A specific collection order is as follows:

- Field Parameters (Temperature, pH, Specific Conductivity, Turbidity)
- Volatile Organics
- Metals
- Inorganics

2.4.3 Sampling Equipment/Procedures

Groundwater wells will be sampled using dedicated bladder pumps. These are the same pumps used for well purging.

2.4.4 VOC Sample Collection

Filling VOC sample containers involves extra care. The water should be gently added to each vial until a positive meniscus is formed over the top of the container. This insures no headspace is present in the sample vial upon replacing the cap. After the cap has been placed on the vial and tightened, the vial should be checked for air bubbles by turning upside down and tapping with finger. If a bubble is seen rising to the top of the inverted vial, the process outlined above should be repeated. If no air bubbles are seen in each vial, the process is complete.

2.4.5 Sample Filtration

All efforts must be made to delete or minimize controllable factors to allow the collection of as representative and turbid-free sample as possible. Utah DEQ, UAC, Solid Waste Permitting and Management Rules does not currently allow for field sample filtration of constituents listed in R315-308-4 prior to laboratory analysis (R315-308-2 (4)(d)). The facility may collect samples for laboratory filtration and analysis of dissolved metals when deemed necessary. Otherwise, metal and inorganic indicator analyses will be for total concentrations.

2.4.6 Sample Preservation

All samples will be containerized and preserved according to Appendix B, *Recommended Containerization and Preservation of Samples.* In the goal to obtain the most representative sample possible, preserving the sample for transportation and storage to the laboratory is also important.

Methods of preservation are intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce the volatility of constituents. Samples requiring refrigeration to four degrees Centigrade will be accomplished by placing the sample containers immediately into coolers containing wet ice and delivering to the analytical laboratory as soon as possible.

2.4.7 Field Measurements

Required field measurements include water levels, temperature, pH, specific conductivity, and turbidity. Each of these measurements is important in the documentation of properly collected groundwater samples.

All instruments shall be properly calibrated and checked with standards according to the manufacturer's instructions and/or the field crew's standard operating procedures. Any improper operating instruments must be replaced prior to continuing sample collection operations.

2.5 Record Keeping

2.5.1 Field Logs

All field notes must be completely and accurately documented to become part of the final report for a monitoring event. All field information will be entered on a Field Data Sheet (see Appendix A) or equivalent form.

All entries shall be legible and made in indelible ink. Entry errors will be crossed out with a single line, dated, and initialed by the person making the corrections.

2.5.2 Chain-of-Custody

Proper chain of custody records are required to insure the integrity of the samples and the conditions of the samples upon receipt at the laboratory, including the temperature of the samples at the time of log in. The sample collector shall fill in all applicable sections and forward the original, with the respective sample(s), to the laboratory performing the analysis. Upon receipt of the samples at the laboratory, the sample coordinator is to complete the chain of custody, make a copy for his/her files, and make the original documents part of the final analytical report (see example provided as Appendix D). All sample containers will be labeled to prevent misidentification. The following will be indicated on an adhesive label with a waterproof pen:

- Collector's name, date and time of sampling
- Sample source
- Sample identification number
- Sample preservatives
- Test(s) to be performed on the sample

Sample shuttle kits (coolers) will employ a tamper proof seal.

2.6 Sample Transport

Samples shall be shipped from the field back to the analytical laboratory either by hand delivery or utilizing an overnight courier service. Samples are to be shipped in sealed insulated shipping containers. Standard shipping containers must be a sturdy waterproof design (ice chests are commonly used) equipped with bottle dividers and cushion material to prevent breakage during shipment. Since wet ice is the most common means by which to refrigerate the samples, appropriate measures need to be taken to fully waterproof the contents from leakage. The field crew shall contact the laboratory each time samples are sent to identify the samples being sent and the transportation carrier along with the shipping identification number.

The laboratory shall provide a notification concerning the receipt of the groundwater samples as soon as practical after they have been received. The notification will include the date, temperature, and condition of sample bottles received.

3 LABORATORY PROCEDURES/ PERFORMANCE STANDARDS

3.1 Analytical Methods

Chemical analyses will be performed by a laboratory that is certified by the State of Utah to analyze each Table 1 constituent. Methods and reporting limits will conform to Table 1 and will be performed in accordance with test procedures presented in USEPA *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, September 1986 and any subsequent revisions or additions.

Alternative methods that provide equivalent or better performance than those listed in EPA publication SW-846 and analytical methods for constituents not listed in EPA publication SW-846 may be implemented with the approval of the Executive Secretary.

3.2 Deliverables (General and Supplemental QA/QC)

3.2.1 General Requirements

For general reporting of quantitative results for Subtitle D groundwater monitoring projects, the following reporting requirements apply:

- Methodology Summary - reporting of all the analytical test methods used in the analyses of the samples with a reference made for each to the method manual and the test method number to confirm compliance with Table 1.

- Summary of the analytical results, indicating appropriate unit, and reporting RL: and supervisor approval – concentration units must be consistently applied throughout report. Data cannot be method blank corrected. It must be appropriately flagged.

- Chain-of-Custody Form – As per Section 2.5.2.

- Field Data Sheets (see Appendix A) or equivalent form.

3.2.2 Supplemental QA/QC Reporting Requirements

- Laboratory Chronicles – must include date of sampling, sample receipt, preservation, preparation, analysis, and supervisor approval signature.

- Non-Conformance Summary for GC/MS Data Reports – must state if the following do not meet QA/QC requirements:

  GC/MS Tune Specifications
  GC/MS Tune Frequency
  Calibration Frequency
  Calibration Requirements – System Performance Check
  Compounds, Calibration Check Compounds
  Blank Contamination
  Surrogate Recoveries
  Sample Holding Times
  Minimum Detection Limits

3.2.3 Requirements for Organics: Volatiles

1. Quality Assurance (QA) Data Form – must include minimum detection limits, method blanks, field/trip blanks if specified in Sampling Plan, lab replicate. Quality Control (QC) samples may be other than project samples, but must be of same batch and similar matrix. A single QA Data Form should be used for a number of samples; however, pertinent sample numbers must be listed on the form.

2. Surrogate Compound Recovery Summary – for samples and blanks – as per most recent version of applicable SW-846 method 8260.

3. Other requirements per Laboratory Quality Assurance Plan and regulatory requirements.

3.2.4 Laboratory Requirements for Metals

At a minimum, method detection limits must be established and method blank results are mandatory.

3.2.5 Requirements for Inorganic - General Chemistry

Quality Assurance (QA) Data Form - must include minimum detection limits, method blanks, field/trip blanks as specified in Sampling Plan, lab replicate. Quality Control

(QC) samples may be other than project samples, but must be of same batch and similar matrix.

A single QA Data Form should be used for a number of samples; however, pertinent sample numbers must be listed on the form. In addition, spiked sample results must be included.

3.3 Data Quality Objectives

3.3.1 Required Reporting Limits

Data reported must be such that the method used shall achieve the nominal reporting limits (RLs) listed in Table 1 - Background/Detection Monitoring Parameters

3.3.2 Precision

Precision refers to the reproducibility of method results when a second aliquot of the same sample undergoes duplicate analysis. The degree of agreement is expressed as the Relative Percent Difference (RPD). Precision requirements shall be as per applicable method and laboratory standards.

3.3.3 Accuracy

Accuracy refers to the agreement between the amount of a constituent measured by a test method and the amount actually known to be present. Accuracy is usually expressed as a percent Recovery (R). Accuracy shall be as per applicable method and laboratory standards.

4 SAMPLING FREQUENCY AND REPORTING REQUIREMENTS

4.1 Background

As per UAC R315-308-2 (4)(a), a minimum of eight (8) independent samples will be collected and analyzed to establish background for the constituents listed in Table 1 to establish background concentrations. Each monitor well in the site groundwater monitoring program will be defined as background or detection.

4.2 Detection Monitoring Events

After establishment of background values, sampling and analysis for both upgradient and downgradient detection monitoring wells will be conducted on a semi-annual basis (every six (6) months) for constituents listed in Table 1.

4.3 Groundwater Analysis Result Submittals

Two (2) bound copies of a report of all groundwater sampling and analysis results will be submitted to the Executive Secretary. The report will be submitted in standard laboratory format and on any applicable state agency reporting forms. Within a reasonable period of time after completing sampling, the owner/operator must determine whether there has been a statistically significant change over background (SSC) at each monitoring well as per UAC R315-308-2 (4) (f) (v).

If there has been a statistically significant change over background of any tested constituent at any monitoring well, a notice in writing to the UDEQ will be submitted within fourteen (14) days after the finding.

5 STATISTICAL METHODOLOGY - GROUND WATER DATA ANALYSIS

Statistical comparisons will be performed using Sanitas™, a commercial software program developed by Intelligent Decision Technologies, Inc. or another comparable computer program. Statistical analyses of groundwater data will be performed in accordance with UAC R315-308-2 (7). A statistical analysis plan has been prepared and included as Appendix E. Appendix E Statistical Analysis Plan has been prepared using generally accepted statistical analysis principals and practices (IDT, 2002). However, it is not possible to predict all of the potential future circumstances. Therefore, alternative methods may be used that are more appropriate for the data distribution of the constituents being evaluated.

5.1 Statistically Significant Constituents and Verification Resampling

Statistical analysis of selected constituents in Table 1 will commence within six (6) months after completion of eight (8) quarterly background events for a particular well. An initial Statistically Significant Change over background (SSC) will be based on any compound detected in any downgradient monitor well at a concentration above the specific constituent's statistical limit. If an initial SSC of any constituent is indicated at any downgradient monitoring well, a notice will be made to the Department in the form of a statistical analysis report as referenced in Section 4.3 of this plan.

Verification resampling is an integral part of the presented statistical methodology. In the event of an initial SSC, verification resampling may be conducted and the results provided to the Executive Secretary in accordance with UAC R315-308-2 (10) (b).

As per UAC R315-308-2 (10) (c), the owner/operator may demonstrate, to the satisfaction of the Executive Secretary, within 90 days of the finding that the SSC is the result of a source other than the Municipal Solid Waste Landfill (MSWLF), such as error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Otherwise, the owner/operator must initiate an assessment monitoring program under UAC R315-308-2 (11).

6 REFERENCES

American Society of Testing and Materials (ASTM), 1986. *Standard Guide for Sampling Groundwater Monitoring Wells.* D 4448 - 850.

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Martin, W.F., Lippitt, J.M., and Protherd, T.G. 1987. *Hazardous Waste Handbook For Health and Safety,* Butterworth Publishers, Stoneham, Massachusetts, pp. 28 - 30.

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U.S. Environmental Protection Agency, 1989. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington D.C.

U.S. Environmental Protection Agency, 1992. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington D.C.

U.S. Environmental Protection Agency, 1992. *RCRA Groundwater Monitoring: Draft Technical Guidance.* EPA/530-R-93-001, NTIC # PB93-139-350, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, 1991b. *Handbook - Groundwater, Volume II: Methodology.* EPA/625/6-90/0166.

U.S. Environmental Protection Agency, November 1986. *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, Third Edition (Revised),* SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, November 1993. *Solid Waste Disposal Facility Criteria Technical Manual.* EPA/530-R-93-017, NTIC #PB94-100-450, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, Federal Register, 40 CFR 258, October 9, 1991.

TABLES

Table 1
List of Analytical Parameters
ECDC Environmental Facility

Inorganic Constituents	CAS	Method[1]	RL[2] (mg/L)
Ammonia as Nitrogen	7664-41-7	350.1	1
Carbonate/Bicarbonate		310.1	10
Calcium		6010 or 6020	0.6
Chemical Oxygen Demand (COD)		410.2	10
Chloride		300.0	10
Iron	7439-89-6	6010 or 6020	0.1
Magnesium		6010 or 6020	0.2
Manganese	7439-96-5	6010 or 6020	0.015
Nitrate as Nitrogen		300.0 or 353.2	5
pH		150.1	N/A
Potassium		6010 or 6020	5
Sodium		6010 or 6020	5
Sulfate		300.0 or 375.4	10
Total Dissolved Solids (TDS)		160.1	10
Total Organic Carbon (TOC)		415.1	2
Heavy Metals	**CAS**	**Method[1]**	**RL[2] (mg/L)**
Antimony	7440-36-0	6010 or 6020 or 200.8	0.005
Arsenic	7440-38-2	7041 or 6020	0.04
Barium	7440-39-3	6010 or 6020	0.02
Beryllium	7440-41-7	7091 or 6020	0.002
Cadmium	7440-43-9	6010 or 6020	0.001
Chromium		6010 or 6020	0.05
Cobalt	7440-48-4	6010 or 6020	0.07
Copper	7440-50-8	6010 or 6020	0.05
Lead		7421 or 6020 or 200.8	0.01
Mercury	7439-97-6	6020 or 7470	0.001
Nickel	7440-02-0	6010 or 6020	0.01
Selenium	7782-49-2	7740 or 6010 or 6020	0.02
Silver	7440-22-4	6010 or 6020	0.07
Thallium		7841 or 6020 or 200.8	0.002

Table 1 (Continued)

Heavy Metals	CAS	Method[1]	RL[2] (mg/L)
Vanadium	7440-62-2	6010 or 7911	0.02
Zinc	7440-66-6	6010 or 6020	0.01

Volatile Organic Compounds	CAS	Method[1]	RL[2] (µg/L)
Acetone	67-64-1	8260B	10
Acrylonitrile	107-13-1	8260B	50
Benzene	71-43-2	8260B	4
Bromochloromethane	74-97-5	8260B	4
Bromodichloromethane	75-27-4	8260B	4
Bromoform (tribromomethane)	75-25-2	8260B	4
Carbon disulfide	75-15-0	8260B	4
Carbon tetrachloride	56-23-5	8260B	4
Chlorobenzene	108-90-7	8260B	4
Chloroethane (ethyl chloride)	75-00-3	8260B	8
Chloroform (trichloromethane)	67-66-3	8260B	4
Dibromochloromethane (Chlorodibromomethane)	124-48-1	8260B	4
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260B	0.2
1,2-Dibromoethane (ethylene dibromide, EDB)	106-93-4	8260B	0.05
o-Dichlorobenzene (1,2-dichlorobenzene)	95-50-1	8260B	4
p-Dichlorobenzene (1,4 dichlorobenzene)	106-46-7	8260B	4
trans-1,4-Dichloro-2-butene	110-57-6	8260B	4
1,1-Dichloroethane (ethylidene chloride)	75-34-3	8260B	4
1,2-Dichloroethane (ethylene dichloride)	107-06-2	8260B	4
1,1-Dichloroethylene (1,1-dichloroethene)	75-35-4	8260B	4
cis-1,2-Dichloroethylene (1,1-dichloroethene)	156-59-2	8260B	4
trans-1,2-Dichloroethylene (trans-1,2-dichloroethene)	156-60-5	8260B	4
1,2-Dichloropropane (propylene dichloride)	78-87-5	8260B	4
cis-1,3-dichloropropene	10061-01-5	8260B	2
trans-1,3-dichloropropene	10061-02-6	8260B	2

Table 1 (Continued)

Volatile Organic Compounds	CAS	Method[1]	RL[2](µg/L)
Ethylbenzene	100-41-4	8260B	4
2-Hexanone (methyl butyl ketone)	591-78-6	8260B	5
Methyl bromide (bromomethane)	74-83-9	8260B	5
Methyl chloride (chloromethane)	74-87-3	8260B	2
Methylene bromide (dibromomethane)	74-95-3	8260B	4
Methylene chloride (dichloromethane)	75-09-2	8260B	4
Methyl ethyl ketone (MEK, 2-butanone)	78-93-3	8260B	5
Methyl iodide (iodomethane)	74-88-4	8260B	4
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1	8260B	5
Styrene	100-42-5	8260B	4
1,1,1,2-Tetrachloroethane	630-20-6	8260B	4
1,1,2,2-Tetrachloroethane	79-34-5	8260B	4
Tetrachloroethylene (tetrachloroethene)	127-18-4	8260B	4
Toluene	108-88-3	8260B	4
1,1,1-Trichloroethane (methylchloroform)	71-55-6	8260B	4
1,1,2-Trichloroethane	79-00-5	8260B	4
Trichloroethylene (trichloroethene)	79-01-6	8260B	4
Trichlorofluoromethane (CFC-11)	75-69-4	8260B	4
1,2,3-Trichloropropane	96-18-4	8260B	4
Vinyl acetate	108-05-4	8260B	5
Vinyl chloride	75-01-4	8260B	2
Xylenes (total)	1330-20-7	8260B	4

1. Equivalent or better methods may be submitted as appropriate
2. Reporting Limits

For the compounds DBCP and EDB, any detectable amount between the RL and MCL will be estimated and flagged with an appropriate symbol.

APPENDIX A

FIELD DATA SHEET

ECDC ENVIRONMENTAL FACILITY

GROUNDWATER SAMPLING FIELD DATA SHEET

Well Number:_____

Sample I.D.: _____ (if different from well no.)

Project: _____

Personnel:_____

Date: _____

Weather: _____ Air Temp: _____

WELL DATA:

Casing Diameter: _____ (in) ☐ PVC ☐ Other: _____

DEPTH TO: Static Water Level (WL): _____ (ft) Total Depth (TD): _____ (ft)

DATUM: ☐ Top of Well Casing ☐ Top of Protective Casing

CONDITION: Is well clearly labeled? ☐ Yes ☐ No

Is prot. casing in good cond.? (not bent or corroded) ☐ Yes ☐ No

Is concrete pad intact? (not cracked or frost heaved) ☐ Yes ☐ No

Is padlock functional? ☐ Yes ☐No Is inner casing intact? ☐ Yes ☐ No

Is inner casing properly capped and vented? ☐ Yes ☐ No

Comments: _____

PURGE DATA:

One Casing Volume = (d/24)2 (23.5)(TD-WL)

METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____ Low-Flow Purging Used? ☐Yes ☐ No

MATERIALS: Type of Pump: _

Tubing: ☐Teflon® ☐ Polyethylene ☐ Polypropylene ☐ Other: _____

PURGING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐ Field-Cleaned

PROCEDURES: Pump & Tubing Vol.: _____(ml) Pumping Rate: _____ (ml/min)

CALIBRATION: pH Meter Model: _____ Meter S/N: _____ Time: _____

Cond. Meter Model: _____ Meter S/N: _____ Time: _____

Disposition of Purge Water: _____

TIME SERIES DATA:

Time:	_____	_____	_____	_____	_____	_____	_____
Cum. Volume(ml)	_____	_____	_____	_____	_____	_____	_____
Temperature (®C)	_____	_____	_____	_____	_____	_____	_____
pH (s.u.):	_____	_____	_____	_____	_____	_____	_____
Spec. Cond. (µmhos/cm):	_____	_____	_____	_____	_____	_____	_____
Turbidity (NTU):	_____	_____	_____	_____	_____	_____	_____
Other	_____	_____	_____	_____	_____		

SAMPLING DATA:

Sample Collection Time: _____

Water Level at Time of Sample: _____

METHOD: ☐ Bladder Pump ☐ Bailer ☐ Other: _____

SAMPLING EQUIPMENT: ☐ Dedicated ☐ Prepared Off-Site ☐Field-Cleaned

APPEARANCE: ☐ Clear Turbid (NTU): _____Color: _____ ☐ Contains Immiscible Liquid

FIELD DETERMINATIONS: Temp. (°C):_____pH (s.u.):_____Spec. Cond. (µmhos/cm): _____

General Remarks: _____

_____

_____

I certify that this sample was collected and handled in accordance with applicable regulatory and project protocols.

Signature:_____ Date:_____

APPENDIX B

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Measurement	Volume (mL)	Container[a]	Preservative	Holding Times	Reference
Physical Properties					
Specific Cond. (Field)	100	P,G	None	Det. on Site	1
Specific Cond. (Lab)	100	P,G	Cool, 4 °C	28 Days	1
pH (Field)	50	P,G	None	Det. on Site	1,2
pH (Lab)	50	P,G	None	24 Hrs	1,2
Temperature	1000	P,G	None	Det. On Site	1
Turbidity	100	P,G	None	Det. On Site	1

Measurement	Volume (mL)	Container[a]	Preservative	Holding Times	Reference
Inorganics, Non-Metallics					
Carbonate/Bicarbonate	200	P,G	Cool, 4 °C	14 days	1
Chloride	200	P,G	None	28 Days	1,2
Nitrate plus Nitrite	200	P,G	Cool, 4 °C H_2SO_4 to pH <2	28 days	1,2
COD	50	P,G	H_2SO_4 to pH <2	28 days	1
Sulfate	100	P,G	Cool, 4 °C	28 days	1,2
Ammonia as Nitrogen	1000	P,G	Cool, 4 °C H_2SO_4 to pH <2	28	1
Total Dissolved Solids (TDS)	500	P,G	Cool, 4 °C	7	1
Total Organic Carbon (TOC)	250	P,G	Cool, 4 °C HCL or H_2SO_4 to pH <2	28	1,2

RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES

Measurement	Volume (mL)	Container[a]	Preservative	Holding Times	Reference
Metals (except mercury)					
Total	500	P,G	HNO_3 to pH <2	6 Mos	1,2
Dissolved	500	P,G	Filt. + HNO_3 to pH <2	6 Mos	1,2
Mercury – Total	500	P,G	HNO_3 to pH <2	28 days	1,2
Mercury – Dissolved	300	P,G	Filt. + HNO_3 to pH <2	28 days	1,2

Measurement	Volume (mL)	Container[a]	Preservative	Holding Times	Reference
Organics					
Volatile Organics by GC/MS	100 (2 vials @ 40ml)	G, Teflon septum cap	Cool, 4 °C HCL to pH <2	14 days	2,3
Herbicides	1000	Glass Only	Cool, 4 °C	7 days [b] 40 days [c]	2,3
Pesticides and PCB's	1000	Glass Only	Cool, 4 °C	7 days [b] 40 days [c]	2,3
Semi-Volatiles Acid and Base/Neutral Compounds	2000	Glass Only	Cool, 4 °C	7 days [b] 40 days [c]	2,3

NOTES:

a Plastic (P) or Glass (G). For metals, polyethylene with an all polypropylene cap is preferred.

b Maximum holding time from sampling to extraction.

c Maximum holding time from extraction to analysis.

REFERENCES:

1 Methods for Chemical Analysis of Water and Wastes, March, 1983, USEPA, 600/4-79-020 and additions thereto.

2 Test Methods for Evaluating Solid Waste, Physical/Chemical Method, November, 1986, Third Edition, USEPA, SW-846 and additions thereto.

3 "Guidelines Establishing Test Procedures for the Analysis of Pollutant Under the Clean Water Act", Environmental Protection Agency, Code of Federal Regulations (CFR), Title 40, Part 136.

APPENDIX C

CALIBRATION DATA SHEET

Calibration Data Sheet

Project:_____
Calibrated By:_____
Date:_____ **Time:**_____

Calibration Solution Temperature:_____ C

pH Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known pH _____

Conductivity Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known Conductance _____

Turbidity Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known Turbidity _____

Date:_____ **Time:**_____

Calibration Solution Temperature:_____ C

pH Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known pH _____

Conductivity Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known Conductance _____

Turbidity Meter
Model _____
Serial Number _____
Calibration Solution _____
Instrument Reading _____
Known Turbidity _____

Comments:_____
_____

APPENDIX D

SAMPLE CHAIN-OF-CUSTODY

Chain of Custody Record

SEVERN TRENT **STL**

Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client	Project Manager	Date	Chain of Custody Number 168232
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page _____ of _____
City / State / Zip Code	Site Contact	Lab Contact	Analysis (Attach list if more space is needed)
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH

SAMPLE

Possible Hazard Identification

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other_____

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

APPENDIX E

STATISTICAL ANALYSIS PLAN

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E-3 – 95 Percent Confidence Interval Flow Chart

1 INTRODUCTION

This document provides a statistical methodology for groundwater monitoring at the ECDC Landfill. A tiered evaluation approach has been developed for detection monitoring wells. Intrawell comparisons of metals and inorganic indicator parameters will be conducted using Shewhart-CUSUM control charts. Non-parametric prediction limits combined with Sen's Slope/MannKendall trend analysis will be applied to those parameters with greater than 50 percent non-detections (25 percent under ASTM standards) in the background data set. Statistical limits for volatile organic compounds in detection monitoring wells will be based on reporting limits (RLs). Assessment monitoring constituents will be statistically evaluated using detection monitoring statisticis and 95 percent confidence interval analysis. Details of each method are provided in the following sections. Statistical comparisons will be performed using Sanitas™, a commercial software program developed by Intelligent Decision Technologies, Inc. or another comparable computer program.

This document has been prepared using generally accepted statistical analysis principals and practices. However, it is not possible to predict all of the potential future circumstances. Therefore, alternative methods may be used that are more appropriate for the data distribution of the constituents being evaluated.

2 DETECTION MONITORING STATISTICAL ANALYSES

2.1 Metals and Inorganic Indicator Constituents

2.1.1 Shewhart-CUSUM Control Charts

Metals and inorganic indicator constituents will be statistically evaluated using combined Shewhart-CUSUM Control Charts. This procedure assumes that the data are independent and normally distributed with a fixed mean and constant variance. The most important assumption is independence, therefore wells should be sampled no more frequently than quarterly (Gibbons, 1994). The assumption of normality is less of a concern and natural log or ladder of powers transformations are adequate for most applications. The analysis is only applied to constituents that have greater than 50 percent detections (25 percent under ASTM standards) in the background data. For those metals and inorganic indicator constituents with fewer than 50 percent detections in the background data set, a non-parametric prediction limit/Sen's Slope/Mann Kendall trend analysis will be used.

Shewhart-CUSUM control charts allow detection of both major and gradual releases from the facility independent of spatial variation. This procedure is specifically recommended in the USEPA document *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (April 1989).

2.1.2 Procedure

Control charts are a form of time-series graph, on which a parametric statistical representation of concentrations of a given constituent are plotted at intervals over time. The statistics are computed and plotted together with an upper and/or lower control limit on a chart where the x-axis represents time.

The Procedure for conducting the intrawell analysis using combined Shewhart-CUSUM Control Charts is provided below and a flow chart illustrating the decision making process is provided as Figure E-1.

Three parameters are selected prior to plotting:

h - The control limit to which the cumulative sum (CUSUM) values are compared. The EPA recommended value for **h** is 5 units of standard deviation.

k - A reference value that establishes the upper limit for the acceptable displacement of the standardized mean. The EPA recommended value for k is 1.

SCL - The upper Shewhart control limit to which the standardized mean will be compared. The EPA recommended value for **SCL** is 4.5.

For each time period, T_i, take n_i independent samples (n_i may be one), and calculate the mean, $\bar{x}_i$. Compute the standardized mean Z_i of the measured concentrations where only a single new measurement is obtained for each constituent at each event as :

$$Z_i = \left(X_i - \overline{X}\right)\sqrt{n_i} / S$$

Where:

x_i = value obtained for a constituent during monitoring event i.

s = The standard deviation obtained from prior monitoring data from the same well.

When applicable, for each time period, T_i, compute the cumulative sum, S_i, as:

$$S_i = \max\{0, (Z_i - k) + S_{i-1}\}$$

Where max {A,B} is the maximum of A and B, and $S_o = 0$.

Plot Z_i and S_i against Ti on the control chart. The results may be plotted in standardized units or converted to the concentration units of the constituents being evaluated. An "out-of-control" situation (potential contamination) occurs whenever $Z_i \geq$ SCL or $S_i \geq$ h. Two different types of situation are controlled by the limits. Too large a standardized mean will occur if there is a rapid increase in concentration in the well. Too large a cumulative sum may also occur for a more gradual trend. A verified statistically significant change (SSC) will occur if both the initial result *and* a verification sample result consecutively exceed one of the above mentioned statistical limits. Upgradient wells will be monitored for informational purposes only and will not be part of the verification resampling program.

2.1.2.1 Verification Resamples

The Shewhart and CUSUM portions of the control chart are affected differently by initial statistically significant changes from background (SSCs). The Shewhart portion of the

control chart compares each individual new measurement to the control limit, therefore the next monitoring event constitutes an independent verification of the original result. However, the CUSUM procedure incorporates all historical values in the computation, therefore, the effect of the apparent SSC will be present in both the initial and verification sample. Hence, the statistical test will be invalid unless the verification sample value replaces the initial SSC value. Therefore, initial SSC values will be replaced by verification resample results in order to confirm a SSC (Gibbons, 1994).

2.1.2.2 Updating Control Charts

As monitoring continues, the background mean and variance will be updated periodically to incorporate new data. At a minimum of every two years all new data that are in control will be pooled with the initial eight background samples and the mean and variance will be recomputed and used in constructing future control charts. UDEQ (Utah Department of Environmental Quality) approval will be obtained prior to updating the background data pool.

2.1.2.3 Censored Data

If less than 15 percent of the background observations are nondetects, these will be replaced with one half of the laboratory reporting limit prior to running the analysis (U.S. EPA, April 1989).

If more than 15 percent but less than 50 percent of the background data are less than the detection limit, the data's sample mean and sample standard deviation are adjusted according to the method of Cohen or Aitchison.

If more than 50 percent of the background data are less than the detection limit, a nonparametric prediction limit will be computed.

2.1.3 Non-Parametric Prediction Limits and Sen's Slope/Mann Kendall Trend Analysis

For those metals and inorganic indicator constituents with fewer than 50-percent detections within the background pool, a combined non-parametric upper prediction limit/Sen's Slope/MannKendall trend ananlysis will be applied. Parameters will be initially tested using the non-parametric prediction limit analysis. Constituents exceeding the non-parametric prediction limit will then be tested using the Sen's Slope/Mann Kendall trend analysis. An initial statistical exceedence will be indicated if the measured concentration exceeds both the non-parametric prediction limit and exhibitis a significant upward trend. The combined methods provide a non-parametric control chart equivalent to allow detection of both major and gradual releases from the facility independent of spatial variation.

2.1.3.1 Non-Parametric Prediction Limit Analysis

An upper prediction limit is a statistical limit calculated to include one or more observations from the same population with a specified confidence. In groundwater monitoring, an upper prediction limit approach may be used to make comparisons between background and compliance well data. The limit is constructed to contain all **k** observations with stated confidence. Any observation exceeding the upper prediction limit provides statistically significant evidence that the observation is not representative of the background group. The number of observations, **k**, to be compared to the limit must be specified in advance. A flow chart illustrating the decision making process during the analysis is provided as Figure E-2.

The highest value from the background data is used to set the upper prediction limit. In the case of a two-tailed test, the lowest value from the background data is used to set the lower prediction limit. Under EPA Standards, the false positive rate is based upon the formula:

$$1-(n/(n+k))$$

Where:

n = The background sample size, and

k = The number of future values being compared to the limit.

2.1.3.2 Sen's Slope/Mann Kendall Trend Analysis

The Sen's Slope/Mann Kendall trend analysis procedure determines the significance of an apparent trend and evaluates the magnitude (slope) of that trend (IDT, 2002). The Mann Kendall test for temporal trend is a non-parametric procedure designed to test the null hypothesis, H_0:

H_0: No significant trend of a constituent exists over time.

And the alternative hypothesis, H_A:

H_A: A significant upward trend of a constituent concentration exists over time.

Wells for which less than 41 data points are available, the exact test is applied. For 41 or more data points, the Normal Approximation test is used.

The Sen's Slope estimator portion of the combined method provides an estimate of the true slope. The method is a non-parametric procedure not greatly affected by gross data errors or outliers, and can be computed when data are missing.

2.2 Statistical Evaluation of Volatile Organic Compounds

Volatile organic compounds (VOCs) will be routinely monitored during the detection monitoring program. The statistical limit for VOCs detected in wells under detection monitoring will be set equal to the laboratory reporting limit (RL). RLs are provided in Table 1 of the facility's Groundwater Sampling and Analysis Plan (GWSAP). As with the prediction limit statistical method, VOC detections will not be considered statistically significant unless confirmed by verification resampling. Verification resampling procedures are provided in Section 2.3 and in the GWSAP.

2.3 Verification Resampling

Results for constituents that exceed statistical limits will not be considered statistically significant unless they are confirmed through verification resampling.

If a statistically significant change (SSC) from background of any tested constituent at any monitor well has occurred (i.e. is confirmed) and there is reasonable cause that a source other than the landfill exists, then a report will be submitted documenting the source as per Section 5.1 of the GWSAP and UAC R315-308-2 (10)(c). Otherwise, assessment monitoring will be implemented in accordance with Section 5.1 of the GWSAP and UDEQ regulations.

3 ASSESSMENT MONITORING STATISTICAL ANALYSIS

For assessment wells, constituents exceeding detection monitoring statistical limits and that have a groundwater protection standard (GWPS) established by the USEPA or the UDEQ, and/or any VOC detections will be statistically compared to GWPS using one-sided 95-percent lower confidence limits (LCL). Evaluations are conducted per Gibbons and Coleman (2001). The method constructs a normal confidence interval on the mean concentration of a constituent incorporating, at a minimum, the four most recent semi-annual measurements. A separate interval is constructed for each constituent of interest in each well of interest. A confidence interval is generally used when downgradient samples are being compared to a GWPS. A flow chart depicting the decision making process during the analysis is provided as Figure E-3.

The lower 95-percent confidence limit on the mean will be compared to a GWPS to decide initially whether the mean concentration of a constituent of interest has exceeded a GWPS. If the lower 95-percent confidence limit on the mean exceeds the GWPS then there is statistically significant evidence that the mean concentration of that constituent exceeds the GWPS. Upper 95-percent confidence limit analyses may be applied to constituents in which it's 95 percent LCL has exceeded a GWPS. If the upper 95-percent confidence limit on the mean occurs lower that the GWPS then there is statistically significant evidence that the mean concentration of that constituent has returned to less than the GWPS.

3.1 Assumptions

The sample data used to construct the limits must be normally or transformed-normally distributed. In the case of a transformed-normal distribution, the confidence limit must be constructed on the transformed sample concentration values. In addition to the limit construction, the comparison must be made to the transformed GWPS value. When none of the transformed models can be justified, a nonparametric version of each limit may be utilized.

3.2 Distribution

The distribution of the data is evaluated by applying the Shapiro-Wilk or Shapiro-Francia test for normality to the raw data or, when applicable, to the Ladder of Powers (Helsel & Hirsch, 1992) transformed data. The null hypothesis, $\mathbf{H_O}$, to be tested is:

H_O: The population has a normal (or transformed-normal) distribution.

The alternative hypothesis, $\mathbf{H_A}$, is:

H_A: The population does not have a normal (or transformed-normal) distribution.

3.3 Censored Data

If less than 15 percent of the observations are non-dectects, these will be replaced with one half the method detection limit prior to running the normality test and constructing the confidence limit.

If more than 15 percent, but less than 50 percent, of the data are less than the detection limit, the data's sample mean and standard deviation are adjusted according to the method of Cohen or Aitchison (U.S. EPA, April 1989). This adjustment is made prior to construction of the confidence limit.

If more than 50 percent of the data are less than the detection limit, these values are replaced with one half the method detection limit and a nonparametric confidence limit is constructed.

3.4 Parametric Confidence Limit Procedures

A minimum of four sample values is required for the construction of the parametric confidence limit. The mean, **X**, and standard deviation, **S**, of the sample concentration values are calculated separately for each compliance well. For each well, the confidence limit is calculated as:

$$\overline{X} \pm t_{(1-\alpha,\, n-1)} \frac{S}{\sqrt{n}}$$

Where:

S = The compliance point's standard deviation;

n = The number of observations for the compliance point; and

$t_{(1-\alpha,n-1)}$ is obtained from the Student's t-Distribution (appendix B; U.S. EPA, April 1989) with (n-1) degrees of freedom.

The use of the 95th percentile of the t-Distribution is consistent with the 5 percent α - level of individual well comparisons. If the lower limit is above the compliance limit, there is statistically significant evidence that the constituent exceeds a GWPS.

3.5 Nonparametric Confidence Limit Procedure

The nonparametric confidence limit procedure requires at least seven observations in order to obtain a one-sided significance level of 1 percent. The observations are ordered from smallest to largest and ranks are assigned separately within each well. Average ranks are assigned to tied values. The critical values of the order statistics are determined as follows.

If the minimum seven observations are used, the critical values are the first and seventh values. Otherwise, the smallest integer, **M**, is found such that the cumulative binomial distribution with parameters **n** (sample size) and probability of success, p=0.5, is at least 0.99.

The exact confidence coefficient for sample sizes from 4 to 11 are given by the EPA (Table 6-3; U.S. EPA, April 1989). For larger samples, take as an approximation the nearest integer value to:

$$\mathbf{M} = \frac{n}{2} \mathbf{+1+} \mathbf{Z}_{(1-\alpha)} \sqrt{\frac{n}{4}}$$

Where:

$\mathbf{Z}_{(1-\alpha)}$ = The 1-α percentile from the normal distribution found in Table 4 (appendix B; U.S. EPA, April 1989); and

n = The number of observations in the sample.

Once **M** has been determined, **(n+1-M)** is computed and the confidence limits are taken as the order statistics, **X(M)** and **X(n+1-M)**. These confidence limits are compared to the GWPS as discussed in Section 3.

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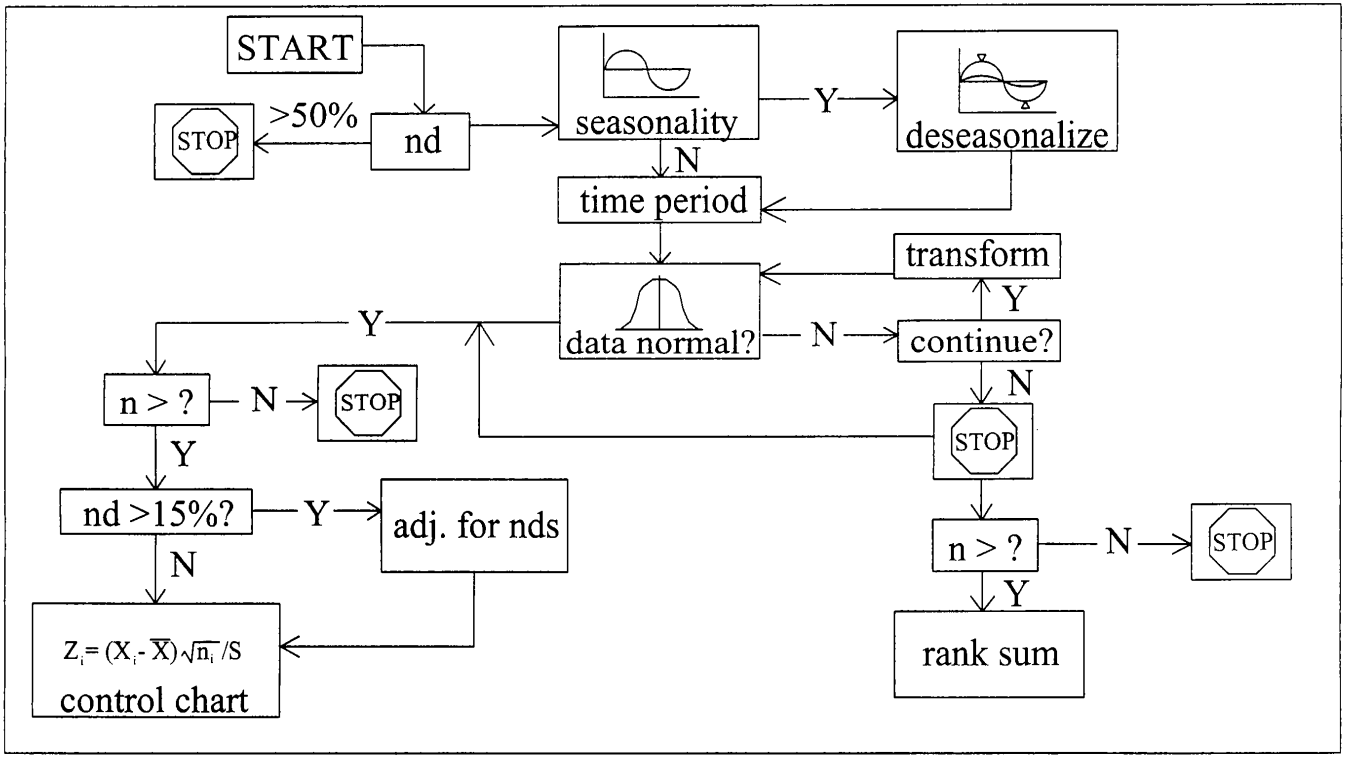
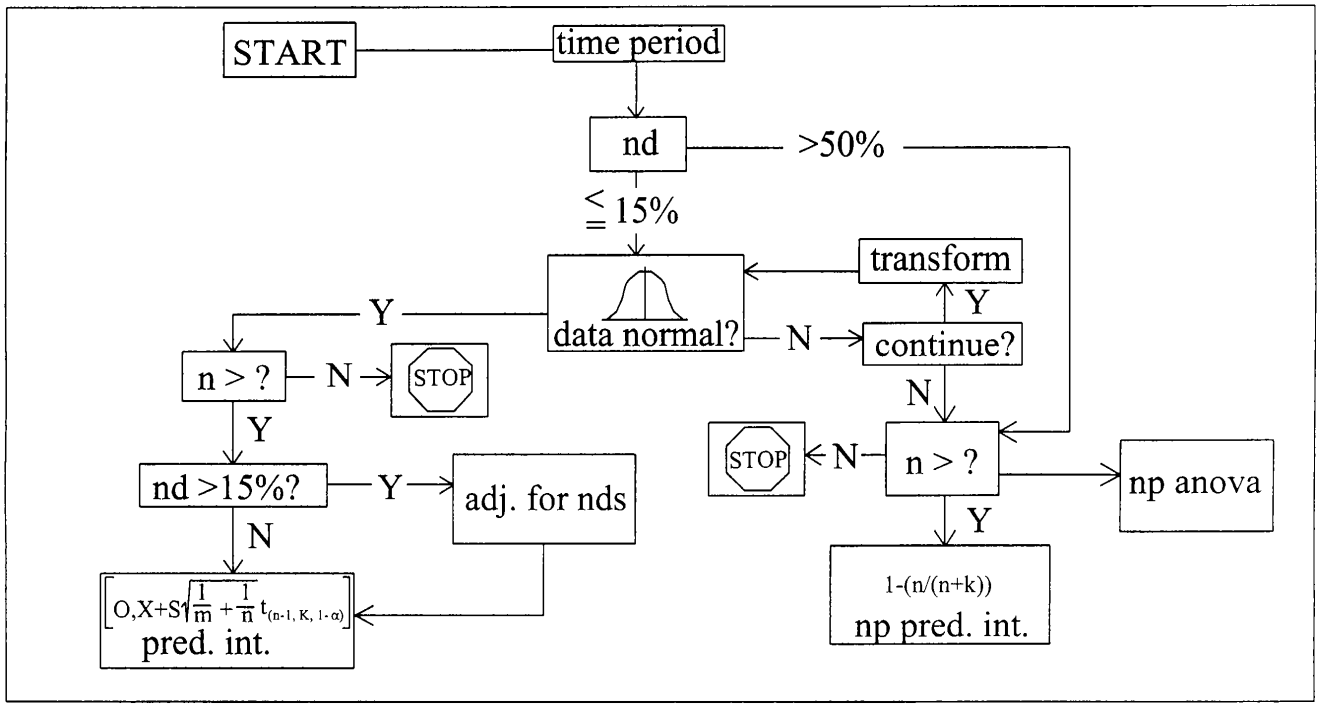
FIGURES

FIGURE E-1
CONTROL CHART FLOWCHART



Source: Sanitas™ version 7.5

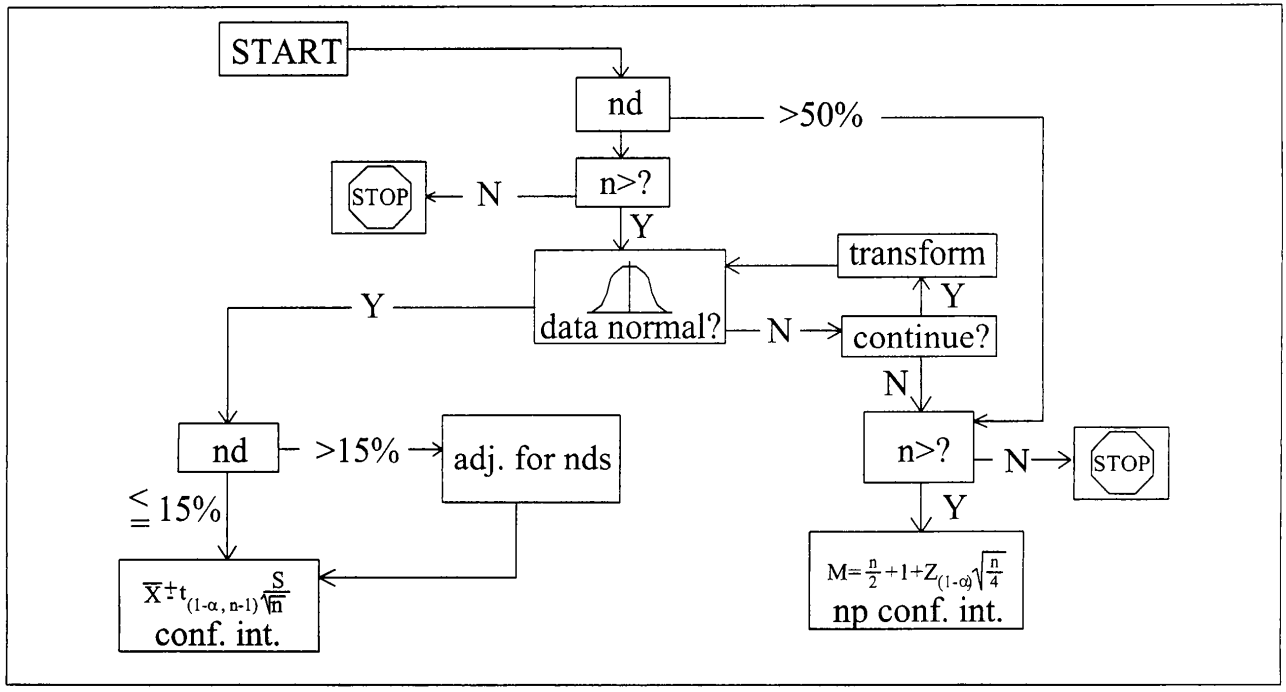
FIGURE E-2
PREDICTION LIMIT FLOWCHART



Source: Sanitas™ version 7.5

FIGURE E-3

95% CONFIDENCE INTERVAL FLOWCHART



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UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

Mr. Dennis R. Downs, Executive Director
Department of Environmental Quality
Division of Solid and Hazardous
288 North 1460 West
Salt Lake City, UT 84114

June 20, 2007

RE: ECDC Environmental, Operations Plan

Dear Mr. Downs,

Enclosed you will find an updated Operations Plan for ECDC Environmental. ECDC respectively requests the Division review the plan and provided written comment or approval.

If you have questions regarding this information please call me at 801-888-4418 x 22.

Sincerely,

Darin Olson
Environmental Manager

1111 West Highway 123 P.O. Box 69 East Carbon, UT 84520 Toll Free (800) 444-4451 Tel. (435) 888-4451 Fax (435) 888-5557

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ECDC Environmental	P.O. Box 69 East Carbon, UT 84520	Jeff Green	Operations Manager	435-888-4418 Ext #26	801-573-7533	435-888-0577
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ECDC ENVIRONMENTAL, L.C.
PLAN of OPERATIONS

LIST OF DOCUMENTS

1. STORM WATER POLLUTION PREVENTION PLAN
2. SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN
3. EXPOSURE CONTROL PLAN
4. EMERGENCY ACTION PLAN
5. DAILY COVER REQUIREMENT PLAN
6. LITTER CONTROL PLAN
7. FIRE CONTROL PLAN
8. RADIATION MONTORING PROCEDURES
9. DUST CONTROL PLAN
10. SCAVENGING POLICY
11. TRAINING SCHEDULE
12. WASTE ARRIVAL AND UNLOADING PROCEDURE

STORM WATER POLLUTION PREVENTION PLAN

ECDC LANDFILL FACILITY
EAST CARBON, UTAH

FEBRUARY 2003

Prepared By

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ECDC ENVIRONMENTAL LANDFILL FACILITY STORM WATER POLLUTION PREVENTION PLAN

FEBRUARY 2003 REVISION

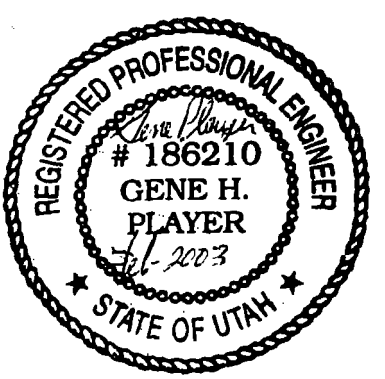
PREPARATION

The following Storm Water Pollution Prevention Plan (SWP) was prepared by ***Player Consulting, L.C.*** for the ECDC Landfill Facility located within the boundaries of East Carbon City, Carbon County, Utah adjacent to State Highway 123. The site encompasses approximately 2,400 acres excluding the Denver and Rio Grande Railroad right-of-way. The facility is an existing municipal and non-hazardous solid waste disposal facility. The facility consists of office building, support buildings, and active landfill cells. The initial cell was fully approved and operational in September 1992 and currently operates under permit number 9422 issued by the Utah Division of Solid and Hazardous Waste.

The SWP3 was prepared in essential accordance with the requirements contained in the ECDC *General Multi-Sector Permit for Storm Water Discharges Associated with Industrial Activity,* the requirements of the *Utah Department of Environmental Quality*, and the requirements of the *Division of Water Quality.*

AMENDMENTS

This SW3P will be amended whenever there is a change in design, construction, or maintenance, which has a significant effect on the potential for the discharge of contaminated storm water to the waters of the State of Utah or if the SW3P proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified in this permit, or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity at the site. The site will be inspected at annually by members of the Pollution Prevention Team, and this plan will be reviewed within two weeks of that inspection for effectiveness and validity. All changes to the SW3P will occur at the time of the annual review.



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1.0 Introduction

Landfills that discharge storm water runoff from any active or inactive areas without a stabilized final cover and that have received any industrial wastes are considered to meet the definition of "storm water discharge associated with industrial activity" in 40 CFR 122-26(b)(14) and are required to obtain an NPDES permit. Landfills seeking coverage under a Utah Pollutant Discharge Elimination System (UPDES) Multi Sector permit are required to submit a Notice of Intent and prepare a Storm Water Pollution Prevention Plan (SW3P).

ECDC Landfill Facility has submitted a Notice Of Intent for coverage under the Multi Sector General Permit for Industrial Activities. In accordance with the permit, this SW3P has been prepared and will be maintained on-site.

ECDC is a private entity formed for the purpose of overseeing operation of a Subtitle D solid waste landfill. The landfill operates under a permit (#9422) from the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste.

The general direction of surface flow at the facility is to the west. The Site Map in ***Attachment #1*** shows the pre-construction contours of the facility. The pre-construction contours and elevations are still applicable except for the developed cell portions of the facility. The majority of developed cell areas are shown on the Site Map. All other areas of the facility are not utilized at this time with the exception of the rail unloading areas, the intermodal area, the bottom dump, and the facility administrative buildings.

The ECDC facility is located in a region of very low annual precipitation less than 12 inches per year. Ditches seldom have water flow, and standing water is rare. There is no storm water run-on to the facility. Leachate waters are collected and separated from storm water. Perimeter and intra cell berms are used

to route local run-off and prevent run-on from entering the active landfill areas. Storm water which contacts the waste is contained within the landfill and is handled as leachate.

2.0 Storm Water Pollution Prevention Plan

This Storm Water Pollution Prevention Plan (SW3P) was developed and prepared in accordance with good engineering practices and in accordance with the factors outlined in *40CFR 125.3(d)(2) or (3)* as appropriate. This plan identifies potential sources of pollution that may reasonably be expected to affect the quality of storm water discharges associated with industrial activity from the ECDC Landfill Facility. In addition, the plan describes and ensures the implementation of practices that are to be used to reduce the pollutants in storm water discharges associated with industrial activity at the facility and to assure compliance with the terms and conditions of the Storm Water Permit #UTR000194 issued by Utah Division of Water Quality. The ECDC Landfill Facility shall implement the provisions of the SW3P required under this part as a condition of the Storm Water Permit.

2.1 Signature and Plan Review

2.1.1 Signature/Location

The SW3P shall be signed in accordance with the Signatory Requirements section of the Storm Water Permit and be retained on-site at the ECDC Landfill Facility.

2.1.2 Plan Availability

This SW3P shall be available upon request to the *Executive Secretary;* other local agencies approving storm water management plans; interested members of the public; local government officials; or to the operators of a municipal separate storm sewer receiving discharges from the site. Viewing

by the public shall be at reasonable times during regular business hours (advance notice by the public of the desire to view the plan may be required, not to exceed two working days).

2.1.3 Required Modifications

Upon notification from the *Executive Secretary*, or authorized representative, that the plan does not meet one or more of the minimum requirements of the Storm Water Permit and identify which provisions of the plan that requires modifications, the permittee shall make the required changes to the plan and shall submit to the *Executive Secretary* a written certification that the requested changes have been made.

2.2 Keeping Plans Current

The ECDC Landfill Facility shall amend the plan whenever there is a change in design, construction, operation, or maintenance that has a significant effect on the potential for the discharge of pollutants to the waters of the State or if the SW3P proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified in this SW3P, or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. Amendments to the SW3P shall be made available to be reviewed by the *Executive Secretary,* or an authorized representative upon request.

2.3 Contents of the SW3P

The contents of this SW3P complies with the requirements of the Storm Water Permit including the requirements listed in Appendix II.L.3.

2.4 Consistency With Other Plans

This SW3P is consistent with other plans developed for the ECDC Landfill Facility including the Class V Landfill Permit, Spill Prevention, Control, and Countermeasure Plan, and the Fugitive Dust Emissions Control Plan.

2.5 Other Laws and Requirements

2.5.1 Local Storm Water Control Requirements

The ECDC Landfill Facility shall comply with other local laws affecting storm water discharges.

2.5.2 Threatened or Endangered Species & Historic Properties

The ECDC Landfill Facility shall comply with Federal or State laws pertaining to threatened or endangered species or historic properties.

3.0 Pollution Prevention Team

Members of a Storm Water Pollution Prevention Team are responsible for developing the SW3P and assisting the facility or plant manager in its implementation, maintenance, and revision. Following is a list of team members and their responsibilities. Activities and responsibilities of each team member address all aspects of the facility's storm water pollution prevention plan.

Team Member Information

Team Leader:	Kirk Treece	**Title:**	General Manager
		Office Phone:	(435) 888-4418 ext. 25

Responsibilities: Signatory approval; SW3P review and oversight.

Team Member: Darin Olson **Title:** Facility Engineer
Office Phone: (435) 888-4418 ext. 22

Responsibilities: Conducting storm water sampling and coordinating and implementing all facets of developing and administering the SW3P, monitoring and analysis reporting, record keeping, and employee training.

Overseeing spill response, clean up activities, and housekeeping.

Team Member: Jeff Green **Title:** Facility Operations Manager
Office Phone: (435) 888-4418 ext. 26

Responsibilities: Recommending and designing control measures to reduce or prevent significant pollution sources affecting the storm water runoff. Analyzing, designing, and implementing erosion prevention measures as needed and are possible. Reviewing and commenting on the effect of proposed construction or process modifications on storm water discharges.

Conducting visual inspections. Designing, coordinating, implementing, and completing employee training. Implementing preventive maintenance program.

4.0 Description of Potential Pollutant Sources

Following is a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Also, following are all activities and significant materials which may potentially be significant pollutant sources.

4.1 Drainage

4.1.1 Site Map.

A Site Map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations of active and closed landfill cells or trenches, locations of active and closed land application areas, locations where open dumping is occurring or has occurred, locations of any known leachate springs or other areas where uncontrolled leachate may commingle with runoff, locations of any leachate collection and handling systems, locations of major spills or leaks, and locations of the following activities where such activities are exposed to precipitation: fueling station, vehicle and equipment maintenance and/or cleaning areas, and waste and other significant material loading/unloading and storage areas are located in ***Attachment #1*** of this SW3P. The site map also indicates the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

4.1.2 Direction of Flow.

Contained on the Site Map in ***Attachment #1*** is a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. The factors that were considered include the toxicity of chemicals; quantities of chemicals used, produced or discharged; the likelihood of contact with storm water; and the history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion are also identified on the Site Map.

The general direction of surface flow at the facility is to the west and southwest. The Site Map shows the pre-construction contours of the facility. The pre-construction contours and elevations are still applicable except for the developed cell portions of the facility. The developed cell areas are shown on the Site Map. All other areas of the facility are not utilized at this time with the exception of the rail unloading areas, the intermodal area, and the facility administrative buildings.

4.2 Exposed Inventory of Materials

Following is an inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory includes a narrative description of significant materials that have been handled, treated, or disposed of at the facility; method and location of on-site storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

The types of materials handled at the site that potentially may be exposed to precipitation include solid waste in the following categories: municipal, certain exempt industrial waste, municipal incinerator ash, mining waste, and other non-hazardous waste. This solid waste landfill accepts approximately 800,000 cubic yards of waste annually. A wide variety of materials and substances are accepted at the facility; however, the facility does not accept radioactive, hazardous, or wastes requiring to be managed as PCBs under the Toxic Substances and Control Act.

The majority of wastes accepted at the facility are brought to the site via rail equipment. The waste containers are then off-loaded from the railcars, loaded onto haul trucks, weighed, and taken to the active landfill face. The waste containers are covered until the loads are weighed which is done just prior to

unloading at the active landfill face. This precludes wastes from contacting run-off because wastes are placed into the contained, lined portion of the landfill.

Other wastes are brought to the facility by over-the-road haul trucks that haul wastes from local municipalities. These trucks are weighed and then off-loaded at the active landfill face within the lined portion of the landfill. No chemicals are stored outside without proper packaging to reduce contamination of water or soil from spills, accidental releases, or exposure to storm water.

Liquid wastes that are accepted at the facility are taken to the Solidification Facility and off-loaded. This facility is self-contained and the liquids are never allowed to contact storm water run-off. The liquid wastes are then solidified, loaded on haul trucks, and taken to the active landfill face.

The coal incinerator ash that is accepted at the facility is used to solidify liquid wastes. The coal incinerator ash is stored within the lined portions of the landfill facility. Storing the material in this way will not allow contact with run-off. They are taken to the Solidification Facility when required.

Machine-graded slopes prevent storm water from entering structures at the facility. The facility also uses gravel paving on haul roads as well as the parking areas to minimize dust and run-off. The rotary dump unloading area and the bottom dump area are designed to preclude storm water contamination through proper grading.

The storm water run-off from the areas of possible contamination is through a ditch along the south edge of the intermodal area. This drainage structure contains storm water that falls either on the rail line grade or on the intermodal haul road. These areas may contain stored containers, rail equipment, off-loading and on-loading equipment, and loaded waste containers. Any run-off water that enters this drainage structure drains to the west along the haul road. Water then enters a retention pond area constructed to preclude storm water run-off water from leaving

the ECDC Facility Property. The stored water is then allowed to evaporate or infiltrate into the ground.

Diesel and gasoline tanks are stored within diked areas in the northeast corner of the field office parking lot. Used oil is stored in a tank inside maintenance building. Equipment maintenance takes place inside the maintenance building, and all drums are stored indoors.

There is no treatment of storm water at the ECDC facility due to materials management practices employed by the ECDC facility personnel. These practices minimize contact of potentially contaminating materials with storm water run-off. All storm water that falls within the active portion of the landfill is treated as leachate: therefore, never leaves the lined landfill.

4.3 Spills and Leaks

There have been no significant spills or significant leaks of toxic or hazardous pollutants that have occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility. All significant spills and leaks will be recorded by the Spill Prevention and Response Team as noted in this document. The annual revisions of this document will include all records of significant spills and leaks that have occurred at the facility since the last revision.

A few small spills have occurred at the facility in the last five years. These spills occurred on asphalt areas and were cleaned up by facility personnel using industry standard procedures.

4.4 Sampling Data

A summary of existing discharge sampling data is contained in the appropriate files at the ECDC Facility Landfill. Sampling shall take place as soon as possible and when weather permits. Samples shall be taken at the Outfall #1 location and the Outfall #2 location as indicated on the Site Map contained in

Attachment #1. These sampling activities shall include quarterly samples as well as all other required sampling events.

4.5 Risk Identification and Summary of Potential Pollutant Sources

Following is a narrative description of potential pollutant sources associated with earth/soil moving; waste hauling and loading/unloading; outdoor storage of significant materials including daily, interim and final cover material stockpiles as well as temporary waste storage areas; exposure of active and inactive landfills; haul roads; and vehicle tracking of sediments. The narrative description specifically lists significant potential sources of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern is identified.

4.5.1 Construction Periods

The landfill facility experiences construction periods during each year of operation as well as daily earth moving activities. During these construction periods and activities, moving of soil materials occurs. The construction of landfill cells requires that soil material be excavated, loaded, hauled, placed, and compacted. The potential pollutant source associated with earth/soil moving is soil particles suspended in run-off.

4.5.2 Waste Hauling and Loading/Unloading

The ECDC Landfill Facility receives waste by many methods which includes railcar containers, railcar, waste hauling vehicles, and liquid tankers. Waste that arrives in containers on railcars are loaded onto facility haul trucks, weighed, detarped, and taken to the active landfill face for unloading. Loaded railcars are taken to the Railcar Rollover Facility to be unloaded. They are dumped within the building by being rolled over. The waste is then loaded into facility haul trucks and taken to the active landfill face. Waste hauling vehicles enter the ECDC facility, are weighed, and are taken to the active landfill face to be unloaded. All solid waste is

unloaded within the lined portion of active landfill. Liquid tankers are received at the Solidification Facility and off loaded. Municipal incinerator ash is off-loaded at the Solidification Facility and used for solidifying the liquid wastes brought to the facility. The liquid is contained within a concrete basin. The potential pollutant source associated with waste hauling and loading/unloading is solid waste entering the run-off.

4.5.3 Outdoor Storage of Significant Materials

The ECDC Landfill Facility excavates and stores significant materials including daily, interim, and final cover material stockpiles. There are no temporary waste storage areas at the facility. The potential pollutant source associated with outdoor storage of significant materials including daily, interim and final cover material stockpiles ARE soil particles suspended in run-off.

4.5.4 Exposure of Active and Inactive Landfills

There are active and inactive landfill cells at the ECDC Landfill Facility. The potential pollutant sources associated with active and inactive landfill cells are soil particles and solid waste entering the run-off.

4.5.5 Vehicle Tracking of Sediments

Haul roads are utilized at the facility to facilitate placement of the solid waste at the active landfill face. Haul roads are covered with gravel/granular material to minimize vehicle tracking of sediments. The potential pollutant source associated with haul roads and vehicle tracking of sediments is soil particles suspended in run-off.

Dust control at the facility takes place in essential accordance with the Fugitive Dust Emissions Control Plan produced by ECDC.

4.5.6 Container Wash Bay Area

The Container Wash Bay area is an area where waste containers are washed and cleaned. The containers are washed with heigh pressure heated water. The water then drains into a sump where the water is collected. The water is not allowed to enter any ditches or uncontrolled drainage areas. The Container Wash Bay Sump is drained by pumping the water into a water truck. The waste water is then placed into the lined areas of the active landfill.

5.0 Measures and Controls

The following is a description of storm water management controls appropriate for the facility. These controls are or shall be implemented at the ECDC Landfill Facility. The controls reflect identified potential sources of pollutants at the facility. The description of storm water management controls address the following minimum components, including a schedule for implementing such controls.

5.1 Good Housekeeping

Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. Following is a narrative of the good housekeeping controls at the facility.

Good housekeeping practices are developed to maintain a clean, efficient, and safe work environment. A clean workplace not only benefits the employees who have a safe work environment; it will also reduce pollutant sources which could pose both environmental and employee hazards. The ECDC Landfill Facility is a safety and good housekeeping conscious facility. All employees will be trained to regularly inspect for leaks or conditions that could lead to discharges to storm water.

Good housekeeping in areas of material storage (active cells, inactive cells, roads, and building areas) will include minimizing erosional opportunities for storm water, adhering to daily cover provisions of the Solid Waste Permit, and maintaining

grass/ground cover in areas of run-off or potential surface erosion location. Good housekeeping procedures to reduce tracking of sediment and waste are also used.

The facility is operated and maintained to the highest quality standards with each employee trained to observe and report to the landfill operations manager any maintenance that may be required. Maintenance personnel provide checks of machines and tanks on an ongoing basis. All maintenance on equipment is completed inside the maintenance building. This prevents the potential contact of vehicle fluids to the environment.

5.2 Preventive Maintenance

A preventive maintenance program involves timely inspection and maintenance of storm water management devices as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

A preventive maintenance program is established by maintenance personnel who methodically inspect and correct any problems throughout the facility before storm water pollution occurs. A copy of the inspection log is in ***Attachment 2***.

Equipment or areas to be regularly inspected include the following:

- Sediment collection ditches
- Facility conveyance ditches
- Facility haul roads
- Intermodal area
- Solidification Facility
- Railcar Rollover Facility
- Diversion berms and storm water routing channels
- Permanent and temporary cover on active and inactive landfill cells
- Equipment maintenance areas
- Fuel and waste oil storage areas
- Active waste disposal areas

ECDC personnel shall also maintain all elements of leachate collection and treatment systems to prevent commingling of leachate with storm water run-off. Personnel shall maintain the integrity and effectiveness of any intermediate or final cover, including making repairs to the cover as necessary to minimize the effects of settlement, settling, and erosion.

5.3 Spill Prevention and Response Procedures

Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points have been identified clearly in the storm water pollution prevention plan. Following is a narrative description of these areas.

An 18,000 gallon off-road diesel fuel storage tank is stored in the field office parking lot. A potential spill could occur during the filling of the tank or dispensing the fuel into facility vehicles.

A 1,000 gallon highway diesel fuel storage tank is stored in the field office parking lot. A potential spill could occur during the filling of the tank or dispensing the fuel into facility vehicles.

A 1,000 gallon unleaded fuel storage tank is stored in the field office parking lot. A potential spill could occur during the filling of the tank or dispensing the fuel into facility vehicles.

A 300 gallon Chemloc storage tank and a 3,000 gallon Chemloc storage tank are stored on the facility haul roads. The tanks store material used in waste container maintenance. A potential spill could occur during the filling of the tanks or dispensing the fuel into facility vehicles.

All storage tanks are stored within concrete diked area except the Chemloc tanks which are contained in soil material dikes. Rain water is removed with the

assistance of a vacuum truck. Proper grading in the area of the Chemloc tanks prevents any spilled material contacting storm water run-off.

Herbicides and pesticides are not used outdoors at the ECDC Landfill Facility.

No chemicals are stored outside at this facility without proper packaging to reduce contamination of water or soil from spills, accidental releases, or exposure to storm water run-off.

Spill prevention and response (SPR) is coordinated by the landfill operations manager. A general policy of containing and immediately cleaning up all spills is enforced at the facility. The drainage areas will be inspected as described in Section 5.2 to determine if remedial action is necessary to minimize the potential for spills.

The landfill operations manager is responsible for identifying the facility spill response team to respond to spills and ensuring spill response equipment is readily available. The landfill operations manager is also responsible for notifying the appropriate authorities for assistance.

5.4 Inspections

The qualified facility personnel that shall inspect designated equipment and areas of the facility are the members of the Pollution Prevention Team. Other facility personnel are also encouraged to report any issues or problems that would prevent storm water pollution.

5.4.1 Weekly Inspections

The average annual precipitation for the ECDC Facility 11.98 inches. Due to this precipitation amount, qualified facility personnel shall inspect areas of landfills that have not yet received final stabilization, active land application areas, areas used for storage of

materials/wastes that are exposed to precipitation, stabilization and structural control measures, leachate collection and treatment systems, and locations where equipment and waste trucks enter and exit the site at least once every month. There are no closed landfill cells at the ECDC facility. A copy of the inspection log is in ***Attachment 2***.

5.4.2 Quarterly Inspections

Qualified facility personnel shall inspect inactive landfills, open dumps, and land application sites on a quarterly basis. The personnel shall include in the inspections landfill or open dump stabilization, structural erosion control measures, leachate collection and treatment systems, and all closed land application areas. A copy of the inspection log is in ***Attachment 2***.

5.4.3 Follow-up Procedures

A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. The SW3P shall be revised to address any problems found during inspections. Records of inspections shall be maintained at the ECDC Landfill Facility.

5.5 Employee Training

Employees shall be trained on the implementation and goals of the SW3P. Training will address the following components of the SW3P:

- Good housekeeping
- Preventive maintenance
- Spill prevention and response
- Purpose and maintenance of storm water management control equipment

Points to be covered in the facility personnel training include:

- Locations of housekeeping and spill response equipment

- Instruction for housekeeping and preventive maintenance inspections
- Appropriate spill response procedures
- Recording of all inspections, maintenance, and spill response activities

Training shall be conducted at least annually, or whenever a change in facility operation requires an update or change in training.

5.6 Record Keeping and Internal Reporting Procedures

All significant spills and leaks will be dealt with as per required in the facility SPCC Plan and in accordance to with the existing Class V Landfill Permit. The annual revisions of this document will include all records of significant spills and leaks that have occurred at the facility since the last revision.

ECDC personnel inspections and maintenance activities shall be documented and records of such activities shall be maintained. As provided by the Solid Waste Permit, a tracking system for the types of wastes disposed of in each cell shall be maintained.

5.7 Non-Storm Water Discharges

5.7.1 Certification

At this time ECDC does not discharge any non-storm water to the environment. The only non-storm water discharge that takes place at ECDC is from the Container Wash Bay. The wash water drains into a sump and then removed and taken to the lined areas of the landfill. Storm water run-off that may leave the property drains from undisturbed areas. Therefore, a visual inspection of storm water leaving the facility is not possible. ECDC will annually evaluate whether non-storm water could enter storm water run-off and amend this section as necessary. Certification of this SW3P certifies the continuation of this non-storm water discharge condition.

5.7.2 Exceptions

The following are potential sources of non-storm water run-off at the ECDC Landfill Facility. However, these are not significant sources of water. Measures discussed in the section shall be implemented to ensure pollution prevention of the storm water run-off.

- Fire fighting activities
- Fire hydrant flushing
- Potable water sources including waterline flushing
- Irrigation drainage
- Lawn watering
- Air conditioning condensate
- Uncontaminated compressor condensate
- Uncontaminated springs on the property
- Uncontaminated ground water
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred and where detergents are not used.

5.7.3 Certification of Non-Storm Water Discharges

The facility was evaluated for the presence of non-storm water discharges when the general baseline permit was first issued to the facility. A visual assessment during the dry season of the channels indicated no additional water streams at the facility. Certifying the SW3P also certifies this evaluation.

5.8 Sediment and Erosion Control

Areas at the ECDC Landfill Facility that have a high potential for soil erosion include the active working area, closed areas with intermediate cover, soil material stockpile areas, and soil borrow areas.

Permanent vegetation will be established in final cover areas and in soil borrow areas that are at final grade. In active areas of the landfill, ECDC uses grading and design to maintain any leachate waters separate from storm water. Very little precipitation falls at the facility, and the storm water in the active areas drains to the center of the active area from which it evaporates or percolates into the ground.

Isolation and diversion berms shall be used to prevent run-on to or run-off from the active disposal area. Dust control measures control dispersal of sediment from roads and areas that do not have vegetative cover. Leachate waters are handled according to the current Class V Landfill Permit.

Erosion is controlled at the facility by grading, drainage ditches, piping, and vegetative growth. During the site inspections, any erosion which can be remedied shall be noted and addressed appropriately as the landfill operations manager directs.

5.9 Management of Run-off

The ECDC Landfill Facility shall implement traditional storm water management practices used to divert, infiltrate, reuse, or otherwise manage storm water run-off in a manner that reduces pollutants in storm water discharges from the site. These practices shall include: silt fences, earth dikes, gradient terraces, drainage swales, sediment traps, check dams, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions and temporary or permanent sediment basins, or other equivalent measures. Structural practices shall be placed on upland soils as practicable.

6.0 Comprehensive Site Compliance Evaluation

Qualified personnel shall conduct site compliance evaluations once per year. Such evaluations shall provide:

6.1 Areas Contributing to Storm Water

Areas contributing to a storm water discharge associated with industrial activity at the landfill, open dump and land application sites shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan such as spill response equipment, shall be made.

6.2 Results of the Evaluation

Based on the results of the evaluation, the SW3P shall be revised as appropriate within two weeks of such evaluation and shall provide for implementation of any changes to the plan in timely manner, but in no case more than 12 weeks after the evaluation.

6.3 Report Summarizing the Scope of the Evaluation

A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the SW3P for at least three years from the date of the evaluation shall be produced. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with *Part VI. G.* (Signatory Requirements) of the Storm Water Permit #UTR000194 issued by Utah Division of Water Quality.

All pollution prevention plans, reports, certifications, or other information submitted to the permitting authority or required to be maintained on-site must be signed by a "principal executive officer or ranking elected official." Any person signing documents as part of this SW3P shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

_____ _____

Site Manager Date

ATTACHMENT #1

ATTACHMENT #2

QUARTERLY INSPECTION LOG
ECDC Environmental, L.C.

Area of Inspection	OK	Needs Repair	Comments
Wash Water Sump			
Solidification Facility			
Run-On/Run-Off Drainage for Cell #7			
Run-On/Run-Off Drainage for Cell #10			
Run-On/Run-Off Drainage for Super Cell 1-A			
Leachate Collection System for Cell #7			
Leachate Collection System for Cell #10			
Leachate Collection System for Super Cell 1-A			
Perimeter Fencing and Access Gates			
Landfill Cell #7			
Landfill Cell #10			
Landfill Super Cell 1-A			
Structural Erosion Control Measures			
Date:	**Inspector:**		

MONTHLY INSPECTION LOG
ECDC Environmental, L.C.

Area of Inspection	OK	Needs Repair	Comments
Sediment collection ditches			
Facility conveyance ditches			
Facility haul roads			
Intermodal area			
Solidification Facility			
Railcar Rollover Facility			
Diversion berms and storm water routing channels			
Permanent and temporary cover on active and inactive landfill cells			
Equipment maintenance areas			
Fuel and waste oil storage areas			
Active waste disposal areas			
Landfills that have not yet received final stabilization			
active land application areas			
Areas used for storage of materials/wastes that are exposed to precipitation			
Leachate collection and treatment systems			
Stabilization and structural control measures			
Locations where equipment and waste trucks enter and exit the site			
Date:	**Inspector:**		

SPILL PREVENTION, CONTROL AND COUNTERMEASURE PLAN

ECDC Environmental, L.L.C.
ECDC Landfill
East Carbon, Utah

Prepared for:

ALLIED WASTE SERVICES
1111 W. Highway 123
East Carbon, Utah 84520
July 2006

Prepared by

Shaw® Shaw Environmental, Inc.
305 S. Euclid Ave. Suite 101
Tucson, Arizona 85719

520.792.2800

Project: 118501

If a spill has occurred, go to Appendix A.

The ECDC landfill is subject to the federal Spill Prevention, Control and Countermeasure (SPCC) Plan requirements because it stores more than 1,320 gallons of new and used oil products in aboveground storage tanks (greater than or equal to 55 gallons) on its site. The SPCC Plan does not need to be submitted to the EPA unless requested; however, a copy of the up-to-date SPCC Plan must be available on site during normal business hours.

This SPCC Plan was prepared for the ECDC Landfill to satisfy the applicable federal requirements under 40 CFR Part 112. This written plan is to prevent the spill and discharge of oil products into navigable waters (e.g., streams, creeks, rivers and lakes) of the United States. The SPCC Plan also addresses the spill response procedures and actions that must be implemented if a spill occurs at this facility.

The ECDC landfill must annually train appropriate staff as described in this plan. Training must include spill prevention, potential spill situations including tanks, piping, material transfer, vehicle collisions, and spill/emergency response regulations and activities applicable to the facility. Training records should be kept with this plan.

The SPCC regulations require periodic equipment and facility inspections and documentation of those inspections. Tanks, pumps, piping, and containment structures must be regularly inspected and inspection records should be kept with this plan.

This document includes the emergency procedures that the ECDC landfill should follow from the discovery of the release to its containment and cleanup. Post-cleanup activities, including internal and external reporting procedures, are also described for The ECDC landfill to use as a guide.

This SPCC Plan requires a review and evaluation at least every five years. Technical amendments to the Plan must be reviewed and certified by a professional engineer. Amendments to the Plan will be implemented as soon as possible, but no later than six months after preparing the amendment.

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Appendix H Substantial Harm Criteria

MANAGEMENT CERTIFICATION AND SPCC PLAN REVIEW

Name of Facility: ECDC Environmental, LLC.
ECDC Landfill

Type of Facility: Landfill

Year of Initial Facility Operation: 1990

Location of Facility: 1111 W. Highway 123
East Carbon, Utah 84520

Name and Address of Owner: Same as Above

Management Certification

This SPCC Plan has been reviewed and approved by management with the authority to commit necessary resources for its implementation. The programs and procedures outlined in the Plan will be implemented and periodically reviewed and updated in accordance with 40 CFR Part 112, and with applicable state and local requirements.

Signature _____ Date 7-1-06

Name of Management Representative Jeff Green
(printed)

Title Site Manager

SPCC Plan Review

This SPCC Plan requires review and evaluation at least every five years. Changes in equipment, design, construction, operation, or maintenance that materially affect the facility's potential to discharge oil into waters of the United States require amending the SPCC Plan. Technical amendments to the Plan must be reviewed and certified by a professional engineer. Amendments to the Plan will be implemented as soon as possible, but no later than six months after preparing the amendment.

Review	Date	Update or Amendment Required?	Name (Print)	Signature
1				
2				
3				

Notes:

ENGINEER CERTIFICATION

In accordance with 40 CFR 112.3(d), I hereby certify that:

- ✓ I am familiar with the provisions of 40 CFR Part 112 – Oil Pollution Prevention.
- ✓ I, or my agent, have visited and examined the facility described herein.
- ✓ This SPCC Plan has been prepared in accordance with good engineering practices, including consideration of applicable industry standards, and with the applicable requirements of 40 CFR Part 112.
- ✓ Procedures for required inspections and testing have been established.
- ✓ This SPCC Plan is adequate for the facility.

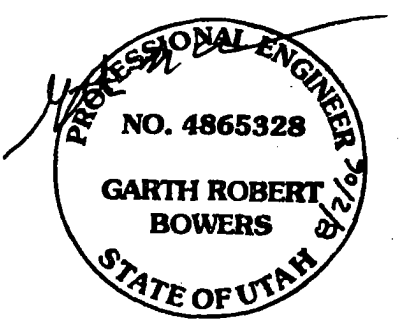
Facility Name and Address: ECDC Environmental, LLC.
1111 West Highway 123, East Carbon, Utah 84520

Signature, Registered Professional Engineer

Garth R. Bowers
Printed Name, Registered Professional Engineer

Date 8/2/06 Registration No. 4865328 State Utah

PE Engineering Seal



40 CFR 112 Cross-Reference Matrix

40 CFR Part 112 Section	Description of Section	Plan Section
112.1	General Applicability of 40CFR, Part 112	Throughout Plan
112.2	Definitions of Terms	Throughout Plan
112.3	Preparation Requirements, Engineer Certification	page iv
112.4	SPCC plan amendment by Regional Administrator	N.A.
112.5	Plan Amendments required by changes or 5-year period	page iii
112.6	Reserved	N.A.
112.7a(1)	Conformance with Requirements	Throughout Plan
112.7a(2)	Deviations from requirements – Equivalent environmental protection	Section 2.5
112.7a(3)	Facility Description and Site Layout	Section 2; Figure 2-1
112.7(a)(3)(i)	Type of Oil and Storage Capacity	Tables 1-4
112.7(a)(3)(ii)	Discharge Prevention Measures	Section 2.3; Section 5
112.7(a)(3)(iii)	Discharge Drainage Controls	Tables 1-4
112.7(a)(3)(iv)	Countermeasures for Discharge Discovery, Response, and Cleanup	Section 5
112.7(a)(3)(v)	Methods of Disposal of Recovered Materials	Section 6.3
112.7(a)(3)(vi)	Contact List and Phone Numbers	Spill Response Procedures, Appendix A
112.7(a)(4)	Discharge Reporting Information	Appendix F – Incident Report Form
112.7(a)(5)	Organization of Response Procedures	Section 5, Section 6
112.7(b)	Potential Spill Prediction Information	Table 5
112.7(c)	Containment and Diversion Structures or Equipment	Tables 1-4
112.7(d)	Oil Spill Contingency Plan	N.A.; see 112.7(c)
112.7(e)	Inspections, Integrity Testing and Recordkeeping Practices	Section 7
112.7(f)	Personnel Training, and Discharge Prevention Procedures	Sections 4, 5
112.7(g)(1)	Security – Site Access	Section 2.4
112.7(g)(2)	Security – Secured master flow and drain valves	Section 2.4
112.7(g)(3)	Security – Locking and location of pump starter controls	Section 2.4
112.7(g)(4)	Security – Capped and blank-flanged pipelines	Section 2.4
112.7(g)(5)	Security – Adequate facility lighting	Section 2.4
112.7(h)	Facility Tank Car and Truck Loading/Unloading Rack	Section 2.5
112.7(i)	Field-constructed Aboveground Container Repair	N.A.
112.7(j)	Applicable State Rules and Regulations	Throughout plan
112.8(a)	General Requirements	112.7; 112.8(b-d)
112.8(b)	Facility drainage requirements for diked and undiked areas	Section 3.2
112.8 (c)(1)	Bulk Storage Container Material of Construction	N.A.
112.8 (c)(2)	Bulk Storage Container Secondary Containment	Tables 1-4
112.8 (c)(3)	Bulk Storage Container Area Drainage – Check discharge before release	Section 3.2
112.8 (c)(4)	Completely Buried Metallic Tank Cathodic Protection	N.A.
112.8 (c)(5)	Partially Buried Metallic Tank Cathodic Protection	N.A.

40 CFR Part 112 Section	Description of Section	Plan Section
112.8 (c)(6)	Integrity Test Aboveground Containers	Section 2.5 & 7.3
112.8 (c)(7)	Leak Control of Heating Coils	N.A.
112.8 (c)(8)	Discharge Prevention Devices – overfill protection	Tables 1-3
112.8 (c)(9)	Inspection of Effluent Treatment Systems	N.A.
112.8 (c)(10)	Visible Discharges/Accumulation of Oil – Clean up	Section 7.4
112.8 (c)(11)	Mobile or Portable Storage Containers	Table 3
112.8(d)(1)	Piping and Valve Requirements -- Buried Piping	N.A.
112.8(d)(2)	Piping and Valve Requirements -- Terminal Connection	Section 2.4 - See 112.7g(4)
112.8(d)(3)	Piping and Valve Requirements -- Pipe Supports	Section 2.6
112.8(d)(4)	Piping and Valve Requirements -- Inspection of Aboveground Piping	Section 7
112.8(d)(5)	Piping and Valve Requirements – Security from vehicle damage	Section 4.1
112.9	Oil production facility requirements	N.A.
112.10	Onshore oil drilling or workover facilities requirements	N.A.
112.11	Offshore oil drilling, production, or workover facilities requirements	N.A.
112.12	Animal fats and oils and greases, fish and marine mammal oils, and vegetable oils – General Requirements	N.A.
112.13	Onshore oil production facilities requirements	N.A.
112.14	Onshore oil drilling and workover facilities requirements	N.A.
112.15	Offshore oil drilling, production, or workover facilities requirements	N.A.
112.20	Substantial harm criteria and the need for a facility response plan	Does not meet criteria. Appendix H
112.21	Facility response training and drills/exercises	N.A. – See 112.20

1.0 Introduction

The ECDC landfill is subject to the federal Spill Prevention, Control and Countermeasure (SPCC) Plan requirements because it stores more than 1,320 gallons of new and used oil products in aboveground storage tanks (greater than or equal to 55 gallons) on its site.

Oil is defined in 40 CFR, Part 112.2, as "...oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil." This SPCC Plan lists the procedures and equipment required to prevent discharge of oil and hazardous substances in quantities that:

- violate applicable water quality standards.
- cause a sheen upon or discoloration of the surface of navigable waters or adjoining shorelines.
- cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

The Plan also addresses the spill response procedures and actions that must be implemented if a spill does occur at this facility.

This Plan has been prepared for ECDC Environmental, LLC. for the ECDC landfill facility pursuant to 40 CFR Part 112 (see Appendix B). The Plan does not need to be submitted to the EPA unless requested; a complete copy of the Plan shall be maintained at The ECDC landfill and be made available to the EPA Regional Administrator and his agents, upon request, for on-site review during normal working hours

Appropriate employees at the facility shall become familiar with the contents of the Plan. The SPCC Coordinator shall be responsible for implementation of emergency spill response activities. In addition, a second full-time employee shall be trained to assume the SPCC Coordinator's responsibilities in the Coordinator's absence.

This plan shall be amended whenever there is a change in facility design, construction, operation, or maintenance that affects the facility's potential for the discharge of oil to navigable waters. Non-technical changes to the plan, such as updating employee information, do not require its recertification.

2.0 Facility Information

2.1 Site History

ECDC Environmental, LLC. purchased this facility in 1997 from Laidlaw Environmental. The site was originally developed by the East Carbon Development Corporation (ECDC) in 1990. Reportedly, there have been no significant releases of petroleum products within the last three years at the site.

2.2 Oil Products Storage and Spill Containment Systems

The following is a list of oil products stored (tanks and drums) and used at The ECDC landfill that are regulated under provisions of 40 CFR Part 112.

- Diesel Fuel used to fuel facility vehicles and heavy equipment.
- Gasoline used to fuel facility vehicles and heavy equipment.
- Lubricating Fluids (motor oil, gear oil, etc) are used in facility vehicles and heavy equipment and machinery.
- Hydraulic Fluids (hydraulic oil, transmission fluid, brake fluid, etc.) are used in facility vehicles and heavy equipment and machinery.
- Used motor and hydraulic oils are stored on site prior to collection for disposal or recycling.
- Solvents/Mineral Spirits are used for mechanical parts degreasing.

Tanks and containment systems are summarized as follows:

- Tank and secondary containment inventory — Table 2-1
- Potential tank failure modes, flow rates, direction of flows — Table 2-2
- Facility Site Plan — Figure 2-1

2.3 Fueling Operations

Fueling operations occur at this facility. The following vehicle fueling items are ECDC landfill's Best Management Practices (BMPs) to contain leaks and spills.

- **Facility and Supplies**
  - A drip bucket/pan.
  - A spill kit that includes absorbent material, salvage drum, plastic sheeting, and spill containment socks.
  - A shovel.
  - A yard brush.
  - Dispensing hoses for the diesel fuel tank should be fitted with a breakaway coupling.

- **Operating Procedures**
  - Fueling must be conducted on a paved surface.
  - The vehicle's ignition must be turned off during fueling.
  - The fueler must remain with the vehicle while fueling.
  - The fueler must not overfill the tank.
  - The fueler must not keep the nozzle open using a device or method other than his hand.
  - If a spill of less than 25 gallons occurs, no matter how small, the fueler must immediately place absorbent on the spilled fuel, pick up the absorbed material with a sweeping brush and shovel, and place the material in the 'Used Absorbent' receptacle.
  - The fuel pad must be dry cleaned (sweep and shovel - absolutely no water).
  - The 'Clean Absorbent' and 'Used Absorbent' storage containers must be covered or otherwise protected from rain at all times.
  - Used absorbent must be disposed of properly.
  - The 'Clean Absorbent' container must be refilled when it has been depleted to less than half of its capacity.
  - The shovel and drip pan/bucket must always be replaced at the fueling area following use.
  - The drip pan/bucket must be stored up-side down when not in use.
  - If a spill of 25 gallons or more occurs, refer to Sections 5.0 and 6.0.

2.4 Security Systems

Site access is restricted by fencing and building access. Site buildings and gates are locked when the site is unoccupied.

All tanks, with master flow and drain valves, are located inside buildings that are locked or are located in the fenced yard and their valves are locked.

The starter control for all oil pumps is located at a site only accessible to authorized personnel. The starter controls are locked.

SPCC regulations require the facility to have and maintain adequate lighting— commensurate with the type and location of the facility—that will assist in discovering discharges occurring during hours of darkness and will discourage acts of vandalism that may cause discharges. The ECDC landfill has lighting that meets the regulations. Lighting for the storage tanks inside the buildings consists of overhead florescent lighting.

2.5 Equivalent Environmental Protection

In accordance with 40 CFR Part 112.7(a)(2), a facility may deviate from certain aspects of the SPCC plan requirements provided that equivalent environmental protection is achieved through other means of spill prevention, control, or countermeasure. For this facility, the equivalent environmental protection includes:

- Equivalent environmental protection in lieu of integrity testing requirements of 40 CFR 112.8(c)(6) based on good engineering practices considering the various tanks size, installation, and alternative measures implemented by the facility. Facility personnel perform monthly and annual inspections of all of the ASTs present at the site. In addition, daily observations during normal work days of the tanks are made by facility personnel using the tanks allowing for signs of tank deterioration to be observed prior to the monthly or annual inspections. Inspection records are maintained in Appendix F of this document. The personnel performing these inspections are knowledgeable of storage facility operations, characteristics of the liquids stored, the type of aboveground storage tank and its associated components. All of the ASTs except for the 25,000-gallon diesel fuel tanks have a storage capacity of 10,000-gallons or less and are located on concrete or asphalt pads which function as a release prevention barrier. The 25,000-gallon diesel tank is located on a concrete pad, but the bottom of the tank is not visible for inspection. In addition, some of the tanks are double-walled or have a secondary containment system to contain releases from the tanks. The 1,000-gallon gasoline tank, 1,000-gallon diesel tank, 500-gallon motor oil tanks, and 500-gallon used oil tanks are elevated allowing all sides of the tanks to be observed for tank integrity. If signs of leakage or deterioration of a tank are observed by facility personnel, the tank is to be inspected by a tank inspector certified by the American Petroleum Institute or the Steel Tank Institute or an equivalent industry institute. This may include integrity testing as per 40 CFR 112.8(c)(6). The various tanks physical sizes and configurations, combined with daily observations, monthly and annual inspections ensures that any small leak that could develop in the tank shell will be detected before it can become significant, escape secondary containment, and reach the environment. This approach provides equivalent environmental protect to the non-destructive shell testing requirements of 40 CFR 112.8(c)(6).

- Equivalent environmental protection in lieu of overfill protection requirements of 40 CFR 112.8(c)(8) for the 500-gallon waste oil tanks (Tanks A-7 & A-8 in Table 1) based on good engineering practices considering the various tanks size, installation, and alternative measures implemented by the facility. The liquid level in the tank is visually observed to determine available capacity. Waste oil will be added by hand in quantities which are less than the available capacity by site personnel. This approach provides equivalent environmental protection to the overfill protection requirements of 40 CFR 112.8(c)(8).

2.6 Facility Piping and Valves

Based on the volume of product used and the level of risk, the pipes and pipe supports are designed to minimize abrasion and corrosion, and allow for expansion and contraction.

If tanks or piping are not in service for an extended period, the loading/unloading connections must be securely capped or blank-flanged to secure them.

Table 1
Tank Inventory Table - AST

AST	AST Capacity (gal)	Is AST in use? (Yes/No)	AST Contents	AST Construction Type/Material	Secondary Containment Type (Steel, Dirt, Lined Dirt, None)	Secondary Containment Capacity (gal)	Type of High Level Indicator (Depth, Volume, Sight Glass, None)? Operational?	Is AST protected from moving vehicles?	Is AST anchored? (Y/N)	Is AST electrically grounded? (Y/N)	Is there adequate lighting near the tank or dispenser? (Y/N)	Comments
A-1	25,000	Yes	Diesel	Shop/Steel	Concrete	≈33,000	Volume Gauge	Yes	No	No		
A-2	1,000	Yes	Unleaded	Shop/Steel	Concrete	≈33,000	None	Yes	No	No		
A-3	1,000	No	Diesel	Shop/Steel	Concrete	≈33,000	None	Yes	No	No		
A-4	500	Yes	Motor Oil	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	
A-5	500	Yes	Motor Oil	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	
A-6	500	Yes	Motor Oil	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	
A-7	500	Yes	Used Oil	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	
A-8	500	Yes	Used Oil	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	
A-9	55	Yes	Varies	Shop/Steel	Concrete	≈1,400	None	Yes	No	No	Yes	3 Motor Oil 3 Antifreeze 1 Grease 1 Empty Grease

Table 2
Tank Inventory Table - UST

UNDERGROUND STORAGE TANKS (List all USTs)												
	UST Capacity (gal)	Is UST in use? (Yes/No)	UST Contents	State ID No.	Date UST Installed	Date of Last Leak Test	Did the UST leak? (Y/N)	Tank Construction Material	Type of Corrosion Protection	Spill/Overfill Prevention	Is there adequate lighting near the tank or dispenser? (Y/N)	Comments
U-1	No Underground Storage Tanks											

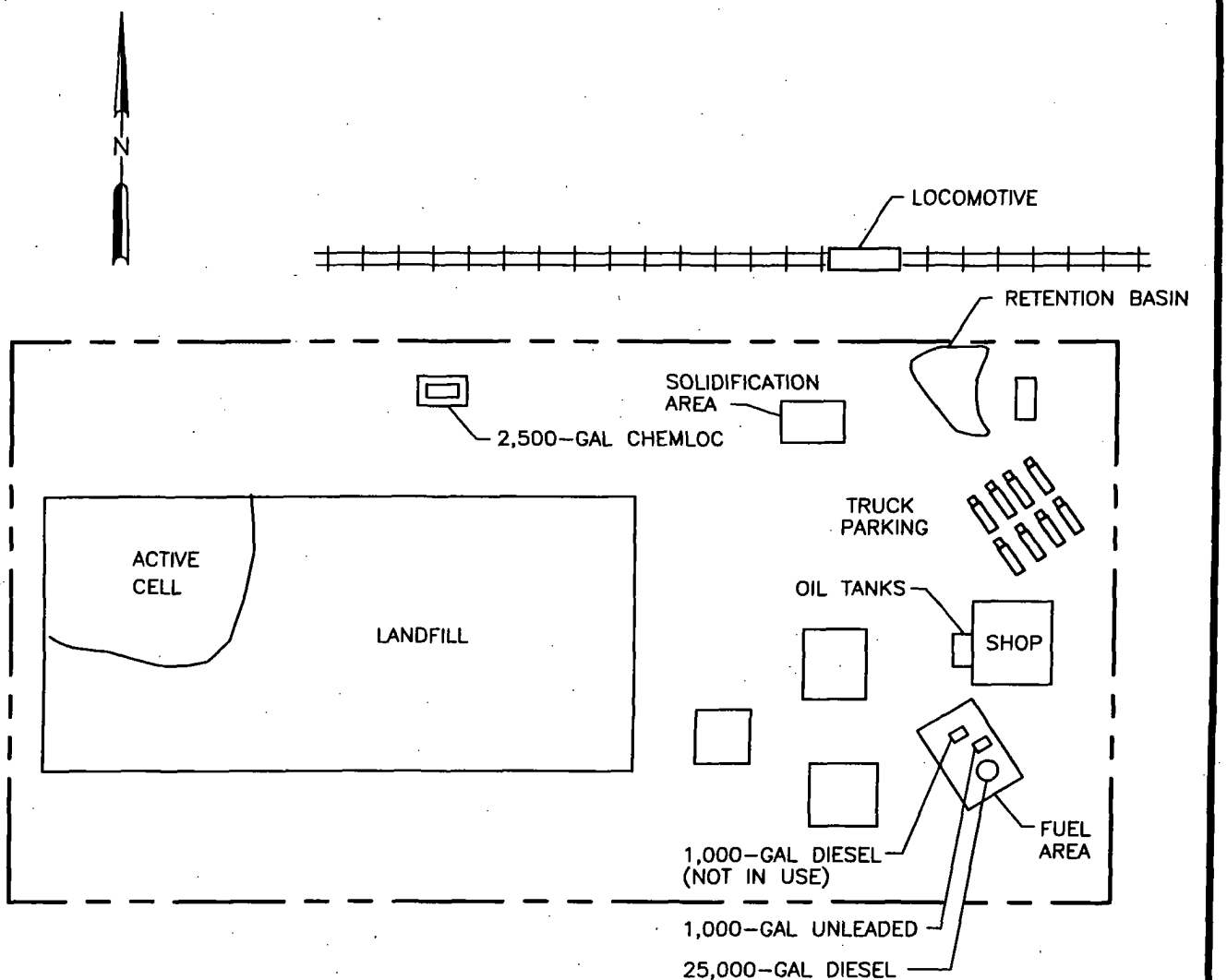
Table 3
Tank Inventory Table - Mobile AST

MOBILE ABOVEGROUND STORAGE TANKS (List all mobile ASTs >= 55 gal other than on-board vehicle fuel tanks)										
	AST Capacity (gal)	Is AST in use? (Yes/No)	AST Contents	AST Construction Type/Material	Secondary Containment Type (Steel, Dirt, Lined Dirt, None)	Secondary Containment Capacity (gal)	Type of High Level Indicator (Depth, Volume, Sight Glass, None)? Operational?	Is AST protected from moving vehicles?	Is AST electrically grounded?	Comments
M-1	1,000	Yes	Diesel	Steel	Steel	Double Walled	None	No	No	Mobile Service Truck
M-2	100	Yes	Motor Oil	Steel	Steel	Double Walled	None	No	No	Mobile Service Truck
M-3	100	Yes	Used Oil	Steel	Steel	Double Walled	None	No	No	Mobile Service Truck
M-4	55	Yes	Chain Oil	Steel	Steel	Double Walled	None	No	No	Mobile Service Truck

Table 4
Reasonable Potential for Tank Failure Modes

	Loading/Unloading equipment failure			Tank overflow			Tank rupture			Leakage		
Tank #	Flow rate (gpm)	Total Quantity (gal)	Direction	Flow rate (gpm)	Total Quantity (gal)	Direction	Flow rate (gpm)	Total Quantity (gal)	Direction	Flow rate (gpm)	Total Quantity (gal)	Direction
A-1	50	3,000	North	50	500	North	Varies[1]	25,000	North	< 1	25,000	North
A-2	20	1,000	North	20	100	North	Varies[1]	1,000	North	< 1	1,000	North
A-3	20	1,000	North	20	100	North	Varies[1]	1,000	North	< 1	1,000	North
A-4	20	500	North	20	100	North	Varies[1]	500	North	< 1	500	North
A-5	20	500	North	20	100	North	Varies[1]	500	North	< 1	500	North
A-6	20	500	North	20	100	North	Varies[1]	500	North	< 1	500	North
A-7	20	500	North	5	5	North	Varies[1]	500	North	< 1	500	North
A-8	20	500	North	5	5	North	Varies[1]	500	North	< 1	500	North
A-9	5	55	North	5	25	North	Varies[1]	55	North	< 1	55	North
M-1	20	1,000	Varies[2]	20	100	Varies[2]	Varies[1]	1,000	Varies[2]	< 1	1,000	Varies[2]
M-2	10	100	Varies[2]	10	50	Varies[2]	Varies[1]	100	Varies[2]	< 1	100	Varies[2]
M-3	10	100	Varies[2]	5	5	Varies[2]	Varies[1]	100	Varies[2]	< 1	100	Varies[2]
M-4	5	55	Varies[2]	5	25	Varies[2]	Varies[1]	55	Varies[2]	< 1	55	Varies[2]

Notes: Varies[1] - The flowrate of a tank rupture depends on the size and location of the rupture.
Varies[2] - The flow direction would vary based upon where the vehicle is parked each night.



EXPLANATION

APPROXIMATE SITE BOUNDARY

NOT TO SCALE

1" 0" 1"

XREF Files: IMAGE Files:
File: N:\Project Files\118501 - Allied Utah SPCC 2005\ECDC\ECDC Fig 2-1.dwg Layout: Layout1 User: craig.young Jul 26, 2006 - 11:25am

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PROJECT NO. 118501

FIGURE 2-1
ECDC LANDFILL
SPCC PLAN
ECDC, UTAH

FACILITY SITE PLAN

3.0 Facility Drainage and Storm Water Management

3.1 Surface Drainage

Surface drainage for the areas around the storage tanks is to the northwest into a stormwater retention basin. Drainage for equipment parked on the landfill varies depending on which portion of the landfill the equipment is parked on.

3.2 Storm Water Management

The 25,000 gallon diesel, 1,000 gallon unleaded, 1,000 gallon diesel, and all of the mobile and equipment tanks are exposed to storm water. Storage of oil products in outside tanks is permissible under the UPDES Multi-Sector General Permit provided that the storm water BMPs in the SWPPP are implemented. SWPPP BMPs generally include following the requirements of this SPCC plan.

Storm water discharge from the site is covered under the UPDES Multi-Sector General Permit.

Storm water ponding in the secondary containers will be removed as necessary. Storm water will not be discharged to waters of the U.S. if an oil sheen is present. A log of storm water drainage activities from secondary containers is included in Appendix F.

4.0 Personnel Training

4.1 Spill Prevention Training

4.1.1 Permanent Personnel

Appropriate facility personnel will be trained annually in how to:

- perform their duties in a way to prevent the discharge of harmful quantities of oil or hazardous substances.
- perform their duties for compliance with the spill and emergency response regulations applicable to the facility.
- respond to potential spill situations including tanks, aboveground and underground piping, and transfer of oil products.
- avoid vehicle collisions with tanks, aboveground and underground piping.

Appropriate new personnel will be trained after entering the facility.

4.1.2 Transient Personnel

When necessary, transient personnel will be advised of applicable spill prevention measures upon entering the facility. Transient personnel and drivers of vehicles not regularly employed at the facility will be advised, when necessary, of the presence of aboveground and below ground pipes, tanks, and other potential spill sources.

4.1.3 Tank Truck Drivers

Tank truck drivers loading or unloading oil products at the facility shall adhere to the following guidelines.

- Remain with the vehicle while loading/unloading.
- Drain the loading/unloading lines to the storage tank and close the drain valves before disconnecting lines and make sure a drain pan or other appropriate containment device is located under all connections.
- Inspect the vehicle before departure to be sure loading/unloading lines have been disconnected and drain and vent valves are closed.
- Immediately report any leaks or spills, including quantity, to the SPCC Coordinator.

The instructions listed above are to be documented using the notice to tank truck drivers found in Appendix D.

4.2 Spill Response Training

Appropriate facility personnel will be trained annually in spill and emergency response procedures. This training includes reporting, stopping, containing, cleaning up, and disposing of spill materials, emergency communications, etc.

4.3 Record Keeping

Accurate records will be maintained of personnel emergency response training. Personnel training will be recorded on forms and will be kept in safety training files. Copies of training forms should be kept with this SPCC plan.

4.4 Appointed Trainers

Initial training will be conducted by, or under the supervision of the SPCC Coordinator or his designated representative chosen by the General Manager. Supervisors may then conduct training for appropriate facility workers.

5.0 Emergency Procedures/Spill Response

IF THERE IS AN IMMEDIATE THREAT TO HUMAN LIFE (E.G., A FIRE IN PROGRESS OR FUMES OVERCOMING WORKERS), MAKE AN ANNOUNCEMENT TO EVACUATE THE BUILDING AND CALL 911.

5.1 General

If a spill has occurred, open Appendix A and refer to the Spill Response Flowchart outlining specific steps to be followed. Site personnel should be familiar with this flowchart and utilize it in the event of a spill.

EPA regulations state that a discharge includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping of oil excluding discharges in compliance with a permit under section 402 of the Clean Water Act or authorized by a permit issued under Section 13 of the River and Harbor Act of 1899. For purposes of this plan, storm sewers, ditches, and swales are considered to fall under the definition of a "navigable waterway" since they usually discharge into a navigable waterway. Contaminated groundwater may also have the potential to seep, leach, or flow into navigable water, which would be included in this definition.

An important facet of an effective response procedure during an oil or substance release incident is to keep the material separated from water to minimize migration and the resulting potential increase in human and environmental exposure. Every effort should be made to prevent spills and emphasize substance containment at the source rather than resort to separation of the material from expanded portions of the environment or downstream waters.

5.2 Discovery of a Release

The person discovering a release of material from a container, tank, or operating equipment should immediately report the incident to the Supervisor and the SPCC Coordinator. If there is an immediate threat to human life (e.g. a fire in progress or fumes overcoming workers), make an announcement to evacuate the building, and call the fire department.

- **Extinguish any nearby sources of ignition.** Assure that no danger to human health exists. Unless the spilled material is identified as nonflammable and noncombustible, all potential sources of ignition in the area should be turned off, extinguished, or removed. Vehicle's engines should be turned off. If the ignition source is stationary,

attempt to move spilled material away from ignition source. Avoid sparks and movement creating static electricity.

- **Attempt to stop the release at its source.** Assure that no danger to human health exists. Simple procedures (e.g., turning valves, plugging leaks) may be attempted by the discoverer if there is a reasonable certainty of the leak's origin. All other efforts to control leaks should be supervised by the SPCC Coordinator or Assistant SPCC Coordinator.
- **Initiate spill notification and reporting procedures.** Request the assistance of the fire department's hazardous materials response team if an uncontrollable spill has occurred and/or if the spill has migrated beyond the facility boundary (see Section 6.0). The SPCC Coordinator will perform necessary corporate and external regulatory notifications.

5.3 Containment of a Release

If material is released outside the containment areas, the material must be accurately identified and appropriate control measures taken in the safest possible manner. Consult the MSDS notebook in the facility office. To contain a release, follow these procedures:

- **Attempt to stop the release at the source.** If the source of the release has not been found; if special protective equipment is necessary to approach the release area; or if assistance is required to stop the release, call the fire department to halt the discharge at its source. Site personnel should remain available to guide the fire department's efforts.
- **Contain the material released into the environment.** Following proper safety procedures, contain the spill by placing absorbent materials and dikes using shovels and brooms. A spill kit that includes adsorbent material, containment socks, rags, plastic, and a salvage drum is located in the facility. Consult applicable MSDSs for material compatibility, safety, and environmental precautions.
- **Continue the notification procedure.** Inform the SPCC Coordinator of the release (the Coordinator shall perform subsequent notification as appropriate). Obtain outside contractors to clean up the spill, if necessary.

5.4 Communications

In case of a fire, spill, or other emergency, use facility telephones, paging systems and/or two-way radios to contact appropriate personnel.

5.5 Spill, Fire, and Safety Equipment

Portable fire extinguishers are located throughout the facility, are well marked, and are easily accessible. Records are kept on fire equipment in service and regular testing is performed in accordance with established good practices. A recommended list of fire extinguishers, spill, and safety equipment is included in Appendix G.

5.6 Spill Cleanup

Appropriate personal protective equipment and clean-up procedures can be found in the MSDSs. Care must be taken when cleaning up spills to minimize waste generation. The Environmental Manager can provide assistance for the issues discussed below. The Environmental Manager must be made aware of all cleanups of spills over 25 gallons.

- **Recover or clean up the spilled material** - As much material as possible should be recovered and reused where appropriate. Material that cannot be reused must be declared waste. Solid materials used to absorb liquids shall be shoveled into 55-gallon drums or, if the size of the spill warrants, into a roll-off container. When drums are filled after a cleanup, the drum lids shall be secured and the drums appropriately labeled to identify the substance, the date of the spill/cleanup, and the facility name and location. Combining non-compatible materials can potentially cause dangerous chemical and/or physical reactions or may severely limit disposal options. Compatibility information can be found on MSDSs.
- **Cleanup of the spill area** - Surfaces that are contaminated by the release shall be cleaned by the use of an appropriate substance or water. Cleanup water must be minimized, contained and properly disposed. Occasionally, porous materials (such as wood, soil, or oil-dry) may be contaminated; such materials will require special handling for disposal.
- **Decontaminate tools and equipment used in cleanup** - Even if dedicated to cleanup efforts, tools and equipment that have been used must be decontaminated before replacing them in the spill control kit.

5.7 Post-Cleanup Procedures

Post-cleanup procedures are discussed in Section 6.

5.8 Liaison with Local Authorities

Copies of this plan will be submitted to the local fire department, police department, and hospital as requested. In addition, familiarization sessions may be held with personnel from these organizations as necessary. It is important that personnel responding to an emergency be familiar with chemicals used, the possibilities for releases of hazardous materials, and the location of the fire equipment such as hydrants and extinguishers.

6.0 Emergency Contacts and Reporting Procedures

In the event of an accident or chemical spill at the facility, the manager with direct responsibility for the day-to-day facility operation will make internal and external contacts, as appropriate, as soon as practical after the incident has occurred (see Tables 6 and 7). If spill discharge to surface waters is imminent, the regulatory emergency agencies (see Section 6.2.1) should be immediately notified of the potential discharge.

Hazardous chemical spills are not covered under this plan and need to be handled according to the facility's Emergency Response Plan.

Table 5
SPCC Team Members

Team Position	Name	Title
SPCC Coordinator	Darin Olson	ECDC Environmental Manager
Assistant SPCC Coordinator	Jeff Green	Site Manager

* - *Designated Individual Responsible for Spill Prevention*

Internal Contacts

Team Position	Name	Work Telephone	Mobile Telephone
Site Manager	Jeff Green	435.888.4418x25	81.573.7533
Environmental Manager	Darin Olson	435.888.4418 x22	801.573.7514
General Manager	Kirk Treece	801.924.8454	801.573.7583
Division Manager	Kory Coleman	801.972.4234 x253	801.573.5110
Regional Engineer	Lee Kuhn	281.673.0393	832.671.0393

6.1 Internal Reporting

In the event of a spill it is the SPCC Coordinator's responsibility to make the necessary internal contacts (see Table 6) and any required regulatory contacts (see Table 7). Table 7 contains a listing of the reporting requirement thresholds.

6.2 Reporting to Outside Agencies

The SPCC Coordinator is responsible for determining if notifying regulatory agencies is necessary (see Table 7). If regulatory agencies are contacted, the contact information must be recorded in the Incident Report form (Appendix F). In addition, the Regional Engineer must be notified that a regulatory agency has been contacted.

Table 6
Spill Reporting Thresholds

Hazardous substances as defined in 40 CFR 117 may have smaller reportable quantities than those listed above, are not covered under this plan, and will be handled per a separate Emergency Response Plan.

Reporting Level	Regulatory Driver	On-site Contained Spill with No Surface or Storm Water Impact	Off-site Contained Spill with No Surface or Storm Water Impact
Tier 1 – Internal Only	SPCC Plan	If spill results in a surface stain of 1 foot diameter or more – Report to the SPCC Coordinator. If the spill takes more than one day to clean up, contact the Environmental Manager and Regional Engineer.	Report to the SPCC Coordinator, Environmental Manager, and Regional Engineer.
Tier 2 – Internal, State	State of Utah Regulations	State of Utah requires that spills of 25 gallons or more be reported (see Appendix C). Notify SPCC Coordinator, Environmental Manager, and Regional Engineer.	State of Utah requires that spills of 25 gallons or more be reported (see Appendix C). Notify SPCC Coordinator, Environmental Manager, and Regional Engineer.
Tier 3 – Internal, State, EPA	EPA Regulations	1,000 gallons or more for a single event, or 42 gallons from two or more spills in a 12-month period. A spill that impacts surface or storm water to violate applicable water quality standards or causes a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. Report to the EPA Regional Administrator. Notify SPCC Coordinator, Environmental Manager, and Regional Engineer.	

6.2.1 Releases/spills to Land, Air, Navigable or Other Waters

If a spill threatens to reach an off-site waterway, and the spill cannot be contained and recovered by facility personnel, then the following contacts shall be made in addition to the above contacts:

East Carbon Fire Department

435.888.2100 or **911**

Utah Environmental Response and Remediation
801.538.6146 (Utah Division of Water Quality)
801.536.4123 (24 hours)

National Response Center (U.S. Coast Guard)
800.424.8802

Utah Department of Environmental Quality
801.536.4127
801.536.4123 (24 hour incident reporting number)

Environmental Protection Agency, 8
1.866.EPASPILL (1.866.372.7745)

Carbon County Emergency Services
435.636.3290 x290

6.2.2 Reporting Procedures

The following information shall be communicated in reporting to outside agencies.

- Name, title, telephone number, and address of reporter
- Name, telephone number, and address of facility/spill
- Time, type and amount of materials involved
- Extent of injuries/illness, if known
- Possible hazards to human health and environment
- Any body of water involved
- The cause of accident/spill
- The action taken or proposed by the facility/personnel

6.3 Post-Cleanup Procedures

Post-cleanup procedures are discussed in Section 6.

- **Notify outside agencies** - The SPCC Coordinator shall determine if a reportable spill has occurred (See Section 6). Verbal notifications to government agencies and emergency planning committees shall be made, if necessary. Where verbal notification is given, a confirming written report shall be sent to the same entity.
- **Arrange for proper disposal** - Waste material from the cleanup must be properly characterized. If going to a Company-owned or -operated landfill, the Company Special Waste Approval Group must approve the disposal. Representative sampling and analysis may be necessary to make this determination. In any case, the SPCC Coordinator shall assure that the waste is transported and disposed in compliance with applicable laws and regulations. When manifests are needed, the SPCC Coordinator shall see that they are prepared and, when appropriate, returned in the allotted time by the disposal site.
- **Review contingency and spill plans** - Management and operating personnel shall review spill response efforts, notification procedures, and cleanup equipment usage to evaluate their adequacy during the episode. Where deficiencies are found, the SPCC Plan shall be revised and amended.

6.4 Internal Report

Spills that are regulated per this plan must be documented using the Incident Report Form or equivalent (see Appendix F). The report shall be prepared by the SPCC Coordinator. At a minimum, the report will document the following items.

- Date, time, and duration of release.
- Source and total volume of the release.
- Spill cleanup procedures.
- Personnel who discovered and/or participated in the spill remediation.
- Equipment used during the cleanup.
- Waste disposal method.
- Unusual events, injuries, or agency inspections.

7.0 Facility Inspections/Observations

The SPCC Coordinator or his designee shall inspect the facility for malfunctions, deterioration, operator errors, and discharge that may be causing, or may lead to, spills of oil and hazardous substances. Inspections shall be conducted often enough to identify problems in time to correct them before a spill occurs. The following schedule should provide adequate protection against a spill due to equipment failure:

- Aboveground Tanks, Containers, and Containment:
  - Exterior inspection – monthly
  - Structural supports – monthly
  - Secondary containment – monthly
  - Integrity testing – See section 2.5
  - Overfill Protection Devices – monthly
- Aboveground Piping
  - Exterior inspection – monthly
- Underground Fuel Tanks and Piping
  - Not applicable. There are no underground fuel tanks or pipes at this facility.

7.1 Daily Observations

If a problem is detected in observations during daily operations, the SPCC Coordinator must be notified and the appropriate action initiated. The following daily observations may be performed during the normal operations at the site.:

- AST connections may be observed for leakage, drainage, tightness, and appropriate capping.
- Pumps may be observed for evidence of leakage, proper operation, and damage.
- Aboveground piping may be observed for dripping, loose joints, damage to supports, and pipe deflection.
- Paved and unpaved ground may be observed for evidence of spills or leaks.
- After the facility has closed for the day, the security of the tanks should be checked; i.e., pumps are turned off, buildings and gates are locked.

7.2 Periodic Inspections

ASTs (including drums) containing oil or hazardous substances will be visually examined on a periodic basis to note their condition and potential maintenance needs. ASTs' foundations and structural supports should be examined. Tank exteriors will be observed for signs of

Aboveground Piping. Aboveground valves and piping will be examined for general condition of supports, flange joints, expansion joints, valve glands and bodies, and drip pans. Periodic pressure or other non-destructive integrity testing may be warranted for piping where facility drainage is such that a failure might lead to a spill event. Out-of-service pipes that are connected to in-use tanks will be observed for leaks or potential leaks.

Containment Structures. Secondary containment structures, walls, and berms will be visually inspected at frequent intervals to find accumulations of oil or hazardous substances and determine their sources. An oil stain can create a sheen on the surface of rainwater standing in containment areas. It is a violation of the SPCC regulations to release rainwater with that has an oil sheen.

7.3 Certified Inspections/Integrity Testing

ASTs will be inspected and integrity tested as a baseline during the 5 year period of this SPCC plan. Based upon this inspection and integrity test, a schedule for future inspections and integrity testing will be developed for each tank based upon its baseline inspection.

7.4 Repairs

ECDC landfill personnel will promptly correct visible discharges that result in a loss of oil from containers including, but not limited to, seams, gaskets, piping, pumps, valves, rivets, and bolts. Accumulations of oil in containment areas must be promptly removed. Residues shall be removed to the greatest extent possible by wiping the area with sorbent pads (or comparable material).

7.5 Inspection Records

Inspections and repairs will be documented (see Appendix F), signed by the SPCC Coordinator, and kept on file at the facility with the SPCC plan (per 40 CFR 112.7.e) for a period of three years.

Appendix A
Spill Response Procedures

If there is an immediate threat to human life (e.g. a fire in progress or fumes overcoming workers), make an announcement to evacuate the building and call 911.

EMERGENCY RESPONSE GOAL: An effective response procedure during an oil or substance release incident is to keep the material separated from water to minimize migration and the resulting potential increase in human and environmental exposure.

EMERGENCY CONTACTS:

A. SPCC COORDINATOR
Darin Olson
435.888.4418x22
801.573.7514 (Cell)

B. ASSISTANT SPCC COORDINATOR
Jeff Green
435.888.4418x25
801.573.7533 (Cell)

C. EAST CARBON FIRE DEPARTMENT
435.888.2100 or 911

D. CASTLEVIEW HOSPITAL
300 N. Hospital Drive
Price, Utah 84501
435.637.4800 or **911**

E. UTAH ENVIRONMENTAL RESPONSE AND REMEDIATION
801.538.6146 (Utah Division of Water Quality)
801.536.4123 (24 hours EMERGENCY MANAGEMENT PROGRAM

F. NATIONAL RESPONSE CENTER (U.S. COAST GUARD)
800.424.8802

G. UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
801.536.4127
801.536.4123 (24 hour incident reporting number)

H. ENVIRONMENTAL PROTECTION AGENCY, 8
1.866.EPASPILL (1.866.372.7745)

I. CARBON COUNTY EMERGENCY SERVICES
435.636.3290 x290

Discovery of a Release

The person discovering a release of material from a container, tank, or operating equipment should immediately report the incident to the Supervisor and the SPCC Coordinator.

- **Extinguish any nearby sources of ignition.** Assure that no danger to human health exists. Unless the spilled material is identified as nonflammable and noncombustible, all potential sources of ignition in the area should be turned off, extinguished, or removed. Vehicles engines should be turned off. If the ignition source is stationary, attempt to move spilled material away from ignition source. Avoid sparks and movement creating static electricity.
- **Attempt to stop the release at its source.** Assure that no danger to human health exists. Simple procedures (e.g., turning valves, plugging leaks) may be attempted by the discoverer if there is a reasonable certainty of the leak's origin. All other efforts to control leaks should be supervised by the SPCC Coordinator or Assistant SPCC Coordinator.
- **Initiate spill notification and reporting procedures.** Request the assistance of the fire department's hazardous materials response team if an uncontrollable spill has occurred and/or if the spill has migrated beyond the facility boundary. The SPCC Coordinator will perform necessary corporate and external regulatory notifications.

Containment of a Release

If material is released outside the containment areas, the material must be accurately identified and appropriate control measures taken in the safest possible manner. Consult the MSDS notebook in the facility office. To contain a release, follow these procedures:

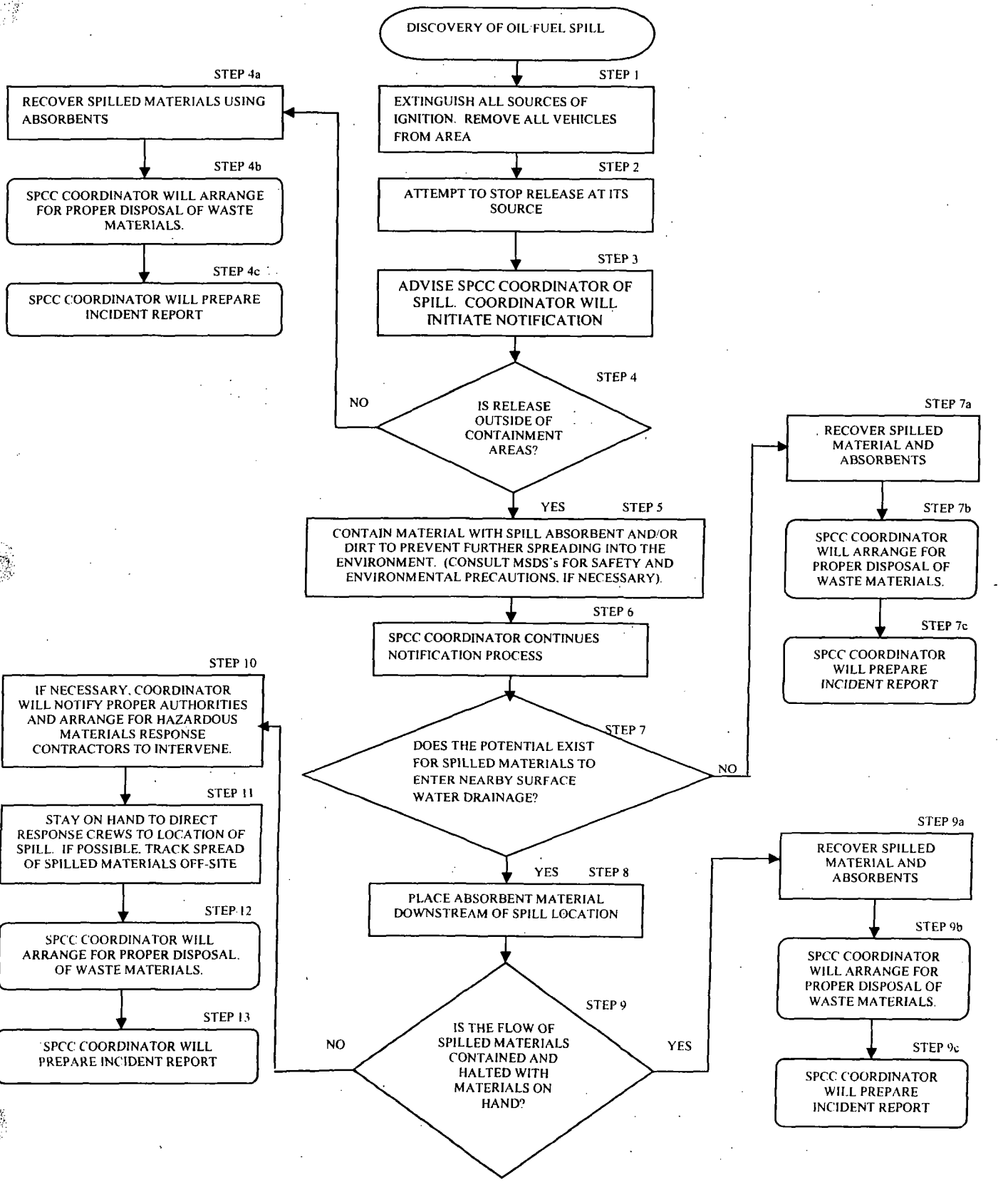
- **Attempt to stop the release at the source.** If the source of the release has not been found; if special protective equipment is necessary to approach the release area; or if assistance is required to stop the release, call the fire department to halt the discharge at its source. Site personnel should remain available to guide the fire department's efforts.
- **Contain the material released into the environment.** Following proper safety procedure, contain the spill by placing absorbent materials and dikes using shovels and brooms. A spill kit that includes adsorbent material, containment socks, rags, plastic, and a salvage drum is located in the facility. Consult applicable MSDSs for material compatibility, safety, and environmental precautions.
- **Continue the notification procedure.** Inform the SPCC Coordinator of the release (the Coordinator shall perform subsequent notification as appropriate).

Spill Cleanup and Reporting

Once the spill situation is under control and the release has been contained, facility personnel should commence the cleanup and reporting procedure described in Section 6. Obtain outside contractors to clean up the spill, if necessary.

ECDC LANDFILL

SPILL RESPONSE FLOWCHART



Appendix B
SPCC Regulations
40 CFR 112

40 CFR

Protection of Environment

CHAPTER I

ENVIRONMENTAL PROTECTION AGENCY (CONTINUED)

Subchapter D -- Water Programs

PART 112 -- OIL POLLUTION PREVENTION

Sec.

Subpart A -- Applicability, Definitions, and General Requirements For All Facilities and All Types of Oils

Sec.
112.1 General applicability.
112.2 Definitions.
112.3 Requirement to prepare and implement a Spill Prevention, Control, and Countermeasure Plan.
112.4 Amendment of Spill Prevention, Control, and Countermeasure Plan by Regional Administrator.
112.5 Amendment of Spill Prevention, Control, and Countermeasure Plan by owners or operators.
112.6 [Reserved].
112.7 General requirements for Spill Prevention, Control, and Countermeasure Plans.

Subpart B -- Requirements for Petroleum Oils and Non-Petroleum Oils, Except Animal Fats and Oils and Greases, and Fish and Marine Mammal Oils; and Vegetable Oils (Including Oils from Seeds, Nuts, Fruits, and Kernels)

Sec.
112.8 Spill Prevention, Control, and Countermeasure Plan requirements for onshore facilities (excluding production facilities).
112.9 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil production facilities.
112.10 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil drilling and workover facilities.
112.11 Spill Prevention, Control, and Countermeasure Plan requirements for offshore oil drilling, production, or workover facilities.

Subpart C -- Requirements for Animal Fats and Oils and Greases, and Fish and Marine Mammal Oils; and for Vegetable Oils, Including Oils from Seeds, Nuts, Fruits and Kernels

Sec.
112.12 Spill Prevention, Control, and Countermeasure Plan requirements for onshore facilities (excluding production facilities).
112.13 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil production facilities.
112.14 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil drilling and workover facilities.
112.15 Spill Prevention, Control, and Countermeasure Plan requirements for offshore oil drilling, production, or workover facilities.

Subpart D -- Response Requirements

Sec.
112.20 Facility response plans.
112.21 Facility response training and drills/exercises.

Appendix A to Part 112 -- Memorandum of Understanding Between the Secretary of Transportation and the Administrator of the Environmental Protection Agency
Appendix B to Part 112 -- Memorandum of Understanding Among the Secretary of the Interior, Secretary of Transportation, and Administrator of the Environmental Protection Agency
Appendix C to Part 112 -- Substantial Harm Criteria

Authority: 33 U.S.C. 1251 *et seq.*; 33 U.S.C. 2720; E.O. 12777 (October 18, 1991), 3 CFR, 1991 Comp., p. 351.
Source: 38 FR 34165, Dec. 11, 1973, unless otherwise noted.
Editorial Note: Nomenclature changes to part 112 appear at 65 FR 40798, June 30, 2000.

Subpart A -- Applicability, Definitions, and General Requirements for All Facilities and All Types of Oils

Source: 67 FR 47140, July 17, 2002 unless otherwise noted.

§112.1 General applicability.

(a) (1) This part establishes procedures, methods, equipment, and other requirements to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable waters of the United States or adjoining shorelines, or into or upon the waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or that may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Magnuson Fishery Conservation and Management Act).

(2) As used in this part, words in the singular also include the plural and words in the masculine gender also include the feminine and vice versa, as the case may require.

(b) Except as provided in paragraph (d) of this section, this part applies to any owner or operator of a non-transportation-related onshore or offshore facility engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming oil and oil products, which due to its location, could reasonably be expected to discharge oil in quantities that may be harmful, as described in part 110 of this chapter, into or upon the navigable waters of the United States or adjoining shorelines, or into or upon the waters of the contiguous zone, or in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974, or that may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Magnuson Fishery Conservation and Management Act) that has oil in:

(1) Any aboveground container;

(2) Any completely buried tank as defined in §112.2;

(3) Any container that is used for standby storage, for seasonal storage, or for temporary storage, or not otherwise "permanently closed" as defined in §112.2;

(4) Any "bunkered tank" or "partially buried tank" as defined in §112.2, or any container in a vault, each of which is considered an aboveground storage container for purposes of this part.

(c) As provided in section 313 of the Clean Water Act (CWA), departments, agencies, and instrumentalities of the Federal government are subject to this part to the same extent as any person.

(d) Except as provided in paragraph (f) of this section, this part does not apply to:

(1) The owner or operator of any facility, equipment, or operation that is not subject to the jurisdiction of the Environmental Protection Agency (EPA) under section 311(j)(1)(C) of the CWA, as follows:

(i) Any onshore or offshore facility, that due to its location, could not reasonably be expected to have a discharge as described in paragraph (b) of this section. This determination must be based solely upon consideration of the geographical and location aspects of the facility (such as proximity to navigable waters or adjoining shorelines, land contour, drainage, etc.) and must exclude consideration of manmade features such as dikes, equipment or other structures, which may serve to restrain, hinder, contain, or otherwise prevent a discharge as described in paragraph (b) of this section.

(ii) Any equipment, or operation of a vessel or transportation-related onshore or offshore facility which is subject to the authority and control of the U.S. Department of Transportation, as defined in the Memorandum of Understanding between the Secretary of Transportation and the Administrator of EPA, dated November 24, 1971 (Appendix A of this part).

(iii) Any equipment, or operation of a vessel or onshore or offshore facility which is subject to the authority and control of the U.S. Department of Transportation or the U.S. Department of the Interior, as defined in the Memorandum of Understanding between the Secretary of Transportation, the Secretary of the Interior, and the Administrator of EPA, dated November 8, 1993 (Appendix B of this part).

(2) Any facility which, although otherwise subject to the jurisdiction of EPA, meets both of the following requirements:

(i) The completely buried storage capacity of the facility is 42,000 gallons or less of oil. For purposes of this exemption, the completely buried storage capacity of a facility excludes the capacity of a completely buried tank, as defined in §112.2, and connected underground piping, underground ancillary equipment, and containment systems, that is currently subject to all of the technical requirements of part 280 of this chapter or all of the technical requirements of a State program approved under part 281 of this chapter. The completely buried storage capacity of a facility also excludes the capacity of a container that is "permanently closed," as defined in §112.2.

(ii) The aggregate aboveground storage capacity of the facility is 1,320 gallons or less of oil. For purposes of this exemption, only containers of oil with a capacity of 55 gallons or greater are counted. The aggregate aboveground storage capacity of a facility excludes the capacity of a container that is "permanently closed," as defined in §112.2.

(3) Any offshore oil drilling, production, or workover facility that is subject to the notices and regulations of the Minerals Management Service, as specified in the Memorandum of Understanding between the Secretary of Transportation, the Secretary of the Interior, and the Administrator of EPA, dated November 8, 1993 (Appendix B of this part).

(4) Any completely buried storage tank, as defined in §112.2, and connected underground piping, underground ancillary equipment, and containment systems, at any facility, that is subject to all of the technical requirements of part

280 of this chapter or a State program approved under part 281 of this chapter, except that such a tank must be marked on the facility diagram as provided in §112.7(a)(3), if the facility is otherwise subject to this part.
(5) Any container with a storage capacity of less than 55 gallons of oil.
(6) Any facility or part thereof used exclusively for wastewater treatment and not used to satisfy any requirement of this part. The production, recovery, or recycling of oil is not wastewater treatment for purposes of this paragraph.

(e) This part establishes requirements for the preparation and implementation of Spill Prevention, Control, and Countermeasure (SPCC) Plans. SPCC Plans are designed to complement existing laws, regulations, rules, standards, policies, and procedures pertaining to safety standards, fire prevention, and pollution prevention rules. The purpose of an SPCC Plan is to form a comprehensive Federal/State spill prevention program that minimizes the potential for discharges. The SPCC Plan must address all relevant spill prevention, control, and countermeasures necessary at the specific facility. Compliance with this part does not in any way relieve the owner or operator of an onshore or an offshore facility from compliance with other Federal, State, or local laws.

(f) Notwithstanding paragraph (d) of this section, the Regional Administrator may require that the owner or operator of any facility subject to the jurisdiction of EPA under section 311(j) of the CWA prepare and implement an SPCC Plan, or any applicable part, to carry out the purposes of the CWA.

(1) Following a preliminary determination, the Regional Administrator must provide a written notice to the owner or operator stating the reasons why he must prepare an SPCC Plan, or applicable part. The Regional Administrator must send such notice to the owner or operator by certified mail or by personal delivery. If the owner or operator is a corporation, the Regional Administrator must also mail a copy of such notice to the registered agent, if any and if known, of the corporation in the State where the facility is located.
(2) Within 30 days of receipt of such written notice, the owner or operator may provide information and data and may consult with the Agency about the need to prepare an SPCC Plan, or applicable part.
(3) Within 30 days following the time under paragraph (b)(2) of this section within which the owner or operator may provide information and data and consult with the Agency about the need to prepare an SPCC Plan, or applicable part, the Regional Administrator must make a final determination regarding whether the owner or operator is required to prepare and implement an SPCC Plan, or applicable part. The Regional Administrator must send the final determination to the owner or operator by certified mail or by personal delivery. If the owner or operator is a corporation, the Regional Administrator must also mail a copy of the final determination to the registered agent, if any and if known, of the corporation in the State where the facility is located.
(4) If the Regional Administrator makes a final determination that an SPCC Plan, or applicable part, is necessary, the owner or operator must prepare the Plan, or applicable part, within six months of that final determination and implement the Plan, or applicable part, as soon as possible, but not later than one year after the Regional Administrator has made a final determination.
(5) The owner or operator may appeal a final determination made by the Regional Administrator requiring preparation and implementation of an SPCC Plan, or applicable part, under this paragraph. The owner or operator must make the appeal to the Administrator of EPA within 30 days of receipt of the final determination under paragraph (b)(3) of this section from the Regional Administrator requiring preparation and/or implementation of an SPCC Plan, or applicable part. The owner or operator must send a complete copy of the appeal to the Regional Administrator at the time he makes the appeal to the Administrator. The appeal must contain a clear and concise statement of the issues and points of fact in the case. In the appeal, the owner or operator may also provide additional information. The additional information may be from any person. The Administrator may request additional information from the owner or operator. The Administrator must render a decision within 60 days of receiving the appeal or additional information submitted by the owner or operator and must serve the owner or operator with the decision made in the appeal in the manner described in paragraph (f)(1) of this section.

§112.2 Definitions.

For the purposes of this part:

Adverse weather means weather conditions that make it difficult for response equipment and personnel to clean up or remove spilled oil, and that must be considered when identifying response systems and equipment in a response plan for the applicable operating environment. Factors to consider include significant wave height as specified in Appendix E to this part (as appropriate), ice conditions, temperatures, weather-related visibility, and currents within the area in which the systems or equipment is intended to function.

Alteration means any work on a container involving cutting, burning, welding, or heating operations that changes the physical dimensions or configuration of the container.

Animal fat means a non-petroleum oil, fat, or grease of animal, fish, or marine mammal origin.

Breakout tank means a container used to relieve surges in an oil pipeline system or to receive and store oil transported by a pipeline for reinjection and continued transportation by pipeline.

Bulk storage container means any container used to store oil. These containers are used for purposes including, but not limited to, the storage of oil prior to use, while being used, or prior to further distribution in commerce. Oil-filled electrical, operating, or manufacturing equipment is not a bulk storage container.

Bunkered tank means a container constructed or placed in the ground by cutting the earth and re-covering the container in a manner that breaks the surrounding natural grade, or that lies above grade, and is covered with earth, sand, gravel, asphalt, or other material. A bunkered tank is considered an aboveground storage container for purposes of this part.

Completely buried tank means any container completely below grade and covered with earth, sand, gravel, asphalt, or other material. Containers in vaults, bunkered tanks, or partially buried tanks are considered aboveground storage containers for purposes of this part.

Complex means a facility possessing a combination of transportation-related and non-transportation-related components that is subject to the jurisdiction of more than one Federal agency under section 311(j) of the CWA.

Contiguous zone means the zone established by the United States under Article 24 of the Convention of the Territorial Sea and Contiguous Zone, that is contiguous to the territorial sea and that extends nine miles seaward from the outer limit of the territorial area.

Contract or other approved means means:
(1) A written contractual agreement with an oil spill removal organization that identifies and ensures the availability of the necessary personnel and equipment within appropriate response times; and/or
(2) A written certification by the owner or operator that the necessary personnel and equipment resources, owned or operated by the facility owner or operator, are available to respond to a discharge within appropriate response times; and/or
(3) Active membership in a local or regional oil spill removal organization that has identified and ensures adequate access through such membership to necessary personnel and equipment to respond to a discharge within appropriate response times in the specified geographic area; and/or
(4) Any other specific arrangement approved by the Regional Administrator upon request of the owner or operator.

Discharge includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping of oil; but excludes discharges in compliance with a permit under section 402 of the CWA; discharges resulting from circumstances identified, reviewed, and made a part of the public record with respect to a permit issued or modified under section 402 of the CWA, and subject to a condition in such permit; or continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of the CWA, that are caused by events occurring within the scope of relevant operating or treatment systems. For purposes of this part, the term discharge shall not include any discharge of oil that is authorized by a permit issued under section 13 of the River and Harbor Act of 1899 (33 U.S.C. 407).

Facility means any mobile or fixed, onshore or offshore building, structure, installation, equipment, pipe, or pipeline (other than a vessel or a public vessel) used in oil well drilling operations, oil production, oil refining, oil storage, oil gathering, oil processing, oil transfer, oil distribution, and waste treatment, or in which oil is used, as described in Appendix A to this part. The boundaries of a facility depend on several site-specific factors, including, but not limited to, the ownership or operation of buildings, structures, and equipment on the same site and the types of activity at the site.

Fish and wildlife and sensitive environments means areas that may be identified by their legal designation or by evaluations of Area Committees (for planning) or members of the Federal On-Scene Coordinator's spill response structure (during responses). These areas may include wetlands, National and State parks, critical habitats for endangered or threatened species, wilderness and natural resource areas, marine sanctuaries and estuarine reserves, conservation areas, preserves, wildlife areas, wildlife refuges, wild and scenic rivers, recreational areas, national forests, Federal and State lands that are research national areas, heritage program areas, land trust areas, and historical and archaeological sites and parks. These areas may also include unique habitats such as aquaculture sites and agricultural surface water intakes, bird nesting areas, critical biological resource areas, designated migratory routes, and designated seasonal habitats.

Injury means a measurable adverse change, either long- or short-term, in the chemical or physical quality or the viability of a natural resource resulting either directly or indirectly from exposure to a discharge, or exposure to a product of reactions resulting from a discharge.

Maximum extent practicable means within the limitations used to determine oil spill planning resources and response times for on-water recovery, shoreline protection, and cleanup for worst case discharges from onshore non-transportation-related facilities

in adverse weather. It includes the planned capability to respond to a worst case discharge in adverse weather, as contained in a response plan that meets the requirements in §112.20 or in a specific plan approved by the Regional Administrator.

Navigable waters means the waters of the United States, including the territorial seas.
(1) The term includes:

(i) All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide;
(ii) All interstate waters, including interstate wetlands;
(iii) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters:

(A) That are or could be used by interstate or foreign travelers for recreational or other purposes; or
(B) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or,
(C) That are or could be used for industrial purposes by industries in interstate commerce;

(iv) All impoundments of waters otherwise defined as waters of the United States under this section;
(v) Tributaries of waters identified in paragraphs (1)(i) through (iv) of this definition;
(vi) The territorial sea; and
(vii) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraph (1) of this definition.

(2) Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the CWA (other than cooling ponds which also meet the criteria of this definition) are not waters of the United States. Navigable waters do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other Federal agency, for the purposes of the CWA, the final authority regarding CWA jurisdiction remains with EPA.

Non-petroleum oil means oil of any kind that is not petroleum-based, including but not limited to: Fats, oils, and greases of animal, fish, or marine mammal origin; and vegetable oils, including oils from seeds, nuts, fruits, and kernels.

Offshore facility means any facility of any kind (other than a vessel or public vessel) located in, on, or under any of the navigable waters of the United States, and any facility of any kind that is subject to the jurisdiction of the United States and is located in, on, or under any other waters.

Oil means oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil.

Oil Spill Removal Organization means an entity that provides oil spill response resources, and includes any for-profit or not-for-profit contractor, cooperative, or in-house response resources that have been established in a geographic area to provide required response resources.

Onshore facility means any facility of any kind located in, on, or under any land within the United States, other than submerged lands.

Owner or operator means any person owning or operating an onshore facility or an offshore facility, and in the case of any abandoned offshore facility, the person who owned or operated or maintained the facility immediately prior to such abandonment.

Partially buried tank means a storage container that is partially inserted or constructed in the ground, but not entirely below grade, and not completely covered with earth, sand, gravel, asphalt, or other material. A partially buried tank is considered an aboveground storage container for purposes of this part.

Permanently closed means any container or facility for which:
(1) All liquid and sludge has been removed from each container and connecting line; and
(2) All connecting lines and piping have been disconnected from the container and blanked off, all valves (except for ventilation valves) have been closed and locked, and conspicuous signs have been posted on each container stating that it is a permanently closed container and noting the date of closure.

Person includes an individual, firm, corporation, association, or partnership.

Petroleum oil means petroleum in any form, including but not limited to crude oil, fuel oil, mineral oil, sludge, oil refuse, and refined products.

Production facility means all structures (including but not limited to wells, platforms, or storage facilities), piping (including but not limited to flowlines or gathering lines), or equipment (including but not limited to workover equipment, separation equipment, or auxiliary non-transportation-related equipment) used in the production, extraction, recovery, lifting, stabilization, separation or treating of oil, or associated storage or measurement, and located in a single geographical oil or gas field operated by a single operator.

Regional Administrator means the Regional Administrator of the Environmental Protection Agency, in and for the Region in which the facility is located.

Repair means any work necessary to maintain or restore a container to a condition suitable for safe operation, other than that necessary for ordinary, day-to-day maintenance to maintain the functional integrity of the container and that does not weaken the container.

Spill Prevention, Control, and Countermeasure Plan; SPCC Plan, or Plan means the document required by §112.3 that details the equipment, workforce, procedures, and steps to prevent, control, and provide adequate countermeasures to a discharge.

Storage capacity of a container means the shell capacity of the container.

Transportation-related and non-transportation-related, as applied to an onshore or offshore facility, are defined in the Memorandum of Understanding between the Secretary of Transportation and the Administrator of the Environmental Protection Agency, dated November 24, 1971, (Appendix A of this part).

United States means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, American Samoa, the U.S. Virgin Islands, and the Pacific Island Governments.

Vegetable oil means a non-petroleum oil or fat of vegetable origin, including but not limited to oils and fats derived from plant seeds, nuts, fruits, and kernels.

Vessel means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water, other than a public vessel.

Wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include playa lakes, swamps, marshes, bogs, and similar areas such as sloughs, prairie potholes, wet meadows, prairie river overflows, mudflats, and natural ponds.

Worst case discharge for an onshore non-transportation-related facility means the largest foreseeable discharge in adverse weather conditions as determined using the worksheets in Appendix D to this part.

§112.3 Requirement to prepare and implement a Spill Prevention, Control, and Countermeasure Plan.

The owner or operator of an onshore or offshore facility subject to this section must prepare a Spill Prevention, Control, and Countermeasure Plan (hereafter "SPCC Plan" or "Plan)," in writing, and in accordance with §112.7, and any other applicable section of this part.

(a) If your onshore or offshore facility was in operation on or before August 16, 2002, you must maintain your Plan, but must amend it, if necessary to ensure compliance with this part, on or before February 17, 2006, and must implement the amended Plan as soon as possible, but not later than August 18, 2006. If your onshore or offshore facility becomes operational after August 16, 2002, through August 18, 2006, and could reasonably be expected to have a discharge as described in §112.1(b), you must prepare a Plan on or before August 18, 2006, and fully implement it as soon as possible, but not later than August 18, 2006.

(b) If you are the owner or operator of an onshore or offshore facility that becomes operational after August 18, 2006, and could reasonably be expected to have a discharge as described in §112.1(b), you must prepare and implement a Plan before you begin operations.

(c) If you are the owner or operator of an onshore or offshore mobile facility, such as an onshore drilling or workover rig, barge mounted offshore drilling or workover rig, or portable fueling facility, you must prepare, implement, and maintain a facility Plan as required by this section. You must maintain your Plan, but must amend and implement it, if necessary to ensure compliance with this part, on or before August 18, 2006. If your onshore or offshore mobile facility becomes operational after August 18, 2006, and could reasonably be expected to have a discharge as described in §112.1(b), you must prepare and implement a Plan before you begin operations. This provision does not require that you prepare a new Plan each time you move the facility to a new site. The Plan may be a general Plan. When you move the mobile or portable facility, you must locate and install it using the

discharge prevention practices outlined in the Plan for the facility. The Plan is applicable only while the facility is in a fixed (non-transportation) operating mode.

(d) A licensed Professional Engineer must review and certify a Plan for it to be effective to satisfy the requirements of this part.

(1) By means of this certification the Professional Engineer attests:

(i) That he is familiar with the requirements of this part ;

(ii) That he or his agent has visited and examined the facility;

(iii) That the Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards, and with the requirements of this part;

(iv) That procedures for required inspections and testing have been established; and

(v) That the Plan is adequate for the facility.

(2) Such certification shall in no way relieve the owner or operator of a facility of his duty to prepare and fully implement such Plan in accordance with the requirements of this part.

(e) If you are the owner or operator of a facility for which a Plan is required under this section, you must:

(1) Maintain a complete copy of the Plan at the facility if the facility is normally attended at least four hours per day, or at the nearest field office if the facility is not so attended, and

(2) Have the Plan available to the Regional Administrator for on-site review during normal working hours.

(f) *Extension of time.*

(1) The Regional Administrator may authorize an extension of time for the preparation and full implementation of a Plan, or any amendment thereto, beyond the time permitted for the preparation, implementation, or amendment of a Plan under this part, when he finds that the owner or operator of a facility subject to this section, cannot fully comply with the requirements as a result of either nonavailability of qualified personnel, or delays in construction or equipment delivery beyond the control and without the fault of such owner or operator or his agents or employees.

(2) If you are an owner or operator seeking an extension of time under paragraph (f)(1) of this section, you may submit a written extension request to the Regional Administrator. Your request must include:

(i) A full explanation of the cause for any such delay and the specific aspects of the Plan affected by the delay;

(ii) A full discussion of actions being taken or contemplated to minimize or mitigate such delay; and

(iii) A proposed time schedule for the implementation of any corrective actions being taken or contemplated, including interim dates for completion of tests or studies, installation and operation of any necessary equipment, or other preventive measures. In addition you may present additional oral or written statements in support of your extension request.

(3) The submission of a written extension request under paragraph (f)(2) of this section does not relieve you of your obligation to comply with the requirements of this part. The Regional Administrator may request a copy of your Plan to evaluate the extension request. When the Regional Administrator authorizes an extension of time for particular equipment or other specific aspects of the Plan, such extension does not affect your obligation to comply with the requirements related to other equipment or other specific aspects of the Plan for which the Regional Administrator has not expressly authorized an extension.

[67 FR 47140, July 17, 2002, as amended at 68 FR 1351, Jan. 9, 2003; 68 FR 18894, Apr. 17, 2003; 69 FR 48798, Aug. 11, 2004]

§112.4 Amendment of Spill Prevention, Control, and Countermeasure Plan by Regional Administrator.

If you are the owner or operator of a facility subject to this part, you must:

(a) Notwithstanding compliance with §112.3, whenever your facility has discharged more than 1,000 U.S. gallons of oil in a single discharge as described in §112.1(b), or discharged more than 42 U.S. gallons of oil in each of two discharges as described in §112.1(b), occurring within any twelve month period, submit the following information to the Regional Administrator within 60 days from the time the facility becomes subject to this section:

(1) Name of the facility;

(2) Your name;

(3) Location of the facility;

(4) Maximum storage or handling capacity of the facility and normal daily throughput;

(5) Corrective action and countermeasures you have taken, including a description of equipment repairs and replacements;

(6) An adequate description of the facility, including maps, flow diagrams, and topographical maps, as necessary;

(7) The cause of such discharge as described in §112.1(b), including a failure analysis of the system or subsystem in which the failure occurred;

(8) Additional preventive measures you have taken or contemplated to minimize the possibility of recurrence; and

(9) Such other information as the Regional Administrator may reasonably require pertinent to the Plan or discharge.

(b) Take no action under this section until it applies to your facility. This section does not apply until the expiration of the time permitted for the initial preparation and implementation of the Plan under §112.3, but not including any amendments to the Plan.

(c) Send to the appropriate agency or agencies in charge of oil pollution control activities in the State in which the facility is located a complete copy of all information you provided to the Regional Administrator under paragraph (a) of this section. Upon receipt of the information such State agency or agencies may conduct a review and make recommendations to the Regional Administrator as to further procedures, methods, equipment, and other requirements necessary to prevent and to contain discharges from your facility.

(d) Amend your Plan, if after review by the Regional Administrator of the information you submit under paragraph (a) of this section, or submission of information to EPA by the State agency under paragraph (c) of this section, or after on-site review of your Plan, the Regional Administrator requires that you do so. The Regional Administrator may require you to amend your Plan if he finds that it does not meet the requirements of this part or that amendment is necessary to prevent and contain discharges from your facility.

(e) Act in accordance with this paragraph when the Regional Administrator proposes by certified mail or by personal delivery that you amend your SPCC Plan. If the owner or operator is a corporation, he must also notify by mail the registered agent of such corporation, if any and if known, in the State in which the facility is located. The Regional Administrator must specify the terms of such proposed amendment. Within 30 days from receipt of such notice, you may submit written information, views, and arguments on the proposed amendment. After considering all relevant material presented, the Regional Administrator must either notify you of any amendment required or rescind the notice. You must amend your Plan as required within 30 days after such notice, unless the Regional Administrator, for good cause, specifies another effective date. You must implement the amended Plan as soon as possible, but not later than six months after you amend your Plan, unless the Regional Administrator specifies another date.

(f) If you appeal a decision made by the Regional Administrator requiring an amendment to an SPCC Plan, send the appeal to the EPA Administrator in writing within 30 days of receipt of the notice from the Regional Administrator requiring the amendment under paragraph (e) of this section. You must send a complete copy of the appeal to the Regional Administrator at the time you make the appeal. The appeal must contain a clear and concise statement of the issues and points of fact in the case. It may also contain additional information from you, or from any other person. The EPA Administrator may request additional information from you, or from any other person. The EPA Administrator must render a decision within 60 days of receiving the appeal and must notify you of his decision.

§112.5 Amendment of Spill Prevention, Control, and Countermeasure Plan by owners or operators.

If you are the owner or operator of a facility subject to this part, you must:

(a) Amend the SPCC Plan for your facility in accordance with the general requirements in §112.7, and with any specific section of this part applicable to your facility, when there is a change in the facility design, construction, operation, or maintenance that materially affects its potential for a discharge as described in §112.1(b). Examples of changes that may require amendment of the Plan include, but are not limited to: commissioning or decommissioning containers; replacement, reconstruction, or movement of containers; reconstruction, replacement, or installation of piping systems; construction or demolition that might alter secondary containment structures; changes of product or service; or revision of standard operation or maintenance procedures at a facility. An amendment made under this section must be prepared within six months, and implemented as soon as possible, but not later than six months following preparation of the amendment.

(b) Notwithstanding compliance with paragraph (a) of this section, complete a review and evaluation of the SPCC Plan at least once every five years from the date your facility becomes subject to this part; or, if your facility was in operation on or before August 16, 2002, five years from the date your last review was required under this part. As a result of this review and evaluation, you must amend your SPCC Plan within six months of the review to include more effective prevention and control technology if the technology has been field-proven at the time of the review and will significantly reduce the likelihood of a discharge as described in §112.1(b) from the facility. You must implement any amendment as soon as possible, but not later than six months following preparation of any amendment. You must document your completion of the review and evaluation, and must sign a statement as to whether you will amend the Plan, either at the beginning or end of the Plan or in a log or an appendix to the Plan. The following words will suffice, "I have completed review and evaluation of the SPCC Plan for (name of facility) on (date), and will (will not) amend the Plan as a result."

(c) Have a Professional Engineer certify any technical amendment to your Plan in accordance with §112.3(d).

§112.6 [Reserved]

§112.7 General requirements for Spill Prevention, Control, and Countermeasure Plans.

If you are the owner or operator of a facility subject to this part you must prepare a Plan in accordance with good engineering practices. The Plan must have the full approval of management at a level of authority to commit the necessary resources to fully implement the Plan. You must prepare the Plan in writing. If you do not follow the sequence specified in this section for the Plan, you must prepare an equivalent Plan acceptable to the Regional Administrator that meets all of the applicable requirements listed in this part, and you must supplement it with a section cross-referencing the location of requirements listed in this part and the equivalent requirements in the other prevention plan. If the Plan calls for additional facilities or procedures, methods, or equipment not yet fully operational, you must discuss these items in separate paragraphs, and must explain separately the details of installation and operational start-up. As detailed elsewhere in this section, you must also:

(a) (1) Include a discussion of your facility's conformance with the requirements listed in this part.
(2) Comply with all applicable requirements listed in this part. Your Plan may deviate from the requirements in paragraphs (g), (h)(2) and (3), and (i) of this section and the requirements in subparts B and C of this part, except the secondary containment requirements in paragraphs (c) and (h)(1) of this section, and §§112.8(c)(2),112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11),112.13(c)(2), and 112.14(c), where applicable to a specific facility, if you provide equivalent environmental protection by some other means of spill prevention, control, or countermeasure. Where your Plan does not conform to the applicable requirements in paragraphs (g), (h)(2) and (3), and (i) of this section, or the requirements of subparts B and C of this part, except the secondary containment requirements in paragraphs (c) and (h)(1) of this section, and §§112.8(c)(2), 112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11), 112.13(c)(2), and 112.14(c), you must state the reasons for nonconformance in your Plan and describe in detail alternate methods and how you will achieve equivalent environmental protection. If the Regional Administrator determines that the measures described in your Plan do not provide equivalent environmental protection, he may require that you amend your Plan, following the procedures in §112.4(d) and (e).
(3) Describe in your Plan the physical layout of the facility and include a facility diagram, which must mark the location and contents of each container. The facility diagram must include completely buried tanks that are otherwise exempted from the requirements of this part under §112.1(d)(4). The facility diagram must also include all transfer stations and connecting pipes. You must also address in your Plan:
(i) The type of oil in each container and its storage capacity;
(ii) Discharge prevention measures including procedures for routine handling of products (loading, unloading, and facility transfers, *etc.*);
(iii) Discharge or drainage controls such as secondary containment around containers and other structures, equipment, and procedures for the control of a discharge;
(iv) Countermeasures for discharge discovery, response, and cleanup (both the facility's capability and those that might be required of a contractor);
(v) Methods of disposal of recovered materials in accordance with applicable legal requirements; and
(vi) Contact list and phone numbers for the facility response coordinator, National Response Center, cleanup contractors with whom you have an agreement for response, and all appropriate Federal, State, and local agencies who must be contacted in case of a discharge as described in §112.1(b).
(4) Unless you have submitted a response plan under §112.20, provide information and procedures in your Plan to enable a person reporting a discharge as described in §112.1(b) to relate information on the exact address or location and phone number of the facility; the date and time of the discharge, the type of material discharged; estimates of the total quantity discharged; estimates of the quantity discharged as described in §112.1(b); the source of the discharge; a description of all affected media; the cause of the discharge; any damages or injuries caused by the discharge; actions being used to stop, remove, and mitigate the effects of the discharge; whether an evacuation may be needed; and, the names of individuals and/or organizations who have also been contacted.
(5) Unless you have submitted a response plan under §112.20, organize portions of the Plan describing procedures you will use when a discharge occurs in a way that will make them readily usable in an emergency, and include appropriate supporting material as appendices.

(b) Where experience indicates a reasonable potential for equipment failure (such as loading or unloading equipment, tank overflow, rupture, or leakage, or any other equipment known to be a source of a discharge), include in your Plan a prediction of the direction, rate of flow, and total quantity of oil which could be discharged from the facility as a result of each type of major equipment failure.

(c) Provide appropriate containment and/or diversionary structures or equipment to prevent a discharge as described in §112.1(b). The entire containment system, including walls and floor, must be capable of containing oil and must be constructed so that any discharge from a primary containment system, such as a tank or pipe, will not escape the containment system before cleanup occurs. At a minimum, you must use one of the following prevention systems or its equivalent:
(1) For onshore facilities:
(*i*) Dikes, berms, or retaining walls sufficiently impervious to contain oil;

(ii) Curbing;
(iii) Culverting, gutters, or other drainage systems;
(iv) Weirs, booms, or other barriers;
(v) Spill diversion ponds;
(vi) Retention ponds; or
(vii) Sorbent materials.

(2) For offshore facilities:

(i) Curbing or drip pans; or
(ii) Sumps and collection systems.

(d) If you determine that the installation of any of the structures or pieces of equipment listed in paragraphs (c) and (h)(1) of this section, and §§112.8(c)(2), 112.8(c)(11), 112.9(c)(2), 112.10(c), 112.12(c)(2), 112.12(c)(11), 112.13(c)(2), and 112.14(c) to prevent a discharge as described in §112.1(b) from any onshore or offshore facility is not practicable, you must clearly explain in your Plan why such measures are not practicable; for bulk storage containers, conduct both periodic integrity testing of the containers and periodic integrity and leak testing of the valves and piping; and, unless you have submitted a response plan under §112.20, provide in your Plan the following:

(1) An oil spill contingency plan following the provisions of part 109 of this chapter.

(2) A written commitment of manpower, equipment, and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful.

(e) *Inspections, tests, and records.* Conduct inspections and tests required by this part in accordance with written procedures that you or the certifying engineer develop for the facility. You must keep these written procedures and a record of the inspections and tests, signed by the appropriate supervisor or inspector, with the SPCC Plan for a period of three years. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph.

(f) *Personnel, training, and discharge prevention procedures.*

(1) At a minimum, train your oil-handling personnel in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC Plan.

(2) Designate a person at each applicable facility who is accountable for discharge prevention and who reports to facility management.

(3) Schedule and conduct discharge prevention briefings for your oil-handling personnel at least once a year to assure adequate understanding of the SPCC Plan for that facility. Such briefings must highlight and describe known discharges as described in §112.1(b) or failures, malfunctioning components, and any recently developed precautionary measures.

(g) *Security (excluding oil production facilities).*

(1) Fully fence each facility handling, processing, or storing oil, and lock and/or guard entrance gates when the facility is not in production or is unattended.

(2) Ensure that the master flow and drain valves and any other valves permitting direct outward flow of the container's contents to the surface have adequate security measures so that they remain in the closed position when in non-operating or non-standby status.

(3) Lock the starter control on each oil pump in the "off" position and locate it at a site accessible only to authorized personnel when the pump is in a non-operating or non-standby status.

(4) Securely cap or blank-flange the loading/unloading connections of oil pipelines or facility piping when not in service or when in standby service for an extended time. This security practice also applies to piping that is emptied of liquid content either by draining or by inert gas pressure.

(5) Provide facility lighting commensurate with the type and location of the facility that will assist in the:

(i) Discovery of discharges occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel (the general public, local police, etc.); and

(ii) Prevention of discharges occurring through acts of vandalism.

(h) *Facility tank car and tank truck loading/unloading rack (excluding offshore facilities).*

(1) Where loading/unloading area drainage does not flow into a catchment basin or treatment facility designed to handle discharges, use a quick drainage system for tank car or tank truck loading and unloading areas. You must design any containment system to hold at least the maximum capacity of any single compartment of a tank car or tank truck loaded or unloaded at the facility.

(2) Provide an interlocked warning light or physical barrier system, warning signs, wheel chocks, or vehicle break interlock system in loading/unloading areas to prevent vehicles from departing before complete disconnection of flexible or fixed oil transfer lines.

(3) Prior to filling and departure of any tank car or tank truck, closely inspect for discharges the lowermost drain and all outlets of such vehicles, and if necessary, ensure that they are tightened, adjusted, or replaced to prevent liquid discharge while in transit.

(i) If a field-constructed aboveground container undergoes a repair, alteration, reconstruction, or a change in service that might affect the risk of a discharge or failure due to brittle fracture or other catastrophe, or has discharged oil or failed due to brittle fracture failure or other catastrophe, evaluate the container for risk of discharge or failure due to brittle fracture or other catastrophe, and as necessary, take appropriate action.

(j) In addition to the minimal prevention standards listed under this section, include in your Plan a complete discussion of conformance with the applicable requirements and other effective discharge prevention and containment procedures listed in this part or any applicable more stringent State rules, regulations, and guidelines.

Subpart B -- Requirements for Petroleum Oils and Non-Petroleum Oils, Except Animal Fats and Oils and Greases, and Fish and Marine Mammal Oils; and Vegetable Oils (Including Oils from Seeds, Nuts, Fruits, and Kernels)

Source: 67 FR 47146, July 17, 2002, unless otherwise noted.

§112.8 Spill Prevention, Control, and Countermeasure Plan requirements for onshore facilities (excluding production facilities).

If you are the owner or operator of an onshore facility (excluding a production facility), you must:

(a) Meet the general requirements for the Plan listed under §112.7, and the specific discharge prevention and containment procedures listed in this section.

(b) *Facility drainage.*

(1) Restrain drainage from diked storage areas by valves to prevent a discharge into the drainage system or facility effluent treatment system, except where facility systems are designed to control such discharge. You may empty diked areas by pumps or ejectors; however, you must manually activate these pumps or ejectors and must inspect the condition of the accumulation before starting, to ensure no oil will be discharged.

(2) Use valves of manual, open-and-closed design, for the drainage of diked areas. You may not use flapper-type drain valves to drain diked areas. If your facility drainage drains directly into a watercourse and not into an on-site wastewater treatment plant, you must inspect and may drain uncontaminated retained stormwater, as provided in paragraphs (c)(3)(ii), (iii), and (iv) of this section.

(3) Design facility drainage systems from undiked areas with a potential for a discharge (such as where piping is located outside containment walls or where tank truck discharges may occur outside the loading area) to flow into ponds, lagoons, or catchment basins designed to retain oil or return it to the facility. You must not locate catchment basins in areas subject to periodic flooding.

(4) If facility drainage is not engineered as in paragraph (b)(3) of this section, equip the final discharge of all ditches inside the facility with a diversion system that would, in the event of an uncontrolled discharge, retain oil in the facility.

(5) Where drainage waters are treated in more than one treatment unit and such treatment is continuous, and pump transfer is needed, provide two "lift" pumps and permanently install at least one of the pumps. Whatever techniques you use, you must engineer facility drainage systems to prevent a discharge as described in §112.1(b) in case there is an equipment failure or human error at the facility.

(c) *Bulk storage containers.*

(1) Not use a container for the storage of oil unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature.

(2) Construct all bulk storage container installations so that you provide a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. You must ensure that diked areas are sufficiently impervious to contain discharged oil. Dikes, containment curbs, and pits are commonly employed for this purpose. You may also use an alternative system consisting of a drainage trench enclosure that must be arranged so that any discharge will terminate and be safely confined in a facility catchment basin or holding pond.

(3) Not allow drainage of uncontaminated rainwater from the diked area into a storm drain or discharge of an effluent into an open watercourse, lake, or pond, bypassing the facility treatment system unless you:

(i) Normally keep the bypass valve sealed closed.

(ii) Inspect the retained rainwater to ensure that its presence will not cause a discharge as described in §112.1(b).

(iii) Open the bypass valve and reseal it following drainage under responsible supervision; and

(iv) Keep adequate records of such events, for example, any records required under permits issued in accordance with §§122.41(j)(2) and 122.41(m)(3) of this chapter.

(4) Protect any completely buried metallic storage tank installed on or after January 10, 1974 from corrosion by coatings or cathodic protection compatible with local soil conditions. You must regularly leak test such completely buried metallic storage tanks.

(5) Not use partially buried or bunkered metallic tanks for the storage of oil, unless you protect the buried section of the tank from corrosion. You must protect partially buried and bunkered tanks from corrosion by coatings or cathodic protection compatible with local soil conditions.
(6) Test each aboveground container for integrity on a regular schedule, and whenever you make material repairs. The frequency of and type of testing must take into account container size and design (such as floating roof, skid-mounted, elevated, or partially buried). You must combine visual inspection with another testing technique such as hydrostatic testing, radiographic testing, ultrasonic testing, acoustic emissions testing, or another system of non-destructive shell testing. You must keep comparison records and you must also inspect the container's supports and foundations. In addition, you must frequently inspect the outside of the container for signs of deterioration, discharges, or accumulation of oil inside diked areas. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph.
(7) Control leakage through defective internal heating coils by monitoring the steam return and exhaust lines for contamination from internal heating coils that discharge into an open watercourse, or pass the steam return or exhaust lines through a settling tank, skimmer, or other separation or retention system.
(8) Engineer or update each container installation in accordance with good engineering practice to avoid discharges. You must provide at least one of the following devices:

(i) High liquid level alarms with an audible or visual signal at a constantly attended operation or surveillance station. In smaller facilities an audible air vent may suffice.

(ii) High liquid level pump cutoff devices set to stop flow at a predetermined container content level.

(iii) Direct audible or code signal communication between the container gauger and the pumping station.

(iv) A fast response system for determining the liquid level of each bulk storage container such as digital computers, telepulse, or direct vision gauges. If you use this alternative, a person must be present to monitor gauges and the overall filling of bulk storage containers.

(v) You must regularly test liquid level sensing devices to ensure proper operation.

(9) Observe effluent treatment facilities frequently enough to detect possible system upsets that could cause a discharge as described in §112.1(b).
(10) Promptly correct visible discharges which result in a loss of oil from the container, including but not limited to seams, gaskets, piping, pumps, valves, rivets, and bolts. You must promptly remove any accumulations of oil in diked areas.
(11) Position or locate mobile or portable oil storage containers to prevent a discharge as described in §112.1(b). You must furnish a secondary means of containment, such as a dike or catchment basin, sufficient to contain the capacity of the largest single compartment or container with sufficient freeboard to contain precipitation.

(d) *Facility transfer operations, pumping, and facility process.*

(1) Provide buried piping that is installed or replaced on or after August 16, 2002, with a protective wrapping and coating. You must also cathodically protect such buried piping installations or otherwise satisfy the corrosion protection standards for piping in part 280 of this chapter or a State program approved under part 281 of this chapter. If a section of buried line is exposed for any reason, you must carefully inspect it for deterioration. If you find corrosion damage, you must undertake additional examination and corrective action as indicated by the magnitude of the damage.
(2) Cap or blank-flange the terminal connection at the transfer point and mark it as to origin when piping is not in service or is in standby service for an extended time.
(3) Properly design pipe supports to minimize abrasion and corrosion and allow for expansion and contraction.
(4) Regularly inspect all aboveground valves, piping, and appurtenances. During the inspection you must assess the general condition of items, such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces. You must also conduct integrity and leak testing of buried piping at the time of installation, modification, construction, relocation, or replacement.
(5) Warn all vehicles entering the facility to be sure that no vehicle will endanger aboveground piping or other oil transfer operations.

§112.9 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil production facilities.

If you are the owner or operator of an onshore production facility, you must:

(a) Meet the general requirements for the Plan listed under §112.7, and the specific discharge prevention and containment procedures listed under this section.

(b) *Oil production facility drainage.*

(1) At tank batteries and separation and treating areas where there is a reasonable possibility of a discharge as described in §112.1(b), close and seal at all times drains of dikes or drains of equivalent measures required under §112.7(c)(1), except when draining uncontaminated rainwater. Prior to drainage, you must inspect the diked area and take action as provided in §112.8(c)(3)(ii), (iii), and (iv). You must remove accumulated oil on the rainwater and return it to storage or dispose of it in accordance with legally approved methods.

(2) Inspect at regularly scheduled intervals field drainage systems (such as drainage ditches or road ditches), and oil traps, sumps, or skimmers, for an accumulation of oil that may have resulted from any small discharge. You must promptly remove any accumulations of oil.

(c) *Oil production facility bulk storage containers.*

(1) Not use a container for the storage of oil unless its material and construction are compatible with the material stored and the conditions of storage.

(2) Provide all tank battery, separation, and treating facility installations with a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. You must safely confine drainage from undiked areas in a catchment basin or holding pond.

(3) Periodically and upon a regular schedule visually inspect each container of oil for deterioration and maintenance needs, including the foundation and support of each container that is on or above the surface of the ground.

(4) Engineer or update new and old tank battery installations in accordance with good engineering practice to prevent discharges. You must provide at least one of the following:

(i) Container capacity adequate to assure that a container will not overfill if a pumper/gauger is delayed in making regularly scheduled rounds.

(ii) Overflow equalizing lines between containers so that a full container can overflow to an adjacent container.

(iii) Vacuum protection adequate to prevent container collapse during a pipeline run or other transfer of oil from the container.

(iv) High level sensors to generate and transmit an alarm signal to the computer where the facility is subject to a computer production control system.

(d) *Facility transfer operations, oil production facility.*

(1) Periodically and upon a regular schedule inspect all aboveground valves and piping associated with transfer operations for the general condition of flange joints, valve glands and bodies, drip pans, pipe supports, pumping well polish rod stuffing boxes, bleeder and gauge valves, and other such items.

(2) Inspect saltwater (oil field brine) disposal facilities often, particularly following a sudden change in atmospheric temperature, to detect possible system upsets capable of causing a discharge.

(3) Have a program of flowline maintenance to prevent discharges from each flowline.

§112.10 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil drilling and workover facilities.

If you are the owner or operator of an onshore oil drilling and workover facility, you must:

(a) Meet the general requirements listed under §112.7, and also meet the specific discharge prevention and containment procedures listed under this section.

(b) Position or locate mobile drilling or workover equipment so as to prevent a discharge as described in §112.1(b).

(c) Provide catchment basins or diversion structures to intercept and contain discharges of fuel, crude oil, or oily drilling fluids.

(d) Install a blowout prevention (BOP) assembly and well control system before drilling below any casing string or during workover operations. The BOP assembly and well control system must be capable of controlling any well-head pressure that may be encountered while that BOP assembly and well control system are on the well.

§112.11 Spill Prevention, Control, and Countermeasure Plan requirements for offshore oil drilling, production, or workover facilities.

If you are the owner or operator of an offshore oil drilling, production, or workover facility, you must:

(a) Meet the general requirements listed under §112.7, and also meet the specific discharge prevention and containment procedures listed under this section.

(b) Use oil drainage collection equipment to prevent and control small oil discharges around pumps, glands, valves, flanges, expansion joints, hoses, drain lines, separators, treaters, tanks, and associated equipment. You must control and direct facility drains toward a central collection sump to prevent the facility from having a discharge as described in §112.1(b). Where drains and sumps are not practicable, you must remove oil contained in collection equipment as often as necessary to prevent overflow.

(c) For facilities employing a sump system, provide adequately sized sump and drains and make available a spare pump to remove liquid from the sump and assure that oil does not escape. You must employ a regularly scheduled preventive maintenance

inspection and testing program to assure reliable operation of the liquid removal system and pump start-up device. Redundant automatic sump pumps and control devices may be required on some installations.

(d) At facilities with areas where separators and treaters are equipped with dump valves which predominantly fail in the closed position and where pollution risk is high, specially equip the facility to prevent the discharge of oil. You must prevent the discharge of oil by:

(1) Extending the flare line to a diked area if the separator is near shore;
(2) Equipping the separator with a high liquid level sensor that will automatically shut in wells producing to the separator; or
(3) Installing parallel redundant dump valves.

(e) Equip atmospheric storage or surge containers with high liquid level sensing devices that activate an alarm or control the flow, or otherwise prevent discharges.

(f) Equip pressure containers with high and low pressure sensing devices that activate an alarm or control the flow.

(g) Equip containers with suitable corrosion protection.

(h) Prepare and maintain at the facility a written procedure within the Plan for inspecting and testing pollution prevention equipment and systems.

(i) Conduct testing and inspection of the pollution prevention equipment and systems at the facility on a scheduled periodic basis, commensurate with the complexity, conditions, and circumstances of the facility and any other appropriate regulations. You must use simulated discharges for testing and inspecting human and equipment pollution control and countermeasure systems.

(j) Describe in detailed records surface and subsurface well shut-in valves and devices in use at the facility for each well sufficiently to determine their method of activation or control, such as pressure differential, change in fluid or flow conditions, combination of pressure and flow, manual or remote control mechanisms.

(k) Install a BOP assembly and well control system during workover operations and before drilling below any casing string. The BOP assembly and well control system must be capable of controlling any well-head pressure that may be encountered while the BOP assembly and well control system are on the well.

(l) Equip all manifolds (headers) with check valves on individual flowlines.

(m) Equip the flowline with a high pressure sensing device and shut-in valve at the wellhead if the shut-in well pressure is greater than the working pressure of the flowline and manifold valves up to and including the header valves. Alternatively you may provide a pressure relief system for flowlines.

(n) Protect all piping appurtenant to the facility from corrosion, such as with protective coatings or cathodic protection.

(o) Adequately protect sub-marine piping appurtenant to the facility against environmental stresses and other activities such as fishing operations.

(p) Maintain sub-marine piping appurtenant to the facility in good operating condition at all times. You must periodically and according to a schedule inspect or test such piping for failures. You must document and keep a record of such inspections or tests at the facility.

Subpart C -- Requirements for Animal Fats and Oils and Greases, and Fish and Marine Mammal Oils; and for Vegetable Oils, including Oils from Seeds, Nuts, Fruits, and Kernels.

Source: 67 FR 57149, July 17, 2002, unless otherwise noted.

§112.12 Spill Prevention, Control, and Countermeasure Plan requirements for onshore facilities (excluding production facilities)

If you are the owner or operator of an onshore facility (excluding a production facility), you must:

(a) Meet the general requirements for the Plan listed under §112.7; and the specific discharge prevention and containment procedures listed in this section.

(b) *Facility drainage.*

(1) Restrain drainage from diked storage areas by valves to prevent a discharge into the drainage system or facility effluent treatment system, except where facility systems are designed to control such discharge. You may empty diked areas by pumps or ejectors; however, you must manually activate these pumps or ejectors and must inspect the condition of the accumulation before starting, to ensure no oil will be discharged.
(2) Use valves of manual, open-and-closed design, for the drainage of diked areas. You may not use flapper-type drain valves to drain diked areas. If your facility drainage drains directly into a watercourse and not into an on-site wastewater treatment plant, you must inspect and may drain uncontaminated retained stormwater, subject to the requirements of paragraphs (c)(3)(ii), (iii), and (iv) of this section.
(3) Design facility drainage systems from undiked areas with a potential for a discharge (such as where piping is located outside containment walls or where tank truck discharges may occur outside the loading area) to flow into ponds, lagoons, or catchment basins designed to retain oil or return it to the facility. You must not locate catchment basins in areas subject to periodic flooding.
(4) If facility drainage is not engineered as in paragraph (b)(3) of this section, equip the final discharge of all ditches inside the facility with a diversion system that would, in the event of an uncontrolled discharge, retain oil in the facility.
(5) Where drainage waters are treated in more than one treatment unit and such treatment is continuous, and pump transfer is needed, provide two "lift" pumps and permanently install at least one of the pumps. Whatever techniques you use, you must engineer facility drainage systems to prevent a discharge as described in §112.1(b) in case there is an equipment failure or human error at the facility.

(c) *Bulk storage containers.*

(1) Not use a container for the storage of oil unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature.
(2) Construct all bulk storage container installations so that you provide a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. You must ensure that diked areas are sufficiently impervious to contain discharged oil. Dikes, containment curbs, and pits are commonly employed for this purpose. You may also use an alternative system consisting of a drainage trench enclosure that must be arranged so that any discharge will terminate and be safely confined in a facility catchment basin or holding pond.
(3) Not allow drainage of uncontaminated rainwater from the diked area into a storm drain or discharge of an effluent into an open watercourse, lake, or pond, bypassing the facility treatment system unless you:

(i) Normally keep the bypass valve sealed closed.
(ii) Inspect the retained rainwater to ensure that its presence will not cause a discharge as described in §112.1(b).
(iii) Open the bypass valve and reseal it following drainage under responsible supervision; and
(iv) Keep adequate records of such events, for example, any records required under permits issued in accordance with §§122.41(j)(2) and 122.41(m)(3) of this chapter.

(4) Protect any completely buried metallic storage tank installed on or after January 10, 1974 from corrosion by coatings or cathodic protection compatible with local soil conditions. You must regularly leak test such completely buried metallic storage tanks.
(5) Not use partially buried or bunkered metallic tanks for the storage of oil, unless you protect the buried section of the tank from corrosion. You must protect partially buried and bunkered tanks from corrosion by coatings or cathodic protection compatible with local soil conditions.
(6) Test each aboveground container for integrity on a regular schedule, and whenever you make material repairs. The frequency of and type of testing must take into account container size and design (such as floating roof, skid-mounted, elevated, or partially buried). You must combine visual inspection with another testing technique such as hydrostatic testing, radiographic testing, ultrasonic testing, acoustic emissions testing, or another system of non-destructive shell testing. You must keep comparison records and you must also inspect the container's supports and foundations. In addition, you must frequently inspect the outside of the container for signs of deterioration, discharges, or accumulation of oil inside diked areas. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph.
(7) Control leakage through defective internal heating coils by monitoring the steam return and exhaust lines for contamination from internal heating coils that discharge into an open watercourse, or pass the steam return or exhaust lines through a settling tank, skimmer, or other separation or retention system.
(8) Engineer or update each container installation in accordance with good engineering practice to avoid discharges. You must provide at least one of the following devices:

(i) High liquid level alarms with an audible or visual signal at a constantly attended operation or surveillance station. In smaller facilities an audible air vent may suffice.
(ii) High liquid level pump cutoff devices set to stop flow at a predetermined container content level.
(iii) Direct audible or code signal communication between the container gauger and the pumping station.
(iv) A fast response system for determining the liquid level of each bulk storage container such as digital computers, telepulse, or direct vision gauges. If you use this alternative, a person must be present to monitor gauges and the overall filling of bulk storage containers.
(v) You must regularly test liquid level sensing devices to ensure proper operation.

(9) Observe effluent treatment facilities frequently enough to detect possible system upsets that could cause a discharge as described in §112.1(b).
(10) Promptly correct visible discharges which result in a loss of oil from the container, including but not limited to seams, gaskets, piping, pumps, valves, rivets, and bolts. You must promptly remove any accumulations of oil in diked areas.
(11) Position or locate mobile or portable oil storage containers to prevent a discharge as described in §112.1(b). You must furnish a secondary means of containment, such as a dike or catchment basin, sufficient to contain the capacity of the largest single compartment or container with sufficient freeboard to contain precipitation.

(d) *Facility transfer operations, pumping, and facility process.*

(1) Provide buried piping that is installed or replaced on or after August 16, 2002, with a protective wrapping and coating. You must also cathodically protect such buried piping installations or otherwise satisfy the corrosion protection standards for piping in part 280 of this chapter or a State program approved under part 281 of this chapter. If a section of buried line is exposed for any reason, you must carefully inspect it for deterioration. If you find corrosion damage, you must undertake additional examination and corrective action as indicated by the magnitude of the damage.
(2) Cap or blank-flange the terminal connection at the transfer point and mark it as to origin when piping is not in service or is in standby service for an extended time.
(3) Properly design pipe supports to minimize abrasion and corrosion and allow for expansion and contraction.
(4) Regularly inspect all aboveground valves, piping, and appurtenances. During the inspection you must assess the general condition of items, such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces. You must also conduct integrity and leak testing of buried piping at the time of installation, modification, construction, relocation, or replacement.
(5) Warn all vehicles entering the facility to be sure that no vehicle will endanger aboveground piping or other oil transfer operations.

§112.13 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil production facilities.

If you are the owner or operator of an onshore production facility, you must:

(a) Meet the general requirements for the Plan listed under §112.7, and the specific discharge prevention and containment procedures listed under this section.

(b) *Oil production facility drainage.*

(1) At tank batteries and separation and treating areas where there is a reasonable possibility of a discharge as described in §112.1(b), close and seal at all times drains of dikes or drains of equivalent measures required under §112.7(c)(1), except when draining uncontaminated rainwater. Prior to drainage, you must inspect the diked area and take action as provided in §112.12(c)(3)(ii), (iii), and (iv). You must remove accumulated oil on the rainwater and return it to storage or dispose of it in accordance with legally approved methods.
(2) Inspect at regularly scheduled intervals field drainage systems (such as drainage ditches or road ditches), and oil traps, sumps, or skimmers, for an accumulation of oil that may have resulted from any small discharge. You must promptly remove any accumulations of oil.

(c) *Oil production facility bulk storage containers.*

(1) Not use a container for the storage of oil unless its material and construction are compatible with the material stored and the conditions of storage.
(2) Provide all tank battery, separation, and treating facility installations with a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. You must safely confine drainage from undiked areas in a catchment basin or holding pond.
(3) Periodically and upon a regular schedule visually inspect each container of oil for deterioration and maintenance needs, including the foundation and support of each container that is on or above the surface of the ground.
(4) Engineer or update new and old tank battery installations in accordance with good engineering practice to prevent discharges. You must provide at least one of the following:

(i) Container capacity adequate to assure that a container will not overfill if a pumper/gauger is delayed in making regularly scheduled rounds.
(ii) Overflow equalizing lines between containers so that a full container can overflow to an adjacent container.
(iii) Vacuum protection adequate to prevent container collapse during a pipeline run or other transfer of oil from the container.
(iv) High level sensors to generate and transmit an alarm signal to the computer where the facility is subject to a computer production control system.

(d) *Facility transfer operations, oil production facility.*

(1) Periodically and upon a regular schedule inspect all aboveground valves and piping associated with transfer operations for the general condition of flange joints, valve glands and bodies, drip pans, pipe supports, pumping well polish rod stuffing boxes, bleeder and gauge valves, and other such items.
(2) Inspect saltwater (oil field brine) disposal facilities often, particularly following a sudden change in atmospheric temperature, to detect possible system upsets capable of causing a discharge.
(3) Have a program of flowline maintenance to prevent discharges from each flowline.

§112.14 Spill Prevention, Control, and Countermeasure Plan requirements for onshore oil drilling and workover facilities.

If you are the owner or operator of an onshore oil drilling and workover facility, you must:

(a) Meet the general requirements listed under §112.7, and also meet the specific discharge prevention and containment procedures listed under this section.

(b) Position or locate mobile drilling or workover equipment so as to prevent a discharge as described in §112.1(b).

(c) Provide catchment basins or diversion structures to intercept and contain discharges of fuel, crude oil, or oily drilling fluids.

(d) Install a blowout prevention (BOP) assembly and well control system before drilling below any casing string or during workover operations. The BOP assembly and well control system must be capable of controlling any well-head pressure that may be encountered while that BOP assembly and well control system are on the well.

§112.15 Spill Prevention, Control, and Countermeasure Plan requirements for offshore oil drilling, production, or workover facilities.

If you are the owner or operator of an offshore oil drilling, production, or workover facility, you must:

(a) Meet the general requirements listed under §112.7, and also meet the specific discharge prevention and containment procedures listed under this section.

(b) Use oil drainage collection equipment to prevent and control small oil discharges around pumps, glands, valves, flanges, expansion joints, hoses, drain lines, separators, treaters, tanks, and associated equipment. You must control and direct facility drains toward a central collection sump to prevent the facility from having a discharge as described in §112.1(b). Where drains and sumps are not practicable, you must remove oil contained in collection equipment as often as necessary to prevent overflow.

(c) For facilities employing a sump system, provide adequately sized sump and drains and make available a spare pump to remove liquid from the sump and assure that oil does not escape. You must employ a regularly scheduled preventive maintenance inspection and testing program to assure reliable operation of the liquid removal system and pump start-up device. Redundant automatic sump pumps and control devices may be required on some installations.

(d) At facilities with areas where separators and treaters are equipped with dump valves which predominantly fail in the closed position and where pollution risk is high, specially equip the facility to prevent the discharge of oil. You must prevent the discharge of oil by:
(1) Extending the flare line to a diked area if the separator is near shore;
(2) Equipping the separator with a high liquid level sensor that will automatically shut in wells producing to the separator; or
(3) Installing parallel redundant dump valves.

(e) Equip atmospheric storage or surge containers with high liquid level sensing devices that activate an alarm or control the flow, or otherwise prevent discharges.

(f) Equip pressure containers with high and low pressure sensing devices that activate an alarm or control the flow.

(g) Equip containers with suitable corrosion protection.

(h) Prepare and maintain at the facility a written procedure within the Plan for inspecting and testing pollution prevention equipment and systems.

(i) Conduct testing and inspection of the pollution prevention equipment and systems at the facility on a scheduled periodic basis, commensurate with the complexity, conditions, and circumstances of the facility and any other appropriate regulations. You must use simulated discharges for testing and inspecting human and equipment pollution control and countermeasure systems.

(j) Describe in detailed records surface and subsurface well shut-in valves and devices in use at the facility for each well sufficiently to determine their method of activation or control, such as pressure differential, change in fluid or flow conditions, combination of pressure and flow, manual or remote control mechanisms.

(k) Install a BOP assembly and well control system during workover operations and before drilling below any casing string. The BOP assembly and well control system must be capable of controlling any well-head pressure that may be encountered while that BOP assembly and well control system are on the well.

(l) Equip all manifolds (headers) with check valves on individual flowlines.

(m) Equip the flowline with a high pressure sensing device and shut-in valve at the wellhead if the shut-in well pressure is greater than the working pressure of the flowline and manifold valves up to and including the header valves. Alternatively you may provide a pressure relief system for flowlines.

(n) Protect all piping appurtenant to the facility from corrosion, such as with protective coatings or cathodic protection.

(o) Adequately protect sub-marine piping appurtenant to the facility against environmental stresses and other activities such as fishing operations.

(p) Maintain sub-marine piping appurtenant to the facility in good operating condition at all times. You must periodically and according to a schedule inspect or test such piping for failures. You must document and keep a record of such inspections or tests at the facility.

Subpart D -- Response Requirements

Source: 67 FR 47151, July 17, 2002, unless otherwise noted.

§112.20 Facility response plans.

(a) The owner or operator of any non-transportation-related onshore facility that, because of its location, could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines shall prepare and submit a facility response plan to the Regional Administrator, according to the following provisions:

(1) For the owner or operator of a facility in operation on or before February 18, 1993 who is required to prepare and submit a response plan under 33 U.S.C. 1321(j)(5), the Oil Pollution Act of 1990 (Pub. L. 101-380, 33 U.S.C. 2701 *et seq.*) requires the submission of a response plan that satisfies the requirements of 33 U.S.C. 1321(j)(5) no later than February 18, 1993.

(i) The owner or operator of an existing facility that was in operation on or before February 18, 1993 who submitted a response plan by February 18, 1993 shall revise the response plan to satisfy the requirements of this section and resubmit the response plan or updated portions of the response plan to the Regional Administrator by February 18, 1995.

(ii) The owner or operator of an existing facility in operation on or before February 18, 1993 who failed to submit a response plan by February 18, 1993 shall prepare and submit a response plan that satisfies the requirements of this section to the Regional Administrator before August 30, 1994.

(2) The owner or operator of a facility in operation on or after August 30, 1994 that satisfies the criteria in paragraph (f)(1) of this section or that is notified by the Regional Administrator pursuant to paragraph (b) of this section shall prepare and submit a facility response plan that satisfies the requirements of this section to the Regional Administrator.

(i) For a facility that commenced operations after February 18, 1993 but prior to August 30, 1994, and is required to prepare and submit a response plan based on the criteria in paragraph (f)(1) of this section, the owner or operator shall submit the response plan or updated portions of the response plan, along with a completed version of the response plan cover sheet contained in Appendix F to this part, to the Regional Administrator prior to August 30, 1994.

(ii) For a newly constructed facility that commences operation after August 30, 1994, and is required to prepare and submit a response plan based on the criteria in paragraph (f)(1) of this section, the owner or operator shall submit the response plan, along with a completed version of the response plan cover sheet contained in Appendix F to this part, to the Regional Administrator prior to the start of operations (adjustments to the response plan to reflect changes that occur at the facility during the start-up phase of operations must be submitted to the Regional Administrator after an operational trial period of 60 days).

(iii) For a facility required to prepare and submit a response plan after August 30, 1994, as a result of a planned change in design, construction, operation, or maintenance that renders the facility subject to the criteria in paragraph (f)(1) of this section, the owner or operator shall submit the response plan, along with a completed version of the response plan cover sheet contained in Appendix F to this part, to the Regional

Administrator before the portion of the facility undergoing change commences operations (adjustments to the response plan to reflect changes that occur at the facility during the start-up phase of operations must be submitted to the Regional Administrator after an operational trial period of 60 days).

(iv) For a facility required to prepare and submit a response plan after August 30, 1994, as a result of an unplanned event or change in facility characteristics that renders the facility subject to the criteria in paragraph (f)(1) of this section, the owner or operator shall submit the response plan, along with a completed version of the response plan cover sheet contained in Appendix F to this part, to the Regional Administrator within six months of the unplanned event or change.

(3) In the event the owner or operator of a facility that is required to prepare and submit a response plan uses an alternative formula that is comparable to one contained in Appendix C to this part to evaluate the criterion in paragraph (f)(1)(ii)(B) or (f)(1)(ii)(C) of this section, the owner or operator shall attach documentation to the response plan cover sheet contained in Appendix F to this part that demonstrates the reliability and analytical soundness of the alternative formula.

(4) *Preparation and submission of response plans -- Animal fat and vegetable oil facilities.* The owner or operator of any non-transportation-related facility that handles, stores, or transports animal fats and vegetable oils must prepare and submit a facility response plan as follows:

(i) *Facilities with approved plans.* The owner or operator of a facility with a facility response plan that has been approved under paragraph (c) of this section by July 31, 2000 need not prepare or submit a revised plan except as otherwise required by paragraphs (b), (c), or (d) of this section.

(ii) *Facilities with plans that have been submitted to the Regional Administrator.* Except for facilities with approved plans as provided in paragraph (a)(4)(i) of this section, the owner or operator of a facility that has submitted a response plan to the Regional Administrator prior to July 31, 2000 must review the plan to determine if it meets or exceeds the applicable provisions of this part. An owner or operator need not prepare or submit a new plan if the existing plan meets or exceeds the applicable provisions of this part. If the plan does not meet or exceed the applicable provisions of this part, the owner or operator must prepare and submit a new plan by September 28, 2000.

(iii) *Newly regulated facilities.* The owner or operator of a newly constructed facility that commences operation after July 31, 2000 must prepare and submit a plan to the Regional Administrator in accordance with paragraph (a)(2)(ii) of this section. The plan must meet or exceed the applicable provisions of this part. The owner or operator of an existing facility that must prepare and submit a plan after July 31, 2000 as a result of a planned or unplanned change in facility characteristics that causes the facility to become regulated under paragraph (f)(1) of this section, must prepare and submit a plan to the Regional Administrator in accordance with paragraph (a)(2)(iii) or (iv) of this section, as appropriate. The plan must meet or exceed the applicable provisions of this part.

(iv) *Facilities amending existing plans.* The owner or operator of a facility submitting an amended plan in accordance with paragraph (d) of this section after July 31, 2000, including plans that had been previously approved, must also review the plan to determine if it meets or exceeds the applicable provisions of this part. If the plan does not meet or exceed the applicable provisions of this part, the owner or operator must revise and resubmit revised portions of an amended plan to the Regional Administrator in accordance with paragraph (d) of this section, as appropriate. The plan must meet or exceed the applicable provisions of this part.

(b) (1) The Regional Administrator may at any time require the owner or operator of any non-transportation-related onshore facility to prepare and submit a facility response plan under this section after considering the factors in paragraph (f)(2) of this section. If such a determination is made, the Regional Administrator shall notify the facility owner or operator in writing and shall provide a basis for the determination. If the Regional Administrator notifies the owner or operator in writing of the requirement to prepare and submit a response plan under this section, the owner or operator of the facility shall submit the response plan to the Regional Administrator within six months of receipt of such written notification.

(2) The Regional Administrator shall review plans submitted by such facilities to determine whether the facility could, because of its location, reasonably be expected to cause significant and substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines.

(c) The Regional Administrator shall determine whether a facility could, because of its location, reasonably be expected to cause significant and substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines, based on the factors in paragraph (f)(3) of this section. If such a determination is made, the Regional Administrator shall notify the owner or operator of the facility in writing and:

(1) Promptly review the facility response plan;

(2) Require amendments to any response plan that does not meet the requirements of this section;

(3) Approve any response plan that meets the requirements of this section; and

(4) Review each response plan periodically thereafter on a schedule established by the Regional Administrator provided that the period between plan reviews does not exceed five years.

(d) (1) The owner or operator of a facility for which a response plan is required under this part shall revise and resubmit revised portions of the response plan within 60 days of each facility change that materially may affect the response to a worst case discharge, including:

(i) A change in the facility's configuration that materially alters the information included in the response plan;

(ii) A change in the type of oil handled, stored, or transferred that materially alters the required response resources;

(iii) A material change in capabilities of the oil spill removal organization(s) that provide equipment and personnel to respond to discharges of oil described in paragraph (h)(5) of this section;

(iv) A material change in the facility's spill prevention and response equipment or emergency response procedures; and

(v) Any other changes that materially affect the implementation of the response plan.

(2) Except as provided in paragraph (d)(1) of this section, amendments to personnel and telephone number lists included in the response plan and a change in the oil spill removal organization(s) that does not result in a material change in support capabilities do not require approval by the Regional Administrator. Facility owners or operators shall provide a copy of such changes to the Regional Administrator as the revisions occur.

(3) The owner or operator of a facility that submits changes to a response plan as provided in paragraph (d)(1) or (d)(2) of this section shall provide the EPA-issued facility identification number (where one has been assigned) with the changes.

(4) The Regional Administrator shall review for approval changes to a response plan submitted pursuant to paragraph (d)(1) of this section for a facility determined pursuant to paragraph (f)(3) of this section to have the potential to cause significant and substantial harm to the environment.

(e) If the owner or operator of a facility determines pursuant to paragraph (a)(2) of this section that the facility could not, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines, the owner or operator *shall complete and maintain at the facility the certification form contained* in Appendix C to this part and, in the event an alternative formula that is comparable to one contained in Appendix C to this part is used to evaluate the criterion in paragraph (f)(1)(ii)(B) or (f)(1)(ii)(C) of this section, the owner or operator shall attach documentation to the certification form that demonstrates the reliability and analytical soundness of the comparable formula and shall notify the Regional Administrator in writing that an alternative formula was used.

(f) (1) A facility could, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines pursuant to paragraph (a)(2) of this section, if it meets any of the following criteria applied in accordance with the flowchart contained in Attachment C-I to Appendix C to this part:

(i) The facility transfers oil over water to or from vessels and has a total oil storage capacity greater than or equal to 42,000 gallons; or

(ii) The facility's total oil storage capacity is greater than or equal to 1 million gallons, and one of the following is true:

(A) The facility does not have secondary containment for each aboveground storage area sufficiently large to contain the capacity of the largest aboveground oil storage tank within each storage area plus sufficient freeboard to allow for precipitation;

(B) The facility is located at a distance (as calculated using the appropriate formula in Appendix C to this part or a comparable formula) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments. For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III of the "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (see Appendix E to this part, section 13, for availability) and the applicable Area Contingency Plan prepared pursuant to section 311(j)(4) of the Clean Water Act;

(C) The facility is located at a distance (as calculated using the appropriate formula in Appendix C to this part or a comparable formula) such that a discharge from the facility would shut down a public drinking water intake; or

(D) The facility has had a reportable oil discharge in an amount greater than or equal to 10,000 *gallons within the last 5 years.*

(2) (i) To determine whether a facility could, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines pursuant to paragraph (b) of this section, the Regional Administrator shall consider the following:

(A) Type of transfer operation;

(B) Oil storage capacity;

(C) Lack of secondary containment;

(D) Proximity to fish and wildlife and sensitive environments and other areas determined by the Regional Administrator to possess ecological value;

(E) Proximity to drinking water intakes;
(F) Spill history; and
(G) Other site-specific characteristics and environmental factors that the Regional Administrator determines to be relevant to protecting the environment from harm by discharges of oil into or on navigable waters or adjoining shorelines.

(ii) Any person, including a member of the public or any representative from a Federal, State, or local agency who believes that a facility subject to this section could, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines may petition the Regional Administrator to determine whether the facility meets the criteria in paragraph (f)(2)(i) of this section. Such petition shall include a discussion of how the factors in paragraph (f)(2)(i) of this section apply to the facility in question. The RA shall consider such petitions and respond in an appropriate amount of time.

(3) To determine whether a facility could, because of its location, reasonably be expected to cause significant and substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines, the Regional Administrator may consider the factors in paragraph (f)(2) of this section as well as the following:

(i) Frequency of past discharges;
(ii) Proximity to navigable waters;
(iii) Age of oil storage tanks; and
(iv) Other facility-specific and Region-specific information, including local impacts on public health.

(g) (1) All facility response plans shall be consistent with the requirements of the National Oil and Hazardous Substance Pollution Contingency Plan (40 CFR part 300) and applicable Area Contingency Plans prepared pursuant to section 311(j)(4) of the Clean Water Act. The facility response plan should be coordinated with the local emergency response plan developed by the local emergency planning committee under section 303 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (42 U.S.C. 11001 et seq.). Upon request, the owner or operator should provide a copy of the facility response plan to the local emergency planning committee or State emergency response commission.

(2) The owner or operator shall review relevant portions of the National Oil and Hazardous Substances Pollution Contingency Plan and applicable Area Contingency Plan annually and, if necessary, revise the facility response plan to ensure consistency with these plans.

(3) The owner or operator shall review and update the facility response plan periodically to reflect changes at the facility.

(h) A response plan shall follow the format of the model facility-specific response plan included in Appendix F to this part, unless you have prepared an equivalent response plan acceptable to the Regional Administrator to meet State or other Federal requirements. A response plan that does not follow the specified format in Appendix F to this part shall have an emergency response action plan as specified in paragraphs (h)(1) of this section and be supplemented with a cross-reference section to identify the location of the elements listed in paragraphs (h)(2) through (h)(10) of this section. To meet the requirements of this part, a response plan shall address the following elements, as further described in Appendix F to this part:

(1) *Emergency response action plan.* The response plan shall include an emergency response action plan in the format specified in paragraphs (h)(1)(i) through (viii) of this section that is maintained in the front of the response plan, or as a separate document accompanying the response plan, and that includes the following information:

(i) The identity and telephone number of a qualified individual having full authority, including contracting authority, to implement removal actions;
(ii) The identity of individuals or organizations to be contacted in the event of a discharge so that immediate communications between the qualified individual identified in paragraph (h)(1) of this section and the appropriate Federal officials and the persons providing response personnel and equipment can be ensured;
(iii) A description of information to pass to response personnel in the event of a reportable discharge;
(iv) A description of the facility's response equipment and its location;
(v) A description of response personnel capabilities, including the duties of persons at the facility during a response action and their response times and qualifications;
(vi) Plans for evacuation of the facility and a reference to community evacuation plans, as appropriate;
(vii) A description of immediate measures to secure the source of the discharge, and to provide adequate containment and drainage of discharged oil; and
(viii) A diagram of the facility.

(2) *Facility information.* The response plan shall identify and discuss the location and type of the facility, the identity and tenure of the present owner and operator, and the identity of the qualified individual identified in paragraph (h)(1) of this section.

(3) *Information about emergency response.* The response plan shall include:

(i) The identity of private personnel and equipment necessary to remove to the maximum extent practicable a worst case discharge and other discharges of oil described in paragraph (h)(5) of this section, and to mitigate or prevent a substantial threat of a worst case discharge (To identify response resources to meet the facility

response plan requirements of this section, owners or operators shall follow Appendix E to this part or, where not appropriate, shall clearly demonstrate in the response plan why use of Appendix E of this part is not appropriate at the facility and make comparable arrangements for response resources);
(ii) Evidence of contracts or other approved means for ensuring the availability of such personnel and equipment;
(iii) The identity and the telephone number of individuals or organizations to be contacted in the event of a discharge so that immediate communications between the qualified individual identified in paragraph (h)(1) of this section and the appropriate Federal official and the persons providing response personnel and equipment can be ensured;
(iv) A description of information to pass to response personnel in the event of a reportable discharge;
(v) A description of response personnel capabilities, including the duties of persons at the facility during a response action and their response times and qualifications;
(vi) A description of the facility's response equipment, the location of the equipment, and equipment testing;
(vii) Plans for evacuation of the facility and a reference to community evacuation plans, as appropriate;
(viii) A diagram of evacuation routes; and
(ix) A description of the duties of the qualified individual identified in paragraph (h)(1) of this section, that include:

(A) Activate internal alarms and hazard communication systems to notify all facility personnel;
(B) Notify all response personnel, as needed;
(C) Identify the character, exact source, amount, and extent of the release, as well as the other items needed for notification;
(D) Notify and provide necessary information to the appropriate Federal, State, and local authorities with designated response roles, including the National Response Center, State Emergency Response Commission, and Local Emergency Planning Committee;
(E) Assess the interaction of the discharged substance with water and/or other substances stored at the facility and notify response personnel at the scene of that assessment;
(F) Assess the possible hazards to human health and the environment due to the release. This assessment must consider both the direct and indirect effects of the release (i.e., the effects of any toxic, irritating, or asphyxiating gases that may be generated, or the effects of any hazardous surface water runoffs from water or chemical agents used to control fire and heat-induced explosion);
(G) Assess and implement prompt removal actions to contain and remove the substance released;
(H) Coordinate rescue and response actions as previously arranged with all response personnel;
(I) Use authority to immediately access company funding to initiate cleanup activities; and
(J) Direct cleanup activities until properly relieved of this responsibility.

(4) *Hazard evaluation.* The response plan shall discuss the facility's known or reasonably identifiable history of discharges reportable under 40 CFR part 110 for the entire life of the facility and shall identify areas within the facility where discharges could occur and what the potential effects of the discharges would be on the affected environment. To assess the range of areas potentially affected, owners or operators shall, where appropriate, consider the distance calculated in paragraph (f)(1)(ii) of this section to determine whether a facility could, because of its location, reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines.

(5) *Response planning levels.* The response plan shall include discussion of specific planning scenarios for:

(i) A worst case discharge, as calculated using the appropriate worksheet in Appendix D to this part. In cases where the Regional Administrator determines that the worst case discharge volume calculated by the facility is not appropriate, the Regional Administrator may specify the worst case discharge amount to be used for response planning at the facility. For complexes, the worst case planning quantity shall be the larger of the amounts calculated for each component of the facility;
(ii) A discharge of 2,100 gallons or less, provided that this amount is less than the worst case discharge amount. For complexes, this planning quantity shall be the larger of the amounts calculated for each component of the facility; and
(iii) A discharge greater than 2,100 gallons and less than or equal to 36,000 gallons or 10 percent of the capacity of the largest tank at the facility, whichever is less, provided that this amount is less than the worst case discharge amount. For complexes, this planning quantity shall be the larger of the amounts calculated for each component of the facility.

(6) *Discharge detection systems.* The response plan shall describe the procedures and equipment used to detect discharges.

(7) *Plan implementation.* The response plan shall describe:

(i) Response actions to be carried out by facility personnel or contracted personnel under the response plan to ensure the safety of the facility and to mitigate or prevent discharges described in paragraph (h)(5) of this section or the substantial threat of such discharges;
(ii) A description of the equipment to be used for each scenario;

(iii) Plans to dispose of contaminated cleanup materials; and

(iv) Measures to provide adequate containment and drainage of discharged oil.

(8) *Self-inspection, drills/exercises, and response training.* The response plan shall include:

(i) A checklist and record of inspections for tanks, secondary containment, and response equipment;

(ii) A description of the drill/exercise program to be carried out under the response plan as described in §112.21;

(iii) A description of the training program to be carried out under the response plan as described in §112.21; and

(iv) Logs of discharge prevention meetings, training sessions, and drills/exercises. These logs may be maintained as an annex to the response plan.

(9) *Diagrams.* The response plan shall include site plan and drainage plan diagrams.

(10) *Security systems.* The response plan shall include a description of facility security systems.

(11) *Response plan cover sheet.* The response plan shall include a completed response plan cover sheet provided in Section 2.0 of Appendix F to this part.

(i) (1) In the event the owner or operator of a facility does not agree with the Regional Administrator's determination that the facility could, because of its location, reasonably be expected to cause substantial harm or significant and substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines, or that amendments to the facility response plan are necessary prior to approval, such as changes to the worst case discharge planning volume, the owner or operator may submit a request for reconsideration to the Regional Administrator and provide additional information and data in writing to support the request. The request and accompanying information must be submitted to the Regional Administrator within 60 days of receipt of notice of the Regional Administrator's original decision. The Regional Administrator shall consider the request and render a decision as rapidly as practicable.

(2) In the event the owner or operator of a facility believes a change in the facility's classification status is warranted because of an unplanned event or change in the facility's characteristics (i.e., substantial harm or significant and substantial harm), the owner or operator may submit a request for reconsideration to the Regional Administrator and provide additional information and data in writing to support the request. The Regional Administrator shall consider the request and render a decision as rapidly as practicable.

(3) After a request for reconsideration under paragraph (i)(1) or (i)(2) of this section has been denied by the Regional Administrator, an owner or operator may appeal a determination made by the Regional Administrator. The appeal shall be made to the EPA Administrator and shall be made in writing within 60 days of receipt of the decision from the Regional Administrator that the request for reconsideration was denied. A complete copy of the appeal must be sent to the Regional Administrator at the time the appeal is made. The appeal shall contain a clear and concise statement of the issues and points of fact in the case. It also may contain additional information from the owner or operator, or from any other person. The EPA Administrator may request additional information from the owner or operator, or from any other person. The EPA Administrator shall render a decision as rapidly as practicable and shall notify the owner or operator of the decision.

[59 FR 34098, July 1, 1994, as amended at 65 FR 40798, June 30, 2000; 66 FR 34560, June 29, 2001]

§112.21 Facility response training and drills/exercises.

(a) The owner or operator of any facility required to prepare a facility response plan under §112.20 shall develop and implement a facility response training program and a drill/exercise program that satisfy the requirements of this section. The owner or operator shall describe the programs in the response plan as provided in §112.20(h)(8).

(b) The facility owner or operator shall develop a facility response training program to train those personnel involved in oil spill response activities. It is recommended that the training program be based on the USCG's Training Elements for Oil Spill Response, as applicable to facility operations. An alternative program can also be acceptable subject to approval by the Regional Administrator.

(1) The owner or operator shall be responsible for the proper instruction of facility personnel in the procedures to respond to discharges of oil and in applicable oil spill response laws, rules, and regulations.

(2) Training shall be functional in nature according to job tasks for both supervisory and non-supervisory operational personnel.

(3) Trainers shall develop specific lesson plans on subject areas relevant to facility personnel involved in oil spill response and cleanup.

(c) The facility owner or operator shall develop a program of facility response drills/exercises, including evaluation procedures. A program that follows the National Preparedness for Response Exercise Program (PREP) (see Appendix E to this part, section 13, for availability) will be deemed satisfactory for purposes of this section. An alternative program can also be acceptable subject to approval by the Regional Administrator.

[59 FR 34101, July 1, 1994, as amended at 65 FR 40798, June 30, 2000]

Appendix A to Part 112 -- Memorandum of Understanding Between the Secretary of Transportation and the Administrator of the Environmental Protection Agency

SECTION II – DEFINITIONS

The Environmental Protection Agency and the Department of Transportation agree that for the purposes of Executive Order 11548, the term:

(1) *Non-transportation-related onshore and offshore facilities* means:

(A) Fixed onshore and offshore oil well drilling facilities including all equipment and appurtenances related thereto used in drilling operations for exploratory or development wells, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(B) Mobile onshore and offshore oil well drilling platforms, barges, trucks, or other mobile facilities including all equipment and appurtenances related thereto when such mobile facilities are fixed in position for the purpose of drilling operations for exploratory or development wells, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(C) Fixed onshore and offshore oil production structures, platforms, derricks, and rigs including all equipment and appurtenances related thereto, as well as completed wells and the wellhead separators, oil separators, and storage facilities used in the production of oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(D) Mobile onshore and offshore oil production facilities including all equipment and appurtenances related thereto as well as completed wells and wellhead equipment, piping from wellheads to oil separators, oil separators, and storage facilities used in the production of oil when such mobile facilities are fixed in position for the purpose of oil production operations, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(E) Oil refining facilities including all equipment and appurtenances related thereto as well as in-plant processing units, storage units, piping, drainage systems and waste treatment units used in the refining of oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(F) Oil storage facilities including all equipment and appurtenances related thereto as well as fixed bulk plant storage, terminal oil storage facilities, consumer storage, pumps and drainage systems used in the storage of oil, but excluding inline or breakout storage tanks needed for the continuous operation of a pipeline system and any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(G) Industrial, commercial, agricultural or public facilities which use and store oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(H) Waste treatment facilities including in-plant pipelines, effluent discharge lines, and storage tanks, but excluding waste treatment facilities located on vessels and terminal storage tanks and appurtenances for the reception of oily ballast water or tank washings from vessels and associated systems used for off-loading vessels.

(I) Loading racks, transfer hoses, loading arms and other equipment which are appurtenant to a nontransportation-related facility or terminal facility and which are used to transfer oil in bulk to or from highway vehicles or railroad cars.

(J) Highway vehicles and railroad cars which are used for the transport of oil exclusively within the confines of a nontransportation-related facility and which are not intended to transport oil in interstate or intrastate commerce.

(K) Pipeline systems which are used for the transport of oil exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended to transport oil in interstate or intrastate commerce, but excluding pipeline systems used to transfer oil in bulk to or from a vessel.

(2) *Transportation-related onshore and offshore facilities* means:

(A) Onshore and offshore terminal facilities including transfer hoses, loading arms and other equipment and appurtenances used for the purpose of handling or transferring oil in bulk to or from a vessel as well as storage tanks and appurtenances for the reception of oily ballast water or tank washings from vessels, but excluding terminal waste treatment facilities and terminal oil storage facilities.

(B) Transfer hoses, loading arms and other equipment appurtenant to a non-transportation-related facility which is used to transfer oil in bulk to or from a vessel.

(C) Interstate and intrastate onshore and offshore pipeline systems including pumps and appurtenances related thereto as well as in-line or breakout storage tanks needed for the continuous operation of a pipeline system, and pipelines from onshore and offshore oil production facilities, but excluding onshore and offshore piping from wellheads to oil separators and pipelines which are used for the transport of oil exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended to transport oil in interstate or intrastate commerce or to transfer oil in bulk to or from a vessel.

(D) Highway vehicles and railroad cars which are used for the transport of oil in interstate or intrastate commerce and the equipment and appurtenances related thereto, and equipment used for the fueling of locomotive units, as well as the

rights-of-way on which they operate. Excluded are highway vehicles and railroad cars and motive power used exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended for use in interstate or intrastate commerce.

Appendix B to Part 112 -- Memorandum of Understanding Among the Secretary of the Interior, Secretary of Transportation, and Administrator of the Environmental Protection Agency

PURPOSE

This Memorandum of Understanding (MOU) establishes the jurisdictional responsibilities for offshore facilities, including pipelines, pursuant to section 311 (j)(1)(c), (j)(5), and (j)(6)(A) of the Clean Water Act (CWA), as amended by the Oil Pollution Act of 1990 (Public Law 101-380). The Secretary of the Department of the Interior (DOI), Secretary of the Department of Transportation (DOT), and Administrator of the Environmental Protection Agency (EPA) agree to the division of responsibilities set forth below for spill prevention and control, response planning, and equipment inspection activities pursuant to those provisions.

BACKGROUND

Executive Order (E.O.) 12777 (56 FR 54757) delegates to DOI, DOT, and EPA various responsibilities identified in section 311(j) of the CWA. Sections 2(b)(3), 2(d)(3), and 2(e)(3) of E.O. 12777 assigned to DOI spill prevention and control, contingency planning, and equipment inspection activities associated with offshore facilities. Section 311(a)(11) defines the term "offshore facility" to include facilities of any kind located in, on, or under navigable waters of the United States. By using this definition, the traditional DOI role of regulating facilities on the Outer Continental Shelf is expanded by E.O. 12777 to include inland lakes, rivers, streams, and any other inland waters.

RESPONSIBILITIES

Pursuant to section 2(i) of E.O. 12777, DOI redelegates, and EPA and DOT agree to assume, the functions vested in DOI by sections 2(b)(3), 2(d)(3), and 2(e)(3) of E.O. 12777 as set forth below. For purposes of this MOU, the term "coast line" shall be defined as in the Submerged Lands Act (43 U.S.C. 1301(c)) to mean "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters."

1. To EPA, DOI redelegates responsibility for non-transportation-related offshore facilities located landward of the coast line.

2. To DOT, DOI redelegates responsibility for transportation-related facilities, including pipelines, located landward of the coast line. The DOT retains jurisdiction for deepwater ports and their associated seaward pipelines, as delegated by E.O. 12777.

3. The DOI retains jurisdiction over facilities, including pipelines, located seaward of the coast line, except for deepwater ports and associated seaward pipelines delegated by E.O. 12777 to DOT.

EFFECTIVE DATE

This MOU is effective on the date of the final execution by the indicated signatories.

LIMITATIONS

1. The DOI, DOT, and EPA may agree in writing to exceptions to this MOU on a facility-specific basis. Affected parties will receive notification of the exceptions.
2. Nothing in this MOU is intended to replace, supersede, or modify any existing agreements between or among DOI, DOT, or EPA.

MODIFICATION AND TERMINATION

Any party to this agreement may propose modifications by submitting them in writing to the heads of the other agency/department. No modification may be adopted except with the consent of all parties. All parties shall indicate their consent to or disagreement with any proposed modification within 60 days of receipt. Upon the request of any party, representatives of all parties shall meet for the purpose of considering exceptions or modifications to this agreement. This MOU may be terminated only with the mutual consent of all parties.
Dated: November 8, 1993.
Bruce Babbitt,
Secretary of the Interior.
Dated: December 14, 1993.

Federico Pen a,
Secretary of Transportation.
Dated: February 3, 1994.
Carol M. Browner,
Administrator, Environmental Protection Agency.
[59 FR 34102, July 1, 1994]

Appendix C to Part 112 -- Substantial Harm Criteria

1.0 Introduction

The flowchart provided in Attachment C-I to this appendix shows the decision tree with the criteria to identify whether a facility "could reasonably be expected to cause substantial harm to the environment by discharging into or on the navigable waters or adjoining shorelines." In addition, the Regional Administrator has the discretion to identify facilities that must prepare and submit facility-specific response plans to EPA.

1.1 Definitions

1.1.1 *Great Lakes* means Lakes Superior, Michigan, Huron, Erie, and Ontario, their connecting and tributary waters, the Saint Lawrence River as far as Saint Regis, and adjacent port areas.

1.1.2 Higher Volume Port Areas INCLUDE
(1) Boston, MA;
(2) New York, NY;
(3) Delaware Bay and River to Philadelphia, PA;
(4) St. Croix, VI;
(5) Pascagoula, MS;
(6) Mississippi River from Southwest Pass, LA to Baton Rouge, LA;
(7) Louisiana Offshore Oil Port (LOOP), LA;
(8) Lake Charles, LA;
(9) Sabine-Neches River, TX;
(10) Galveston Bay and Houston Ship Channel, TX;
(11) Corpus Christi, TX;
(12) Los Angeles/Long Beach Harbor, CA;
(13) San Francisco Bay, San Pablo Bay, Carquinez Strait, and Suisun Bay to Antioch, CA;
(14) Straits of Juan de Fuca from Port Angeles, WA to and including Puget Sound, WA;
(15) Prince William Sound, AK; and
(16) Others as specified by the Regional Administrator for any EPA Region.

1.1.3 *Inland Area* means the area shoreward of the boundary lines defined in 46 CFR part 7, except in the Gulf of Mexico. In the Gulf of Mexico, it means the area shoreward of the lines of demarcation (COLREG lines as defined in 33 CFR 80.740 -- 80.850). The inland area does not include the Great Lakes.

1.1.4 *Rivers and Canals* means a body of water confined within the inland area, including the Intracoastal Waterways and other waterways artificially created for navigating that have project depths of 12 feet or less.

2.0 Description of Screening Criteria for the Substantial Harm Flowchart

A facility that has the potential to cause substantial harm to the environment in the event of a discharge must prepare and submit a facility-specific response plan to EPA in accordance with Appendix F to this part. A description of the screening criteria for the substantial harm flowchart is provided below:

2.1 *Non-Transportation-Related Facilities With a Total Oil Storage Capacity Greater Than or Equal to 42,000 Gallons Where Operations Include Over-Water Transfers of Oil.* A non-transportation-related facility with a total oil storage capacity greater than or equal to 42,000 gallons that transfers oil over water to or from vessels must submit a response plan to EPA. Daily oil transfer operations at these types of facilities occur between barges and vessels and onshore bulk storage tanks over open water. These facilities are located adjacent to navigable water.

2.2 *Lack of Adequate Secondary Containment at Facilities With a Total Oil Storage Capacity Greater Than or Equal to 1 Million Gallons.* Any facility with a total oil storage capacity greater than or equal to 1 million gallons without secondary containment sufficiently large to contain the capacity of the largest aboveground oil storage tank within each area plus sufficient freeboard to allow for precipitation must submit a response plan to EPA. Secondary containment structures that meet the standard

of good engineering practice for the purposes of this part include berms, dikes, retaining walls, curbing, culverts, gutters, or other drainage systems.

2.3 *Proximity to Fish and Wildlife and Sensitive Environments at Facilities With a Total Oil Storage Capacity Greater Than or Equal to 1 Million Gallons.* A facility with a total oil storage capacity greater than or equal to 1 million gallons must submit its response plan if it is located at a distance such that a discharge from the facility could cause injury (as defined at 40 CFR 112.2) to fish and wildlife and sensitive environments. For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (see Appendix E to this part, section 13, for availability) and the applicable Area Contingency Plan. Facility owners or operators must determine the distance at which an oil discharge could cause injury to fish and wildlife and sensitive environments using the appropriate formula presented in Attachment C-III to this appendix or a comparable formula.

2.4 *Proximity to Public Drinking Water Intakes at Facilities with a Total Oil Storage Capacity Greater than or Equal to 1 Million Gallons* A facility with a total oil storage capacity greater than or equal to 1 million gallons must submit its response plan if it is located at a distance such that a discharge from the facility would shut down a public drinking water intake, which is analogous to a public water system as described at 40 CFR 143.2(c). The distance at which an oil discharge from an SPCC-regulated facility would shut down a public drinking water intake shall be calculated using the appropriate formula presented in Attachment C-III to this appendix or a comparable formula.

2.5 *Facilities That Have Experienced Reportable Oil Discharges in an Amount Greater Than or Equal to 10,000 Gallons Within the Past 5 Years and That Have a Total Oil Storage Capacity Greater Than or Equal to 1 Million Gallons.* A facility's oil spill history within the past 5 years shall be considered in the evaluation for substantial harm. Any facility with a total oil storage capacity greater than or equal to 1 million gallons that has experienced a reportable oil discharge in an amount greater than or equal to 10,000 gallons within the past 5 years must submit a response plan to EPA.

3.0 Certification for Facilities That Do Not Pose Substantial Harm

If the facility does not meet the substantial harm criteria listed in Attachment C-I to this appendix, the owner or operator shall complete and maintain at the facility the certification form contained in Attachment C-II to this appendix. In the event an alternative formula that is comparable to the one in this appendix is used to evaluate the substantial harm criteria, the owner or operator shall attach documentation to the certification form that demonstrates the reliability and analytical soundness of the comparable formula and shall notify the Regional Administrator in writing that an alternative formula was used.

4.0 References

Chow, V.T. 1959. Open Channel Hydraulics. McGraw Hill.
USCG IFR (58 FR 7353, February 5, 1993). This document is available through EPA's rulemaking docket as noted in Appendix E to this part, section 13.

ATTACHMENTS TO 40 CFR 112 APPENDIX C – SUBSTANTIAL HARM CRITERIA

ATTACHMENT C-II -- CERTIFICATION OF THE APPLICABILITY OF THE SUBSTANTIAL HARM CRITERIA

Facility Name:_____ Facility Address:_____

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons?

Yes ___ No ___

2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area?

Yes ___ No ___

3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula [1]) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (see Appendix E to this part, section 13, for availability) and the applicable Area Contingency Plan.

Yes ___ No ___

4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula [1]) such that a discharge from the facility would shut down a public drinking water intake [2]?

[1]If a comparable formula is used, documentation of the reliability and analytical soundness of the comparable formula must be attached to this form.

[2]For the purposes of 40 CFR part 112, public drinking water intakes are analogous to public water systems as described at 40 CFR 143.2(c).

Yes ___ No ___

5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil discharge in an amount greater than or equal to 10,000 gallons within the last 5 years?

Yes ___ No ___

Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Signature _____

Name (please type or print) _____

Title _____

Date _____

Appendix C
State of Utah Regulations

A Summary of Utah State and Federal Hazardous Substance/Waste/Material Environmental Regulations Requiring Immediate to Within 24 Hour Notification of Utah DEQ or EPA

Regulation	When Required	Information Required	Notify Whom	Oral Notice Time	Phone Numbers	Written Notice Time
Air Quality						
R307-107.2	Air pollution control equipment breakdown > 2 hrs	Not specified	Div. of Air Quality.	3-18 hrs	536-4000 536-4123 (off hours)	7 days
40 CFR 58	Air pollution control malfunction	Not specified	State	24 hours	536-4000 536-4123 (off hours)	14 days
40 CFR 59	Monitoring system malfunctions	Not specified	State Air Program Director.	24 hours	536-4000 536-4123 (off hours)	14 days
40 CFR 52	When in violation of National Ambient Air Quality Standards	Not specified	State Air Program Director	24 hours	536-4000 536-4123 (off hours)	
Hazardous Waste/Material/Substance						
R315-9-1(b)	Spill of one kilogram of "acutely hazardous waste", which includes: 1. "P"wastes, 2. F999 wastes (chemical warfare agents), and 3. "F" wastes with a hazard code of "H" (identified in 40 CFR 261.31 and includes wastes from the production or use of chlorphenols and chlorobenzenes). Spill of 100 kilograms of other hazardous waste. Notify for a spill of a lesser quantity if there is a potential threat to human health or the environment.	Name, phone number, and address of responsible party. Name, title and phone of person reporting. Time and date of the spill. Spill location. Nearest town, city, highway or waterway. Waste description and amount. Cause. Extent of injuries. Potential hazards to human health or the environment. Estimated quantity and disposition of recovered material.	Div. of Solid & Hazardous Waste	Immediately	538-6170 536-4123 (off hours)	15 days
40 CFR 263.30	When a transporter spills a hazardous waste, immediate action must be taken to protect the environment, including notification of local authorities.	Not specified	Div. of Solid & Hazardous Waste	Immediately	538-6170 536-4123 (off hours)	
CERCLA 103	Any CERCLA listed substance spilled over the reportable quantity into the environment.	Name, phone number, and address of responsible party; name, title and phone of person reporting; time and date of the spill; spill location; nearest town, city, highway or waterway; waste description and amount; cause; action taken.	NRC	Immediately	1-800-424-8802	
40 CFR 302.6	Discharge of a hazardous substance in quantities greater than the reportable quantity over 24 hours	Not specified	NRC	Immediately	1-800-424-8802	

This brief summary is meant to be used for general information only, may not include all regulatory reporting requirements, and does not contain the detail in the actual text.
Revised July 2000

Hazardous Waste/Material/Substance Continued

Regulation	When Required	Information Required	Notify Whom	Oral Notice Time	Phone Numbers	Written Notice Time
49 CFR 171.15 49 CFR 195.52	Hazardous materials release (as defined by DOT in 29 CFR 171.8) causes death, serious injury, major property damage, evacuation, closure of a major highway, aircraft flight path altered, pollution of a water body, release of infectious substance, or continuing danger to life	Reporter name and phone number, name and address of carrier, incident date, time and location, extent of injuries, classification, name and quantity of hazardous materials involved, type of incident and nature of hazardous materials involvement, whether a continuing danger to life exists.	NRC	earliest practicable moment	1-800-4248802	30 days (see 49 CFR 171.16 for details)
EPCRA 304 40 CFR 355.40	Release of "Extremely Hazardous Substance" or CERCLA substance, over the RQ, exposing persons outside the facility boundaries	Chemical name, quantity, release time and duration, health risks, medical advice, precautions, contact names and phone numbers	LEPC SERC	Immediately	Various 536-4123 (24 hours)	As soon as practicable
R315-8-4.7(a) R315-7-11.7(a)	Any imminent or actual emergency at a hazardous waste Treatment, Storage or Disposal (TSD) permitted facility	Facility name, address, EPA ID number; Incident date, time and type. Quantity of waste. Injuries.	DEQ, federal OSC, State and local response agencies	Immediately		15 days
40 CFR 264.56/ 265.56 40 CFR 279.52	Imminent or actual emergency situation at a TSD or used oil processor or used oil refiner facility	Facility name, address, EPA ID number. Incident date, time and type. Quantity of waste. Injuries. Possible hazards to human health or the environment outside the facility.	State and local response agencies, NRC	Immediately	1-800-424-8802	15 days
40 CFR 262.34 40 CFR 264.56	When a fire, explosion or other release at a hazardous waste generator or TSD facility could threaten human health outside the facility, or when the spill has reached surface water	Facility name, address, EPA ID number Incident date, time and type. Quantity of waste Injuries. Quantity of recovered materials. Possible hazards to human health or the environment outside the facility.	NRC	Immediately	1-800-424-8802	15 days
R315-8-4.7(d) R315-7-11.7(d)	When a fire, explosion or other release at a hazardous waste TSD facility could threaten human health or the environment outside the facility	Name and phone number of reporter. Facility name, address. Incident date, time and type. Name and quantity of waste. Injuries. Human health or environmental hazards.	DEQ Federal OSC NRC	Immediately	538-4170 1-303-293-1788 1-800-424-8802	5 days
R315-3-10(i)(6) 40 CFR 270.30	Any TSD permittee noncompliance which may endanger health or the environment	Releases of hazardous waste that may cause endangerment to public drinking water systems. Information on releases of hazardous waste or fire or explosions which could threaten the environment or human health outside the facility. Name and phone number of reporter. Facility name, address. Incident date, time and type. Name and quantity of waste. Injuries. Description of occurrence. Human health or environmental hazards. Estimated quantity and disposition of recovered material.	Div of Solid & Hazardous Waste	24 hours	536-6170	5 days

Hazardous Waste/Material/Substance Continued						
Regulation	**When Required**	**Information Required**	**Notify Whom**	**Oral Notice Time**	**Phone Numbers**	**Written Notice Time**
40 CFR 264.196(d) 265.196(d) R315-8-10 R315-7-12	When a hazardous waste disposal facility discovers a tank or secondary containment system leak	Not specified	EPA administrator Div of Solid & Hazardous Waste	24 hours	1-303-293-1788 538-6170	
40 CFR 761.125	When PCB contaminated material contaminates surface water, sewers, drinking water, grazing lands or vegetable gardens.	Not specified	EPA Region	24 hours	1-303-293-1788	
40 CFR 302.6	Release of PCB's into the environment in amounts greater than 1 pound.	Not specified	NRC	Immediately	1-800-424-8802	
R315-303-5(7)(c)	When a landfill operator discovers receipt of a hazardous waste or PCB contaminated waste	Not specified	Div of Solid & Hazardous Waste, Hauler, Generator	24 hours	538-6170 536-4123 (off hours)	
R315-303-4-(5)	When methane levels at a landfill exceed state limits in R315-303(2)(a)	Not specified	Div. of Solid & Hazardous Waste	Immediately	538-6170 536-4123 (off hours)	
40 CFR 258.23	When methane levels at a landfill exceed specified federal limits.	Not specified	State Director	Immediately	538-6170 536-4123 (off hours)	
Radioactive Materials						
R313-38-77(2)(b)	If a sealed radiation source or device containing radioactive material is damaged, or if contamination is detected at the surface after the source is used in a subsurface tracer study.	Circumstances of the loss and request approval of abandonment procedures	Div of Rad. Control	Immediately	536-4250 536-4123 (off hours)	
R313-38-77(5)(b)	If radioactive material has been lost in or to an underground potable water source.	Well location. Magnitude and extent of radioactive material loss. Consequences of such loss. Efforts being taken to mitigate these consequences.	Div of Rad. Control	Immediately	536-4250 536-4123 (off hours)	
R313-32-33(1)	Misadministration of a radioactive material in a therapy procedure	Not specified	Div of Rad. Control	24 hours	536-4250 536-4123 (off hours)	
R313-15-1202(1)	Event involving a radioactive material which caused or threatens to cause a specified exposure or specified amount of property damage	Not specified	Div. of Rad. Control	Immediately	536-4250 536-4123 (off hours)	

Radioactive Materials Continued						
Regulation	**When Required**	**Information Required**	**Notify Whom**	**Oral Notice Time**	**Phone Numbers**	**Written Notice Time**
R313-15-1202(2)	Loss of licensed or registered source of radiation that may have caused or threatens to cause a specified exposure or specified amount of property damage.	Not specified	Div. of Rad. Control	24 hours	536-4250 536-4123 (off hours)	
Releases From Underground Storage Tanks						
Utah Code 19-6-420 (3)	Releases from an underground storage tank presenting the possibility of an imminent and substantial danger to public health or the environment	Abatement action taken	Div. of Env. Response & Remediation	24 hours	**536-4123 (24 hours)**	
R311-201-7	Discovery of a release from an underground storage tank	Not specified	Div. of Env. Response & Remediation	24 hours	**536-4123 (24 hours)**	
40 CFR 280.50	Release of a regulated substance, unusual operation conditions or monitoring results that indicate a release	Not specified	State	24 hours	**536-4123 (24 hours)**	
40 CFR 280.53	A spill or overfill that is: 1. > 25 gallons; or 2. causes a sheen on surface water; or 3. > reportable quantity of a CERCLA hazardous substance into the environment; or 4. In violation of Clean Water Act 311(b)(3)	Not specified	Div. of Env. Response and Remediation (see also ref 8,31,32)	24 hours	**536-4123 (24 hours)**	
Used Oil						
R315-15-9	Used oil spills > 25 gallons or potential threat to human health or environment.	Name, phone number and address of person responsible for spill. Name, title and phone number of individual reporting. Time and date of spill. Spill location - including nearest city, highway, or waterway. Amount and description of material spilled. Cause of the spill. Action taken to minimize threats to human health and the environment.	DEQ	Immediately	536-4123	15 Days

Water Quality

Regulation	When Required	Information Required	Notify Whom	Oral Notice Time	Phone Numbers	Written Notice Time
Utah Code 19-5-114	Spill of substance which could pollute the waters of the state	Material, actions taken, cleanup and disposal plan	Div. of Water Quality	Immediately	538-6146 536-4123 (off hours)	
40 CFR 110	If oil or hazardous substance release: (1)causes a sheen; or (2)violates water quality standards; or (3) causes sludge or emulsion to be deposited below water level	Not specified	NRC	Immediately	1-800-424-8802	
R317-8-4 (b)(12)(f)	Any UPDES permittee noncompliance which may endanger health or the environment including, but not limited to: (1) unanticipated bypasses which exceed effluent permit limitations; (2) any upset which exceeds effluent limitation; (3) violation of maximum daily discharge limitation for permit listed pollutants.	Name and telephone number of reporting party. Time and type of incident. Name and quantity of materials released Injuries. Health hazards	Div. of Water Quality	24 hours	538-6146 536-4123 (off hours)	5 days
R318-8.10 (7)(b) R318-8.13 (c) and 8.14 (3)(b)	1. Sampling indicates a violation of water pollution control pretreatment standards. 2. A pretreatment system "upset" that exceeds pretreatment standards. 3. An unanticipated pretreatment bypass.	Not specified	"Control Authority", which is DEQ or the POTW, depending on the permit.	24 hours		
40 CFR 403.12 40 CFR 403.16/17	1. Sampling indicates a violation of water pollution control pretreatment standards. 2. A pretreatment system "upset" that exceeds pretreatment standards. 3. An unanticipated pretreatment bypass.	Not specified	"Control Authority", which is DEQ or the POTW, depending on the permit.	24 hours		
R317-6-6.13	Mechanical or discharge system failures affecting the chemical characteristics or volume of a ground water discharge	Not specified	Div. of Water Quality	Immediately	538-6146 536-4123 (off hours)	30 days
R317-6-6.11	Commencement of groundwater discharge	Not specified	Div of Water Quality	Immediately	538-6146 536-4123 (off hours)	
R317-6-6.11	Discontinuance of groundwater discharge due to spill, leak or accidental release	Not specified	Div. of Water Quality	Immediately	538-6146 536-4123 (off hours)	5 days
R317-6-6.18	Out of compliance with ground water discharge permit	Not specified	Div. of Water Quality	Immediately	538-6146 536-4123 (off hours)	5 days

Appendix D
Notice to Tank Truck Drivers

NOTICE TO TANK TRUCK DRIVERS

Tank Truck Drivers

To prevent the release of substances hazardous to the environment, tank truck drivers entering this facility are to comply with the following rules:

- Exercise caution when maneuvering to avoid damage to tanks or containment walls.
- Block truck wheels before starting to load/unload.
- Inspect tank, fitting, and liquid level indicator prior to filling. Note available capacity in tank prior to filling.
- Place drip pans under all pump hose fittings prior to loading/unloading.
- Remain with the vehicle while loading/unloading.
- Monitor tank liquid levels during loading/unloading to prevent overfilling.
- Drain loading/unloading line to storage tank.
- Verify that drain valves are closed before disconnecting loading/unloading lines.
- Inspect vehicle before departure to be sure loading/unloading lines have been disconnected and vent valves are closed.
- Immediately report leakage or spillage to the Facility Emergency and Spill Coordinator or other management personnel.

SPCC Coordinator
ECDC Environmental, LLC.
ECDC Landfill

Appendix E
Emergency Personnel and Duties

Emergency Personnel and Duties

Responsibilities are assigned to individuals by name. Keep in mind, however, that responsibilities are designated primarily by position/title/descriptions. If individuals are not available due to vacations, trips, transfers, terminations, etc., the person filling the position automatically assumes responsibility. Also, keep in mind that this plan is flexible, and personnel must work together to minimize the effects of an emergency.

Management and supervisory persons must review this plan annually to ensure that they are familiar with it. There is no time to do so after the emergency occurs. Direct coordination between persons is encouraged to help eliminate problems.

Suggestions for improvement or modifications should be directed to the SPCC Coordinator for review and inclusion in the next revision. Managers and supervisors will assist the SPCC Coordinator in training his personnel as necessary, and training will be held at least annually.

Individuals are responsible for notifying the SPCC Coordinator of any changes in home or office telephone numbers and position so the call list can be updated regularly and accurately.

The SPCC Coordinator will direct and coordinate emergency plan activities, and will advise management and company officers as to the extent of the emergency and possible consequences. The SPCC Coordinator will be familiar with environmental control devices and hazard response firms/teams. This person also is responsible for coordination of first aid to injured persons and will probably be one of the first responders to the emergency. If the SPCC Coordinator is not based on site, the Assistant SPCC Coordinator shall be based on-site to serve as the first responder. The on site SPCC Coordinator (or Assistant if the SPCC Coordinator is off-site) is responsible for training of on site personnel. The SPCC Coordinator will be responsible for monthly site inspections of the overall site housekeeping. If these duties overlap with the Storm Water Pollution Prevention Plan, (SWPPP) these inspections may be recorded in the SWPPP documentation.

After the emergency is under control, this person will direct the salvage and restart operations and approve any information release to the news media as applicable. The SPCC Coordinator assures the establishment of liaison and communications as necessary with appropriate agencies, and allocates resources necessary to carry out the duties of this plan, etc. They also direct emergency maintenance, utility, and electrical work to prevent injury and minimize damage to property, product, and the environment. Maintenance personnel are responsible for the safe shutdown of the facility.

PERSONNEL TRAINING RECORD
SPILL PREVENTION, CONTROL, AND COUNTERMEASURE PLAN
ECDC ENVIRONMENTAL, LLC.
ECDC LANDFILL

Description of Training _____

Instructor_____ Date_____

EMPLOYEES' NAMES

Printed Name	Signature

Appendix F
Inspection Record and Incident Report Forms

Aboveground Storage Tank
Monthly Inspection Record

Inspection Date/ Inspector	Tank Name and/or No.	Location	Contents	Signs of leakage from valves, seals, and gaskets? (YES/NO)	Signs of Oil, Fuel, or Chemicals in Fueling Area or Containment? (YES/NO)	Condition of container supports and foundations	Comments

Describe leaks and/or spills: _____

Corrective action taken: _____

General housekeeping with respect to petroleum staining (Aspects of this may overlap with requirements of the Storm Water Pollution Prevention Plan (SWPPP) and may be recorded in the SWPPP: _____

Storm Water Drainage from Secondary Containment Areas

ECDC Environmental, LLC.
ECDC Landfill

Tank Number	Date	Approximate Volume of Water Removed	Was Oil Present in the Discharged Water?	How was Oil Removed before Discharge?	Where was the Water Discharged?

INCIDENT REPORT FORM
ECDC ENVIRONMENTAL, LLC.
ECDC LANDFILL

1. TIME PROBLEM DISCOVERED: _____ DATE: _____
2. TIME PROBLEM STOPPED: _____ DATE: _____
3. APPROXIMATE LOCATION AND TYPE OF ACCIDENT (E.G., FIRE, EXPLOSION, SPILL):

   _____

   _____
4. MATERIAL SPILLED: _____
5. APPROXIMATE AMOUNT: _____
6. SOURCE OF THE DISCHARGE: _____
7. AFFECTED MEDIA: _____
8. CAUSE OF THE DISCHARGE: _____
9. EXTENT OF INJURIES (IF ANY): _____

   _____
10. WHAT ARE POSSIBLE HAZARDS TO HUMAN HEALTH AND THE ENVIRONMENT?__

    _____
11. ESTIMATED AMOUNT OF MATERIAL RECOVERED: _____
12. WHAT WAS DONE WITH RECOVERED MATERIAL? _____

    _____
13. ACTIONS TAKEN TO STOP, REMOVE, AND MITIGATE THE EFFECTS OF THE DISCHARGE:

    _____

    _____

    _____
14. WAS EVACUATION OF THE SITE NECESSARY? _____
15. NAME, ORGANIZATION, DATE, AND TIME CONTACTED CONCERNING THE INCIDENT:

    _____

INCIDENT REPORT FORM
ECDC ENVIRONMENTAL, LLC.
ECDC LANDFILL
(CONTINUED)

16. ACTIONS TAKEN TO CORRECT THE CAUSE AND PREVENT FURTHER PROBLEMS:

_____

_____

_____

_____

_____

17. UNUSUAL EVENTS AND AGENCY INSPECTIONS RELATING TO THIS EVENT:

_____

_____

18. NAME OF INCIDENT REPORTER: _____

TITLE: _____

TELEPHONE NUMBER: (____) _____

FACILITY NAME AND ADDRESS OF INCIDENT REPORTER: _____

_____

19. NAME OF FACILITY WHERE SPILL OCCURRED: _____

FACILITY TELEPHONE NUMBER: _____

ADDRESS OF FACILITY: _____

_____

SIGNATURE (MANAGER) _____

DATE _____

Appendix G
Spill, Fire, and Safety Equipment

SPILL, FIRE, AND SAFETY EQUIPMENT

The following safety equipment is available in order to protect employees and provide containment of contaminants in the event of a spill:

- Spill control/containment materials:
  - Drum/Toter in maintenance building
  - Oil Dry (or equivalent)
  - Sorbent Socks
  - Shovels
  - Brooms
  - Drain Pans
  - All trucks are equipped with spill booms
- Fire extinguishers
  - ABC universal fire extinguishers are located throughout facility buildings.
  - All trucks are equipped with fire extinguishers.

Appendix H
Substantial Harm Criteria

CERTIFICATION OF THE APPLICABILITY OF THE SUBSTANTIAL HARM CRITERIA

Facility Name: ECDC Landfill
Facility Address: 1111 West Highway 123, East Carbon, Utah 84780

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons?

Yes ___ No _X_

2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area?

Yes ___ No _X_

3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments?

Yes ___ No _X_

4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility would shut down a public drinking water intake?

Yes ___ No _X_

5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil discharge in an amount greater than or equal to 10,000 gallons within the last 5 years?

Yes ___ No _X_

Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

Signature _____
Name (please type or print) _____
Title _____
Date _____

ALLIED WASTE

Safety Manual

Bloodborne Pathogens Program

(Exposure Control Plan)

ECDC Environmental

I. PURPOSE

Minimize exposure of personnel to blood or other potentially infectious material and provide proper handling methods, personal protective equipment, and disposal procedures in the event that an incident occurs. The program also assures the location's compliance with OSHA 29 CFR 1910.1030.

II. DEFINITIONS

Bloodborne Pathogens - Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Body Fluids - Fluid contained within the body, this includes urine, saliva (containing blood), cerebral spinal fluid, joint fluid, tears, blood, serum, semen, vaginal fluid, etc.

Contaminated - The presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Contaminated Sharps - Any contaminated object that can penetrate the skin including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

Decontamination - The use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.

Exposure Incident - A specific eye, mouth, other mucous membrane, non-intact skin, or other contact with blood or other potentially infectious materials that result from the performance of an employee's duties. This may occur through piercing mucous membranes or the skin through such events as needle-sticks, human bites, cuts, abrasions, or splashes, etc.

First Aid Provider – Personnel designated to administer emergency first aid and are reasonably anticipated to have exposure to human blood or other infectious materials.

HBV - Hepatitis B Virus

HIV - Human Immunodeficiency Virus

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Bloodborne Pathogens Program

(Exposure Control Plan)

Infectious Waste - Any substance or category of substances that has the potential to transmit disease and that meet the specific definition of the Center for Disease Control and Prevention, the U.S. E.P.A. or any other state regulations.

Medical Waste Spill Investigator – Personnel who conduct the initial investigation of any incident involving employee exposure to blood or other potentially infectious material. The person initiates follow-up actions without performing any cleanup or removal unless trained as a medical waste spill responder.

Occupational Exposure - Reasonably anticipated skin, eye, mucous membrane, or non-intact skin or other contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

Other Potentially Infectious Material - The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids;

Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and

HIV – containing cell or tissue cultures, organ cultures, and HIV or HBV – containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Regulated Waste - Liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps, and pathological and microbiological wastes containing blood or other potentially infectious materials.

Sharp Containers - Container used to store contaminated needles, scalpels and other devices capable of puncturing or cutting the skin.

Spill Responder - Employees that remove, clean and decontaminate area after an incident involving human blood or potentially infectious materials.

Universal Precautions - An approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens. Healthcare workers are expected to use appropriate barrier methods to avoid any contact with human blood and/or body fluids.

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III. RESPONSIBILITY

The Facility Manager, or his/her designee, is responsible for administering the Bloodborne Pathogens program. These duties include:

a. Communicating the hazards associated with BBP to all personnel
b. Performing an exposure determination to determine who and which tasks are at risk at the facility
c. Conducting BBP training
d. Developing and ensuring personnel follow safe work practices, engineering, and administrative controls to prevent exposure to BBP
e. Making certain any spills of material, which may be contaminated with BBP, are promptly cleaned up and disinfected. That proper housekeeping and decontamination procedures are followed
f. Ensuring all BBP exposure incidents are investigated
g. Guaranteeing pre and post exposure procedures are followed
h. Ensuring that vaccination procedures are followed for appropriate personnel
i. Ensuring that the proper PPE is provided and used by personnel responding to BBP incidents
j. Ensuring that personnel training is conducted

IV. COMMUNICATION OF HAZARDS TO EMPLOYEES

A. Exposure Determination

Job classifications that may have reasonably anticipated contact with human blood or other potentially infectious materials include:

Job Classifications	Task and Procedures	Potential Routes of Exposure
Designated first aid provider	Administering emergency first aid.	Skin, mouth and eye contact and puncture from sharps
Medical waste spill responders	Cleaning and packaging spills of sharps, blood or other potentially infectious materials.	Skin, mouth and eye contact and puncture from sharps

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B. First Aid Provider and Medical Waste Spill Responder Training

Employees who are designated as first aid providers and medical waste spill responders (typically supervisor or operations managers) will participate in a BBP training program. Medical Waste spill responders will receive spill cleanup and personal protective equipment training in addition to the Bloodborne Pathogens training. First aid providers will also receive first aid and CPR training from a recognized training provider (e.g., American Red Cross). First aid and CPR will be repeated as necessary to ensure that designated first aid providers maintain training certification.

C. Medical Waste Spill Investigators

The role of employees trained as medical waste spill investigators (normally route supervisors) is to:

1. Conduct an initial investigation of any incident involving employee exposure to blood or other potentially infectious material through contact with medical waste or while providing first aid; and
2. Initiate the appropriate follow-up actions from such incidents; including requesting assistance from a qualified medical waste spill responder.

Medical waste spill investigators will not perform any cleanup or removal of the potentially infectious materials, unless they are also trained as a medical waste spill responder.

D. General Employee Awareness Training

All other operations and maintenance personnel will be trained to recognize sources of occupational exposure to human blood and other potentially infectious materials.

V. WORK PRACTICES

A. Work Practice/Engineering Controls

In the municipal solid waste industry the following work practices and engineering controls may be utilized to reduce occupational exposure to bloodborne pathogens:

Task(s)	Control Method
Collection	• Drivers and helpers should be instructed to visually inspect the containers for protruding sharp objects before lifting. Plastic bags and other "soft" containers should be lifted from the top whenever practical and carried away from the body to avoid contact with protruding sharps. • Residential customers should be required to properly dispose of household medical waste as directed by the USEPA, American Diabetes Association, local health department or the local municipal/county waste authority. • Regulated medical waste should not be accepted as Municipal Solid Waste (MSW) or recyclable waste.
Processing, Transfer and Disposal	• Employees who work on tipping floors at transfer stations, dirty (mixed refuse/recyclable) Material Recovery Facilities (MRFs) and at tipping areas of landfills should be instructed to be alert for medical waste when walking on or through refuse. • Employees should be instructed to visually inspect any materials for protruding sharp objects before lifting or moving them. Plastic bags and other "soft" containers should be lifted from the top whenever practical and carried away from the body to avoid contact with protruding sharps. • Refuse and recyclables should be moved by mechanical equipment, such as front loaders, compactors, conveyors, tongs, shovels, and other tools when possible.
Truck and Container Repair	• Mechanics should be instructed not to place their hands into parts of the equipment that may contain medical waste. Mirrors, tools, and PPE should be used when such work is necessary.

Bloodborne Pathogens Program

(Exposure Control Plan)

Task(s)	Control Method
Management of Medical Waste Incidents	• Only trained employees are allowed to respond to employee medical or potentially infectious waste incidents. Whenever possible, the customer or appropriate local authority should be contacted to arrange for proper disposal of these materials. • If it is necessary, the designated responder should wear the assigned PPE, apply a disinfectant before handling potentially infectious materials, allowing sufficient time for the disinfectant to act, then properly dispose of the waste, using the assigned PPE and tools. • Employees who respond to needle-stick incidents will use the assigned PPE and tools to cleanup sharps whenever the recovery does not represent a danger of an additional puncture wound or significant exposure to potentially infectious materials.
First-Aid Providers	• Trained emergency response professionals should be used wherever possible. Only qualified and BBP trained personnel designated as first aid providers may provide CPR and first aid while awaiting the arrival of professional emergency response personnel.

Periodic inspections are conducted to ensure that hazards are identified and appropriate corrective actions are followed.

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B. Procedure Upon Discovering Blood Or Other Infectious Material

Task(s)	Control Method
Unauthorized medical waste found in a residential container on the route	• Do not to touch the load • Notify the dispatcher and supervisor. • Do not service the container. Instead, tag the container with the reason for no pick up. • State the reason the container was tagged (e.g., not serviced due to unacceptable medical waste).
Unauthorized medical waste first noted after it has been dumped into the hopper	• Notify the dispatcher and supervisor. • The dispatcher or supervisor will contact a medical waste spill investigator. • If the medical waste spill investigator determines that an incident has occurred that requires removal, cleanup and decontamination, personnel trained as a medical waste spill responder will be contacted. • The medical waste spill responder will use the appropriate PPE, follow spill clean-up and decontamination procedures and make arrangements for proper transport to an approved medical waste treatment facility (check state permit for transporting medical waste).

C. Universal Precautions

The following control methods (universal precautions) are intended to minimize or eliminate exposures associated with bloodborne pathogens:

Potential Routes of Exposure	Control Method
Contact with infectious agents	• All human blood and certain body fluids, medical wastes, and implements are treated as infectious materials.
Contact through the mouth and eyes	• Eating, drinking, storage of food or drink, smoking, applying cosmetics or lip balm to the eyes or mouth, and handling contact lenses is prohibited in work areas where blood or other potentially infectious materials are present.
Skin Contact	• Hand, eye, and other appropriate protective equipment will be provided and worn when working in conditions that may result in exposure to blood or other potentially infectious materials.
Puncture	• Medical waste, sharps, and other BBP contaminated items are not to be picked up directly with the hands.

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VI. EXPOSURE / INCIDENT PROGRAM

A. Exposure Treatment

If any employee is exposed to human blood or other potentially infectious materials as a result of the performance of employee's duties, first aid will be provided. Immediately upon notification of the incident, Allied Waste will also offer, and at no expense to the employee, medical treatment for the exposure.

B. Incident Investigation

A medical waste investigator, or a designated member of management, will investigate the exposure incident and its cause in an effort to prevent the occurrence from happening again.

Under no circumstances should identification of the source involve employees opening containers or manually (by hand) handling medical waste.

If possible by visual inspection, the source of improperly disposed blood or other potentially infectious material will be identified and the source of origin noted. The medical waste investigator will contact the source of medical waste and attempt to ensure that the waste is properly disposed of in the future.

The medical waste investigator will complete the top portion of the BBP Exposure Incident Follow-up Report (Form 1065) and will provide a copy of the completed form to the Allied Waste Contract Physician.

Note: When a needle-stick or other injury occurs from a contaminated medical device (needle, scalpel, etc.), it is an OSHA recordable injury. Other BBP exposures may be considered an OSHA recordable case depending on the situation.

C. Post-Exposure Treatment and Evaluation

After each exposure incident, the examining physician will be provided with the complete results of the investigation and a copy of the BBP Exposure Incident Follow-up Report (Form 1065). The physician will also be provided a copy of the Bloodborne Pathogens Standard from OSHA (29 CFR 1910.1030) and a copy of this Bloodborne Pathogens Program.

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The physician is responsible for providing to Allied the completed medical evaluation (Form 1065), which includes their written opinion and:

1. Whether Hepatitis B vaccination is indicated for the affected employee, and if the employee has received such vaccination;
2. Information that the employee has been informed of the results of the evaluation; and
3. That the employee has been told about any medical conditions resulting from exposure to blood or other potentially infectious materials which require further evaluation or treatment.

A copy of the completed BBP Exposure Incident Follow-up Report (Form 1065) will be provided to the employee within 15 days. The employee will sign a second copy of the physician's opinion and it will be kept in a confidential file.

Medical records are retained by the physician and are not to be disposed of until directed in writing by Allied Waste.

VII. VACCINATION PROCEDURES FOR FIRST AID PROVIDERS AND MEDICAL WASTE SPILL RESPONDERS

Vaccination is a preventative measure for the employees who, in the course of tasks associated with spill response or first aid, are determined to have a reasonable anticipation of encountering human blood or other potentially infectious materials.

The Hepatitis B vaccination shot series (3 shots) will be initiated within 10 working days of initial assignment to a job determined to have reasonably anticipated exposure to blood or other potentially infectious materials. This vaccination shot series will be provided at no cost to employees. The employee will go to a clinic providing medical services to Allied Waste during work hours to allow for reasonable access to the vaccination.

Hepatitis B vaccinations are given according the following guidelines from the U.S. Centers for Disease Control:

- First Dose-within ten (10) working days of initial assignment into a position with reasonably anticipated exposure.
- Second Dose-one (1) month following the first injection.
- Third Dose-six (6) months following the first injection.
- Booster Dose-none (no routinely accepted schedule for boosters or the need to boost Hepatitis B Vaccine has been established).

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- Blood test to check immunity and test for antibodies to Hepatitis B two-three months after the third shot.
- Injections are to be given into the upper arm muscle (deltoid) using a Hepatitis B recombinant vaccine.

If a person declines the vaccine, the risks of Hepatitis B infection must be explained to the employee and the Hepatitis B Vaccine Declination Form (Form 1031 or an equivalent) must be signed.

VIII. EMPLOYEE ACCESS TO MEDICAL EXPOSURE RECORDS

Employees, or their designated representative, have the right to access personal medical information and exposure data related to an exposure incident or vaccination. Personnel will be informed initially upon employment, and annually thereafter, of the existence, locations and availability of any work related medical or exposure records. In accordance with State laws, the Allied Waste's Contract Physician will maintain the complete medical file produced during all medical exams related to work related incidents or exposures. Facility management receives only the completed BBP Exposure Incident Follow-up Report (Form 1065).

The Contract Physician is responsible for conveying the findings of medical examination to the employee.

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IX. PROTECTIVE EQUIPMENT

Based on evaluation of potential routes, the following levels of personal protection and specific protective equipment for each level of protection have been designated for the applicable work areas or tasks:

Task(s)	Procedures	Level of Protection	Equipment
1	**Administer Emergency First-Aid**	D	Work clothes, work shoes, latex or nitrile gloves, CPR mouthpiece, eye protection where a splash hazard exists, other PPE as required.
2	**Medical Waste Spill Response**	C or D	Work clothes, puncture resistant work shoes, latex or nitrile gloves, puncture resistant gloves, N-100 dust/mist/fume respirator, disposable coveralls, goggles, tongs other PPE as required.

Protective equipment is provided at no cost and maintained in adequate supplies to protect all employees. Hypoallergenic (nitrile) gloves are available for employees who exhibit allergic reactions with the use of regular equipment.

Garments, which are penetrated by blood or other potentially infectious materials, are removed immediately or as soon as feasible. All personal protective equipment is to be removed prior to leaving the work area and placed in a designated area or container for storage, washing, decontamination, or disposal.

X. SPILL / CLEAN UP PROCEDURES

A. General

No materials will be handled directly with hands. Barriers must be maintained between the medical waste and hands, skin, nose, mouth and any areas of the body with cuts or open sores. Barriers can be created by using puncture resistant gloves, goggles/face shield

and/or uniform overalls. The use of these barriers depends upon the nature of the improperly disposed blood or other potentially infectious material.

The medical waste spill responder must assess the spill to determine the order and necessity of the following steps:

1. Prepare necessary medical waste bags and containers (including sharps containers) that will hold the spill;
2. Wear appropriate PPE before attempting to remove the spill;
3. Using a shovel, tongs or the appropriate mechanical means, place sharps into a sharps container.
4. Using a shovel, tongs, or the appropriate mechanical means, place solid portion of the spilled material into a medical waste container.
5. Apply disinfectant solution over any surfaces and tools that may have come into contact with the spilled material. Once disinfected, cleaned, and dried the tools can be returned to their storage container.
6. Remove PPE in a manner that allows for contaminated surfaces to turn inside and uncontaminated surfaces to be outside.
7. Place disposable PPE into a medical waste container.
8. Wash hands thoroughly.

Depending on the situation, certain protective equipment may not be necessary. For example, if the waste is a syringe, then only tongs and puncture resistant gloves may be necessary.

Cleaning, laundering, repair, replacement, and disposal of all protective equipment under this standard are provided by Allied Waste at no cost to the employee.

B. Housekeeping

After known contamination with blood or other potentially infectious material, equipment and working surfaces are cleaned and decontaminated using the disinfection techniques contained in this Program.

Contaminated laundry that has been soiled with blood or other potentially infectious materials or may contain sharps is to be:

1. Placed and transported in labeled bags/containers;

2. Decontaminated then handled as non-regulated laundry;
3. Not taken home by any employee until they have been decontaminated.

Contaminated laundry is handled as little as possible and is not to be sorted or rinsed in the location where it was used. Contaminated laundry is transported in labeled or color-coded moisture proof bags or containers. Employees who have contact with contaminated laundry wear protective gloves and other appropriate personal protective equipment.

Broken glassware and debris that may be contaminated with blood or potentially infectious materials is to be cleaned up using mechanical means such as a brush and dust pan, tongs, or forceps.

Contaminated sharps are discarded immediately using containers that are closable, puncture resistant, leak proof on sides and bottom, and labeled or color-coded. Containers that are being used for contaminated sharps are kept in areas that are easily accessible to personnel, maintained upright, and not allowed to be overfilled.

When moving or transporting containers of contaminated sharps, the containers are closed before moving them to prevent spillage or protrusion of contents and placed in a secondary container if leakage is possible. All secondary containers are closable, puncture and leak proof, and labeled or color-coded.

Reusable containers will not be opened, emptied, or cleaned in any manner that would pose an exposure risk to employees.

Regulated waste other than sharps shall be disposed of in containers that are closable, leak proof, and labeled or color-coded. Such containers will be closed prior to moving them to prevent spillage or protrusion of contents. If the outside of the container becomes contaminated it shall be placed in a second container meeting the above requirements.

All regulated waste will be disposed in accordance with all federal, state, and local regulations.

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C. Decontamination

Equipment and working surfaces that have been contaminated with potentially infectious materials will be properly decontaminated according to the following procedure:

1. Personnel will wear the appropriate protective clothing (e.g., latex gloves) before beginning any decontamination activities.
2. Debris will be first misted with disinfectant and then removed with tongs, scoops, and/or shovels.
3. Contaminated areas will be washed with a soap/detergent and water solution, followed by a wash with a disinfectant.
4. Equipment, gloves, or clothing that comes in contact with the bloody materials or other potentially infectious material are considered to be contaminated with pathogenic microorganisms.

According to the nature of the contamination, use of one or a combination of the solutions as listed below renders the equipment, gloves, or clothing decontaminated:

- Use of disinfecting solution will include EPA registered "hospital disinfectants";
- Use of hypochlorite solution with 500 ppm of available chlorine. This solution is made with a 1:10 dilution of common household bleach and water (approximately 1/4 cup bleach per one-gallon water); and
- Use of quaternary ammonium salt solution (400 ppm active agent).

All waste from the cleanup activity must be treated as potentially infectious until it has been disinfected (decontaminated).

Employees must wash their hands with soap and water after removal of gloves and other personal protective equipment. Where handwashing facilities are not immediately available, employees must wash with appropriate antiseptic towelettes, and then wash with soap and running water as soon as feasible.

Emergency decontamination will include isolation of equipment and property until full decontamination can be performed and cleaning contacted skin areas with appropriate disinfecting towelettes.

XI. TRAINING

All operations and maintenance personnel are trained to recognize sources of occupational exposure to human blood and other potentially infectious materials. Training will include the:

a. Recognition of medical waste, such as syringes, red bags, and red sharps containers, and methods of handling waste so as to avoid contact with potential hazards;
b. Procedures to follow for immediate notification of a supervisor or the dispatcher when any medical waste is encountered;
c. Application of universal precautions when encountering medical waste;
d. Procedures to follow for immediate notification of a supervisor or the dispatcher when an employee has an exposure incident;
e. A Bloodborne Pathogens (BBP) training program; and
f. Fact sheets in Appendices A through D that may be used to supplement training.

Employees who are designated as first aid providers, medical waste spill responders, and medical waste spill investigators (typically supervisor or operations managers), and other personnel who may have occupational exposure to BBP will participate in a more detailed training program. The OSHA Bloodborne Pathogen Standard requires the training for these people on the following subjects.

a. General explanation of the epidemiology and symptoms of bloodborne diseases.
b. Explanation of the modes of transmission of bloodborne pathogens.
c. Explanation of Allied Waste's Bloodborne Pathogens Program and means by which personnel may obtain a written copy.
d. Explanation of appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials.
e. Explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment.
f. Information on types, proper use, location, removal, handling, decontamination and disposal of personal protective equipment.
g. Explanation of the basis for selection of personal protective equipment.
h. Information on Hepatitis B vaccine, including information on its effectiveness, safety, method of administration, benefits of being vaccinated, and that Allied Waste pays for the vaccination.
i. Information on actions to take and persons to contact in an emergency involving blood or other potentially infectious materials.
j. Explanation of procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available.

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k. Information on the post exposure evaluation and follow-up that Allied Waste is required to provide personnel following an exposure incident.
l. Explanation of signs, labels, and color coding.
m. Opportunity for interactive questions and answers with the person conducting the training.
n. All First Aid Providers, Medical Waste Investigators, and Medical Waste Spill Responders should receive BBP training.
o. A copy of 1910.1030 must be available for employee review during the training session.

Training will occur at the time of initial assignment to tasks where occupational exposure may take place and annually thereafter.

Additional training will be provided upon occurrence of changes that affect the employee's occupational exposure, such as modification of tasks or procedures, or the beginning of new tasks or procedures. The additional training may be limited to addressing the new exposures created.

A person knowledgeable in the subject matter will conduct the training as it relates to Allied Waste facilities and be available to answer employee questions.

XII. CONTRACTORS

The following provisions have been made for Contractors or temporary labor assigned to job classifications identified above:

1. Training is provided prior to assignment and documented on the Temporary Labor Service Agreement Contract (see Contracts section or an equivalent form).

2. Contractors are required to complete the Contractor's Safety Declaration Contract (see Contracts section or an equivalent form).

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XIII. RECORDKEEPING

Note: When a needle-stick or other injury occurs from a contaminated sharp, i.e. needle, scalpel, etc. it is considered an OSHA recordable injury.

All work-related needle-stick injuries and cuts from sharp objects that are contaminated with another person's blood or other potentially infectious material must be recoded on the OSHA 300 Log as an injury. The name of the individual must be left off the OSHA 300 log for confidentiality reasons.

In addition, a Sharps Injury Log (Form 1060) must be completed. The Sharps Log is to be maintained in a secure location to protect the confidentiality of the injured employee.

Personnel who are splashed or exposed to blood or other potentially infectious material without being cut or scratched do not need to be recorded on the OSHA log unless:

a. It meets one or more of the recording criteria in § 1904.7. For instance, if the person receives the Hepatitis B vaccine as follow-up to the BBP exposure, it is recordable because this is considered medical treatment; or,
b. The exposure results in the diagnosis of a bloodborne illness, such as HIV, hepatitis B, or hepatitis C

XIV. PROGRAM ENFORCEMENT

The Facility Manager is responsible for enforcement of the Bloodborne Pathogen Program. Anyone who directs someone to violate, or has knowledge of a violation, and takes no corrective action will receive appropriate disciplinary action.

All personnel are responsible for following the procedures in this program. Personnel found in violation of this program will be subject to disciplinary action explained in the Allied Waste Employee Handbook.

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APPENDIX A

Hepatitis Fact Sheet

Definition:	"Hepatitis" means inflammation of the liver. It may be caused by medicines, alcohol, chemicals, and/or a variety of infectious agents.
Types of Hepatitis:	There are a number of types of viral hepatitis. A type of germ called a virus causes these diseases and all are infectious but are spread in different ways. Those of most concern are: • Hepatitis A (Infectious Hepatitis) • Hepatitis B (Serum Hepatitis) • Hepatitis C (Non A/Non B) • Other Hepatitis'
Hepatitis A:	The virus that causes Hepatitis A is present in the bowel movements (feces) of infected persons. The fecal/oral route, through close person-to-person contact or ingestion of contaminated food or water, transmits the virus. In most cases, the virus must be ingested to cause infection. It may be found in food contaminated by direct contact by a person's soiled hands who harbors the virus. The virus can be ingested by eating uncooked foods contaminated with the virus, such as raw shellfish harvested from waters polluted with sewage or fruits and vegetables grown in contaminated soil. Linen and clothing in contact with feces or an infected person can spread the disease. Only those persons who live in the same house or apartment with an infected person or have very intimate physical contact are considered to have a significant risk of contracting the disease. Travelers to certain overseas areas are at high risk. Occupational risk of exposure would be very rare. The Hepatitis A virus does not lead to chronic disease.
Hepatitis B:	A virus, totally different from the virus that causes Hepatitis A, causes Hepatitis B. The Hepatitis B virus circulates in the bloodstream and is excreted in the infected person's body fluids. The disease may be spread by contact with blood or blood products that contain the virus, or by contact with objects contaminated with infectious blood or blood products. The virus is also present in other body fluids like saliva, semen, and vaginal secretions. Hepatitis B is most commonly passed from person-to-person through sexual contact. Thus, very close personal or sexual contact may cause infection of Hepatitis B. The virus can survive outside the body for at least 7 days on a dry surface

Bloodborne Pathogens Program

(Exposure Control Plan)

APPENDIX A

Hepatitis Fact Sheet

Hepatitis B: (continued)	and is 100 times more contagious than HIV (the virus that causes AIDS). IV drug users who share needles are at risk. The virus can cause liver cell damage, lead to cirrhosis, and cancer.
Hepatitis C:	Hepatitis C is a virus much like the Hepatitis B Virus. The virus circulates in the bloodstream and is excreted in the infected person's body fluids. People at risk include anyone who has had a blood transfusion prior to July 1992 (today's blood supply is now tested for Hepatitis C), injection drug users, those with tattoos, hemodialysis patients, and those with multiple sexual partners. Body piercing and cocaine snorting are also risk factors.
Other Hepatitis':	Hepatitis D, E, F, and G are also known to exist. Hepatitis D only infects those persons with Hepatitis B. Hepatitis E is rare in the United States and is transmitted through the fecal/oral route or contaminated water supplies in other countries. There is no chronic state from this form of hepatitis.
Signs and symptoms of Hepatitis:	Early recovery and the opportunity to take preventive steps to protect others from viral hepatitis are possible with recognition of the signs and symptoms and testing the blood for the virus. Persons with viral hepatitis may have some or all of these symptoms: • Aches in the back, joints, or head; • Fever, nausea, and vomiting; • Tenderness over the liver or a heavy feeling in the abdomen; • A washed-out feeling, like flu; • Yellow (jaundiced) appearance of the skin and eyes. The above symptoms can vary widely from person-to-person. Some infected persons will have no symptoms while others will experience mild to moderate illness. Still others will experience very serious illness. Unfortunately, some will die from the disease and 6-10% of all hepatitis-infected persons will become a carrier of the disease.
Treatment:	There are no drugs that cure hepatitis. No antibiotics are known to kill the virus causing disease. Rest, proper nutrition, avoiding alcohol, and time is important in a person's recovery. Interferon is effective for Hepatitis C with varying success of those treated.

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Hepatitis B Vaccine:	• Based on current knowledge, Hepatitis B vaccine provides protection against illness and development of the carrier state. Immune memory remains intact for ≥ 13 years following immunization. When antibody levels decline below 10 ml U/ml AND there is a bloodborne pathogen exposure, a booster dose should be provided. • Immunization schedule for Hepatitis B requires three (3) doses of vaccine: Initial injection; then the second injection one (1) month later; and the third injection five (5) months after the second injection.. • Once immunized, antibodies will reduce below detectable levels in many people. If these individuals are exposed to HBV, they develop a rapid recall of the antibody response and the person does not become ill or develop HBV carrier state. • Some people experience soreness at the injection site. Some people experience mild symptoms (fever, headache, tiredness or nausea). • Serious systemic adverse events and allergic reactions are rarely reported following hepatitis vaccine. • For children of adults with normal immune status, booster doses of vaccine are not recommended nor is routine serologic testing to assess immune status indicated.
Hepatitis A Vaccine:	• An immunization of Hepatitis A requires two doses of vaccine. The initial injection and then one (1) injection 6-12 months later.
Hepatitis C Vaccine:	• No vaccines are currently available for Hepatitis C.

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Bloodborne Pathogens Program

(Exposure Control Plan)

APPENDIX B

The ABC's of Viral Hepatitis

	HEPATITIS A (HAV)	HEPATITIS B (HBV)	HEPATITIS C (HCV)
What is it?	HAV is a virus that causes inflammation of the liver. It does not lead to chronic disease	HBV is a virus that causes inflammation of the liver. The virus can cause liver cell damage, leading to cirrhosis and cancer.	HCV is a virus that causes inflammation of the liver. This infection can lead to cirrhosis and cancer.
Incubation period (time from exposure to illness)	15 - 50 days Average 30 days	4 - 25 weeks Average 8 - 12 weeks	2 – 25 weeks Average 7 – 9 weeks
How is it spread?	Transmitted by fecal/oral route, through close person-to-person contact, changing diapers without good hand washing, anal/oral sex, or ingestion of contaminated food or water.	Contact with infected blood, seminal fluid, or vaginal secretions. Sexual contact, contaminated needles, tattoo or body-piercing tools and other sharp instruments. Infected mother to newborn. Human bite.	Contact with infected blood, contaminated IV needles, razors and tattoo/body piercing tools and other sharp instruments. Infected mother to newborn. Not easily spread through sex.
Symptoms:	May have none, especially young children. Symptoms may include light stools, dark urine, fatigue, fever, and jaundice (yellow skin or eyes). Jaundice by age group: < 6 yrs: < 10 % 6-14 yrs: 40-50% > 14 yrs: 70-80%	May have none, especially young children. Some persons have mild flu like symptoms, dark urine, light stools, jaundice, fatigue and fever. Jaundice by age group: < 5 yrs: < 10 % ≥ 5 yrs: 30-50%	If have symptoms, similar as with HBV. Between 30-40% with acute HCV develop symptoms and 20-30% develop jaundice. Most people infected with HCV do not have symptoms and are leading normal lives.
Percent who develop chronic disease: **Percent who develop chronic disease: (continued)**	None	Varies by age of onset of infection < 5 yrs: 30-90 % ≥ 5 yrs: 2-10%	75%-85%
Treatment of Chronic Disease:	Not applicable	Anti-virals with varying success. Treated success with Interferon up to 35-45%. Therapy is expensive.	Interferon alone or in combination with ribavirin with varying success. Therapy is expensive.

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APPENDIX B

The ABC's of Viral Hepatitis

	HEPATITIS A (HAV)	HEPATITIS B (HBV)	HEPATITIS C (HCV)
Vaccine:	Two doses of vaccine to anyone over the age of two. Recommended for children living in high-risk HBA areas of foreign travelers.	Three doses of vaccine to all children and high-risk adults.	No vaccine available.
Who is at risk?	Household or sexual contact with an infected person or living in an area with HAV outbreak. Easily spread in day cares with diapered children. Travelers to developing countries, men who have sex with men and IV drug users.	Infant born with infected mother, having sex with infected person or multiple partners, IV drug users, health care workers, men who have sex with men and hemodialysis patients.	Anyone who had a blood transfusion prior to 1992. Contact with infected blood or contaminated needles. IV drug users. Infants born to infected HVC mother, hemodialysis patients, having multiple sex partners.
Prevention:	Immune Globulin (IG) within 2 weeks of exposure. Vaccination. Washing hands with soap and water after using the toilet. Use of household bleach to clean surfaces contaminated with feces, such as changing tables. Safe sex.	Hepatitis B Immune Globulin (HBIG) after known exposure. Vaccination. Safe sex. Clean up blood with gloves. Do not share razors, toothbrushes, and needles.	Clean up spilled blood with bleach and wear gloves when touching blood. Do not share toothbrushes, razors or needles. Safe sex.

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Bloodborne Pathogens Program

(Exposure Control Plan)

APPENDIX C

Tuberculosis Fact Sheet

Definition:	Active disease of Tuberculosis (TB) is caused by an infection with the germ (microorganism) called Mycobacterium Tuberculosis. It most often affects the lungs, but it may attack almost any system or organ in the body. **TB disease** means a person who has active untreated TB germs in their lungs or body. **TB infection** means a person who at some time in the past was exposed to the TB germ and the germs are in the body but the body's defenses has built a wall around them and the germs are now inactive. This is much like a scab forming over a cut. Millions of Americans have TB infection. For most of them, the germ will always be inactive.
History:	Years ago tuberculosis was considered a dreaded disease. Its cause and spread were not known and there was no effective treatment or cure. Today TB is a preventable and curable disease. The cause and spread of TB is well defined and there are a variety of effective drugs to prevent, cure, and interrupt the transfer of TB from one person to another. In spite of all this, tuberculosis still occurs.
How do you get the disease?	TB is spread when people who have active untreated TB germs in their lungs or throat cough, sneeze, or speak, and send their germs into the air. The droplets carrying the TB germs are invisible to see. People who breathe these germs into their lungs can become infected. Indoors they can float on the air for approximately one or two hours after being expelled from the infected person's mouth. The transfer of TB germs is possible indoors when there are people sharing the same air in close quarters for a long period of time – such as 6-8 hours a day, day after day – with someone who has active TB disease. In outdoor air, TB germs rapidly disperse and the ultra violet light coming from the sun kills them. You're not likely to get TB from someone coughing in the subway or at a restaurant. Dishes, drinking glasses, sheets, or clothing do not spread the disease.

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APPENDIX C

Tuberculosis Fact Sheet

Signs and Symptoms:	TB can attack any part of the body, but the lungs are the most common targets. People with TB disease may have some or all of the following symptoms: • A cough that hangs on for more than 3 weeks • Fevers • Weight loss • Night sweats • Constant tiredness • Loss of appetite
Screening:	If you are concerned that you have been infected with the tuberculosis germs, have a Tuberculin Mantoux PPD skin test. If a person reacts to the TB skin test, it means that the individual has been exposed to and infected with tuberculosis at some time in the past. When the skin test is positive, a chest x-ray will be done. The chest x-ray can show whether the infection has caused any damage to the lung tissue. If the chest x-ray is abnormal, the person has live tuberculosis germs in the mouth, throat or lungs. Once it is known that a person is infected with mycobacterium tuberculosis, she/he is treated with medicines to kill the TB germs. Some people have had prior vaccination with BCG (Bacilli Calmette Guerin); this vaccine complicates interpretation of the tuberculin skin test. If you had a BCG in the past and you suspect a possible exposure to TB, go to your local health department for help.
Fact:	Tuberculosis is a disease that can damage a person's lungs or other part of the body and cause serious illness. **Tuberculosis is not a highly infections disease**. To get TB requires close, frequent or prolonged exposure to someone with the disease. The people who are at risk of TB infection are those persons who spend a great deal of time in close contact; i.e., such as family members and close friends, to a person with *active, infectious tuberculosis disease.* A person *infected* with TB, who does not have the disease, cannot transfer TB to others. Therefore, contacts at work are not necessarily at risk.
Contributing factors to an increased risk:	• Crowding of people and insufficient ventilation. • Presence of other conditions in a person such as:

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APPENDIX C

Tuberculosis Fact Sheet

Contributing factors to an increased risk: (continued)	– Human immunodeficiency virus (HIV) infection, poor nutrition, alcoholism, intravenous drug use, and other medical conditions. • People with active TB disease that do not complete TB drug therapy remain infectious to others and become resistant to TB drugs. • Foreign-born persons from countries with high rate of TB (i.e., Asia, Africa, Latin America). • Medically under-served minority populations (i.e., African Americans, Hispanics, Native Americans).
Treatment:	The duration of treatment with TB medicines varies from person-to-person; it depends upon whether preventative therapy for infection or drug therapy for active disease is needed. Generally, treatment can last from 6 to 12 months. Modern medical treatment for TB is very effective when taken as prescribed for as long as required. Stopping the medicine too soon may allow some TB germs to survive, which could put the person at risk of becoming ill and infectious again. Those persons with TB disease who do not complete the standard course of anti-tuberculosis therapy may develop a drug-resistant strain of Mycobacterium tuberculosis and further spread the TB to others. The recovery rate for those who receive the complete drug treatment is so successful that the great majority of persons with TB are able to return to work and continue their former activity after control of the disease is established.
Drug Resistant TB:	Drug resistant TB develops when a person with active TB stops taking their medication too soon, or if they have not been given the right TB medicine. A person with untreated drug resistant TB of the lungs or throat can transmit these resistant germs. Sometimes, TB germs are "resistant" to one or more of the TB medicines most often prescribed by doctors. When this happens, combinations of other TB medicines are given to the patient. Drug resistant TB can take longer to cure than regular TB, but most patients can be cured.
Prevention in the workplace:	There are no special precautions needed in the workplace other than providing good ventilation inside buildings. The usual good house cleaning practices done according to routine policy are adequate. A

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APPENDIX C

Tuberculosis Fact Sheet

	personal hygiene practice done by all employees is always smart business. Hand washing, covering the mouth and nose when coughing or sneezing, and proper disposal of soiled tissues can reduce the spread of many communicable diseases. Maintain a healthy lifestyle, good nutrition, proper rests, exercise, drink in moderation, don't smoke, and don't do drugs – it will help you resist disease.

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APPENDIX D

HIV/AIDS Fact Sheet

Facts:	• It is estimated that one in every 250 people in the United States is infected with HIV, "Human Immunodeficiency Virus". Most HIV infections develop into AIDS ("Acquired Immunodeficiency Syndrome") within 10 years. HIV/Aids ranks as the third-leading cause of death among those 25 to 44 years old and sixth among people 15 to 24 years old. • HIV lives only in blood and certain other body fluids; it cannot live or grow outside these environments. • HIV infection may be identified through testing the blood for the presence of HIV antibodies. • Antibodies against HIV in an infected individual's blood can be detected by a series of tests. Tests that show the presence of antibodies between 6 to 12 weeks after exposure. • Some HIV infected persons suffer less severe symptoms than those with diagnosed cases of AIDS. These lesser symptoms may include loss of appetite, weight loss, fever, night sweats, skin rashes, diarrhea, fatigue, lack of resistance to infection, and swollen lymph nodes. • AIDS is the result of the progressive destruction of a person's immune system, which is the body's defense against the disease. This destruction allows diseases that the body can normally fight, to threaten the person's health and life. • Pneumonia, cancer, tuberculosis and certain other infections often invade a body weakened by HIV. • HIV can also attack the nervous system and cause damage to the brain. This may take years to develop. The symptoms may include memory loss, indifference, and loss of coordination, partial paralysis, or mental disorder.
Risk factor for HIV Infection:	The risk factor for HIV infection is behavior. There are certain lifestyle behaviors associated with the transmission of the virus, such as: intravenous drug use and unprotected, indiscriminate sexual activities that place a person at risk for IV infection. Situations that cause a worker to encounter HIV contaminated blood or other fluids by needle-stick or contact with an open wound or broken, non-intact skin, or mucous membranes of the eyes, nose or mouth, have the potential for infection. **There is no risk or transmission of the virus from an HIV-infected person to**

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APPENDIX D

HIV/AIDS Fact Sheet

Risk factor for HIV Infection: (continued)	**coworkers through ordinary workplace contact.** The Centers for Disease Control studied healthcare workers who were exposed to blood known to be HIV positive. Most of the workers were stuck by needles that had been used on AIDS patients. Of the workers exposed, 0.3% (less than one percent) became infected with the AIDS virus.
Signs and Symptoms:	If infected with the Human Immunodeficiency Virus, a mononucleosis or flu-like syndrome may occur within two months after exposure. • Diarrhea • Fatigue • Fever • Joint pain • Muscle pain • Night sweats • Rash • Swollen lymph nodes Some persons infected with the human immunodeficiency virus will develop a persistent, generalized disorder of the lymph system (lymphadenopathy) that lasts more than three (3) months. There are specific diseases considered indicators of AIDS. The most common infections and causes of death in AIDS patients are: • A parasitic disease – Pneumocystis Carinii Pneumonia – "PCP" • A malignant skin cancer – Kaposi's Sarcoma – "KS" • Fungal diseases such as Candidiasis • Viral diseases such as Cytomegalovirus There is no cure for AIDS. Currently in use are experimental drugs and a number of treatment procedures on patients at various stages of infection.

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Bloodborne Pathogens Program

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HIV/AIDS Fact Sheet

If a potential exposure to Bloodborne Pathogens occurs:	• Wash and clean wound with soap and water. • Report incident to your supervisor and safety manager. • Go to the clinic for proper medical care which will include: – Blood tests for antibodies to Hepatitis B surface antigen and HIV counseling as needed. – Repeat HIV testing at: ♦ 6 weeks after exposure ♦ 12 weeks after exposure ♦ 6 months after exposure • HBIG (Hepatitis B Immune Globulin) provides temporary protection against Hepatitis B. (Passive protection from HBIG lasts up to 6 weeks.) • Hepatitis B Vaccine will provide protection for at least 13 years and probably longer. Antibodies will reduce below detectable levels for these individuals, however they develop a rapid recall of the antibody response and the person does not become ill or develop HBV carrier state. Schedule: 1st injection - ASAP or within 7 days 2nd injection - 1 month later 3rd injection - 6 months from 1st injection • Tetanus/Diphtheria Booster if not given in the last ten years. **YOUR MEDICAL RECORD AND TESTING WILL BE KEPT CONFIDENTIAL.**

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SHARPS INJURY LOG

(Per the requirements of 29 CFR 1910.1030(h)(5)(I-iii))

Case No.	Date of Injury	Type and brand of device involved in the incident.	Department or work area where the incident occurred.	Explanation of how the incident occurred.

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Hepatitis B Vaccine Declination

I understand that due to my occupational exposure to blood or other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine, at no charge to myself. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine I continue to be at risk of acquiring hepatitis B, a serious disease. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with hepatitis B vaccine, I can receive the vaccination series at no charge to me.

Print Name:_____S.S. Number: _____

Signature:_____Date: _____

(NOTE: The wording on this document may not be changed in any manner.)

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BBP Exposure Incident Follow-up Report

To be completed at the Allied Waste Facility and provided to the Contract Physician

Employee Name	Social Security Number	Job Title
Company Name	**Street Address**	**City**

State	Zip Code	Name and Title of Allied Waste Contact	Phone Number

Date of exposure incident/time: _____ / _____ AM/PM

Route of exposure:
____ Needlestick, puncture, laceration.
____ Bodily contact to skin with beaks, cuts sores, rashes, etc.
____ Bodily contact with eyes, nose or mouth.

Source of exposure:
____ Untreated medical waste.
____ Treated authorized medical waste (after autoclave or incinerator).
____ Blood from known contact while providing first aid.

Source individual:
____ Unknown
____ Known Name: _____
Phone #: _____

To be completed at the Contract Physician's Facility and returned to Allied Waste

Clinic or Medical Facility Name	Street Address	City

State	Zip Code	Name and Title of CP's Contact	Phone Number

I certify that I have been provided with copy of the Allied Waste's written Bloodborne Pathogens Program and a copy of the OSHA Standard on Bloodborne Pathogens, 29 CFR 1910.1030, and I further certify that:
(circle choice)

Hepatitis B vaccination is indicated for this employee; vaccination has been received.	Yes	No
Hepatitis B vaccination is indicated for this employee; vaccination has not been received.	Yes	No
Hepatitis B vaccination is not indicated for this employee; vaccination has not been received.	Yes	No
Employee has been informed of the results of his/her evaluation.	Yes	No
Employee has been advised of any medical conditions resulting from exposure to blood or other potentially infectious material that requires further evaluation or treatment.	Yes	No

ALL OTHER MEDICAL FINDINGS OR DIAGNOSES REMAIN CONFIDENTIAL

Printed Name of PHLCP: _____

Signature of PHLCP: _____ **Date of Evaluation:** _____

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ECDC Environmental

Emergency Action Plan

ECDC Environmental

I. PURPOSE

This Emergency Action Plan is designed to provide guidance to personnel in the event of an emergency and outlines the required procedures for responding to emergencies. Emergencies both man-made and natural may require this facility to be evacuated or shelter-in-place. These may include, but are not limited to, fires, explosions, floods, earthquakes, hurricanes, tornados, toxic material release, radiological and biological accidents, civil disturbances, and workplace violence.

This plan has been developed to provide direction in responding to these and other types of emergencies and ensure the facility's compliance with OSHA 29 CFR 1910.38, Emergency Action Plans.

II. DEFINITIONS

None

III. RESPONSIBILITY

The Facility Manager is in charge of any emergency at this facility. All communication, questions, etc., are to be directed to the Facility Manager, who has full authority, including the management decisions listed within this plan.

The Facility Manager is responsible for:

a. Assigning alternates to serve in his/her absence, they are listed on the Emergency Contact List in Appendix C.

b. Designating the appropriate emergency response personnel for the various types of emergencies outlined in this plan, and who will assist the Facility Manager in the evaluation and response to emergencies.

c. Ensuring that all personnel are trained on the procedures outlined in this plan.

d. Making the decision to shut down operation and whether to shelter-in-place or evacuate during an emergency

e. Directing the shelter-in-place, evacuation and search of the facility, and recall of personnel during an emergency

f. Communicating with local law enforcement and local emergency response personnel to review this plan, the facility, and communicate with them during an emergency.

g. Conducting mock emergency drills to train personnel and test this plan at least annually.

h. Ensuring that this plan and the contact personnel are kept up to date with current work practices and contacts.

IV. EMERGENCY ACTION PLAN OVERVIEW

Depending on the circumstances and the type of emergency, the first important decision is whether to stay at the facility (shelter-in-place) or evacuate. Facility management will use all available information to determine if there is an immediate danger. In any emergency, local authorities may or may not immediately be able to provide information on what is happening and what the facility should do.

Facility management will make the decision to either shelter-in-place or evacuate in the absence of direction from outside agencies. This plan is designed to account for both possibilities. Facility management will use available information to assess the situation. If there is a large amount of debris in the air, or if local authorities say the air is badly contaminated, the decision may be to "shelter-in-place." Information will be gathered from watching TV, listening to the radio, or checking the Internet often for information or official instructions as it becomes available. There are numerous emergencies that may prompt personnel to shelter-in-place. Examples of these types of emergencies include; terrorist attacks, toxic material releases, radiological and biological accidents, civil disturbances, workplace violence, and tornados.

If told to evacuate or seek medical treatment from the authorities, the facility will do so immediately.

In preparation for these events the facilities has designed the following plans to help instruct personnel on who to contact, where to go, and the basic emergency supplies information.

1. Emergency Information List (Appendix A)

The emergency information list contains emergency responders, contact phone numbers, emergency assembly locations, and shelter-in-place locations. It outlines the basic actions that must be taken in the event of an emergency.

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2. Emergency Contact List (Appendix B)

The emergency contact list is posted at various locations around the facility and at phones that may be used to initiate this emergency action plan. This list contains the home and work phone numbers of key staff and support personnel (e.g., corporate staff, police, fire, emergency medical support, and relevant government agencies). It also contains the names and/or titles of those individuals who are assigned to serve as the facility's Emergency Coordinator, spokesperson, and their designated alternates.

3. Spill Response Information (Appendix C)

The spill response information contains information on chemicals stored on site, storage amounts, spill cleanup supplies, personal protective equipment, and the names of personnel trained in spill response procedures.

4. Site Evacuation Map

The site evacuation map(s) contain the emergency escape routes for the buildings and/or area. In addition fire extinguishers, first aid kits, spill response kits, and other emergency response equipment are indicated. Upon notification of an evacuation, all personnel who are not directly involved in responding to the emergency must go directly to the emergency assembly location(s) indicated on this map. Once at the emergency assembly location point, a headcount will be conducted to account for all personnel at the facility.

The emergency assembly areas were selected because there is sufficient area to accommodate all personnel. They are located away from busy streets and out of the way where they will not interfere with rescue and emergency response operations. The location is also up-wind from the most common or prevailing wind direction from the potentially hazardous areas on site.

5. Employee Personal Information

Personal emergency response information is kept with the human resources department. This information, which may be needed in the event of an emergency includes:

a. Home telephone numbers

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b. Names and telephone number of next of kin, and

c. Medical information

This information is maintained in such a way that it can be readily retrieved in the event of an emergency.

6. Rescue

Rescue operations at this facility will only be performed by outside agencies that have professionally trained, equipped, and certified personnel to perform rescue operations.

7. Detailed Procedures

Below are detailed procedures for each of the following events:

a. Fire Response Procedures
b. Shelter-in-Place Procedure
c. Evacuation Procedure
d. Medical
e. Weather
f. Spill Response Plan
g. Bomb Threat

V. FIRE RESPONSE PROCEDURES

This outlines when it is safe, and not safe, to fight a fire with a fire extinguisher. Promptly reporting a fire is always the first response. This is to alert everyone and make sure they are evacuated to the emergency assembly location if necessary.

1. Report Fires Immediately

Activate the emergency alarm system and report all fires immediately to the facility manager or the nearest member of management and notify the fire department.

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2. Small Fires

Personnel who have completed annual fire extinguisher training may attempt to extinguish small fires. A small fire is defined as a fire that can be controlled or extinguished by the use of portable fire extinguishers without the need for personal protective equipment. Individuals must use their judgment based on their training and experience to determine whether or not it is safe to fight a fire with portable fire extinguishers.

The following is provided as general guidance in helping personnel in making this decision.

3. When it may be safe to extinguish a fire using a fire extinguisher

a. Size of the Fire – if the fire is limited to the original material ignited, it is contained (such as in a waste basket) and has not spread to other materials. The flames are no higher than the firefighter's head.
b. Condition of the Air in the Area – if the fire has not depleted the oxygen in the room and is producing only small quantities of toxic gases and no respiratory protection equipment is required.
c. Amount of Smoke and Heat – if heat is being generated, but the room temperature is only slightly increased. Smoke may be accumulating on the ceiling, but visibility is good and no special personal protective equipment is required
d. Evacuation Path - there is a clear evacuation path that is behind you as you fight the fire.

4. When it is not safe to use a fire extinguisher to fight a fire:

a. Type, size, and location of the fire - If the fire involves flammable solvents, has spread over more than 60 square feet, or is partially hidden behind a wall or ceiling, or can not be reached from a standing position.
b. Condition of the air - if the smoke and products of combustion from the fire require respiratory protection in the area
c. Amount of Heat – If the radiated heat is easily felt on exposed skin making it difficult to approach within 10-15 feet of the fire (or the effective range of the extinguisher)
d. Visibility - If the person must crawl on the floor due to heat or smoke. Smoke is quickly filling the room, decreasing visibility.
e. Evacuation Path - If the fire is not contained, and fire, heat, or smoke may block the evacuation path

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VI. SHELTER-IN-PLACE PROCEDURE

1. Shelter-in-Place Rooms

To "shelter-in-place," an interior room(s) is selected that is above the ground floor, with the fewest windows or vents. The room(s) should have adequate space for everyone to be able to sit. Overcrowding is avoided by selecting additional rooms if necessary. Large storage closets, utility rooms, pantries, copy and conference rooms without exterior windows work well. Avoid selecting a room with mechanical equipment like ventilation blowers or pipes, because this equipment may not be able to be sealed from the outdoors.It is ideal to have a hard-wired telephone in the room(s) you select. Cellular telephone equipment may be overwhelmed or damaged during an emergency.

2. Emergency Supplies

Shelter-in-place disaster supplies may include items such as nonperishable food, bottled water, battery-powered radios, first-aid supplies, flashlights, batteries, duct tape, plastic sheeting, and plastic garbage bags.

3. Shelter-in-Place Emergency Action Plan

The following is a basic outline of the typical procedures used for sheltering-in-place. When authorities provide directions to shelter-in-place, they want everyone to take these steps immediately.

a. Close the facility.

b. If there are customers, clients, or visitors at the facility, provide for their safety by asking them to stay. Instruct these people that it is best for their safety not to leave their current location. Do not drive or walk outdoors.

c. Unless there is an imminent threat, ask employees, customers, clients, and visitors to call their emergency contact (i.e. family member, etc.) and let them know where they are sheltering (staying) and that they are safe.

d. Turn on call-forwarding or alternative telephone answering systems or services. If the business has voice mail or an automated attendant, change the recording to indicate that the business is closed, and that staff and visitors are remaining in the building until authorities advise it is safe to leave.

e. Quickly lock exterior doors and close windows, and air vents. Have employees familiar with your building's mechanical systems turn off all fans, heating and air conditioning

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systems. Some systems automatically provide for exchange of inside air with outside air. These systems, in particular, need to be turned off, sealed, or disabled. Close or tape-off all vents in the "shelter-in-place" room(s).

f. If you are told there is danger of an explosion, close the window shades, blinds, or curtains.

g. Take your emergency supplies and go into the designated shelter-in-place room(s). Seal all windows, doors, and vents with plastic sheeting and duct tape or anything else you have on hand.

h. Consider precutting plastic sheeting (heavier than food wrap) to seal windows, doors, and air vents. Each piece should be several inches larger than the space you want to cover so that it lies flat against the wall. Label each piece with the location of where it fits.

i. Call emergency contacts and have the phone available if you need to report a life-threatening condition.

j. Write down the names of everyone in the room, and call the designated emergency response coordinator to report who is in the room(s) with you, and their affiliation with your business (employee, visitor, client, or customer).

k. Listen to the radio, watch television, or use the Internet for further instructions until you are told all is safe or to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

VII. EVACUATION PROCEDURE

1. Activate Emergency Alarm System

Employees are notified of the need for an emergency notification by the sounding of an alarm, announcement over the building communication system, or by notification initiated by their supervisor.

2. Shut Off Equipment

Equipment or operations will only be shut off if time permits and only if your personal safety is not at risk. Critical operations that need to be shut down are included in the Facility Emergency Information List.

3. Use Designated Exit Routes

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Plans/maps that identify designated emergency exits, routes and the locations of fire extinguishers and fire hoses are posted in key locations within the Facility. Employees must always evacuate through an exit closest to your location in the event of an emergency or fire requiring evacuation. Each supervisor, or in his/her absence an individual designated by the supervisor, is responsible to ensure that all assigned evacuation routes and exits are clear from obstructions that could hinder evacuation during an emergency.

4. Clear the Building / Area

Supervisors are responsible in the event of an evacuation to ensure that all employees and visitors safely evacuate from the supervisor's assigned work area. Supervisors are also responsible for ensuring that any disabled person located in the supervisor's work area is either evacuated with other employees or is relocated to a designated (on the evacuation map) location for evacuation by emergency response personnel. Those supervisors whose assigned work areas include restrooms and other inside rooms are responsible to ensure that those areas have been evacuated.

5. Evacuation Precautions

When evacuating during a fire, do not open doors if the doors or knobs are hot. If they are cool, open doors slowly. If smoke is encountered when exiting, kneel down on the floor and crawl to escape. Never use an elevator during a fire. Smoke and heat rises so the elevator may be filled with smoke.

6. Proceed Immediately to Assembly Locations

Employees are instructed to quickly exit the building and to assemble at the primary or secondary assembly locations. See Facility Specific Emergency Information List for the primary and secondary locations.

7. Conduct Headcount

Supervisors, with the assistance of employees, are to take headcounts at the assembly area. Emergency personnel are to be notified of names and last known location of any missing personnel who might require rescue.

Emergency personnel or the facility manager will make the decision once a headcount is taken if the situation warrants a further evacuation. This may require sending personnel home by normal means or providing them with transportation to an offsite location.

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8. Do Not Re-Enter Building / Area Until Authorized

Once emergency response personnel or a member of management has given the "all clear" to employees and their supervisors, they may reenter the facility and proceed to their designated work areas.

9. Review Plan

Senior management will conduct a formal critique of the incident and associated actions, to identify necessary recommendations for improvement.

VIII. MEDICAL EMERGENCIES

1. Reporting a Medical Emergency

During normal working hours, evenings, or weekends:

a. Report minor injuries to your supervisor or designated first aid provider.

b. Drivers are to call dispatch.

c. Serious or life threatening injuries, call 911/Fire Department, and facility management.

2. Emergency First Aid Assistance

First aid is only to be provided by designated first aid providers who have received first aid and/or CPR training, and whose job description duties include providing first aid. First aid supplies are limited to those materials approved by the Allied Waste's medical provider. Additionally, the Allied Waste's contract medical provider has established a procedure to provide post-exposure treatment in the event that an employee is exposed to blood or other potentially infectious substances when voluntarily providing emergency assistance or first-aid. Refer to the Safe Work Procedures – First Aid for additional details.

Note: Employees who have received Allied Waste provided first aid or CPR training, and are not designated as first aid providers are instructed that their job does not require that they perform first aid services.

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Emergency Action Plan

IX. WEATHER – TORNADOS, HURRICANES, FLASH FLOODS

The Facility Manager will make the determination to shut down operations if threatening weather is in the area. The Facility Manager will decide whether it will be better to leave the facility if time permits or "shelter-in-place."

1. Monitor Weather Conditions

When threatening weather suggests that a tornado, or other dangerous weather condition, could occur in the vicinity, the Emergency Response Coordinator (ERC) will monitor local news/weather radio broadcasts for warnings issued for areas in or around the Facility.

2. Proceed to Designated Shelters

When a weather-related warning is issued for the area the ERC will notify all supervisors to be prepared to move their employees to their assigned shelter areas. At the first sign of an approaching tornado or threatening weather, supervisors must direct their employees to shelter. If time permits, turn off your equipment, prior to proceeding to the designated shelter area.

3. If Designated Shelter is Not Available

Personnel who are unable to reach designated shelters are instructed to use the following guidance to seek alternative shelter. Shelters should ideally be below grade, or if not feasible, above grade in an area without windows and of substantial construction. Typically, fire stairwells and washrooms are examples of appropriate shelter areas. Interior corridors are less desirable as past incidents have indicated that they can become filled with flying shrapnel. If the above shelters are not readily available, cover should be sought under heavy furniture, on the lowest floor, and away from windows, glass doors, etc. All office trailers should be evacuated, and those personnel should move to a more permanent shelter or lie flat in the nearest depression or ditch. Personnel who are outdoors and cannot get to shelter should seek a low-lying area, ditch, depression or low area.

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4. Headcount and Recovery

After the threat of threatening weather has passed, supervisors, with the assistance of employees, are to take headcount to determine that all employees are safe and uninjured. Remain in the shelter area until instructed to return to your work area by the ERC.

5. Call For Emergency Assistance

Call 911 or the Fire Department if any employee requires medical assistance or rescue. Give the Fire Department the appropriate address and the exact location where assistance is required.

X. SPILL RESPONSE

1. Pre - Planning

Chemicals used or stored at the facility are stored and labeled in approved containers according to the requirements of the Facility's Hazard Communication (Right-To-Know) Program. Material Safety Data Sheets (MSDS) are available for each of these chemicals. Each supervisor is responsible for ensuring that his/her employees are aware of the hazardous chemicals that are used in their work area.

Employees are advised, depending on their work assignment, to either leave from the area of a spill and notify the appropriate personnel of the spill/release, or to respond to the spill/release by stopping, containing, or cleaning up the spill. Appendix C contains a list of chemicals and the amounts if spilled that would require personnel to leave the area.

2. Reporting a Spill

a. Minor Spill

If the spill/release is small (i.e., not large enough to require employees to leave the area) report it immediately to your supervisor.

b. Moderate Spill

Leave the area of the spill/release, then immediately notify your supervisor or a designated spill responder. They will initiate the actions that are required to stop, cleanup, or otherwise respond to the spill/release.

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c. Major Spill

Leave the area of the spill, then immediately notify your supervisor or the Facility Manager, and contact the Fire Department.

3. Limits of Response

Appendix C contains a list of spill supplies, personal protective equipment to be used for spill responses, and list of personnel who are the designated spill responders for small and moderate sized spills.

a. Minor Spill

Most employees have received routine Hazard Communication training and have been provided with supplemental training on how to use spill cleanup supplies and additional personal protective equipment which will allows them to cleanup minor spills/releases as a part of their routine work assignments. Moderate and larger spills/releases are either handled by moderate spill responders or by Hazardous Materials (HAZMAT) responders.

b. Moderate Spill

Responders for moderate sized spills are used at this facility for leak prevention and cleanup, where conditions do not exceed the thresholds established in this plan for HAZMAT response. Employees who have been assigned to respond to moderate sized spills have received routine Hazard Communication training and have been provided with supplemental training to use spill cleanup supplies and additional personal protective equipment. In the event of a moderate spill/release employees are either:

- Required to leave the area until the situation is corrected; or
- Trained and qualified, as a member of the spill response team, to stop the leak and/or cleanup the spill/release.

c. Major Spill

HAZMAT responders are required whenever release of the hazardous chemical creates conditions in the spill/release area that:

- Are life or injury threatening;
- Pose a fire or explosion hazard;
- Present an oxygen deficient atmosphere; or
- Cause high levels of a toxic substance.

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Professional fire and emergency assistance are requested (see emergency contact list) where either the facility does not have a HAZMAT response team or when backup assistance is required for the facility's HAZMAT response team

XI. BOMB THREAT

1. Bomb Threat Analysis

Proper response to the threat involves at least three continuous and related but distinct steps:

a. Analysis of the threat and estimate of the need for response.

b. Decision on what is the proper response.

c. Implementing the response decision within the allowable time frame.

2. Procedure To Be Followed After A Bomb Threat Has Been Received

The person who receives the threat should immediately contact the Facility Manager or the designated alternate.

The person receiving the threat should then immediately fill out a Bomb Threat Checklist (Form 1019, or an equivalent form). This Checklist should be completed for each threat received, noting the time and, if possible, the exact words used in the threat.

In the case of a phone threat, record the conversation if possible and consider taping subsequent calls.

Once he/she is notified the Facility Manager will:

a. Notify the local law enforcement agency, or where the facility has a security officer, contact security to notify local law enforcement (where a security service or security office is used it is recommended that the shift commander be requested, to insure confidentiality);

b. Notify all supervisors and instruct them whether to evacuate the facility and/or conduct a search. The Bomb Threat Search Procedure is contained in Bomb Threat Checklist (Form 1019).

If any employee is so concerned that he/she wants to leave the facility because of the bomb threat, he/she shall be allowed to do so. Such employee will be instructed to punch out upon leaving the facility and will not be paid for the remainder of the shift. Employees will further be instructed not to report for work until the beginning of his/her next shift.

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If a decision is made to evacuate the facility, supervisors will be responsible for shutting down in the normal manner. Employees will be instructed to proceed to the emergency assembly locations and to remain there for further instructions.

When a decision has been made to return to work, employees will be advised to return to work. Procedures should be in place to contact employees. Supervisors should turn in the names of any missing personnel to their managers or the facility manager.

XII. TRAINING

Training employees is a critical component of this plan in preparing personnel in how to respond to an emergency. All employees are trained, on their first day of employment, on the actions that they are required to follow during an emergency. Additional training, as appropriate, is provided:

- For employees who are assigned to assume additional responsibilities during an emergency;
- Whenever employee's responsibilities or designated actions under the plan change
- Whenever the plan is changed, and
- As necessary to maintain the required skills of personnel.

The training program provided to personnel covers this emergency action plan and includes the following topics:

- Individual roles and responsibilities;
- Potential threats, hazards, and protective actions;
- Notification, warning, and communications procedures;
- Means for locating family members in an emergency;
- Emergency response procedures;
- Evacuation locations, shelter-in-place locations, and accountability procedures;
- Location and use of common emergency equipment; and
- Emergency shutdown procedures.

XIII. ANNUAL DRILLS AND PERIODIC UPDATES

This facility conducts a test of this emergency action plan at least annually so personnel become familiar with the emergency procedures, the evacuation routes, emergency assembly locations, and shelter locations. The facility reviews this plan with other companies in the area to ensure emergency response efforts are coordinated between neighboring facilities.

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Additionally, the plan is reviewed with local emergency response officials to help facilitate the coordination of emergency response efforts. A relationship has been promoted with the local fire department and ambulance provider so they know the layout of the facility, potential hazards, and are familiar with site emergency response personnel.

The plan is stored in a location and manner that can be readily reviewed by employees or their designated representatives. This plan is routinely updated as changes occur.

XIV.PROGRAM ENFORCEMENT

The Facility Manager is responsible for enforcement of this Emergency Action Plan. Anyone who directs someone to violate, or has knowledge of a violation, and takes no corrective action will receive appropriate disciplinary action.

All personnel are responsible for following the procedures in this program. Personnel found in violation of this program will be subject to disciplinary action explained in the Allied Waste Employee Handbook

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ECDC Environmental

Emergency Action Plan

Appendix A - Emergency Information List

Emergency Responders, Phone Numbers, & Assembly Locations

Facility Name: **ECDC Environmental**

Emergency Response Coordinator (ERC): **Jeff Green**

Address: 1111 West Highway 123, East Carbon, UT 84520

Office Phone Number: (435) 888-4418

Fire Department: Phone Number: ( ) _____ - _____ or Emergency dial 911.

1. Fire and Evacuation

Equipment needed to be shut down in an emergency:

1. Rotary Main Power, Main Gas Shutoff
2. Shop Main Power, Main Gas Shutoff
3. Operations Main Power, Main Gas Shutoff
4. Main Office Main Power, Main Gas Shutoff

Responsible persons to shutdown equipment:

1. Gilbert Palacios – Rotary
2. Grant Laws – Shop
3. Jeff Green – Operations Building
4. Kristy Candelaria Main Office

Emergency assembly locations:

Primary: Parking Lot in front of operations building

Secondary: Bottom west gate of facility

2. Medical

Medical assistance personnel (if other than fire department): Carbon Medical Clinic, Sunnyside Ambulance – EMT's

Number of minutes it takes for professional medical assistance to reach this facility is 8 minutes.

The facility X has or __ does not have designated and trained employees to serve as first aid responders.

Location of first aid supplies: Shop, Operations Building

3. Shelter-in-place Emergencies, Weather, etc. -

Location of the shelter-in-place and emergency shelters:

1. _____
2. _____

4. Spill Response

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Emergency Action Plan

The facility __ has or X does not have designated and trained employees as HAZMAT responders. If yes, list names: _____ _____

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Appendix B - Emergency Contact List

Facility Name: ECDC Environmental Address: 1111 W. Highway 123
Cross Streets:

Title/Agency	Contact	Business Hours Phone	After-Hours Phone
Emergency Response Coordinator (ERC)	Jeff Green	(435) 888-4418	(801) 573-7533 (435) 472-5102
First Alternate ERC	Gilbert Palacios	(435) 888-4418	(435) 820-0769
Second Alternate ERC	Darin Olsen	(435) 888-4418	(801) 573-7514 (435) 472-8332
Police Department	East Carbon City	911	911
Fire Department	East Carbon City	911	911
Emergency Medical Services	Ambulance Carbon Medical Clinic	911 (435) 888-4411	911 (435) 636-2526 Pager

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Emergency Management Program

Appendix C - Spill Response Information

Spills/releases of the following chemicals, at the following locations, in excess of the listed amounts, will require an employee to leave the area:

Location No Chemicals at facility

Chemical (Product) Name	Size of spill (lbs., gallons, etc.)

In the event of this type of a spill, go to _____

until advised to return.

Location _____

Chemical (Product) Name	Size of spill (lbs., gallons, etc.)

In the event of this type of a spill, go to _____
until advised to return.

Location _____

Chemical (Product) Name	Size of spill (lbs., gallons, etc.)

In the event of this type of a spill, go to _____
until advised to return.

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Responders for Minor Spills

The following **supplies** are maintained for minor spill response:

Location	Type of Supply	Minimum On-Hand Quantity
Shop	**Floor Dry**	**4 Bags**
Solidifier	**Floor Dry**	**55 Gallon Barrel**
Fuel Station	**Floor Dry**	**55 Gallon Barrel**
Fuel Station	**Absorbent Socks**	**4 Absorbent Socks**

The following **personal protective equipment** is maintained for minor spill response:

Chemical (Product) Name	Assigned Personal Protective Equipment
_____	_____
_____	_____
_____	_____

Responders for Moderate-Sized Spills

The following **supplies** are maintained for moderate spill response:

Location	Type of Supply	Minimum On-Hand Quantity
Shop	**Floor Dry**	**4 Bags**
Solidifier	**Floor Dry**	**55 Gallon Barrel**
Fuel Station	**Floor Dry**	**55 Gallon Barrel**
Fuel Station	**Absorbent Socks**	**4 Absorbent Socks**

The following **personal protective equipment** is maintained for moderate spill response:

Chemical (Product) Name	Assigned Personal Protective Equipment
_____	_____
_____	_____
_____	_____

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The following **personnel** are assigned as moderate spill responders:

Job Title/Description

Maintenance Manager / Grant Laws

Environmental Engineer / Darin Olson

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Emergency Management Program

Appendix D - Site Evacuation Map

The site evacuation map(s) contains the emergency escape routes for this building and/or area. In addition, fire extinguishers, first aid kit, and spill response kit and equipment are indicated. All personnel who are not directly involved in responding to the emergency upon notification of an evacuation are to go directly to the emergency assembly location(s) indicated on this map.

Once at the emergency assembly location point, a headcount will be conducted to account for all personnel at the facility.

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Safety Manual

Bomb Threat Checklist

1. When the Threat is Called In:

a) Keep the caller on the line as long as possible. If possible, record the conversation.

Use pages 2 and 3 of this form to note all relevant information from the call.

b) If not indicated, ask the caller for the location of the bomb and the time of possible detonation.

c) Inform the caller that the building is occupied, and the detonation of a bomb could result in death or serious injury to many innocent people.

d) Pay particular attention to peculiar background noises such as motors running, music, and any other noise, which may give a clue as to the location of the caller.

e) Listen closely to the voice (male or female), voice quality (calm, excited), accents, unique phrasing, and speech impediments. Does this voice immediately remind you of a certain individual? If so, list that.

f) Report the call and gathered information immediately to the _____ (Facility Manager or designee).

g) The _____ (Facility Manager or designee). will notify local police and fire department

h) Follow the directions given by the local police or fire department.

2. Written Threats

a) Save all materials, including any envelope or container.

b) Once the message is recognized as a threat, further unnecessary handling should be avoided. Every possible effort must be made to retain evidence such as fingerprints, handwriting or typing, paper, and postal marks that are essential to tracing the threat and identifying the writer.

c) Report the call and gathered information immediately to the _____ (Facility Manager or designee).

d) The _____ (Facility Manager or designee). will notify local police and fire department

e) Follow the directions given by the local police or fire department.

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Bomb Threat Checklist

IF A TELEPHONE BOMB THREAT IS RECEIVED, THE PERSON TAKING THE CALL SHOULD REMAIN CALM AND TRY TO GET AS MUCH INFORMATION AS POSSIBLE

Key Points: **1. Keep the caller talking – Do not interrupt!**

2. Ask the caller to speak loader.

3. Ask the caller to repeat.

4. Write out the caller's message entirely, if possible.

Date: _____

Time: _____ AM/PM

Received By: _____

Exact Words of Caller: _____

_____

_____

_____

_____

_____

_____

Questions to ask:

1. When is bomb going to explode? _____
2. Where is it located? _____
3. What does it look like? _____
4. What kind of bomb is it? _____
5. Why did you place the bomb? _____
6. What do you hope to accomplish? _____
7. What is your name? _____
8. Where are you calling from? _____

Information Regarding the Call and Caller:

Voice Characteristics:

Familiar	_____	Male	_____	Female	_____
Child	_____	Nasal	_____	Loud	_____
Soft	_____	High	_____	Raspy	_____
Deep	_____	Pleasant	_____		

Other _____

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Safety Manual

Bomb Threat Checklist

Speech Characteristics:

Fast	_____	Slow	_____	Intoxicated	_____
Stutter	_____	Slurred	_____		
Other	_____				

Accent Characteristics:

Local	_____	Region	_____	Foreign	_____
Other	_____				

Manner of Caller:

Calm	_____	Angry	_____	Deliberate	_____
Emotional	_____	Laughing	_____	Incoherent	_____
Righteous	_____	Rational	_____	Coherent	_____
Other	_____				

Origin of Call:

Internal	_____	External	_____	Cell Phone	_____
Local	_____	Long Distance	_____		

Did the caller appear to be familiar with the facility? Yes _____ No _____

Number/extension at which the call was received: _____

Other _____

Background Noises:

Office Machines	_____	Street Traffic	_____	Voices	_____
Factory Machines	_____	Airplanes	_____	Trains	_____
Animals	_____	Trucks	_____	Music	_____
Quiet	_____	Party	_____	Static	_____
Other	_____				

People Contacted:	**Yes**	**No**	**Time**
Facility Manager	_____	_____	_____
Police Department	_____	_____	_____
Fire Department	_____	_____	_____
Other _____	_____	_____	_____
Other _____	_____	_____	_____
Other _____	_____	_____	_____

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Safety Manual

Bomb Threat Checklist

Bomb Threat Search Procedure

a. Authorization and Report

1. Your supervisor will instruct you when to search and the specific area to be covered. Your supervisor should also give you a time limit when to stop searching.
2. Report back to your supervisor when the search is complete or at a prearranged time.

b. Search Team

1. A minimum of two persons and a maximum of three should be used. (Should normally include supervisor and one other person familiar with the area.)

DO NOT TOUCH ANY SUSPICIOUS ITEMS OR UNIDENTIFIABLE PACKAGES

c. Search Technique

1. Take your time and use caution.
2. Be systematic, use upward coverage method: first, floors; then machines; then windows, shelves; then ceiling; then desks.
3. Always be as quiet as possible, listening for timing devices.
4. Search high-potential areas first.

   i. Toilets (check all closed and locked stalls)

   ii. Lunchrooms

   iii. Stairwells

   iv. Elevators (top of car) and elevator shafts (pits)

   v. Utility rooms, closets, janitors' supply areas

   vi. Areas open or near to exterior doors, lobbies, etc

   vii. Indoor trash receptacles

   viii. Utilities

d. Unidentifiable Package

1. A bomb device may be in any shape; lunch boxes, briefcases, cigar boxes, lead pipes, shoe boxes, and paper bags are the most common.

   i. The rule of thumb to follow during a search is to attempt to answer the question; "Does this item look like it belongs here?"

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ii. An expensive looking briefcase, for example, in an executive's office might not be cause for alarm. Found in a locked toilet stall, however, it could indicate the presence of a device.

iii. By the same token, a cigar box placed under a stairwell would likewise be indicative of a device.

2. If a suspected device is located, one member of the search team is required to report by phone or in person to the Facility Manager, or designated alternate, who will then investigate to determine how likely the suspected device is to be a bomb.

   i. Keep your cool when suspicious objects are found.

   ii. No attempt should be made by the employee to remove or inspect the item!

   iii. No radio or walkie-talkie transmissions should be made as the keying of a microphone could detonate a device.

3. The Facility Manager, or designated alternate, will direct that appropriate personnel from the area in question and be questioned regarding concerning the suspected device

The Facility Manager, or designated alternate, will make the necessary arrangements for the police bomb disposal squad to investigate.

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Daily Cover Requirements

Daily Cover

An owner or operator of a landfill shall, at the close of each day of operation completely cover the waste with at least 6 in. of soil or other suitable material approved by the executive secretary that will control vectors, fires, odor, blowing litter, and scavenging without presenting a threat to human health or the environment.

Solid waste shall be covered at the end of each working day with a minimum of six inches material. In the event that ECDC remains in operation 24 hours per day, the waste shall be covered intermittently during the day. Other material may be used for daily cover such that those materials control vectors, fires, odors, and scavenging animals. (ECDC Environmental, L.C. - Permit and Permit Renewal Application - Permit Section pg. 5)

State and federal regulations on daily cover require placement of a minimum of six inches of cover material on all exposed refuse at the end of each operating day. Daily cover may be of any soil type and should only be applied after the refuse has been placed, compacted, and trimmed to the proper grade. Before soil cover is placed track-walking must be completed on all working faces. Daily cover is most easily and efficiently placed on refuse that is well compacted and trimmed to a smooth finish. Daily cover is a very important part of a landfill. It helps to stop blowing litter and curb the propagation of vectors. A continuous layer of daily cover will also greatly decrease the chances of a fire occurring in the landfill. (Handbook of Landfill Operations - Sec. 5.7.1.)

The application of suitable soil cover to solid waste can:

- reduce litter, odors, vermin and other "nuisances"
- reduce infiltration of water and potential leachate generation
- provide better access to work face
- enhance final use potential of site
- increase safety of site patrons and personnel
- control landfill gas migration
- support vegetation growth
- minimize fire danger

Alternative Daily Cover (ADC)

Alternative Daily Cover systems may provide an improved overnight seal, may be less expensive than placing cover soil, and may greatly increase the landfill's life. Most states

require that any proposed alternative daily cover system be approved before they are used. Sometimes a pilot program may be required in order to demonstrate that the proposed alternative daily cover material will work at a specific site. Because of the cost to place daily cover and the value of airspace which it consumes, many site operators use ADC. The savings in soil handling costs and airspace can be significant. It is a mistake to assume that using ADC saves only the equivalent of 6 in. of daily cover over the face. In fact, the savings in soil depth is much greater. Several factors affect the amount of cover soil required. These include:

- Type of Waste
- Density of Waste
- Type of equipment used to finish the cell
- Method used to place cover soil
- Type of soil
- Moisture content of soil

(The Handbook of Landfill Operations - Ch.7 - Pg. 7)

Reviewed: January 1, 2007

Daily Cover Training
Sign In Sheet

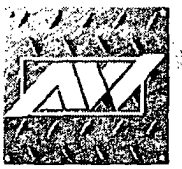
DATE:_____

TIME_____

Training given by_____

I the undersigned understand the regulations concerning the placement of daily cover. I also understand that these rule Are State and Federal regulations. I myself can be reprimanded with discipline up to and including termination if the rules governed by the State and Federal regulations are not followed. ECDC Environmental has trained me in all method and manner of the placement of daily cover.

NAME	SOCIAL SECURITY NUMER
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____



LITTER AND BLOWN PAPER CONTROL

Standard

1. Windblown waste will be **contained** to as small an area as possible near the working face.
2. All blown paper leaving the site will be **collected** by the close of business that day.
3. All on-site blown paper will be continuously **collected.**

Requirements

The use of movable paper fences and perimeter fences will serve to minimize the spread of blown paper. There will be three layers of fence protection at a site to meet this *standard:*

a. **Portable panels** at the working face.

b. Chicken wire or some other **temporary T-post** type fence constructed 300'-500' from the working face.

c. The site boundary **perimeter fence** .

Push Points

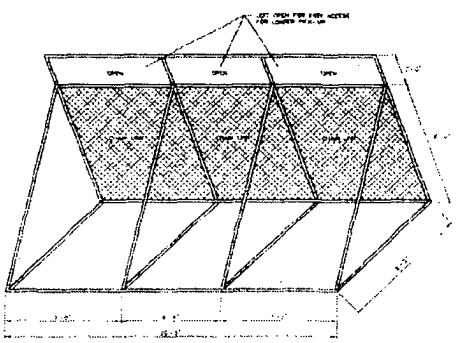
- **Use three layers of protection**
- **Portable panel placement**
- **No off site paper at days end**

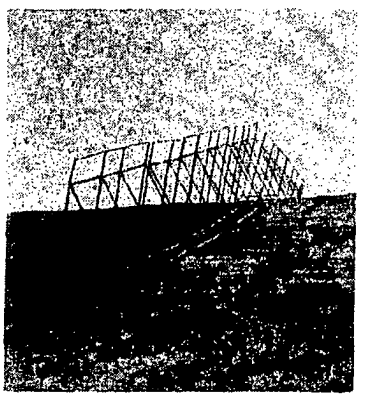
The key to keeping a site free of blown paper is to contain the paper to as small an area as possible by the use of the 3 layers of containment. *Primary protection is provided by the use of portable* fence panels. The portable fences at the working face will be a minimum of 10' tall and in 15-20' wide sections. The number of panels needed depends on the size of the working face but in all cases a minimum of 10 panels will be available. Fences will be placed within 50' of the working face on the down wind side and will be capable of being moved quickly if the wind shifts. Containment close to the working face within the portable panel containment area will reduce the time necessary for blown paper collection. Without portable panel containment, many acres of the site can be left unprotected, which will result in additional manpower hours needed to pick blown paper from the larger area.

Secondary line of protection fencing referred to as T-post fences will be used in conjunction with portable panels. They are not a replacement for

... *continues on next page*

the panels. By their nature portable panels have to be moved periodically, they may also have gaps between the panels due to irregular terrain, soil rutting etc. Some paper in small amounts may blow between or over the panels. Secondary fences are placed 300-500 ft down wind of the portable panels and are intended to catch any blow by paper from those panels. The emphasis is containment of the paper to as small an area as possible. T-post fencing will be liberally placed around the site and added to as the face panels move. Moving T-post fencing can become impractical because of its flimsy material. Replace ment as well as adding to the lines of T- post fencing is more efficient. Paper stopped by the row of fencing is easier and quicker to collect than combing acres of land for blown paper not contained by fence rows.





PAPER PANEL LOADER BUCKET PICK-UP DESIGN

The third layer of protection is the site perimeter or site boundary fence. This is considered the final layer of the paper containment system, but can not be the only containment on site. The perimeter fences at a site are typically what is viewed by the public. The paper it traps will be only that which escapes the previous two layers of protection. Site perimeter fencing can vary from chain link for security purposes to golf

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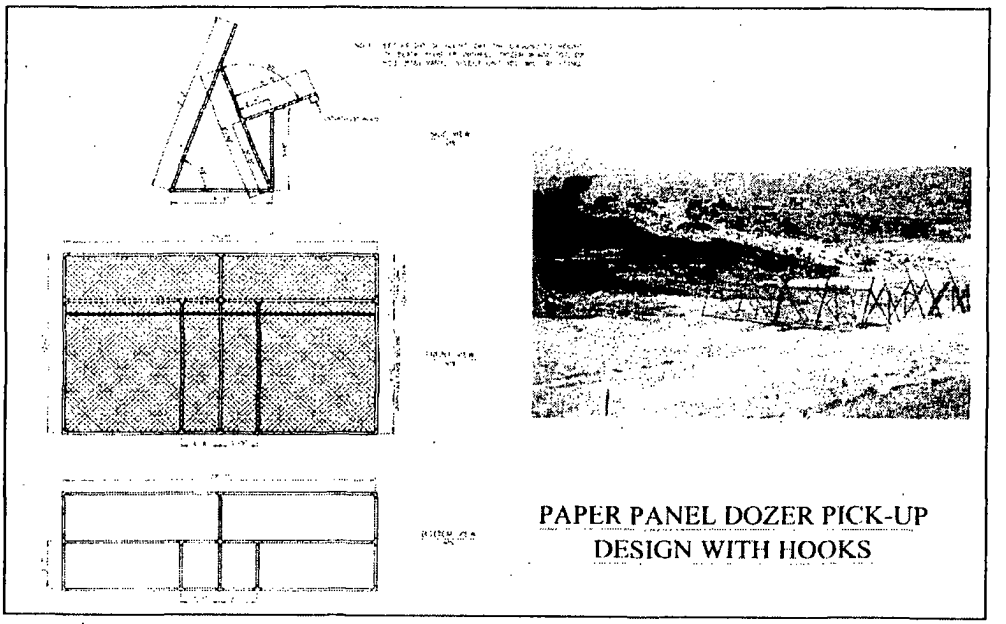


PAPER PANEL DOZER PICK-UP DESIGN WITH HOOKS

course type netting depending on the site terrain, normal wind conditions for the site and proximity to a neighborhood.

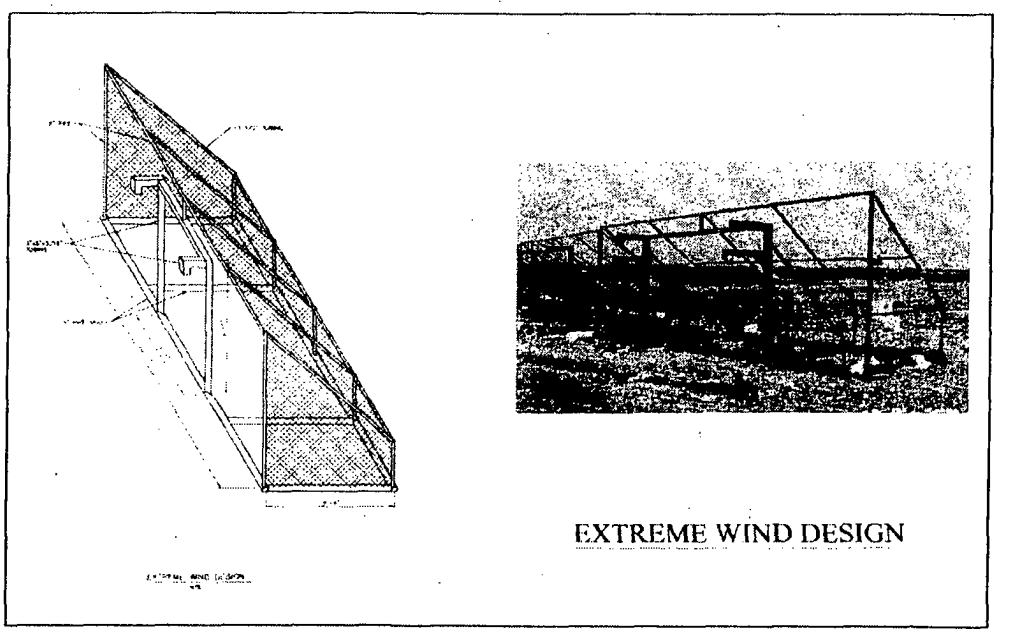
It is imperative that the multi-layer litter control system is in place to ensure compliance with the second part of the standard **(all blown paper leaving the site will be collected by the close of business that day)**. No neighbor or passer by to the facility will be impacted by blown litter that has left the site. Paper blown on site and trapped by the three layers of protection will be continuously collected, bagged and transported back to the working face. Site personnel will patrol roads surrounding the site and leading to the site for paper that may have blown off trucks on route to the landfill.

Before closing for the day, the weather forecast will be checked and panels placed where the forecast predicts the wind will be blowing when you open the next day. Waiting until the next day to place the panels can result in early loads being blown before the panels are in the proper location. Any bagged trash collected by the paper picking crews will be collected the same day. Illegal dumping on site perimeter roads will be cleaned immediately and not allowed to accumulate or impact neighbo rs. Daily cover will be placed immediately in excessively high

... continues on next page

winds to help reduce the amount of blowing paper. The cover can significantly reduce the size of the face reducing the amount of blown paper exposure. In extreme cases, the site will have to close the face completely until the wind subsides.

Picking up paper immediately after a wind storm and on a daily basis is necessary for compliance. If additional labor is needed to clean after a high wind event, it will be done promptly.



EXTREME WIND DESIGN

FIRE CONTROL

Standard

To train personnel in fire prevention and methods to safely react to a fire should it occur.

Requirement

Prevention is the key to fire safety at any facility. No smoking signs must be posted at the working face at all times. All fire extinguisher s must be kept fully charged and will be inspected per the Allied Waste Safety Policy.

Push Points

- **Prevention first**
- **Hot Load fires**
- **Fires in the waste**
- **Machine fires**
- **Safety priorities (man then machine)**

HOT LOAD PROCEDURES - If a hot load is discovered in a truck away from the landfill, the driver would be instructed by the dispatcher to eject the load in a safe area before reaching the landfill. However, a load may arrive hot or be discovered hot on the way to the landfill.

If the truck is located close enough to the landfill at the time of discovery, it will be instructed to compact the load in the truck as tightly as possible and proceed to the landfill to avoid putting the general public at risk. It is crucial that a landfill plan ahead and have an area prepared at all times for hot loads. **The hot load area** will be away from the active working face and there will be a sufficient supply of cover dirt stockpiled to smother a truck load fire. A truck entering the landfill in the case of a hot load would not be required to stop at the scale.

The hot load area is intended to be an isolated spot so the load can be allowed to cool or be extinguished with water.

The stockpiled soil at the hot load area can be used to crowd and contain the fire in periods of high wind. Once the hot load is unloaded on the ground, flare up is likely due to the addition of oxygen.

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When the fire is contained and under control, the soil will be placed over the hot load to insure the fire is completely smothered. To protect the people and machine in the covering of the waste with stockpiled dirt, there will be someone standing by with a fire extinguisher. Allow the covered pile to sit for at least 24 hours. The load will be broken open and checked for hot spots, use water or foam if necessary to make sure the fire is completely out. Do not incorporate the load back into the active face until you are certain the load is cold and will not re-ignite.

FIRES IN THE WORKING FACE REFUSE - Types of landfill fires can vary. They normally consist of

a. **chemical** - those caused by an oxidizer or reactive agent;

b. **ignited** - those caused by hot sparks, matches, cigarettes, and;

c. **spontaneous combustion** - caused by compacted wet grass, trash, etc.

All sites will maintain a minimum 3-day stockpile of daily soil cover in close proximity to the working face. The primary purpose of the stockpile is to make sure daily cover is readily available during periods of extreme wet weather conditions when hauling soil from the borrow area is not possible. This stockpile can also be used for fighting fires at the working face. If not needed for fire control the stockpile would be consumed by normal daily cover operations but will be replenished as the working face moves.

In any fire, the protection of the customer, employee and equipment is a priority. When a fire is discovered, immediately notify the supervisor or management on site. If it is deemed necessary or required by the site's permit, the local fire department will be notified. For those fires that are too large to extinguish by landfill personnel, the primary responsibility would be to contain and control the fire until the fire department can extinguish it.

Waste hauling trucks should be diverted to another section of the landfill. Personn el should be used to watch for additional outbreaks and to spot fires around the landfill equipment being used to contain the fire.

Small face fires will be cut off the working face with heavy equipment and placed near the turnaround area where it can be covered and smothered with stockpiled daily cover Soil. When cutting a fire off at the working face, the machine should never drive directly into open flames. Use the blade to roll up un-burned material in front of the machine as a protective barrier between the machine and the flames.

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Crowd the burning waste off the working face and away from additional waste that may ignite and continue to feed the flames. While the material is being crowded or pushed from the face, site personnel or fire departmen t personnel should be present to continuously hose down the waste and machine. If the fire is too large to cut from the face it should be watered or foamed in place and covered with soil until it is cold enough to cut off from the face.

Even after a fire has been hosed down, when it is disturbed by the dozing, it can flair up again. Continual inspection for flair ups and hot spots is necessary. Site personnel should take direction from the fire department and site management during this operation to insure protect ion of persons first and equipment second. The waste that is cut from the face should be thoroughly soaked and covered with clean soils and left for at least 24 hours before final disposition. Never place the burned waste back into the lift until all hot spots are eliminated and site management has cleared the material for re burial.

MACHIN E FIRES - When a machine fire starts, reaction is very important. As soon as a fire is detected, do the following five things:

WHAT TO DO:

1. Quickly move the machine off the working face
2. Turn the machine OFF!
3. Quickly activate the fire suppression system by pulling the safety ring pin and pushing down the actuator plunger
4. Get away from the machine. Take a hand portable fire extinguisher with you, if possible.
5. Stand by with the portable extinguisher

WHY DO IT:

1. Moving the machine off the face will prevent the fire from spreading to the waste. If the fire grows too rapidly to move the machine, activate the fire suppression system and abandon the machine.
2. If the machine is left running, it may add fuel or flammable oils to the fire or re-start the fire.
3. React quickly in activating the suppression system to reduce the threat of spreading fire.
4. By leaving the immediate area, you are protected from flames, explosion s or other dangers created by the fire.

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5. Heat from the fire will cause re-ignition after the Fire suppression System has discharged. Therefore, it is important that someone standby at a safe distance with a portable extinguisher.

WHAT TO EXPECT WHEN YOU DISCHARGE A FIRE EXTINGUISHER
When the system discharges, there is considerable noise accompanied by clouds of dry chemical. The extinguishing agent is non-toxic but exposure should be limited.

AFTER THE FIRE IS OUT WHAT DO YOU DO
Machinery should not be re-started until it has been serviced, cleaned and repaired.

IMMEDIATELY recharge the fire suppression system!

ECDC ENVIRONMENTAL

Radiation Check & Alarm Procedure

Written by: Darin Olson

PURPOSE: To assure radioactive material, which may inadvertently arrive at the landfill, is identified and managed appropriately.

- Radiation monitors will be calibrated at least yearly by the manufacture.
- Radiation monitors will be inspected by site personnel monthly to assure they are working properly.
- All waste material arriving at the landfill facility will be screened for radiation. If radiation is detected the load is immediately be rejected.
- During regular business hours, when waste arrives at the facility, site personnel will observe the radiation monitors. For rail delivered loads which may arrive on holidays or weekends, the radiation monitor printout will be checked. If an alarm has occurred a manager will be immediately notified.
- Management will contact the sales person and or generator and inform them of the situation and assist in proper management of the waste. Transportation and disposal regulations will be addressed.
- Management may chose to contact appropriate regulatory authorities to assist in proper management of radioactive waste.

Any deviation or alteration from this policy could result in discipline up to and including discharge.

July 30, 2002

ECDC RADIATION MONITOR CHECK

(Please Sign Detector Location)

ROTARY: _____

INTERMODAL: _____

MAIN OFFICE: _____

Date: _____

Time: _____

Comments / Follow up:

_____

_____

_____

_____

_____

Attach Printout:

_____

_____

_____

_____

FUGITIVE DUST EMISSIONS CONTROL PLAN
ECDC ENVIRONMENTAL, L.C.

1. Introduction

This Fugitive Dust Emissions Control Plan has been developed by ECDC Environmental, L.C. (ECDC) to address methods of controlling on-site fugitive dust resulting from normal operations at the East Carbon landfill. It is the intent of ECDC to implement control strategies for the minimization of fugitive dust as required by Utah Code Rule R307-205 and prior negotiations between ECDC and the Utah Division of Air Quality.

2. Source Information

ECDC operates a solid waste landfill one mile west of East Carbon City, in Carbon County, Utah (UTM: 4,377,500 meters North, 548,000 meters East). This facility accepts non-hazardous solid waste as permitted by the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste. In addition to normal waste processing operations, this facility will proceed under expansion construction approximately four months per year during the expected 250-year life. The process at the facility includes acceptance and final placement of non-hazardous solid waste. During normal facility operation, many sources of fugitive dust are possible. Each of these sources are described in Section 3 of this plan. The types of materials that could emit fugitive dust at ECDC are non-hazardous waste material, imported soil material, and on-site soil materials. ECDC accepts approximately 1,000,000 tons of non-hazardous and soil waste materials per year. The waste that is accepted at ECDC is hauled to either of the two operating landfill cells for final placement. The on-site soils which are produced are used for road and landfill construction. The individuals who are responsible for the implementation and maintenance of fugitive dust control measures at the site are as follows:

Mr. Kirk Treece	Mr. Jeff Green
Site Manager	Operations Supervisor
435-888-4418	435-888-4418

3. Description of Fugitive Dust Emission Activities

ECDC will implement this Fugitive Dust Control Plan to monitor and control fugitive dust emissions from the following sources:

3.1 Railcar Rollover Facility

The Railcar Rollover Facility operates to dump the contents of railcars. The waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. The operation includes the use of a railcar rollover mechanism, railcar washout water sprayers, front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The facility is covered and enclosed on three sides with

one side open for access. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the imported waste material and loading the waste material into the waste hauling vehicles. The building that houses this activity is 110' X 126'. This fugitive dust source is identified in Attachment B.

3.2 Railcar Bottom Dump Facility

The Railcar Bottom Dump Facility operates to dump the contents of railcars. The waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. This facility is rarely used. The operation includes the use of a railcar bottom dump mechanism, front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The wastes that could be encountered at this source and could emit fugitive dust include all types of select (soils) waste. The emission of dust is possible during the dumping of the imported waste material and loading the waste material into the waste hauling vehicles. The activity site is 200 feet by 200 feet and has a maximum emission area of 0.0014 square mile (0.92 acre). This fugitive dust source is identified in Attachment A.

3.3 Paved Haul Roads

The Paved Haul Roads source consist of roadways for waste hauling vehicles, transportation vehicles, personal vehicles, and support vehicles. The operation includes the use of waste hauling vehicles, transportation vehicles, support vehicles, and a road cleaning vehicle. The average speed on the paved haul roads is 30 miles per hour. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. Such materials exist on the paved haul roads due to spillage from the waste hauling vehicles. Also, waste exist on the paved haul roads because of waste material sticking to the waste hauling vehicles tires and then falling off on the roads. The emission of fugitive dust is possible during the travel of all vehicles on the paved roads and in high wind events. The total release area of paved haul roads during this activity is 0.0361 square mile (23.08 acres). This fugitive dust source is identified in Attachment A.

3.4 Landfill Cell Haul Roads

The Landfill Cell Haul Roads source consists of roadways in the two landfill cells. The operation includes the use of waste hauling vehicles, a water truck, transportation vehicles, waste placement equipment, construction material hauling vehicles, and support vehicles. The average speed on the landfill cell haul roads is 10 miles per hour. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. Such materials exist on the cell haul roads due to spillage from the

waste hauling vehicles and wind blown waste materials from within the landfill cells. The emission of fugitive dust is possible during the travel of all vehicles on the unpaved landfill cell haul roads and in high wind events. The total length of landfill cell haul roads in use during this activity varies from day to day but is approximately three miles with a release area of 0.0121 square mile (7.76 acres). This fugitive dust source is identified in Attachment A.

3.5 Gravel/Dirt Haul Roads

The Gravel/Dirt Haul Roads source consists of roadways on the property for construction material hauling vehicles, waste hauling vehicles, transportation vehicles, and support vehicles. The average speed on the gravel/dirt haul roads is 30 miles per hour. The operation includes the use of construction material hauling vehicles, waste hauling vehicles, a water truck, transportation vehicles, and support vehicles. The source of fugitive dust for this activity include the materials that the unpaved haul roads are constructed of, the spillage of construction and waste materials from the material hauling vehicles, and waste tracked from loading areas by the waste hauling vehicles. The emission of fugitive dust is possible during the travel of all types of vehicles on the gravel/dirt haul roads and in high wind events. The total release area length of gravel/dirt haul roads is approximately 0.0374 square mile (23.94 acres). This fugitive dust source is identified in Attachment A.

3.6 Haul Vehicle and Container Unloading

The Haul Vehicle and Container Unloading activity operates to dump the contents of waste hauling end dump vehicles and various waste containers into the landfill cells. The waste material is end-dumped from the waste hauling vehicles and the waste containers. The operation includes the use of waste and container hauling vehicles, and dust suppression water sprayers. This activity takes place at several different areas in the two landfill cells during normal operation at the facility. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the waste material from the waste hauling vehicles and the various waste containers. The size of each dumping area varies day to day but is approximately .0016 square mile (1 acre). This fugitive dust source is identified in Attachment C.

3.7 Rollover Waste Container Dumping

The Rollover Waste Container Dumping activity operates to dump the contents of large waste containers. The waste material is dumped into the landfill cell by using a large rollover mechanism. The material is then moved by dozing, placed in lifts, and compacted. The operation includes the use of waste container hauling vehicles, rollover mechanism, track-type tractors, sheepsfoot landfill compactors, and dust suppression

water sprayers. This activity takes place within the boundaries of the landfill cells. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the dumping of the containers, moving, placing, and compacting the waste material. The size of each dumping area varies day to day but is approximately 0.0031 square mile (2 acres). This fugitive dust source is identified in Attachment D.

3.8 Waste Compaction

The Waste Compaction activity operates to compact the waste material within the landfill cells. The waste material is compacted by using a sheepsfoot landfill compactor. The operation includes the use of sheepsfoot landfill compactors and dust suppression water sprayers. This activity takes place within the boundaries of the landfill cell. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The emission of dust is possible during the compacting of the various waste materials. The size of the compaction area varies day to day but is approximately 0.0031 square mile (2 acres). This fugitive dust source is identified in Attachment E.

3.9 Soil Excavation

The Soil Excavation activity operates primarily for excavation and moisture treatment of on-site construction materials. The construction material is excavated and moisture conditioned to allow use as embankment building materials and bedding materials. The operation includes the use of construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, and support vehicles. This activity takes place on the ECDC property. The materials that could be encountered at this source and could emit fugitive dust include all types of silts, clays, and sands. The emission of dust is possible during the excavation and loading activities. The size of each excavation area is approximately 0.0313 square mile (20 acres). This fugitive dust source is identified in Attachment A.

3.10 Solidification Facility

The Solidification Facility operates to solidify liquid waste. The liquid waste material is mixed with coal ash. The mixed waste material is then loaded into waste hauling vehicles with front-end loaders for transport to the designated landfill cell. The operation includes the use of a front-end loaders, waste hauling vehicles, and dust suppression water sprayers. The wastes that could be encountered at this source and could emit fugitive dust include coal ash material from local power plants. The emission of dust is possible during the dumping of the imported coal ash material, mixing of liquid waste and coal ash material, and loading the mixed waste material into the waste hauling vehicles. The activity is 70' X 100' with an area of 0.0003 square mile (0.16 acre). This

fugitive dust source is identified in Attachment F.

3.11 Soil Screening and Stockpiling

The Soil Screening and Stockpiling activity operates to provide a soil cover for imported waste materials and cover for the geomembrane liner. The operation includes the use of cover material hauling vehicles, track-type tractors, track-type excavators, dust suppression water sprayers, a screen mechanism, and support vehicles. These activities take place within the landfill cell boundaries. The materials that could be encountered at this source and could emit fugitive dust include all types of silts, clays, and sands. The emission of dust is possible during screening, stockpiling, and loading activities. The size of operation area varies but is approximately 0.0078 square mile (5 acre). This fugitive dust source is identified in Attachment A.

3.12 Landfill Cell #7

Landfill Cell #7 operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0750 square mile (48 acres). This fugitive dust source is identified in Attachment A.

3.13 Landfill Cell #10

Landfill Cell #10 operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0211 square mile (13.5 acres). This fugitive dust source is identified in Attachment A.

3.14 Landfill Super Cell 1-A

Landfill Super Cell 1-A operates as an area for final placement of imported waste materials. The waste material is placed, compacted, and covered within the boundaries of the landfill cell. The operation includes the use of sheepsfoot landfill compactors, waste

hauling vehicles, a large rollover mechanism, construction material hauling vehicles, track-type tractors, track-type excavators, a motor grader, a water truck, transportation vehicles, dust suppression water sprayers, and support vehicles. The wastes that could be encountered at this source and could emit fugitive dust include all types of sands and soils, demolition and construction debris, ash material, and exempt household wastes. The size of the landfill area is approximately 0.0188 square mile (12 acres). This fugitive dust source is identified in Attachment A.

4. Description of Fugitive Dust Emission Controls

Opacity readings will be taken randomly to ensure compliance with this plan. The results of the readings will be recorded on a log and will be available for review by representatives of the Utah Division of Air Quality. Refer to Attachment G for an example of the log sheet.

Three different levels of control are proposed for each source. Level 1 will be implemented at an estimated opacity reading of 0 - 5%. Level 2 will be implemented at an estimated opacity reading of 5 - 15%. Level 3 will be implemented at an estimated opacity reading of 15%. ECDC will apply the levels of control for each of the following identified on-site fugitive dust sources:

4.1 Railcar Rollover Facility

Level 1 — No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 — Waste material will be partially wetted with the dust suppression water sprayers during dumping operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders.

Level 3 — Material will be wetted with the dust suppression water sprayers prior to and during dumping operations. Additional water spray will be applied to the waste material after dumping as determined by the facility operator. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.2 Railcar Bottom Dump Facility

Level 1 No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 Waste material will be partially wetted with the dust suppression water sprayers during dumping operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders.

Level 3 Material will be wetted with the dust suppression water sprayers prior to and during dumping operations. Additional water spray will be applied to the waste material after dumping as determined by the facility operator. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.3 Paved Haul Roads

Level 1 No action will be required due to the conditions of the haul roads or operating weather conditions. All paved haul roads are washed and swept routinely as permitted by weather conditions.

Level 2 All haul roads will be sprayed with water or washed and swept as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions. The operation of the water truck and sweeper vehicle will be directed by the Operations Supervisor.

Level 3 The application rate will be increased as determined by the Site manager or his representative to a level that will minimize fugitive dust emissions without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.4 Landfill Cell Haul Roads

Level 1 No action will be required due to the condition of the haul roads or

operating weather conditions. All roads within the landfill cells are routinely sprayed with water for fugitive dust control during normal operations as permitted by weather conditions. The operation of the water truck will be directed by the Operations Supervisor.

Level 2 — All haul roads will be sprayed with water as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions by the Operations Supervisor.

Level 3 — The application rate of water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emission without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.5 Construction Haul Roads

Level 1 — No action will be required due to the condition of the haul roads or operating weather conditions. All haul roads are routinely sprayed with water for fugitive dust control during normal operations as permitted by weather conditions. The operation of the water truck will be directed by the Operations Supervisor.

Level 2 — All haul roads will be sprayed with water as directed by the Operations Supervisor, Site Manager or his representative. The water application rate will be determined on a daily basis to minimize fugitive dust emissions by the Operations Supervisor.

Level 3 — The application rate of water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emission without compromising road safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the traffic pattern may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.6 Haul Vehicle and Container Unloading

Level 1 No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 Imported waste materials will be treated with dust suppression water sprayers during unloading operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the unloading activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.7 Rollover Waste Container Dumping

Level 1 No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 Imported waste materials will be treated with dust suppression water sprayers during dumping operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the dumping activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.8 Waste Compaction

Level 1 — No action will be required due to the condition of the imported waste material or operating weather conditions.

Level 2 — Imported waste materials will be treated with dust suppression water sprayers during compaction operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor. Also, waste placement and compaction methods may be altered by the operators to minimize fugitive dust emissions.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. Waste placement and compaction methods may be altered by the operators as directed by the Operations Supervisor, Site Manager or his representative to minimize fugitive dust emissions without compromising operator safety. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the waste compaction activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.9 Soil Excavation

Level 1 — No action will be required due to the condition of the excavated material or operating weather conditions.

Level 2 — Excavated materials will be treated with dust suppression water sprayers during excavating and loading operations to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality,

the excavating and loading activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.10 Solidification Facility

Level 1 — No action will be required due to the moisture condition of the imported waste material or operating weather conditions.

Level 2 — Ash material will be partially wetted with the dust suppression water sprayers during dumping and mixing operations. Wet and dry waste materials will be mixed while waste hauling vehicles are loaded with front-end loaders. The water application rate will be determined by the Operations Supervisor.

Level 3 — Ash material will be wetted with the dust suppression water sprayers prior to and during dumping and mixing operations. The application rate of the water will be determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. Additional water spray will be applied to the waste material after dumping and mixing as determined by the facility operator, Operations Supervisor, Site Manager or his representative. Wet and dry materials will be mixed prior to and during loading of the waste material into the waste hauling vehicles. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the solidification activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. The area and facility is cleaned after it has be used. Therefore, no action will be required at those times.

4.11 Soil Screening and Stockpiling

Level 1 — No action will be required due to the condition of the screened material or operating weather conditions.

Level 2 — Screened materials will be treated with dust suppression water sprayers during screening and stockpiling operations to minimize dust emissions.

The water application rate will be determined by the Operations Supervisor.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. If the opacity readings exceed 20% as determined by the Operations Supervisor, Site Manager, his representative, or a representative of the Utah Department of Air Quality, the screening and stockpiling activity may be altered or halted until operating conditions improve.

This source of fugitive dust is not in operation during off hours. Therefore, no action will be required at those times.

4.12 Landfill Cell #7

Level 1 — No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 — Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 — The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

4.13 Landfill Cell #10

Level 1 — No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 — Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

4.14 Landfill Super Cell 1-A

Level 1 No action will be required due to the condition of the landfill materials, cover materials, or operating weather conditions.

Level 2 Landfill materials will be treated with dust suppression water sprayers to minimize dust emissions. The water application rate will be determined by the Operations Supervisor.

Level 3 The application rate of the water will be increased as determined by the Operations Supervisor, Site Manager or his representative to a level that will minimize fugitive dust emissions. The application of a hydromulch may be implemented under the direction of the Operations Supervisor, Site Manager or his representative. The hydromulch will be a cellulose fiber product manufactured using fiber stock.

This source of fugitive dust will be monitored during off hours and levels of control will be implemented as required.

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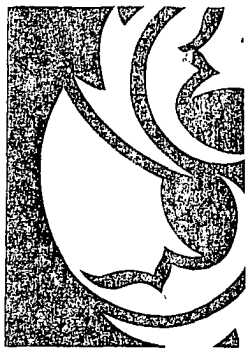

SCAVENGING

It is Company policy that any material or waste stream arriving at any of the Company's MRF's, transfer stations or landfills is the property of the Company. Therefore, the removal of any material from these facilities without the written approval from the Director of Compliance (with three weeks notice) is considered theft. Facility management should instruct their personnel and make known to their customers that scavenging absolutely is not permitted without facility management permission. Facility managers must check with their District Manager, in writing, and get an approval in writing from the Director of Compliance and Landfill Development prior to any scavenging at any of the Company's facilities.

9/5/00

Kirk Treece
General Manager

1111 West Highway 123 P.O. Box 69 East Carbon, UT 84520 Toll Free (800) 444-4451 Tel. (435) 888-4451 Fax (435) 888-5557

ALLIED WASTE

ECDC SAFETY AND COMPLIANCE CALENDAR 2007

Month	Monthly Safety Meeting Topics	Monthly Activities/ Specialized Training	Compliance Tasks/ Program Updates
Repeating Items covered every Month	YTD Division Accident/Injury Trends New Safety Alerts MonthlyAccident and Injury Review	GM Monthly Facility Inspection Cab Inspections/ Fleet Inspection Safety Committee Meeting Employee Observations	Paint Logs Waste Generation Logs Respond to Concorde emails re DQF files SPCC & SWPP Inspections
One time Annual events- Division Scheduled		Corporate Safety Training Safety Awards Banquet	
January	Employee Observations- Purpose and Process Safe Container handling Review Safe Actions For Excellence Corporate Standard: Eye and face protetion- safety glasses	Powered Industrial Heavy EquipmentTraining(Fork lift)(Loader Operators) Corporate Standard- Container Standard Load checking requirements Review Dedicated to Safety Program(if applicable) Identifying Hazardous Materials	Post Listing of Certified Powered Industrial Heavy Equipment Operators Annual Fire Extinguisher Inspections LOTO Periodic observation Update/ Finalize OSHA 300, 301, 300a Summary Fire Detection Standard- Installation or inspection
February	Safety Topic: Back Injury Prevention Corporate Standard- High Visibility Clothing Safety topic: Operating Equipment on Slopes Safety Topic:Towing Safety	CPR/First Aid Training & Post Listing Hand & Power Tool Usage(Mechanics) Basic Tool Safety (Mechanics) Housekeeping training	Post OSHA Log Summary Until April 30 Update Tier II Reports Annual Heavy Equip Fire Suppression inspection/certification Corporate Standard- Housekeeping
March	Operations of Excavators and Dozers Operations of Compactors and Loaders Corporate Standard- Cell phones, radios and other distractions Emergency Preparedness employee training	Machine Guarding (Mechanics) Review Security Camera Corporate Standard	Continue OSHA Log Posting Submit Tier II Reports (NLT March 1) Facility Permits Quarterly Review of Contracts/ Certs of Ins. Update emergency preparedness plan Annual Fire Drill
April	Corporate Standard- Facility and Vehicle Security Safety Topic:Emergency & Veh Spill Response Proceedures	Corporate Supervisor Safety Training Spill Prev Control & Counter Measures Storm Water Pollution Prevent Plan Grinder adjustments and Ring Testing	LOTO Periodic observation Annual SWPP Committee Meeting Complete Annual Storm Water Report Storm/Process Water Analytical Data Facility Permits(include Sewer Use permit) Remove OSHA 300 Log on April 30
May	Safety Topic: Heat Stroke/Exhaustion Safety Topic VCR/VIR Reports PreTrip/Post Trip-Practical demonstration	Hearing Conservation (Container Shop) VCR Training_Mechanics Excavating and trenching requirements training	Dump the Hump review
June	Safety Topic: Heat Stroke/Exhaustion Safety Topic: Personal Protective Equipment	Electrical Safety (Mechanics) Prohibited Waste/ Waste Exclusion Training Pre Operations Inspections Semi Annual Policy Review	Quarterly Review of Contracts/ Certs of Ins. Tank Tightness Test(Annual) Dump the Hump review

ALLIED WASTE

ECDC SAFETY AND COMPLIANCE CALENDAR 2007

Month	Monthly Safety Meeting Topics	Monthly Activities/ Specialized Training	Compliance Tasks/ Program Updates
	Monthly Safety Meeting Topics	**Monthly Activities/ Specialized Training**	**Compliance Tasks/Program Update**
July	Safety Topic: Heat Stroke/Exhaustion Dump the Hump status report Review Safe Actions For Excellence	Brake Certification (Mechanics) Out of Service Training(Mechanics)- Completed Confined Space Training	Dump the Hump review Annual Sprinkler System Inspection Update Confined Space Proc/Eval Confine Spaces LOTO Periodic observation
August	LOTO/Confined Space Training Dump the Hump status report Disposal Facility Safety Training	Single/Multi Piece Rims Training- including Torque wrench use and calibration LOTO (Maintenance)	Dump the Hump review Update Lock out Tag Out Program
September	Dump the Hump status report Safety Topic Proper Backing Procedures Substance Abuse (Need to Know) Training	Supervisor Substance Abuse Training Asbstos Hauling training if indicated Housekeeping Landfill Gas Safety	Dump the Hump review Section II Physicals Update MSDS & Chemical Inventory Quarterly Review of Contracts/ Certs of Ins.
October	Safety Topic: Hazard Communication Seatbelt Policy review Accident and Injury Reporting proceedures	Respirator Fit Test & Training Welding Safety Accident Investigation Procedures(Supervisor)	LOTO Periodic observation Repiratory Protection Program Hazcomm Program Update Calibrate Torque wrench(annual)
November	Slips, Trips & Falls Review Company Policy re Alcohol in Trucks and Facilities Safety Topic:Bloodborne Pathogens	BBP First Responders(Safety manual BBP, IV, B) Cold stress and associated PPE	Blood Borne Pathogens Program Hot Works Plan Update Update Exposure Control Plan & First Resp Posting Corporate Standard: Video Standard
December	Topic:Operating In Inclement Weather Safety Topic Fire Prevention / Fire Extinguisher Training	Cranes, Hoists & Slings(Maintenance)	Update/ Finalize OSHA 300, 301, 300a Summary Quarterly Review of Contracts/ Certs of Ins Vehicle list for insurance cards PPE Program review and Hazard Assessment- Form 1010 Annual Scale Certificatioin if indicated

ECDC ENVIRONMENTAL

Waste Arrival & Unloading Procedure

Written by: Darin Olson

Purpose: To assure proper and safe unloading of waste material approved for disposal at ECDC Environmental's East Carbon Landfill.

- All generators wishing to dispose of waste material at ECDC Environmental's landfill are required to fill out a waste profile sheet. ECDC landfill personnel will review the profile sheet and all supporting documents. If it is determined the waste is acceptable for disposal and ECDC chooses to manage the waste, a signed Waste Acceptance Sheet will be issued to the generator. The acceptance sheet lists an ECDC Approval # for each waste stream. This number is used for tracking the waste material throughout the transportation and disposal process. A detailed description of the waste is included on the Waste Acceptance Sheet.

- A detailed description of the waste is also included on a Project Listing. The Project Listing is updated periodically and distributed to each operation area. The list provides additional information such as: color and special handling for each waste stream.

- If waste material is accepted which requires special handling, ECDC will identify the wastes on the Arrival sheet with an SW following the ECDC Approval #, i.e. 97-1800SW. ECDC will write a procedure to assure the health and safety of all employees and proper management of any such waste. Procedural training will be provided for all appropriate operation areas.

- ECDC employees designated by management will create a list of each container, railcar or truck that arrives at the facility. The list will include: railcar, container or truck number. Markings, stickers and radiation activity will also be documented.

- During regular business hours, a lead man, supervisor or employee will observe radiation monitors at the three-arrival locations. If waste arrives, on weekends or holiday's, the radiation monitors will be checked prior to accepting or unloading any waste material. If a radiation alarm has been activated, a supervisor or manager will be immediately contacted to resolve any issues.

- A Railcar and Container Arrival Report is produced each day for all waste received by rail and distributed to the appropriate operation area. The Arrival Report includes railcar and container numbers, Bill of lading numbers, ECDC Approval Number or Job Number, and a comment and signature box. Any markings, stickers, placards and radiation activity identified on the railcar or container will also be listed on the arrival report.

- Appropriate shipping documents are required for all industrial wastes, i.e. manifest. Appropriate shipping documents are defined as a manifest or similar paperwork that:

    1. Identifies a generator on the ECDC Active Project Listing.
    2. Designates ECDC as the disposal facility.
    3. The waste description correlates to the Project Listing
    4. Lists an active ECDC Approval number
    5. Lists appropriate railcars and or container numbers
    6. The signature date correlates to the arrival date.
    7. Is an original, not a photocopy?

- Asbestos loads shall be managed according to the attached ASBESTOS PROCEDURES and Allied Waste Asbestos Policy and Training Manual.

- Prior to unloading and disposal of any industrial waste material all shipping documents will be reviewed. If shipping documents are appropriate, the Railcar and Container Arrival Reports will be signed by the manifest coordinator or by an employee, designated by management. This signature only indicates the shipping documents are appropriate and sufficient for unloading.

- No railcar or container will be unloaded without a signature indicating all issues and shipping documents are appropriate.

- Shipping documents are not required for municipal solid waste (MSW)

- If shipping documents are not appropriate, or if markings, stickers, placards, radiation activity are present, the material is considered unacceptable for disposal. As a result, the waste arrival report will indicate: DO NOT UNLOAD (DNU). For railcars and containers listed as DNU, an ECDC Manager will review the issues and determine if the material is acceptable.

- Prior to ECDC officially accepting any waste material for disposal, field personnel will visually inspect all sides of each railcar, container or truck for stickers, placards or markings. If a sticker, placard or marking is present, a lead man, supervisor or manager will immediately be contacted to resolve any issues. The material will not be unloaded until the issue is resolved.

- Additionally, field personnel will inspect each load to assure the waste resembles the description provided on the Project Listing. For Asbestos loads Cubic Yards will be verified. If there is a discrepancy the waste pile will be segregated and or flagged off. A lead man, supervisor or manager will immediately be contacted to resolve any issue. Manifests will reflect any discrepancies.

- All stickers, marking, placards and paperwork will be removed prior to containers or railcars leaving ECDC property.

Any deviation of alteration from this policy may result in discipline up to and including discharge.

Revised: March 15, 2001
February 3, 2004

36758

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MAY 15 2007
UTAH DIVISION OF
SOLID & HAZARDOUS WASTE

May 11, 2007

Mr. Dennis R. Downs
Utah Department of Environmental Quality
Division of Solid and Hazardous Waste
288 North 1460 West
Salt Lake City, UT 84116

Dear Mr. Downs:

On behalf of Allied Waste Industries, Vector Engineering, Inc. has prepared a permit design modification for an alternative bottom liner system at the ECDC Environmental Landfill in East Carbon City, Utah.

The design modification is proposed for approval under the UDEQ Solid Waste Permitting and Management Rules, Section R315-303(3)(b)(i) which states:

> *3(b)(i) The Executive Secretary may approve an alternative liner design, on a site specific basis, if it can be documented that, under the conditions of location and hydrogeology, the performance standard of Subsection R313-303-2(1) can be met.*

Enclosed find the proposed permit design modification with supporting technical documentation, which includes (1) regulatory compliance and justification, (2) technical evaluation of the alternative lining system components, (3) hydraulic performance equivalency comparison between the proposed modified liner, the existing liner system, and the prescriptive UDEQ bottom liner system, (4) stability analyses of the alternative lining system, including both interim soil veneer and global slope stability, and (4) modified lining system construction quality assurance (CQA) which includes a geoelectric leak detection survey of the geomembrane after construction.

Based on these findings, Allied requests that the UDEQ approve the proposed supercell modified lining system for all future bottom liner expansions at ECDC.

If you have any questions or comments please contact me or Jake Russell at 435-888-4418 x 22 and 530-272-2448. We look forward to your review and approval of the permit modification with the UDEQ.

Sincerely,

Darin Olson, Allied Waste
Environmental Manager

VECTOR
ENGINEERING, INC.

April 6, 2007
Project No. 061212.01

Darin Olson
ECDC Environmental Manager
Allied Waste Industries, Inc.
1111 West Highway 123
East Carbon, Utah

Re: ECDC Landfill Liner Design Modification Report
East Carbon City, Utah Landfill

Darin,

Vector Engineering is pleased to provide Allied with the attached draft report for the liner system design modification. The design modification is proposed for approval by the Utah Department of Environmental Quality (UDEQ) Solid Waste Permitting and Management Rules, under Section R315-303(3)(b)(i) which states:

> *3(b)(i) The Executive Secretary may approve an alternative liner design, on a site specific basis, if it can be documented that, under the conditions of location and hydrogeology, the performance standard of Subsection R313-303-2(1) can be met.*

The purpose of this report is to demonstrate and inform the UDEQ that, in our professional opinion, the proposed liner permit modification should be approved. The report was prepared in accordance with industry-accepted geotechnical practices applicable at the time the report was prepared and presents a state-of-the-practice lining system design.

The general overview of the permit modification and supporting technical documentation includes (1) regulatory compliance and justification, (2) technical evaluation of the alternative lining system components, (3) hydraulic performance equivalency comparison between the proposed modified liner, the existing liner system, and the prescriptive UDEQ bottom liner system, (4) stability analyses of the alternative lining system, including both interim soil veneer and global slope stability, and (4) modified lining system construction quality assurance (CQA) which includes a geoelectric leak detection survey of the geomembrane after construction.

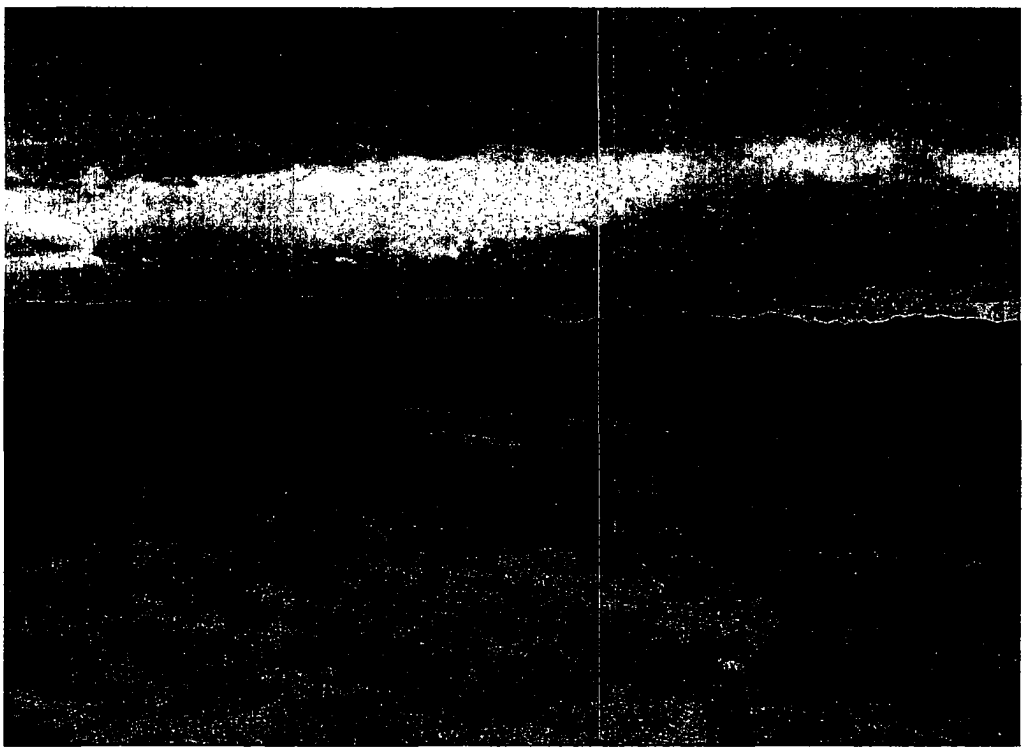
If you have any questions or comments please contact Jake or myself. We look forward to your review and submittal of the report to the UDEQ for approval.

Regards,
VECTOR ENGINEERING, INC.

Richard B. Erickson
Senior Engineer

cc: Jake Russell; Scott Purdy

Permit Modification
Proposed Alternative Bottom Liner Design
ECDC Environmental Landfill
East Carbon City, Utah



Prepared for:

ALLIED WASTE INDUSTRIES, INC.
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UTAH DIVISION OF
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Project No. 060612.01
April 4, 2007

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PERMIT MODIFICATION
PROPOSED ALTERNATIVE BOTTOM LINER DESIGN
ECDC ENVIRONMENTAL LANDFILL
EAST CARBON CITY, UTAH

Prepared for:

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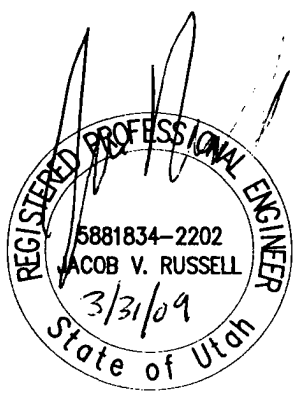

Project No. 061212.01
April 4, 2007

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1.0 DESIGN MODIFICATION OVERVIEW

Vector Engineering, Inc. (Vector) has prepared the following evaluation in support of a proposed alternative bottom lining system at the ECDC Environmental (ECDC) in East Carbon City, Utah, which is owned and operated by Allied Waste Industries, Inc (Allied). As described in Vector's letter to the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste (UDEQ), dated November 1, 2006, the purpose of the modified bottom liner is to replace the current lining system with an alternative lining system that is protective of the environment as mandated by State of Utah Administrative Code Solid Waste Permitting and Management Rules, Section R315-303(3)(b)(i).

The aim of the engineering analyses and supporting documentation presented in this document is to evaluate the performance of the proposed modified liner system, and to establish its compliance with regulatory requirements. The evaluation and analyses included the following:

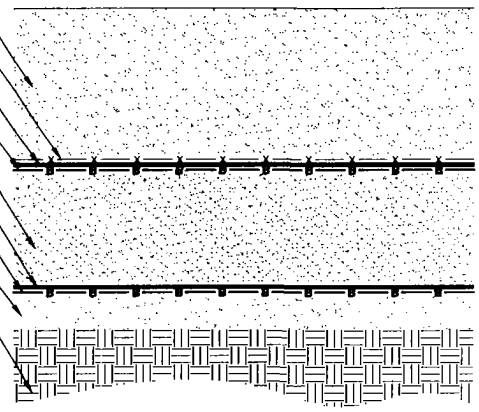
1. UDEQ regulatory requirements
2. Modified lining system components
3. Performance equivalency demonstration compared with the current permitted lining system
4. Hydraulic and leakage performance
5. Interim and global slope stability
6. Construction quality assurance (CQA)

Past design reports and site-related documents used in this evaluation are:

1. East Carbon Development Corporation Permit Application Consolidation (March, 1992)
2. ECDC Environmental, L.C. Permit and Permit Renewal Application, Solid Waste Permit No. 9422 (January 1996)
3. ECDC Environmental Landfill, Hydrogeologic Report (RB&G Engineering, Inc., March 1996)

4. Class V Landfill Permit Application, ECDC Environmental, L.C. Landfill Facility (EarthFax Engineering, Inc., February, 2001)

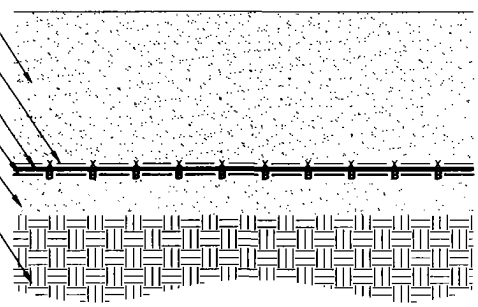
Figure 1 provides a detail of both the current permitted liner system as well as the proposed modified liner for the cell floor. The modified liner system replaces the existing double-lined composite (geomembrane-GCL) liner system with a single-composite liner system. It also proposes a supplemental geoelectric leak detection survey of the geomembrane after construction of the lining system.



CURRENT PERMITTED LINING SYSTEM DESIGN

DETAIL 1

NTS



MODIFIED LINING SYSTEM DETAIL

DETAIL 2

NTS

NOTE:

1. CQA to Include Electrical Leak Detection Survey of Modified Lining System after Construction.

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MODIFIED CELL FLOOR LINER DESIGN

FIGURE NO. 1

PROJECT NO. 061212.01

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As shown in Figure 1, the current lining system, from top to bottom, includes the following components:

- 24-inch protective soil cover
- Filter fabric and drainage net (drainage geocomposite)
- Primary 60 mil HDPE geomembrane liner
- Primary geosynthetic clay liner (GCL)
- 18-inch deep separation soil (leak detection layer)
- Secondary 60 mil HDPE geomembrane liner
- Secondary GCL
- 6-inch screened soil cushion layer or 16 oz geotextile cushion layer
- Prepared subgrade

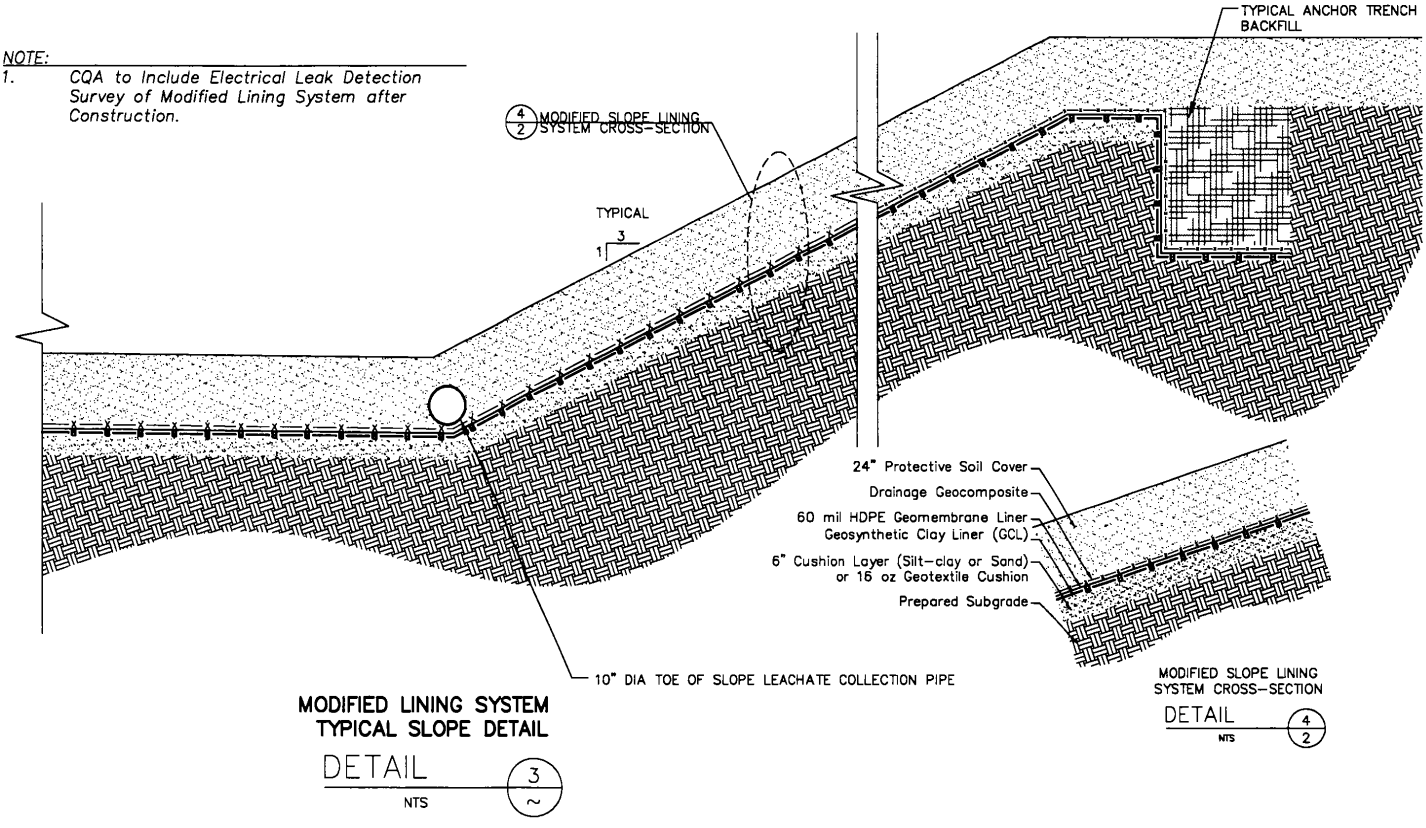
Allied is proposing the following changes in the modified design system.

- Removal of the secondary GCL
- Removal of the secondary 60 mil HDPE geomembrane liner
- Removal of the 18-inch separation soil
- Inclusion of a geoelectric leak detection survey of the lining system after installation and soil covering

Figure 2 illustrates the proposed modified lining system on slopes, the anchor trench detail, and tie-in to the toe of slope leachate collection pipe.

NOTE:

1. CQA to Include Electrical Leak Detection Survey of Modified Lining System after Construction.



MODIFIED LINING SYSTEM TYPICAL SLOPE DETAIL

DETAIL 3/~ NTS

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MODIFIED SLOPE LINER DESIGN

FIGURE NO. 2

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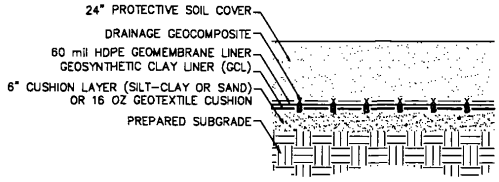
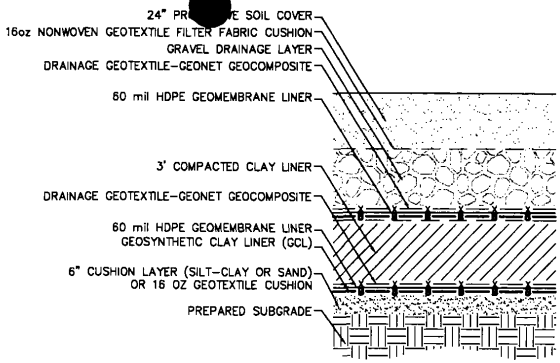
The proposed modified lining system is requested for the cell floor and typical slopes. As for the leachate collection sumps on the cell floor, the current double-lined composite lining system will remain, as specified in the existing permitted lining system. A detail of the typical leachate collection sumps and adjacent modified lining system is shown in Figure 3.



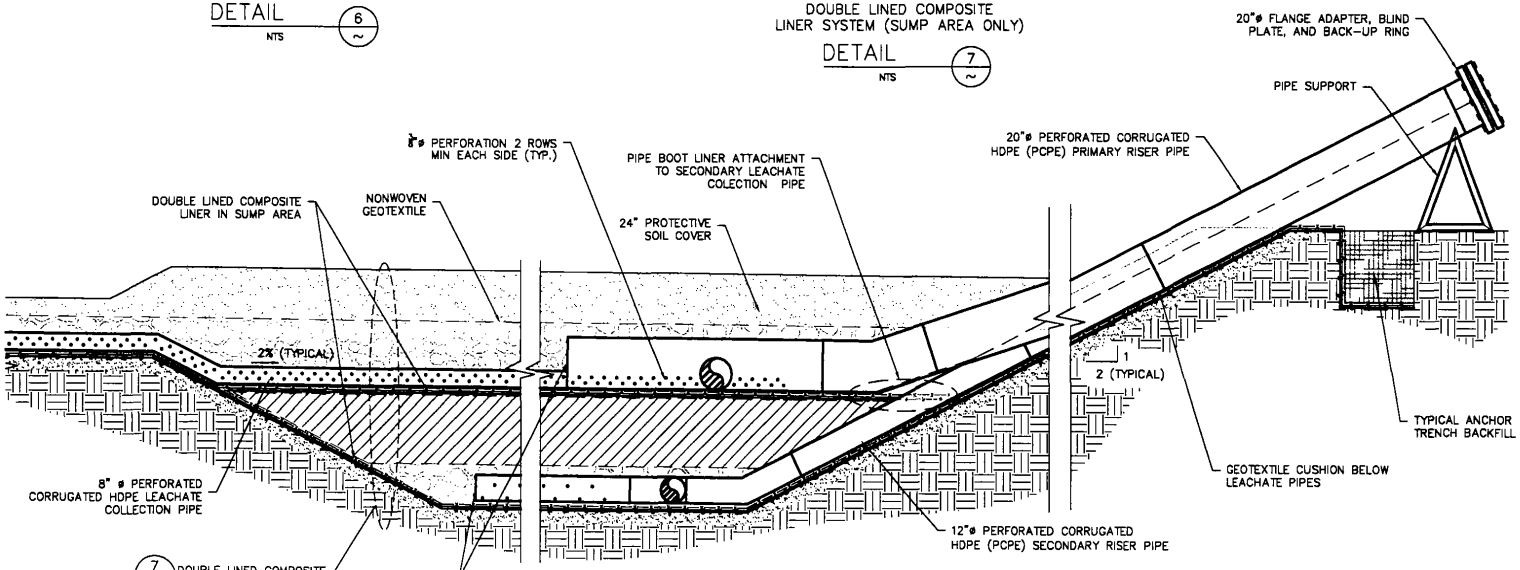
MODIFIED SLOPE LINER SYSTEM

DETAIL 6 NTS



DOUBLE LINED COMPOSITE LINER SYSTEM (SUMP AREA ONLY)

DETAIL 7 NTS



LEACHATE COLLECTION SUMP AND RISER SUPPORT

DETAIL 5 NTS

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LEACHATE SUMP DETAILS

FIGURE NO. 3

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2.0 REGULATORY COMPLIANCE OF THE ALTERNATIVE LINER SYSTEM

2.1 Justification for an Alternative Lining System

Installation of an alternative landfill liner design is permissible under the Utah Administrative Code, R315-303 (3)(b)(i), which states:

> *3(b)(i) Alternative Design (1) The Executive Secretary may approve an alternative liner design, on a site specific basis, if it can be documented that, under the conditions of location and hydrology, the performance standard of Subsection R313-303-2(1) can be met.*

Consistent with regulatory performance standards, this evaluation of an alternative design addresses both potential contamination of the ground water and the integrity of the lining system. Specifically, as stated in Subsection R313-303-2(1):

> *2(1) Ground Water. An owner or operator of a disposal facility shall not contaminate the ground water underlying the facility beyond the ground water quality standard set in Section R315-308-4 or, for constituents not set in Section R315-308-4, as established by the Executive Secretary based on health risk standards.*

Approval of an alternative lining system would therefore be founded upon the lining system's effective prevention of groundwater contamination. It is understood that any such approval is at the discretion of the Executive Secretary, based on the merits and demonstrated hydraulic performance of the proposed alternative lining system.

2.2 Basis for Demonstrating the Performance of an Alternative Lining System

Based on the performance requirement stated in Subsection R313-303-2(1), for any alternative lining system to adversely affect the groundwater in comparison to the current lining system, there would have to be significant leakage as a result of lining system failure. For any lining system, the potential for failure would be the result of (1) breaches of an intact system due to failure of the bottom liner materials (geosynthetics and/or soils), material installation, or construction, and/or (2)

instability of the constructed cell floor or slopes in conjunction with the bottom liner system.

Based on these two potential sources of failure, our demonstration and analyses focus on the hydraulic performance of the modified lining system and the stability of the modified lining system. The analyses were performed in accordance with standard engineering practices for landfill design, and are consistent with the evaluation from the initial geotechnical investigations for the current permitted bottom liner system.

The hydraulic performance of the modified lining system and water balance was evaluated utilizing the Hydraulic Evaluation of Leakage Performance (HELP) model, as presented in Section 4.1. The analysis includes a comparison of the performance of the modified liner system and that of the existing configuration.

Regarding slope stability associated with the modified lining system, the interim and global stability of all associated components is evaluated in Section 4.2. Veneer stability, or interim stability after lining system construction before waste filling, was evaluated using an infinite slope analysis method. The global stability of the lining system, after waste filling, was subsequently evaluated utilizing an industry standard limit equilibrium stability modeling program, GSTABL7 (Gregory, 2003).

2.3 Alternative Lining System Components

In the modified lining system design, Allied has conformed to all requirements outlined in Section R315-303-3 *Standards for Design* to comply with all UDEQ lining system performance standards. Section R315-303-3 (3)(a) states the following:

> *(3)(a) Standard Design. The design shall have a composite liner system consisting of two liners and the associated liner protection layers and a*

drainage system for leachate collection: (i) an upper liner made of synthetic material with a thickness of at least 60-mils; and (ii) a lower liner of at least two feet thickness of recompacted clay or other soil material with a permeability of no more than 1 x 10^{-7} cm/sec having the bottom liner sloped no less than 2% and the side liners sloped no more than 33%, except where construction and operational integrity can be demonstrated at steeper slopes, with the synthetic liner installed in direct and uniform contact with the compacted soil component.

As shown in Figure 1, the geosynthetic components of the modified lining system consists of a GCL, primary 60 mil HDPE geomembrane, and overlying drainage geocomposite. All geosynthetic lining and drainage products proposed in the modified lining system have been previously approved by the UDEQ and were utilized in several prior cells at ECDC.

The modified design includes a GCL component as an alternative to the compacted clay liner. Selection of the GCL is based on the Utah Administrative Subsection R313-303-2(1) allowance for alternative lining system components. As previously approved by the UDEQ, GCLs are currently utilized at ECDC as an effective replacement for the compacted clay liner component in the bottom liner system and the modified lining system is consistent with the current liner system with regard to the GCL component.

2.4 UDEQ Approved Single Composite Lining Systems

In all essential regards the proposed modified liner system is equivalent to the design currently permitted and employed at the Washington County Landfill in Washington, Utah and at the Wasatch Regional Landfill in Tooele County, Utah. Both systems are performing as designed and include a single composite (geomembrane-GCL) bottom liner system.

The proposed design modification is intended to be incorporated into future Super Cell expansions planned at the ECDC facility.

3.0 MODIFIED LINER MATERIALS AND INSTALLATION SPECIFICATIONS

3.1 Component Materials

As mentioned previously and outlined in Figure 1, the modified lining system consists of, from top to bottom, the following components.

- 24-inch protective soil cover
- Drainage geocomposite
- 60 mil HDPE geomembrane liner
- 6-inch screened soil cushion layer or 16 oz geotextile cushion
- Prepared subgrade

Compared with the current permitted liner, the modified lining system removes the secondary geomembrane and GCL, and removes the 18-inch separation soil layer. The modified system also incorporates a geoelectric leak location survey after construction to improve the installed geomembrane liner's integrity concerning environmental containment.

The material specifications and CQA requirements for the geosynthetic lining and drainage products are attached in Appendices A through C. A summary of the modified lining system components is outlined below.

3.1.1 24-inch Protective Soil Cover

The proposed soil protection layer will remain as designed and permitted. The cover soil will be free of debris, organic material, and sharp or angular rocks greater than 1 inch.

3.1.2 250 mil Double Sided 8 oz/yd^2 Nonwoven Drainage Geocomposite

The drainage geocomposite in the modified lining system is consistent with the currently permitted 250 mil drainage geocomposite used at ECDC. The geocomposite conforms to all industry ASTM and GRI material and test standards for drainage geocomposites.

The geocomposite provides leachate collection drainage above the 60 mil geomembrane and puncture protection of the underlying geomembrane. The leachate collection system for the cell floor consists of the specified drainage geocomposite in conjunction with a series of lateral and main leachate collection pipes to effectively collect and remove leachate and potential build-up on the primary geomembrane. It also provides drainage below the protective soil on the slopes to prevent leachate build-up on the textured 60 mil geomembrane and reduce pore pressures within the soil to improve slope stability.

The material and CQA specifications are included in Appendix A.

3.1.3 60 mil HDPE Geomembrane

The geomembrane in the modified lining system is equivalent to the current 60 mil membrane used in the bottom liner system at ECDC. The proposed geomembrane meets and exceeds all current ASTM and GRI standards for HDPE geomembranes.

As currently designed, on the cell floor the geomembrane includes a 60 mil smooth HDPE geomembrane. To improve slope stability and the geomembrane's friction resistance against the overlying geocomposite and underlying GCL on the slopes, the membrane is specified as 60 mil double sided textured HDPE geomembrane. The material specification also includes requirements for the demonstration of long-term durability and performance in accordance with GRI-GM13 industry standards for HDPE geomembranes. The material and CQA specifications for the 60 mil geomembrane are included in Appendix B.

3.1.4 Fabric Encased GCL

Consistent with the current design, the GCL specified for the floor of future Super Cell construction includes an industry standard 0.75 lb/ft^2 bentonite loading encapsulated between a cap 6 oz/yd^2 nonwoven geotextile and a carrier 3 oz/yd^2

woven geotextiles. For the cell slopes, the GCL is specified with cap and carrier 6 oz/yd^2 nonwoven geotextile with heavy internal reinforcement to maximize internal and interface shear strength on cell slopes. The material and installation specifications for the GCL are included in Appendix C.

To improve slope stability and long-term performance of the GCL, the material is specified with upper-cap and lower-carrier nonwoven geotextiles. The needlepunch reinforcement exceeds the current GRI-GCL3 standard for peel strength in order to maximize the internal shear strength of the GCL.

3.1.5 6-inch Soil Cushion Layer or 16 oz/yd^2 Geotextile Cushion and Prepared Subgrade

The 6-inch screened soil cushion layer and prepared subgrade remain as currently designed and approved in the existing lining system. Alternately, as currently permitted, a 16 oz geotextile cushion may be used as a replacement for the 6-in screened soil cushion layer.

4.0 HYDRAULIC PERFORMANCE DEMONSTRATION

The hydraulic performance of the proposed modified lining system balance was evaluated utilizing the Hydraulic Evaluation of Landfill Performance (HELP) model as presented in Section 4.1. The analysis includes a comparison of the water balance and leakage performance comparison of the proposed modified liner system with that of the current permitted configuration.

4.1 Design Approach

The current approved bottom liner system for construction at ECDC consists of a composite double-liner with primary and secondary geosynthetic clay liners (GCLs) and 60 mil HDPE geomembranes. The proposed modified liner system for future cell expansions consists of a single composite liner that is similar to the prescriptive "standard" liner system outlined in the State of Utah Administrative Code as governed by the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste (UDEQ).

The UDEQ will consider an alternative landfill liner design if the performance of its design can be demonstrated to be equivalent to that of the current design and the prescriptive design. Water balance modeling for the double composite liner system was previously performed utilizing the HELP model (USPCI, June 1994). The previous HELP modeling and supporting data are presented in Appendix 10 of the ECDC Permit Application Report (EarthFax 2001).

To demonstrate equivalent performance in this evaluation, HELP model simulations were computed for the currently approved composite liner system with the HELP model, Version 3.06, then compared the results to those of the proposed modified liner configuration. Since the HELP model cannot accurately predict leakage through a secondary geomembrane liner system, such as the one in the current design at ECDC, the design approach described by Giroud et al. (1997a) was

employed. These results were evaluated in conjunction with predictions of leakage through the primary liner, as derived from the HELP model, in order to predict leakage through the secondary geomembrane liner.

The performance criteria used for comparison in this analysis included 1) percolation (leakage) through the GCL/liner system, and 2) maximum leachate hydraulic head build-up on the geomembrane. The results of the HELP model analysis are attached in Appendix D.

4.2 HELP Model Description

The U.S. Army Corps of Engineers first generated the HELP model in 1983 under a contract with the United States Environmental Protection Agency (US EPA). Documentation for version 3.0 of the HELP model is documented by Schroeder et al. (1994). The HELP model is a one-dimensional, deterministic, water balance model that utilizes daily climate data, soil and refuse characteristics, and cover/liner system design data to predict the movement of water into, within, and out of landfill boundaries.

The daily climate data, which consist of precipitation, temperature and solar radiation values, can be generated empirically for up to 100 years of daily values by the HELP model, either from a database or as defined by the user. The HELP model includes default climate data from 139 U.S. cities, five types of vegetative covers, soil characteristics for 42 soil types and geosynthetic liners, and run-off curve statistics for the default soil and vegetation types. The HELP model also allows the user to modify the default parameters to values that are specific to the design and location of a given landfill.

Once the daily climate data are established and the soil characteristics and design criteria defined, the movement of water within a landfill is divided into various

hydrologic processes including surface runoff, infiltration, plant canopy interception, evapotranspiration, percolation/drainage, and soil moisture storage. These water balance parameters are predicted by the model on a daily basis for the specified duration of the simulation.

4.3 HELP Model Input

4.3.1 Landfill Profiles

Water balance of the ECDC landfill was evaluated for two different depths of waste. The critical period of landfill construction with respect to leachate generation consists of a very thin waste layer, due to the low water storage capacity of a thin waste layer as compared to a thick waste layer. Therefore, to be conservative, simulations were performed with a 10-foot waste thickness and no cover. Additional simulations were performed using a maximum waste thickness of 102 feet and no cover, for purposes of comparison.

4.3.2 Material Properties

A summary of the soil and material properties are shown in Table 1. The HELP model defaults were used for quantifying the waste, drainage net, geomembrane, and GCL layers. The protective soil cover layer, soil drainage layer, and bedding/subgrade soils were assigned the default properties for Soil Texture No. 4 in the HELP model, which are classified as sandy silt (SM) - consistent with the silts and sands that are predominant at the ECDC landfill. The HELP model defaults were specified for initial moisture in all layers.

TABLE 1
SUMMARY OF HELP MODEL LAYER INPUT PARAMETERS

LAYER DESCRIPTION	THICKNESS (in)	HYDRAULIC CONDUCTIVITY (CM/SEC)	POROSITY (VOL/VOL)	FIELD CAPACITY (VOL/VOL)	WILTING POINT (VOL/VOL)
Municipal Solid Waste	120	$1.0x10^{-3}$	0.671	0.292	0.077
Protective Cover	24	$1.7x10^{-3}$	0.437	0.105	0.047
Drainage Net	0.2	$1.0x10^{1}$	0.85	0.01	0.005
HDPE Membrane	0.06	$2.0x10^{-13}$	N/A	N/A	N/A
GCL	0.16	$3.0x10^{-9}$	0.75	0.747	0.40
Subgrade	6	$1.7x10^{-3}$	0.437	0.105	0.047

The placement quality of the primary HDPE geomembrane in the double composite liner simulation was considered to be "good", based upon accepted industry values of 3 installation defects and 3 pinholes per acre. For the proposed composite liner system, the geomembrane pinhole density was reduced from 3 per acre to 1 per acre, and installation defects were reduced to 0 per acre. This density was selected because the proposed liner system construction quality assurance (CQA) includes a geoelectric leak location survey be conducted after installation of the liner system and protective cover soil layer. The survey will locate areas of damage/holes in the installed geomembrane that can be uncovered and repaired prior to waste placement to minimize potential defects in the installed lining system. An overview of the geoelectric leak detection survey is presented in Section 6.1.

For the lateral drainage layers, a drainage length of 400 feet and a minimum floor slope of 1% were utilized as design parameters. HELP also allows the user to specify several surface runoff parameters. A runoff curve number (CN) of 81.5 was selected to conservatively define the runoff conditions for the cover.

4.3.3 Climatological Input

Twenty years of climatological data were generated based on the HELP model's synthetic weather generator using parameters for Salt Lake City, Utah. The weather station nearest to the ECDC landfill (in Sunnyside, Utah) reports an average annual rainfall of 14.65 inches; the average annual precipitation generated in these analyses was 14.38 inches. Evapotranspirative parameters used as model input are summarized in Table 2, which are based on the model's defaults for Salt Lake City.

Average daily temperatures and solar radiation were synthetically generated in the model based on the default normal mean monthly temperatures for Salt Lake City. Additional model input pertinent to evapotranspiration (ET) calculations included the evapotranspirative zone depth, maximum leaf area index (LAI), growing season start and end of day, average annual wind speed, and average quarterly relative humidity. These parameters are summarized in Table 2. To be conservative, plants were not included in these analyses, as is evident from the specified maximum leaf area index of 0.0.

TABLE 2
ESTIMATED EVAPOTRANSPIRATION DATA FOR TOOELE COUNTY, UTAH

Evapotranspiration Zone Depth (in.)	16.0
Maximum Leaf Area Index	0.00
Growing Season Start Day (Julian Date)	117
Growing Season End Day (Julian Date)	289
Average Annual Wind Speed (mph)	8.8
Avg. First Quarter Relative Humidity (%)	67.0
Avg. Second Quarter Relative Humidity (%)	48.0
Avg. Third Quarter Relative Humidity (%)	39.0
Avg. Fourth Quarter Relative Humidity (%)	65.0

The average annual snowfall measured at the Sunnyside weather station is equal to 42.7 inches, and the highest annual snowfall on record is 88.3 inches. In simulations that use the HELP model, snow accumulation is accounted for based on mean monthly temperature input. However, no initial surface water inflow from snow or ice was specified.

4.4 Help Model Results

HELP model results are summarized in Table 3 in terms of average annual percolation/leakage and maximum hydraulic head build-up on the geomembrane liner throughout the duration of the 20-year simulation period. This was a sufficient period to achieve steady state percolation through the bottom layer GCL. The HELP model output files are included in Appendix D.

TABLE 3
HELP MODEL WATER BALANCE PREDICTIONS THROUGH PRIMARY LINER

GEOMEMBRANE QUALITY	WASTE HEIGHT	RESULTS					
		AVERAGE ANNUAL (IN/UNIT AREA)				PEAK DAILY MAX HEAD ON GM (IN)	LEAKAGE THROUGH GCL (GAL/ACRE-YR) *
		PRECIP	RUNOFF	ET	Δ STORAGE		
Without Leak Detection	102 ft	14.38	0.60	13.16	0.089	0.025	0.0744
	10 ft	14.38	0.60	13.16	0.089	0.024	0.0744
With Leak Detection	102 ft	14.38	0.60	13.16	0.089	0.025	0.0094
	10 ft	14.38	0.60	13.16	0.089	0.024	0.0094

* Drainage output was lower than the precision of the model, and therefore calculated according to the methodology presented by Giroud et al. (1997b). See Appendix E for leakage calculations.

Note that very little surface runoff was predicted, which is conservative for a water balance design since more precipitation water is available to infiltrate the profile.

Due to the semi-arid climate of the ECDC landfill, the majority of precipitation water is returned to the atmosphere via evaporation. The storage predictions did not change with varying depths of waste.

The predicted leakage through the primary liner system decreased by a value of 0.065 gal/yr, or 87% decrease in leakage, after inclusion of the geoelectric leak survey in the CQA, which reduced the number of assumed geomembrane holes resulting from installation damage. However, the predicted leakage for both cases was below the acceptable precision of the model, so that leakage was therefore deemed negligible.

4.5 Secondary Liner Leakage Prediction

Although predicted leakage through the primary liner system was deemed negligible, for purposes of comparison, leakage percolation through the secondary liner of the currently approved liner configuration was evaluated. Any liquid that leaks through a primary composite liner system will enter the leak detection separation gravel, travel through the separation soil and into the drainage geocomposite, and build-up on top of the secondary geomembrane. While leachate is flowing over the secondary geomembrane, the possibility exists for some liquid to leak through defects in the secondary geomembrane.

Potential leakage through the secondary geomembrane of the currently approved double composite liner system was evaluated by the procedure described by Giroud et al. (1997a). This method accounts for the spatial variability of defect locations and liquid flow between the primary and secondary liner systems, which the HELP model is not capable of computing.

Output from the secondary geomembrane leakage analysis, modeled after Giroud (1997a), is included in Appendix E. The methodology presented by Giroud et al.,

1997a estimates leakage through a secondary liner system, and is summarized below.

1. The maximum height of the leachate phreatic surface above the primary geomembrane and leakage through the primary composite liner (geomembrane-GCL) system, were calculated using the HELP model.
2. The fraction of wetted area on the secondary geomembrane (i.e. within the leak detection layer), which is caused by leakage through an assumed number of random defects in the primary liner, was calculated using equations developed by Giroud et al. (1997a).
3. The average height of the leachate above the secondary geomembrane in the wetted areas within the leak detection layer, was calculated using equations developed by Giroud et al. (1997a).
4. The leakage caused by leachate build-up above the secondary geomembrane and through a defect, was calculated using the industry-accepted "Giroud Equation" for leakage past defects in composite liners (Giroud et al. 1997b).
5. The calculated leakage rate through a defect in the secondary liner was multiplied by the assumed number of defects in the secondary geomembrane, and by the fraction of wetted area, to arrive at a total rate of estimated leakage past the double lined liner system.

Based on the Giroud et al. (1997a) analyses for 3 pinholes and 3 installation defects per acre in the secondary geomembrane, the resulting leakage rate through the secondary liner was calculated as 1.4E-6 in/yr with a maximum head of 4.1E-7 in. These results are based on the 3.0E-6 in/yr of leakage through the primary liner, as shown in Table 3.

4.6 Summary of Leakage Results

The predicted leakage and hydraulic head build-up on the geomembranes associated with the currently approved double composite liner, alongside those of the proposed single composite liner, are listed in Table 4. For comparison, Table 4 also presents the predicted leakage through the UDEQ prescriptive composite liner

system (60 mil HDPE geomembrane with 2-foot, 1 x 10^{-7} cm/sec permeability, and a compacted clay liner).

TABLE 4
COMPARISON OF COMPOSITE LINER LEAKAGE PREDICTIONS

LINER PROFILE	PRIMARY LINER		SECONDARY LINER	
	LEAKAGE (GAL/AC-YR)	MAXIMUM HEAD (IN)	LEAKAGE (GAL/AC-YR)	MAXIMUM HEAD (IN)
Double Composite (current)	0.0744	0.025	8.7E-05	1.4E-04
Single Composite (proposed)	0.0094	0.025	NA	NA
Prescriptive UDEQ Liner (geomembrane/2 ft CCL)	0.9794	0.025	NA	NA

* Leakage was derived by applying the Giroud et al. (1997b) Leakage Equation to the assumed number of geomembrane defects and the maximum daily leachate head build-up over the liner calculated using the HELP model.

The maximum leachate hydraulic head build-up over the primary geomembrane that is allowable by CFR and UDEQ regulation is 12 inches. As these analyses show, both liner systems result in significantly less than 12 inches of leachate head build-up on the liner system. In addition, both liner systems resulted in negligible predicted leakage through the liner system. Both liner systems are also more resistant to leakage than the UDEQ prescriptive composite liner system.

Therefore, based on HELP model analyses in conjunction with secondary liner leakage calculations, the proposed modified liner system is comparable to the current bottom liner system with regard to hydraulic performance. Both the modified and current liner systems resulted in negligible leakage well below the precision of the HELP model. This analysis thus demonstrates that the proposed bottom liner does not adversely affect the groundwater, and complies with the

requirement for approval of an alternative liner system as outlined in the Utah Administrative Code, Subsection R315-303 (3)(b)(i)

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5.0 SLOPE STABILITY ANALYSIS

5.1 Method of Analysis

The stability of the proposed alternative lining system for future cells at the ECDC landfill was evaluated in the context of the global stability of the waste mass, and the interim stability of the veneer operations layer (protective cover over the liner). Static slope stability was evaluated utilizing limit equilibrium slope stability methods to calculate a factor of safety against failure. The factor of safety was defined as the ratio of total equilibrium shear stress to available shear strength. The global static stability of the landfill was analyzed using the computer program GSTABL7 (Gregory, 2003), and the interim condition veneer stability of the operations layer on top of the liner system was analyzed using veneer stability procedures described by Koerner and Soong (1998).

The current approved bottom liner system consists of a composite double-liner including primary and secondary geosynthetic clay liners (GCLs), 60 mil HDPE geomembranes, and a leak detection layer. The modified liner system proposed for future cell expansions consists of a single composite liner that is equivalent to the standard liner system standard outlined in the State of Utah Administrative Code, Section R315-303-3 (3)(a). The following stability analyses are intended to show that the modified liner system proposed for future cell expansions will be stable under both interim and long-term conditions.

5.2 Material Properties

The material properties used in the stability analyses are summarized in Table 5. The shear strength parameters for municipal solid waste (MSW) were based on the bi-linear envelope recommended in the US EPA RCRA Subtitle D seismic design guidance manual (US EPA, 1995). The shear strength envelope is characterized by a cohesion of 500 psf and friction angle of 0 for normal stresses up to 625 pcf, and a cohesion of 0 psf and friction angle of 33 degrees for normal stresses above 625 pcf.

To be conservative, the lower normal stress MSW strengths were not used in the analyses and a friction angle equal to 33 degrees was used. A unit weight equal to 85 pcf was used for MSW in the analyses.

TABLE 5
SUMMARY OF MATERIAL SHEAR STRENGTHS FOR STABILITY ANALYSES

MATERIAL	TOTAL MOIST UNIT WEIGHT (PCF)	FRICTION ANGLE (DEGREES)	COHESION (PSF)
Municipal Solid Waste	85	33	0
Bottom Liner Critical Interface (residual-for Global) (residual-for Veneer)	 100 100	 13 24	 0 0
Operations Layer	130	34	0
Toe Berm	135	35	0
Native Subgrade	130	40	0

The shear strength parameters for the bottom liner system are based on a direct shear database of geosynthetic-to-geosynthetic and geosynthetic-to-soil interfaces (GRI, 2005). The weakest interface in the modified composite liner system was determined to be where the textured 60-mil HDPE geomembrane contacts the nonwoven, needle-punched GCL, which was assigned a friction angle of 13°, and zero cohesion under large normal loads for the global stability. For interim veneer stability of the geomembrane-GCL interface, a residual friction angle of 24° and zero cohesion was assumed, as is shown in Table 5.

Estimates of the operations layer, toe berm, and subgrade shear strength parameters are all based on a previous embankment stability analysis for Cell 7 of

the ECDC landfill, which was performed by Rollins, Brown and Gunnell, Inc. (1990).

5.3 Veneer Stability (Interim Conditions)

Data and results for the interim veneer stability (prior to waste filling) are presented in Appendix F and are summarized in Table 6. A two-foot-thick veneer cover was analyzed for 2:1, 2.5:1, and 3:1 slopes. The liner slope (embankment slope) was assumed to stay constant at 2:1. Therefore, for the 2.5:1 and 3:1 veneer slope analyses, the veneer was assumed thicker at the toe of the slope, thus resulting in the 2.5:1 and 3:1 veneer slopes overlying the 2:1 liner slope.

TABLE 6
FACTORS OF SAFETY FOR VENEER STABILITY

SLOPE	SLOPE HEIGHT			
	5 FEET	10 FEET	20 FEET	50 FEET
2:1	1.73	1.22	1.05	0.95
2.5:1	2.15	1.33	1.09	0.97
3:1	2.82	1.44	1.13	0.98

* Based on Koerner and Soong (1998)

A tapered veneer of varying thickness can be accounted for in the Koerner and Soong (1998) stability analysis method. The critical interface evaluated included the point of contact between the textured HDPE geomembrane and the GCL, which was assigned a residual friction angle of 24° and 0 cohesion. No reinforcing tensile strength was assumed for the geosynthetics in the lining system cross-section due to material anchorage at the crest of the slope.

An acceptable factor of safety for interim conditions was assumed to be 1.3. For a 10-foot or higher slope height, the factor of safety for stability was less than 1.3 for a

2:1 veneer slope. For the 2.5:1 veneer slope, an acceptable interim factor of safety of 1.33 was achieved for slope heights equal to or less than 10 feet. Therefore, in accordance with the current waste fill operations at ECDC, the soil operations layer placed on a 2:1 slope composite liner system should be graded to a maximum 2.5:1 surface slope with a slope height not exceeding 10 feet. This procedure is currently approved for placement of the soil operations layer over the double composite liner systems for ECDC Super Cell construction.

5.4 Global Stability

Global stability data and results from the GSTABL7 computer model are presented in Appendix G. A factor of safety for block failure surfaces through the waste mass and liner system was calculated by GSTABL7 using Spencer's method (Spencer, 1967). The shear strength of the liner system was modeled with strength parameters based on the interface between the textured HDPE geomembrane and the underlying GCL, which was deemed the critical (i.e., weakest) interface associated with the bottom liner system. Liner and waste shear strength parameters are described in detail above, in Section 5.2.

The profile evaluated consisted of a 55-foot toe embankment berm with 2:1 slopes, a waste out-slope of 4:1, and a maximum waste depth of 102 feet. A slope of 2% was used for the bottom liner floor, and a top deck slope of 3% was specified up to a maximum waste elevation of 5,990 feet msl.

The global configuration proved to be stable, with a minimum factor of safety equal to 2.8 for a sliding block failure along the liner system. Therefore, the modified liner system proposed for future cell construction will be stable with respect to static slope stability. Additional stability analyses should be performed if waste heights or slope angles are increased to values greater than those used in this

analysis, or if the embankment berm height is reduced below the value used in this analysis.

6.0 CONSTRUCTION QUALITY ASSURANCE

The modified lining system components will be installed and constructed in accordance with industry standards as outlined in the material specifications included in Appendix A (drainage geocomposite), Appendix B (60 mil HDPE geomembrane), and Appendix C (GCL). This includes monitoring by a qualified third party construction quality assurance (CQA) firm and on-site monitors.

In addition to conventional CQA of the lining system, it is proposed that an electrical leak location survey (termed geoelectric leak survey) be conducted on the constructed bottom liner. This will improve the integrity of project construction and minimize potential breaches of the intact geomembrane liner.

6.1 Overview of the Geoelectric Leak Location Survey

Geoelectric leak location procedures involve impressing a voltage across a geomembrane, which then allows the detection of points where electrical current flows through holes and defects. The electrical leak survey of geomembranes was first developed by the US EPA in 1980, with the first surveys of intact membranes conducted in 1985. Since that time, the technology has evolved into a proven technology that effectively locates and repairs damage to geomembranes after liner construction and covering (Thiel et al., July 2003).

This method of testing can be performed on exposed liners as well as liners covered with soil or water. Either using a water puddle method (exposed membranes, ASTM D 7702) or dipole method (soil/water covered membranes, ASTM D 7007), as much as 100% of the installed liner can be non-destructively tested for the presence of leaks/defects. These state-of-the-art technologies, along with a qualified CQA firm, offer powerful and cost-effective CQA tools to boost the quality of the liner installation.

Approximately 73% of damage to geomembranes is caused during the placement of soil and/or gravel over the liner, which results in larger geomembrane holes and tears (Forget et al., 2005). To greatly minimize this threat, the dipole geoelectric survey at ECDC will be conducted after the protective soil covering of the proposed modified bottom liner system is in place. Conducting a dipole geoelectric leak location survey of the modified liner system at ECDC will significantly reduce the potential for leakage, as well as the risk of environmental contamination. A general description of the procedures for conducting a dipole geoelectric leak survey is discussed below. A copy of the ASTM D 7007 is presented in Appendix H, which outlines the general procedures for conducting the dipole geoelectric test survey.

6.2 Description of the Dipole Geoelectric Testing Methodology

For the bottom liner system at ECDC, the dipole method will consist of introducing a voltage potential between the earthen subgrade cushion below the GCL/geomembrane composite liner and the soil protective layer above it. The 60 mil HDPE geomembrane acts as a barrier to the flow of current. In the case of a hole in the geomembrane, current flows through that hole and signals an anomaly in the voltage potential field at that specific location. In order to locate these anomalies, readings of voltage potential are taken in a grid pattern throughout the bottom liner survey. The typical configuration of the dipole geoelectric survey method is diagramed in Figure 4.

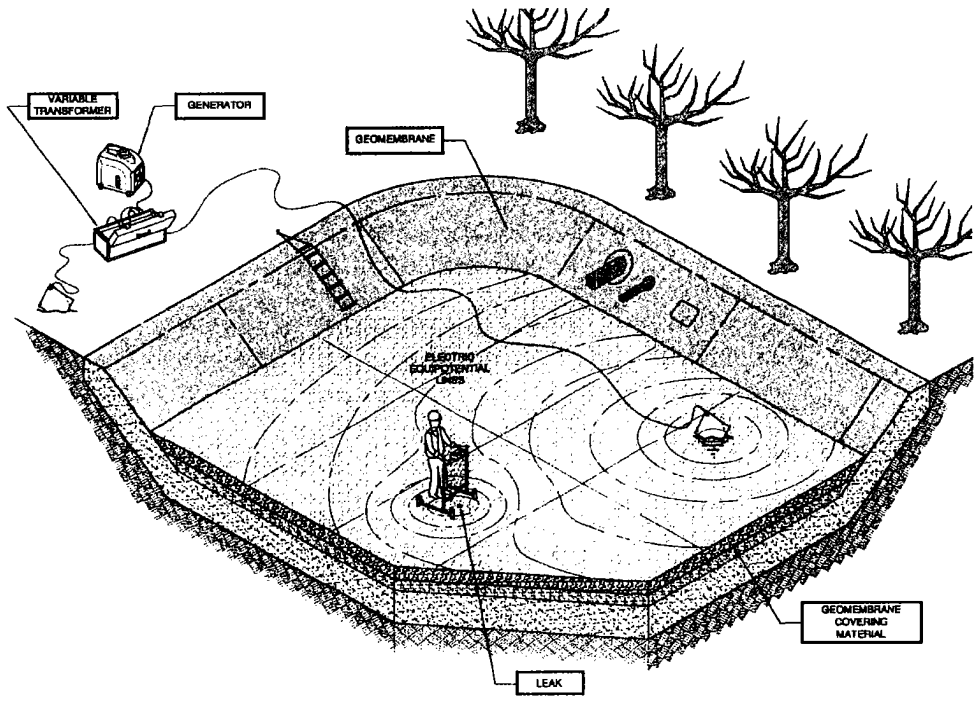

Figure 4. Typical dipole geoelectric leak survey configuration.

During a dipole survey, the dipole operator observes voltage potential measurements at specified intervals (usually every three to five feet) in a grid pattern throughout the lined project area. As the operator proceeds, he/she observes the degree of changes in voltage and watches for spikes or dips in the potential field. Wherever a significant change is found, that area is marked and immediately checked so that the anomaly can be confirmed or dismissed. A signal greater than three times the background noise is considered confirmation when it can be reproduced at least five times at the same location. The location of every such confirmed anomaly is then flagged for excavation of the cover soil, inspection of the liner system, and the repair of any damage found.

6.3 Survey Sensitivity to Moisture and Soil

The sensitivity of the survey can be adversely affected by areas of low moisture content and increased soil thickness. Given that the protective soil cover over the composite liner and drainage geocomposite is 2 feet, this factor should not affect the efficacy of the survey. As regards moisture content, when moisture content exceeds natural moisture content by approximately 10%, an effective geoelectric survey can generally be performed. Based on previous testing at the site, this necessary degree of moisture content can be achieved in the proposed cover soil.

Since the subgrade soil and cover soil are similar, the moisture in the underlying subgrade soil will also provide adequate conductance for the survey. With regard to the drainage geocomposite above the geomembrane, to ensure adequate moisture, wetting will be performed after installation by spraying the geocomposite with water before soil covering.

These two factors affecting electrical conductance – soil thickness and the degree of soil moisture – will be evaluated during the calibration test described below, so that any required adjustments can be made before the dipole survey is conducted.

6.4 Calibration Test

Prior to the dipole survey, a calibration test will be performed to determine the specified hole size (typically 0.25-inch to 0.5 inch diameter) that can be located by the dipole equipment, the maximum grid spacing for voltage measurements, and the effects of soil moisture and thickness. This test is performed with a real or artificial leak fabricated and placed in accordance with ASTM D 7007 (Appendix H). ASTM procedures require that the target hole size produce a signal to background noise ratio of at least 3. Background noise is defined as the natural oscillation of the voltage potential in the absence of a hole.

6.5 Summary of Dipole Geoelectric Leak Survey

The dipole geoelectric leak survey is a proven state-of-the-art technology that will identify and remediate defects in the geomembrane liner, the impermeable component of the lining system. Though the method's efficacy in part depends on the moisture content and thickness of the overlying cover soil cover, neither the 2-foot protection layer nor the actual soil moisture present any real barrier, since both will be measured, evaluated and modified during the calibration process. The CQA program and procedures are included in Appendix H.

Incorporation of a dipole geoelectric leak survey into the CQA plan for the modified lining system will greatly improve the system's integrity and environmental containment, offering protections that exceed those offered by the current accepted CQA program.

7.0 SUMMARY

The proposed modified lining system presented herein is based on a thorough geotechnical evaluation, which demonstrates that it meets or exceeds all UDEQ regulatory requirements for consideration of an alternative landfill lining system. Areas that this analysis investigated include (1) the technical evaluation of the modified lining system components, (2) hydraulic performance of the modified and current lining systems, (3) stability analyses of the proposed lining system, including both interim soil veneer and global slope stability, and (4) modified CQA requirements which include a geoelectric leak detection survey after construction of the alternative lining system.

Based on these findings, Allied requests that the UDEQ approve the proposed modified lining system for all future bottom liner expansions at ECDC.

8.0 REFERENCES

Class V Landfill Permit Application, ECDC Environmental, L.C. Landfill Facility (EarthFax Engineering, Inc., February, 2001).

East Carbon Development Corporation Permit Application Consolidation (March, 1992).

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APPENDIX A
GEOCOMPOSITE DRAINAGE LAYER

SECTION 02621

GEOCOMPOSITE DRAINAGE LAYER

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Specifications and guidelines for MANUFACTURING and INSTALLING geocomposite.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. D 1505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique
2. D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics
3. D 4355-02 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
4. D 4491-99 Standard Test Method for Water Permeability of Geotextiles by Permittivity
5. D 4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
6. D 4751-99 Standard Test Method for Determining Apparent Opening Size of a Geotextile
7. D 4833-88 (1996) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
8. D 5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
9. D 5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
10. D 5261-92 (1996) Standard Test Method for Measuring the Mass Per Unit Area of Geotextiles
11. D7005-03 Determining The Bond Strength (Ply-Adhesion) of Geocomposites

B. Relevant publications from the Environmental Protection Agency (EPA):
1. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities,* EPA/600/R-93/182.

1.03 DEFINITIONS

A. Construction Quality Assurance Consultant (CONSULTANT)- Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

B. ENGINEER- The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

C. Geocomposite Manufacturer (MANUFACTURER)- The party responsible for manufacturing the geocomposite rolls.

D. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)-

Party, independent from the MANUFACTURER and INSTALLER,

responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.

E. INSTALLER- Party responsible for field handling, transporting, storing and deploying the geocomposite.

F. Lot- A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene geocomposite rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.04 QUALIFICATIONS

A. MANUFACTURER
1. Geocomposite shall be manufactured by the following:
   a. GSE Lining Technology, Inc.
   b. Skaps Environmental
   c. Poly-Flex Inc.
   d. approved equal
2. MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geocomposite material during the last year.

B. INSTALLER
1. Installation shall be performed by an engineered approved installer.
2. INSTALLER shall have installed a minimum of 5,000,000 square feet of geocomposite in the last 5 years.
3. The Installation Supervisor shall have worked in a similar capacity on 5 projects similar in size and complexity to the project described in the Contract Documents.

1.05 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling- Each roll delivered to the site shall be wrapped and labeled by the MANUFACTURER. The label will identify:
1. manufacturer's name
2. product identification
3. length
4. width
5. roll number

B. Delivery- Rolls will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location provided by the CONTRACTOR to protect the geonet from abrasions, excessive dirt and moisture shall have the following characteristics:
1. level (no wooden pallets)
2. smooth
3. dry
4. protected from theft and vandalism
5. adjacent to the area being lined

D. Handling
1. The CONTRACTOR and INSTALLER shall handle all rolls in such a manner to ensure they are not damaged in any way.

2. The INSTALLER shall take any necessary precautions to prevent damage to underlying layers during placement of the drainage material.

1.06 WARRANTY

A. Material shall be warranted, on a pro-rata basis against defects for a period of 1-year from the date of the geocomposite installation.

B. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geocomposite completion.

PART 2: PRODUCTS

2.01 GEOCOMPOSITE PROPERTIES

A. A geocomposite shall be manufactured by extruding two crossing strands to form a 250 mil bi-planar drainage net structure with 8 oz/square yard nonwoven geotextiles bonded to both sides.

B. The geocomposite shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by the ENGINEER.

C. The geocomposite shall meet the minimum average roll value (MARV) properties and be tested by the manufacturer as listed in Table 1.

Table 02621-1 – Geocomposite Properties, Test Methods/Frequencies, and Values

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE ROLL VALUE		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Product Code			F52060060S	F52080080S	F52100100S
Transmissivity[b], gal/min/ft (m²/sec)	ASTM D 4716	1/540,000 ft²	2.41 (5x10⁻⁴)	2.41 (5x10⁻⁴)	2.41 (5x10⁻⁴)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft²	1.0 (178)	1.0 (178)	1.0 (178)
Roll Width[c], ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length[c], ft (m)			200 (60)	190 (57.9)	180 (54.9)
Roll Area, ft² (m²)			2,900 (269)	2,755 (256)	2,610 (242)
Geonet core[d]					
Transmissivity[b], gal/min/ft (m²/sec)	ASTM D 4716		14.49 (3x10⁻³)	14.49 (3x10⁻³)	14.49 (3x10⁻³)
Thickness, mil (mm)	ASTM D 5199	1/50,000 ft²	250 (6.3)	250 (6.3)	250 (6.3)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035	1/50,000 ft²	55 (9.6)	55 (9.6)	55 (9.6)
Carbon Black Content, %	ASTM D 1603	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[d,e]					
Mass per Unit Area, oz/yd² (g/m²)	ASTM D 5261	1/90,000 ft²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft²	170 (755)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft²	90 (395)	120 (525)	165 (725)
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec⁻¹)	ASTM D 4491	1/540,000 ft²	1.5	1.5	1.2
Flow Rate, gpm/ft² (l/min/m²)	ASTM D 4491	1/540,000 ft²	110 (4,480)	110 (4,480)	85 (3,460)
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70

NOTES:

- [b]These are MARV values and are based on the cumulative results of specimens tested and as determined by GSE. AOS in mm is a maximum average roll value.
- [b]Gradient of 0.1, normal load of 10,000 psf, water at 70° F between stainless steel plates for 15 minutes.
- [c]Roll widths and lengths have a tolerance of ±1%.
- [d]Component properties prior to lamination.
- [e]Refer to geotextile product data sheet for additional specifications.

C. Geonet Resin
   1. Resin shall be new first quality, compounded polyethylene resin.
   2. Natural resin (without carbon black) shall meet the additional *minimum requirements in Table 2.*

Table 02621-2 – Geonet Resin Requirements

Property	Test Method	Value
Density (g/cm³)	ASTM D 1505	≥0.94
Melt Flow Index (g/10 min)	ASTM D 1238	≤ 1.0

2.02 CONFORMANCE TESTING

A. The geocomposite shall be conformance tested by an independent qualified and approved labo in accordance with the test methods and frequencies listed below in Table 3.

Table 02621-3 Conformance Quality Control Test Frequencies

Characteristics	Test Method	Units	FREQUENCY
Resin			
Polymer Density	ASTM D 1505	g/cm^3	1/100,000 ft
Melt Flow Index	ASTM D 1238	g/10 min	1/100,000 ft
Geonet			
Carbon Black	ASTM D 1603	%	1/100,000 ft^2
Tensile Strength, MD	ASTM D 5035	lb/ ft	1/100,000 ft^2
Density	ASTM D 1505	g/cm^3	1/100,000 ft^2
Geotextile			
Mass per Unit Area	ASTM D 5261	oz/yd^2	1/100,000 ft^2
Grab Tensile	ASTM D 4632	lb	1/100,000 ft^2
Puncture	ASTM D 4833	lb	1/100,000 ft^2
AOS, US Sieve	ASTM D 4751	mm	1/100,000 ft^2
Water Flow Rate	ASTM D 4491	gpm/ft^2	1/100,000 ft^2
UV Resistance	ASTM D 4355 (after 500 hours)	% retained	Once per resin formulation
Geocomposite			
Ply Adhesion	ASTM D7005	lb/in	1/100,000 ft^2
Transmissivity	ASTM D 4716	m^2/sec	1/100,000 ft^2

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection
   1. Prior to implementing any of the work in the Section to be lined, the INSTALLER shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.
   2. If the INSTALLER has any concerns regarding the installed work of other Sections, he shall notify the Project ENGINEER.

3.02 MATERIAL PLACEMENT

A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the ENGINEER.

B. If the project contains long, steep slopes, special care should be taken so that only full length rolls are used at the top of the slope.

C. In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

D. The geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.

E. In applying fill material, no equipment can drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure up to 5 psi direct load.

F. The cover soil shall be placed in the geocomposite in a manner that prevents damage

to the geocomposite. Placement of the cover soil shall proceed immediately following the placement and inspection of the geocomposite.

3.03 SEAMS AND OVERLAPS

A. Each component of the geocomposite will be secured or seamed to the like component at overlaps.

B. Geonet Components
1. Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.
2. The overlaps shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 5 feet along the roll length.
3. Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width.
4. The geonet portion should be tied every 6 inches in the anchor trench or as specified by the ENGINEER.

3.04 REPAIR

A. Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.

B. Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geonet by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be cut out and the two portions of the geonet shall be joined in accordance with Subsection 3.03.

END OF SECTION

APPENDIX B
60 MIL HDPE GEOMEMBRANE

SECTION 02778

60 MIL HDPE GEOMEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes furnishing and installing double-side textured HDPE geomembrane for the landfill composite liner in accordance with the Specifications and the Drawings.

1.2 RELATED SECTIONS

A. Section 02221 — Excavating and Stockpiling.

B. Section 02222 — Engineered Fill, Foundation Layer, Operations Layer, and Anchor Trench Backfill.

C. Section 02774 — Drainage Geocomposite.

D. Section 02779 — Geosynthetic Clay Liner.

1.3 REFERENCES

A. GRI-GM11— Accelerated Weathering of Geomembranes using a Fluorescent UVA Condensation

B. GRI-GM12 — Standard Specification for Asperity Measurement of Textured Geomembranes using a Depth Gage.

C. GRI-GM13 — Standard Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

D. ASTM D792 — Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

E. ASTM D1004 — Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

F. ASTM D1505 — Standard Test Method for Density of Plastics by the Density Gradient Technique.

G. ASTM D1603 — Standard Test Method for Carbon Black in Olefin Plastics.

H. ASTM D3895 — Standard Test Method for Copper Induced Oxidative Induction Time of Polyolefins by Thermal Analysis.

I. ASTM D4833 — Standard Test Method for Index Puncture of Geotextiles, Geomembranes, and Related Products.

J. ASTM D4873 — Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

K. ASTM D5199 — Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

L. ASTM D5397 — Standard Test Method for Evaluation of Stress Crack of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

M. ASTM D5596 — Standard Test Method for Microscopic Evaluation of Dispersion of Carbon Black in Polyolefin Geosynthetics.

N. ASTM D5617 — Standard Test Method for Multi-Axial Tension Test for Geosynthetics.

O. ASTM D5885 — Standard Test Method for Oxidation Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

P. ASTM D5994 — Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

Q. ASTM D6243 — Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

R. ASTM D6392 — Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

S. ASTM D6693 — Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

1.4 DEFINITIONS

A. Batch: A quantity of resin, usually the capacity of one rail car, used in the manufacture of high density polyethylene (HDPE) geomembrane sheet. A roll number corresponding to the particular lot of resin used will identify the finished sheet.

B. Bridging: The condition when geomembrane becomes suspended over its subgrade due to contraction of the material or poor installation.

C. Construction Quality Assurance Consultant (CQAC): The party, independent from MANUFACTURER or INSTALLER, that is responsible for observing and documenting activities related to the quality assurance of production and installation of the geosynthetic components of the lining system.

D. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site.

E. Construction Quality Assurance (CQA) Monitor: The site representative of the CQAC.

F. Extrudate: The molten polymer that is emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon rod, bead or pellets.

G. Fabricator: The party responsible for the fabrication of geomembrane panels constructed from rolls received from the MANUFACTURER.

H. Geomembrane MANUFACTURER: The party responsible for the production of the geomembrane rolls from resin and for the quality of the resin.

I. Geomembrane: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).

J. Geomembrane Subsurface: The soil or geosynthetic surface on which the geomembrane lies.

K. INSTALLER: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining (against wind), and installation of the geomembrane.

L. Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll without any seams.

1.5 PRE-CONSTRUCTION SUBMITTALS (MANUFACTURER AND INSTALLER)

A. Submit the following to the OWNER, 7 days prior to receiving material at site.

B. Resin Data. (MANUFACTURER)

1. Statement of production date or dates.

2. Certification stating that the resin meets the product requirements (see paragraph 2.2).

3. Certification stating that all resin is from the same MANUFACTURER.

4. Copy of quality control certificates issued by MANUFACTURER.

5. Test reports from MANUFACTURER.

C. Geomembrane Roll. (MANUFACTURER)

1. Statement of production date or dates.

2. Laboratory test results and certification stating that the geomembrane meets the product requirements (see paragraph 2.3).

3. Certification stating that all geomembrane rolls are furnished by one supplier, and that all rolls are manufactured from one resin type obtained from one resin supplier.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Typical test results of complete notched constant tensile load test (ASTM D5397) for specified resin and sheet thickness.

7. Statement certifying that no reclaimed polymer is added to the resin.

8. Statement listing percentages of processing aids, antioxidants, and other additives other than carbon black added to or in the resin.

9. Geomembrane delivery, storage, and handling instructions.

10. Geomembrane installation instructions.

11. Sample warranties for review.

D. Extrudate Beads and/or Rod. (MANUFACTURER)

1. Statement of the production date or dates.

2. Laboratory certification stating that the extrudate meets the product requirements (see paragraph 2.4).

3. Certification stating that one MANUFACTURER manufactures all extrudate and one supplier supplies the resin.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Certification stating that the extrudate bead or rod resin is the same type, from the same MANUFACTURER and compatible with the resin used to manufacture the geomembrane supplied for this project.

E. Schedules and drawings (INSTALLER).

1. Work schedule: Submit the installation schedule one week prior to installation. Include hours worked per day, per week and per shift. Indicate all weather delays built into schedule.

2. Installation layout drawings: Two weeks prior to installation of the geomembrane, submit drawings showing the panel layout indicating both fabricated (if applicable) and field seams, and details not conforming to the Drawings. Upon acceptance, use these drawings for installation of geomembrane.

F. Qualifications (INSTALLER).

1. Submit, two weeks prior to installation, the name of INSTALLER, and resume of installation supervisor/field ENGINEER to be assigned to the project.

2. Submit, two weeks prior to installation, resume of master seamer(s).

G. Equipment and Personnel: Submit the following two weeks prior to installation: (INSTALLER).

1. Equipment list stating quantity and types.

2. List of personnel to perform field seaming operations.

1.6 SUBMITTALS DURING CONSTRUCTION (INSTALLER)

A. Submit quality control documentation prepared during the installation.

B. Submit daily prior to the start of installation, subgrade acceptance certificate signed by the installation supervisor for each area to be covered by geosynthetics.

1.7 SUBMIT UPON COMPLETION OF THE INSTALLATION (INSTALLER)

A. Certificate stating the liner has been installed in accordance with the Drawings and Specifications.

B. The warranty obtained from the MANUFACTURER/Fabricator and the installation warranty.

C. As built drawings showing location of panels, seams, repairs, patches, and destructive samples, including measurements.

D. Copies of seam test results and statistical analysis of each welder's performance.

1.8 QUALIFICATIONS

A. MANUFACTURER/Fabricator/Installation Firm.

1. GSE, Inc., 19103 Gundle Road, Houston, Texas 77073, (800) 435-2008.

2. Poly-Flex, 2000 West Marshall Drive, Grand Prairie, Texas 75051, (888) 765-9359.

3. AGRU/America, Inc., 600 Rockmead, Suite 300, Kingwood, Texas 77339, (800) 373-2478.

B. INSTALLER: Must have successfully installed a minimum of 10,000,000 square feet of welded polyethylene geomembrane with documented references.

C. Master Welder Qualifications: Must have completed a minimum of 5,000,000 square feet of polyethylene geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

D. Other Seamer's Qualifications: Must have seamed a minimum of 1,000,000 square feet of HDPE geomembrane.

1.9 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC), and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of geomembrane material being installed unless otherwise specified.

1.10 DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. General: Conform to the MANUFACTURER's requirements.

B. Delivery.

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until OWNER determines proper disposition of material.

3. OWNER will determine the extent of damage to geomembrane.

4. Deliver in rolls, do not fold.

C. Storage on Site: (INSTALLER).

1. Store geomembrane rolls in the space allocated by the OWNER.

2. Store geomembrane rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geomembrane rolls on prepared surface (not on wooden pallets).

4. Stack geomembrane no more than three rolls high.

D. Handling on Site: (INSTALLER).

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader, and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material will be rejected.

3. CONTRACTOR is responsible for off loading, storage, and transporting material from storage area to installation site.

1.11 WARRANTY (MANUFACTURER)

A. Provide MANUFACTURER's warranty for geomembrane material in compliance with provisions of the Conditions of the Contract. Provide a minimum 20 year pro rata warranty for the material against deterioration due to exposure to the elements, either exposed or buried. The warranty for material must cover costs of material replacement and installation; assuming the area is rendered in a clean, dry, unencumbered condition. In the event the area cannot be rendered as such, compensation for defective material will be provided to the OWNER on a pro rata basis for the estimated cost to the OWNER at that time of supplying and installing material to a clean, dry, and unencumbered condition by a third party INSTALLER.

B. Installation: Provide an installation warranty for geomembrane material in compliance with the conditions of the Contract. Provide a minimum of 2 year, non-pro rata warranty for the installation against defects.

PART 2 PRODUCTS (MANUFACTURER)

2.1 PRE-APPROVED MANUFACTURER

A. GSE, Inc., 19103 Gundle Road, Houston, Texas.

B. Poly-Flex, 2000 West Marshall Drive, Grand Prairie, Texas 75051, (888) 765-9359.

C. AGRU/America, Inc., 600 Rockmead, Suite 300, Kingwood, Texas 77339, (800) 373-2478.

2.2 GEOMEMBRANE RESIN

A. High Density Polyethylene (HDPE), new, first quality, and manufactured specifically for producing HDPE geomembrane.

B. Do not mix resin types during manufacturing.

C. Do not use recycled materials or seconds in manufacturing.

D. Meeting the following requirements unless otherwise approved:

TABLE 02778-1

HDPE RESIN PROPERTIES

Test	Test Designation	Requirement
Density(1)	ASTM D792 Method A or ASTM D1505	Greater than 0.932 g/cm^3
Notes: (1) Measured on resin prior to addition of carbon black. Greater than 0.940 g/cm^3 with carbon black.		

2.3 60 MIL HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

A. Manufacturing.

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black or pigment. Identify percentage of processing aids, antioxidants, and other additives other than carbon black.

2. Do not exceed 3.5 percent by weight of finished geomembrane for total combined processing aids, antioxidants, carbon black, and other additives.

3. Textured on both sides.

4. All additives for UV protection, thermal stability, color, or processing agents must not "bloom" to the surface over time or inhibit welding.

5. Use materials produced in the United States or Canada.

6. Provide finished product free from blemishes, holes, pin holes, bubbles, blisters, excessive gels, undispersed resins, and/or carbon black, contamination by foreign matter and nicks or cuts on edges.

7. Roll manufactured sheets or panel for shipment.

8. The 60 mil smooth HDPE and 60 mil double sided HDPE textured geomembranes shall meet the minimum average roll values (MARV) and requirements of Table 02778-2 and Table 02778-3, respectively, unless otherwise specified or approved. 60 mil textured will be used on all slopes greater than 8 degrees.

TABLE 02778-2

PROPERTIES FOR 60 MIL SMOOTH HDPE GEOMEMBRANE

Test	Test Designation	Requirement
Sheet Thickness	ASTM D5994	60 mils MARV, min 54 mils
Sheet Density	ASTM D792 / ASTM D1505	0.940 to 0.950 g/cm^3
Oxidation Induction Time[1]	ASTM D3895, 200°C, 1 atm	Min. 100 minutes
	Or ASTM D5885	Min. 400 minutes
Tensile Strength at Yield	ASTM D6693, Type IV, 2 ipm	130 lbs/in-width
Elongation at Yield	ASTM D6693, Type IV, 2 ipm, 1.3 in. gage length	13%
Elongation at Break	ASTM D6693, Type IV, 2 ipm, 2.0 in. gage length	700%
Tear Resistance	ASTM D1004, Die C	42 lbs
Puncture Resistance	ASTM D4833	108 lbs
Axi-Symmetric Break Strain	ASTM D5617	Min. 13%
Notched Constant Tensile Load[2]	ASTM D5397	Min 300 hrs @ 30% of yield stress
UV Resistance / High Pressure OIT[3]	GRI-GM13	Min 50%
Carbon Black Content	ASTM D1603	2% to 3%
Carbon Black Dispersion	ASTM D5596	9 of 10 different views in Categories 1 or 2, and 1 of 10 in Category 3.
Asperity Height[4]	GRI GM12	20 mils avg, min 16 mils
Interface Shear Strength[5]	ASTM D6243	Confining Stress (lbs/ft^2) / Shear Stress (lbs/ft^2): 2,000 / 281; 4,000 / 562; 8,000 / 1,124

(1) The MANUFACTURER has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(2) P-NCTL test is not appropriate for testing geomembranes with irregular rough surfaces. The test should be conducted on smooth edge of textured rolls or on smooth sheets made from the same formulation as the textured material being evaluated. Each test performed with five samples; all must pass.

(3) UV resistance is based on percent retained after 1600 hours regardless of the original HP-OIT value.

(4) The ENGINEER may accept a lower value if it can be demonstrated that the proposed lower asperity height can achieve the interface strengths shown.

(5) Requirements apply to the post-peak HDPE geomembrane/GCL interface strength at 3.0 inches of displacement.

TABLE 02778-3

PROPERTIES FOR 60 MIL TEXTURED DOUBLE-SIDED HDPE GEOMEMBRANE

Test	Test Designation	Requirement
Sheet Thickness	ASTM D5994	60 mils MARV, min 54 mils
Sheet Density	ASTM D792 / ASTM D1505	0.940 to 0.950 g/cm^3
Oxidation Induction Time[1]	ASTM D3895, 200°C, 1 atm Or ASTM D5885	Min. 100 minutes Min. 400 minutes
Tensile Strength at Yield	ASTM D6693, Type IV, 2 ipm	130 lbs/in-width
Elongation at Yield	ASTM D6693, Type IV, 2 ipm, 1.3 in. gage length	13%
Elongation at Break	ASTM D6693, Type IV, 2 ipm, 2.0 in. gage length	150%
Tear Resistance	ASTM D1004, Die C	42 lbs
Puncture Resistance	ASTM D4833	108 lbs
Axi-Symmetric Break Strain	ASTM D5617	Min. 15%, Avg. 18%
Notched Constant Tensile Load[2]	ASTM D5397	Min 300 hrs @ 30% of yield stress
UV Resistance / High Pressure OIT[3]	GRI-GM13	Min 50%
Carbon Black Content	ASTM D1603	2% to 3%
Carbon Black Dispersion	ASTM D5596	9 of 10 different views in Categories 1 or 2, and 1 of 10 in Category 3.
Asperity Height[4]	GRI GM12	20 mils avg, min 16 mils
Interface Shear Strength[5]	ASTM D6243	Confining Stress (lbs/ft^2) / Shear Stress (lbs/ft^2) 2,000 / 281 4,000 / 562 8,000 / 1,124

(1) The MANUFACTURER has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(2) P-NCTL test is not appropriate for testing geomembranes with irregular rough surfaces. The test should be conducted on smooth edge of textured rolls or on smooth sheets made from the same formulation as the textured material being evaluated. Each test performed with five samples; all must pass.

(3) UV resistance is based on percent retained after 1600 hours regardless of the original HP-OIT value.

(4) The ENGINEER may accept a lower value if it can be demonstrated that the proposed lower asperity height can achieve the interface strengths shown.

(5) Requirements apply to the post-peak HDPE geomembrane/GCL interface strength at 3.0 inches of displacement

2.4 EXTRUDATE ROD OR BEAD

A. Meeting the geomembrane MANUFACTURER requirements.

B. Made from same resin as the geomembrane.

C. Thoroughly disperse additives throughout rod or bead.

D. Containing 2 to 3 percent carbon black.

E. Free of contamination by moisture or foreign matter.

2.5 WELDING EQUIPMENT FOR INSTALLATION

A. Maintain sufficient operational seaming apparatus to continue work without delay.

B. Use power source capable of providing constant voltage under combined line load.

C. Provide protective lining and splash pad large enough to catch spilled fuel under electric generator, if located on liner.

D. Tensiometers capable of measuring seam strength, calibrated and accurate within 2 pounds.

E. Dies for cutting seam samples.

2.6 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the following quality control tests at the manufacturing plant on geomembrane products as listed in Table 02778-4:

TABLE 02778-4

MANUFACTURER'S QUALITY CONTROL TESTING REQUIREMENTS

Test	Test Designation	Frequency (see footnotes)
Sheet Thickness	ASTM D5994	10 per roll
Sheet Density	ASTM D792 or ASTM D1505	(a)
Oxidation Induction Time	ASTM D3895 or D5885	(b)
Tensile Strength Yield	ASTM D6693, Type IV	(c)
Elongation at Yield	ASTM D6693, Type IV	(c)
Elongation at Break	ASTM D6693, Type IV	(c)
Tear Resistance	ASTM D1004, Die C	(c)
Puncture Resistance	ASTM D4833	(c)
Axi-Symmetric Break Strain	ASTM D5617	(b)
Notched Constant Tensile Load	ASTM D5397	(b)
UV Resistance (HP OIT)	GRI-GM 11 / ASTM D5885	(b)
Carbon Black Content	ASTM D1603	(c)
Carbon Black Dispersion	ASTM D5596	(c)
Asperity Height	GRI GM12	10 per roll (each side)
Interface Shear Strength	ASTM D6243	(d)

(a) One per 100,000 square feet or one per resin batch, whichever results in the greatest number of tests.

(b) One test per resin batch.

(c) One per 50,000 square feet or one per resin batch, whichever results in the greater number of tests.

(d) One test per project, per material on representative geomembrane and seam. Perform a tensile test (ASTM D6693) on a sample obtained from the same sheet and a test (ASTM D6392) on the seam.

PART 3 EXECUTION (INSTALLER)

3.1 EXAMINATION OF GEOMEMBRANE SUBSURFACE

A. Verify that the GCL has been installed, tested, and approved prior to placement of the geomembrane.

3.2 PREPARATION

A. Repair damage caused to the underlying materials during deployment.

B. Round edges of anchor trenches.

3.3 PERFORM TRIAL SEAM WELDS AS FOLLOWS:

A. Perform trial welds on samples of geomembrane to verify the performance of welding equipment, seaming methods, and conditions.

B. No seaming equipment or welder will be allowed to perform production welds until equipment and welders have successfully completed trial weld.

C. Frequency of trial welds:

1. Minimum of two trial welds per day per equipment and welder, with one prior to the start of work and one at mid shift.

2. When directed by the CQA Monitor.

3. Every two hours when using a wedge weld to weld across seams.

4. Minimum one trial weld per person per shift.

5. When ambient temperature changes more than 20°F since previous trial weld.

D. Make trial welds in the same surroundings and environmental conditions as the production welds, i.e., in contact with subgrade.

E. Make trial weld sample at least 2 feet long, 3 feet long for double wedge welding machines and 12 inches wide with the seam centered lengthwise.

F. Cut four, one inch wide test strips randomly selected across the length of the trial weld. Test specimens for peel adhesion and for bonded seam strength (shear) (ASTM D6392).

G. A specimen is considered passing when the following results are achieved. For double wedge welding, both welds must pass in peel and shear.

1. The break is a film tearing bond (FTB).

2. The break is ductile.

3. The peel strength is a minimum of 70 percent of the specified sheet strength at yield for wedge welds or flat welds and a minimum of 60 percent of the specified sheet strength at yield for extrusion welds.

4. There is no more than 10 percent separation of the weld. For wedge welds the width of the weld must be equal to the width of the nip roller.

5. The shear strength is 90 percent of the specified sheet strength at yield for all weld types. Minimum elongation between the grips is 2 inches based on an initial grip separation of 2 inches from the edge of the weld.

H. A trial weld sample is considered passing when all specimens pass peel and shear tests.

I. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear.

J. When repeated trial welds fail, do not use welding apparatus and welder until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

3.4 DEPLOYMENT

A. Ambient Conditions: Give careful consideration to the timing and temperature during deployment. The CQA organization will focus on verifying that (a) there is no bridging or stresses in the geomembrane and (b) there are no wrinkles in the geomembrane that will fold over when covering with soil material. Ideally, deployment, welding, and covering would all occur at the same temperature. In a practical sense the CONTRACTOR should strive to perform these activities within as narrow a temperature range as practical, and avoid these activities during peak hot or cold conditions.

B. Panel Identification: Assign each panel an identifying code number or letter consistent with the CONTRACTOR's submitted panel layout drawing. The coding is subject to approval by the CQA Monitor. The installer is responsible to place the identification code on the installed liner which consists of panel number, roll number, and panel length.

C. Daily Panel Deployment: Deploy no more panels in one shift than can be welded or secured during that same day.

D. Do not deploy in the presence of excessive moisture, precipitation, ponded water, or high winds.

E. Do not damage geomembrane by handling, by trafficking, or leakage of hydrocarbons or any other means.

F. Do not wear damaging shoes or engage in activities that could damage the geomembrane.

G. Unroll geomembrane panels using methods that will not damage, stretch or crimp geomembrane. Protect underlying surface from damage.

H. Use methods that minimize wrinkles and differential wrinkles between adjacent panels.

I. Place ballast on geomembrane to prevent uplift from wind.

J. Use ballast that will not damage geomembrane, such as sandbags or equivalent.

K. The subgrade will be smooth drum rolled, free of debris and organic material, maximum size protrusions of 0.5-inch, and free of vertical indentations and rutting more than 1-inch.

L. Protect the geomembrane in areas of equipment or repeated foot traffic by placing protective cover that is compatible with and will not damage geomembrane.

M. Repair damage to the subgrade or other underlying materials prior to completing deployment of the geomembrane.

N. Do not allow any vehicular traffic directly on unprotected geomembrane.

O. Remove wrinkled or folded material.

P. Visually inspect geomembrane for imperfections. Mark faulty or suspect areas for repair.

Q. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material, such as compensation wrinkles at the toe of slopes, as needed to avoid bridging.

R. Before wrinkles fold over, attempt to push them out. For wrinkles that cannot be pushed out, cut them out and repair cuts prior to burial or at the direction of the OWNER.

3.5 SEAM LAYOUT

A. Orient seams parallel to the line of maximum slope, i.e., orient down not across slopes.

B. Minimize the number of field seams in corners, odd shaped geometric locations, and outside corners.

C. Keep horizontal seams (seams running approximately parallel to slope contours) at least 6 feet away from toe or crest of slopes unless otherwise approved by the OWNER.

D. Use a seam numbering system consistent with panel number system.

E. Shingle panels on all slopes and grades as directed by the OWNER.

3.6 SEAM WELDING PERSONNEL

A. Provide at least one welder (master welder) who has experience welding over 5 million square feet of geomembrane using the same type of welding apparatus in use at site.

B. Qualify personnel performing welding operations by experience and by successfully passing field welding tests performed on site.

C. The master welder will provide direct supervision over other welders.

3.7 SEAM WELDING EQUIPMENT

A. Extrusion welder: equipped with gauges showing temperatures in extruder apparatus at the barrel and nozzle of the extruder. External temperature gauges may measure temperature at nozzle.

B. Hot wedge welder: Automated variable speed vehicular mounted devices equipped with devices adjusting and giving temperatures of the wedges. Pressure controlled by spring, pneumatic, or other system that allows for variation in sheet thickness. Rigid frame fixed position equipment is not acceptable.

C. Maintain adequate quality of welding apparatus in order to avoid delaying the project.

D. Use a power source capable of providing constant voltage under combined line load.

3.8 GENERAL WELDING PROCEDURES

A. Do not commence welding with welding equipment until the trial weld test samples, made by that equipment, passes the test weld.

B. Clean all geomembrane surfaces of grease, moisture, dust, dirt, debris, or other foreign material.

C. Overlap panels a minimum of 3 inches for extrusion welding and 4 inches for hot wedge welding.

D. Do not use solvents or adhesives.

E. Provide adequate material on each weld to allow peel testing of both sides of double wedge welds and extrusion welds.

F. Extend welding to the outside edge of all panels.

G. If required, provide a firm substrate by using a geomembrane rub sheet, a flat board, a conveyor belt, or similar hard surface directly under the weld overlap to achieve firm support.

H. Provide adequate illumination if welding operations are carried out at night.

I. Cut fishmouths or wrinkles along the ridge of the wrinkle in order to achieve a flap overlap. Extrusion weld the cut fishmouths or wrinkles where the overlap is more than 3 inches. When there is less than 3 inches overlap, patch with an oval or round patch extending a minimum of 6 inches beyond the cut in all directions.

3.9 INSTALLATION QUALITY CONTROL

A. Log the following every two hours:

1. Temperature directly on the geomembrane surface being welded.

2. Extrudate temperatures in barrel and at nozzle (extrusion welder).

3. Operating temperature of hot wedge (hot wedge welder) and any pressure adjustments made.

4. Preheat temperature.

5. Speed of hot wedge welder in feet per minute.

B. Weld only when ambient temperature, measured 6 inches above the geomembrane, is between 32°F and 130°F.

C. If the INSTALLER wishes to use methods which may allow seaming at ambient temperatures below 32°F or above 130°F, the INSTALLER shall demonstrate and certify that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 32°F and below 130°F, and that the overall quality of the geomembrane is not adversely affected. Then, the temperatures in the above quality assurance procedure shall be modified accordingly.

3.10 DEFECTS AND REPAIRS

A. Examine all welds and non weld areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of the examination.

B. Repair and non destructively test each suspect location both in weld and non weld areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

C. Extrusion weld a patch over all "cross" or "tee" welds.

3.11 EXTRUSION TYPE OF WELDING

A. Use procedures to tack bond adjacent panels together that do not damage the geomembrane and allow quality control tests to be performed.

B. Purge welding apparatus of heat degraded extrudate before welding.

C. Bevel the top edges of top geomembrane a minimum of 45° and full thickness of the geomembrane before extrusion welding.

D. Clean seam welding surfaces of oxidation by disc grinder or equivalent not more than 30 minutes before extruding weld. Change grinding discs frequently. Do not use clogged discs.

E. Do not remove more than 4 mils of material when grinding.

F. Grind across, not parallel to, welds.

G. Cover the entire width of grind area with extrudate.

H. When restarting welding, grind ends of all welds that are more than five minutes old.

3.12 HOT WEDGE WELDING

A. Place a smooth insulating plate or fabric beneath hot welding apparatus after usage so as to not damage the geomembrane.

B. Protect against moisture build up between panels.

C. If welding cross seams, conduct field test welds at least every two hours, otherwise, once prior to start of work and once at mid day.

D. Bevel edges of top and bottom panels on cross seams.

E. Do not weld on geomembrane until equipment has passed trial weld test.

F. Extrusion weld a repair patch over all seam intersections as described in paragraph 3.10.

3.13 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. MANUFACTURER, Fabricator, and INSTALLER will participate in and conform with all terms and requirements of the OWNER's quality assurance program. The CONTRACTOR is responsible for assuring this participation. Quality control and quality assurance requirements are as specified in this paragraph.

3.14 CONFORMANCE TESTING (PERFORMED BY CONSTRUCTION QUALITY ASSURANCE LABORATORY)

A. Allow 3 days for conformance testing following the date material is available to the CQA Laboratory.

B. Perform conformance testing on geomembrane rolls.

C. Obtain 3-feet samples across entire roll width not including the first 3 feet of material. The CQA Monitor will obtain samples with assistance from CONTRACTOR. At the option of the OWNER, conformance samples may be obtained directly from the MANUFACTURER.

D. Forward samples to Construction Quality Assurance Laboratory.

E. Test samples for conformance with design specifications and guaranteed properties.

F. Perform, as a minimum, the following tests to determine the geomembrane characteristics.

1. Sheet Density: ASTM D792 or ASTM D1505.

2. Thickness and asperity height: Measured with appropriate equipment. Take five measurements across the roll width.

3. Tensile Strength: ASTM D6693.

4. Carbon Black Content: ASTM D1603.

5. Carbon Black Dispersion: ASTM D5596.

6. Where optional procedures are noted in the test method, the requirements of the specifications prevail.

7. Additional tests may be performed at the discretion of the CQAC.

8. Interface strength tests as outlined in Section 02779, 1.5.A.3.e.

G. Sampling Procedures

1. Sample across the entire width of the roll.

2. Cut sample 3 feet long by width of roll.

3. Mark machine direction on the samples with an arrow. CQA Monitor will be responsible for markings.

4. Sample at a rate of one per batch or one per one hundred thousand square feet of material supplied, whichever results in greatest number.

3.15 FIELD TESTING (PERFORMED BY INSTALLER)

A. General: Non destructively test all field seams over their full length using a vacuum test unit, air pressure (for double fusion seams only), spark testing, or other approved methods. Perform testing as the seaming progresses and not at the completion of all the field seaming. Complete all required repairs in accordance with this specification.

B. Vacuum Testing Equipment

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole, or valve assembly, and a vacuum gauge.

2. A vacuum pump assembly equipped with a pressure control.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A soapy solution and an applicator.

C. Vacuum Box Test Procedures

1. Place the box over the wetted seam area (soapy solution).

2. Ensure that a leak tight seal is created.

3. Energize the vacuum pump and reduce the vacuum box pressure to approximately 10 inches of mercury, i.e., five psi gauge.

4. Examine the geomembrane through the viewing window for the presence of soap bubbles for a period of not less than ten seconds.

5. All areas where soap bubbles appear shall be marked and repaired in accordance with repair procedures described in this specification.

D. Air pressure testing for seaming processes producing a double seam with an enclosed channel.

1. Equipment, comprised of the following:

a. An air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure over 40 psi and mounted on a cushion to protect the geomembrane.

b. A rubber hose with fittings and connections.

c. A sharp hollow needle, or other approved pressure feed device.

d. A pressure gauge with an accuracy of plus or minus one psi.

2. Test Procedures.

a. Seal both ends of the welded seam to be tested.

b. Insert needle or other approved pressure feed device into the tunnel created by the weld.

c. Energize the air pump to a minimum pressure of 30 psi or 1/2 psi per mil of liner thickness, whichever is greater, close valve and sustain pressure for at least five minutes.

d. If loss of pressure exceeds three psi (ten mm mercury), or otherwise approved, or does not stabilize, locate faulty area and repair in accordance with repair procedures described in this specification.

e. Puncture opposite end of seam to release air. If blockage is present, locate and test seam on both sides of blockage.

f. Remove needle or other approved pressure feed device and seal the penetration holes.

E. Spark Testing for penetrations or other difficult areas not accessible to vacuum testing.

1. Equipment and Materials.

a. 24 gauge copper wire.

b. Low-amperage electric detector, 20,000 to 30,000 volt, with brush-type electrode capable of causing visible arc up to ¾ inch from copper wire.

2. Procedures.

a. Place copper wire within 1/4 inch of the edge of extrusion seam or clamp seal.

b. Pass electrode over the seam or clamp the area and observe for a spark. If a spark is detected perform a repair.

3.16 LABORATORY DESTRUCTIVE TESTING (PERFORMED BY OWNER AND THE INSTALLER)

A. Location and Frequency of Testing.

1. Collect destructive test samples at a minimum frequency of one test location per 500 feet of seam length.

2. Determine test locations during welding. Locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or suspected defect. The OWNER will be responsible for choosing the locations. The Monitor will not notify INSTALLER in advance of selecting locations where weld samples will be taken.

3. The OWNER may increase the test frequency based on marginal results.

B. Sampling Procedures.

1. Cut samples at locations designated by the OWNER as the welding progresses. Verify that laboratory test results have been obtained before the geomembrane is covered by another material.

2. The OWNER will number each sample and mark sample number and location in compliance with the CQA program.

3. Immediately repair all holes in the geomembrane resulting from destructive test sampling. Repair in accordance with repair procedures described in this Section. Test the continuity of the repair in accordance with this Section.

4. Size of Samples: minimum 12 inches wide by 42 inches long with the seam centered lengthwise. Cut a one-inch wide strip from each end of the sample and test these for (shear and peel) in the field. Cut the remaining sample into three parts for distribution as follows:

a. One portion for the INSTALLER: 12 inches by 12 inches.

b. One portion for Construction Quality Assurance Laboratory: 12 inches by 18 inches.

c. One portion to the OWNER for archive storage: minimum 12 inches by 12 inches.

3.17 FIELD TESTING (PERFORMED BY INSTALLER)

A. Test the two, one-inch wide strips specified in paragraph 3.16, B, by tensiometer for peel and shear, respectively.

B. Both test strips must meet peel and shear requirements for welded seams specified in paragraph 3.3.

C. If any field test sample fails, follow failed test procedures outlined in this Section.

3.18 LABORATORY TESTING PERFORMED INDEPENDENTLY BY CONSTRUCTION QUALITY ASSURANCE (CQA) LABORATORY

A. Test "seam strength" and "peel adhesion" (ASTM D6392).

B. Minimum acceptable values to be obtained for these tests are specified in paragraph 3.3, H.

C. Test at least five specimens for each test method. Five of five specimens must meet minimum requirements. None of the peel specimens may peel 100 percent, or the entire sample will be considered as failing.

D. Select specimens alternately by test from the samples (i.e., peel, shear, peel, shear...).

E. Provide test results no more than 48 hours after receiving samples.

F. For double wedge welded samples, test both sides in peel.

3.19 FAILED WELD PROCEDURES

A. Follow these procedures when there is a destructive test failure. Procedures apply when test failure is determined by the Construction Quality Assurance Laboratory, the INSTALLER, or by field tensiometer. Follow one of the following two options:

1. First Option.

a. Reconstruct or cap strip the seam between any two passing test locations. Cannot extrusion weld flap.

2. Second Option.

a. Trace the weld at least 10 feet minimum in both directions from the location of the failed test, or to the end of the weld.

b. Obtain a small sample at both locations for an additional field test.

c. If these additional test samples pass field tests, then take laboratory samples.

d. If the laboratory samples pass, then reconstruct the weld or cap between the two test sample locations that bracket the failed test location.

e. If any sample fails, then repeat the process to establish the zone in which the weld must be reconstructed.

3.20 ACCEPTABLE WELDED SEAMS

A. Bracketed by two locations from which samples have passed destructive tests.

B. For reconstructed seams exceeding 50 feet, a sample taken from within the reconstructed weld passes destructive testing.

C. Whenever a sample fails, provide additional testing for seams that were welded by the same welder and welding apparatus or welded during the same time shift.

3.21 SEAMS THAT CANNOT BE NON DESTRUCTIVELY TESTED, PERFORM THE FOLLOWING:

A. If the weld is accessible to testing equipment prior to final installation, non-destructively test the weld prior to final installation.

B. If the weld cannot be tested prior to final installation, cap strip the weld. The OWNER and the INSTALLER must observe the welding and cap stripping operations for uniformity and completeness.

3.22 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair, removal, and replacement are at CONTRACTOR's expense if the damage results from the CONTRACTOR's, the INSTALLER's, or the CONTRACTOR's SUBCONTRACTOR activities.

C. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. Agreement upon the appropriate repair method will be determined between the OWNER'S Representative and the INSTALLER. Do not commence welding on liner until trial weld test sample, made by that equipment and operator, passes trial test. Repair procedures available include:

1. Patching: Used to repair large holes (over 3/8 inch diameter), tears (over 2 inches long), undispersed raw materials, contamination by foreign matter, and to cover cross and tee connections.

2. Abrading and re-welding: Used to repair small sections of seams.

3. Spot welding or seaming: Used to repair small tears (less than 2 inches long), pin holes or other minor, localized flaws.

4. Capping: Used to repair large lengths of failed seams.

5. Removing the seam and replacing with a strip of new material.

D. In addition, satisfy the following procedures:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one (1) hour prior to the repair.

2. Clean and dry all surfaces at the time of repair.

3. The OWNER's representative, the CQAC, and the INSTALLER must accept the repair procedures, materials, and techniques in advance of the specific repair.

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches.

5. Unless otherwise instructed by the OWNER, cut geomembrane below large caps to avoid water or gas collection between the sheets.

E. Verification of repair:

1. Number and log each patch repair.

2. Non-destructively test each repair using methods specified in paragraph 3.15 of this Section.

3. Destructive tests may be required at the discretion of the OWNER's Representative.

4. Reconstruct repairs until tests indicate passing results.

3.23 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for the geomembrane until acceptance by the OWNER.

B. OWNER will accept geomembrane installation when:

1. All required documentation from the MANUFACTURER, Fabricator, and INSTALLER has been received and accepted.

2. The installation is finished.

3. Test reports verifying completion of all field seams and repairs, including associated testing, is in accord with the Section.

4. The OWNER has received written certification documents and drawings.

END OF SECTION

APPENDIX B
60 MIL TEXTURED DOUBLE SIDED HDPE GEOMEMBRANE

SECTION 02778

60 MIL TEXTURED DOUBLE-SIDED HDPE GEOMEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes furnishing and installing double-side textured HDPE geomembrane for the landfill composite liner in accordance with the Specifications and the Drawings.

1.2 RELATED SECTIONS

A. Section 02221 — Excavating and Stockpiling.

B. Section 02222 — Engineered Fill, Foundation Layer, Operations Layer, and Anchor Trench Backfill.

C. Section 02774 — Drainage Geocomposite.

D. Section 02779 — Geosynthetic Clay Liner.

1.3 REFERENCES

A. GRI-GM11— Accelerated Weathering of Geomembranes using a Fluorescent UVA Condensation

B. GRI-GM12 — Standard Specification for Asperity Measurement of Textured Geomembranes using a Depth Gage.

C. GRI-GM13 — Standard Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

D. ASTM D792 — Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.

E. ASTM D1004 — Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

F. ASTM D1505 — Standard Test Method for Density of Plastics by the Density Gradient Technique.

G. ASTM D1603 — Standard Test Method for Carbon Black in Olefin Plastics.

H. ASTM D3895 — Standard Test Method for Copper Induced Oxidative Induction Time of Polyolefins by Thermal Analysis.

I. ASTM D4833 — Standard Test Method for Index Puncture of Geotextiles, Geomembranes, and Related Products.

J. ASTM D4873 — Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.

K. ASTM D5199 — Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

L. ASTM D5397 — Standard Test Method for Evaluation of Stress Crack of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

M. ASTM D5596 — Standard Test Method for Microscopic Evaluation of Dispersion of Carbon Black in Polyolefin Geosynthetics.

N. ASTM D5617 — Standard Test Method for Multi-Axial Tension Test for Geosynthetics.

O. ASTM D5885 — Standard Test Method for Oxidation Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

P. ASTM D5994 — Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

Q. ASTM D6243 — Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

R. ASTM D6392 — Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

S. ASTM D6693 — Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

1.4 DEFINITIONS

A. Batch: A quantity of resin, usually the capacity of one rail car, used in the manufacture of high density polyethylene (HDPE) geomembrane sheet. A roll number corresponding to the particular lot of resin used will identify the finished sheet.

B. Bridging: The condition when geomembrane becomes suspended over its subgrade due to contraction of the material or poor installation.

C. Construction Quality Assurance Consultant (CQAC): The party, independent from MANUFACTURER or INSTALLER, that is responsible for observing and documenting activities related to the quality assurance of production and installation of the geosynthetic components of the lining system.

D. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site.

E. Construction Quality Assurance (CQA) Monitor: The site representative of the CQAC.

F. Extrudate: The molten polymer that is emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon rod, bead or pellets.

G. Fabricator: The party responsible for the fabrication of geomembrane panels constructed from rolls received from the MANUFACTURER.

H. Geomembrane MANUFACTURER: The party responsible for the production of the geomembrane rolls from resin and for the quality of the resin.

I. Geomembrane: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).

J. Geomembrane Subsurface: The soil or geosynthetic surface on which the geomembrane lies.

K. INSTALLER: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining (against wind), and installation of the geomembrane.

L. Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll without any seams.

1.5 PRE-CONSTRUCTION SUBMITTALS (MANUFACTURER AND INSTALLER)

A. Submit the following to the OWNER, 7 days prior to receiving material at site.

B. Resin Data. (MANUFACTURER)

1. Statement of production date or dates.

2. Certification stating that the resin meets the product requirements (see paragraph 2.2).

3. Certification stating that all resin is from the same MANUFACTURER.

4. Copy of quality control certificates issued by MANUFACTURER.

5. Test reports from MANUFACTURER.

C. Geomembrane Roll. (MANUFACTURER)

1. Statement of production date or dates.

2. Laboratory test results and certification stating that the geomembrane meets the product requirements (see paragraph 2.3).

3. Certification stating that all geomembrane rolls are furnished by one supplier, and that all rolls are manufactured from one resin type obtained from one resin supplier.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Typical test results of complete notched constant tensile load test (ASTM D5397) for specified resin and sheet thickness.

7. Statement certifying that no reclaimed polymer is added to the resin.

8. Statement listing percentages of processing aids, antioxidants, and other additives other than carbon black added to or in the resin.

9. Geomembrane delivery, storage, and handling instructions.

10. Geomembrane installation instructions.

11. Sample warranties for review.

D. Extrudate Beads and/or Rod. (MANUFACTURER)

1. Statement of the production date or dates.

2. Laboratory certification stating that the extrudate meets the product requirements (see paragraph 2.4).

3. Certification stating that one MANUFACTURER manufactures all extrudate and one supplier supplies the resin.

4. Copy of the quality control certificates issued by MANUFACTURER.

5. Test reports from the MANUFACTURER.

6. Certification stating that the extrudate bead or rod resin is the same type, from the same MANUFACTURER and compatible with the resin used to manufacture the geomembrane supplied for this project.

E. Schedules and drawings (INSTALLER).

1. Work schedule: Submit the installation schedule one week prior to installation. Include hours worked per day, per week and per shift. Indicate all weather delays built into schedule.

2. Installation layout drawings: Two weeks prior to installation of the geomembrane, submit drawings showing the panel layout indicating both fabricated (if applicable) and field seams, and details not conforming to the Drawings. Upon acceptance, use these drawings for installation of geomembrane.

F. Qualifications (INSTALLER).

1. Submit, two weeks prior to installation, the name of INSTALLER, and resume of installation supervisor/field ENGINEER to be assigned to the project.

2. Submit, two weeks prior to installation, resume of master seamer(s).

G. Equipment and Personnel: Submit the following two weeks prior to installation: (INSTALLER).

1. Equipment list stating quantity and types.

2. List of personnel to perform field seaming operations.

1.6 SUBMITTALS DURING CONSTRUCTION (INSTALLER)

A. Submit quality control documentation prepared during the installation.

B. Submit daily prior to the start of installation, subgrade acceptance certificate signed by the installation supervisor for each area to be covered by geosynthetics.

1.7 SUBMIT UPON COMPLETION OF THE INSTALLATION (INSTALLER)

A. Certificate stating the liner has been installed in accordance with the Drawings and Specifications.

B. The warranty obtained from the MANUFACTURER/Fabricator and the installation warranty.

C. As built drawings showing location of panels, seams, repairs, patches, and destructive samples, including measurements.

D. Copies of seam test results and statistical analysis of each welder's performance.

1.8 QUALIFICATIONS

A. MANUFACTURER/Fabricator/Installation Firm.

1. GSE, Inc., 19103 Gundle Road, Houston, Texas 77073, (800) 435-2008.

2. Poly-Flex, 2000 West Marshall Drive, Grand Prairie, Texas 75051, (888) 765-9359.

3. AGRU/America, Inc., 600 Rockmead, Suite 300, Kingwood, Texas 77339, (800) 373-2478.

B. INSTALLER: Must have successfully installed a minimum of 10,000,000 square feet of welded polyethylene geomembrane with documented references.

C. Master Welder Qualifications: Must have completed a minimum of 5,000,000 square feet of polyethylene geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

D. Other Seamer's Qualifications: Must have seamed a minimum of 1,000,000 square feet of HDPE geomembrane.

1.9 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC), and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of geomembrane material being installed unless otherwise specified.

1.10 DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. General: Conform to the MANUFACTURER's requirements.

B. Delivery.

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Separate damaged rolls from undamaged rolls and store at locations designated by the OWNER until OWNER determines proper disposition of material.

3. OWNER will determine the extent of damage to geomembrane.

4. Deliver in rolls, do not fold.

C. Storage on Site: (INSTALLER).

1. Store geomembrane rolls in the space allocated by the OWNER.

2. Store geomembrane rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geomembrane rolls on prepared surface (not on wooden pallets).

4. Stack geomembrane no more than three rolls high.

D. Handling on Site: (INSTALLER).

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader, and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material will be rejected.

3. CONTRACTOR is responsible for off loading, storage, and transporting material from storage area to installation site.

1.11 WARRANTY (MANUFACTURER)

A. Provide MANUFACTURER's warranty for geomembrane material in compliance with provisions of the Conditions of the Contract. Provide a minimum 20 year pro rata warranty for the material against deterioration due to exposure to the elements, either exposed or buried. The warranty for material must cover costs of material replacement and installation; assuming the area is rendered in a clean, dry, unencumbered condition. In the event the area cannot be rendered as such, compensation for defective material will be provided to the OWNER on a pro rata basis for the estimated cost to the OWNER at that time of supplying and installing material to a clean, dry, and unencumbered condition by a third party INSTALLER.

B. Installation: Provide an installation warranty for geomembrane material in compliance with the conditions of the Contract. Provide a minimum of 2 year, non-pro rata warranty for the installation against defects.

PART 2 PRODUCTS (MANUFACTURER)

2.1 PRE-APPROVED MANUFACTURER

A. GSE, Inc., 19103 Gundle Road, Houston, Texas.

B. Poly-Flex, 2000 West Marshall Drive, Grand Prairie, Texas 75051, (888) 765-9359.

C. AGRU/America, Inc., 600 Rockmead, Suite 300, Kingwood, Texas 77339, (800) 373-2478.

2.2 GEOMEMBRANE RESIN

A. High Density Polyethylene (HDPE), new, first quality, and manufactured specifically for producing HDPE geomembrane.

B. Do not mix resin types during manufacturing.

C. Do not use recycled materials or seconds in manufacturing.

D. Meeting the following requirements unless otherwise approved:

TABLE 02778-1

HDPE RESIN PROPERTIES

Test	Test Designation	Requirement
Density(1)	ASTM D792 Method A or ASTM D1505	Greater than 0.932 g/cm^3
Notes: (1) Measured on resin prior to addition of carbon black. Greater than 0.940 g/cm^3 with carbon black.		

2.3 DOUBLE-SIDE TEXTURED HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

A. Manufacturing.

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black or pigment. Identify percentage of processing aids, antioxidants, and other additives other than carbon black.

2. Do not exceed 3.5 percent by weight of finished geomembrane for total combined processing aids, antioxidants, carbon black, and other additives.

3. Textured on both sides.

4. All additives for UV protection, thermal stability, color, or processing agents must not "bloom" to the surface over time or inhibit welding.

5. Use materials produced in the United States or Canada.

6. Provide finished product free from blemishes, holes, pin holes, bubbles, blisters, excessive gels, undispersed resins, and/or carbon black, contamination by foreign matter and nicks or cuts on edges.

7. Roll manufactured sheets or panel for shipment.

8. Meeting the minimum average roll values (MARV) and requirements of Table 02778-2 unless otherwise specified or approved.

TABLE 02778-2

PROPERTIES FOR 60 MIL TEXTURED DOUBLE-SIDED HDPE GEOMEMBRANE

Test	Test Designation	Requirement
Sheet Thickness	ASTM D5994	60 mils MARV, min 54 mils
Sheet Density	ASTM D792 / ASTM D1505	0.940 to 0.950 g/cm^3
Oxidation Induction Time[1]	ASTM D3895, 200°C, 1 atm	Min. 100 minutes
	Or ASTM D5885	Min. 400 minutes
Tensile Strength at Yield	ASTM D6693, Type IV, 2 ipm	130 lbs/in-width
Elongation at Yield	ASTM D6693, Type IV, 2 ipm, 1.3 in. gage length	13%
Elongation at Break	ASTM D6693, Type IV, 2 ipm, 2.0 in. gage length	150%
Tear Resistance	ASTM D1004, Die C	42 lbs
Puncture Resistance	ASTM D4833	108 lbs
Axi-Symmetric Break Strain	ASTM D5617	Min. 15%, Avg. 18%
Notched Constant Tensile Load[2]	ASTM D5397	Min 300 hrs @ 30% of yield stress
UV Resistance / High Pressure OIT[3]	GRI-GM13	Min 50%
Carbon Black Content	ASTM D1603	2% to 3%
Carbon Black Dispersion	ASTM D5596	9 of 10 different views in Categories 1 or 2, and 1 of 10 in Category 3.
Asperity Height[4]	GRI GM12	20 mils avg, min 16 mils
Interface Shear Strength[5]	ASTM D6243	Confining Stress (lbs/ft^2) / Shear Stress (lbs/ft^2): 4,000 / 670; 8,000 / 1,240; 16,000 / 2,380

(1) The MANUFACTURER has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(2) P-NCTL test is not appropriate for testing geomembranes with irregular rough surfaces. The test should be conducted on smooth edge of textured rolls or on smooth sheets made from the same formulation as the textured material being evaluated. Each test performed with five samples; all must pass.

(3) UV resistance is based on percent retained after 1600 hours regardless of the original HP-OIT value.

(4) The ENGINEER may accept a lower value if it can be demonstrated that the proposed lower asperity height can achieve the interface strengths shown.

(5) Requirements apply to the post-peak HDPE geomembrane/GCL interface strength at 3.0 inches of displacement. Follow procedures referred in Table 02779 1.

2.4 EXTRUDATE ROD OR BEAD

A. Meeting the geomembrane MANUFACTURER requirements.

B. Made from same resin as the geomembrane.

C. Thoroughly disperse additives throughout rod or bead.

D. Containing 2 to 3 percent carbon black.

E. Free of contamination by moisture or foreign matter.

2.5 WELDING EQUIPMENT FOR INSTALLATION

A. Maintain sufficient operational seaming apparatus to continue work without delay.

B. Use power source capable of providing constant voltage under combined line load.

C. Provide protective lining and splash pad large enough to catch spilled fuel under electric generator, if located on liner.

D. Tensiometers capable of measuring seam strength, calibrated and accurate within 2 pounds.

E. Dies for cutting seam samples.

2.6 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the following quality control tests at the manufacturing plant on geomembrane products:

TABLE 02778-3

MANUFACTURER'S QUALITY CONTROL TESTING REQUIREMENTS

Test	Test Designation	Frequency (see footnotes)
Sheet Thickness	ASTM D5994	10 per roll
Sheet Density	ASTM D792 or ASTM D1505	(a)
Oxidation Induction Time	ASTM D3895 or D5885	(b)
Tensile Strength Yield	ASTM D6693, Type IV	(c)
Elongation at Yield	ASTM D6693, Type IV	(c)
Elongation at Break	ASTM D6693, Type IV	(c)
Tear Resistance	ASTM D1004, Die C	(c)
Puncture Resistance	ASTM D4833	(c)
Axi-Symmetric Break Strain	ASTM D5617	(b)
Notched Constant Tensile Load	ASTM D5397	(b)
UV Resistance (HP OIT)	GRI-GM 11 / ASTM D5885	(b)
Carbon Black Content	ASTM D1603	(c)
Carbon Black Dispersion	ASTM D5596	(c)
Asperity Height	GRI GM12	10 per roll (each side)
Interface Shear Strength[(g)]	ASTM D6243	(d)

Test	Test Designation	Frequency (see footnotes)
(a) One per 100,000 square feet or one per resin batch, whichever results in the greatest number of tests.		
(b) One test per resin batch.		
(c) One per 50,000 square feet or one per resin batch, whichever results in the greater number of tests.		
(d) One test per project, per material on representative geomembrane and seam. Perform a tensile test (ASTM D6693) on a sample obtained from the same sheet and a test (ASTM D6392) on the seam.		

PART 3 EXECUTION (INSTALLER)

3.1 EXAMINATION OF GEOMEMBRANE SUBSURFACE

A. Verify that the GCL has been installed, tested, and approved prior to placement of the geomembrane.

3.2 PREPARATION

A. Repair damage caused to the underlying materials during deployment.

B. Round edges of anchor trenches.

3.3 PERFORM TRIAL SEAM WELDS AS FOLLOWS:

A. Perform trial welds on samples of geomembrane to verify the performance of welding equipment, seaming methods, and conditions.

B. No seaming equipment or welder will be allowed to perform production welds until equipment and welders have successfully completed trial weld.

C. Frequency of trial welds:

1. Minimum of two trial welds per day per equipment and welder, with one prior to the start of work and one at mid shift.

2. When directed by the CQA Monitor.

3. Every two hours when using a wedge weld to weld across seams.

4. Minimum one trial weld per person per shift.

5. When ambient temperature changes more than 20°F since previous trial weld.

D. Make trial welds in the same surroundings and environmental conditions as the production welds, i.e., in contact with subgrade.

E. Make trial weld sample at least 2 feet long, 3 feet long for double wedge welding machines and 12 inches wide with the seam centered lengthwise.

F. Cut four, one inch wide test strips randomly selected across the length of the trial weld. Test specimens for peel adhesion and for bonded seam strength (shear) (ASTM D6392).

G. A specimen is considered passing when the following results are achieved. For double wedge welding, both welds must pass in peel and shear.

1. The break is a film tearing bond (FTB).

2. The break is ductile.

3. The peel strength is a minimum of 70 percent of the specified sheet strength at yield for wedge welds or flat welds and a minimum of 60 percent of the specified sheet strength at yield for extrusion welds.

4. There is no more than 10 percent separation of the weld. For wedge welds the width of the weld must be equal to the width of the nip roller.

5. The shear strength is 90 percent of the specified sheet strength at yield for all weld types. Minimum elongation between the grips is 2 inches based on an initial grip separation of 2 inches from the edge of the weld.

H. A trial weld sample is considered passing when all specimens pass peel and shear tests.

I. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear.

J. When repeated trial welds fail, do not use welding apparatus and welder until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

3.4 DEPLOYMENT

A. Ambient Conditions: Give careful consideration to the timing and temperature during deployment. The CQA organization will focus on verifying that (a) there is no bridging or stresses in the geomembrane and (b) there are no wrinkles in the geomembrane that will fold over when covering with soil material. Ideally, deployment, welding, and covering would all occur at the same temperature. In a practical sense the CONTRACTOR should strive to perform these activities within as narrow a temperature range as practical, and avoid these activities during peak hot or cold conditions.

B. Panel Identification: Assign each panel an identifying code number or letter consistent with the CONTRACTOR's submitted panel layout drawing. The coding is subject to approval by the CQA Monitor. The installer is responsible to place the identification code on the installed liner which consists of panel number, roll number, and panel length.

C. Daily Panel Deployment: Deploy no more panels in one shift than can be welded or secured during that same day.

D. Do not deploy in the presence of excessive moisture, precipitation, ponded water, or high winds.

E. Do not damage geomembrane by handling, by trafficking, or leakage of hydrocarbons or any other means.

F. Do not wear damaging shoes or engage in activities that could damage the geomembrane.

G. Unroll geomembrane panels using methods that will not damage, stretch or crimp geomembrane. Protect underlying surface from damage.

H. Use methods that minimize wrinkles and differential wrinkles between adjacent panels.

I. Place ballast on geomembrane to prevent uplift from wind.

J. Use ballast that will not damage geomembrane, such as sandbags or equivalent.

K. The subgrade will be smooth drum rolled, free of debris and organic material, maximum size protrusions of 0.5-inch, and free of vertical indentations and rutting more than 1-inch.

L. Protect the geomembrane in areas of equipment or repeated foot traffic by placing protective cover that is compatible with and will not damage geomembrane.

M. Repair damage to the subgrade or other underlying materials prior to completing deployment of the geomembrane.

N. Do not allow any vehicular traffic directly on unprotected geomembrane.

O. Remove wrinkled or folded material.

P. Visually inspect geomembrane for imperfections. Mark faulty or suspect areas for repair.

Q. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material, such as compensation wrinkles at the toe of slopes, as needed to avoid bridging.

R. Before wrinkles fold over, attempt to push them out. For wrinkles that cannot be pushed out, cut them out and repair cuts prior to burial or at the direction of the OWNER.

3.5 SEAM LAYOUT

A. Orient seams parallel to the line of maximum slope, i.e., orient down not across slopes.

B. Minimize the number of field seams in corners, odd shaped geometric locations, and outside corners.

C. Keep horizontal seams (seams running approximately parallel to slope contours) at least 6 feet away from toe or crest of slopes unless otherwise approved by the OWNER.

D. Use a seam numbering system consistent with panel number system.

E. Shingle panels on all slopes and grades as directed by the OWNER.

3.6 SEAM WELDING PERSONNEL

A. Provide at least one welder (master welder) who has experience welding over 5 million square feet of geomembrane using the same type of welding apparatus in use at site.

B. Qualify personnel performing welding operations by experience and by successfully passing field welding tests performed on site.

C. The master welder will provide direct supervision over other welders.

3.7 SEAM WELDING EQUIPMENT

A. Extrusion welder: equipped with gauges showing temperatures in extruder apparatus at the barrel and nozzle of the extruder. External temperature gauges may measure temperature at nozzle.

B. Hot wedge welder: Automated variable speed vehicular mounted devices equipped with devices adjusting and giving temperatures of the wedges. Pressure controlled by spring, pneumatic, or other system that allows for variation in sheet thickness. Rigid frame fixed position equipment is not acceptable.

C. Maintain adequate quality of welding apparatus in order to avoid delaying the project.

D. Use a power source capable of providing constant voltage under combined line load.

3.8 GENERAL WELDING PROCEDURES

A. Do not commence welding with welding equipment until the trial weld test samples, made by that equipment, passes the test weld.

B. Clean all geomembrane surfaces of grease, moisture, dust, dirt, debris, or other foreign material.

C. Overlap panels a minimum of 3 inches for extrusion welding and 4 inches for hot wedge welding.

D. Do not use solvents or adhesives.

E. Provide adequate material on each weld to allow peel testing of both sides of double wedge welds and extrusion welds.

F. Extend welding to the outside edge of all panels.

G. If required, provide a firm substrate by using a geomembrane rub sheet, a flat board, a conveyor belt, or similar hard surface directly under the weld overlap to achieve firm support.

H. Provide adequate illumination if welding operations are carried out at night.

I. Cut fishmouths or wrinkles along the ridge of the wrinkle in order to achieve a flap overlap. Extrusion weld the cut fishmouths or wrinkles where the overlap is more than 3 inches. When there is less than 3 inches overlap, patch with an oval or round patch extending a minimum of 6 inches beyond the cut in all directions.

3.9 INSTALLATION QUALITY CONTROL

A. Log the following every two hours:

1. Temperature directly on the geomembrane surface being welded.

2. Extrudate temperatures in barrel and at nozzle (extrusion welder).

3. Operating temperature of hot wedge (hot wedge welder) and any pressure adjustments made.

4. Preheat temperature.

5. Speed of hot wedge welder in feet per minute.

B. Weld only when ambient temperature, measured 6 inches above the geomembrane, is between 32°F and 130°F.

C. If the INSTALLER wishes to use methods which may allow seaming at ambient temperatures below 32°F or above 130°F, the INSTALLER shall demonstrate and certify that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 32°F and below 130°F, and that the overall quality of the geomembrane is not adversely affected. Then, the temperatures in the above quality assurance procedure shall be modified accordingly.

3.10 DEFECTS AND REPAIRS

A. Examine all welds and non weld areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of the examination.

B. Repair and non destructively test each suspect location both in weld and non weld areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

C. Extrusion weld a patch over all "cross" or "tee" welds.

3.11 EXTRUSION TYPE OF WELDING

A. Use procedures to tack bond adjacent panels together that do not damage the geomembrane and allow quality control tests to be performed.

B. Purge welding apparatus of heat degraded extrudate before welding.

C. Bevel the top edges of top geomembrane a minimum of 45° and full thickness of the geomembrane before extrusion welding.

D. Clean seam welding surfaces of oxidation by disc grinder or equivalent not more than 30 minutes before extruding weld. Change grinding discs frequently. Do not use clogged discs.

E. Do not remove more than 4 mils of material when grinding.

F. Grind across, not parallel to, welds.

G. Cover the entire width of grind area with extrudate.

H. When restarting welding, grind ends of all welds that are more than five minutes old.

3.12 HOT WEDGE WELDING

A. Place a smooth insulating plate or fabric beneath hot welding apparatus after usage so as to not damage the geomembrane.

B. Protect against moisture build up between panels.

C. If welding cross seams, conduct field test welds at least every two hours, otherwise, once prior to start of work and once at mid day.

D. Bevel edges of top and bottom panels on cross seams.

E. Do not weld on geomembrane until equipment has passed trial weld test.

F. Extrusion weld a repair patch over all seam intersections as described in paragraph 3.10.

3.13 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. MANUFACTURER, Fabricator, and INSTALLER will participate in and conform with all terms and requirements of the OWNER's quality assurance program. The CONTRACTOR is responsible for assuring this participation. Quality control and quality assurance requirements are as specified in this paragraph.

3.14 CONFORMANCE TESTING (PERFORMED BY CONSTRUCTION QUALITY ASSURANCE LABORATORY)

A. Allow 3 days for conformance testing following the date material is available to the CQA Laboratory.

B. Perform conformance testing on geomembrane rolls.

C. Obtain 3-feet samples across entire roll width not including the first 3 feet of material. The CQA Monitor will obtain samples with assistance from CONTRACTOR. At the option of the OWNER, conformance samples may be obtained directly from the MANUFACTURER.

D. Forward samples to Construction Quality Assurance Laboratory.

E. Test samples for conformance with design specifications and guaranteed properties.

F. Perform, as a minimum, the following tests to determine the geomembrane characteristics.

1. Sheet Density: ASTM D792 or ASTM D1505.

2. Thickness and asperity height: Measured with appropriate equipment. Take five measurements across the roll width.

3. Tensile Strength: ASTM D6693.

4. Carbon Black Content: ASTM D1603.

5. Carbon Black Dispersion: ASTM D5596.

6. Where optional procedures are noted in the test method, the requirements of the specifications prevail.

7. Additional tests may be performed at the discretion of the CQAC.

8. Interface strength tests as outlined in Section 02779, 1.5.A.3.e.

G. Sampling Procedures

1. Sample across the entire width of the roll.

2. Cut sample 3 feet long by width of roll.

3. Mark machine direction on the samples with an arrow. CQA Monitor will be responsible for markings.

4. Sample at a rate of one per batch or one per one hundred thousand square feet of material supplied, whichever results in greatest number.

3.15 FIELD TESTING (PERFORMED BY INSTALLER)

A. General: Non destructively test all field seams over their full length using a vacuum test unit, air pressure (for double fusion seams only), spark testing, or other approved methods. Perform testing as the seaming progresses and not at the completion of all the field seaming. Complete all required repairs in accordance with this specification.

B. Vacuum Testing Equipment

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole, or valve assembly, and a vacuum gauge.

2. A vacuum pump assembly equipped with a pressure control.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A soapy solution and an applicator.

C. Vacuum Box Test Procedures

1. Place the box over the wetted seam area (soapy solution).

2. Ensure that a leak tight seal is created.

3. Energize the vacuum pump and reduce the vacuum box pressure to approximately 10 inches of mercury, i.e., five psi gauge.

4. Examine the geomembrane through the viewing window for the presence of soap bubbles for a period of not less than ten seconds.

5. All areas where soap bubbles appear shall be marked and repaired in accordance with repair procedures described in this specification.

D. Air pressure testing for seaming processes producing a double seam with an enclosed channel.

1. Equipment, comprised of the following:

a. An air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure over 40 psi and mounted on a cushion to protect the geomembrane.

b. A rubber hose with fittings and connections.

c. A sharp hollow needle, or other approved pressure feed device.

d. A pressure gauge with an accuracy of plus or minus one psi.

2. Test Procedures.

a. Seal both ends of the welded seam to be tested.

b. Insert needle or other approved pressure feed device into the tunnel created by the weld.

c. Energize the air pump to a minimum pressure of 30 psi or 1/2 psi per mil of liner thickness, whichever is greater, close valve and sustain pressure for at least five minutes.

d. If loss of pressure exceeds three psi (ten mm mercury), or otherwise approved, or does not stabilize, locate faulty area and repair in accordance with repair procedures described in this specification.

e. Puncture opposite end of seam to release air. If blockage is present, locate and test seam on both sides of blockage.

f. Remove needle or other approved pressure feed device and seal the penetration holes.

E. Spark Testing for penetrations or other difficult areas not accessible to vacuum testing.

1. Equipment and Materials.

a. 24 gauge copper wire.

b. Low-amperage electric detector, 20,000 to 30,000 volt, with brush-type electrode capable of causing visible arc up to ¾ inch from copper wire.

2. Procedures.

a. Place copper wire within 1/4 inch of the edge of extrusion seam or clamp seal.

b. Pass electrode over the seam or clamp the area and observe for a spark. If a spark is detected perform a repair.

3.16 LABORATORY DESTRUCTIVE TESTING (PERFORMED BY OWNER AND THE INSTALLER)

A. Location and Frequency of Testing.

1. Collect destructive test samples at a minimum frequency of one test location per 500 feet of seam length.

2. Determine test locations during welding. Locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or suspected defect. The OWNER will be responsible for choosing the locations. The Monitor

will not notify INSTALLER in advance of selecting locations where weld samples will be taken.

3. The OWNER may increase the test frequency based on marginal results.

B. Sampling Procedures.

1. Cut samples at locations designated by the OWNER as the welding progresses. Verify that laboratory test results have been obtained before the geomembrane is covered by another material.

2. The OWNER will number each sample and mark sample number and location in compliance with the CQA program.

3. Immediately repair all holes in the geomembrane resulting from destructive test sampling. Repair in accordance with repair procedures described in this Section. Test the continuity of the repair in accordance with this Section.

4. Size of Samples: minimum 12 inches wide by 42 inches long with the seam centered lengthwise. Cut a one-inch wide strip from each end of the sample and test these for (shear and peel) in the field. Cut the remaining sample into three parts for distribution as follows:

a. One portion for the INSTALLER: 12 inches by 12 inches.

b. One portion for Construction Quality Assurance Laboratory: 12 inches by 18 inches.

c. One portion to the OWNER for archive storage: minimum 12 inches by 12 inches.

3.17 FIELD TESTING (PERFORMED BY INSTALLER)

A. Test the two, one-inch wide strips specified in paragraph 3.16, B, by tensiometer for peel and shear, respectively.

B. Both test strips must meet peel and shear requirements for welded seams specified in *paragraph 3.3.*

C. If any field test sample fails, follow failed test procedures outlined in this Section.

3.18 LABORATORY TESTING PERFORMED INDEPENDENTLY BY CONSTRUCTION QUALITY ASSURANCE (CQA) LABORATORY

A. Test "seam strength" and "peel adhesion" (ASTM D6392).

B. Minimum acceptable values to be obtained for these tests are specified in paragraph 3.3, H.

C. Test at least five specimens for each test method. Five of five specimens must meet minimum requirements. None of the peel specimens may peel 100 percent, or the entire sample will be considered as failing.

D. Select specimens alternately by test from the samples (i.e., peel, shear, peel, shear...).

E. Provide test results no more than 48 hours after receiving samples.

F. For double wedge welded samples, test both sides in peel.

3.19 FAILED WELD PROCEDURES

A. Follow these procedures when there is a destructive test failure. Procedures apply when test failure is determined by the Construction Quality Assurance Laboratory, the INSTALLER, or by field tensiometer. Follow one of the following two options:

1. First Option.

a. Reconstruct or cap strip the seam between any two passing test locations. Cannot extrusion weld flap.

2. Second Option.

a. Trace the weld at least 10 feet minimum in both directions from the location of the failed test, or to the end of the weld.

b. Obtain a small sample at both locations for an additional field test.

c. If these additional test samples pass field tests, then take laboratory samples.

d. If the laboratory samples pass, then reconstruct the weld or cap between the two test sample locations that bracket the failed test location.

e. If any sample fails, then repeat the process to establish the zone in which the weld must be reconstructed.

3.20 ACCEPTABLE WELDED SEAMS

A. Bracketed by two locations from which samples have passed destructive tests.

B. For reconstructed seams exceeding 50 feet, a sample taken from within the reconstructed weld passes destructive testing.

C. Whenever a sample fails, provide additional testing for seams that were welded by the same welder and welding apparatus or welded during the same time shift.

3.21 SEAMS THAT CANNOT BE NON DESTRUCTIVELY TESTED, PERFORM THE FOLLOWING:

A. If the weld is accessible to testing equipment prior to final installation, non-destructively test the weld prior to final installation.

B. If the weld cannot be tested prior to final installation, cap strip the weld. The OWNER and the INSTALLER must observe the welding and cap stripping operations for uniformity and completeness.

3.22 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair, removal, and replacement are at CONTRACTOR's expense if the damage results from the CONTRACTOR's, the INSTALLER's, or the CONTRACTOR's SUBCONTRACTOR activities.

C. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. Agreement upon the appropriate repair method will be determined between the OWNER'S Representative and the INSTALLER. Do not commence welding on liner until trial weld test sample, made by that equipment and operator, passes trial test. Repair procedures available include:

1. Patching: Used to repair large holes (over 3/8 inch diameter), tears (over 2 inches long), undispersed raw materials, contamination by foreign matter, and to cover cross and tee connections.

2. Abrading and re-welding: Used to repair small sections of seams.

3. Spot welding or seaming: Used to repair small tears (less than 2 inches long), pin holes or other minor, localized flaws.

4. Capping: Used to repair large lengths of failed seams.

5. Removing the seam and replacing with a strip of new material.

D. In addition, satisfy the following procedures:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one (1) hour prior to the repair.

2. Clean and dry all surfaces at the time of repair.

3. The OWNER's representative, the CQAC, and the INSTALLER must accept the repair procedures, materials, and techniques in advance of the specific repair.

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches.

5. Unless otherwise instructed by the OWNER, cut geomembrane below large caps to avoid water or gas collection between the sheets.

E. Verification of repair:

1. Number and log each patch repair.

2. Non-destructively test each repair using methods specified in paragraph 3.15 of this Section.

3. Destructive tests may be required at the discretion of the OWNER's Representative.

4. Reconstruct repairs until tests indicate passing results.

3.23 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for the geomembrane until acceptance by the OWNER.

B. OWNER will accept geomembrane installation when:

1. All required documentation from the MANUFACTURER, Fabricator, and INSTALLER has been received and accepted.

2. The installation is finished.

3. Test reports verifying completion of all field seams and repairs, including associated testing, is in accord with the Section.

4. The OWNER has received written certification documents and drawings.

END OF SECTION

APPENDIX C
GEOSYNTHETIC CLAY LINER

SECTION 02779

GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes furnishing and installing geosynthetic clay liner.

1.2 RELATED SECTIONS

A. Section 02221 — Excavating and Stockpiling.

B. Section 02222 — Engineered Fill, Operations Layer, and Anchor Trench Backfill.

C. Section 02223 — Liner Foundation Preparation.

D. Section 02778 — Geomembrane.

1.3 REFERENCES

A. GRI-GCL3 — Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners.

B. ASTM D4354 — Standard Practice for Sampling of Geosynthetics for Testing.

C. ASTM D4759 — Standard Practice for Determining the Specification Conformance of Geosynthetics.

D. ASTM D5084 — Standard Test Method of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

E. ASTM D5261 — Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.

F. ASTM D5751

G. ASTM D5887 — Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.

H. ASTM D5888 — Standard Guide for Storage and Handling of Geosynthetic Clay Liners.

I. ASTM D5889 — Standard Practice for Quality Control of Geosynthetic Clay Liners.

J. ASTM D5890 — Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.

K. ASTM D5891 — Standard Test Method for Fluid Loss of Clay Components of Geosynthetic Clay Liners.

L. ASTM D5993 — Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.

M. ASTM D6102 — Standard Guide for Installation of Geosynthetic Clay Liners.

N. ASTM D6141 — Standard Guide for Screening the Clay Portion of a GCL for Chemical Compatibility to Liquids.

O. ASTM D6243 — Standard Test Method for Determining the Internal and Interface` Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.

P. ASTM D 6495 — Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners.

Q. ASTM D 6496 — Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.

R. ASTM D 6766 — Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.

S. ASTM D 6768 — Standard Test Method for Tensile Strength of Geosynthetic Clay Liners.

1.4 DEFINITIONS

A. Bentonite: Clay soil, comprised primarily of sodium montmorillonite, characterized by high-swelling potential and low-hydraulic conductivity.

B. Construction Quality Assurance Consultant (CQAC): The OWNER or the monitoring firm responsible for implementation of the CQA plan.

C. Construction Quality Assurance (CQA) Laboratory: The party, independent from the OWNER, MANUFACTURER, Fabricator, and INSTALLER, responsible for conducting tests on samples of geosynthetics obtained at the site. Also referred to as the Geosynthetics Laboratory.

D. Construction Quality Assurance (CQA) Officer: The professional representative of the CQA monitoring firm who shall be responsible for implementation of the CQA plan.

E. Construction Quality Assurance (CQA) Monitor: Site representative of the CQA Monitor responsible for documenting field observations and tests.

F. ENGINEER: The individual or firm responsible for the design and preparation of the Drawings and Specifications.

G. Geomembrane: An essentially impermeable synthetic membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).

H. Geosynthetic Clay Liner (GCL): Relatively thin factory-manufactured liner material consisting of bentonite supported by textile backing or geomembrane held together by needling, stitching, or chemical adhesives.

I. INSTALLER: The party responsible for field handling, transporting, storing, deploying, and temporary restraining (against wind) of the GCL.

J. Lot: Group of consecutively numbered rolls from the same manufacturing line.

K. GCL MANUFACTURER (MANUFACTURER): The party responsible for the production and quality of GCL.

L. Minimum Average Roll Value (MARV): Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. Ninety-five percent of any individual samples will have values greater than the MARV for any given property.

M. Textile Backing (textile or geotextile): Geosynthetic support material consisting of woven slit film, needle-punched nonwoven, or spunlaced polymer fabric, used for supporting bentonite in a GCL.

1.5 PRE-CONSTRUCTION SUBMITTALS

A. Product Data (MANUFACTURER): Submit the following 7 days prior to shipping material to the site.

1. Geotextile Backing:

   a. Certification stating that the geotextiles meet the product requirements (Table 02779-1).

   b. Copy of the quality control tests performed by geotextile supplier (if different from GCL MANUFACTURER).

   c. Copy of the quality control tests performed by the GCL MANUFACTURER.

2. Bentonite:

   a. Certification stating that the bentonite meets the product requirements (Table 02779-1).

   b. Copy of the quality control tests performed by bentonite supplier.

   c. Copy of the quality control tests performed by GCL MANUFACTURER.

3. GCL:

   a. Certification stating that the GCL meets the product requirements (Table 02779-1).

   b. Copy of the quality control tests performed by the GCL MANUFACTURER.

   c. Hydraulic Conductivity testing on representative product by an independent laboratory (not necessarily for product delivered to the site).

   d. Laboratory test data on representative product for:

      1) Bentonite free swell.

      2) Hydraulic Conductivity of overlapped GCL seams.

3) Freeze-thaw behavior of the GCL.

e. The CONTRACTOR shall submit a certificate of compliance for the GCL to the ENGINEER for approval at least 14 days before the required delivery of the material. If the asperity height of the geomembrane is proposed to be less than the specified value, the certificate of compliance shall include shear strength test results conducted by a third-party soils laboratory for the GCL - geomembrane interface per ASTM D6243. The shear strengths must meet or exceed the minimum shear strength parameters presented in Table 02779-1.

f. If required, the GCL-HDPE direct shear strength tests will be performed by saturating the GCL under 250 psf normal load for 48 hours, followed by consolidating the fabricated specimens under normal loads of 2,000, 4,000, and 8,000 psf respectively, for a period of 16 hours prior to applying the shear loads. The sample shall be sheared using a constant strain rate of .04 inches per minute up to 3.0 inches of displacement. The post peak shear strength shall be measured at the lowest strength point up to 3.0 inches of displacement.

4. Qualifications (INSTALLER):

a. Submit, three weeks prior to installation, the name of INSTALLER, resume of the installation supervisor/field ENGINEER to be assigned to the project, and a list of projects completed by the INSTALLER that included GCLs.

5. Quality Control Plan and Installation Procedures (MANUFACTURER):

a. Submit, three weeks prior to installation, a copy of the MANUFACTURER's quality control plan including a list of quality control tests performed and typical testing frequencies.

b. Submit, three weeks prior to installation, recommended installation procedures.

B. Submit, upon completion of the installation, the MANUFACTURER's product warranty against MANUFACTURER defects (material not in compliance with this specification). The warranty shall cover the full material replacement cost not including installation.

1.6 QUALIFICATIONS

A. The product shall be obtained from a MANUFACTURER listed in Section 2.1 or a MANUFACTURER-approved distributor.

B. The INSTALLER shall meet the following requirements:

1. Have experience in a similar capacity involving GCLs on at least three landfill projects and have installed a minimum of 10,000,000 square feet of GCL.

1.7 QUALITY ASSURANCE

A. The OWNER will engage and pay for the services of (1) Construction Quality Assurance Consultant (CQAC) and (2) Construction Quality Assurance (CQA) Laboratory for monitoring the quality and installation of the GCL unless otherwise specified.

B. The MANUFACTURER shall not charge any time or material expenses to the OWNER related to a plant visit during manufacturing.

C. The INSTALLER shall aid the OWNER in product sampling by providing personnel and equipment necessary to move, cut, and protect GCL rolls.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General: Conform to the MANUFACTURER's requirements unless otherwise specified.

B. Delivery:

1. Deliver materials to the site only after the OWNER accepts required submittals.

2. Material shall be covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.

3. Ship less than one month prior to scheduled installation.

4. Each roll shall be marked with the following information:

a. MANUFACTURER's name.

b. Product identification.

c. Lot and roll numbers.

d. Roll dimensions and weight.

C. Storage:

1. Store rolls in space allocated by the OWNER. Space should be at high-ground level or elevated above ground surface. Follow the storage procedures outlined in ASTM D5888.

2. Stack no more than 3 rolls high.

3. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

4. Preserve the integrity and readability of roll labels.

D. Handling:

1. Use appropriate handling equipment following the MANUFACTURER's recommendations to load, move, or deploy GCL rolls.

2. Handling of rolls shall be done in a competent manner such that damage does not occur to the product or to its protective wrapping. Follow handling procedures outlined in ASTM D5888.

3. Damage to protective covering due to mishandling or sampling must be repaired immediately. Repairs shall be such that the GCL rolls are protected from moisture or other deleterious conditions.

4. INSTALLER is responsible for off-loading, storage, and transporting material from storage area to installation site.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Name, address, and telephone number of MANUFACTURER's given below (product names are shown in parenthesis):

1. Colloid Environmental Technologies Company (CETCO), 1500 West Shure Drive, Arlington Heights, IL 60004, (800) 527-9948. (Bentomat).

2. GSE, 19103 Gundle Road, Houston, TX 77073, (800) 435-2008. (Bentofix)

3. Material may be provided by a different office than shown above or by a MANUFACTURER-approved distributor.

B. Products other than those shown above may be used only with written pre-bid authorization from the ENGINEER.

2.2 BENTONITE

A. Supplied in granular form.

B. Meet the requirements of Table 02779-1.

2.3 GEOTEXTILE BACKING

A. For slopes greater than 8 degrees, the GCL will consist of cap and carrier needle-punched nonwoven geotextiles.

B. For slopes up to 8 degrees, the GCL will consist of a cap nonwoven and carrier woven geotextile.

2.4 GCL

A. Consists of bentonite encapsulated by two geotextiles.

B. Continuous waterproof laplines and matchlines shall be printed directly on the geotextile-type GCL at 6 and 9 inches from the edges of the rolls, respectively.

C. Wrapped around a structurally sound core that can support the weight of the GCL without excessive bending or buckling. The core shall be accessible to stingers or rods placed full-length within the core.

D. Geotextiles shall be needle-punched or lock-stitched together through the bentonite layer to form a stable composite. Adhesives may be used in addition to, but not in lieu of, needle-punching, or lock-stitching.

E. Continuously inspected for the presence of broken needles and certified to be "needle-free."

F. Meet the requirements of Table 02779-1.

TABLE 02779 1

PROPERTIES FOR THE GEOSYNTHETIC CLAY LINER

Test	Test Designation[1]	Requirements[2]
Bentonite		
Free Swell	ASTM D5890	18 ml / 2 g
Fluid Loss	ASTM D5891	18 ml
Geotextiles		
Mass Per Unit Area, nonwoven	ASTM D5261	6.0 oz/yd^2
Mass Per Unit Area, woven	ASTM D5261	3.0 oz/yd^2
GCL[2]		
Clay Mass Per Unit Area[3]	ASTM D5993	0.75 lbs
Moisture Content	ASTM D5993	30% max.
Peel Strength	ASTM D6496	5.3 lb/in
Tensile Strength	ASTM D6768	38 lb/in
Hydraulic Conductivity[4] 'and'	ASTM D5887	Maximum 5 x 10^{-9} cm/sec
Index Flux[4]	ASTM D5887	Maximum 1 x 10^{-8} m^3/m^2-sec
Post-Peak Shear Strength[5]	ASTM D6243	Confining Stress (lbs/ft^2) / Shear Stress (lbs/ft^2): 2,000 / 281; 4,000 / 562; 8,000 / 1,124
Durability		
Geotextile	GRI-GCL3	65%
Hydraulic Conductivity at 5 psi [6]	GRI-GCL3	Maximum 5 x 10^{-7} cm/sec
Hydraulic Conductivity at 70 psi [6]	GRI-GCL3	Maximum 5 x 10^{-8} cm/sec

Notes: (1) Alternate tests are allowed only with prior written approval by the ENGINEER.
(2) Required values are minimum average roll values (MARV) unless otherwise stated.
(3) Weight of GCL minus weight of geotextiles and corrected to 0 percent bentonite moisture content.
(4) Measured under 5 psi confining pressure and 2 psi head pressure.
(5) Requirement applies to the post-peak HDPE geomembrane/GCL interface strength at 3.0 inches of displacement. Follow procedures in Paragraph 1.5.A.3.f.
(6) GCL hydraulic conductivity after permeation with a 0.01 M calcium chloride solution (11.1 g $CaCl_2$ in 1.0 liter water).

2.5 MANUFACTURER SOURCE QUALITY CONTROL

A. Perform the quality control tests at the frequencies shown on Table 02779-2.

B. Supply copies of test results to the OWNER.

TABLE 02779 2

MANUFACTURER'S TESTING FOR GEOSYNTHETIC CLAY LINER

Test	Frequency[1]
Bentonite	
Free Swell	1 per 50 tons
Fluid Loss	1 per 50 tons
Geotextiles	
Mass Per Unit Area	1 per 200,000 square feet
GCL	
Dried Clay Mass Per Unit Area	1 per 40,000 square feet
Moisture Content	1 per 40,000 square feet
Peel Strength	1 per 40,000 square feet
Tensile Strength	1 per 200,000 square feet
Hydraulic Conductivity 'and' Index Flux	1 per 250,000 square feet
Shear testing	1 per project
Durability	
Geotextile	Yearly / supply data
Hydraulic Conductivity at 5 psi [6]	Yearly / supply data
Hydraulic Conductivity at 70 psi [6]	Yearly / supply data
Notes: (1) One test per quantity indicated; minimum one test per lot. (2) Frequencies based on material with ten percent moisture content. (3) Minimum of two tests for permeability.	

PART 3 EXECUTION

3.1 PREPARATION OF FOUNDATION

A. Foundation shall be prepared as specified in Section 02223.

3.2 DEPLOYMENT

A. General:

1. Deploy only after the OWNER and the INSTALLER accept the foundation.

2. Do not allow foot traffic on the GCL if the material is at the moisture content of 30 percent or greater.

3. Deploy manually or by use of a spreader bar attached to the loader or backhoe.

4. Take care not to entrap objects or moisture beneath the GCL.

5. Beginning deployment implies acceptance of subgrade by the INSTALLER.

3.3 JOINING

A. Overlaps:

1. Using the lapline and matchline as guides, overlap a minimum of 6 inches along lengthwise seams.

2. Overlap a minimum of 12 inches on the widthwise seams at the end of the rolls and in sump areas (if applicable).

3. Overlaps or seams are not allowed perpendicular to slopes greater than 10 percent. In these areas GCLs must be placed parallel to the slope in one piece along the entire slope, unless otherwise approved by the OWNER.

B. Seams:

1. Spread loose bentonite or bentonite paste at the rate of 4 ounces per lineal foot of overlap to augment the seams. Approval to forego bentonite augmentation along seams must be received in writing from the ENGINEER before installation begins.

2. Bentonite used in seam augmentation shall be the same quality clay used in the GCL.

3. Use a lime spreader or equivalent if powdered bentonite is used to reduce wind-blown particles.

4. Do not sew or use mechanical connections except for repairs, at penetrations, and where necessary as approved by the OWNER.

3.4 RESTRAINING AND PROTECTING

A. Restrain GCL against wind uplift using sandbags filled with fine-grained material.

B. Sandbags must remain until the GCL is covered.

C. GCL must be covered with the overlying geomembrane the same day it is installed. If the overlying geomembrane is not seamed the same day, the OWNER may request the geomembrane edges be pulled back to inspect the GCL at no additional cost to the OWNER. Torn, punctured, or hydrated material shall be removed and replaced in accordance with Section 3.5 at no additional cost to the OWNER.

D. Bentonite that becomes hydrated to a moisture content greater than 30 percent before being covered by a seamed geomembrane will be rejected. Rejected material shall be removed and replaced at no additional cost to the OWNER.

3.5 REPAIR PROCEDURES

A. Remove punctured, torn, or hydrated material.

B. The damaged area shall be covered with the same type of GCL material with the same side up.

C. Overlap the defective area by a minimum 12 inches in all directions.

D. Adhesion tape may be used to keep the patch in place.

E. Apply loose bentonite at the patch overlap seams with 4 ounces per linear foot bentonite seam augmentation.

3.6 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. General:

1. Field quality control is the responsibility of the INSTALLER who must document that the installation proceeds in accordance with this specification.

2. Field quality assurance is the responsibility of the OWNER who is assisted by the INSTALLER.

B. The INSTALLER and OWNER shall inspect:

1. The underlying surface for entrapped particles that may impact the GCL.

2. The subgrade will be smooth drum rolled, free of debris and organic material, maximum size protrusions of 0.5-inch, and free of vertical indentations and rutting more than 1-inch.

3. The GCL for needles, punctures, tears, thinning, or other evidence of that the material may not meet the specification requirements.

4. The GCL for evidence of premature bentonite hydration, such as wet areas, bentonite swelling, or visual indentations. Hydrated areas shall be removed and replaced with unhydrated material.

5. Seam overlaps using the visual laplines and matchlines as a guide. The OWNER shall periodically measure the distance of the laplines and matchlines from the edge of the GCL.

6. The bentonite seams to check the location of the seams over the underlying GCL and the amount of bentonite augmentation being used at the overlaps.

7. The OWNER must approve each section of the GCL before the GCL is covered.

C. The INSTALLER shall aid the OWNER in collecting samples for testing:

1. Any roll that cannot be identified shall be rejected.

2. Samples shall be taken at a minimum frequency of one sample per 100,000 square feet.

3. A minimum of one sample shall be taken from each lot.

4. Samples shall be a minimum of two feet long and run the entire width of the roll.

5. Mark the roll number and machine direction on each sample.

D. Laboratory Testing:

1. The following laboratory tests shall be conducted, according to the test methods on Table 02779-1.

a. Moisture content.

b. Mass per unit area.

c. Peel strength.

d. Hydraulic conductivity.

2. The test results shall be evaluated according to ASTM D4759.

3. Testing shall be performed by a qualified laboratory.

3.7 ACCEPTANCE

A. CONTRACTOR shall retain ownership and responsibility of the GCL until acceptance by the OWNER.

B. OWNER will accept GCL installation when:

1. All required documentation from the MANUFACTURER and INSTALLER has been received and accepted.

2. Test reports verifying material properties have been received and accepted.

3. The OWNER has completed final inspection and any noted defects have been repaired.

END OF SECTION

APPENDIX D
HELP MODEL OUTPUT FILES

Without Leak Location Survey

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**********************************************************************************
**********************************************************************************
**                                                                              **
**                                                                              **
**                HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                 **
**                  HELP MODEL VERSION 3.06    (17 AUGUST 1996)                **
**                    DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                      USAE WATERWAYS EXPERIMENT STATION                       **
**                FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                              **
**                                                                              **
**********************************************************************************
**********************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\ECDC2.D4
TEMPERATURE DATA FILE:       C:\HELP3\ECDC2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ECDC2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ECDC2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ECDC5.D10
OUTPUT DATA FILE:            C:\HELP3\ECDC5.OUT


TIME:  14: 7     DATE:   3/14/2007


**********************************************************************************

     TITLE:  ECDC Currently Approved Composite Liner (10 ft waste)

**********************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
          THICKNESS                     =    120.00   INCHES
          POROSITY                      =      0.6710 VOL/VOL
          FIELD CAPACITY                =      0.2920 VOL/VOL
          WILTING POINT                 =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.2828 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.100000005000E-02 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1249	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0102	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	400.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	3.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	3.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.16	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1050	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	400.0	FEET

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	3.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	3.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.16	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 9

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1034	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	81.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	10.736	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.232	INCHES
INITIAL SNOW WATER	=	0.175	INCHES
INITIAL WATER IN LAYER MATERIALS	=	39.682	INCHES
TOTAL INITIAL WATER	=	39.857	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	40.76	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	117	
END OF GROWING SEASON (JULIAN DATE)	=	289	
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00	%

AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 65.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.35	1.33	1.72	2.21	1.47	0.97
0.72	0.92	0.89	1.14	1.22	1.37

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.16	1.15	1.90	2.09	1.32	0.99
	0.66	0.87	0.80	0.90	1.10	1.45
STD. DEVIATIONS	0.63	0.61	0.75	0.94	0.71	0.68
	0.47	0.86	0.67	0.63	0.53	0.63
RUNOFF						
TOTALS	0.182	0.211	0.164	0.003	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.044

STD. DEVIATIONS	0.260	0.244	0.231	0.011	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.116

EVAPOTRANSPIRATION

TOTALS	0.477	0.693	2.227	2.279	1.636	1.080
	0.622	0.867	0.975	0.869	0.709	0.729
STD. DEVIATIONS	0.194	0.417	0.539	1.066	0.772	0.694
	0.408	0.934	0.675	0.530	0.269	0.206

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0255	0.0221	0.0261	0.0455	0.0823	0.0690
	0.0584	0.0503	0.0423	0.0388	0.0327	0.0293
STD. DEVIATIONS	0.0121	0.0096	0.0200	0.0723	0.1022	0.0650
	0.0436	0.0336	0.0256	0.0211	0.0172	0.0128

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0005	0.0004	0.0005	0.0004	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
STD. DEVIATIONS	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003
	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0006	0.0006	0.0006	0.0011	0.0019	0.0016
	0.0013	0.0011	0.0010	0.0009	0.0008	0.0007
STD. DEVIATIONS	0.0003	0.0002	0.0005	0.0017	0.0023	0.0015
	0.0010	0.0008	0.0006	0.0005	0.0004	0.0003

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.38 (2.495)	52210.3	100.00
RUNOFF	0.604 (0.4322)	2191.89	4.198
EVAPOTRANSPIRATION	13.161 (2.0023)	47773.09	91.501
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.52230 (0.36375)	1895.934	3.63134
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.009	0.00002
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.009	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00524 (0.00374)	19.027	0.03644
CHANGE IN WATER STORAGE	0.091 (0.8680)	330.34	0.633

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	0.539	1957.3679
DRAINAGE COLLECTED FROM LAYER 3	0.01720	62.42711
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00004
AVERAGE HEAD ON TOP OF LAYER 4	0.012	
MAXIMUM HEAD ON TOP OF LAYER 4	0.024	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.004	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000051	0.18670
SNOW WATER	1.56	5680.9390

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3655
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1048

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	35.9332	0.2994
2	3.0963	0.1290
3	0.0024	0.0122
4	0.0000	0.0000
5	0.1200	0.7500
6	1.8900	0.1050
7	0.0000	0.0000
8	0.1200	0.7500
9	0.5154	0.0859
SNOW WATER	0.000	

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With Leak Location Survey (Proposed Liner)

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**********************************************************************************
**********************************************************************************
**                                                                              **
**                                                                              **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**                HELP MODEL VERSION 3.06    (17 AUGUST 1996)                   **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                    USAE WATERWAYS EXPERIMENT STATION                         **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                 **
**                                                                              **
**                                                                              **
**********************************************************************************
**********************************************************************************

PRECIPITATION DATA FILE:     C:\HELP3\ECDC2.D4
TEMPERATURE DATA FILE:       C:\HELP3\ECDC2.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\ECDC2.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\ECDC2.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\ECDC6.D10
OUTPUT DATA FILE:            C:\HELP3\ECDC6.OUT

TIME:    8:56      DATE:    3/29/2007

**********************************************************************************

     TITLE:  ECDC Proposed Single Composite Liner (10 ft waste)

**********************************************************************************

     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  18
          THICKNESS                    =    120.00   INCHES
          POROSITY                     =      0.6710 VOL/VOL
          FIELD CAPACITY               =      0.2920 VOL/VOL
          WILTING POINT                =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.2828 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1249	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0102	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	400.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	0.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.16	INCHES

POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1035	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #18 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	81.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	16.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	10.736	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.232	INCHES
INITIAL SNOW WATER	=	0.175	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.673	INCHES
TOTAL INITIAL WATER	=	37.848	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM SALT LAKE CITY UTAH

STATION LATITUDE	=	40.76 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	117

END OF GROWING SEASON (JULIAN DATE)	=	289
EVAPORATIVE ZONE DEPTH	=	16.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.80 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	48.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	39.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	65.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.35	1.33	1.72	2.21	1.47	0.97
0.72	0.92	0.89	1.14	1.22	1.37

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	34.10	40.70	49.20	58.80	68.30
77.50	74.90	65.00	53.00	39.70	30.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SALT LAKE CITY UTAH
AND STATION LATITUDE = 40.76 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.16	1.15	1.90	2.09	1.32	0.99
	0.66	0.87	0.80	0.90	1.10	1.45
STD. DEVIATIONS	0.63	0.61	0.75	0.94	0.71	0.68
	0.47	0.86	0.67	0.63	0.53	0.63

RUNOFF

TOTALS	0.182	0.211	0.164	0.003	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.044
STD. DEVIATIONS	0.260	0.244	0.231	0.011	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.116

EVAPOTRANSPIRATION

TOTALS	0.477	0.693	2.227	2.279	1.636	1.080
	0.622	0.867	0.975	0.869	0.709	0.729
STD. DEVIATIONS	0.194	0.417	0.539	1.066	0.772	0.694
	0.408	0.934	0.675	0.530	0.269	0.206

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0255	0.0221	0.0261	0.0455	0.0823	0.0690
	0.0584	0.0503	0.0423	0.0388	0.0327	0.0293
STD. DEVIATIONS	0.0121	0.0096	0.0200	0.0723	0.1022	0.0650
	0.0436	0.0336	0.0256	0.0211	0.0172	0.0128

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0005	0.0004	0.0005	0.0004	0.0004	0.0004
	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
STD. DEVIATIONS	0.0004	0.0003	0.0004	0.0003	0.0003	0.0003
	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0006	0.0006	0.0006	0.0011	0.0019	0.0016
	0.0013	0.0011	0.0010	0.0009	0.0008	0.0007
STD. DEVIATIONS	0.0003	0.0002	0.0005	0.0017	0.0023	0.0015
	0.0010	0.0008	0.0006	0.0005	0.0004	0.0003

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.38 (2.495)	52210.3	100.00
RUNOFF	0.604 (0.4322)	2191.89	4.198
EVAPOTRANSPIRATION	13.161 (2.0023)	47773.09	91.501
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.52230 (0.36375)	1895.935	3.63134
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.009	0.00002
AVERAGE HEAD ON TOP OF LAYER 4	0.001 (0.001)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00524 (0.00376)	19.026	0.03644
CHANGE IN WATER STORAGE	0.091 (0.8680)	330.34	0.633

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	1.66	6025.800
RUNOFF	0.539	1957.3679
DRAINAGE COLLECTED FROM LAYER 3	0.01720	62.42712
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 4	0.012	
MAXIMUM HEAD ON TOP OF LAYER 4	0.024	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000052	0.18871
SNOW WATER	1.56	5680.9390

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3655
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1048

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	35.9332	0.2994
2	3.0963	0.1290
3	0.0024	0.0122
4	0.0000	0.0000
5	0.1200	0.7500
6	0.5159	0.0860
SNOW WATER	0.000	

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APPENDIX E

GIROUD 1997 LEAKAGE RATE CALCULATIONS

Classic Giroud Eqn for Circular hole:

$$Q_s = C\left[1 + 0.1\left(\frac{h}{t}\right)^{0.95}\right] a_s^{0.1} h^{0.9} k_{sub}^{0.74}$$

where: Q_s is the flow rate through one geomembrane defect, h is head of liquid above the geomembrane, t is thickness of soil component of the composite liner, a_s is defect area, k_{sub} is hydraulic conductivity of soil component of composite liner, and C is a correction factor describing geomembrane placement.
C: Good = 0.21, fair = 0.6; poor = 1.15

Rate of Leachate Migration Through Primary Composite Liner Per Hole:

Hole Type	C	h (m) *	t (m)	a (m^2)	k_{sub} (m/s)	Q (m^3/s)	Q (gpd)	Q (gal/yr)
Geomembrane/GCL Composite								
Large	0.21	0.000635	0.004	0.0001	3.00E-11	1.84E-12	0.0000	**0.0153**
Small (Pinhole)	0.21	0.000635	0.004	7.80E-07	3.00E-11	1.13E-12	0.0000	**0.0094**
Geomembrane/Compacted Clay Composite (Prescriptive)								
Large	0.21	0.000635	0.609	0.0001	1.00E-09	2.43E-11	0.0006	**0.2021**
Small (Pinhole)	0.21	0.000635	0.609	7.80E-07	1.00E-09	1.49E-11	0.0003	**0.1244**

* h is the peak daily maximum head from HELP model simulations

Overall Leakage Through Primary Composite Liner:

Liner Profile	No. of Large Holes Per Acre	No. of Pinholes Per Acre	Q (gal/acre-yr)
Geomembrane/GCL Without Leak Location Survey	3	3	**0.0744**
Geomembrane/GCL With Leak Location Survey	0	1	**0.0094**
Geomembrane/Compacted Clay Without Leak Location Survey	3	3	**0.9794**

Reference:

Giroud, J.P., Badu-Tweneboah, K. and Soderman, K.L. (1997b) "Comparison of Leachate Flow Through Compacted Clay Liners and Liners in Landfill Liner Systems." Geosynthetics International, Vol. 4, Nos. 3-4, pp. 391-431.

APPENDIX F
VENEER STABILITY CALCULATIONS

ECDC Landfill
SECONDARY LINER
LEAKAGE CALCULATIONS

Average length of Cell	675 ft =	205.73 m	
Approx area of Cell IV	10 ac		
Max leng of flow path	400 ft =		Assumes tilted herringbone normal to contour
Gravity (m/s2)	9.81 m/s2		

MAXIMUM HEAD BUILDUP (Giroud, Zornberg, and Zhao [2000])

	Impinge-ment rate (in/day) output from HELP	Impinge-ment rate (m/s) **converted**	Bottom liner slope (ft/ft) same as tan(beta)	Max length of flow path (m)	k (LCRS) (m/s)	Lamda (eqn 9)	j-factor (eqn 39)	Max leachate thickness (m) (eqn 37)	**Max Head (in)**	R (eqn 10)	McEnroe's A* (use if R<0.25)	McEnroe's B* (use if R>0.25)	McEnroe's tmax (m) (eqn 49)	**Max Head (in)**
ECDC avg annual	0.0014301	4.2041E-10	0.01	121.91405	0.1	4.2E-05	0.99986631	5.125E-05	**0.00201773**	4.20455E-05	0.999915905		5.12373E-05	**0.002017315**
ECDC peak daily	0.0172	5.0562E-09	0.01	121.91405	0.1	0.000506	0.99713431	0.0006144	**0.02418936**	0.000505674	0.99898814		0.000614403	**0.02419028**

Hole description	area of hole *a* (m2)	No. of holes per acre	Total no. of holes
Large hole	0.0001	3	30
Small hole	7.80E-07	3	30
TOTAL			**60.00**

SECONDARY WETTED FRACTION AND HEAD BUILDUP

Hole description	No. of holes in primary liner above	Area of Cell IV 2ry liner (m2)	LDS hydraulic conduc. k_{lds} (m/s)	Bottom liner slope (ft/ft)	Max length of flow path (m)	Leakage rate per hole from Primary Liner (m3/s)	u=(Q/k)^.5/ (Lsinb) where Q is leakage from single large hole from above	**lamda (rand) Eqn 123**	**F (defect frequency) Eqn 100**	**R(w rand) Eqn 99 and 122**	Intermed calc of x/L Eqn 183	Head on 2ry liner Eqn 190 for t(avg rand) m	Max width of wetted zone (m) (not needed for leakage calcs)
ECDC OPEN CELL	30	40,465	0.00002	0.01	121.914051	1.84E-12	0.00024879	1.19E-02	7.41E-04	1.31E-01	0.54308046	3.44E-06	5.44E+00

SECONDARY LEAKAGE RATE BY STANDARD GIROUD EQN

Hole description in 2ry liner	area of hole *a* (m2)	hole diam d (m)	Contact coeff Cqo (.21 for good)	liquid head h (m)	Thickness of matl underlying 2ry GM (m)	Kum (perm of underlying) (m/s)	Q (Giroud)	No. of holes per acre	Probability of coincident hole Rw	Subtotal leakage rate (m3/acre-s)	Subtotal leakage rate (gal/acre-yr)
OPEN CELL											
Large hole	0.0001	0.01128379	0.21	3.44E-06	0.004	3.00E-11	1.65E-14	3	1.31E-01	6.51E-15	5.38E-05
Small hole	7.80E-07	0.00099656	0.21	3.44E-06	0.004	3.00E-11	1.02E-14	3	1.31E-01	4.01E-15	3.31E-05
							TOTAL			**1.1E-14**	**8.7E-05**

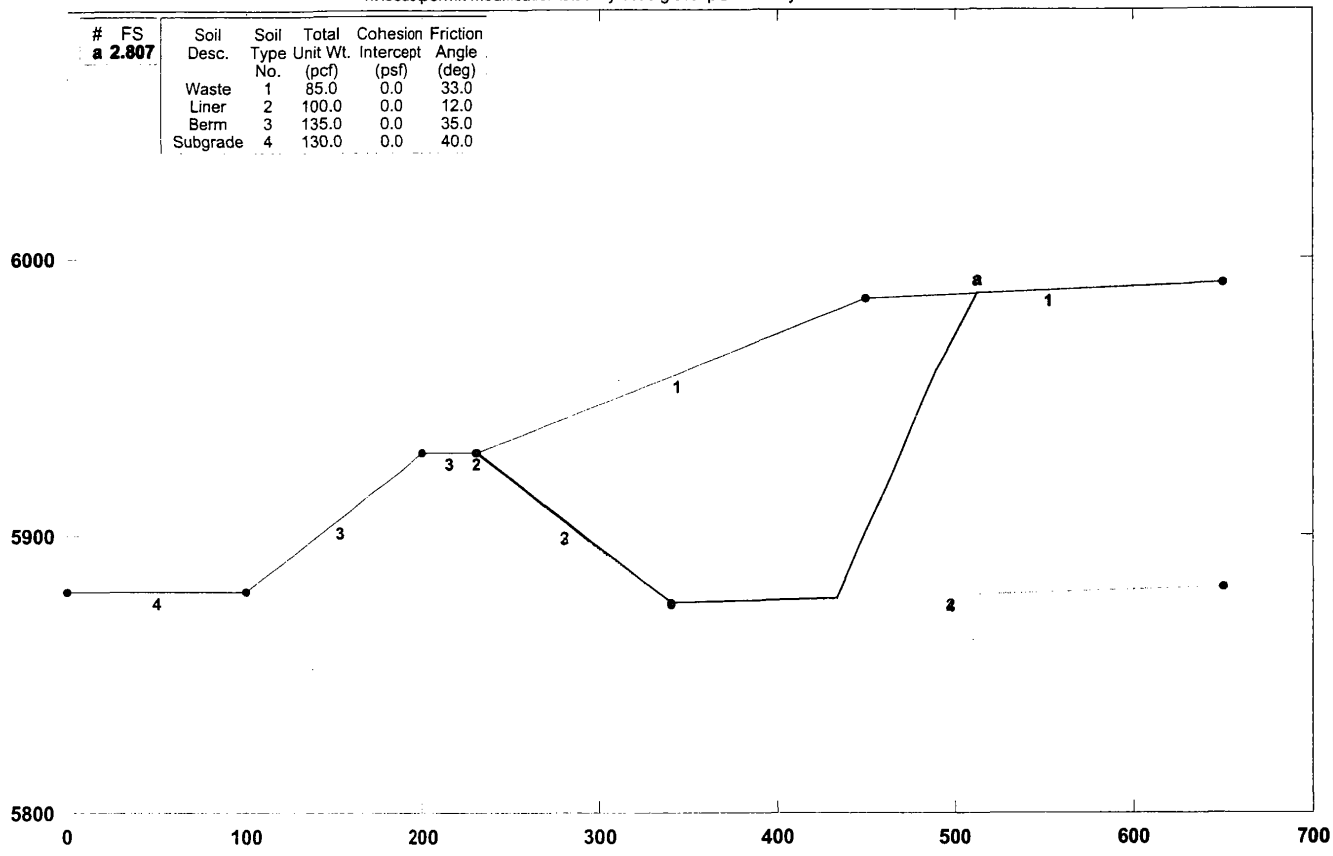
APPENDIX Q
SUPER CELL GLOBAL STATIC STABILITY

ECDC Permit Modification Super Cell Global Static Stability

n:\ecdc\permit modification\stability\ecdc-global.pl2 Run By: Aaron 3/28/2007 12:52PM

#	FS
a	2.807

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Waste	1	85.0	0.0	33.0
Liner	2	100.0	0.0	12.0
Berm	3	135.0	0.0	35.0
Subgrade	4	130.0	0.0	40.0



GSTABL7 v.2 FSmin=2.807

Safety Factors Are Calculated By GLE (Spencer's) Method (0-1)

VECTOR ENGINEERING, INC

APPENDIX H
DIPOLE SURVEYING PROCEDURES

VECTOR ENGINEERING, INC.

DIPOLE SURVEYING

ASTM TEST STANDARD D 7007-03
Standard Practice for Locating Leaks in Geomembranes Covered with Water or Earthen Materials

1.0 Equipment, Tools, Area, Environment and Safety Concerns

1.1 Major Equipment – Earth covered geomembrane surveying requires the use of a power supply, a dipole structure, copper sulfate, a multimeter or other device which measures voltage, a data acquisitioner, a laptop computer to download data, ASTM approved calibration "holes", several spools of wire, steel electrode plates, grounding stakes, poles with attached string to lay out the surveying grid and a generator with at least a 500W output.

1.2 Tools – Various knives, tape, electrical connectors, screwdrivers and wire cutters are needed to assemble the major equipment components. Flag or other hole markers, an extension cord, a multimeter, spray paint and a shovel are needed to perform the survey. Additional 9V batteries are required to perform equipment maintenance.

1.3 Area – At least one area around the liner must be exposed ground. There must be a separation between the area to be surveyed and the surrounding ground so that it is as electrically isolated as possible. GCL under the liner is acceptable, but the grounding wire must be attached to the GCL. In the case of a double liner, the space between the primary and secondary liners may require flooding.

1.4 Environment – The liner cover soils must contain at least a moderate to weak humidity. The presence of frost reduces the electrical insulation of the peripheries of the survey area. This survey cannot be performed under heavy rain or any other event that causes the survey area to be grounded on all sides with the surrounding soil. This survey cannot be performed if the soil cover is too dry and water cannot permeate completely into the cover thickness.

1.5 Safety - The current generated by the power source can cause injury and even death. The main danger lies in bridging one's body across the area to be surveyed and the ground outside the surveying area. Before moving or touching any electrode, test hole or wire, the power source should be shut off. In addition, any person or equipment moving from the charged area to the grounded area should be informed of the danger.

2.0 Calibration Checks and Requirements

2.1 Equipment Set-Up – After adding the copper sulfate to the dipole sensors, one must wait 15-20 minutes before the dipole can be used.

2.2 Check the conductivity of all the electrode plates and calibration holes as well as the wire connecting the dipole sensors to the data acquisition unit.

2.3 Instrument Testing and Calibration – Before each day of surveying, the dipole must be tested for functionality using a real or artificial calibration hole as per ASTM D 7007-03, as described in Section 6.2 of this document. In addition, the background noise of the location must be rechecked each day and in each area where the background noise may be different. The sensitivity of the instrument must be such that the calibration hole (real or artificial) must produce a signal equal to or greater than three times the background noise as per ASTM D 7007-03. At the end of each day of surveying, the instrument must be checked again using either the artificial or actual leak.

3.0 Test Standards Used

3.1 The referenced ASTM Standard is used as the primary procedure for conducting the survey.

4.0 Staff Requirements

4.1 Dipole operators must be experienced and qualified. Minimum experience includes two days of complete training by qualified Solmers or Vector staff.

4.2 An assistant without geoelectric surveying experience and qualifications may be assigned to assist with the physical aspects of the surveying process such as grid set-up.

5.0 Summary of Method

5.1 This standard operation procedure (SOP) provides technical staff specific guidelines for conducting the referenced test. This procedure does not replace the cited technical reference, and it is important for the user to always follow the sited test standard. This SOP provides information unique to equipment and specific methods within the cited test standard. It is provided to simplify and direct the technician to common practice, equipment and methods used by Vector.

5.2 This SOP provides more stringent guidelines than required by ASTM D 7007-03, in accordance with the quality control measures considered necessary by Solmers and Vector.

6.0 Procedure

6.1 Project Set-Up

- Each project shall consist of a planning stage, including obtaining design drawings if possible. A site visit will be made, if possible. In the case of questionable soil liner covers, a calibration test must be performed before the job is accepted.
- Before leaving for the site, the equipment list must be thoroughly checked for general as well as site specific supplies.
- If possible, the project site plan should be inserted into the daily report and daily reports printed out for the entire project.

6.2 On-Site Set-Up

- Dissolve approximately 15 grams (a full teaspoon) of copper sulphate in a liter of water and mix thoroughly. Assemble dipole and add copper sulphate.
- Check the humidity of the cover soils and irrigate if necessary.
- Electrically isolate both the generator and the power source.
- Positive and negative electrode plates are connected to the power source using 16 gauge wires. The negative electrode plate is buried on the ground outside the surveying area to a depth of approximately 20 cm. Water may be added to ensure contact with the soil.
- The positive electrode plate is buried close to the edge of the area to be surveyed (approximately 20 cm deep). Water may be added to ensure contact with the soil.
- The current source must be OFF before connecting the wires from the electrodes. Once the wires are connected, the voltage dial is increased slowly to the recommended value. Surveying should not be performed in a current higher than 400 mA for safety reasons.
- The distance to the end of the positive electrode's influence is determined using the power source at the desired setting.
- The artificial calibration holes are buried at the edge of the power source's influence on top of the liner, or a real hole is drilled into the liner and the area is covered back up in a manner which closely imitates surrounding conditions. As much as 250 ml of water may be added to the excavated hole to ensure good conductivity.
- If used, the ground of the artificial calibration holes must be located approximately the same distance from the negative electrode plate of the power source as the location of the calibration holes. This requires the current to flow through an equivalent length of soil as it would if it were to travel through an actual hole at the artificial hole location.
- A calibration curve is created by surveying in a straight line, approximately ten to twenty feet in either direction of the test hole (to obtain at least 10 measurement points). Several calibration curves should be generated, representing the most sensitive and least sensitive dipole locations.
- The background noise measurements are obtained using the same line, with the power source turned OFF.
- Once the target hole size can be positively located (signal to noise ratio ≥ 3), the most efficient grid spacing, voltage setting, dipole length, maximum survey distance from the positive electrode and dipole orientation are determined.

6.3 Surveying Procedures

- The survey proceeds in a grid pattern whose dimensions are determined during the calibration procedures.
- Data is recorded at each survey point and it is also displayed on the screen of the data acquisition unit.
- In the case of a suspected hole, the location of the highest and lowest signals are marked with a flag during the survey.
- The data obtained from the survey is analyzed at the end of the day.
- Suspected hole locations are thoroughly investigated with the dipole. If the signal to noise ratio is sufficient, the area is dug up and if necessary, the hole is repaired.
- The area of any repaired hole must then be resurveyed to check for additional holes in the area.
- At the end of each day, the area where the survey has been completed and verified shall be clearly marked. In addition, the daily report shall be completely filled out, including a sketch of the repair locations.

7.0 Equipment Care and Storage

7.1 All data aquisition batteries are to be checked before each day of surveying.

7.2 The sensors of the dipole may be stored in a copper sulfate solution overnight.

7.3 When not in use, all equipment shall remain under at least one level of security (locked).

8.0 Required Forms

8.1 Daily Report – The Daily report shall contain the project name and number, the date and day of work, the daily report sequence number, the location of work, the client or manager, weather, geomembrane type and thickness, cover material type and thickness, project acreage, start and end locations for the day, a list of operators with equipment used and the associated calibration and battery checks, a repair log with the number, damage type, dimension and location of repairs, a sketch of the surveyed area with repair locations, specific parameters of survey including dipole spacing, spacing between measurements or scans, spacing between survey lines and dipole orientation along survey lines and any specific conditions of survey.

9.0 Quality Control, Corrective Action

9.1 In the case of a geomembrane repair, the location of the repair is given to the contractor. The area must then be resurveyed after the repair has occurred.

10.0 Reporting

10.1 Final Report – In addition to the items contained in the daily reports, the final report will contain a description of the survey site, the liner system layering, a description of the leak location method, the survey methodology, a description of the artificial or actual leak used, the results of leak detection sensitivity tests, results of periodic leak detection sensitivity tests, a map of the surveyed area and, if requested by the client, ASCII files of the raw data from the survey on a compact disc labeled with the site name, cell name, survey dates, and name of the leak location company.