GROUNDWATER QUALITY DISCHARGE PERMIT UGW350011 MODIFICATION APPLICATION

TAILINGS IMPOUNDMENT KENNECOTT UTAH COPPER LLC SALT LAKE COUNTY, UTAH

Prepared for
Kennecott Utah Copper LLC
Rio Tinto Regional Center
4700 Daybreak Parkway
South Jordan, Utah 84095

September 2012

URS

URS Corporation
8181 E. Tufts Avenue
Denver, CO 80237

Project No. 22242950

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Groundwater Quality Discharge Permit UGW350011 Modification Application
Tailings Impoundment
Kennecott Utah Copper LLC, Salt Lake County, Utah
September 2012

Permit Application Parts A, B and C

MAIL TO:
Division of Water Quality
Utah Department of Environmental Quality
Salt Lake City, Utah 84114-4870

Application No.:______________
Date Received:_______________
(leave both lines blank)

UTAH GROUND WATER DISCHARGE PERMIT APPLICATION

Part A - General Facility Information

Please read and follow carefully the instructions on this application form. Please type or print, except for signatures. This application is to be submitted by the owner or operator of a facility having one or more discharges to groundwater. The application must be signed by an official facility representative who is: the owner, sole proprietor for a sole proprietorship, a general partner, an executive officer of at least the level of vice president for a corporation, or an authorized representative of such executive officer having overall responsibility for the operation of the facility.

1. **Administrative Information.** Enter the information requested in the space provided below, including the name, title and telephone number of an agent at the facility who can answer questions regarding this application.

Facility Name: Kennecott Utah Copper LLC Tailings Impoundment

Mail Address: 4700 Daybreak Parkway, South Jordan, Utah 84095
(Number & Street, Box and/or Route, City, State, Zip Code)

Facility Legal Location* See Table 1 and Figure 1 County: Salt Lake

*Note: A topographic map or detailed aerial photograph should be used in conjunction with a written description to depict the location of the facility, points of ground water discharge, and other relevant features/objects.

Contact's Name: Kelly Payne Phone No.: (801) 204-2000

Title: Manager - Environment

2. **Owner/Operator Information.** Enter the information requested below, including the name, title, and phone number of the official representative signing the application.

Owner

Name: Kennecott Utah Copper LLC Phone No.:(801) 204-2000

Mail Address: 4700 Daybreak Parkway, South Jordan, Utah 84095
(Number & Street, Box and/or Route, City, State, Zip Code)

Operator

Name: Same Phone No________________
(If different than Owner's above)

Mail Address:_______________________________________
(Number & Street, Box and/or Route, City, State, Zip Code)

Official Representative

Name: Paula Doughty Phone No.: (801) 204-3500

Title: Manager, Tailings and Water Services

3. **Facility Classification** (check one)

[ ] New Facility
[X] Existing Facility
[X] Modification of Existing Facility

4. Type of Facility (check one)

[ ] Industrial
[X] Mining
[ ] Municipal
[ ] Agricultural Operation
[ ] Other, please describe:____

5. SIC/NAICS Codes: 331411 (NAICS, Primary Smelting and Refining of Copper), 3331 (SIC),1021 (SIC)

Enter Principal 3 Digit Code Numbers Used in Census & Other Government Reports

6. Projected Facility Life: 30 years

7. Identify principal processes used, or services performed by the facility. Include the principal products produced, and raw materials used by the facility:

Storage of tailings originating from concentrators processing ore from the Bingham Canyon Mine.

8. List all existing or pending Federal, State, and Local government environmental permits:

	Permit Number
[X] NPDES or UPDES (discharges to surface water)	UT0000051
[ ] CAFO (concentrated animal feeding operation)	
[ ] UIC (underground injection of fluids)	
[ ] RCRA (hazardous waste)	
[X] PDS (air emissions from proposed sources)	DAQE-AN0572018-06, 3500346002
[ ] Construction Permit (wastewater treatment)	
[X] Solid Waste Permit (sanitary landfills, incinerators)	35-0011805
[ ] Septic Tank/Drainfield	
[X] Other, specify Dam Safety, Reclamation (South, North), Wetlands	UT00432, M/035/0002, M/035/0015, 199450301

9. Name, location (Lat. _______°________‘________“N, Long. _______°_____‘_____“W) and description of: each well/spring (existing, abandoned, or proposed), water usage(past, present, or future); water bodies; drainages; well-head protection areas; drinking water source protection zones according to UAC 309-600; topography; and man-made structures within one mile radius of the point(s) of discharge site. Provide existing well logs (include total depth and variations in water depths).

Name	Location	Description	Status	Usage

See Table 2 (springs within one mile of facility), Table 3 (wells within one mile of facility), and Figure 2 (wells and springs shown on map)

The above information must be included on a plat map and attached to the application.

Part B - General Discharge Information

Complete the following information for each point of discharge to ground water. If more than one discharge point exists, photocopy and complete this Part B form for each discharge point.

1. **Location** (if different than Facility Location in Part A): County: Same as facility location (Figure 1, Table 1)
   T.____________, R.____________, Sec.____________, ____________1/4 of ____________1/4,
   Lat. ________°____________‘____________"N, Long. ________°__________‘_________"W

2. **Type of fluid to be Discharged or Potentially Discharged**
   (check as applicable)

   Discharges (fluids discharged to the ground)

   [ ] Sanitary Wastewater: wastewater from restrooms, toilets, showers and the like
   [ ] Cooling Water: non-contact cooling water, non-contact of raw materials, intermediate, final, or waste products
   [ ] Process Wastewater: wastewater used in or generated by an industrial process
   [ ] Mine Water: water from dewatering operations at mines
   [ ] Other, specify:____

   Potential Discharges (leachates or other fluids that may discharge to the ground)

   [ ] Solid Waste Leachates: leachates from solid waste impoundments or landfills
   [X] Milling/Mining Leachates: tailings impoundments, mine leaching operations, etc.
   [ ] Storage Pile Leachates: leachates from storage piles of raw materials, product, or wastes
   [ ] Potential Underground Tank Leakage: tanks not regulated by UST or RCRA only
   [ ] Other, specify:____

3. **Discharge Volumes**
   For each type of discharge checked in #2 above, list the volumes of wastewater discharged to the ground or ground water. Volumes of wastewater should be measured or calculated from water usage. If it is necessary to estimate volumes, enclose the number in parentheses. Average daily volume means the average per operating day: ex. For a discharge of 1,000,000 gallons per year from a facility operating 200 days, the average daily volume is 5,000 gallons.

Discharge Type:	Daily Discharge Volume (Average)	all in units of (Maximum)	

4. **Potential Discharge Volumes**
   For each type of potential discharge checked in #2 above, list the maximum volume of fluid that could be discharged to the ground considering such factors as: liner hydraulic conductivity and operating head conditions, leak detection system sensitivity, leachate collection system efficiency, etc. Attach calculation and raw data used to determine said potential discharge. See Attachment 1 (Supplemental Hydrogeology Report, Section 6) for seepage calculations.

Discharge Type:	Daily Discharge Volume (Average)	all in units of (Maximum)	
South Impoundment	700 gpm		
North Impoundment	560 gpm		
Proposed Northeast Expansion	240 gpm		
Diving Board Area	5 gpm		
Total Phase I Seepage Rate	**1505 gpm**		

5. Means of Discharge or Potential Discharge (check one or more as applicable)

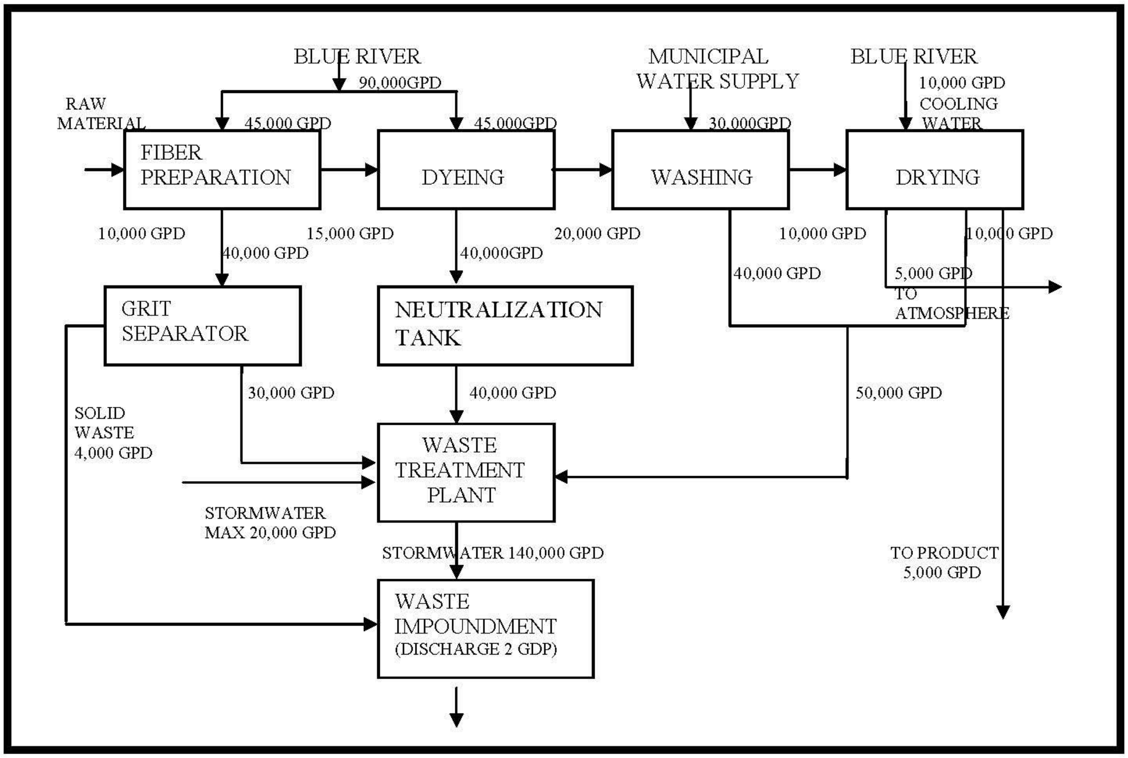
[ ] lagoon, pit, or surface impoundment (fluids)
[ ] land application or land treatment
[ ] discharge to an ephemeral drainage (dry wash, etc.)
[ ] storage pile
[X] landfill (industrial or solid wastes)
[ ] other, specify__________________

[ ] industrial drainfield
[ ] underground storage tank
[ ] percolation/infiltration basin
[ ] mine heap or dump leach
[X] mine tailings pond

6. Flows, Sources of Pollution, and Treatment Technologies

Flows. Attach a line drawing showing: 1) water flow through the facility to the ground water discharge point, and 2) sources of fluids, wastes, or solids which accumulate at the potential ground water discharge point. Indicate sources of intake materials or water, operations contributing wastes or wastewater to the effluent, and wastewater treatment units. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and wastewater outfalls. If a water balance cannot be determined, provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures. See the following example.

See Figure 3 for Schematic Drawing.



7. Discharge Effluent Characteristics

Established and Proposed Ground Water Quality Standards - Identify wastewater or leachate characteristics by providing the type, source, chemical, physical, radiological, and toxic characteristics of wastewater or leachate to be discharged or potentially discharged to ground water (with lab analytical data if possible). This should include the discharge rate or combination of discharges, and the expected concentrations of any pollutant (mg/l). If more than one discharge point is used, information for each point must be provided.

Protection levels and compliance limits have been established for compliance wells at the facility (see Table 1 of UGW350011). Additional chemical data on tailings water and groundwater is provided in Attachment 1 (Supplemental Hydrogeology Report, Section 7). No changes to compliance limits are proposed.

Hazardous Substances - Review the present hazardous substances found in the Clean Water Act, if applicable. List those substances found or believed present in the discharge or potential discharge.

There are no hazardous substances in the potential discharge.

Part C – Accompanying Reports and Plans

The following reports and plans should be prepared by or under the direction of a professional engineer or other ground water professional. Since ground water permits cover a large variety of discharge activities, the appropriate details and requirements of the following reports and plans will be covered in the pre-design meeting(s). For further instruction refer to the Ground Water Permit Application Guidance Document.

8. **Hydrogeologic Report** (See Attachment 1, Supplemental Hydrogeology Report)

   Provide a Geologic Description, with references used, that includes as appropriate:

   Structural Geology – regional and local, particularly faults, fractures, joints and bedding plane joints; **Stratigraphy** – geologic formations and thickness, soil types and thickness, depth to bedrock; **Topography** – provide a USGS MAP (7 ½ minute series) which clearly identifies legal site location boundaries, indicated 100 year flood plain area and applicable flood control or drainage barriers and surrounding land uses.

   Provide a Hydrologic Description, with references used, that includes:

   Ground water – depths, flow directions and gradients. Well logs should be included if available. Include name of aquifer, saturated thickness, flow directions, porosity, hydraulic conductivity, and other flow characteristics, hydraulic connection with other aquifers or surface sources, recharge information, water in storage, usage, and the projected aerial extent of the aquifer. Should include projected ground water area of influence affected by the discharge. Provide hydraulic gradient map indicating equal potential head contours and ground water flow lines. Obtain water elevations of nearby wells at the time of the hydrologic investigation. Collect and analyze ground water samples from the uppermost aquifer which underlies the discharge point(s). Historic data can be used if the applicant can demonstrate it meets the requirements contained within this section. Collection points should be hydraulically up and downgradient and within a one-mile radius of the discharge point(s). Ground water analysis should include each element listed in Ground Water Discharge Permit Application, Part B7.

   NOTE: Failure to analyze for background concentrations of any contaminant of concern in the discharge or potential discharge may result in the Executive Secretary's presumptive determination that zero concentration exist in the background ground water quality.

   Sample Collection and Analysis Quality assurance – sample collection and Preservation must meet the requirements of the EPA RCRA Technical Enforcement Guidance Document, OSWER-9959.1, 1986 [UAC R317-6-6.3(I,6)]. Sample analysis must be performed by State of Utah certified laboratories and be certified for each of the parameters of concern. Analytical methods should be selected from the following sources [UAC R317-6-6.3L]: (Standard Methods for the Examination of Water and Wastewater, 20th Ed., 1998; EPA, Methods for Chemical Analysis of Water and Wastes, 1983; Techniques of Water Resources Investigation of the U.S. Geological Survey, 1998, Book 9; EPA Methods published pursuant to 40 CFR Parts 141, 142, 264 (including Appendix IX), and 270. Analytical methods selected should also include minimum detection limits below both the Ground Water Quality Standards and the anticipated ground water protection levels. Data shall be presented in accordance of accepted hydrogeologic standards and practice.

   Provide Agricultural Description, with references used, that includes:

   If agricultural crops are grown within legal boundaries of the site the discussion must include: types of crops produced; soil types present; irrigation system; location of livestock confinement areas (existing or abandoned).

Note on Protection Levels:

After the applicant has defined the quality of the fluid to be discharged (Ground Water Discharge Permit Application, Part B), characterized by the local hydrogeologic conditions and determined background ground water quality (Hydrogeologic Report), the Executive Secretary will determine the applicable ground water class, based on: 1) the location of the discharge point within an area of formally classified ground water, or the background value of total dissolved solids. Accordingly, the Executive Secretary will determine applicable protection levels for each pollutant of concern, based on background concentrations and in accordance with UAC R317-6-4.

9. **Ground Water Discharge Control Plan:** (See Attachment 2, Groundwater Discharge Control Plan)

Select a compliance monitoring method and demonstrate an adequate discharge control system. Listed are some of the Discharge Control Options available.

No Discharge – prevent any discharge of fluids to the ground water by lining the discharge point with multiple synthetic and clay liners. Such a system would be designed, constructed, and operated to prevent any release of fluids during both the active life and any post-closure period required.

Earthen Liner – control the volume and rate of effluent seepage by lining the discharge point with a low permeability earthen liner (e.g. clay). Then demonstrate that the receiving ground water, at a point as close as practical to the discharge point, does not or will not exceed the applicable class TDS limits and protection levels* set by the Executive Secretary. This demonstration should also be based on numerical or analytical saturated or unsaturated ground water flow and contaminant transport simulations.

Effluent Pretreatment – demonstrate that the quality of the raw or treated effluent at the point of discharge or potential discharge does not or will not exceed the applicable ground water class TDS limits and protection levels* set by the Executive Secretary.

Contaminant Transport/Attenuation – demonstrate that due to subsurface contaminant transport mechanisms at the site, raw or treated effluent does not or will not cause the receiving ground water, at a point as close as possible to the discharge point, to exceed the applicable class TDS limits and protection levels* set by the Executive Secretary.

Other Methods – demonstrate by some other method, acceptable to the Executive Secretary, that the ground water class TDS limits and protection levels* will be met by the receiving ground water at a point as close as practical to the discharge point.

*If the applicant has or will apply for an alternate concentration limit (ACL), the ACL may apply instead of the class TDS limits and protection levels.

Submit a complete set of engineering plans and specifications relating to the construction, modification, and operation of the discharge point or system. Construction Permits for the following types of facilities will satisfy these requirements. They include: municipal waste lagoons; municipal sludge storage and on-site sludge disposal; land application of wastewater effluent; heap leach facilities; other process wastewater treatment equipment or systems.

Facilities such as storage piles, surface impoundments and landfills must submit engineering plans and specifications for the initial construction or any modification of the facility. This will include the design data and description of the leachate detection, collection and removal system design and construction. Provide provisions for run on and run-off control.

10. Compliance Monitoring Plan: (See Attachment 3, Compliance Monitoring Plan Addendum)

The applicant should demonstrate that the method of compliance monitoring selected meets the following requirements:

Ground Water Monitoring – that the monitoring wells, springs, drains, etc., meet all of the following criteria: is completed exclusively in the same uppermost aquifer that underlies the discharge point(s) and is intercepted by the upgradient background monitoring well; is located hydrologically downgradient of the discharge point(s); designed, constructed, and operated for optimal detection (this will require a hydrogeologic characterization of the area circumscribed by the background sampling

point, discharge point and compliance monitoring points); is not located within the radius of influence of any beneficial use public or private water supply; sampling parameters, collection, preservation, and analysis should be the same as background sampling point; ground water flow direction and gradient, background quality at the site, and the quality of the ground water at the compliance monitoring point.

Source Monitoring – must provide early warning of a potential violation of ground water protection levels, and/or class TDS limits and be as or more reliable, effective, and determinate than a viable ground water monitoring network.

Vadose Zone Monitoring Requirements – Should be: used in conjunction with source monitoring; include sampling for all the parameters required for background ground water quality monitoring; the application, design, construction, operation, and maintenance of the monitoring system should conform with the guidelines found in: Vadose Zone Monitoring for Hazardous Waste Sites; June 1983, KT-82-018(R).

Leak Detection Monitoring Requirements – Should not allow any leakage to escape undetected that may cause the receiving ground water to exceed applicable ground water protection levels during the active life and any required post-closure care period of the discharge point. This demonstration may be accomplished through the use of numeric or analytic, saturated or unsaturated, ground water flow or contaminant transport simulations, using actual filed data or conservative assumptions. Provide plans for daily observation or continuous monitoring of the observation sump or other monitoring point and for the reporting of any fluid detected and chemical analysis thereof.

Specific Requirements for Other Methods – Demonstrate that: the method is as or more reliable, effective, and determinate than a viable ground water monitoring well network at detecting any violation of ground water protection levels or class TDS limits, that may be caused by the discharge or potential discharge; the method will provide early warning of a potential violation of ground water protection levels or class TDS limits and meets or exceeds the requirements for vadose zone or leak detection monitoring.

Monitoring well construction and ground water sampling should conform to A Guide to the Selection of Materials for Monitoring Well Construction. Sample collection and preservation, should conform to the EPA RCRA Technical Enforcement Guidance Document, OSWER-9950.1, September, 1986. Sample analysis must be performed by State-certified laboratories by methods outlined in UAC R317-6-6.3L. Analytical methods used should have minimum detection levels which meet or are less than both the ground water quality standards and the anticipated protection levels.

11. **Closure and Post Closure Plan (See Attachment 4):** The purpose of this plan is to prevent ground water contamination after cessation of the discharge or potential discharge and to monitor the discharge or potential discharge point after closure, as necessary. This plan has to include discussion on: liquids or products, soils and sludges; remediation process; the monitoring of the discharge or potential discharge point(s) after closure of the activity.

12. **Contingency and Corrective Action Plans (See Attachment 5):** The purpose of this Contingency plan is to outline definitive actions to bring a discharge or potential discharge facility into compliance with the regulations or the permit, should a violation occur. This applies to both new and existing facilities. For existing facilities that may have caused any violations of the Ground Water Quality Standards or class TDS limits as a result of discharges prior to the issuance of the permit, a plan to correct or remedy any contaminated ground water must be included.

    Contingency Plan – This plan should address: cessation of discharge until the cause of the violation can be repaired or corrected; facility remediation to correct the discharge or violation.

    Corrective Action Plan – for existing facilities that have already violated Ground Water Quality Standards, this plan should include: a characterization of contaminated ground water; facility remediation proposed or ongoing including timetable for work completion; ground water remediation.

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 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.

Paula Doughty, Manager, Tailings and Water Services	(801) 204-3500
NAME & OFFICIAL TITLE (type or print)	PHONE NO. (area code & no.)
SIGNATURE	DATE SIGNED

Table 1
FACILITY LOCATION
Kennecott Utah Copper LLC
Tailings Impoundment
Permit UGW350011

Township, Range	Section
T1S, R2W	Sec 4 Sec 5 Sec 6 Sec 7 Sec 8 Sec 9 Sec 17 W2, W2 of NE4, W2 of SE4 Sec 18 Sec 19 N2, NE4 of SW4 Sec 20 NW4, W2 of NE4
T1S, R3W	Sec 1 Sec 2 Sec 3 E2 of SE4 Sec 10 Sec 11 Sec 12 Sec 13 Sec 14 Sec 15 E2 Sec 23 N2 Sec 24 N2
T1N, R2W	Sec 31 S2 Sec 32 S2 Sec 33 S2
T1N, R3W	Sec 35 S2 of SE4 Sec 36 S2

Table 2
REGISTERED SPRINGS WITHIN ONE MILE OF FACILITY
Kennecott Utah Copper LLC
Tailings Impoundment
Permit UGW350011

Spring ID	Latitude	Longitude
404315112035900	-112.0664	40.7208
404356112102601	-112.1739	40.7322
404400112051001	-112.0861	40.7333
404408112101800	-112.1717	40.7356
404410112100601	-112.1683	40.7361
404605112060200	-112.1006	40.7681
404607112060700	-112.1019	40.7686
404643112060000	-112.1000	40.7786
404649112061001	-112.1028	40.7803

Note:
Springs listed are those registered with the Utah Geologic Survey.

Table 3
REGISTERED WELLS WITHIN ONE MILE OF FACILITY
Kennecott Utah Copper LLC
Tailings Impoundment
Permit UGW350011

Water Right Number	Type	Diameter (inches)	Depth (feet)	Drilled Date	Section	Township	Range	B&M	Location (feet)
0159002M00	Abandonded Well	4	85	7/31/2001	22	1S	3W	SL	S 700 E 1850 NW
0257002M00	Underground	0	0	-	16	1S	2W	SL	S 500 W 1000 NE
0259009M00	Underground	2.5	372	11/7/2002	22	1S	3W	SL	S 575 E 2300 NW
0359003P00	Underground	10	129	4/18/2003	21	1S	2W	SL	N 734 E 438 SW
0359600P00	Unknown	8	148	9/2/2003	20	1S	2W	SL	S 842 W 542 SE
0459013M00	Underground	0	0	8/12/2004	21	1S	2W	SL	S 801 W 327 NE
0759012M00	Underground	1	0	10/25/2007	19	1S	2W	SL	N 123 W 301 S4
0859009M00	Underground	0	0	1/22/2009	19	1S	2W	SL	N 123 W 300 S4
0959017M00	Underground	0	0	12/4/2009	29	1S	2W	SL	N 892 W 663 S4
1059001M00	Underground	0	0	3/17/2010	21	1S	2W	SL	N 2409 W 1799 SE
1059005M00	Underground	1	250	4/22/2010	19	1S	2W	SL	N 554 W 1182 SE
1059006M00	Underground	1	250	4/20/2010	19	1S	2W	SL	N 602 W 1182 SE
1059007M00	Underground	1	250	4/17/2010	19	1S	2W	SL	N 654 W 1182 SE
1059012M00	Underground	2.5	125	5/11/2011	22	1S	3W	SL	S 1271 W 1853 NE
1059013M00	Underground	2	580	4/6/2011	15	1S	3W	SL	N 1980 E 2414 SW
1159006M00	Underground	2	537	5/11/2011	15	1S	3W	SL	N 3195 E 1090 SW
59-1135	Underground	8	200	-	21	1S	2W	SL	N 115 E 640 W4
59-1196	Underground	20	800	-	15	1S	3W	SL	S 1391 E 2130 NW
59-1327	Abandonded Well	0	0	-	19	1S	2W	SL	N 490 W 895 SE
59-1341	Underground	0	0	10/19/1976	22	1S	2W	SL	N 734 E 176 W4
59-1563	Underground	2	105	6/26/1960	30	1S	2W	SL	S 117 E 1312 NW
59-1565	Underground	3	105	8/12/1960	20	1S	2W	SL	N 770 W 703 S4
59-1566	Underground	16	857	11/27/1961	17	1S	2W	SL	S 2460 W 1200 NE
59-1567	Abandonded Well	16	414	11/10/1960	21	1S	2W	SL	N 520 W 2050 E4
59-1596	Underground	3	105	3/21/1961	20	1S	2W	SL	N 830 E 58 S4
59-1656	Underground	3	210	8/13/1964	21	1S	2W	SL	S 463 W 1156 NE
59-1886	Underground	6	301	12/20/1974	21	1S	2W	SL	S 355 W 1185 E4
59-2193	Abandonded Well	0	0	-	20	1S	2W	SL	S 800 E 460 W4
59-2709	Underground	0	0	-	5	1S	2W	SL	S 395 E 90 NW
59-2757	Underground	8	415	1/10/1980	21	1S	2W	SL	N 180 E 1470 W4
59-2902	Underground	6	220	3/29/1978	21	1S	2W	SL	S 180 E 855 N4
59-322	Underground	6	148	6/6/1977	21	1S	2W	SL	N 180 E 1208 W4
59-3247	Underground	3	126	5/18/1961	28	1S	2W	SL	S 572 E 2110 NW
59-3248	Underground	2	128	-	28	1S	2W	SL	S 430 E 2120 NW
59-3250	Underground	6	120	-	21	1S	2W	SL	S 175 W 2300 E4
59-3409	Underground	2	186	5/29/1969	16	1S	2W	SL	N 1040 E 570 S4
59-3569	Underground	4	98	3/1/1969	20	1S	2W	SL	N 275 W 225 SE
59-3572	Underground	6	300	4/20/1969	16	1S	2W	SL	N 1420 W 100 SE
59-3720	Underground	6	205	-	21	1S	2W	SL	S 750 E 2150 W4
59-391	Underground	5	509	-	32	1N	2W	SL	N 975 E 540 W4
59-3978	Underground	8	237	1/7/1974	21	1S	2W	SL	N 980 W 517 E4
59-4122	Unknown	20	585	2/21/1983	20	1S	2W	SL	S 690 E 1095 W4
59-4344	Underground	16	404	4/5/1968	21	1S	2W	SL	N 1470 W 2540 E4
59-4685	Underground	0	0	-	19	1S	2W	SL	N 2842 W 276 S4
59-4750	Underground	0	100	-	6	1S	2W	SL	S 140 W 240 NE
59-5062	Underground	6	215	7/26/1976	31	1S	2W	SL	S 200 W 150 NE
59-5615	Underground	5	200	5/25/2000	22	1S	2W	SL	S 650 E 275 NW
59-5680	Underground	20	885	-	15	1S	3W	SL	S 1520 E 1060 NW
59-682	Underground	20	516	10/6/1995	21	1S	2W	SL	N 1013 W 1074 E4
59-713	Underground	6	150	6/12/1978	21	1S	2W	SL	N 308 E 1890 W4
59-76	Underground	0	0	-	21	1S	2W	SL	N 1136 W 2134 E4
59-798	Underground	6	150	-	15	1S	2W	SL	S 310 W 1420 E4
59-87	Underground	20	430	9/15/1937	5	1S	3W	SL	S 3891 E 3938 NW

Table 3
REGISTERED WELLS WITHIN ONE MILE OF FACILITY
Kennecott Utah Copper LLC
Tailings Impoundment
Permit UGW350011

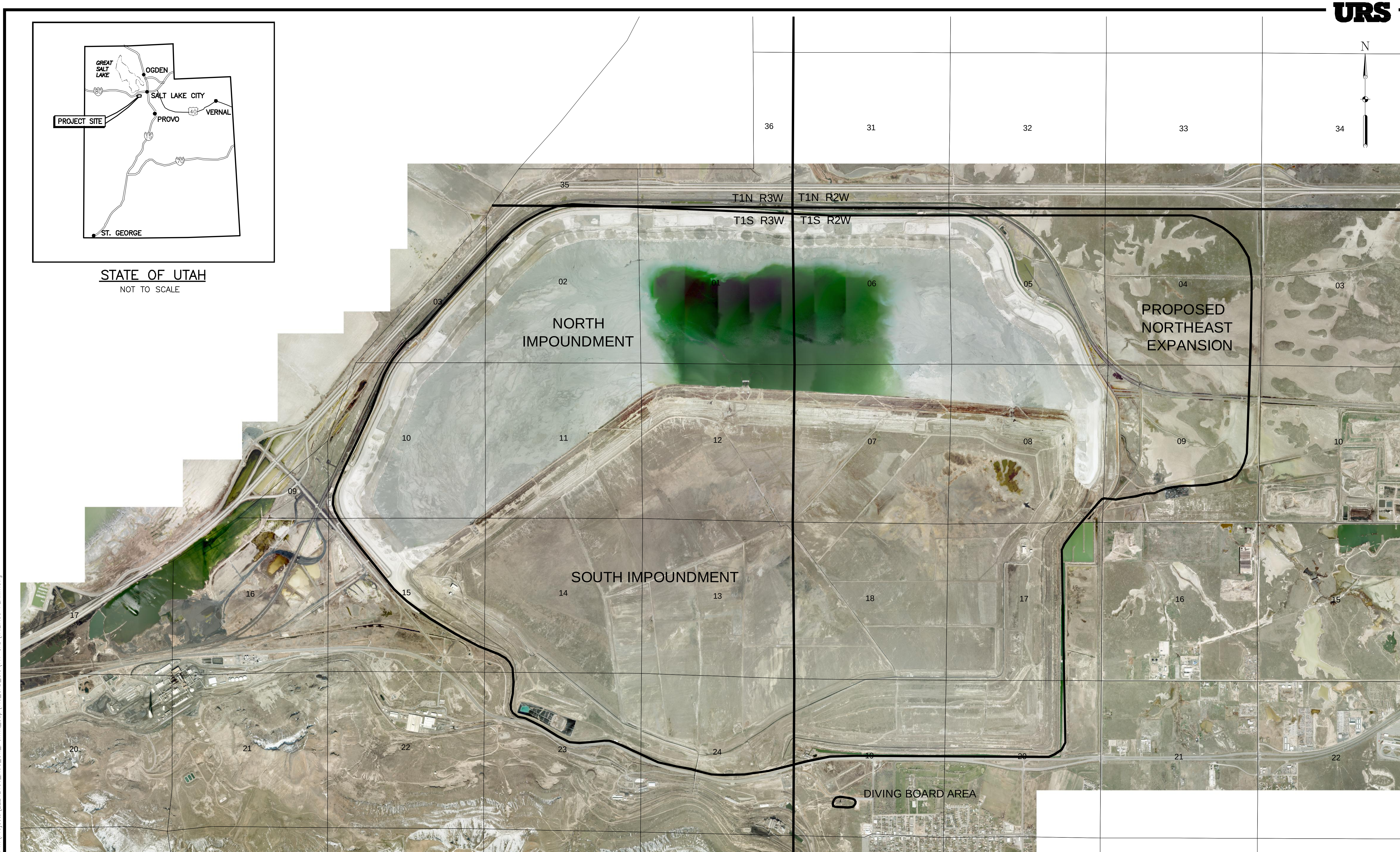
Water Right Number	Type	Diameter (inches)	Depth (feet)	Drilled Date	Section	Township	Range	B&M	Location (feet)
8513001M00	Underground	12	60	10/3/1985	17	1S	2W	SL	S 700 E 200 NW
8759005M00	Underground	2	21	10/7/1987	24	1S	2W	SL	N 1300 W 1200 SE
9159035M00	Underground	4	32	3/11/1992	24	1S	3W	SL	0 0 NE
9359011M00	Underground	0	123	10/13/1993	22	1S	3W	SL	S 1500 W 2500 NE
9359012M00	Underground	2.5	140	11/15/1993	1	1S	3W	SL	N 1750 W 96 SW
9659002M00	Underground	2.5	21	4/11/1996	19	1S	2W	SL	N 2450 W 1300 SE
9659010M00	Underground	0	0	-	25	1S	3W	SL	S 50 W 800 NE
9759001M00	Underground	2.5	127	3/19/1997	23	1S	3W	SL	S 500 E 800 NW
9759006M00	Underground	2.5	222	8/1/1997	22	1S	3W	SL	N 350 E 2150 NE
9759013M00	Underground	2.5	718	9/11/1997	22	1S	3W	SL	S 101 E 2500 NW
9859002M00	Underground	25	133	5/19/1998	15	1S	3W	SL	N 1010 E 1510 SW
9859003M00	Underground	2.5	270	5/19/1998	15	1S	3W	SL	N 1020 E 1520 SW
9959002M00	Underground	2.5	289	3/3/1999	30	1S	2W	SL	N 880 E 2776 SW
a27439	Underground	8	103	12/2/2003	20	1S	2W	SL	N 824 W 542 SE
a37883	Underground	0	0	-	21	1S	2W	SL	S 352 W 1066 E4

Notes:

Wells listed are those registered with the Utah Division of Water Rights. The search radius was 18,000 feet from the northeast corner of T15, R3W, S12, in order to include wells within a one mile radius of the irregular tailings impoundment outer boundary.

B&M = Base and Meridian

SL = Salt Lake

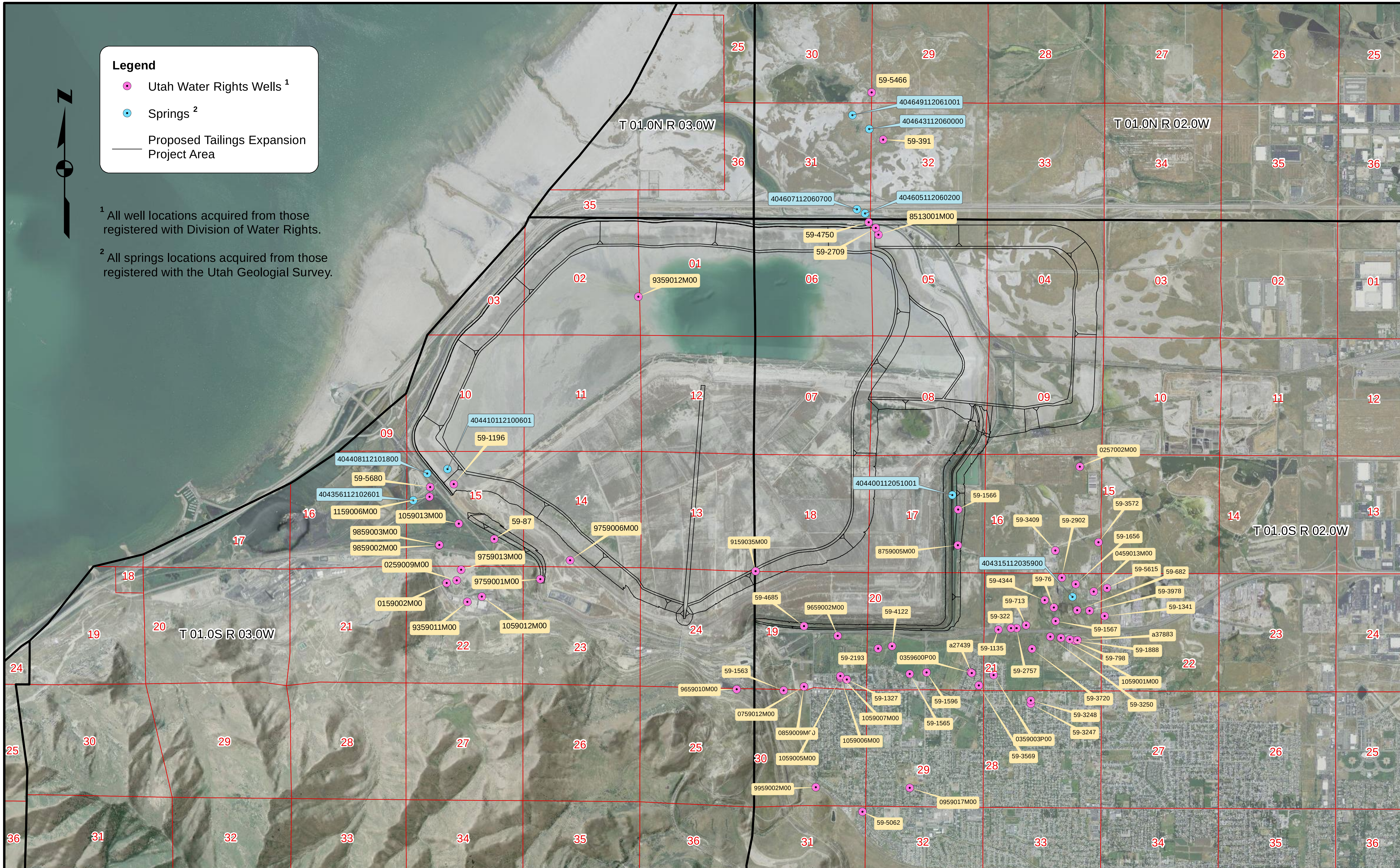


LEGEND:

BOUNDARY OF PERMITTED FACILITIES

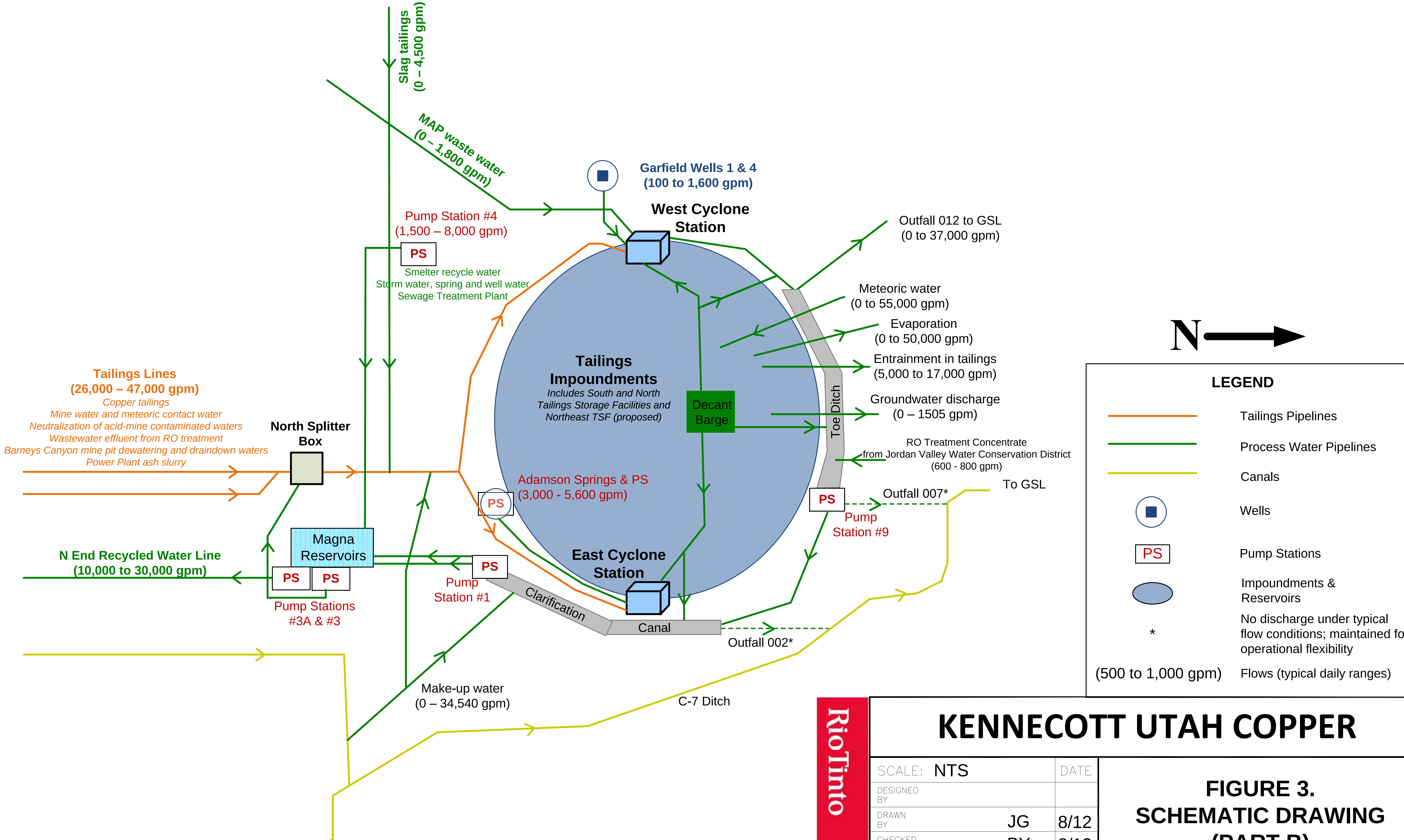
PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	KENNECOTT TAILINGS IMPOUNDMENT GROUNDWATER DISCHARGE PERMIT UGW350011	FIGURE 1 (PART A)
	URS		

URS DRAWING PATH: W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\TAILINGS PERMIT.dwg



4,000 0 4,000
Feet

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	Wells and Springs Within One Mile of Facility	Figure 2 (Part A)
URS	DRAWN BY: JLC DATE: APRIL 2012		



Tailings impoundment water balance assessment as project evolves (proposed phase 1 and phase 2 expansions). Typical flow rates expected to vary based on production rates and climate variability. Only permitted discharge outfalls related to the tailings impoundments are shown.

Rio Tinto

KENNECOTT UTAH COPPER

SCALE: NTS		DATE
DESIGNED BY		
DRAWN BY	JG	8/12
CHECKED BY	BY	8/12
PROJECT ENGINEER		
PROJECT MANAGER		

FIGURE 3. SCHEMATIC DRAWING (PART B)

Job No. Dwg. No. REV 0 REV DATE

Tailings Impoundment Schematic Mid Detail 08_31_12.vsd

K:\Land\Land and Water\Water\Drawings\Maps Diagrams and Figures\

Part C

Attachment 1

Supplemental Hydrogeology Report

FINAL REPORT

SUPPLEMENTAL HYDROGEOLOGY REPORT

GROUNDWATER QUALITY DISCHARGE PERMIT UGW350011 MODIFICATION APPLICATION

TAILINGS IMPOUNDMENT KENNECOTT UTAH COPPER LLC SALT LAKE COUNTY, UTAH

Prepared for
Kennecott Utah Copper LLC
Rio Tinto Regional Center
4700 Daybreak Parkway
South Jordan, Utah 84095

September 2012

URS Corporation
8181 E. Tufts Avenue
Denver, CO 80237

Project No. 22242950

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The Kennecott Utah Copper LLC (Kennecott) tailings impoundment is operated under groundwater discharge permit UGW350011, granted by the Utah Department of Environmental Quality, Division of Water Quality (UDWQ). Permit UGW350011was first issued on December 21, 1995 and it has been renewed on a regular basis every five years. The most recent renewal was on January 12, 2011 (UDWQ 2011a, 2011b). The permitted facility includes: (1) the closed South Impoundment which operated from 1906 to 2002, (2) the North Impoundment which has been in operation since 1999, and (3) the Diving Board area which is a small earthen impoundment originally designed to retain tailings discharges resulting from emergency shutdowns, but currently serves as the capture area for Magna Reservoir in the unlikely event of a failure (Figure 1-1).

Kennecott is applying for a permit modification to address the proposed Tailings Expansion Project (TEP), which is an expansion of the tailings impoundment to the northeast (Northeast Expansion) and increasing the height of the existing North and South Impoundments in two phases of construction. Phase I includes the construction of the Northeast Expansion and raising the existing North Impoundment. Phase II consists of using portions of the existing South Impoundment and continuing to raise the North Impoundment.

This Supplemental Hydrogeologic Report has been prepared to fulfill Part C, Section 8 (Hydrogeologic Report) of the permit modification application package. Extensive hydrogeologic characterization investigations were performed in the early 1990’s to support the original groundwater discharge permit for the tailings impoundment (Kennecott 1993). The intent of this report is to present updated hydrogeologic information for the purpose of demonstrating that the site hydrogeologic conditions are well understood and that potential impacts to groundwater resources from operating the proposed TEP can be readily assessed and minimized.

The remainder of this report provides the following:

- A summary of historical background information on hydrogeology (Section 2.0),
- A geologic overview of the tailings impoundment area (Section 3.0),
- A description of the aquifers units underling the tailings impoundment (Section 4.0),
- Groundwater flow conditions (Section 5.0),
- Estimated seepage rates from the impoundments (Section 6.0),
- A summary of monitoring results from 1995 to 2011 (Section 7.0), and
- Conclusions (Section 8.0).

Investigations of groundwater and subsurface conditions underlying the existing tailings impoundment and the proposed Northeast Expansion area have been performed over the last two decades to support various technical efforts. Extensive subsurface characterization work was performed at the tailings impoundments from 1990 to 1995 in support of the initial groundwater discharge permit application (Kennecott 1993) and the design of the North Impoundment. Groundwater data and information generated during these studies were incorporated into the 1995 Environmental Impact Statement (EIS) to address the construction of the North Impoundment. After 1995, groundwater data were generated at the tailings impoundment primarily during required monitoring under UGW350011 (1996 through present) and recently for the investigation and design of the proposed Northeast Expansion area.

Information and data contained in these historical resources on hydrogeology form the basis of the current site conceptual hydrogeologic model. This information was reviewed, evaluated, and used in conjunction with recent data to update the conceptual hydrogeologic model that is presented in this Supplemental Hydrogeology Report (Sections 3.0 through 8.0). The following provides a summary of the key historical resources reviewed and evaluated for the preparation of this Report:

- Geotechnical Site Characterization Report – Tailings Impoundment Modernization Project, North Expansion (WCC 1991) presents the characterization of foundation materials (e.g., Bonneville Clay) to support the design of the existing North Impoundment.
- Hydrogeologic Report for the Great Salt Lake Area (Kennecott 1992) presents a comprehensive groundwater characterization effort conducted in 1991 and 1992 to support the initial groundwater discharge permit applications for several Kennecott facilities, including the tailings impoundment. This report was submitted to UDWQ to fulfill the requirement to provide a hydrogeologic report of the area(s) to be permitted. This document references and incorporates numerous other studies to provide a comprehensive characterization of groundwater in the tailings impoundment area under pre-modernization, baseline hydrogeologic conditions with the South Impoundment in operation.
- Groundwater Assessment Report [Engineering Technology Associates (ETA) 1992] is a key reference document for KUC (1992).
- Tailings Impoundment Groundwater Discharge Permit Application (Kennecott 1993) was submitted to UDWQ to provide information specific to the tailings impoundment, as required in R317-6.
- Continuity of Upper Bonneville Clay Report (WCC 1994) provides interpretation of the lateral and horizontal extent of the Upper Bonneville Clay in support of evaluating this unit as a natural liner for the tailings impoundments.
- Estimates of Background Concentration of Metals and Non-Metals in Water (Shepherd Miller 1995) provides a comprehensive evaluation of background groundwater quality in the tailings impoundment area.

- 1995 EIS [US Army Corps of Engineers (USACE) 1995] provides a discussion of the baseline hydrogeologic conditions prior to the construction of the North Impoundment using primarily the documents cited above and references therein.
- Cone penetrometer testing, test pits, and exploratory drilling were conducted from 1996 to 2011 to support current operations and the evaluation and design of the proposed TEP. These data provide updated information on soil lithology and groundwater conditions in the proposed Northeast Expansion area and were used in conjunction with other existing data to refine the vertical and horizontal extent of the Bonneville Clay in the tailings impoundment area (Section 3.0).
- Routine monitoring and assessment of various media at the tailings impoundment has been performed since 1995 as specified in UGW350011 (UDWQ 2011a). Kennecott currently submits the results of monitoring and assessments performed under UGW350011 to UDWQ on an annual and semi-annual basis.
- Additional site-wide groundwater monitoring is ongoing in accordance with the Groundwater Characterization and Monitoring Plan (GCMP) for the North and South Facilities, which are projects regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The documents and data listed above are briefly summarized in this report, as needed, to provide the framework of the hydrogeologic conditions at the tailings impoundment area.

The geology of the area of the tailings impoundment is described in detail in prior reports (ETA 1992, WCC 1991, WCC 1994). This section provides an overview of the geology from the prior reports to provide the framework for discussions on current groundwater conditions described in subsequent sections of this report.

The Kennecott tailings impoundment is located in the Jordan Valley within the Basin and Range physiographic province. The northern Oquirrh Mountains are located adjacent to the tailings impoundment along its southern perimeter and to the west near the refinery and smelter (Figure 1-1). Bedrock consists of sedimentary, intrusive, and extrusive rocks. The valley is underlain by Quaternary sediments which consist of clay, silt, sand, and gravel. The majority of the Quaternary sediments are interbedded and extend to depths of over 1,200 feet north of the tailings impoundment. Borings completed in lacustrine deposits have consistently encountered the Bonneville Clay at shallow depths. Thick sequences of alluvial gravel are found along the north Oquirrh Mountain front. The gravel underlies the lacustrine sediments and steeply dips to the north where borings have encountered the top of the gravel at depths of 400 feet below ground surface (bgs) (ETA 1992).

The lacustrine deposits have been the subject of extensive geotechnical investigations (WCC 1991, WCC 1994), as these are the primary deposits that form the foundation of the tailings impoundment. The remainder of this Section focuses on the lacustrine deposits, in particular the Bonneville Clay. The significance of the Bonneville Clay is that it serves as a natural liner under the tailings impoundment and limits the seepage of tailings water into the underlying aquifers (see Section 6.0 for further discussion of seepage).

Lacustrine deposits underlying the tailings impoundment area include the Bonneville Clay, the Cutler Dam series, and the Interglacial and Little Valley lake cycles. The stratigraphic relationship of these deposits is shown in Figure 3-1. A brief description of the lacustrine deposits from the Geotechnical Site Investigation Report (WCC 1991) and the Continuity of Upper Bonneville Clay Report (WCC 1994) is provided below.

The Bonneville Clay includes the two complete Lake Bonneville lake sediment sequences (B1and B2). The Lake Bonneville sequences occur at the natural ground surface in the proposed TEP area and extend to a total depth of approximately 15 feet. The B1 Layer is about 9 feet thick and consists of clay and silty clay with occasional thin beds of sand (typically 1/32 to 2 inches thick) that were deposited during the deep lake interval of the Bonneville Lake Cycle, about 12,000 to 25, 000 years ago. The deeper B2 layer is about 6 feet thick and consists of clay layers and sand lenses (typically less than 1 foot thick) with occasional beds of sand 1/32 to 6 inches thick that were deposited in a shallow transgressive (deepening) lake during the beginning of the Bonneville Lake Cycle.

The Bonneville Clay is underlain by three discrete lacustrine sediment sequences of the Cutler Dam lake cycle (C1, C2 and C3). The three sequences comprising the Cutler Dam lake cycle are a total of approximately 20 feet thick and occur at an approximate depth range of 15 to 35 feet bgs. The three Cutler Dam sequences are clay-dominant lacustrine sediments deposited in ancestral water bodies in cycles of varying depth, which preceded the modern-day Great Salt Lake. They are characterized by interbedded lacustrine clay with silty clay and sand.

The Bonneville and Cutler Dam sequences are underlain by widespread fine-grained lake sediments deposited during the Interglacial and Little Valley lake cycles. These additional deposits together create more than 150 feet of clay-rich lacustrine sediments underlying the proposed TEP area. Quaternary sediments are estimated to extend to a depth of at least 1,200 feet in the area, and a 650 feet deep core hole located approximately one mile north of the North Impoundment encountered a depositional sequence of intervening fluvial-glacial, arid interglacial, and lake cycles in the Quaternary sediments (WCC 1994).

The lacustrine deposits underlying the North and South Tailings Impoundments are serving as a natural barrier to the seepage of tailings water to groundwater. The lateral and vertical extent of the Bonneville Clay was recently re-evaluated to support of the design of the proposed Northeast Expansion of the tailings impoundment. Although the entire sequence of lacustrine deposits within the Bonneville Clay and Cutler Dam lake cycles limit the vertical migration of tailings seepage, the uppermost clay layer within the Bonneville Clay is conservatively considered as the natural clay liner for the purpose of seepage control.

Lithologic data collected from cone penetrometer tests (CPT), test pits, and test holes were recently reviewed to update the lateral and vertical extent of the uppermost clay layer underlying the proposed TEP area. Historical data presented in WCC 1991 and WCC 1994 were reviewed along with more recent data collected during geotechnical investigations conducted from 1996 through 2011 in the tailings impoundment area.

The uppermost clay layer is defined to extend from the ground surface to a depth where the first significant sand layer (of approximately 1 foot thick or greater) is encountered. Over 100 CPT, test hole, and test pit logs were reviewed to delineate the uppermost clay layer. Table 3-1 provides a list of the data reviewed and the estimated thickness of the uppermost clay layer at each location. The thicknesses were contoured and presented on Figure 3-2. The thickness of the uppermost clay layer ranges from 3 feet to greater than 15 feet (where the contact between the Bonneville Clay and Cutler Dam series could not be distinguished due to the absence of sand layers) and the average thickness is 7.5 feet, based on data presented in Table 3-1. The uppermost clay layer illustrated on Figure 3-2 approximately corresponds with the Upper Bonneville Clay (B1) delineated in WCC 1994.

Historical references (Kennecott 1993) have indicated that the southern portion of the South Impoundment may have been underlain by as much as 500 acres of bedrock. However; lithologic data collected more recently in this area confirm the presence of the Bonneville Clay (Figure 3-2). Bedrock crops out immediately south of the South Impoundment and the slope of the bedrock surface likely dips steeply beneath the lacustrine sediments that underlie the South Impoundment. Bedrock does not directly underlie the tailings impoundment in this area, based on available boring data.

The Statement of Basis for the current groundwater discharge permit (UDWQ 2011b) identifies three aquifers in the area of the tailings impoundment: the Shallow Aquifer, the Principal Aquifer, and the Bedrock Aquifer. Characteristics of these aquifers were evaluated in detail during the preparation of the original groundwater discharge permit application for the tailings facility (Kennecott 1993) and a comprehensive discussion of these aquifers is provided in the Groundwater Assessment Report (ETA 1992) and the Hydrogeologic Report for the Great Salt Lake Area (Kennecott 1992). These reports include an assessment of hydraulic conductivity data for the aquifers that were collected from a variety of historical sources.

The following provides a general description of the three aquifers that exist in the tailings impoundment area, based on discussion in ETA (1992), Kennecott (1992), and other information developed for the groundwater discharge permit.

4.1 SHALLOW AQUIFER

The Shallow Aquifer is defined in the groundwater discharge permit (UDWQ 2011b) as the uppermost 35 to 50 feet of saturated sediments in the tailings impoundment area. It generally consists of interbedded sand layers within the Bonneville Clay and Cutler Dam series. These sand layers typically range from 1/32 inch to 1 foot (Section 3.0). For Kennecott wells that are monitored for the tailings groundwater discharge permit (Figure 1-1), the well names ending in the suffix “A” are screened in the Shallow Aquifer.

The Shallow Aquifer is predominately confined in the immediate area of the tailings impoundment (see Section 5.0), but it is reported to exist under unconfined conditions at other locations in the vicinity of the tailings impoundment, depending on the presence and distribution of clay layers within the aquifer (ETA 1992). In the proposed TEP area, the Shallow Aquifer is overlain by a continuous clay layer that extends from the ground surface to 3 to 15 feet bgs (or greater) (Section 3.0, Figure 3-2).

The Shallow Aquifer also refers to gravel deposits and bedrock in the tailings impoundment area at locations where the water table intersects these units, such as in the area south of the South Impoundment. At the southernmost portion of the south impoundment, a gravel deposit was encountered beneath a clay/silt layer approximately 10 feet thick at permit wells NET1491 and NET1492 (Figure 1-1). At well NET1492, bedrock (sandy limestone) also was encountered. These wells are considered Shallow Aquifer wells because they are screened within the upper 35 to 50 feet of the saturated zone. The other Shallow Aquifer wells monitored for the tailings groundwater discharge permit are screened in lacustrine deposits.

4.2 PRINCIPAL AQUIFER

The Principal Aquifer, also referred to as the deep confined aquifer in earlier reports (ETA 1992), is divided into two units, a lacustrine unit and a gravel unit. The lacustrine unit is the predominant unit underlying the tailings impoundment. It directly underlies the Shallow Aquifer and is considered to begin at the next deepest sand layer underlying the Shallow Aquifer (ETA 1992). For Kennecott wells that are monitored for the tailings impoundment groundwater discharge permit (Figure 1-1), the well names ending in the suffix “B” or “C” are screened in the lacustrine deposits of the Principal Aquifer, with “C” being the deeper well of a well nest that includes both “B” and “C” wells. All “B” and “C” wells monitored for the tailings impoundment groundwater discharge permit are screened in the lacustrine deposits.

The gravel unit in the Principal Aquifer flanks the Oquirrh Mountains to the south of the South Impoundment and dips steeply below the lacustrine deposits to depths of approximately 400 feet beneath the tailings impoundment (Section 3.0). Many high-yield water supply wells near the Oquirrh Mountains are completed in the gravel zone of the Principal Aquifer (UDWQ 2011b). As discussed above in Section 4.1, two of the permit wells penetrate the gravel unit in this area (NET1491 and NET1492), but these wells are screened near the water table and are considered to be Shallow Aquifer wells.

4.3 BEDROCK AQUIFER

The bedrock aquifer consists of highly fractured Paleozoic carbonate rocks in the tailings impoundment area (UDWQ 2011b). None of the wells monitored for the tailings impoundment groundwater discharge permit are screened in the Bedrock Aquifer. Only one well, NET1492 penetrates bedrock, but this well is screened near the water table and is considered a Shallow Aquifer well.

The primary source of recharge to the aquifers in the tailings impoundment area is precipitation on the Oquirrh Mountains located to the south of the South Impoundment. The infiltrated precipitation flows downward as groundwater in the fractured bedrock toward the Principal and Shallow Aquifers that underlie the valley, or it discharges as springs along bedrock contacts at the base of the mountains. Groundwater in the valley flows upward from the Principal Aquifer to the Shallow Aquifer and laterally to the northwest toward the Great Salt Lake. Further discussions on the regional groundwater flow conditions in the Great Salt Lake area are provided in Kennecott (1992), ETA (1992), and other published references cited therein.

Both the Shallow and Principal Aquifers are confined in the immediate area of the tailings impoundment, based on hydraulic head data collected from wells monitored for the groundwater discharge permit. The elevation of the hydraulic head measured in wells screened in these aquifers is higher than the bottom of the overlying confining clay layer, and in many cases the hydraulic head was higher than ground surface elevation, indicating that flowing artesian conditions exist. Confined conditions are generally related to the high hydraulic head in the recharge zones in the mountains and the abundance of clay layers in the lacustrine deposits that restrict the upward flow of groundwater along the flow path to the discharge zone in the valley. In the immediate area of the tailings impoundment, pore pressures in the underlying aquifers may be further increased by the total stress applied to the aquifers from the weight of the tailings impoundment combined with the presence of a continuous clay layer within the Bonneville Clay that extends from the ground surface to a depth of 3 to 15 feet bgs (or greater) in the tailings impoundment area (Figure 3-2).

Hydrographs of groundwater elevations measured in each permit well from 1995 through 2011 are presented in Appendix A. Groundwater elevations for nested wells are shown on the same graph. Based on the review of the hydrographs, groundwater elevations in the wells have been relatively stable in the last five years, with variations typically within 5 feet or less. The ground surface elevation is also shown on the hydrographs, revealing which wells are flowing artesian.

Potentiometric maps are shown in Figures 5-1 and 5-2 for the Shallow Aquifer and Principal Aquifer, respectively, using hydraulic head data collected in 2011 from the permit monitoring wells located around the perimeter of the impoundment. The hydraulic head data used on Figures 5-1 and 5-2 and the corresponding measurement date is provided on Table 5-1. The potentiometric surface under the center of the impoundment was interpolated from data around the perimeter and represents the estimated static conditions in the aquifers. The actual hydraulic head in the aquifers directly underlying the tailing impoundment are likely under transient conditions related to a complex set of variables such as the following:

- The response to the underlying aquifers from the loading of the tailings impoundment and increase in total stress; this will result in an increase in aquifer pore pressure or effective stress (compression/compaction of the aquifer matrix) or both;
- The effects of recharge to the Shallow Aquifer from seepage of tailings water; and
- The amount of tailings seepage captured in the embankment seepage control system.

In 2011, the vertical hydraulic gradient was upward from the Principal Aquifer to the Shallow Aquifer in all twelve well nests surrounding the impoundment, with values ranging from 0.005 to 0.444 feet/feet (Table 5-1). The vertical hydraulic gradients are shown on map view in Figure 5-3. In general, the stronger upward hydraulic gradient was observed on the east side of the North and South Impoundments. The upward hydraulic gradient from the Principal Aquifer to the Shallow Aquifer has occurred consistently since 1995, with only few exceptions, as shown on the graph of vertical gradients versus time on Figure 5-4. This is consistent with earlier investigations that reported an upward hydraulic gradient in the area (KUC 1992).

A conceptual cross sectional view of groundwater flow through the aquifers and seepage flow in the tailings impoundment is shown on Figure 5-5. Based on this conceptual model, tailings water flows downward in the center of the impoundments, and more lateral toward the toe drains under the North Impoundment embankment. The uppermost clay layer in the Bonneville Clay serves as a natural liner under the impoundment and restricts downward movement of the tailings water into the Shallow Aquifer. Tailings seepage is prevented from flowing to the Principal Aquifer due to the upward hydraulic gradient from the Principal Aquifer to the Shallow Aquifer. The estimated seepage rate from the tailings impoundment to the Shallow Aquifer is provided in Section 6.

The seepage rate of tailings water to groundwater was presented in the original permit application package (Kennecott 1993) for the South Impoundment (that was in operation at that time) and the North Impoundment (that was being designed at that time). Because different methodologies were used to calculate the seepage rates for each impoundment in Kennecott (1993) and because the status of operation for each impoundment has changed since 1993, seepage rates were re-evaluated for the South and North Impoundments and for the proposed Northeast Expansion using a consistent methodology, as presented in this Section.

The re-evaluated seepage rates represent Phase I construction of the proposed TEP, where the South Impoundment remains closed and is under draining conditions, and the North Impoundment and the proposed Northeast Expansion operate at a maximum assumed height of 4462 feet above mean sea level (amsl).

Seepage was estimated using a one-dimensional approach by employing the following equation from Bouwer (1982) for tailings ponds:

$$v_i = K_c K_t \frac{H_w + L_t + L_c - h_i}{L_c K_t + L_t K_c}$$

where;

v_i = the unit seepage rate (L/T)

H_w = water depth above tailings (L)

K_c = saturated hydraulic conductivity of lining (L/T)

L_c = thickness of lining (L)

h_i = pressure head of water at bottom of lining (L)

K_t =average vertical saturated hydraulic conductivity of tailings (L/T)

L_t = thickness of tailings (L)

The following assumptions were made for the South Impoundment seepage calculations:

- The South Impoundment is at an average elevation of 4440 feet and the ground surface and groundwater elevation is at an average elevation of 4235 feet.
- Water in the tailings is assumed to be at an elevation of 4330 feet or approximately half the height of the tailings to account for the variability of the phreatic surface throughout the impoundment during draining conditions.
- The hydraulic head in the foundation is assumed to be 5 feet above the native ground surface, based on groundwater elevations in the permit wells.
- The area of the impoundment includes the entire footprint of the impoundment as there is no designed drainage system under the South Impoundment.
- Eight feet of Bonneville Clay has been assumed to comprise the lining system, based on the average thickness of the uppermost continuous clay layer (Table 3-1).
- Estimated seepage is to the Shallow Aquifer, based on the observation that there is an upward hydraulic gradient from the Principal Aquifer to the Shallow Aquifer (Section 5.0).

The following assumptions were made for the North Impoundment and proposed Northeast Expansion seepage calculations:

- The final design height of the North Impoundment and proposed Northeast Expansion is at an elevation of 4462 feet and the original ground surface is at an elevation of 4215 feet.
- Water in the tailings is at the top of the tailings (within the impoundment).
- The hydraulic head in the foundation is assumed to be 5 feet above the native ground surface, based on groundwater elevations in the permit wells.
- The embankment construction does not contribute to the seepage as this water is decanted to the interior of the impoundment or flows out through the drain system to the toe ditch (i.e., the area over which seepage occurs does not include the embankments).
- Eight feet of Bonneville Clay has been assumed to comprise the lining system, based on the average thickness of the uppermost continuous clay layer (Table 3-1).
- Estimated seepage is to the Shallow Aquifer, based on the observation that there is an upward hydraulic gradient from the Principal Aquifer to the Shallow Aquifer (Section 5.0).

The estimated seepage rates and the parameters used in the analysis are presented on Table 6-1. The seepage rates are 700 gallons per minute (gpm) for the South Impoundment, 560 gpm for the North Impoundment, and 240 gpm for the proposed Northeast Expansion. These seepage rates are reasonably consistent with the prior estimated seepage rates (Kennecott 1993) of 620 gpm for the South Impoundment, based on a one-dimensional analysis using Darcy's Law, and 240 gpm for the North Impoundment, based on a cross-sectional numerical flow model.

The re-evaluated seepage rates are considered maximum potential rates for Phase I of the proposed TEP in that they represent maximum impoundment heights (for the North Impoundment and proposed Northeast Expansion), they do not account for horizontal flow paths to drains under the embankment, and they do not account for the potential resistance to flow within the underlying Shallow Aquifer due to abundant clay layers in the Bonneville Clay and Cutler Dam series.

The seepage rate for the Diving Board area (Figure 1-1) that is permitted under the tailings impoundment groundwater discharge permit was estimated as 5 gpm in the original groundwater discharge permit application (Kennecott1993). As there are no planned changes to the Diving Board area, the seepage rate of 5 gpm is considered representative for this permit modification package.

Monitoring has been conducted under Permit UGW350011 since December 21, 1995, when the permit was first issued. Permit UGW350011 requires routine monitoring of groundwater in compliance wells located around the perimeter of the tailings impoundment; monitoring of water quality in seeps, tailings pore water, the toe ditch, and clarification canal; assessment of tailings acidification potential; analysis of waste streams; and pipeline inspection. Figure 1-1 provides the locations of monitoring points for UGW350011.

Groundwater at the tailings impoundment ranges from Class II (drinking water) to Class IV (saline) groundwater (UDWQ 2011b). The majority of compliance wells at the tailings impoundment are placed in Class III (limited use) groundwater. Several wells located close to the bedrock contact at the Oquirrh Mountains are Class II groundwater. Wells near the Great Salt Lake, in particular Shallow Aquifer wells with total dissolved solids (TDS) concentrations ranging from 18,000 to 100,000 milligrams per liter (mg/L), are in Class IV groundwater.

UDWQ has established groundwater Protection Levels and Compliance Limits on a well-by-well basis in UGW350011 for the following constituents: pH, TDS, sulfate, arsenic, barium, cadmium, chromium, copper, lead, selenium, and zinc. The Protection Levels and Compliance Limits were developed in accordance with Utah Administrative Code R317-6-4, with consideration of the existing class of groundwater, background concentrations, and the Utah groundwater quality criteria.

Potential impacts to groundwater at the tailings impoundment are assessed at least semi-annually relative to the higher of the groundwater Protection Levels and Compliance Limits established for each well in UGW350011 (permit limit). To date there have been no Notice of Violations under UGW350011 and no enforced compliance actions have ever been required. UDWQ acknowledges that many wells routinely exceed the background concentration due to normal variation around the mean (UDWQ 2011b). Although Compliance Limits have been established to account for this variability, sometimes a limit is exceeded in one or more wells in a given year. When this occurs, monthly sampling is initiated for the well(s) that exceeded the limit until it can be established whether or not an out of compliance status exists. To date, all wells that have been evaluated for out of compliance status were subsequently determined by UDWQ to be in compliance based on the results of monthly sampling and/or other evaluations.

A comprehensive evaluation of background groundwater quality in the North End, which includes the tailings impoundment area, was presented in the report "Estimates of Background Concentration of Metals and Non-Metals in Water" (Shepherd Miller 1995). This evaluation employed statistical methods to provide background concentrations of metals and major ions for groundwater, surface water, and tailings water. Some of the background concentrations for groundwater were adopted by UDWQ as background conditions for compliance monitoring wells under UGW350011. There were no impacts to groundwater identified by Shepherd Miller (1995) that were directly related to the tailings impoundment.

Data collected from the permit monitoring wells from 1995 through 2011 were reviewed to qualitatively (visually) assess trends in the concentrations over time with respect to the Protection Levels and Compliance Limits. Concentrations for the eleven permit parameters are plotted against time on graphs in Appendix B. Table 7-1 provides a summary of the average and maximum concentration of each of the eleven permit parameters for each monitoring location from 1995 through 2011. For the purposes of calculating average concentrations in Table 7-1, the reporting limit was assumed as the concentration for non-detections. The review of trends in concentration with respect to permit limits resulted in the following key observations:

(1) Permit limits have been exceeded at least one time from 1995 through 2011 in more than half the Shallow Aquifer wells with respect to arsenic and cadmium and in more than half the Principal Aquifer wells with respect to arsenic, cadmium, and lead (Table 7-1). When an exceedance of a permit limit occurred, the well was placed on monthly sampling to assess whether the exceedance was a normal variation around the mean or an out-of-compliance status. To date, no wells have been confirmed as having an out-of-compliance status.

(2) Parameter concentrations that appear to be increasing in concentration from 1995 through 2011 (visually based, see graphs in Appendix B) include the following:

- Arsenic in Shallow Aquifer wells NED604A and NET1384A

  Well NED604A, located in the Diving Board area, was placed on monthly sampling in 2011 to further assess the concentration of 0.127 mg/L which slightly exceeds the permit limit of 0.11 mg/L. Arsenic in this well is related to past releases of process water in the area (UDWQ 2011b). Well 1384A was in compliance in 2011 with respect to arsenic.

- Barium in Shallow Aquifer wells NED604A, NET1381A, NET1385A, NET1491, and NET1492, and Principal Aquifer well NET1381B

  All of the above wells were in compliance with respect to barium in 2011.

- Sulfate in Shallow Aquifer wells NEL532A, NET1380A, NET1381A and NET1386A, and Principal Aquifer well NEL532B

  All of the above wells were in compliance with respect to sulfate in 2011.

- Total dissolved solids (TDS) in Shallow Aquifer wells NEL532A, NET1380A, NET1381A, NET1385A, and Principal Aquifer wells NEL1382B, NEL532B and NET1381B

  Wells NET1385A and NET1381B exceeded the TDS permit limit in 2011 and were placed on monthly sampling to assess compliance status; the other wells were in compliance with respect to TDS in 2011.

- Zinc in Shallow Aquifer well NED604A

  This well was in compliance with respect to zinc in 2011.

Note: The above discussion of compliance status for the wells is from the Second Half 2011 Monitoring Report (Kennecott 2012).

(3) Parameter concentrations that appear to be decreasing in concentration from 1995 through 2011 (visually based, see graphs in Appendix B) include the following:

- Arsenic in Principal Aquifer wells NED604B and NET646B
- Barium in Shallow Aquifer wells Net1384A, NEL532B, NET646B
- Sulfate in NET1384A, NET1491, NET1492, NET646A, and Principal Aquifer wells NET1381B and NET646B

- TDS in NET1382A, NET1384A, NET1491, NET1492, NET646A, and Principal Aquifer well NET646B

Table 7-2 presents the average, minimum, and maximum concentrations for the eleven permit parameters from 2006 through 2011, to evaluate more recent groundwater quality conditions. The distribution of arsenic, sulfate, and TDS concentrations in the Shallow and Principal Aquifers from 2006 through 2011 are presented in Figures 7-1 through 7-6; average, minimum, and maximum concentrations are shown. A review of this information resulted in the following key observations:

(1) Arsenic concentrations are generally the highest on the eastern side of the North and South Impoundment in both the Shallow and Principal Aquifers (Figures 7-1 and 7-2). The permit limits are higher in this area due to higher background concentrations; and all wells in this area were in compliance with respect to arsenic in 2011 (Kennecott 2012). Overall, arsenic concentrations appear to be slightly higher in the Principal Aquifer than Shallow Aquifer.

(2) Sulfate concentrations are generally the highest on the north to northwest side of the North Impoundment in the Shallow and Principal Aquifers (Figures 7-3 and 7-4). All wells in this area were in compliance with respect to sulfate in the second half of 2011 (Kennecott 2012). Overall, sulfate concentrations appear to be higher in the Shallow Aquifer than Principal Aquifer.

(3) Similar to sulfate, TDS concentrations are generally the highest on the north to northwest side of the North Impoundment in the Shallow and Principal Aquifers (Figures 7-5 and 7-6). The wells in this area were in compliance in the second half of 2011 (Kennecott 2012). Overall, TDS concentrations appear to be higher in the Shallow Aquifer than Principal Aquifer.

The average, minimum, and maximum concentrations of the process water from 2006 through 2011 (tailings wells, lysimeters, seeps, toe ditch, and clarification canal) for the eleven permit parameters are shown on Table 7-2. The distribution of arsenic, sulfate, and TDS in process water samples are shown on Figures 7-7 through 7-9; average, minimum, and maximum concentrations are shown. A review of this information resulted in the following key observations:

(1) On comparing the distribution of process water arsenic concentrations (Figure 7-7) to concentrations in the Shallow Aquifer (Figure 7-1) and the Principal Aquifer (Figure 7-2), there appears to be no relationship of arsenic concentrations in process water to those in the aquifers. In fact, arsenic concentrations appear to be lower in the process water than the aquifers at all locations except tailings well TLT2575B and lysimeters TLL4134, TLL4133, and TLL4135 located in the southwest portion of the South Impoundment. Arsenic concentrations in lysimeters are likely elevated compared to other monitoring locations because total analyses were performed on arsenic and other metals in lysimeter samples and dissolved analyses were performed on samples from the other monitoring locations.

(2) On comparing the distribution of process water sulfate concentrations (Figure 7-8) to Shallow and Principal Aquifer water (Figures 7-3 and 7-4), there appears to be no relationship of concentrations in process water to those in the aquifers. Overall sulfate

concentrations appear to be slightly higher in the process water than the aquifers, except for the elevated sulfate concentrations in the Shallow Aquifer around the northwest portion of the North Impoundment.

(3) On comparing the distribution of process water TDS concentrations (Figure 7-9) to Shallow and Principal Aquifer water (Figures 7-5 and 7-6), there appears to be no relationship of concentrations in process water to those in the aquifers. Overall TDS concentrations appear to be higher in the aquifers than the process water.

This Supplemental Hydrogeology Report was prepared to provide an update of hydrogeologic conditions to support a groundwater discharge permit modification to address the proposed TEP which includes expanding the tailings impoundment to the northeast and raising the height of the currently active North Impoundment and inactive South Impoundment. This Report identified the following hydrogeologic conditions that mitigate the flow of tailings seepage to groundwater:

- A continuous clay layer 3 to 15 feet (or greater) in thickness exists at the ground surface in the proposed TEP area, based on data collected at over 100 CPTs, borings, and test pits. This layer serves as a natural liner that limits seepage from the tailings to the Shallow Aquifer. Interbedded clay layers in the Shallow and Principal Aquifers further limit the downward flow of seepage.
- There is an upward hydraulic gradient from the Principal Aquifer to the Shallow Aquifer that has consistently existed since 1995, based on data presented in this Report. This condition prevents tailings seepage from flowing downward into the Principal Aquifer.

Evidence of the effectiveness of these natural hydrogeologic controls is demonstrated by the consistency in groundwater concentrations monitored since 1995 before the North Impoundment was constructed. Only a few visually noticeable changes have been observed in groundwater concentrations (i.e., increasing or decreasing trends).

The construction of the proposed TEP is estimated to increase the seepage rate of tailings to groundwater by 250 gpm due to the increased footprint related to the proposed Northeast Expansion. This amount of seepage is less than the estimated rate for the North Impoundment; and hence should result in fewer changes to the Shallow Aquifer hydraulically and chemically. In addition to natural hydraulic controls, engineering controls will be constructed to further control seepage. Engineering controls are discussed in the Discharge Control Plan (Part C, Attachment 2).

The groundwater monitoring network will be modified to address the proposed TEP so that potential changes in water quality and hydraulics due to future operations will be detected in a timely manner. Modifications to the groundwater monitoring program are presented in the Compliance Monitoring Plan Addendum in Part C, Attachment 3.

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Table 3-1
THICKNESS OF UPPERMOST CLAY LAYER IN THE TAILINGS IMPOUNDMENT AREA

Investigation Area and Reference	Location ID	Easting	Northing	Current Ground Surface Elevation (ft amsl)	Top Elevation of Bonneville Clay[a] (ft amsl)	Thickness of Uppermost Clay Layer[b,c,d,e] (ft)
Lee Creek Continuity of UBC report (WCC, 1994)	CP92-017	1,474,126	7,448,516	4217.7	4213	8
	CP-MK94-605	1,474,734	7,447,395	4215	4211	13
	CP92-015	1,476,088	7,446,590	4216	4212	8
	CP-MK94-604	1,476,499	7,446,094	4220	4214	6
	CP-MK94-30	1,478,059	7,446,157	4215	4215	8
	CP92-045	1,478,163	7,444,966	4220	4217	7
	CP-MK94-31	1,478,739	7,444,805	4215	4215	7
	CP92-046	1,478,136	7,444,242	4221.1	4213	5
	CP-WC-210	1,479,095	7,444,254	4219.4	4213	≥7
	DH-MK94-27	1,479,199	7,444,378	4215	4215	15
	CP-WC-128	1,478,934	7,443,200	4217	4215	≥10
	CP92-042	1,480,429	7,443,070	4216.1	4215	5
Kersey Creek Continuity of UBC report (WCC, 1994)	CP92-012	1,479,459	7,442,471	4219	4218	6
	CP87-1010	1,479,296	7,442,109	4226.9	4214	9
	CP92-013	1,480,177	7,441,122	4219.8	4219	6
	CP-WC-100	1,479,625	7,440,099	4223.6	4220	≥6
	CP90-1038	1,478,888	7,440,099	4223.5	4220	6
	CP92-214	1,480,724	7,440,229	4218	4217	4
Brighton Drain Continuity of UBC report (WCC, 1994)	DH-WC-105	1,473,107	7,449,661	4215.6	4215	13
	CP-WC-112	1,473,131	7,449,595	4221.7	4215	8
	CP-WC-217	1,473,443	7,449,104	4216.7	4211	7
	CP-WC-111	1,474,311	7,449,052	4218.6	4212	≥8
	CP92-014	1,476,680	7,447,857	4212.1	4212	7
C-7 Ditch Continuity of UBC report (WCC, 1994)	CP90-1045	1,458,723	7,444,095	4211.8	4207	6
	CP-WC-227	1,459,577	7,444,082	4218.7	4212	≥8
	CP-WC-228	1,461,503	7,444,219	4220.7	4214	≥4
	TP-MK94-115	1,463,111	7,444,347	4220	4216	≥7
	CP-WC-229	1,463,786	7,444,406	4220.7	4209	≥3
	CP92-030	1,464,311	7,444,387	4221.2	4216	6
	CP-WC-124	1,466,414	7,443,934	4217.6	4210	≥3
	CP92-027	1,466,934	7,444,241	4218.8	4216	10
	CP-WC-218	1,470,837	7,444,650	4219.7	4213	≥10
	CP-WC-222	1,473,844	7,444,285	4219	4213	≥5
	DH-MK94-604	1,478,964	7,442,967	4220	4219	12
	CP-MK94-603	1,478,462	7,442,709	4220	4207	6
	CP-MK94-601	1,480,026	7,441,728	4220	4215	8
	CP92-215	1,480,419	7,440,425	4226.8	4223	10
	CP-WC-200	1,479,842	7,439,437	4225.4	4219	≥4
	CP-WC-102	1,478,998	7,439,332	4222.1	4219	≥4
	TP-MK94-36	1,478,050	7,437,099	4225	4224	≥9

Table 3-1

THICKNESS OF UPPERMOST CLAY LAYER IN THE TAILINGS IMPOUNDMENT AREA

Investigation Area and Reference	Location ID	Easting	Northing	Current Ground Surface Elevation (ft amsl)	Top Elevation of Bonneville Clay[a] (ft amsl)	Thickness of Uppermost Clay Layer[b,c,d,e] (ft)
C-7 Ditch West Continuity of UBC report (WCC, 1994)	DH-WC-108	1,455,533	7,444,989	4216	4208	5
	CP-WC-119	1,455,513	7,444,952	4213.6	4206	6
	CP92-040	1,456,600	7,444,658	4215.9	4211	5
	CP-WC-239	1,456,044	7,443,750	4218	4205	10
	CP92-039	1,457,421	7,444,095	4217.8	4212	6
	TH-4	1,457,330	7,443,371	4225.9	4210	10
	TH-3	1,457,219	7,443,229	4226.9	4209	6
	DH-WC-201	1,457,956	7,442,697	4226.6	4211	5
	TH-2	1,459,324	7,441,471	4216.9	4209	4
	CP90-1044	1,459,487	7,441,364	4217.4	4195	3
	CP-WC-242	1,459,462	7,441,345	4217.3	4200	9
	CP-WC-125	1,459,795	7,441,059	4220.5	4208	≥3
	CP-WC-123	1,455,199	7,437,618	4230.8	4198	≥10
	DH-WC-110	1,455,169	7,437,663	4229.9	4202	14
	DH89-1039	1,455,177	7,437,620	4232.4	4204	14
Geotechnical Site Characterization Report - Tailings Impoundment Moernization Project, North Expansion (WCC, 1991)	CP-WC-101	1,484,114	7,440,738	4214.3	4214.3	8
	CP-WC-103	1,480,969	7,439,499	4218.2	4203.2	6
	CP-WC-104	1,482,857	7,439,955	4216.9	4216.9	7
	CP-WC-105	1,484,130	7,442,867	4213.3	4213.3	15
	CP-WC-107	1,484,212	7,447,472	4215.6	4215.6	10
	CP-WC-108	1,482,951	7,449,369	4213.9	4213.9	10
	CP-WC-109	1,479,518	7,449,104	4212.1	4212.1	8
	CP-WC-110	1,477,334	7,449,227	4209.2	4209.2	8
	CP-WC-113	1,470,089	7,449,517	4213.7	4213.7	6
	CP-WC-114	1,467,380	7,449,525	4213.5	4213.5	10
	CP-WC-115	1,465,022	7,449,532	4212	4209	10
	CP-WC-116	1,462,452	7,449,542	4210.5	4208.5	15
	CP-WC-117	1,459,806	7,449,505	4210.4	4208.4	>15
	CP-WC-118	1,457,824	7,447,491	4213.7	4206.7	8
	CP-WC-120	1,454,020	7,443,899	4209.9	4204.9	6
	CP-WC-121	1,452,801	7,440,993	4208.7	4201.7	7
	CP-WC-122	1,453,257	7,438,696	4216.4	4216.4	5
	CP-WC-126	1,463,015	7,443,386	4212.9	4212.9	6
	CP-WC-131	1,477,932	7,434,037	4221.8	4221.8	10
	CP-WC-201	1,482,025	7,439,701	4221.7	4211.7	8
	CP-WC-202	1,483,226	7,440,261	4211.5	4208.5	5
	CP-WC-203	1,484,153	7,441,882	4210.9	4207.9	12
	CP-WC-204	1,484,315	7,444,341	4210.9	4207.9	3
	CP-WC-205	1,484,383	7,446,095	4211	4211	8
	CP-WC-206	1,483,678	7,446,984	4219.8	4212.8	6
	CP-WC-207	1,483,552	7,448,892	4217	4214	5
	CP-WC-208	1,481,342	7,447,071	4215.5	4215.5	6
	CP-WC-209	1,480,342	7,449,093	4212.2	4209.2	6
	CP-WC-211	1,479,105	7,445,908	4214.8	4208.3	7
	CP-WC-213	1,479,162	7,447,162	4213	4206.5	10
	CP-WC-215	1,478,241	7,449,193	4212.1	4209.1	7

Table 3-1

THICKNESS OF UPPERMOST CLAY LAYER IN THE TAILINGS IMPOUNDMENT AREA

Investigation Area and Reference	Location ID	Easting	Northing	Current Ground Surface Elevation (ft amsl)	Top Elevation of Bonneville Clay[a] (ft amsl)	Thickness of Uppermost Clay Layer[b,c,d,e] (ft)
Geotechnical Site Characterization Report - Tailings Impoundment Moernization Project, North Expansion (WCC, 1991)	CP-WC-216	1,475,678	7,449,459	4209.4	4202.9	5
	CP-WC-220	1,470,975	7,446,902	4209	4202.5	9
	CP-WC-221	1,467,814	7,446,879	4213.1	4213.1	11
	CP-WC-223	1,471,642	7,449,512	4212.7	4212.7	15
	CP-WC-224	1,468,444	7,449,519	4213.6	4206.6	8
	CP-WC-225	1,465,892	7,449,533	4210.8	4205.8	8
	CP-WC-231	1,463,637	7,449,539	4210.8	4208.8	10
	CP-WC-232	1,461,010	7,449,550	4210.5	4205.5	10
	CP-WC-233	1,458,586	7,448,402	4212.7	4207.7	12
	CP-WC-234	1,456,753	7,446,263	4213.1	4206.6	10
	CP-WC-235	1,454,625	7,443,780	4210.8	4204.8	5
	CP-WC-236	1,453,488	7,442,088	4211	4208	3
	CP-WC-237	1,452,539	7,440,040	4210.3	4207.3	7
	CP-WC-238	1,454,791	7,438,397	4214.2	4211.2	5
	CP-WC-301	1,474,692	7,430,966	4235.9	4235.9	10
	CP-WC-302	1,475,075	7,430,631	4232.5	4232.5	10
	CP-WC-400	1,467,995	7,449,524	4213	4210	10
	CP-WC-401	1,463,381	7,449,586	4209.8	4209.8	9
1996 CPTs, SE Corner Seismic Upgrade Design (WCC, 1997)	CP96-754	1,477,342	7,434,775	4307	4217	6
	CP96-765	1,472,764	7,431,916	4394	4219	5
	CP96-766	1,472,795	7,432,593	4387	4217	7
2005 CPTs, SE Corner Seismic Stability and Dewatering Evaluation (URS, 2006)	CP05-07	1,475,129	7,433,019	4387	4218	13
	CP05-14	1,477,503	7,434,575	4258	4203	5
	CP05-18	1,476,688	7,437,697	4344	4204	10
	CP05-21	1,477,776	7,438,783	4307	4220	10
2008 CPTs, URS[f]	CP08-04	1,461,705	7,437,589	4441	4190	5
	CP08-14	1,466,711	7,441,308	4429	4187	7
	SCP08-17	1,470,159	7,436,010	4438	4201	6
	CP08-34	1,457,045	7,433,294	4390	4205	9
	CP08-43	1,459,272	7,435,575	4443	4202	6
	CP08-45	1,464,393	7,431,623	4471	4239	5
	CP08-47	1,468,584	7,434,702	4448	4215	8
2009 CPTs, Kennecott[g]	RCPT09-SW01	1,475,250	7,431,262	Not Surveyed		14
	RCPT09-SW02	1,475,250	7,431,262	Not Surveyed		7
2010 CPTs, URS[f]	CP10-16A	1,456,942	7,436,063	4350	4220	10
	CP10-19	1,456,662	7,435,701	4273	4218	8
2011 CPTs, URS[f]	CP11-02	1,457,126	7,436,111	4375	4207	3
	CP11-03	1,456,881	7,435,927	4332	4210	5
	CP11-04	1,456,595	7,435,700	4271	4220	7
	CP11-05	1,456,490	7,435,045	4232	4225	13
	CP11-08	1,458,917	7,434,600	4338	4220	9
	CP11-09	1,458,810	7,434,343	4279	4226	6
	CP11-10	1,458,612	7,434,168	4246	4246	13
	CP11-11	1,476,965	7,437,937	4352	4205	10
	CP11-12	1,477,355	7,438,046	4306	4217	12

Table 3-1
THICKNESS OF UPPERMOST CLAY LAYER IN THE TAILINGS IMPOUNDMENT AREA

Investigation Area and Reference	Location ID	Easting	Northing	Current Ground Surface Elevation (ft amsl)	Top Elevation of Bonneville Clay[a] (ft amsl)	Thickness of Uppermost Clay Layer[b,c,d,e] (ft)
2011 CPTs, URS[f]	CP11-13	1,477,795	7,437,512	4240	4235	10
	CP11-14	1,476,528	7,434,560	4400	4205	10
	CP11-15	1,476,945	7,434,578	4358	4214	10
	CP11-16	1,477,548	7,434,580	4258	4215	10
	CP11-17	1,477,547	7,434,579	4257	4240	10
	CP11-18	1,471,993	7,431,412	4323	4218	6
	CP11-19	1,472,213	7,431,165	4267	4222	12
	CP11-36	1,472,078	7,432,284	4391	4217	7
	CP11-37	1,469,261	7,449,453	4214	4212	12
2011 Test Holes, URS[f]	TH-RR-1	1,482,209	7,449,456	4221	4218	>15
	TH-RR-2	1,484,031	7,448,868	4220	4220	>15
	TH-RR-3	1,484,491	7,448,648	4247	4219	9
	TH-RR-4	1,484,494	7,448,523	4244	4219	14
	TH-RR-5	1,484,455	7,448,371	4240	4219	>15
	TH-RR-6	1,484,446	7,447,866	4226	4219	14
	TH-RR-7	1,484,498	7,447,192	4224	4220	>15
	TH-RR-8	1,484,488	7,466,771	4222	4219	5
	TH-RR-9	1,484,479	7,446,337	4218	4216	5
	BH11-S3-3	1,469,261	7,449,453	4214	4214	15
	BH11-KLC	1,472,078	7,432,284	4391	4217	4
2011 Test Pits, URS[f]	TP11-1	1,481,463	7,439,783	Not Surveyed		≥8
	TP11-2	1,482,687	7,439,978	Not Surveyed		≥8
	TP11-3	1,484,183	7,442,903	Not Surveyed		3
	TP11-4	1,484,033	7,448,441	Not Surveyed		≥8
	TP11-5	1,480,147	7,449,610	Not Surveyed		6

Notes:

ft = feet

amsl = above mean sea level

UBC = Upper Bonneville Clay

[a] The Bonneville Clay typically occurs at the native ground surface, with the exception of locations where construction fill and overlying Holocene sediments exist at ground surface in the proposed TEP area.

[b]Values presented in gray are not shown on the clay layer thickness map because these values are co-located with another value and the coinciding value is more consistent with surrounding thicknesses.

[c]Thicknesses measured from the top of the clay downward until the first significant sandy interval (greater than 1 foot) was encountered.

[d]Thickness values shown >15 feet indicate an overall lack of sandy intervals and an inability to distinguish clay intervals in the lower Bonneville Clay from upper clay intervals of the underlying Cutler Dam series.

[e]Thickness values shown as ≥ are the minimal clay thickness encountered in the field. The CPT was predrilled and the upper portion of the trace is not shown on the log or the test pit did not penetrate the full thickness of the clay layer.

[f]2008 to 2011 CPT, test hole and test pit data from field investigations by URS.

[g]2009 CPT data provided by Kennecott. Location is approximate.

Table 3-1
THICKNESS OF UPPERMOST CLAY LAYER IN THE TAILINGS IMPOUNDMENT AREA

Investigation Area and Reference	Location ID	Easting	Northing	Current Ground Surface Elevation (ft amsl)	Top Elevation of Bonneville Clay[a] (ft amsl)	Thickness of Uppermost Clay Layer[b,c,d,e] (ft)

References:

URS (2006). Dewatering and Seismic Stability Evaluation, Southeast Corner of Kennecott Utah Copper South Impoundment, Final Report January, 2006

Woodward-Clyde Consultants (1991). Geotechnical Site Characterization Report – Tailings Impoundment Modernization Project, North Expansion, Vols. VI-X, December, 1991.

Woodward-Clyde Consultants (1994). Letter Report to Mr. Bob Dunne, Kennecott Utah Copper Corporation, Continuity of the Upper Bonneville Clay, KUC Tailings Modernization Project. August 25.

Woodward-Clyde Consultants (1997). Southeast Corner Seismic Upgrade Design Geotechnical Site Characterization Report – Tailings Impoundment Modernization Project, Draft Report March 13, 1997.

Table 5-1
2011 GROUNDWATER ELEVATIONS AND VERTICAL GRADIENTS

Well ID	Ground Surface Elevation (ft amsl)(1)	Well Screen Depth (ft bgs)	Well Screen Unit(2)	Water Level Measurement Date(3)	Water Level Elevation (ft amsl)(3)	Flowing Artesian in 2011?(4)	Vertical Hydraulic Gradient (ft/ft)(5)
NED604A	4254.49	15 - 25	Shallow	2/3/2011	4240.92	No	0.062
NED604B	4254.50	65 - 80	Principal	2/3/2011	4244.17	No	
NEL1382A	4223.97	10 - 20	Shallow	2/17/2011	4218.17	No	0.444
NEL1382B	4224.17	29 - 39	Principal	2/17/2011	4226.61	Yes	
NEL1382C	4224.19	88 - 98	Principal	2/17/2011	4232.22	Yes	NA
NEL532A	4229.58	11 - 16	Shallow	3/9/2011	4228.47	No	0.262
NEL532B	4230.05	38 - 43	Principal	3/9/2011	4235.55	Yes	
NEL536A	4234.61	10.3 - 15.3	Shallow	3/14/2011	4231.93	No	0.145
NEL536B	4234.41	34.7 - 39.7	Principal	3/14/2011	4235.47	Yes	
NEM1387	4244.88	10 - 20	Shallow	3/2/2011	4242.67	No	NA
NET1380A	4225.74	13.5 - 23.5	Shallow	2/10/2011	4227.31	Yes	0.023
NET1380B	4225.51	54 - 64	Principal	2/24/2011	4228.25	Yes	
NET1381A	4219.36	25 - 35	Shallow	2/16/2011	4222.45	Yes	0.262
NET1381B	4219.26	44 - 54	Principal	2/16/2011	4227.44	Yes	
NET1383A	4214.67	14 - 24	Shallow	5/23/2011	4215.95	Yes	0.072
NET1383B	4215.07	34 - 44	Principal	5/23/2011	4217.39	Yes	
NET1384A	4216.05	13 - 23	Shallow	6/2/2011	4216.85	Yes	0.195
NET1384B	4216.18	50 - 60	Principal	2/24/2011	4224.06	Yes	
NET1385A	4214.99	14.5 - 24.5	Shallow	5/19/2011	4218.39	Yes	0.105
NET1385B	4214.99	60 - 70	Principal	5/19/2011	4223.18	Yes	
NET1386A	4216.38	29 - 39	Shallow	2/16/2011	4224.22	Yes	0.005
NET1386B	4216.49	61 - 71	Principal	2/16/2011	4224.39	Yes	
NET1393A	4218.17	29 - 39	Shallow	7/11/2011	4220.16	Yes	0.037
NET1393B	4218.24	58 - 68	Principal	7/11/2011	4221.23	Yes	
NET1491	4341.19	125.8 - 145	Shallow	2/10/2011	4243.00	No	NA
NET1492	4339.83	107.4 - 127.2	Shallow	2/10/2011	4242.85	No	NA
NET2596	4391.11	123 - 133	Tailing	4/28/2011	4392.82	Yes	NA
NET646A	4216.14	5 - 15	Shallow	2/16/2011	4213.49	No	0.177
NET646B	4215.94	39.6 - 49.6	Principal	6/27/2011	4219.62	Yes	
TLT2452	4407.50	19 - 201	Tailing	6/29/2011	4347.14	No	NA
TLT2575A	4446.89	171 - 181	Tailing	6/23/2011	4330.74	No	-0.276
TLT2575B	4446.75	233 - 245	Tailing	6/23/2011	4313.37	No	
TLT887	4401.82	Unknown	Tailing	5/18/2011	4302.41	No	NA

Table 5-1
2011 GROUNDWATER ELEVATIONS AND VERTICAL GRADIENTS

Notes:
amsl = above mean sea level
bgs = feet below ground surface
ft = feet
NA = not applicable

(1) The ground surface elevation corresponds with the native ground surface at each well except at the following well locations: At wells NET1491 and NET1492 the depth to native ground is 73 feet and 96 feet bgs, respectively. The ground surface elevation of the tailings wells corresponds to the surface elevation of the tailings.

(2) Wells with an "A" suffix are generally screened in the Shallow Aquifer; the well screens are within the uppermost sand interval in the depth range from the native ground surface to approximately 40 feet below native ground. Wells with a "B" suffix are generally screened in the Principal Aquifer; well screens are within a sand interval in the depth range of approximately 35 to 80 feet below native ground. Wells with a "C" suffix are screened in a deeper portion of the Principal Aquifer in the depth range from approximately 80 to 100 feet below native ground.

(3) Water elevations shown on this table were selected for presentation on potentiometric maps. Measurement dates were selected as close together as possible.

(4) When the hydraulic head in the well is above ground surface, it is a flowing artesian well.

(5) The vertical hydraulic gradient is the difference in the hydraulic head of the deeper and shallow well divided by the distance between the well screen mid points. Positive numbers indicate an upward hydraulic gradient.

Table 6-1
ESTIMATED SEEPAGE RATES AND PARAMETERS USED IN CALCULATIONS

	Seepage Rate (gpm)	Parameters Used to Estimate Seepage							
		v_i (ft/yr)	A (acres)	H_w (ft)	K_c (cm/s)	L_c (ft)	h_i (ft)	K_t (cm/s)	L_t (ft)
South Impoundment	**700**	0.20	5700	0	2.00E-08	8	13	1.00E+06	100
North Impoundment	**560**	0.39	2320	0	2.00E-08	8	13	1.00E+06	247
Proposed Northeast Expansion	**240**	0.39	996	0	2.00E-08	8	13	1.00E+06	247

Parameter Definitions:
v_i = the unit seepage rate
A = area of impoundment (excludes embankment area of North Impoundment and Proposed Northeast Expansion)
H_w = water depth above tailings
K_c = saturated hydraulic conductivity of lining
L_c = thickness of lining
h_i = pressure head of water at bottom of lining
K_t =average saturated vertical hydraulic conductivity of tailings
L_t = thickness of tailings

Abbreviations:
cm/s = centimeters per second
ft = feet
yr = year

Table 7-1
SUMMARY OF HISTORICAL WATER QUALITY RESULTS 1995 THROUGH 2011

Unit	Well ID	Number of Samples	pH			Arsenic			Barium			Cadmium			Chromium			Copper			Lead			Selenium			Sulfate			Total Dissolved Solids			Zinc		
			Min	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max	POC	Avg	Max
Process	CLC452	65	6.4	7.31	8.41	NA	0.029	0.074	NA	0.101	0.15	NA	0.0066	0.009	NA	0.010	_0.01_	NA	0.026	0.071	NA	0.005	0.007	NA	0.021	0.073	NA	3087	4380	NA	8448	9820	NA	0.041	0.101
	TLP1436	59	6.9	7.95	9.41	NA	0.023	0.182	NA	0.047	0.1	NA	0.0135	0.028	NA	0.012	0.026	NA	0.138	0.505	NA	0.005	0.006	NA	0.004	0.01	NA	3132	4270	NA	13696	33400	NA	0.543	4.43
	TLP1469	55	6.71	7.76	9.39	NA	0.026	0.074	NA	0.049	0.136	NA	0.0067	0.024	NA	0.010	0.026	NA	0.049	0.2	NA	0.005	0.011	NA	0.007	0.052	NA	2226	3420	NA	8226	12300	NA	0.282	0.98
	TLS1426	41	6.27	6.77	7.97	NA	0.008	0.022	NA	0.020	0.071	NA	0.0021	0.004	NA	0.012	0.03	NA	0.862	2.05	NA	0.005	0.005	NA	0.004	0.04	NA	1736	2370	NA	4872	6970	NA	0.031	0.21
	Summary		6.27	7.45	9.41	NA	0.021	0.182	NA	0.054	0.15	NA	0.0072	0.028	NA	0.011	0.03	NA	0.269	2.05	NA	0.005	0.011	NA	0.009	0.073	NA	2545	4380	NA	8811	33400	NA	0.224	4.43
Lysimeters	TLL4100	29	6.37	6.97	7.6	NA	0.013	0.028	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	0.273	1.6	NA	NM	NM	NA	0.033	_0.1_	NA	2525	4220	NA	NM	NM	NA	0.153	0.419
	TLL4101	37	6.17	6.92	7.37	NA	0.016	0.15	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	1.215	14.32	NA	NM	NM	NA	0.023	_0.1_	NA	3012	4390	NA	NM	NM	NA	0.278	1.475
	TLL4102	34	6.74	7.13	7.54	NA	0.018	0.12	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	0.257	2.37	NA	NM	NM	NA	0.017	_0.1_	NA	2834	3720	NA	NM	NM	NA	0.184	1.12
	TLL4103	35	6.16	6.94	7.31	NA	0.008	0.11	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	0.291	1.4	NA	NM	NM	NA	0.013	_0.1_	NA	2421	3020	NA	NM	NM	NA	0.121	1.08
	TLL4128	41	1.79	5.50	7.79	NA	0.018	0.1	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	93.6	837	NA	NM	NM	NA	0.029	_0.5_	NA	3578	13800	NA	NM	NM	NA	1.695	17
	TLL4129	34	6.47	7.19	8.36	NA	0.014	0.1	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	0.219	1.69	NA	NM	NM	NA	0.009	0.022	NA	2178	2920	NA	NM	NM	NA	0.212	1.5
	TLL4133	16	1.99	2.68	3.86	NA	0.699	3.28	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	450	1150	NA	NM	NM	NA	0.084	0.175	NA	25627	55700	NA	NM	NM	NA	7.721	19.2
	TLL4134	15	2.14	3.65	5.83	NA	0.140	0.76	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	434	2010	NA	NM	NM	NA	0.170	_0.5_	NA	25236	40700	NA	NM	NM	NA	17.995	61
	TLL4135	18	0.90	2.39	4.01	NA	1.245	3.39	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	401	928	NA	NM	NM	NA	0.195	_1_	NA	18404	35900	NA	NM	NM	NA	5.052	15.8
	Summary		0.90	5.49	8.36	NA	0.241	3.39	NA	NM	NM	NA	NM	NM	NA	NM	NM	NA	153.331	2010	NA	NM	NM	NA	0.064	_1_	NA	9535	55700	NA	NM	NM	NA	3.712	61
Tailings Wells	NET2596	30	6.57	6.82	7.23	NA	0.030	0.109	NA	0.013	0.017	NA	0.0026	0.007	NA	0.010	_0.01_	NA	0.030	0.183	NA	0.006	0.024	NA	0.002	0.005	NA	1864	2280	NA	6123	7020	NA	0.043	0.29
	TLT2452	30	7.08	7.43	7.99	NA	0.051	0.076	NA	0.020	0.05	NA	0.0041	0.007	NA	0.011	0.026	NA	0.022	0.076	NA	0.005	0.005	NA	0.007	0.1	NA	1734	2260	NA	5114	5420	NA	0.070	0.85
	TLT2575A	30	7.04	7.29	7.57	NA	0.067	0.081	NA	0.012	0.021	NA	0.0046	0.008	NA	0.011	0.026	NA	0.022	0.064	NA	0.005	0.005	NA	0.002	0.002	NA	2066	2370	NA	5326	5720	NA	0.012	0.023
	TLT2575B	31	5.24	5.83	6.21	NA	0.457	0.693	NA	0.020	0.025	NA	0.0044	0.007	NA	0.010	0.01	NA	3.195	8.35	NA	0.005	0.008	NA	0.003	0.005	NA	1158	1350	NA	6468	7280	NA	0.123	0.24
	TLT887	29	6.54	6.95	7.38	NA	0.007	0.011	NA	0.013	0.016	NA	0.0024	0.004	NA	0.011	0.026	NA	0.021	0.031	NA	0.005	0.005	NA	0.002	0.006	NA	1191	1720	NA	4991	5630	NA	0.883	1.43
	Summary		5.24	6.86	7.99	NA	0.123	0.693	NA	0.015	0.05	NA	0.0036	0.008	NA	0.011	0.026	NA	0.658	8.35	NA	0.005	0.024	NA	0.003	0.1	NA	1603	2370	NA	5604	7280	NA	0.226	1.43
Shallow Aquifer	NED604A	104	6.62	7.24	7.68	0.110	0.075	0.127	0.500	0.043	0.077	0.0013	0.0012	0.004	0.025	0.010	0.01	0.325	0.020	0.04	0.008	0.005	0.007	0.013	0.003	0.026	700	483	928	3000	2128	3420	1.250	0.011	0.033
	NEL1382A	57	7.32	7.92	8.4	0.287	0.210	0.278	1.000	0.086	0.151	0.0025	0.0012	0.003	0.050	0.011	0.03	0.650	0.023	0.06	0.008	0.005	0.005	0.025	0.005	0.022	305	165	419	6450	4783	6550	2.500	0.012	0.061
	NEL532A	54	7.5	7.94	8.3	0.265	0.190	0.274	1.000	0.103	0.156	0.0030	0.0019	0.037	0.050	0.010	0.026	0.650	0.027	0.181	0.008	0.005	0.007	0.025	0.003	0.009	1264	590	1330	8721	6782	7810	2.500	0.012	0.101
	NEL536A	45	6.94	7.60	7.95	0.056	0.040	0.054	0.500	0.176	0.31	0.0013	0.0014	0.004	0.025	0.010	0.01	0.325	0.020	0.02	0.008	0.005	0.005	0.013	0.003	0.012	402	326	376	3000	2315	2540	1.250	0.011	0.022
	NEM1387	47	6.97	7.33	7.62	0.041	0.025	0.05	1.000	0.044	0.07	0.0025	0.0012	0.002	0.025	0.010	0.02	0.325	0.021	0.066	0.008	0.005	0.005	0.013	0.003	0.008	400	314	391	1858	1456	1730	1.250	0.010	0.018
	NET1380A	56	6.98	7.50	8.06	0.025	0.006	0.017	1.000	0.129	0.285	0.0030	0.0014	0.011	0.050	0.010	0.02	0.650	0.022	0.111	0.008	0.005	0.005	0.025	0.004	0.014	1300	705	1270	7500	4408	7170	2.500	0.011	0.036
	NET1381A	57	7.08	7.71	8.15	0.071	0.051	0.069	1.000	0.111	0.191	0.0025	0.0012	0.002	0.050	0.011	0.03	0.650	0.021	0.04	0.008	0.005	0.008	0.025	0.004	0.014	735	365	596	8000	4941	7550	2.500	0.010	0.015
	NET1383A	51	7.5	7.86	8.16	0.278	0.212	0.323	1.000	0.052	0.08	0.0025	0.0013	0.005	0.050	0.012	0.05	0.650	0.031	0.244	0.008	0.006	0.025	0.025	0.006	0.032	327	220	352	8834	7029	7450	2.500	0.012	0.054
	NET1384A	50	6.61	7.00	7.48	0.113	0.055	0.251	2.000	0.049	0.36	0.0050	0.0021	0.01	0.050	0.039	0.26	1.300	0.146	1.02	0.008	0.006	0.05	0.050	0.047	0.417	5000	6635	15500	none	102677	201000	5.000	0.028	0.12
	NET1385A	49	7.65	7.90	8.25	0.130	0.106	0.13	1.000	0.054	0.087	0.0025	0.0012	0.002	0.050	0.010	0.026	0.650	0.021	0.05	0.008	0.005	0.005	0.025	0.004	0.022	212	141	169	5112	4173	5190	2.500	0.010	0.012
	NET1386A	46	7.15	7.62	8.07	0.030	0.012	0.074	2.000	0.974	1.48	0.0025	0.0015	0.01	0.050	0.014	0.05	0.650	0.028	0.1	0.008	0.005	0.025	0.025	0.011	0.044	150	31	221	none	8941	10600	2.500	0.016	0.21
	NET1393A	55	7.17	7.61	8.05	0.071	0.040	0.09	3.000	1.982	3.07	0.0050	0.0036	0.125	0.100	0.016	0.064	1.300	0.026	0.11	0.008	0.005	0.005	0.050	0.011	0.047	150	52	112	none	11691	12700	5.000	0.020	0.06
	NET1490	31	6.94	7.25	7.93	0.013	0.005	0.007	0.500	0.043	0.066	0.0050	0.0010	0.001	0.025	0.010	0.01	0.325	0.022	0.072	0.008	0.005	0.005	0.013	0.006	0.007	361	269	371	2105	1711	2020	1.250	0.013	0.085
	NET1491	33	6.63	7.14	7.44	0.013	0.006	0.008	0.500	0.030	0.049	0.0025	0.0010	0.001	0.025	0.010	_0.026_	0.325	0.020	0.023	0.008	0.005	0.009	0.013	0.007	0.014	808	398	727	3000	2310	3100	1.250	0.013	0.066
	NET1492	47	6.56	7.12	7.33	0.025	0.006	0.009	0.500	0.025	0.049	0.0025	0.0010	0.001	0.050	0.010	0.025	0.650	0.022	0.046	0.008	0.005	0.005	0.025	0.008	0.031	943	513	867	3747	2701	3600	2.500	0.011	0.017
	NET646A	47	6.57	7.02	7.43	0.122	0.058	0.127	2.000	0.073	0.106	0.0050	0.0024	0.01	0.100	0.048	0.26	1.300	0.065	0.35	0.008	0.005	0.008	0.050	0.011	0.1	7890	4580	8460	none	78624	112000	5.000	0.030	0.12
	Summary		6.56	7.49	8.4	NA	0.068	0.323	NA	0.248	3.07	NA	0.0015	0.125	NA	0.015	0.26	NA	0.033	1.02	NA	0.005	0.05	NA	0.008	0.417	NA	987	15500	NA	15417	201000	NA	0.014	0.21
Principal Aquifer	NED604B	50	6.96	7.58	7.81	0.029	0.014	0.049	0.500	0.045	0.14	0.0013	0.0012	0.003	0.025	0.010	0.01	0.325	0.020	0.029	0.008	0.005	0.008	0.013	0.002	0.006	150	119	160	1589	1273	1440	1.250	0.012	0.09
	NEL1382B	48	7.73	8.21	8.8	0.410	0.318	0.465	1.000	0.069	0.095	0.0025	0.0012	0.002	0.050	0.010	0.02	0.650	0.025	0.237	0.008	0.005	0.005	0.025	0.003	0.007	157	70	79	2300	1854	2170	2.500	0.011	0.019
	NEL1382C	50	8.1	8.50	8.98	0.575	0.450	0.59	1.000	0.054	0.215	0.0025	0.0012	0.002	0.050	0.011	0.03	0.650	0.021	0.05	0.008	0.005	0.005	0.025	0.003	0.008	96	64	76	2000	1337	2000	2.500	0.010	0.014
	NEL532B	60	6.98	7.46	8.18	0.292	0.224	0.293	1.727	1.377	1.67	0.0030	0.0013	0.006	0.050	0.010	0.026	0.650	0.024	0.078	0.008	0.005	0.012	0.025	0.004	0.023	105	57	96	10000	6981	8830	2.500	0.021	0.218
	NEL536B	41	7.25	7.84	8.13	0.037	0.018	0.027	0.500	0.077	0.1	0.0013	0.0013	0.004	0.025	0.010	0.01	0.325	0.020	0.02	0.008	0.005	0.005	0.013	0.003	0.008	64	50	61	993	714	784	1.250	0.010	0.013
	NET1380B	42	7.94	8.17	8.56	0.013	0.005	0.009	0.500	0.055	0.07	0.0025	0.0013	0.002	0.025	0.011	0.02	0.325	0.021	0.04	0.008	0.005	0.017	0.013	0.003	0.007	15	6	21	1532	1222	1370	1.250	0.011	0.026
	NET1381B	50	6.77	7.37	7.95	0.175	0.126	0.161	1.000	0.083	0.14	0.0025	0.0012	0.004	0.050	0.012	0.026	0.650	0.034	0.471	0.008	0.005	0.005	0.025	0.006	0.034	1277	796	1030	12800	9581	14800	2.500	0.014	0.095
	NET1383B	51	7.11	7.89	8.22	0.294	0.227	0.263	1.000	0.057	0.09	0.0025	0.0013	0.005	0.050	0.012	0.05	0.650	0.027	0.16	0.008	0.005	0.025	0.025	0.005	0.03	279	186	230	8192	6531	7010	2.500	0.012	0.05
	NET1384B	50	6.79	7.42	7.72	0.290	0.243	0.321	2.000	0.027	0.1	0.0050	0.0014	0.01	0.100	0.017	0.1	1.300	0.057	0.262	0.008	0.006	0.05	0.050	0.011	0.057	3164	2114	2480	none	24235	26500	5.000	0.014	0.1
	NET1385B	50	7.39	7.76	8.19	0.199	0.155	0.189	1.000	0.062	0.11	0.0025	0.0013	0.005	0.050	0.011	0.05	0.650	0.023	0.1	0.008	0.005	0.025	0.025	0.005	0.023	249	168	197	7300	5639	6170	2.500	0.011	0.05
	NET1386B	54	7.12	7.55	7.99	0.077	0.053	0.092	1.000	0.243	1.43	0.0025	0.0013	0.01	0.050	0.013	0.05	0.650	0.027	0.1	0.008	0.005	0.025	0.025	0.007	0.032	72	48	70	10000	8308	10500	2.500	0.012	0.06
	NET1393B	50	7.2	7.49	7.99	0.096	0.060	0.097	2.000	0.260	2.06	0.0050	0.0014	0.01	0.100	0.015	0.05	1.300	0.024	0.1	0.008	0.005	0.025	0.050	0.008	0.034	150	100	136	none	10879	11700	5.000	0.013	0.05
	NET646B	46	6.85	7.26	7.63	0.225	0.133	0.194	2.000	0.069	0.17	0.0050	0.0014	0.01	0.100	0.022	0.26	1.300	0.074	0.38	0.008	0.005	0.008	0.050	0.008	0.115	1738	1069	1410	none	36454	45500	5.000	0.014	0.12
	Summary		6.77	7.73	8.98	NA	0.156	0.59	NA	0.191	2.06	NA	0.0013	0.01	NA	0.013	0.26	NA	0.030	0.471	NA	0.005	0.05	NA	0.005	0.115	NA	373	2480	NA	8847	45500	NA	0.013	0.218

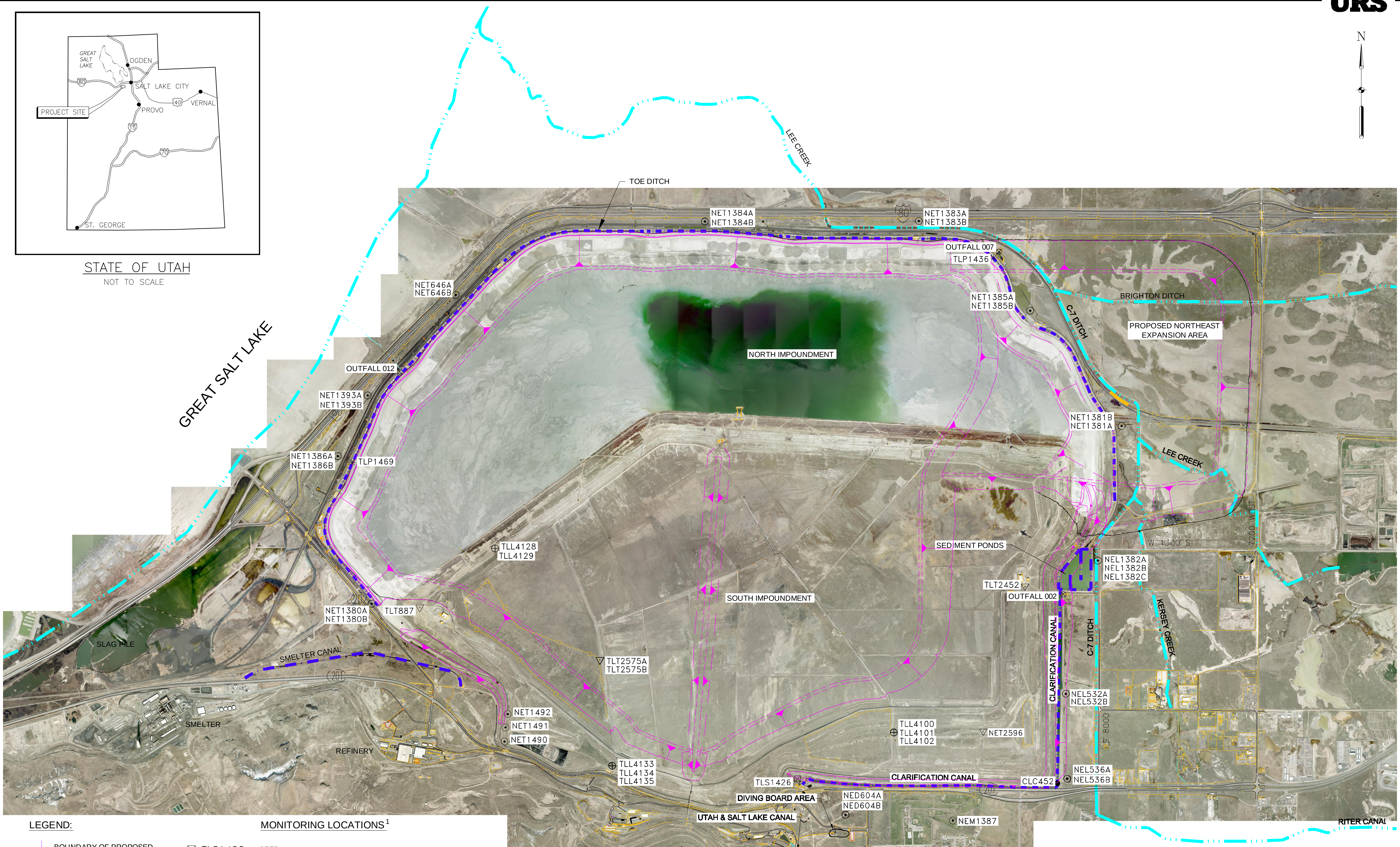
Notes:
NA = not applicable (no limits are established for tailings wells or process water)
NM = not measured. The following analytes were not measured in the lysimeters: barium, cadmium, chromium, lead, and total dissolved solids.
All concentrations are in units of milligrams per liter. Metal concentrations presented are dissolved, with the exception of metals analyzed at the nine lysimeters which are total concentrations.
POC = Concentration that indicates "probable out-of-compliance" (the higher of the Protection Level or Compliance Limit). Also referred to as the permit limit in this report.
Gray shaded cells indicate concentrations that exceed the POC.
Avergage concentrations presented incorporate non-detections, assuming the reporting limit is the concentration. Itacilized and underlined maximum values are the reporting limits for non-detections.

Table 7-2
SUMMARY OF RECENT WATER QUALITY RESULTS 2006 THROUGH 2011

Unit	Well ID	Number of Samples	pH			Arsenic				Barium				Cadmium				Chromium			
			Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max
Process	CLC452	65	6.4	7.31	8.41	NA	0.009	0.029	0.074	NA	0.067	0.101	0.15	NA	0.004	0.0066	0.009	NA	*0.010*	*0.010*	*0.01*
	TLP1436	24	7.31	7.71	8.61	NA	0.009	0.015	0.024	NA	0.033	0.043	0.072	NA	0.007	0.0136	0.022	NA	*0.010*	*0.010*	*0.01*
	TLP1469	24	6.71	7.43	8.83	NA	0.007	0.018	0.047	NA	0.033	0.057	0.136	NA	0.005	0.0086	0.024	NA	*0.010*	*0.010*	*0.01*
	TLS1426	14	6.47	6.70	7.05	NA	*0.005*	0.007	0.022	NA	0.014	0.021	0.065	NA	0.001	0.0023	0.004	NA	*0.010*	*0.010*	*0.01*
	Summary		6.4	7.29	8.83	NA	0.005	0.017	0.074	NA	0.014	0.056	0.15	NA	0.001	0.0078	0.024	NA	0.010	0.010	0.01
Lysimeters	TLL4100	5	6.86	6.92	7.05	NA	0.005	0.013	0.022	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4101	5	6.17	6.50	6.92	NA	0.005	0.008	0.011	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4102	2	6.85	6.98	7.11	NA	0.005	0.020	0.035	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4103	0	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4128	4	2.26	2.32	2.35	NA	0.005	0.011	0.019	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4129	4	6.47	6.65	6.97	NA	0.005	0.005	0.006	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4133	3	2.05	2.58	3.01	NA	0.005	0.007	0.011	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4134	0	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4135	4	0.90	1.80	2.18	NA	0.410	0.815	1.27	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	Summary		0.90	4.82	7.11	NA	0.005	0.126	1.27	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
Tailings Wells	NET2596	19	6.57	6.82	7.23	NA	*0.005*	0.029	0.053	NA	0.012	0.013	0.015	NA	*0.001*	0.0022	0.003	NA	*0.010*	*0.010*	*0.01*
	TLT2452	12	7.18	7.47	7.79	NA	0.046	0.061	0.075	NA	0.017	0.020	0.021	NA	0.002	0.0053	0.007	NA	*0.010*	*0.010*	*0.01*
	TLT2575A	12	7.04	7.24	7.4	NA	0.007	0.063	0.072	NA	*0.010*	0.012	0.014	NA	*0.001*	0.0042	0.006	NA	*0.010*	*0.010*	*0.01*
	TLT2575B	12	5.43	5.86	6.21	NA	0.200	0.447	0.661	NA	0.020	0.022	0.025	NA	0.003	0.0040	0.006	NA	*0.010*	*0.010*	*0.01*
	TLT887	12	6.67	6.91	7.2	NA	*0.005*	0.005	0.006	NA	0.011	0.013	0.015	NA	0.002	0.0023	0.004	NA	*0.010*	*0.010*	*0.01*
	Summary		5.43	6.86	7.79	NA	0.005	0.121	0.661	NA	0.010	0.016	0.025	NA	0.001	0.0036	0.007	NA	0.010	0.010	0.01
Shallow Aquifer	NED604A	36	6.62	7.22	7.56	0.110	0.065	0.084	0.127	0.500	0.028	0.045	0.068	0.0013	*0.001*	0.0011	0.002	0.025	*0.010*	*0.010*	*0.01*
	NEL1382A	12	7.55	7.94	8.14	0.287	0.183	0.241	0.278	1.000	0.061	0.072	0.088	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NEL532A	17	7.5	7.79	8.06	0.265	0.098	0.199	0.274	1.000	0.099	0.127	0.156	0.0030	*0.001*	0.0011	0.002	0.050	*0.010*	0.010	0.012
	NEL536A	6	6.94	7.51	7.83	0.056	0.034	0.037	0.04	0.500	0.131	0.146	0.159	0.0013	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NEM1387	12	6.97	7.24	7.51	0.041	0.021	0.024	0.031	1.000	0.044	0.050	0.054	0.0025	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NET1380A	20	6.98	7.28	7.56	0.025	*0.005*	0.005	0.008	1.000	0.076	0.118	0.17	0.0030	*0.001*	0.0015	0.011	0.050	*0.010*	*0.010*	*0.01*
	NET1381A	20	7.08	7.55	7.86	0.071	*0.005*	0.056	0.066	1.000	0.129	0.157	0.191	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1383A	12	7.65	7.84	8.02	0.278	0.190	0.210	0.221	1.000	0.047	0.050	0.052	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1384A	12	6.77	7.21	7.48	0.113	0.055	0.071	0.082	2.000	0.032	0.036	0.04	0.0050	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	0.015	0.026
	NET1385A	12	7.65	7.84	8.09	0.130	0.094	0.107	0.115	1.000	0.060	0.071	0.087	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1386A	10	7.15	7.42	7.6	0.030	0.007	0.016	0.074	2.000	0.280	1.254	1.48	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1393A	16	7.37	7.55	7.86	0.071	0.033	0.042	0.08	3.000	0.160	1.537	2.04	0.0050	*0.001*	0.0013	0.005	0.100	*0.010*	0.011	0.02
	NET1490	5	7.21	7.28	7.35	0.013	*0.005*	*0.005*	*0.005*	0.500	0.062	0.064	0.066	0.0050	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NET1491	12	6.63	7.16	7.44	0.013	*0.005*	0.005	0.007	0.500	0.031	0.040	0.049	0.0025	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NET1492	12	6.56	7.11	7.3	0.025	*0.005*	0.005	0.009	0.500	0.026	0.036	0.049	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET646A	13	6.77	7.09	7.34	0.122	0.049	0.066	0.094	2.000	0.072	0.088	0.105	0.0050	*0.001*	0.0012	0.002	0.100	*0.010*	0.014	0.034
	Summary		6.56	7.44	8.14	NA	0.005	0.073	0.278	NA	0.026	0.243	2.04	NA	0.001	0.0011	0.011	NA	0.010	0.011	0.034
Principal Aquifer	NED604B	16	6.96	7.50	7.66	0.029	0.007	0.011	0.012	0.500	0.039	0.043	0.046	0.0013	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NEL1382B	12	7.73	8.09	8.3	0.410	0.288	0.302	0.321	1.000	0.074	0.084	0.095	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NEL1382C	14	8.1	8.43	8.59	0.575	0.387	0.451	0.497	1.000	0.040	0.047	0.054	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NEL532B	14	6.98	7.28	7.56	0.292	0.226	0.252	0.293	1.727	1.200	1.364	1.51	0.0030	*0.001*	0.0011	0.002	0.050	*0.010*	0.010	0.014
	NEL536B	6	7.25	7.80	8.11	0.037	0.015	0.017	0.019	0.500	0.072	0.078	0.082	0.0013	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	*0.010*	*0.01*
	NET1380B	6	7.94	8.07	8.29	0.013	*0.005*	*0.005*	*0.005*	0.500	0.044	0.059	0.066	0.0025	*0.001*	*0.0010*	*0.001*	0.025	*0.010*	0.010	0.012
	NET1381B	14	6.77	7.17	7.39	0.175	0.098	0.116	0.136	1.000	0.084	0.109	0.14	0.0025	*0.001*	0.0011	0.002	0.050	*0.010*	*0.010*	*0.01*
	NET1383B	12	7.11	7.77	8.05	0.294	0.216	0.230	0.245	1.000	0.052	0.055	0.058	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1384B	12	6.79	7.30	7.51	0.290	0.190	0.249	0.3	2.000	0.020	0.023	0.028	0.0050	*0.001*	*0.0010*	*0.001*	0.100	*0.010*	0.012	0.016
	NET1385B	12	7.52	7.77	8	0.199	0.017	0.152	0.171	1.000	0.053	0.067	0.077	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1386B	12	7.12	7.40	7.65	0.077	0.013	0.060	0.092	1.000	0.204	0.344	1.43	0.0025	*0.001*	*0.0010*	*0.001*	0.050	*0.010*	*0.010*	*0.01*
	NET1393B	12	7.2	7.41	7.62	0.096	0.037	0.058	0.067	2.000	0.140	0.311	1.97	0.0050	*0.001*	*0.0010*	*0.001*	0.100	*0.010*	0.011	0.017
	NET646B	12	7.05	7.31	7.5	0.225	0.077	0.099	0.139	2.000	0.057	0.061	0.066	0.0050	*0.001*	*0.0010*	*0.001*	0.100	*0.010*	0.014	0.022
	Summary		6.77	7.64	8.59	NA	0.005	0.154	0.497	NA	0.020	0.203	1.97	NA	0.001	0.0010	0.002	NA	0.010	0.011	0.022

Unit	Well ID	Copper				Lead				Selenium				Sulfate				Total Dissolved Solids				Zinc			
		POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max	POC	Min	Avg	Max
Process	CLC452	NA	*0.020*	0.026	0.071	NA	*0.005*	0.005	0.007	NA	*0.002*	0.021	0.073	NA	2230	3087	4380	NA	6980	8448	9820	NA	*0.010*	0.041	0.101
	TLP1436	NA	0.038	0.093	0.241	NA	*0.005*	0.005	0.006	NA	*0.002*	0.003	0.009	NA	2030	2843	3330	NA	8410	10216	12200	NA	0.016	0.149	0.437
	TLP1469	NA	*0.020*	0.071	0.2	NA	*0.005*	0.005	0.008	NA	*0.002*	0.005	0.011	NA	1500	2516	3320	NA	7700	9347	12300	NA	0.011	0.284	0.98
	TLS1426	NA	0.159	0.500	1.25	NA	*0.005*	*0.005*	*0.005*	NA	*0.002*	0.003	0.013	NA	1050	1651	2370	NA	3790	4966	6970	NA	0.015	0.025	0.051
	Summary	NA	0.020	0.173	1.25	NA	0.005	0.005	0.008	NA	0.002	0.008	0.073	NA	1050	2524	4380	NA	3790	8244	12300	NA	0.010	0.125	0.98
Lysimeters	TLL4100	NA	0.170	0.250	0.42	NA	*NM*	*NM*	*NM*	NA	0.005	0.033	0.054	NA	2240	2443	2650	NA	NM	NM	NM	NA	0.110	0.186	0.24
	TLL4101	NA	0.180	8.052	14.32	NA	NM	NM	NM	NA	0.014	0.044	0.056	NA	2800	3880	4390	NA	NM	NM	NM	NA	0.150	1.085	1.475
	TLL4102	NA	0.180	0.305	0.43	NA	NM	NM	NM	NA	0.010	0.028	0.045	NA	2930	2930	2930	NA	NM	NM	NM	NA	0.170	0.171	0.172
	TLL4103	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4128	NA	17.5	77.5	115	NA	NM	NM	NM	NA	0.003	0.009	0.014	NA	2500	3727	4760	NA	NM	NM	NM	NA	0.310	1.615	2.74
	TLL4129	NA	1.195	1.399	1.69	NA	NM	NM	NM	NA	0.004	0.009	0.012	NA	2030	2067	2110	NA	NM	NM	NM	NA	0.560	0.635	0.76
	TLL4133	NA	87	142	176.8	NA	NM	NM	NM	NA	0.021	0.022	0.024	NA	3090	3465	3840	NA	NM	NM	NM	NA	0.550	1.060	1.33
	TLL4134	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM	NA	NM	NM	NM
	TLL4135	NA	251	322	494	NA	NM	NM	NM	NA	0.099	0.132	0.174	NA	13400	15133	16300	NA	NM	NM	NM	NA	2.970	3.860	6.31
	Summary	NA	0.170	78.706	494	NA	NM	NM	NM	NA	0.003	0.039	0.174	NA	2030	4806	16300	NA	NM	NM	NM	NA	0.110	1.230	6.31
Tailings Wells	NET2596	NA	*0.020*	0.026	0.066	NA	*0.005*	*0.005*	*0.005*	NA	*0.002*	*0.002*	*0.002*	NA	1720	1885	2070	NA	5800	6146	6710	NA	0.011	0.039	0.29
	TLT2452	NA	*0.020*	*0.020*	*0.02*	NA	*0.005*	*0.005*	*0.005*	NA	*0.002*	*0.002*	*0.002*	NA	1640	1745	1900	NA	5280	5348	5420	NA	*0.010*	0.010	0.012
	TLT2575A	NA	*0.020*	0.024	0.064	NA	*0.005*	*0.005*	*0.005*	NA	*0.002*	*0.002*	*0.002*	NA	1890	2201	2370	NA	5160	5263	5490	NA	*0.010*	0.012	0.017
	TLT2575B	NA	*0.020*	4.299	8.35	NA	*0.005*	0.005	0.008	NA	*0.002*	0.002	0.005	NA	1030	1218	1350	NA	6320	6646	7280	NA	0.014	0.151	0.24
	TLT887	NA	*0.020*	*0.020*	*0.02*	NA	*0.005*	*0.005*	*0.005*	NA	*0.002*	*0.002*	*0.002*	NA	899	1029	1170	NA	4810	4888	4990	NA	0.598	0.901	1.43
	Summary	NA	0.020	0.878	8.35	NA	0.005	0.005	0.008	NA	0.002	0.002	0.005	NA	899	1616	2370	NA	4810	5658	7280	NA	0.010	0.222	1.43
Shallow Aquifer	NED604A	0.325	*0.020*	0.020	0.036	0.008	*0.005*	0.005	0.007	0.013	*0.002*	0.002	0.003	700	263	488	928	3000	1460	2235	3120	1.250	*0.010*	0.011	0.027
	NEL1382A	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	*0.002*	*0.002*	305	96	112	126	6450	3130	3604	3980	2.500	*0.010*	0.017	0.061
	NEL532A	0.650	*0.020*	0.029	0.181	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.006	1264	347	733	1330	8721	6850	7338	7810	2.500	*0.010*	0.017	0.101
	NEL536A	0.325	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.013	*0.002*	*0.002*	*0.002*	402	265	296	320	3000	2010	2063	2160	1.250	*0.010*	0.012	0.022
	NEM1387	0.325	*0.020*	0.020	0.021	0.008	*0.005*	*0.005*	*0.005*	0.013	*0.002*	0.002	0.005	400	275	302	325	1858	1350	1386	1430	1.250	*0.010*	0.011	0.018
	NET1380A	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.003	1300	772	959	1270	7500	4900	5820	7170	2.500	*0.010*	0.011	0.036
	NET1381A	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	0.005	0.008	0.025	*0.002*	0.002	0.003	735	433	523	596	8000	5410	6365	7550	2.500	*0.010*	*0.010*	*0.01*
	NET1383A	0.650	*0.020*	0.047	0.244	0.008	*0.005*	0.006	0.012	0.025	*0.002*	*0.002*	*0.002*	327	199	226	254	8834	6800	6931	7010	2.500	*0.010*	0.014	0.054
	NET1384A	1.300	*0.020*	0.024	0.038	0.008	*0.005*	0.006	0.012	0.050	*0.002*	0.012	0.044	5000	2150	2388	2630	none	44800	48013	51900	5.000	*0.010*	0.016	0.026
	NET1385A	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.004	0.022	212	130	140	152	5112	4390	4738	5190	2.500	*0.010*	*0.010*	*0.01*
	NET1386A	0.650	*0.020*	0.026	0.078	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.004	150	41	55	78	none	9060	10227	10600	2.500	*0.010*	0.010	0.011
	NET1393A	1.300	*0.020*	0.020	0.023	0.008	*0.005*	*0.005*	*0.005*	0.050	*0.002*	0.003	0.011	150	39	58	112	none	9900	10723	11500	5.000	*0.010*	0.011	0.022
	NET1490	0.325	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.013	0.004	0.005	0.005	361	182	198	217	2105	1440	1462	1500	1.250	*0.010*	*0.010*	*0.01*
	NET1491	0.325	*0.020*	0.020	0.023	0.008	*0.005*	0.005	0.009	0.013	0.005	0.007	0.008	808	144	207	290	3000	1550	1785	2050	1.250	*0.010*	0.012	0.019
	NET1492	0.650	*0.020*	0.022	0.038	0.008	*0.005*	*0.005*	*0.005*	0.025	0.005	0.006	0.008	943	151	235	349	3747	1760	1986	2250	2.500	*0.010*	0.012	0.017
	NET646A	1.300	*0.020*	0.022	0.041	0.008	*0.005*	*0.005*	*0.005*	0.050	*0.002*	0.009	0.051	7890	915	2161	4050	none	31500	48677	70100	5.000	*0.010*	0.024	0.07
	Summary	NA	0.020	0.023	0.244	NA	0.005	0.005	0.012	NA	0.002	0.004	0.051	NA	39	567	4050	NA	1350	10210	70100	NA	0.010	0.013	0.101
Principal Aquifer	NED604B	0.325	*0.020*	0.021	0.029	0.008	*0.005*	*0.005*	*0.005*	0.013	*0.002*	*0.002*	*0.002*	150	111	130	160	1589	1220	1303	1380	1.250	*0.010*	0.010	0.011
	NEL1382B	0.650	*0.020*	0.021	0.03	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	*0.002*	*0.002*	157	65	70	79	2300	1870	2033	2170	2.500	*0.010*	0.012	0.019
	NEL1382C	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	*0.002*	*0.002*	96	58	63	72	2000	1250	1329	1460	2.500	*0.010*	0.010	0.014
	NEL532B	0.650	*0.020*	0.025	0.078	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.006	105	42	77	96	10000	8050	8351	8830	2.500	*0.010*	0.013	0.025
	NEL536B	0.325	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.013	*0.002*	*0.002*	*0.002*	64	45	47	51	993	682	710	740	1.250	*0.010*	*0.010*	*0.01*
	NET1380B	0.325	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.013	*0.002*	*0.002*	*0.002*	15	5	6	9	1532	1200	1223	1260	1.250	*0.010*	0.013	0.026
	NET1381B	0.650	*0.020*	0.054	0.471	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.003	1277	539	664	751	12800	10200	12429	14800	2.500	*0.010*	0.024	0.095
	NET1383B	0.650	*0.020*	0.032	0.16	0.008	*0.005*	0.005	0.007	0.025	*0.002*	*0.002*	*0.002*	279	163	186	202	8192	6360	6493	6560	2.500	*0.010*	0.013	0.04
	NET1384B	1.300	*0.020*	0.023	0.06	0.008	*0.005*	*0.005*	*0.005*	0.050	*0.002*	0.004	0.012	3164	1880	2145	2360	none	23200	25333	26500	5.000	*0.010*	0.015	0.025
	NET1385B	0.650	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	*0.002*	*0.002*	249	165	175	185	7300	5490	5851	6170	2.500	*0.010*	0.010	0.014
	NET1386B	0.650	*0.020*	0.020	0.025	0.008	*0.005*	*0.005*	*0.005*	0.025	*0.002*	0.002	0.004	72	41	52	62	10000	3010	8276	10500	2.500	*0.010*	0.011	0.017
	NET1393B	1.300	*0.020*	0.020	0.021	0.008	*0.005*	0.005	0.007	0.050	*0.002*	*0.002*	*0.002*	150	47	106	125	none	10400	10650	11300	5.000	*0.010*	0.011	0.021
	NET646B	1.300	*0.020*	*0.020*	*0.02*	0.008	*0.005*	*0.005*	*0.005*	0.050	*0.002*	0.003	0.008	1738	613	751	836	none	21800	24297	29700	5.000	*0.010*	0.011	0.014
	Summary	NA	0.020	0.024	0.471	NA	0.005	0.005	0.007	NA	0.002	0.002	0.012	NA	5	344	2360	NA	682	8329	29700	NA	0.010	0.012	0.095

Notes:
NA = not applicable (no limits are established for tailings wells or process water)
NM = not measured. The following analytes were not measured in the lysimeters: barium, cadmium, chromium, lead, and total dissolved solids. Lysimeters TLL4103 and TLL4134 were not sampled between 2006 and 2011.
All concentrations are in units of milligrams per liter. Metal concentrations presented are dissolved, with the exception of metals analyzed at the nine lysimeters which are total concentrations.
POC = Concentration that indicates "probable out-of-compliance" (the higher of the Protection Level or Compliance Limit). Also referred to as the permit limit in this report.
Gray shaded cells indicate concentrations that exceed the POC.
Avergage concentrations presented incorporate non-detections, assuming the reporting limit is the concentration. Itacilized and underlined maximum values are the reporting limits for non-detections.



LEGEND:

- BOUNDARY OF PROPOSED TAILINGS EXPANSION PROJECT
- SURFACE WATER DRAINAGES
- PROCESS WATER DRAINAGES

MONITORING LOCATIONS[1]

⊠ TLS1426	SEEP	▽ TLT2452	TAILINGS WELL
⊕ TLL4100	LYSIMETER	● CLC452	CLARIFICATION CANAL
⊙ NEL532A	MONITORING WELL	⊠ OUTFALL 012	OUTFALL
✳ TLP1469	TOE DITCH		

[1] LOCATIONS WERE RE-SURVEYED IN JANUARY AND MARCH 2012.

0 1500 3000 6000
SCALE IN FEET

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT MODIFICATION	SITE LOCATION, FEATURES, AND MONITORING POINTS	FIGURE 1-1

URS

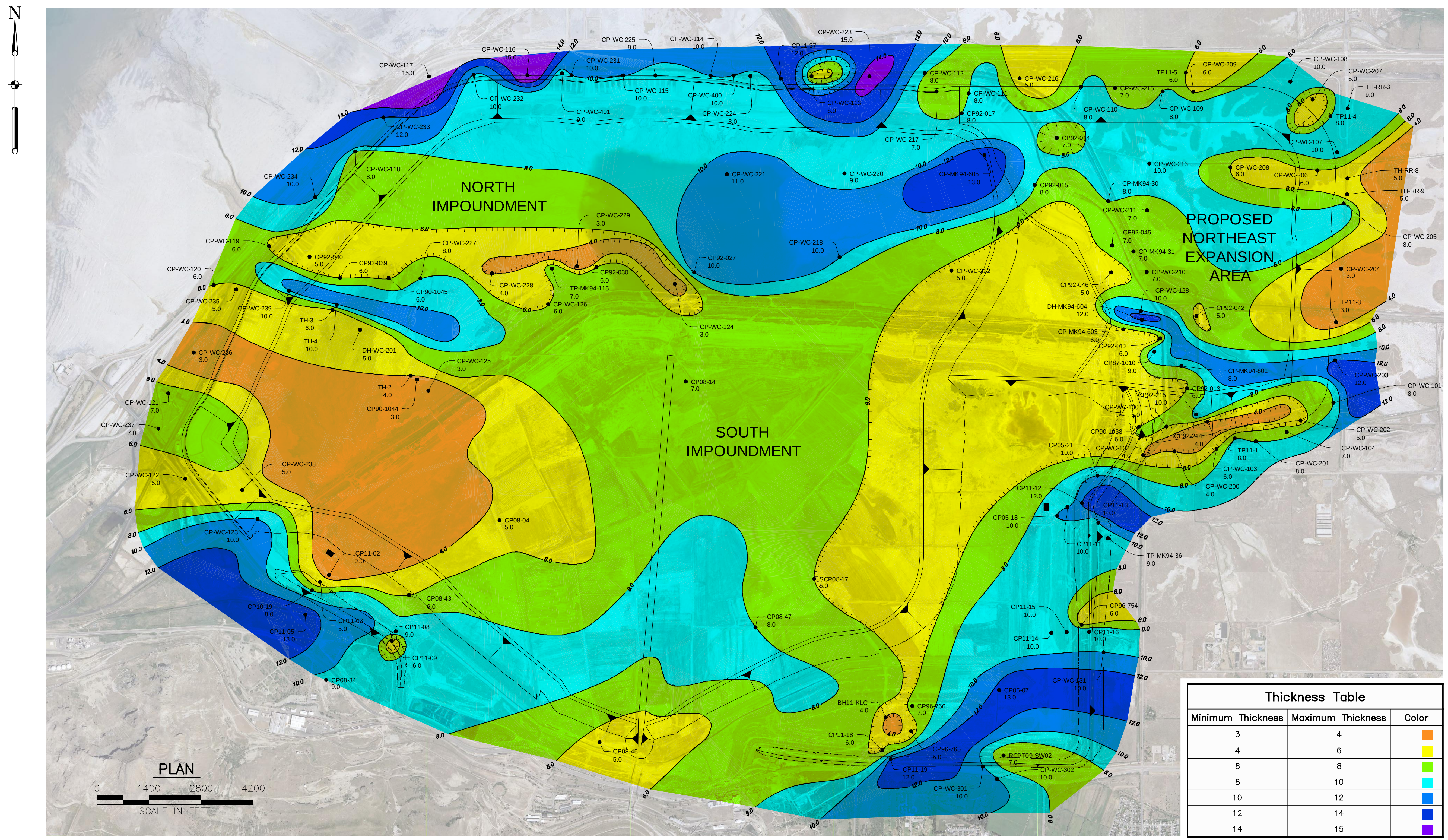
URS DRAWING PATH: W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\WELL LOCATION MAP-GGU.dwg

Figure 3-1
LACUSTRINE STRATIGRAPHY IN THE TAILINGS IMPOUNDMENT AREA

Average Depth Range Below Top of Bonneville (feet)	Lake Cycle	Depositional Environmental	Age (K Years)	Description
0'-9'	Upper Bonneville Clay (B1)	0-3' shallow post-Lake Gilbert "red beds" 3'-9' deep lake	10-11 13-25	Oxidized clay and silty clay Reworked, mottled Bonneville clay with oolitic sand spit Uniform silty clay with occassional thin sand partings
9'-15'	Lower Bonneville Clay (B2)	9'-15' shallow lake	25-30	Clay with thin sand lenses, oolitic sand
15'-35'	Cutler Dam (C1, C2, C3)	15'-20' shallow to deep lake 20'-33' shallow lake 33'-35' deep lake	30-33 33-38 38-45	Clays with sand lenses Deltaic sand and clay with sand lenses Laminated clay and silt
35'-127'	Interglacial Period	35'-127' Series of exposed soil surface hiatus over deposit comprised of delta-lagoon-beach areas Shallow lake intervals at 68'-81' and 107'-127'	60	Weathered clay and sand, modified by oxidation, vegetation Clay with sand lenses, channel sands, oolitic beach sands
127'-150'+	Little Valley	127'-133' Dimple Dell soil equivalent; low lake level 133'-140' shallow lake 140'-175' shallow to deep lake	120	Well-developed soil horizons, oxidized clay Lensed clay with sand, occasional beach sand Laminated clay with silt and fine sand

Note:
Depth of investigation was 150 feet.

From: Woodward-Clyde Consultants, 1991. "Geotechnical Site Characterization Report – Tailings Impoundment Modernization Project, North Expansion". Vols. VI-X. December.



Thickness Table

Minimum Thickness	Maximum Thickness	Color
3	4	orange
4	6	yellow
6	8	green
8	10	cyan
10	12	light blue
12	14	dark blue
14	15	purple

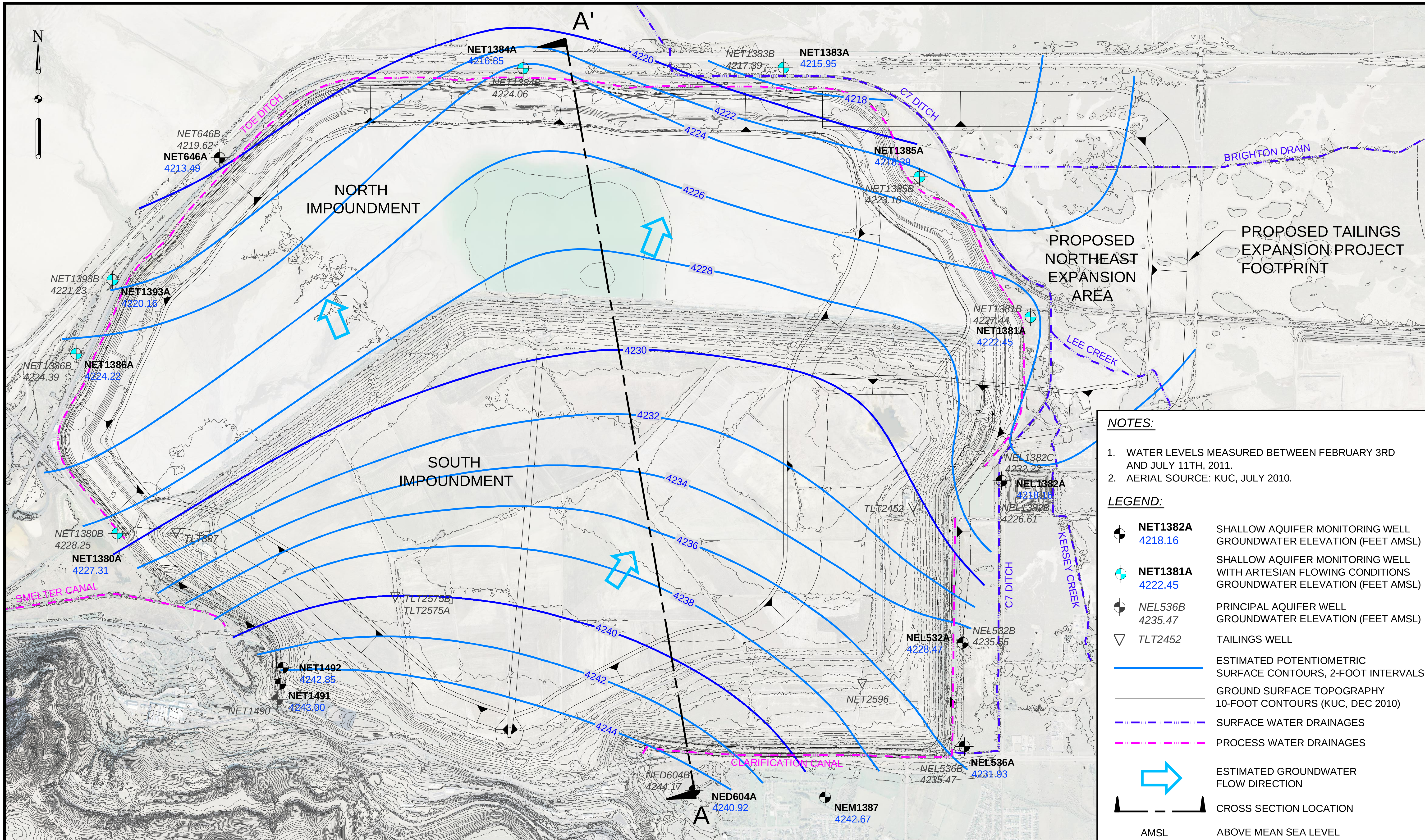
LEGEND

- CP08-43 6.0 — DATA POINT AND THICKNESS OF BONNEVILLE CLAY FROM CONE PENETROMETER (CP) TESTS, BORE HOLES (BH), AND TEST PITS (TP).
- PROPOSED TEP FOOTPRINT
- 12.0 — CONTOUR INTERVAL FOR THE THICKNESS OF THE UPPERMOST CLAY LAYER (FEET)
- HACHURES ON SIDE OF CONTOUR INDICATE AREA OF DECREASING THICKNESS

NOTES:

1. THICKNESS CONTOUR INTERVAL IS 2 FEET.
2. TEP IS TAILINGS EXPANSION PROJECT

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	UPPERMOST CONTINUOUS CLAY LAYER THICKNESS MAP	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 3–2



0 1250 2500 5000

SCALE IN FEET

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	POTENTIOMETRIC SURFACE FOR THE SHALLOW AQUIFER 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 5–1

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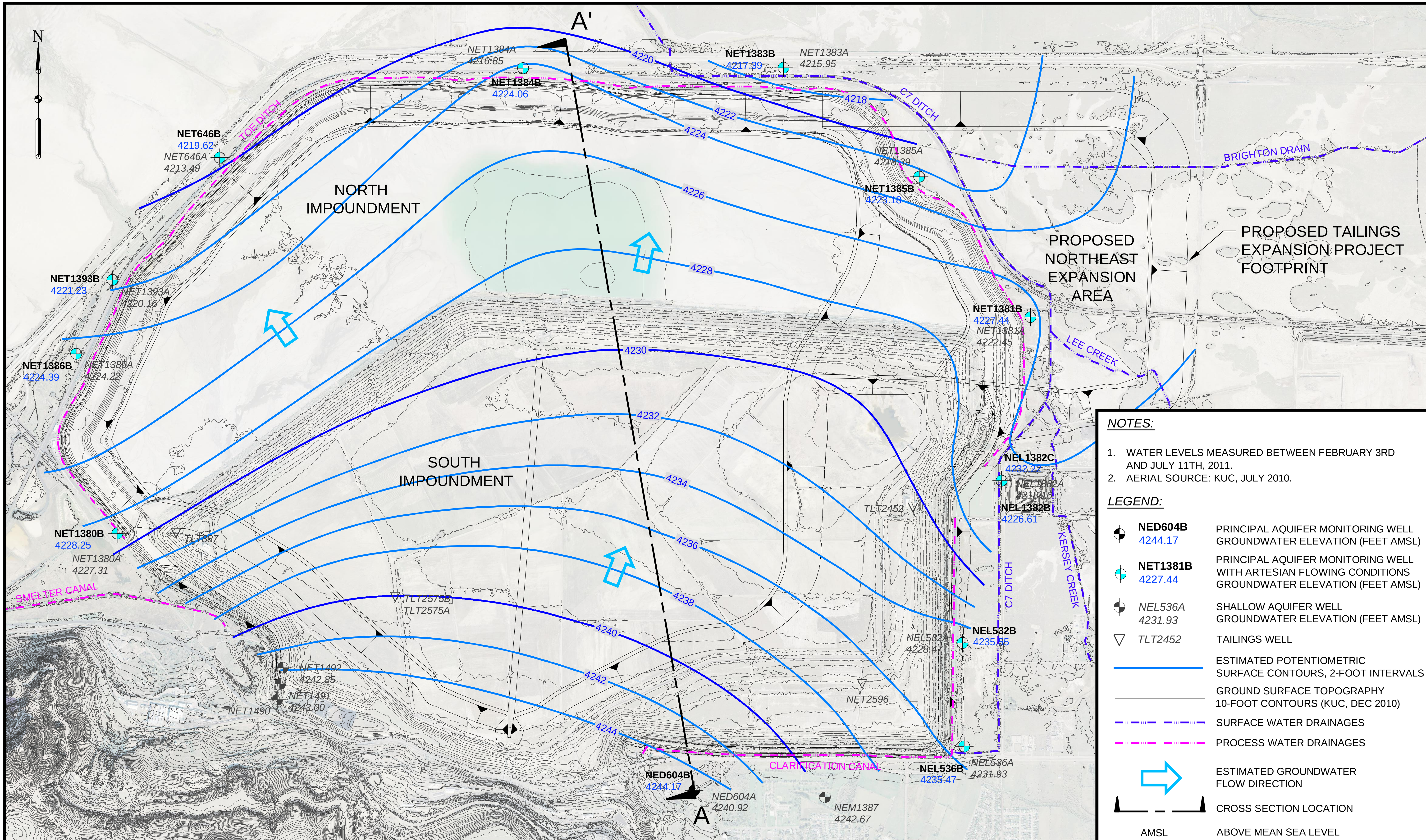

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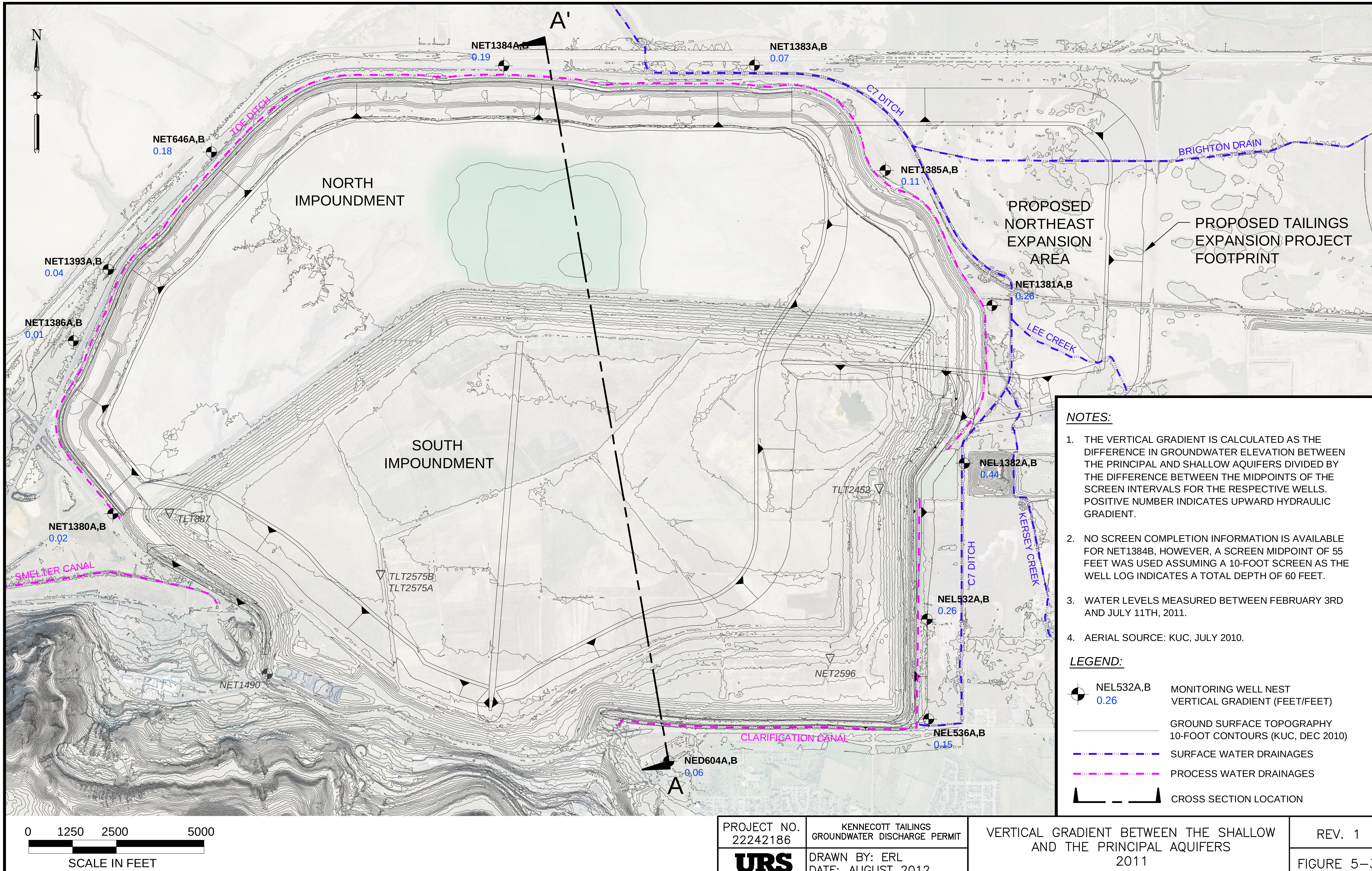
PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	POTENTIOMETRIC SURFACE FOR THE PRINCIPAL AQUIFER 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 5–2



NOTES:

1. THE VERTICAL GRADIENT IS CALCULATED AS THE DIFFERENCE IN GROUNDWATER ELEVATION BETWEEN THE PRINCIPAL AND SHALLOW AQUIFERS DIVIDED BY THE DIFFERENCE BETWEEN THE MIDPOINTS OF THE SCREEN INTERVALS FOR THE RESPECTIVE WELLS. POSITIVE NUMBER INDICATES UPWARD HYDRAULIC GRADIENT.
2. NO SCREEN COMPLETION INFORMATION IS AVAILABLE FOR NET1384B, HOWEVER, A SCREEN MIDPOINT OF 55 FEET WAS USED ASSUMING A 10-FOOT SCREEN AS THE WELL LOG INDICATES A TOTAL DEPTH OF 60 FEET.
3. WATER LEVELS MEASURED BETWEEN FEBRUARY 3RD AND JULY 11TH, 2011.
4. AERIAL SOURCE: KUC, JULY 2010.

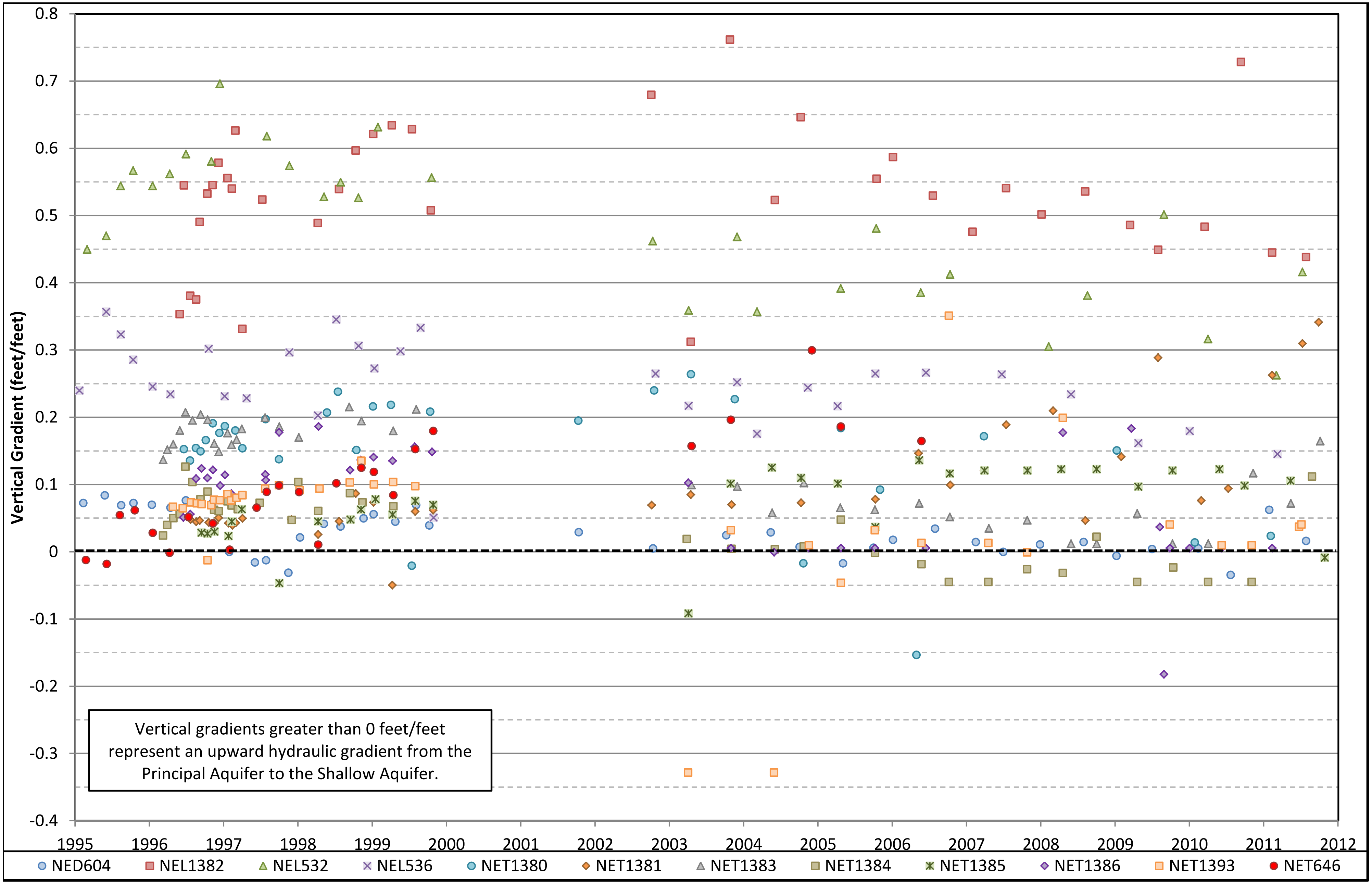
LEGEND:

NEL532A,B 0.26	MONITORING WELL NEST VERTICAL GRADIENT (FEET/FEET)
	GROUND SURFACE TOPOGRAPHY 10-FOOT CONTOURS (KUC, DEC 2010)
	SURFACE WATER DRAINAGES
	PROCESS WATER DRAINAGES
	CROSS SECTION LOCATION

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	VERTICAL GRADIENT BETWEEN THE SHALLOW AND THE PRINCIPAL AQUIFERS 2011	REV. 1
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 5–3

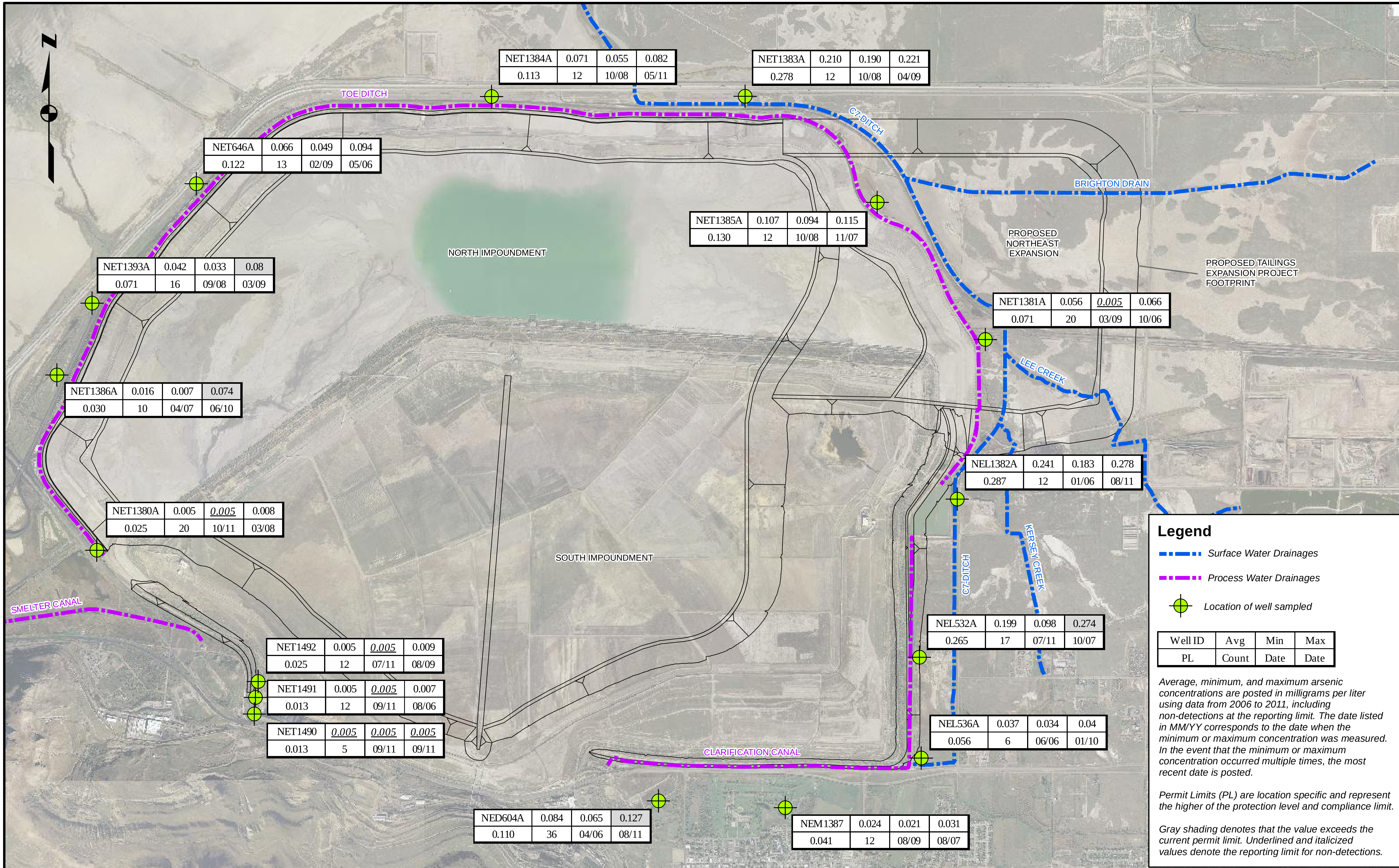
W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\ERL\GW-Contours.dwg

Figure 5-4
GRAPH OF VERTICAL GRADIENT VERSUS TIME FOR WELL NESTS



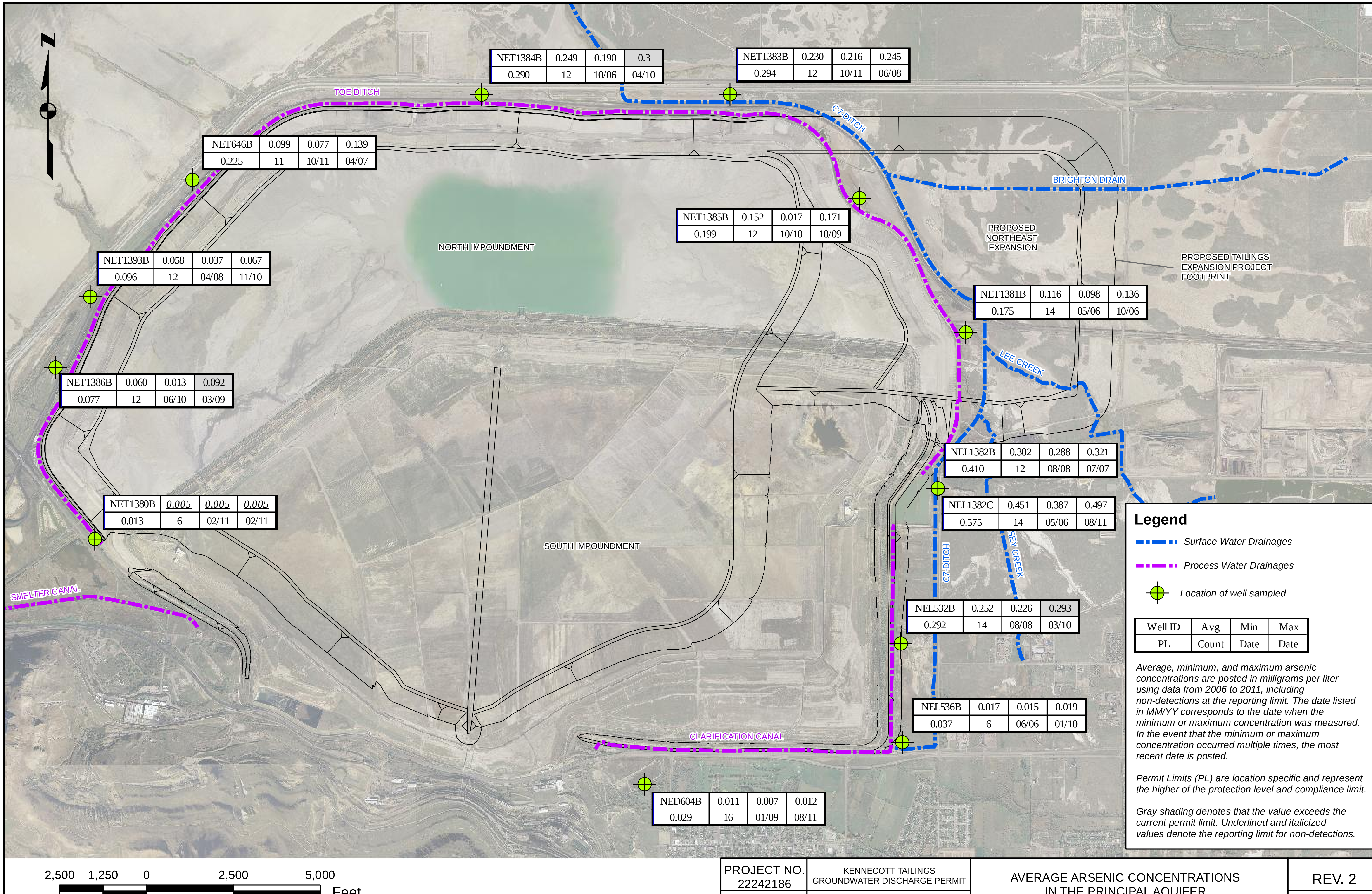
0 250 500 1000
SCALE IN FEET
VERTICAL EXAGGERATION: 10X

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	HYDROGEOLOGIC CROSS SECTION A–A'	REV. 1
URS	DRAWN BY: ERL DATE: JUNE 2012		FIGURE 5–5



2,500 1,250 0 2,500 5,000 Feet

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE ARSENIC CONCENTRATIONS IN THE SHALLOW AQUIFER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-1



PROJECT NO. 22242186

KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT

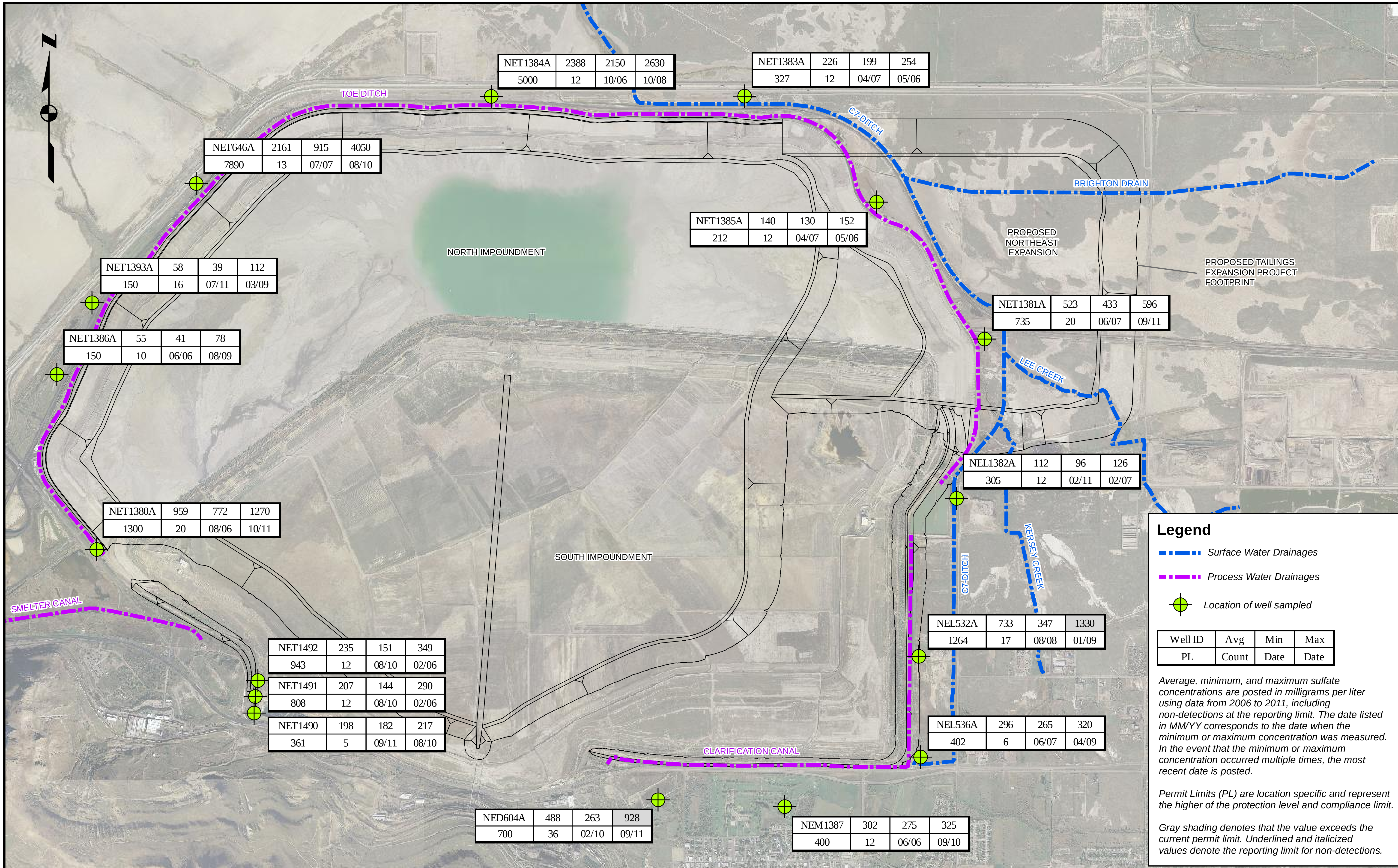
URS

DRAWN BY: ERL
DATE: AUGUST 2012

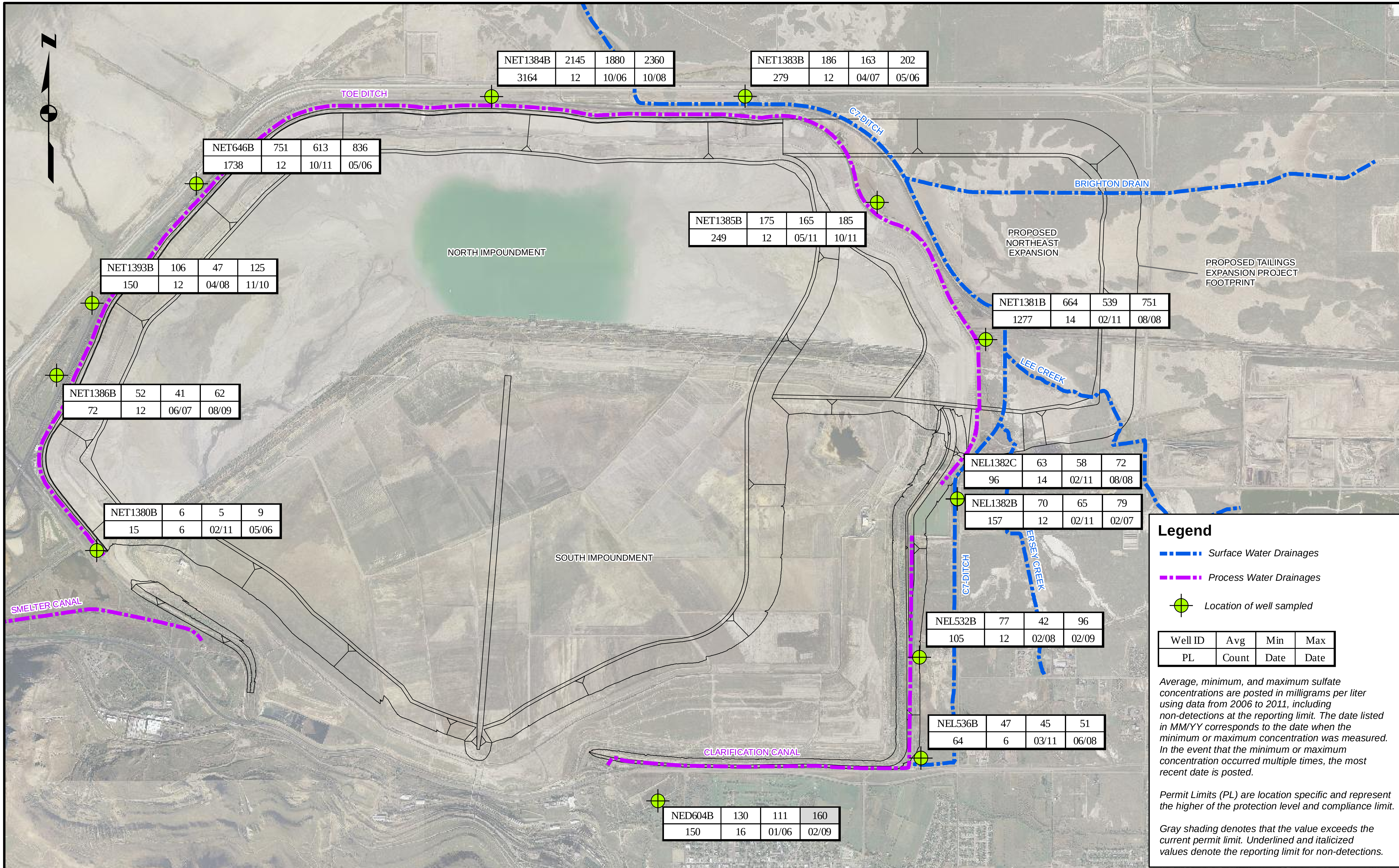
AVERAGE ARSENIC CONCENTRATIONS IN THE PRINCIPAL AQUIFER, 2006 THROUGH 2011

REV. 2

FIGURE 7-2

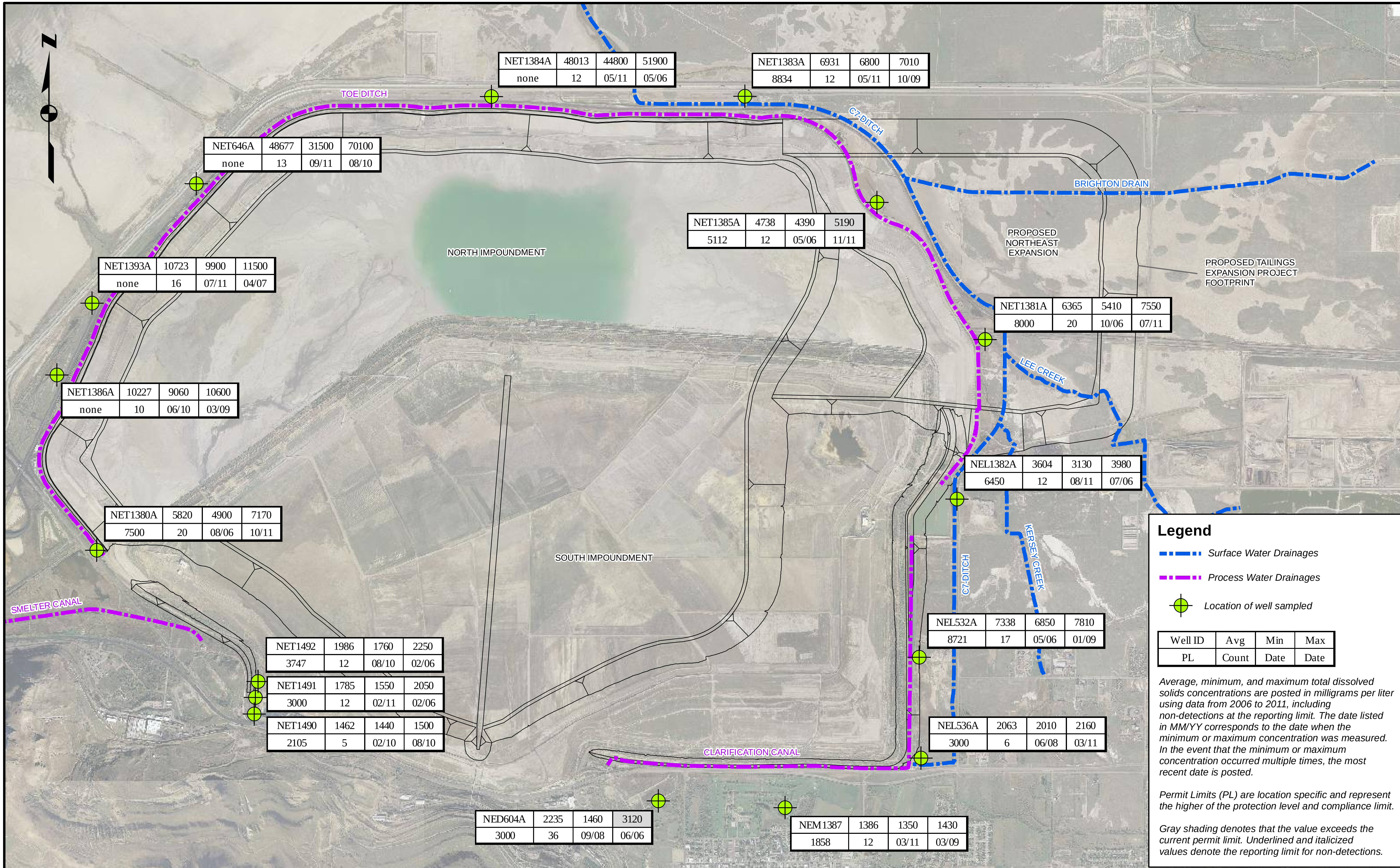


PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE SULFATE CONCENTRATIONS IN THE SHALLOW AQUIFER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-3



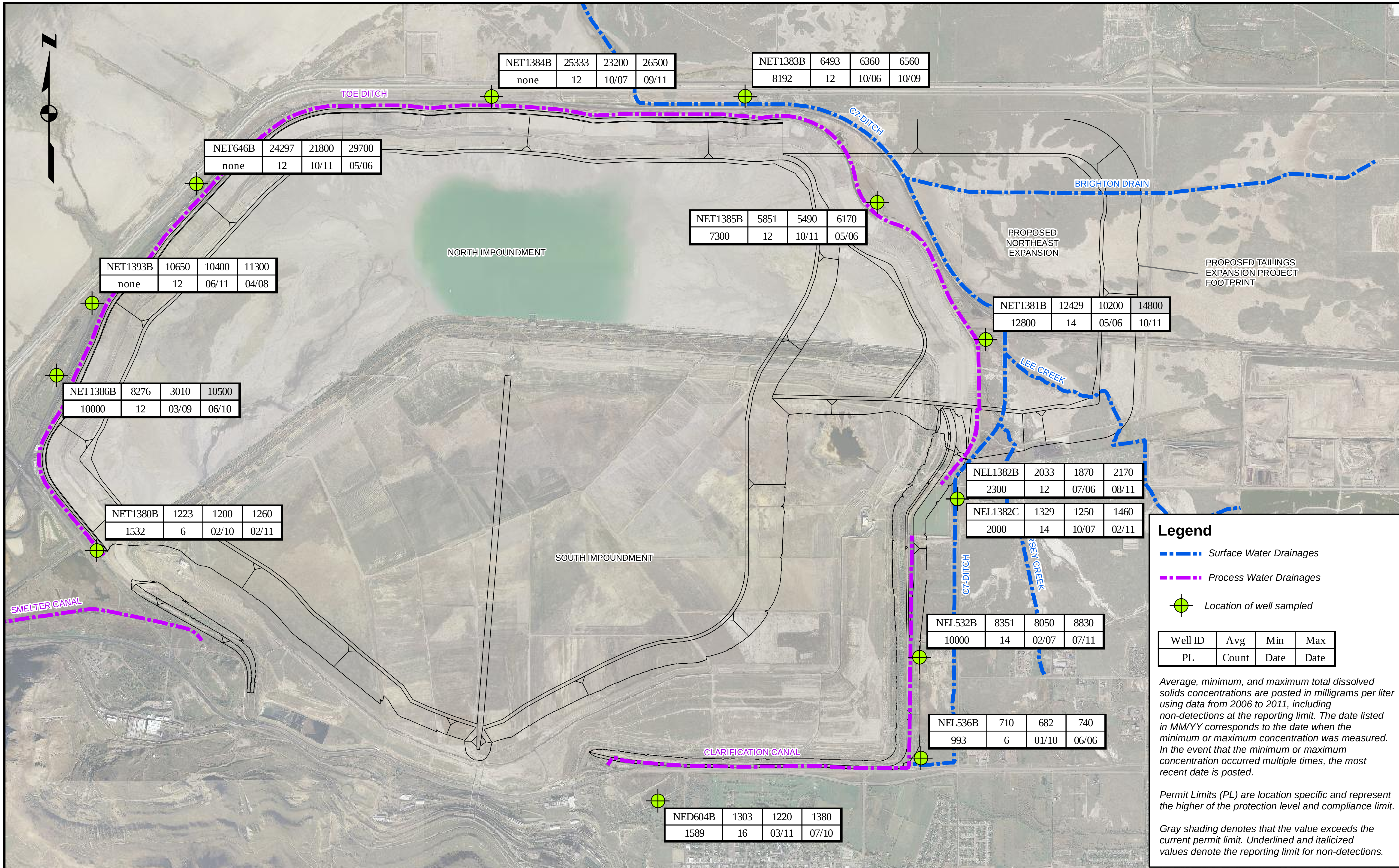
2,500 1,250 0 2,500 5,000
Feet

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE SULFATE CONCENTRATIONS IN THE PRINCIPAL AQUIFER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-4

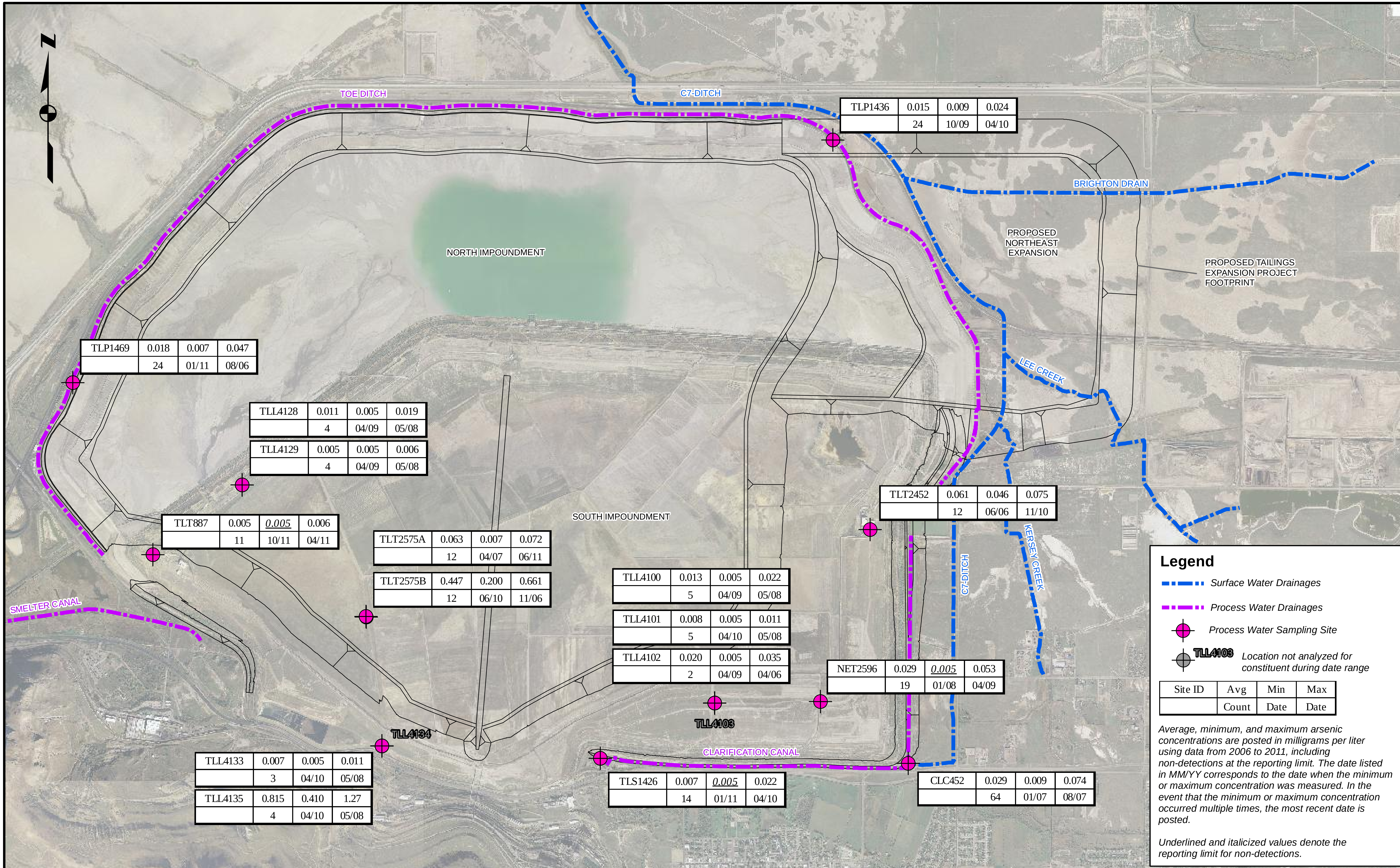


2,500 1,250 0 2,500 5,000
Feet

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN THE SHALLOW AQUIFER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-5



PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN THE PRINCIPAL AQUIFER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-6



2,500 1,250 0 2,500 5,000 Feet

PROJECT NO. 22242186

KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT

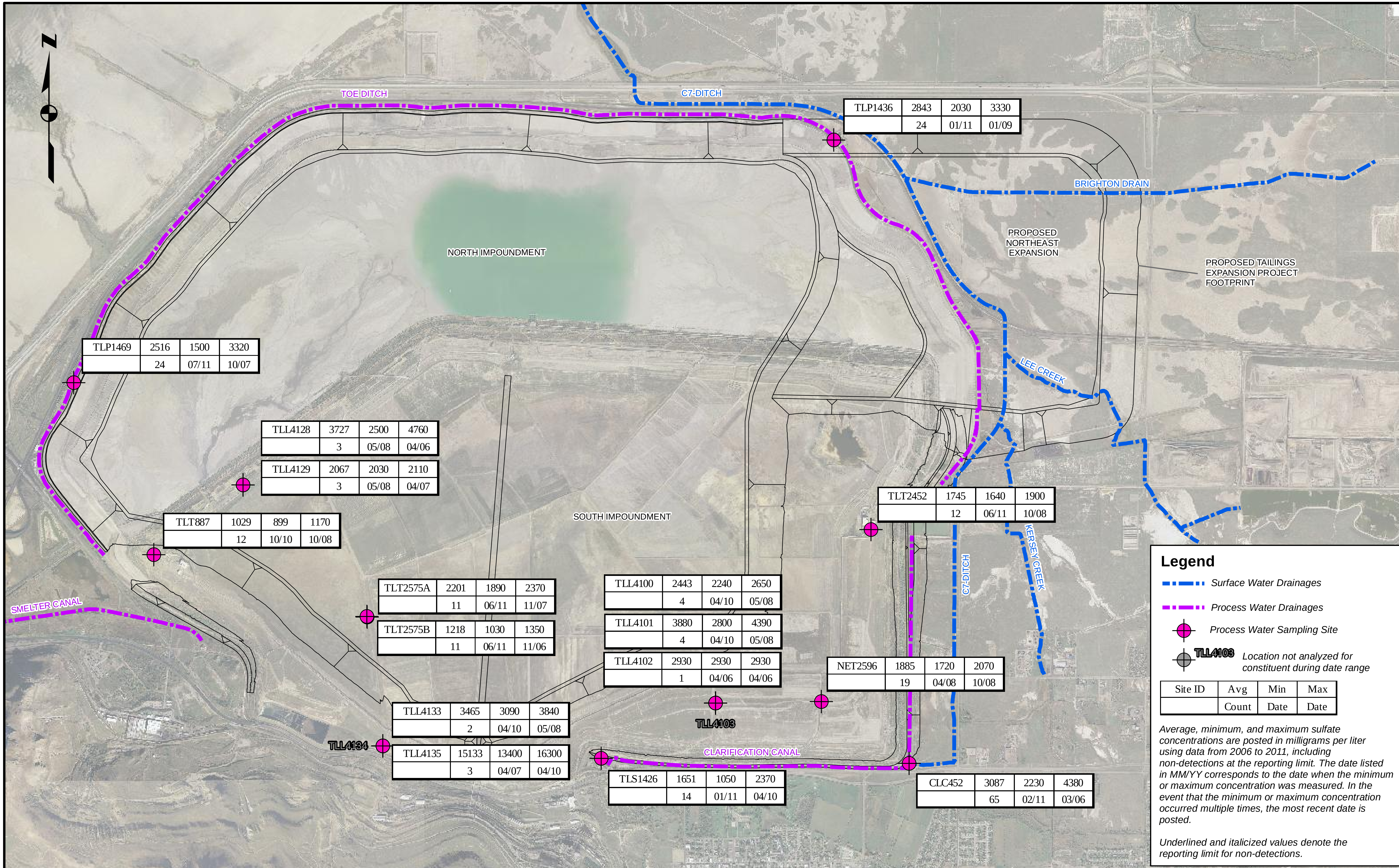
URS

DRAWN BY: ERL
DATE: AUGUST 2012

AVERAGE ARSENIC CONCENTRATIONS IN THE PROCESS WATER, 2006 THROUGH 2011

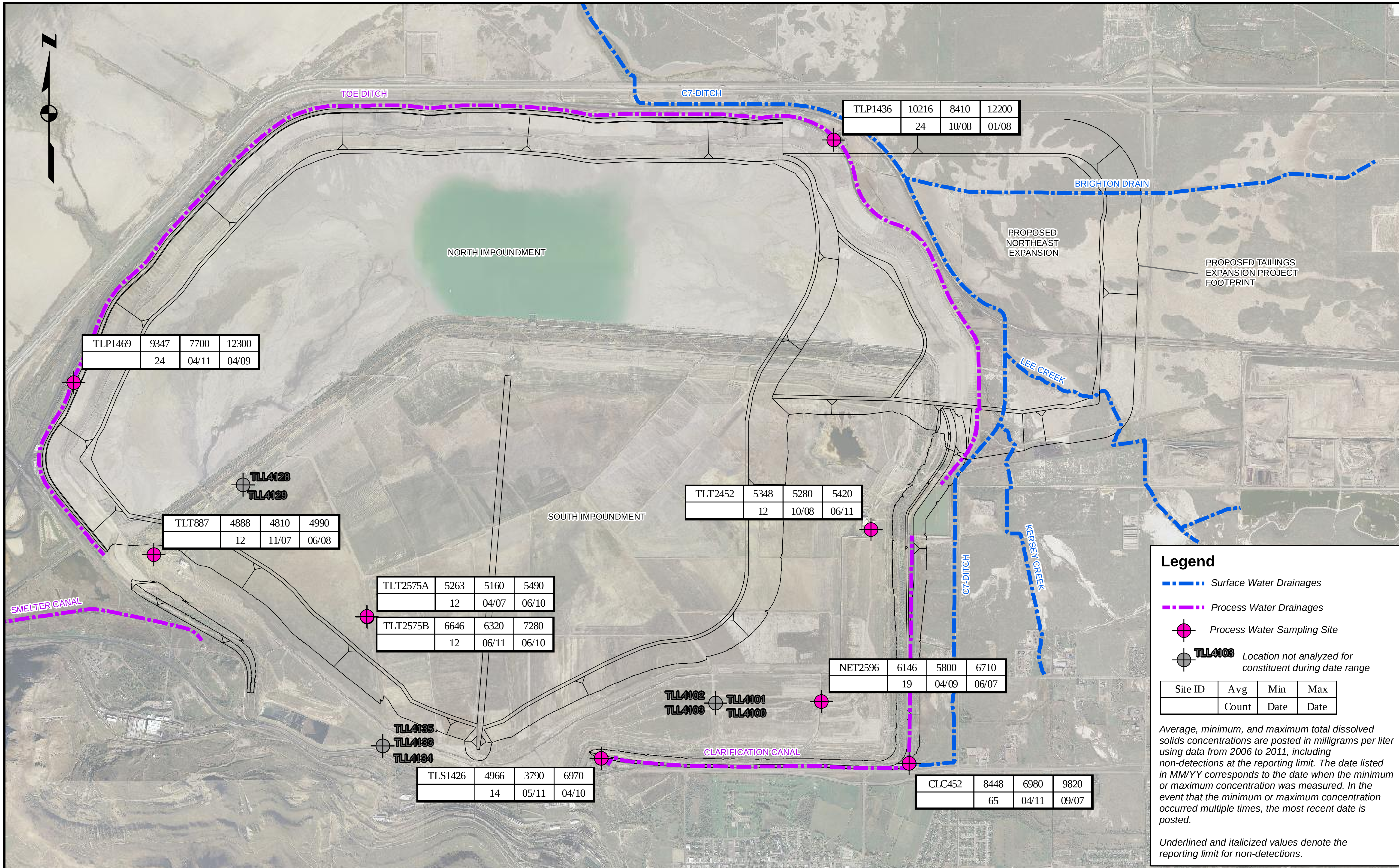
REV. 2

FIGURE 7-7



2,500 1,250 0 2,500 5,000
Feet

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE SULFATE CONCENTRATIONS IN THE PROCESS WATER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-8



PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT	AVERAGE TOTAL DISSOLVED SOLIDS CONCENTRATIONS IN THE PROCESS WATER, 2006 THROUGH 2011	REV. 2
URS	DRAWN BY: ERL DATE: AUGUST 2012		FIGURE 7-9

Appendix A

Hydrographs of Water Level Elevations for Permit Wells
(1995 through 2011)

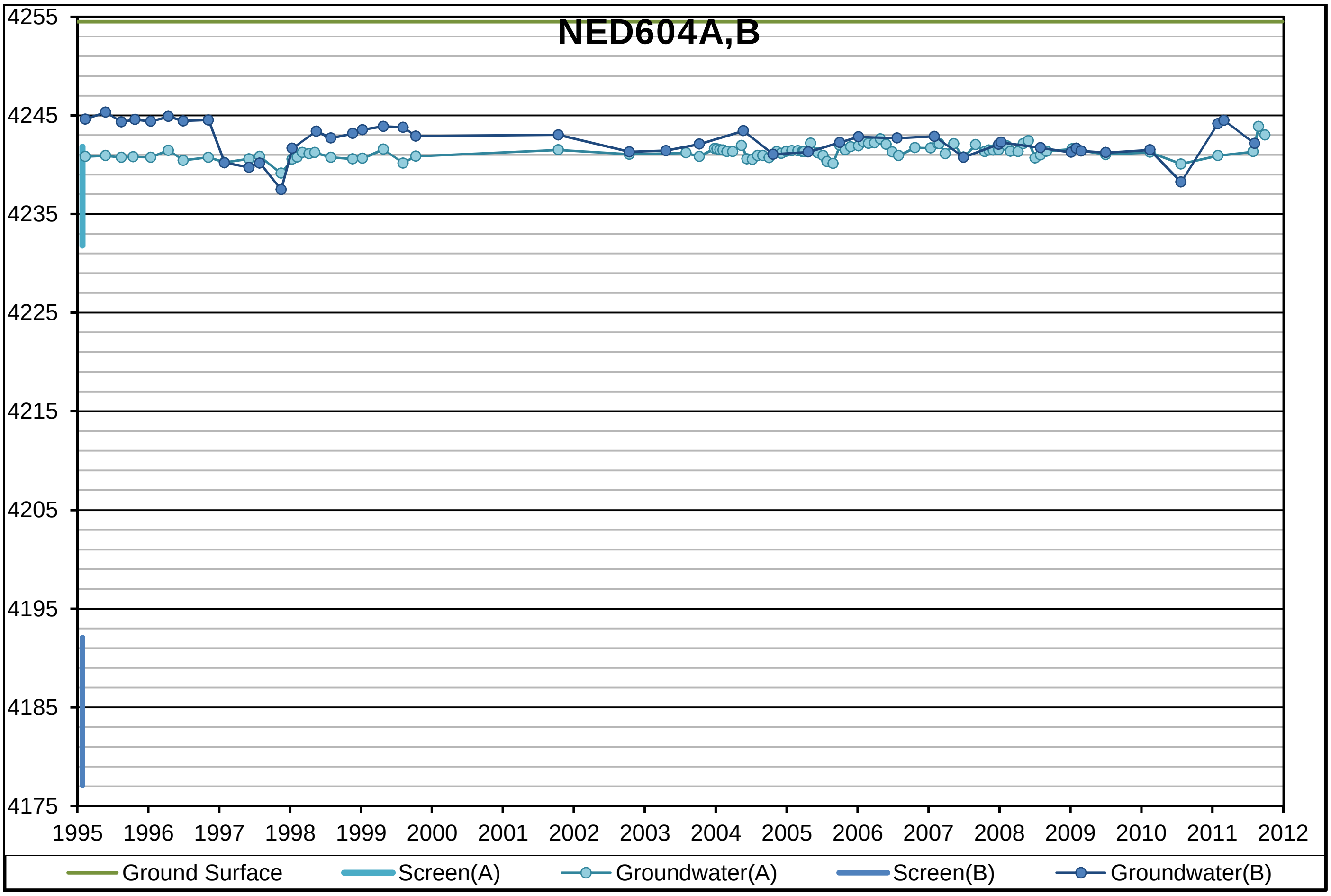
Appendix A
Hydrographs of Water Level Elevations for Permit Wells (1995 through 2011)

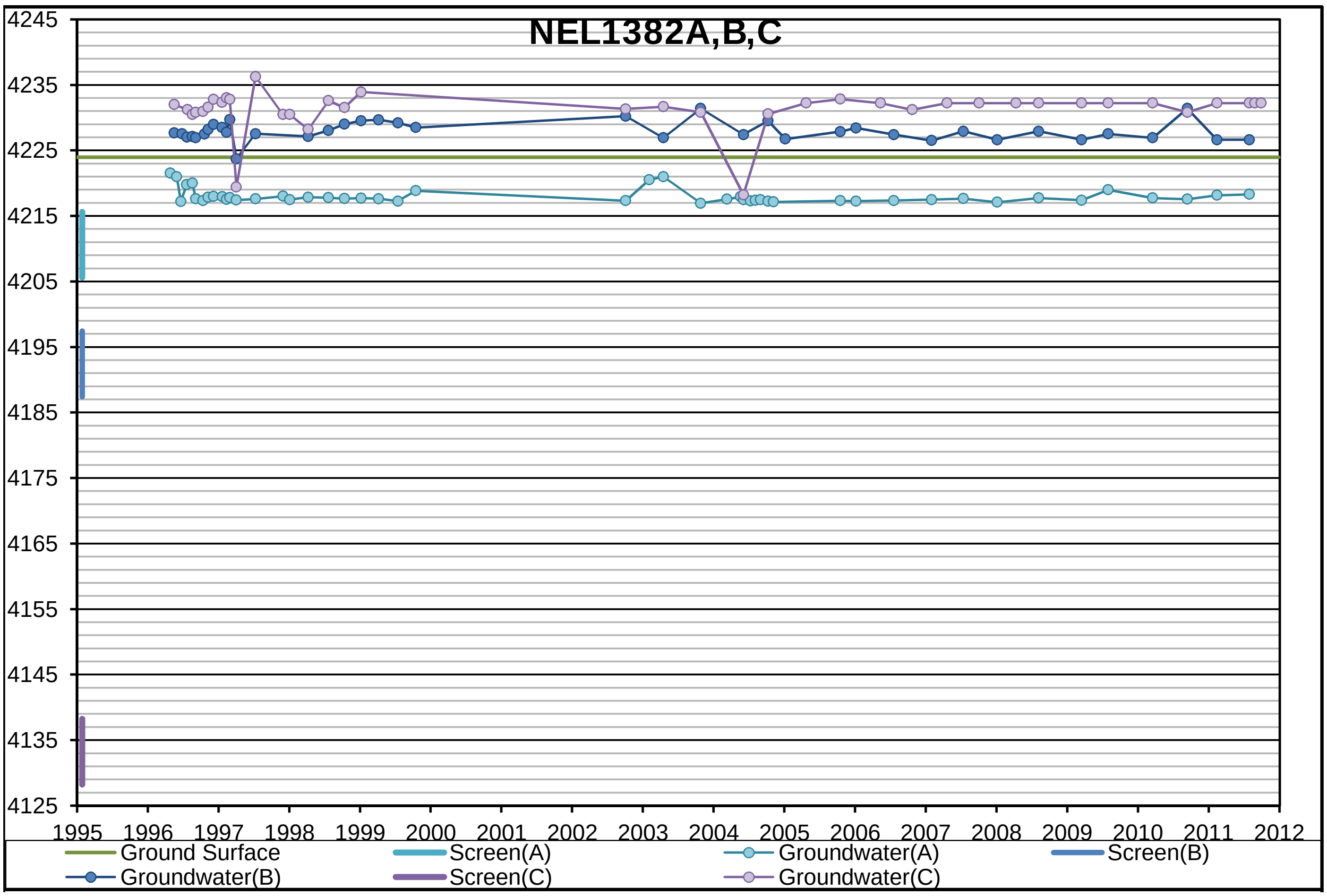
Hydrographs – Well Cluster Locations

NED604A,B
NEL1382A,B,C
NEL532A,B
NEL536A,B
NEM1387
NET1380A,B
NET1381A,B
NET1383A,B
NET1384A,B
NET1385A,B
NET1386A,B
NET1393A,B
NET1491 & NET1492
NET2596
NET646A,B
TLT2452
TLT2575A,B
TLT887

Hydrographs

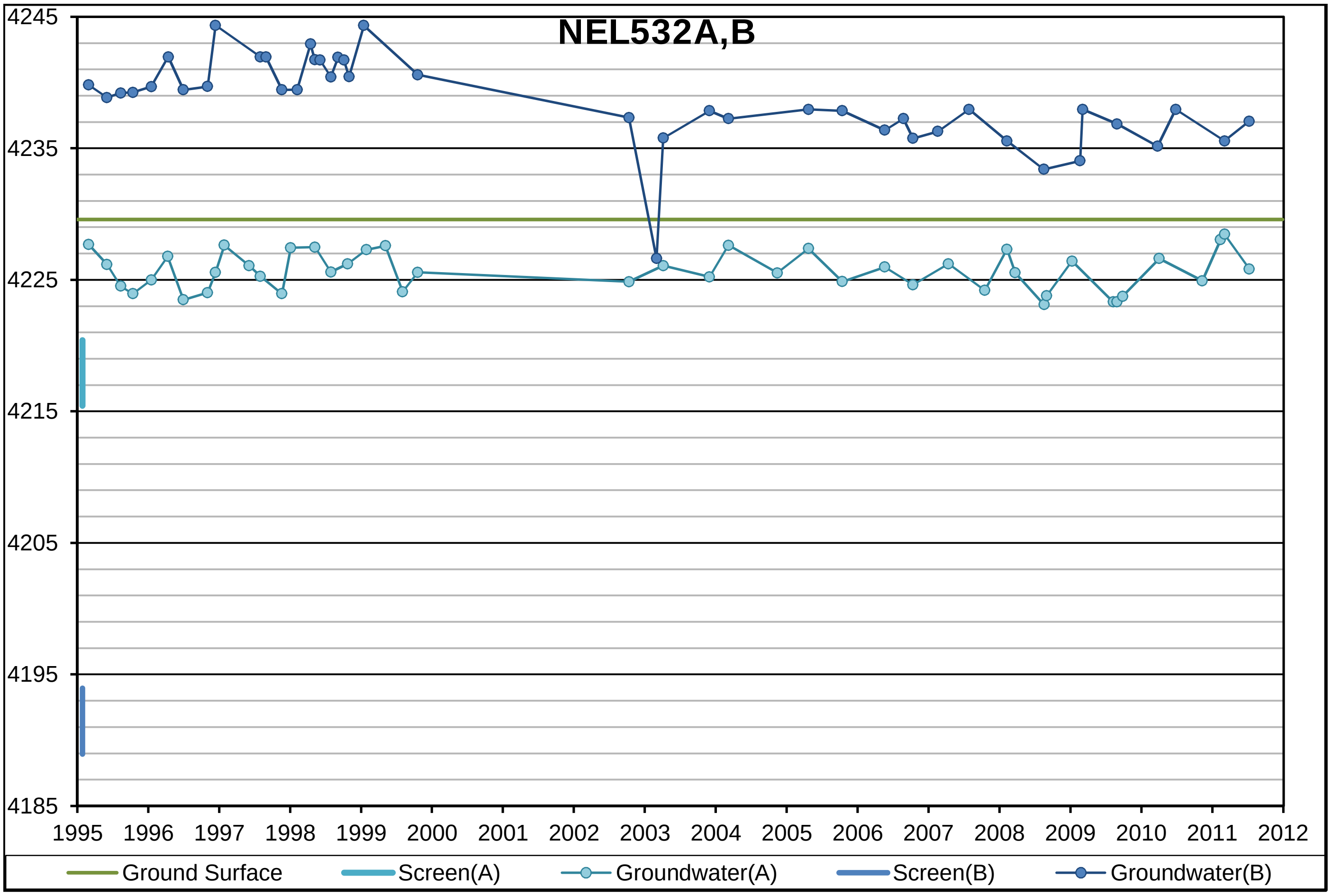
Groundwater Elevations Versus Year

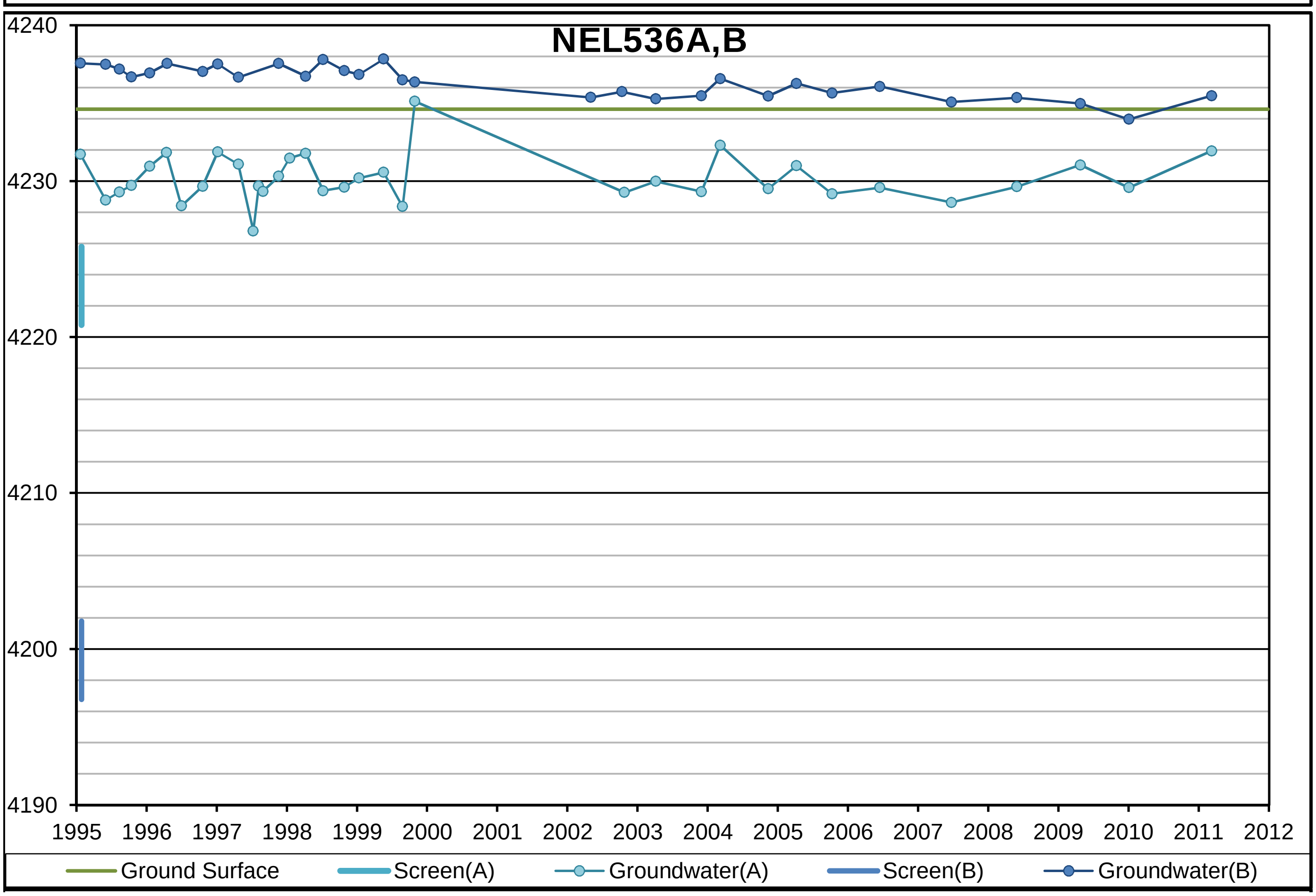




Hydrographs

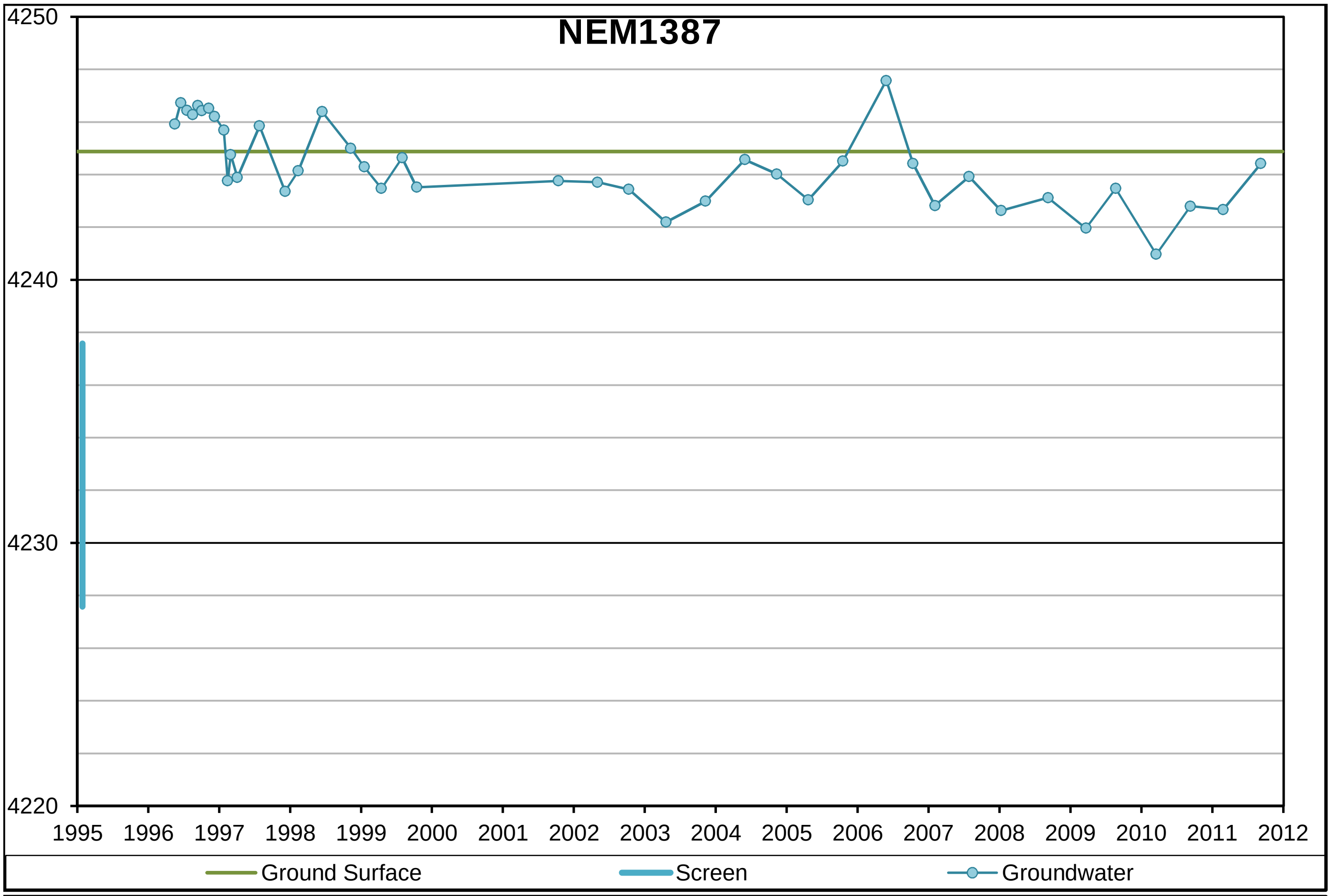
Groundwater Elevations Versus Year

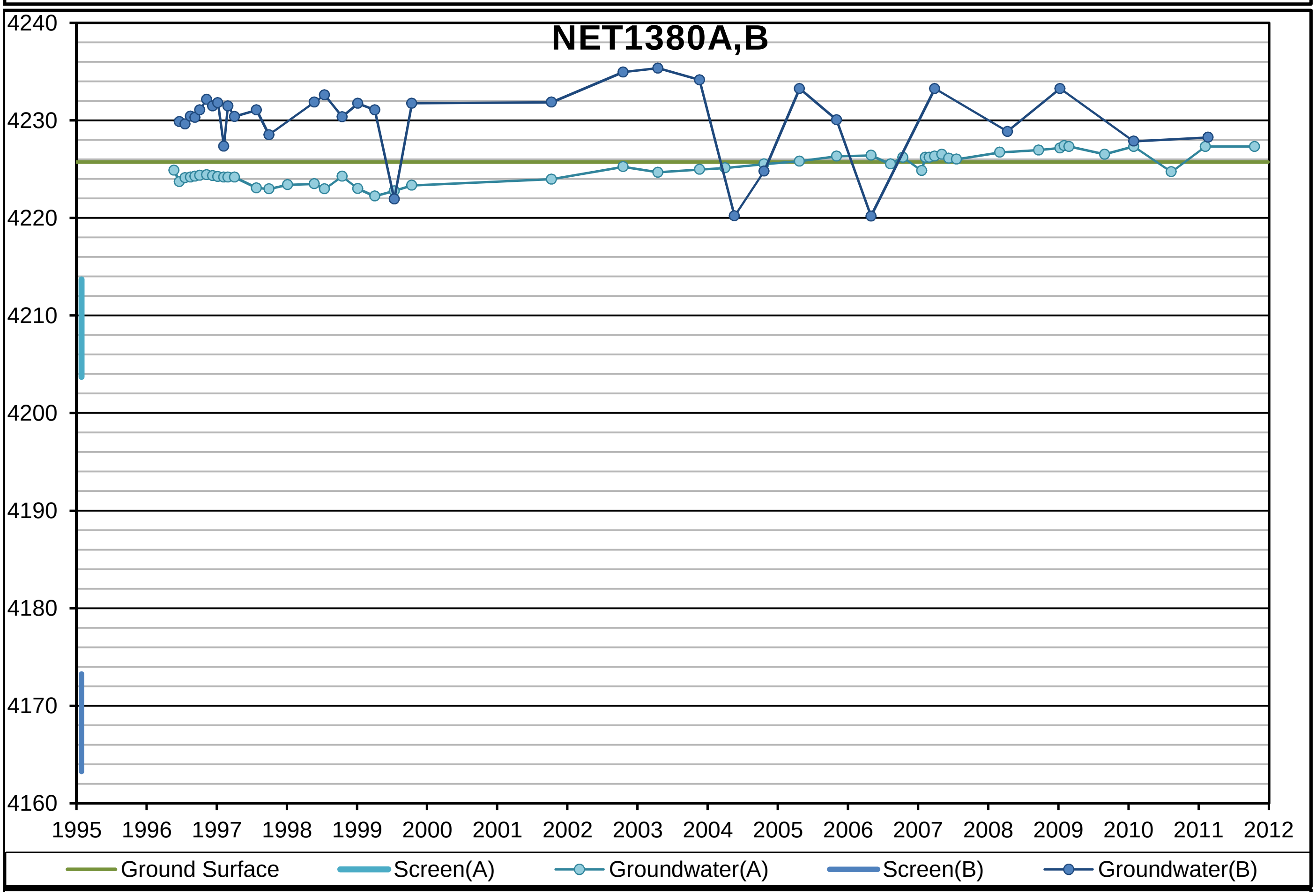


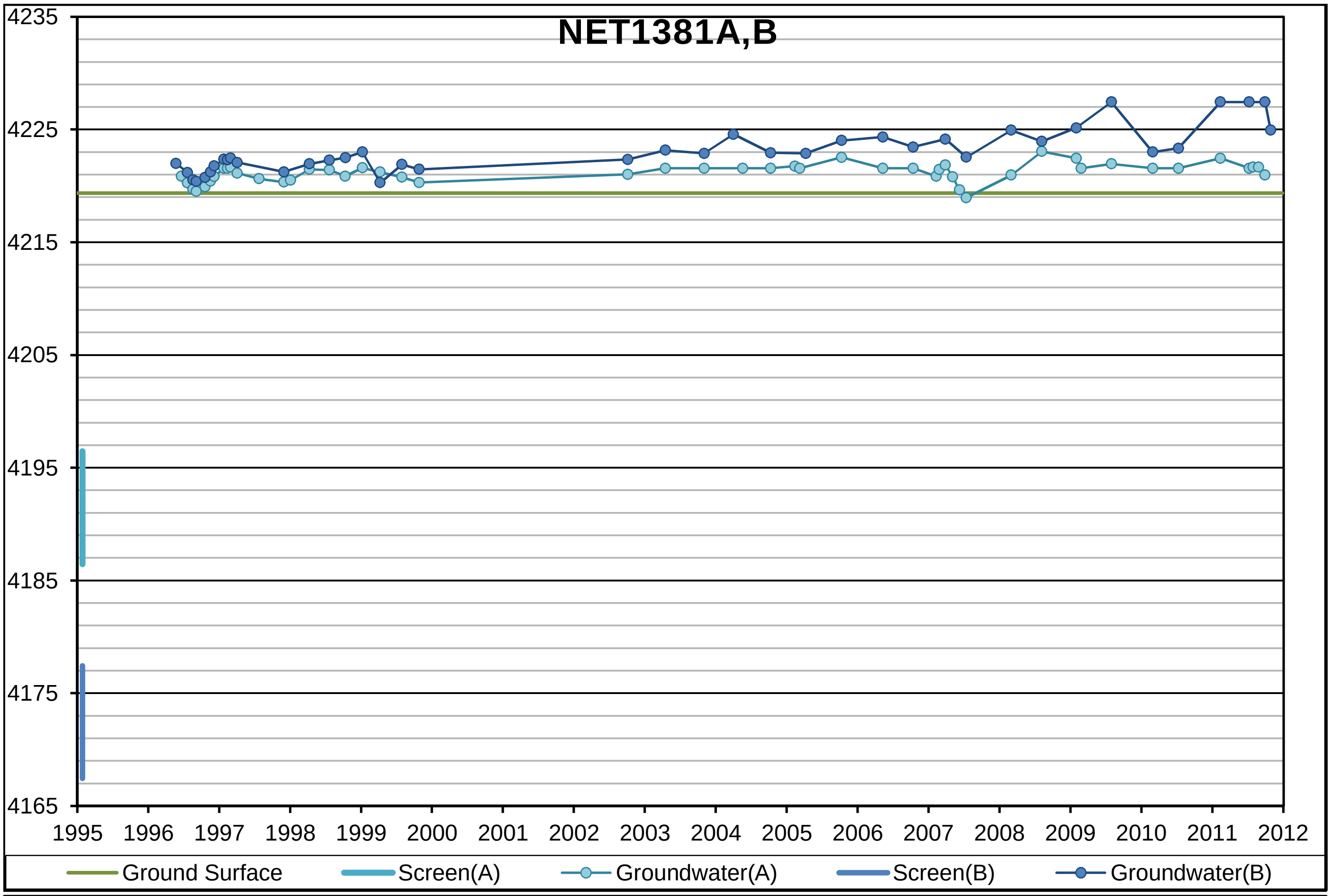


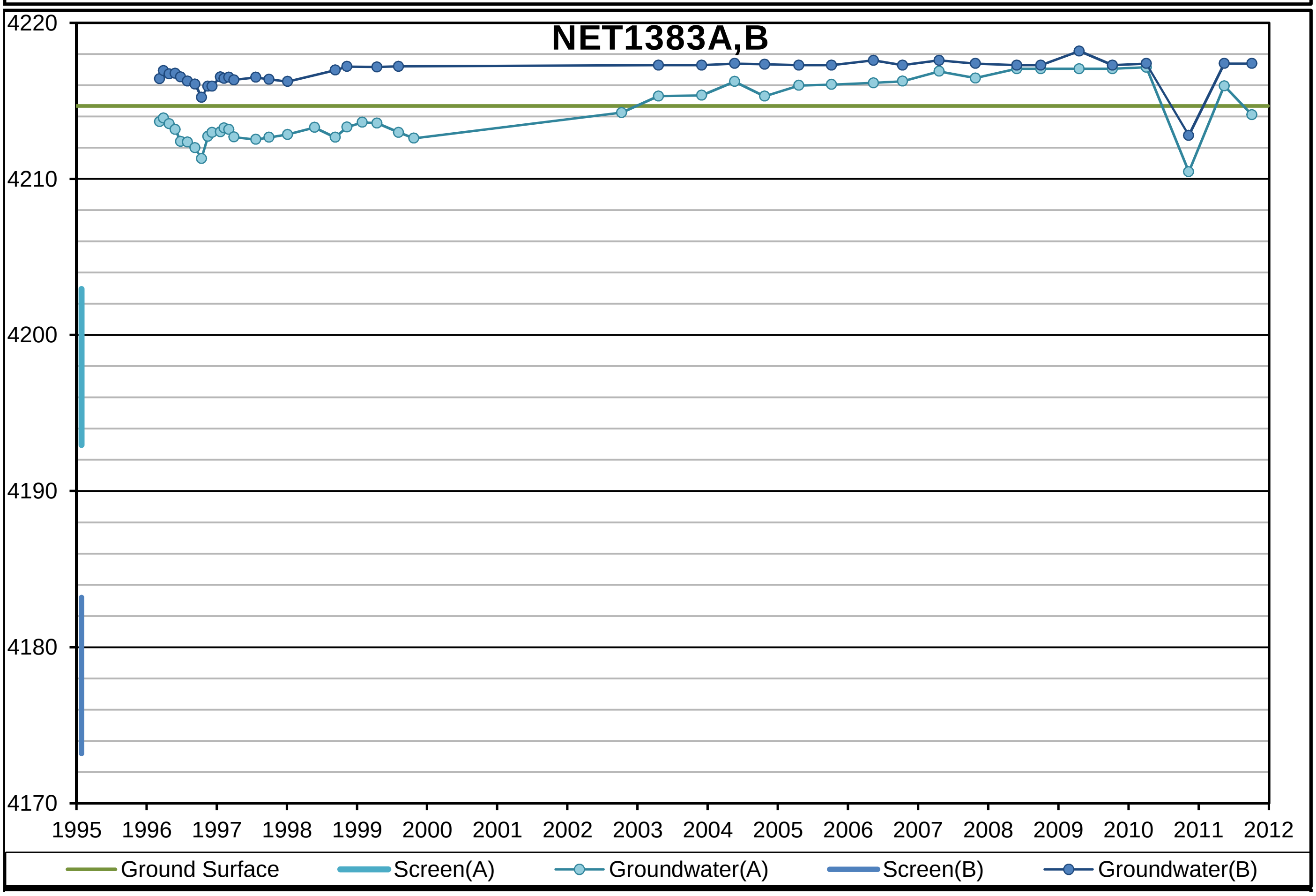
Hydrographs

Groundwater Elevations Versus Year



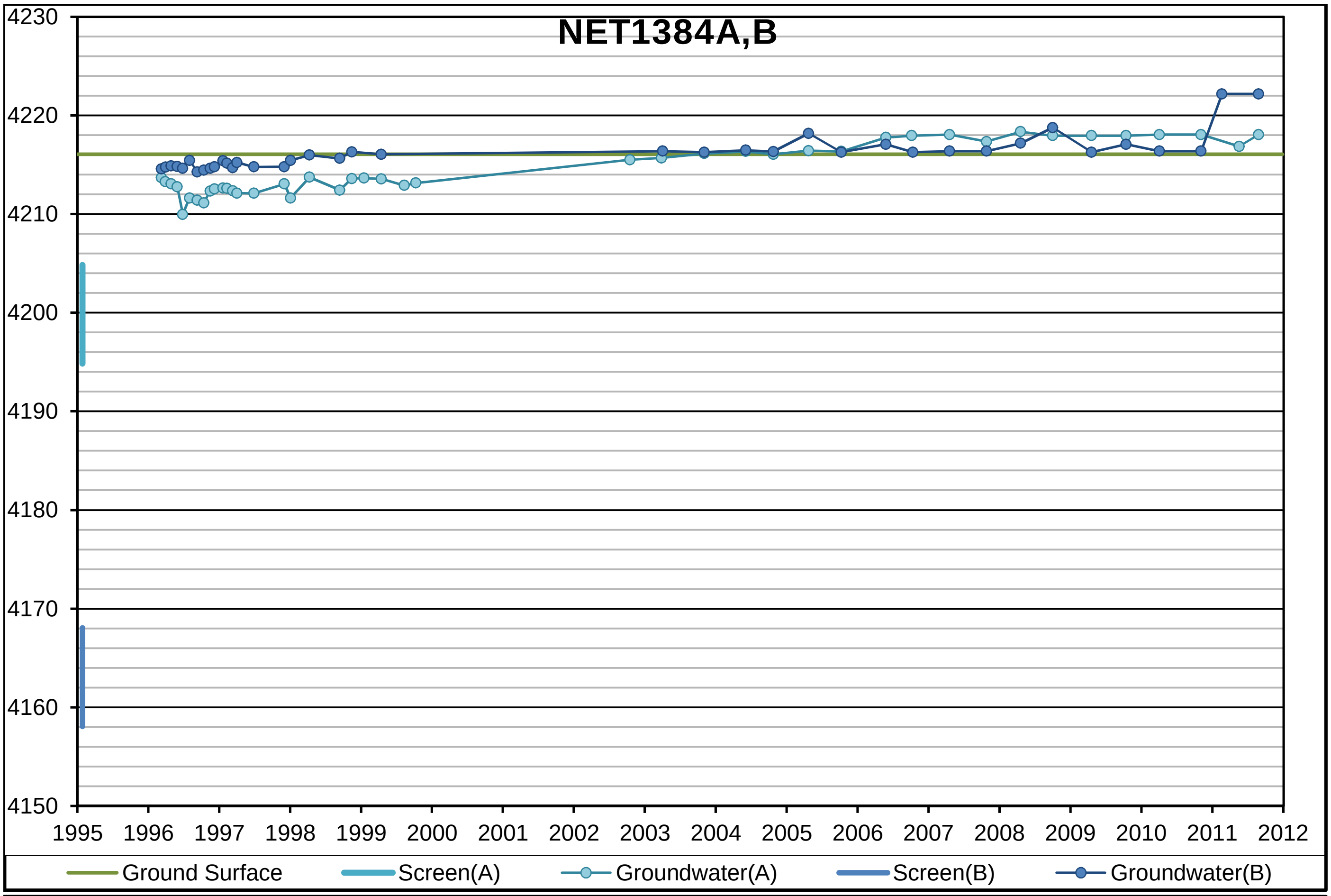


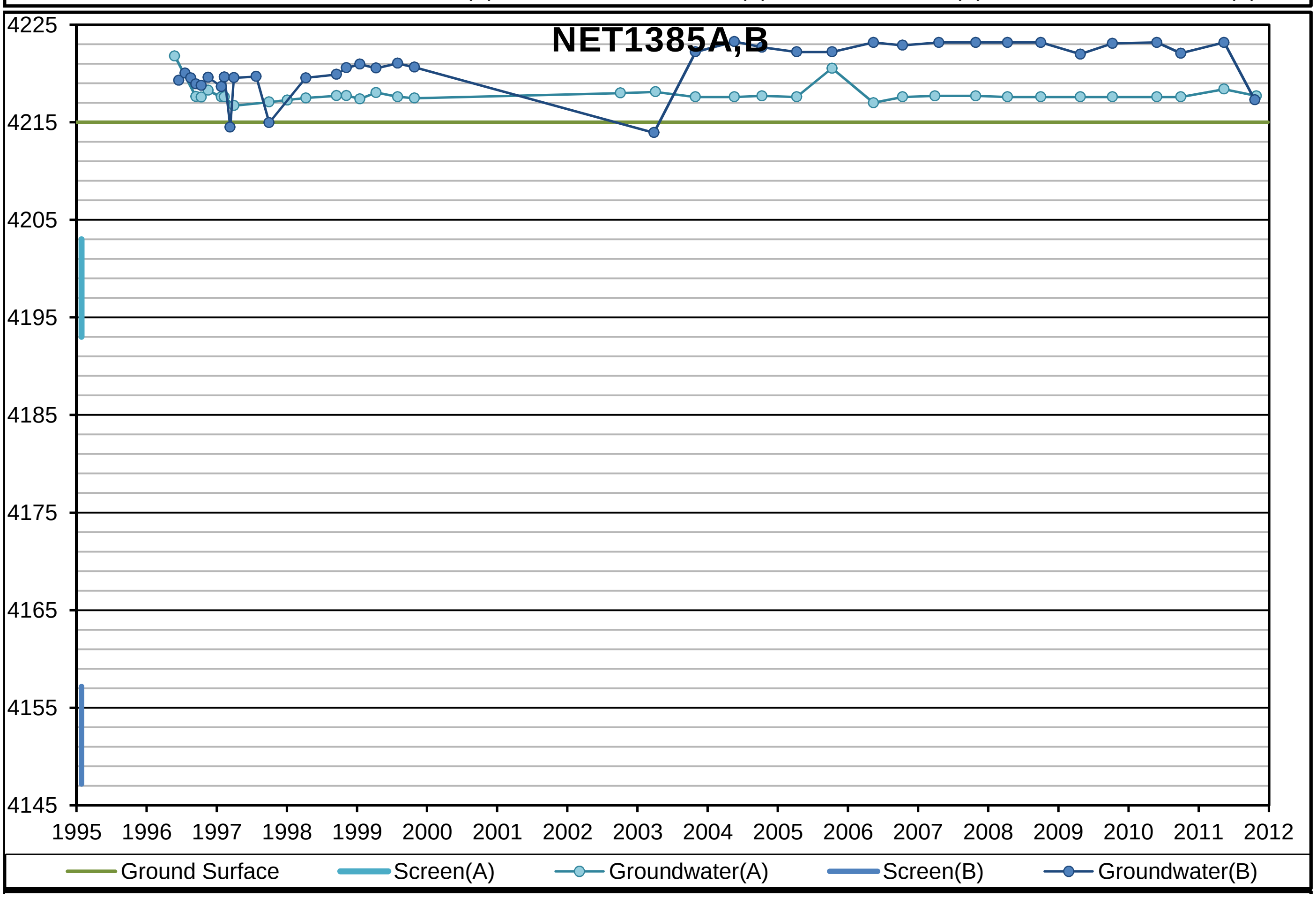

NET1381A,B
4235
4225
4215
4205
4195
4185
4175
4165
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Ground Surface
Screen(A)
Groundwater(A)
Screen(B)
Groundwater(B)


NET1383A,B
4220
4210
4200
4190
4180
4170
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Ground Surface
Screen(A)
Groundwater(A)
Screen(B)
Groundwater(B)

Hydrographs

Groundwater Elevations Versus Year

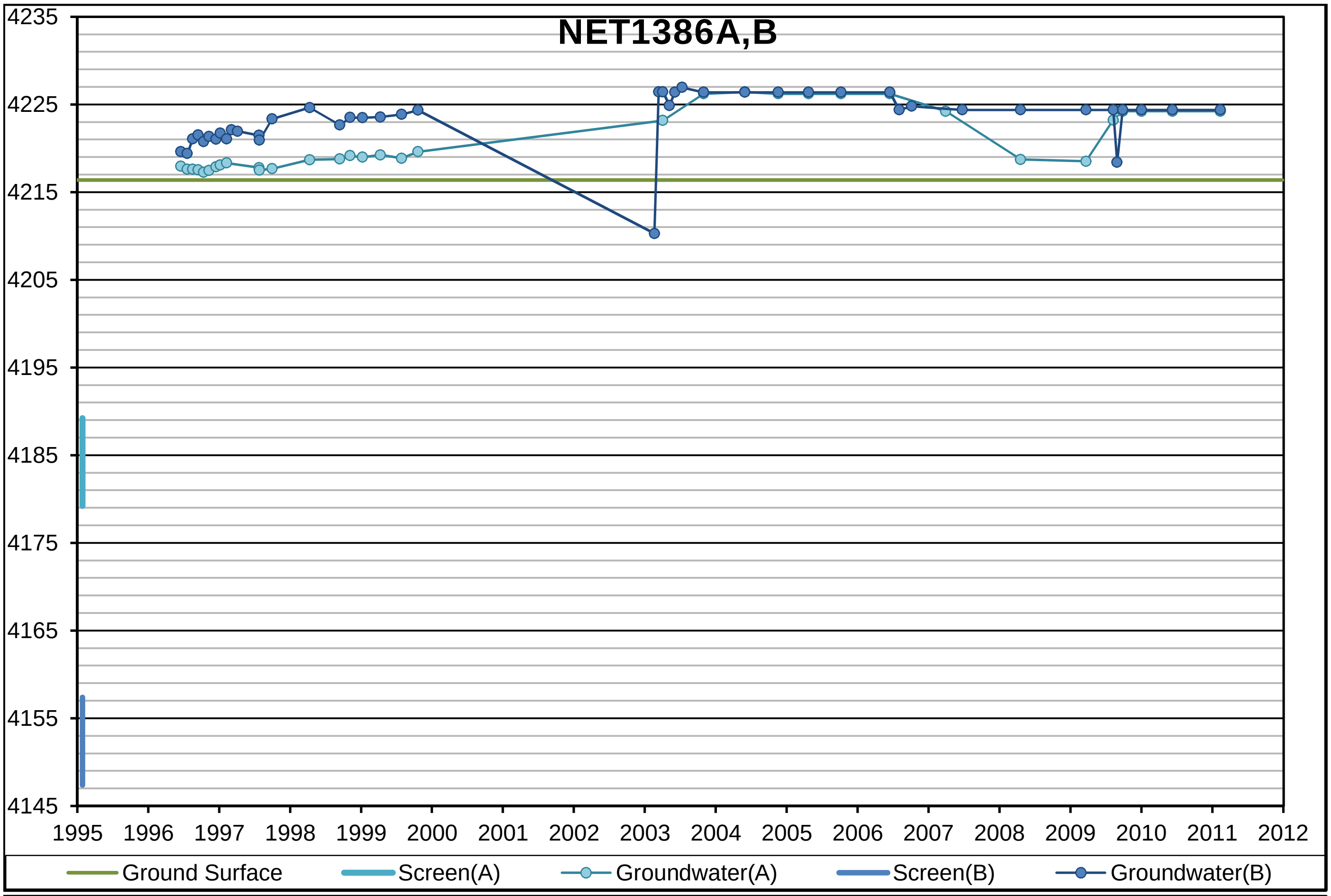


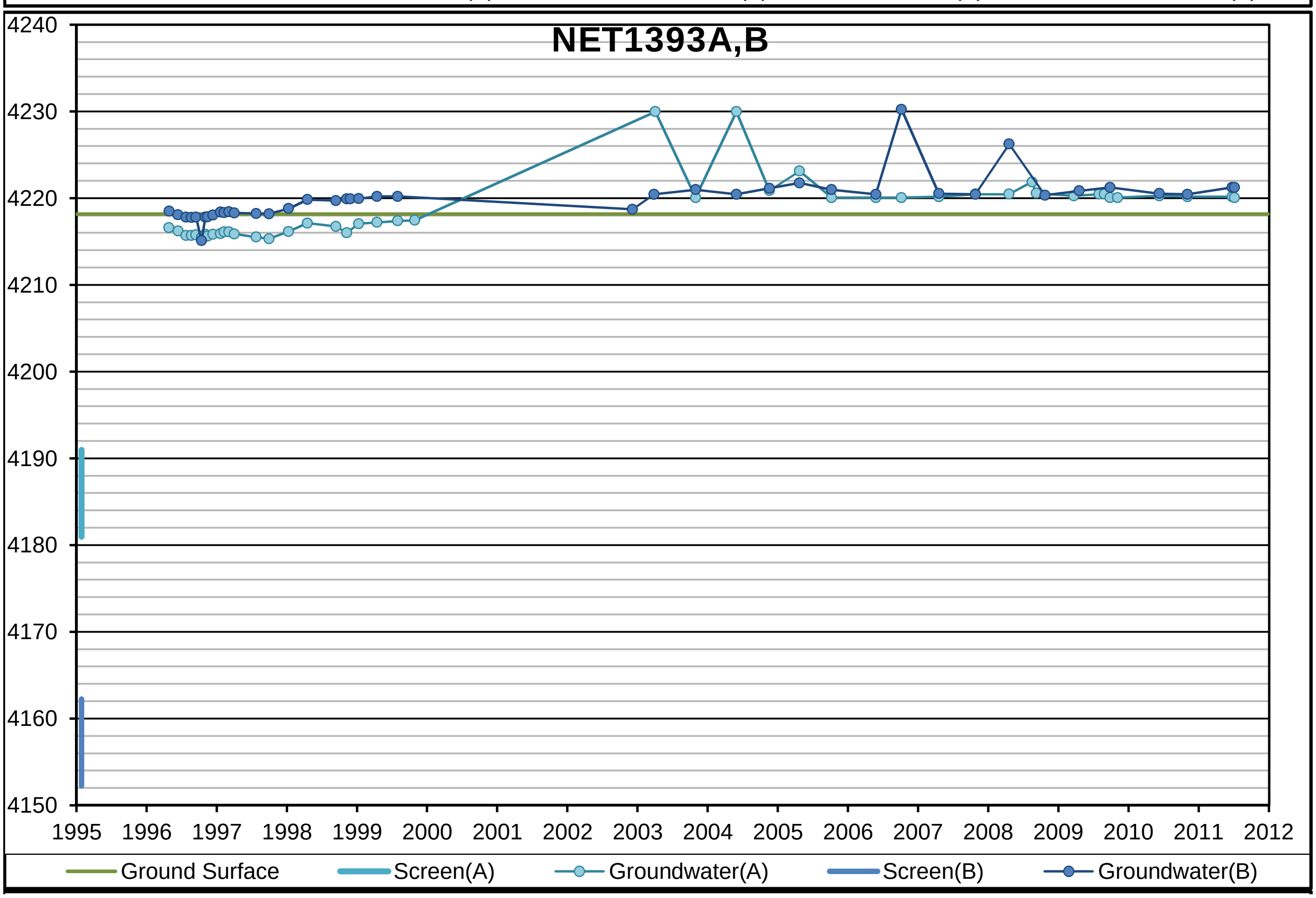


Groundwater elevations are presented in feet above mean sea level

Hydrographs

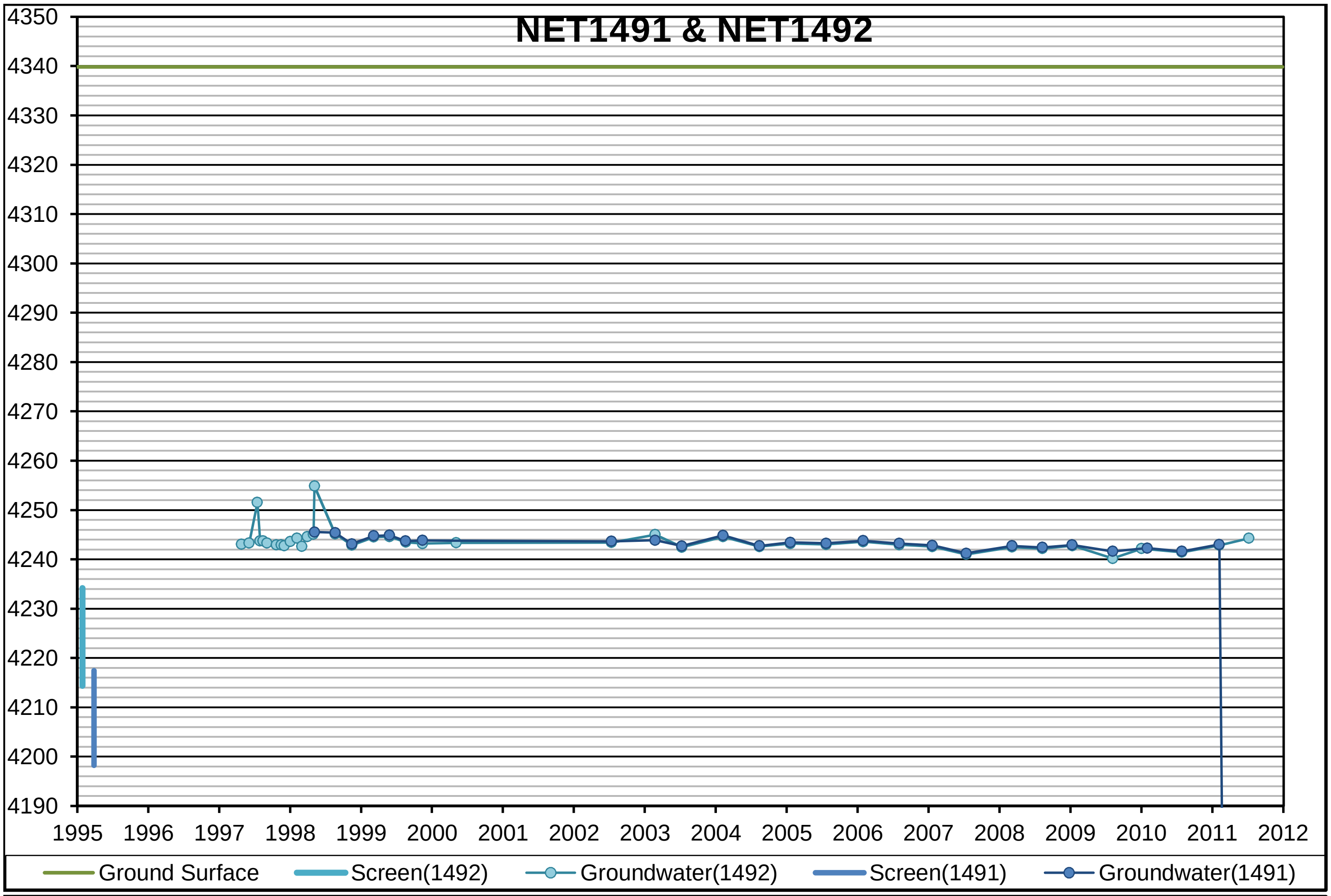
Groundwater Elevations Versus Year

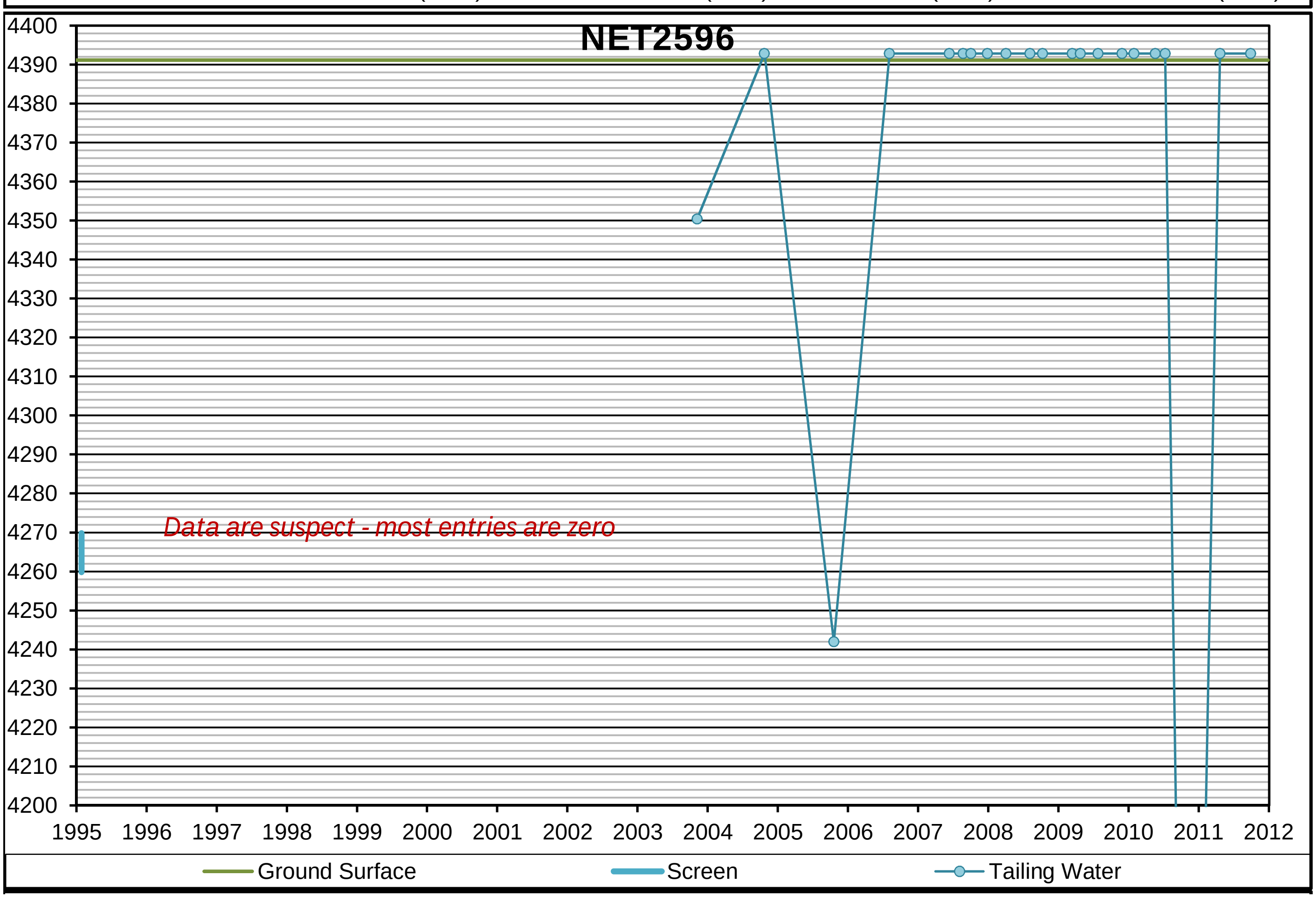




Hydrographs

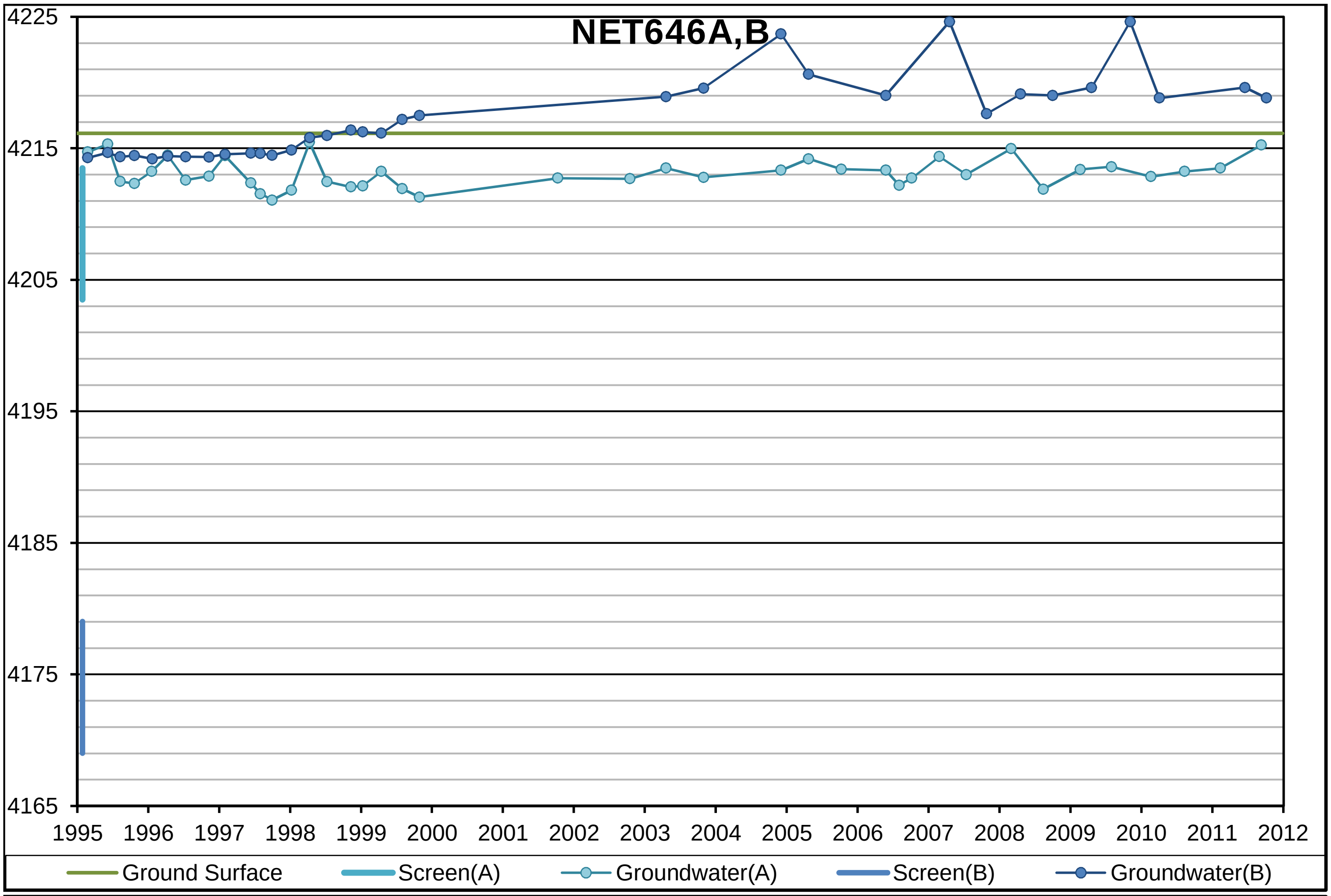
Groundwater Elevations Versus Year

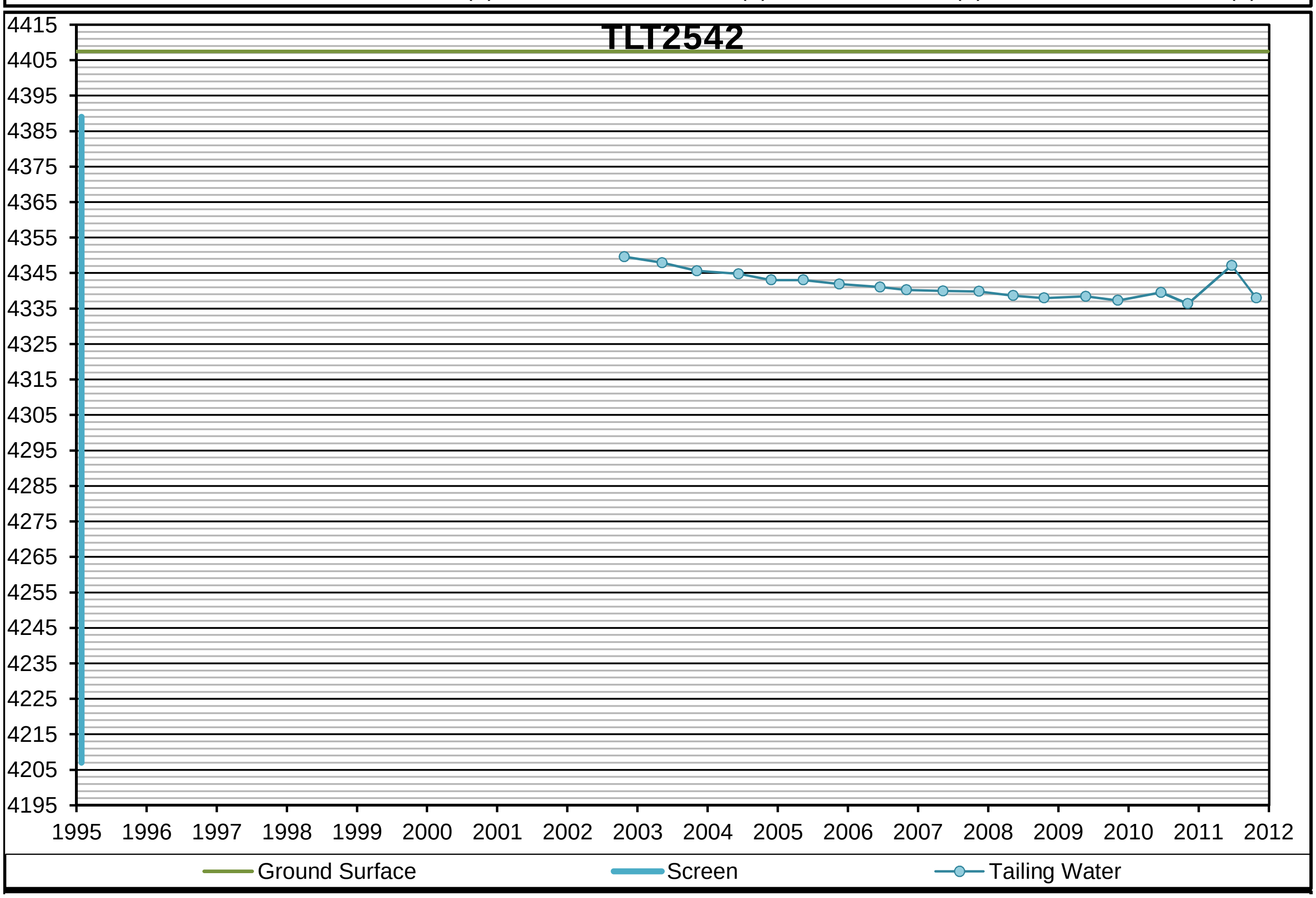




Hydrographs

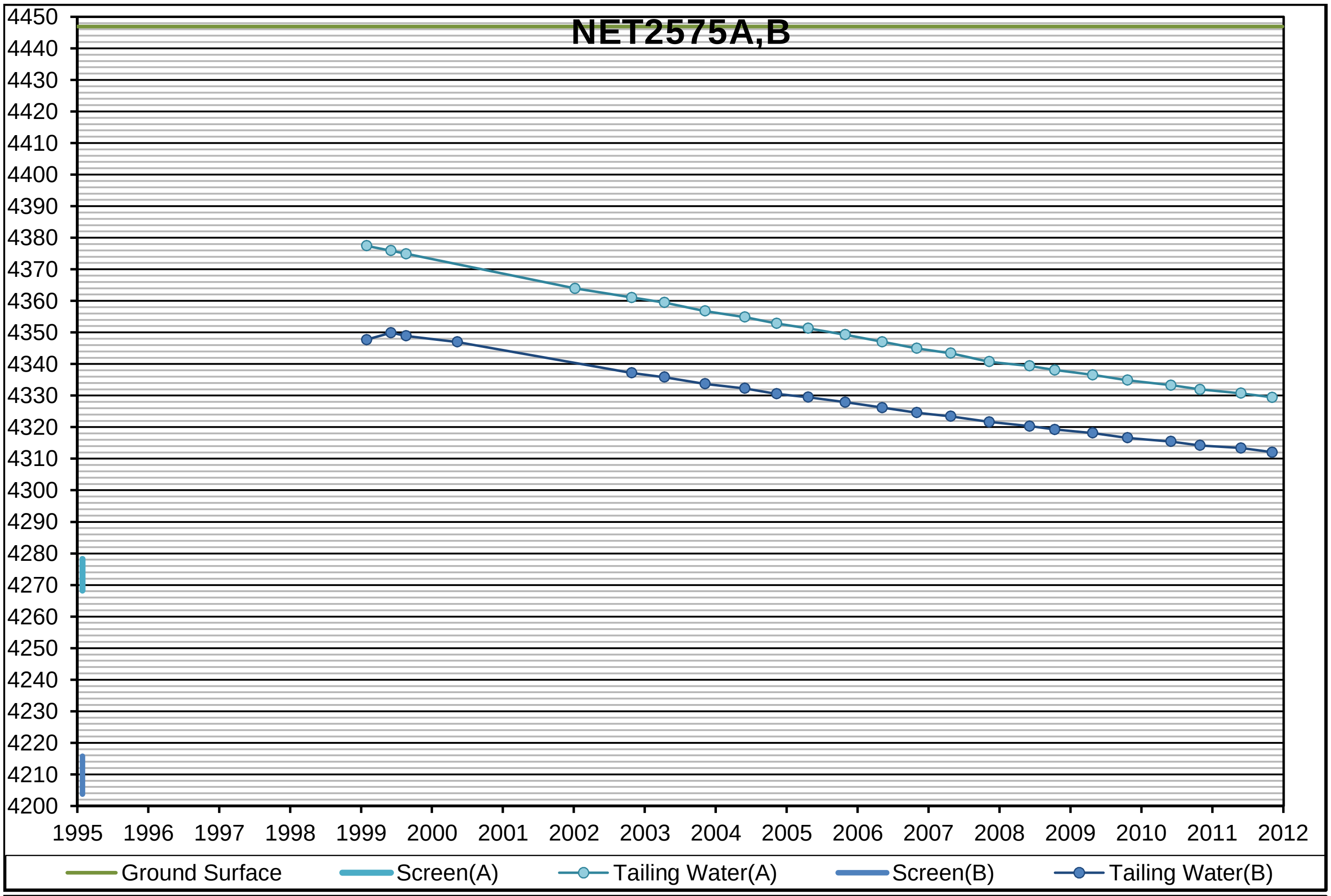
Groundwater Elevations Versus Year

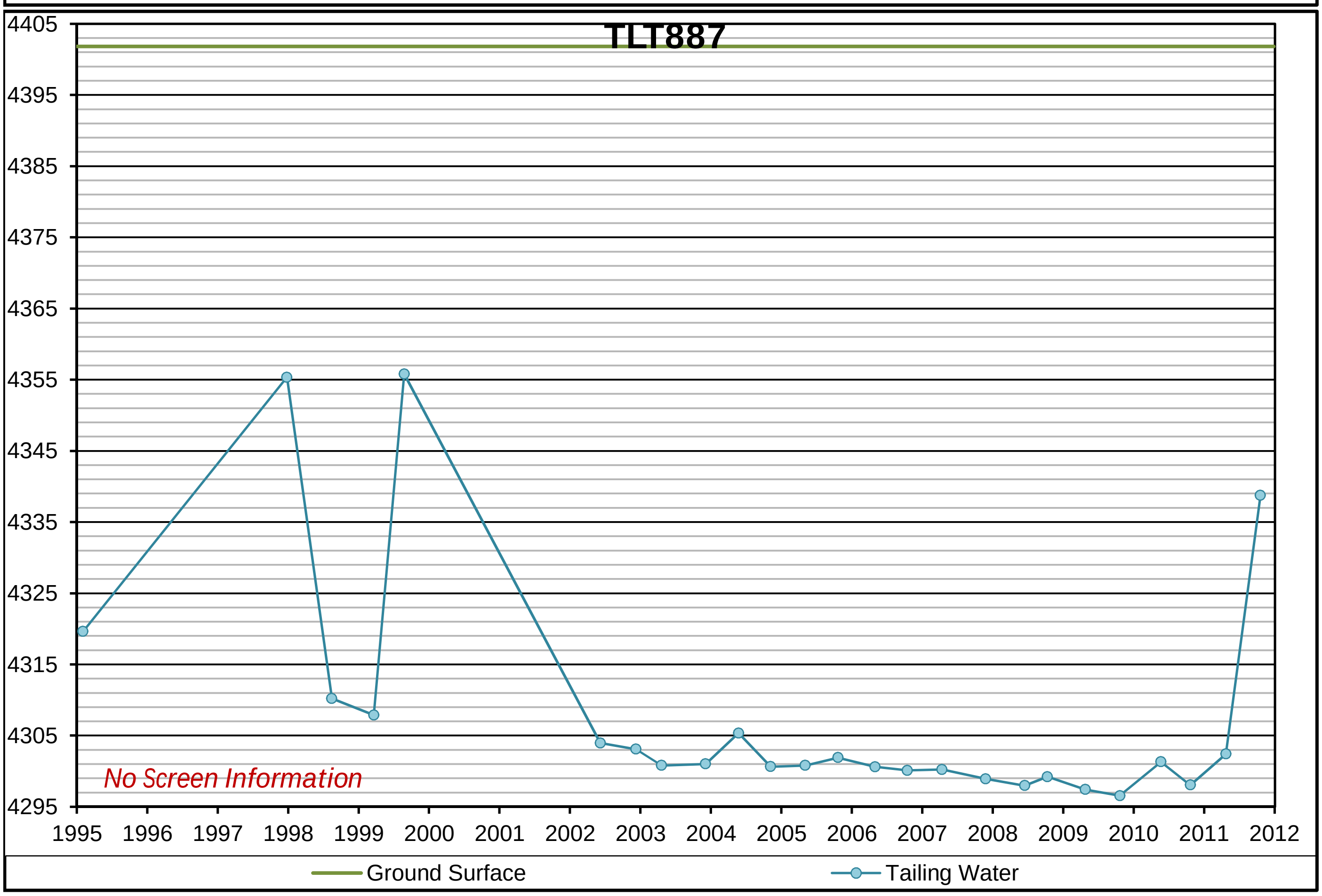




Hydrographs

Groundwater Elevations Versus Year





Appendix B

Concentration versus Time Graphs for Compliance Parameters in Permit Wells (1995 through 2011)

Appendix B
Concentration versus Time Graphs for Compliance Parameters in Permit Wells (1995 through 2011)

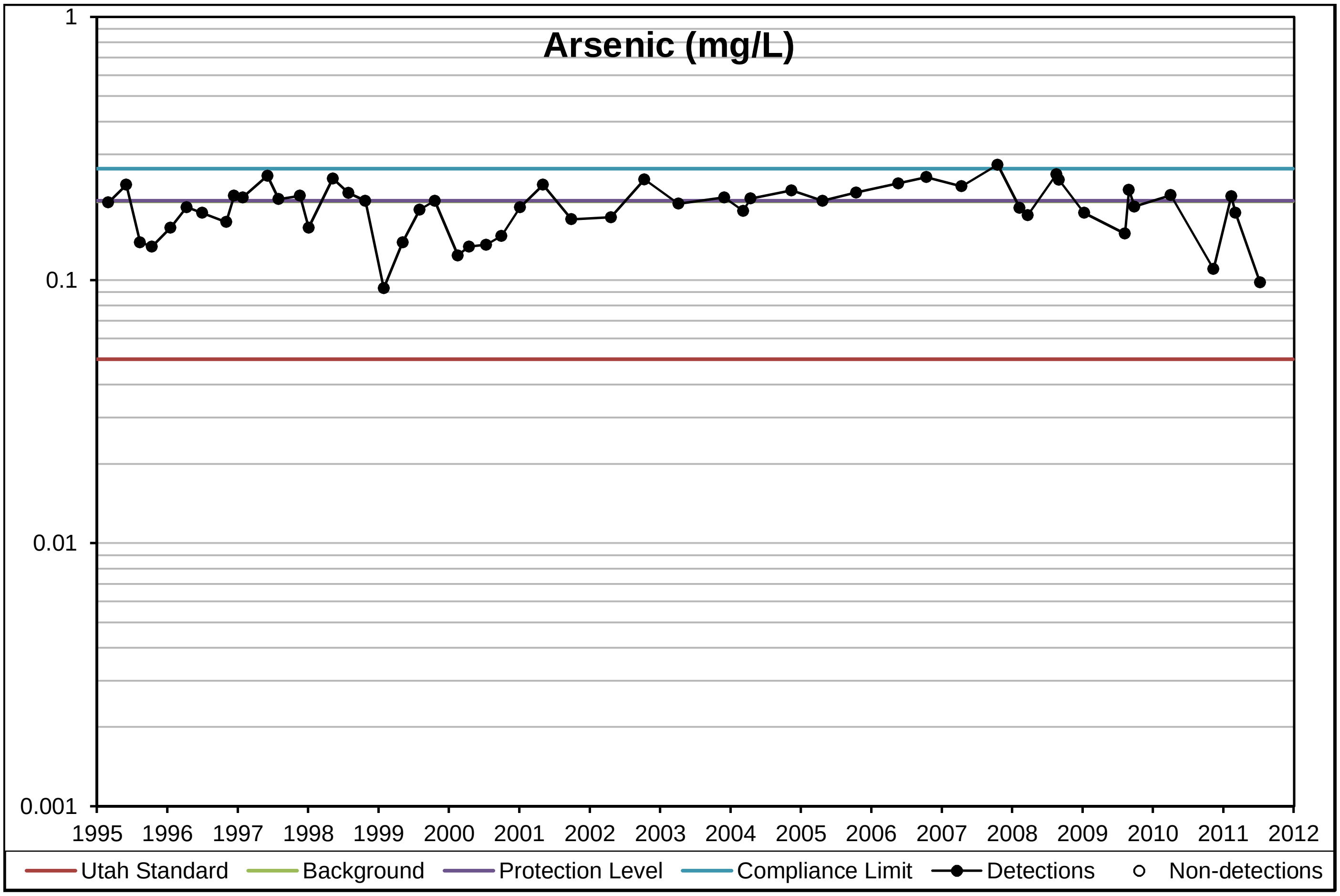
Sampled Compliance Wells

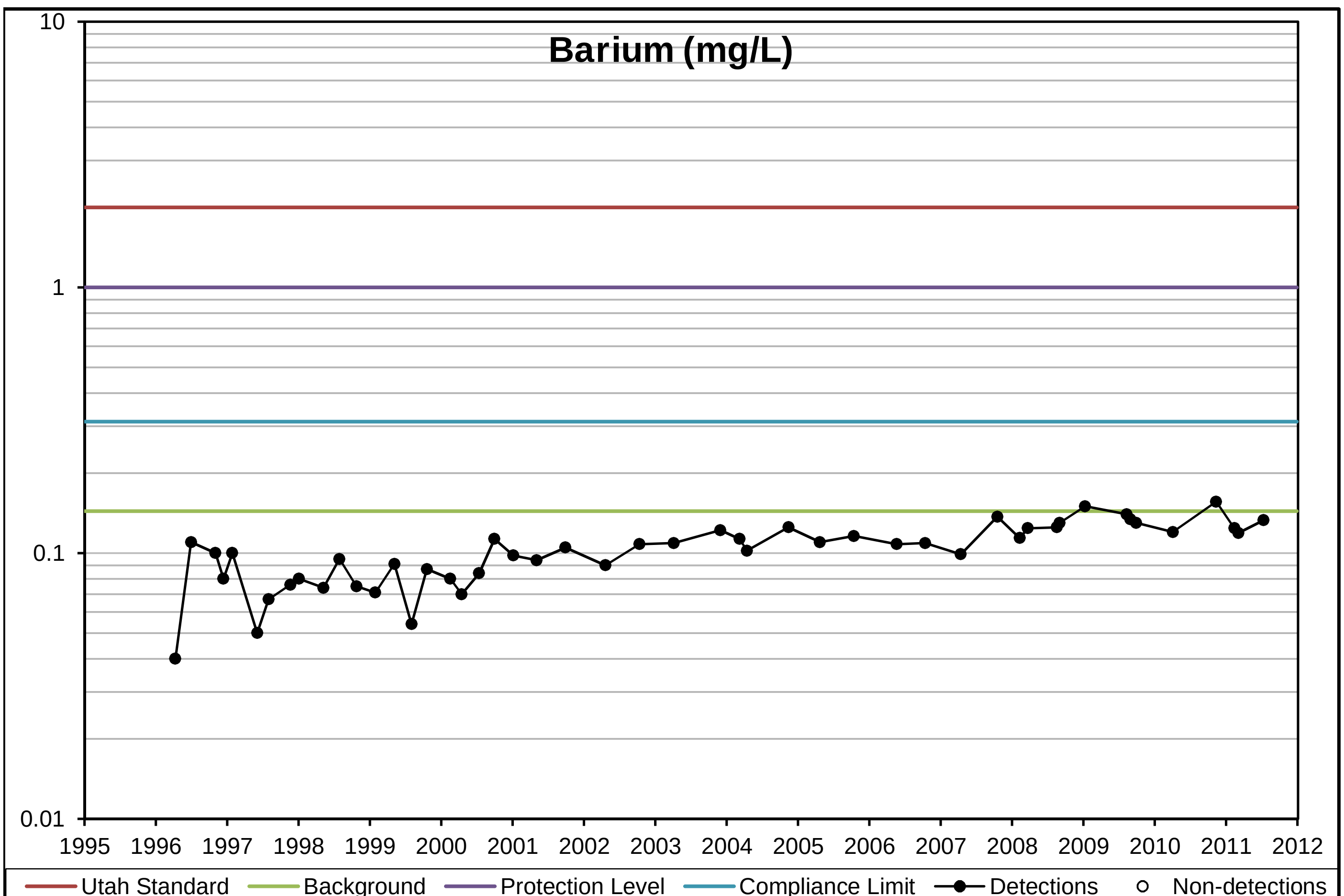
NEL532A
NEL532B
NEL536A
NEL536B
NED604A
NED604B
NET646A
NET646B
NET1380A
NET1380B
NET1381A
NET1381B
NEL1382A
NEL1382B
NEL1382C
NET1383A
NET1383B
NET1384A
NET1384B
NET1385A
NET1385B
NET1386A
NET1386B
NEM1387
NET1393A
NET1393B
NET1490
NET1491
NET1492

Note: background concentrations and compliance and protection levels are established on a location specific basis; background concentrations were not established for constituents not detected

NEL532A

Concentration Versus Year



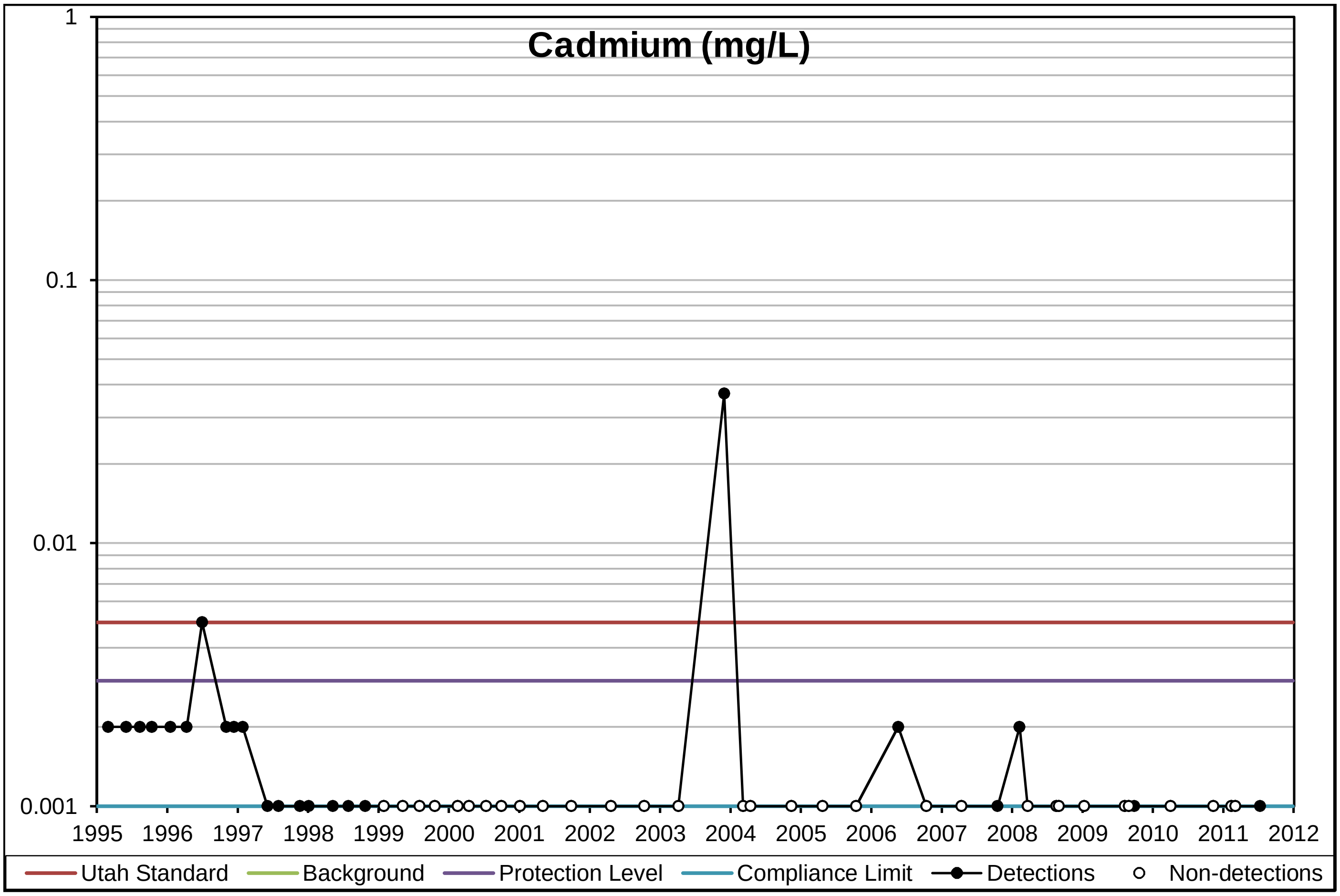


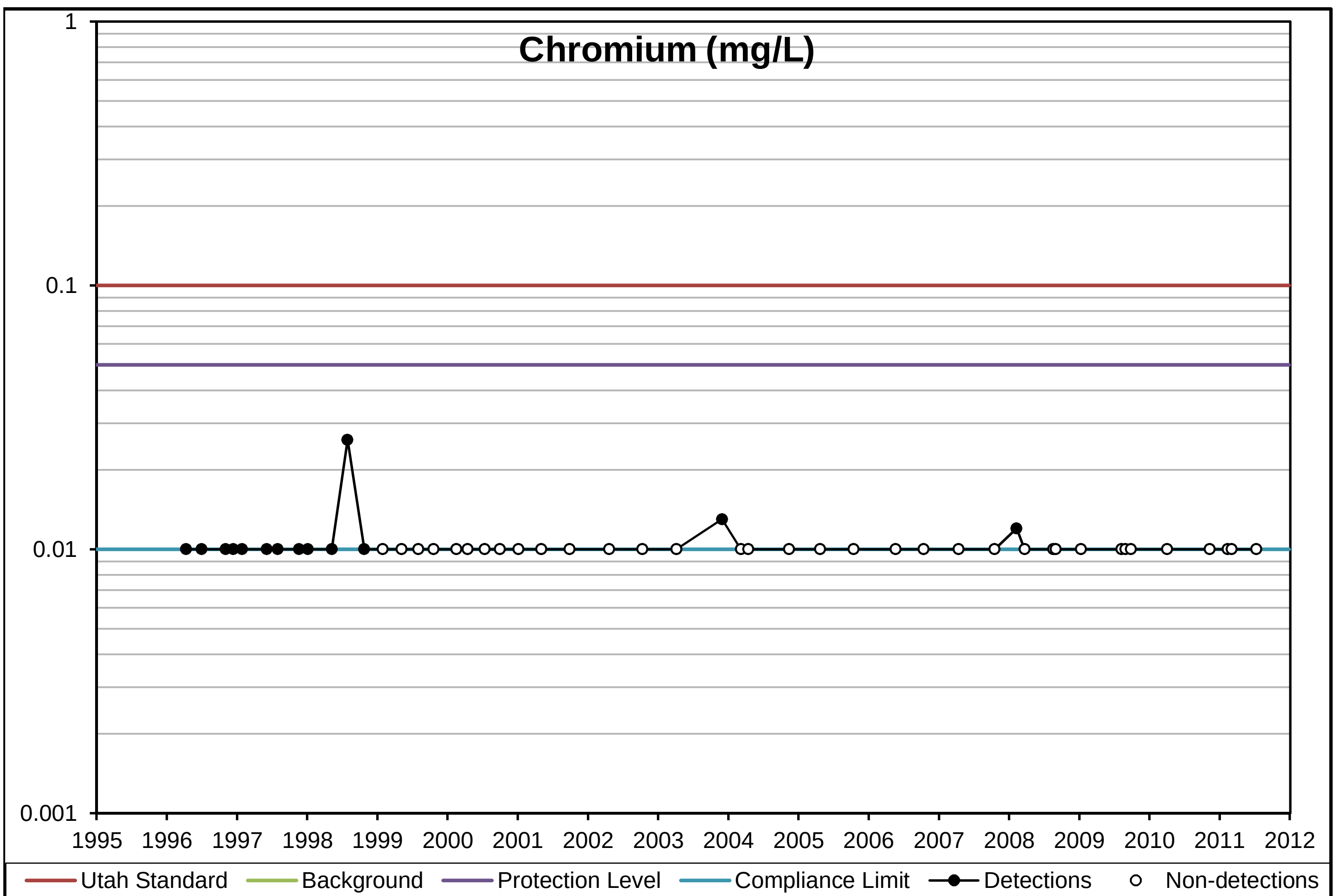
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532A

Concentration Versus Year

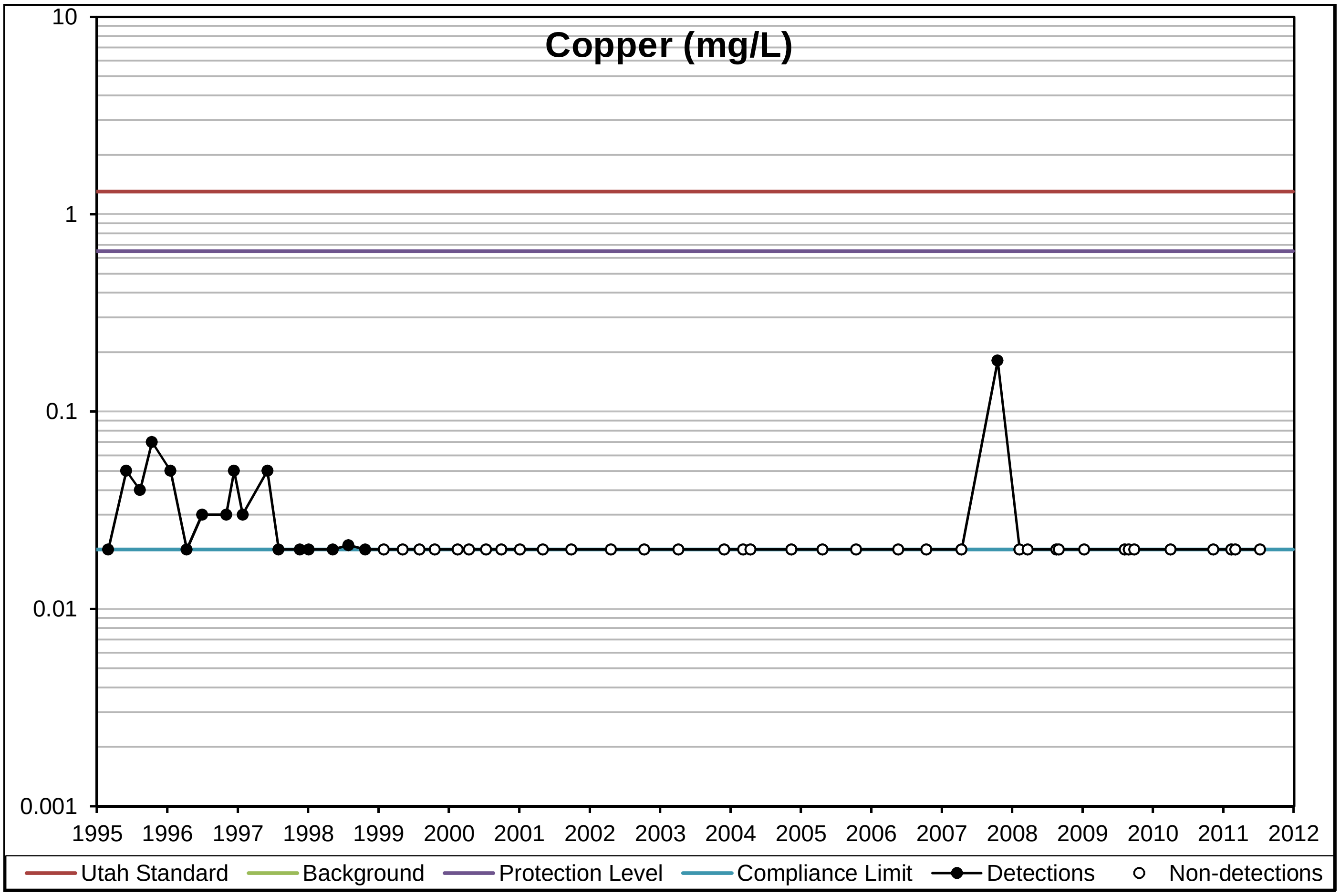


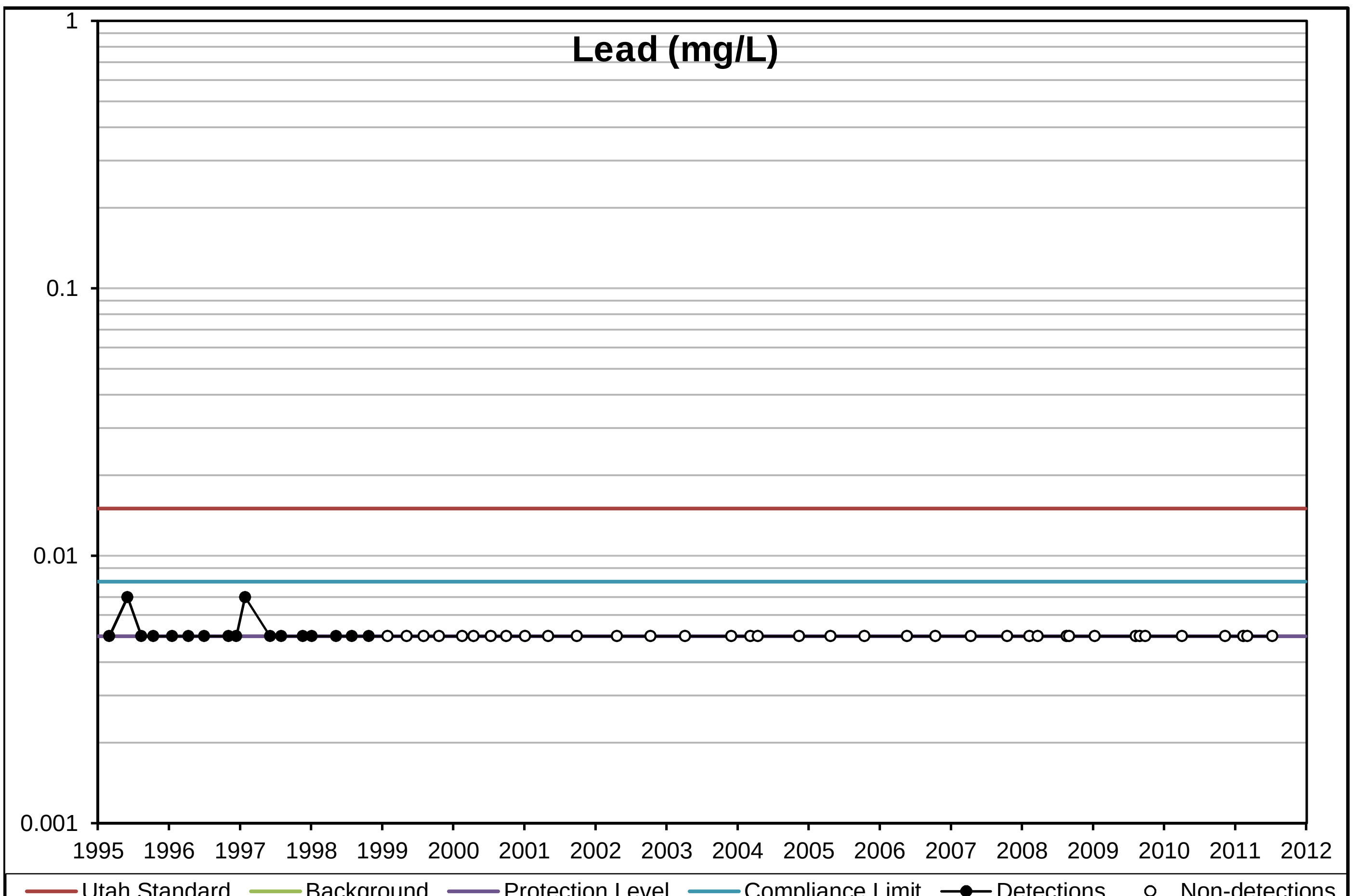


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL532A

Concentration Versus Year

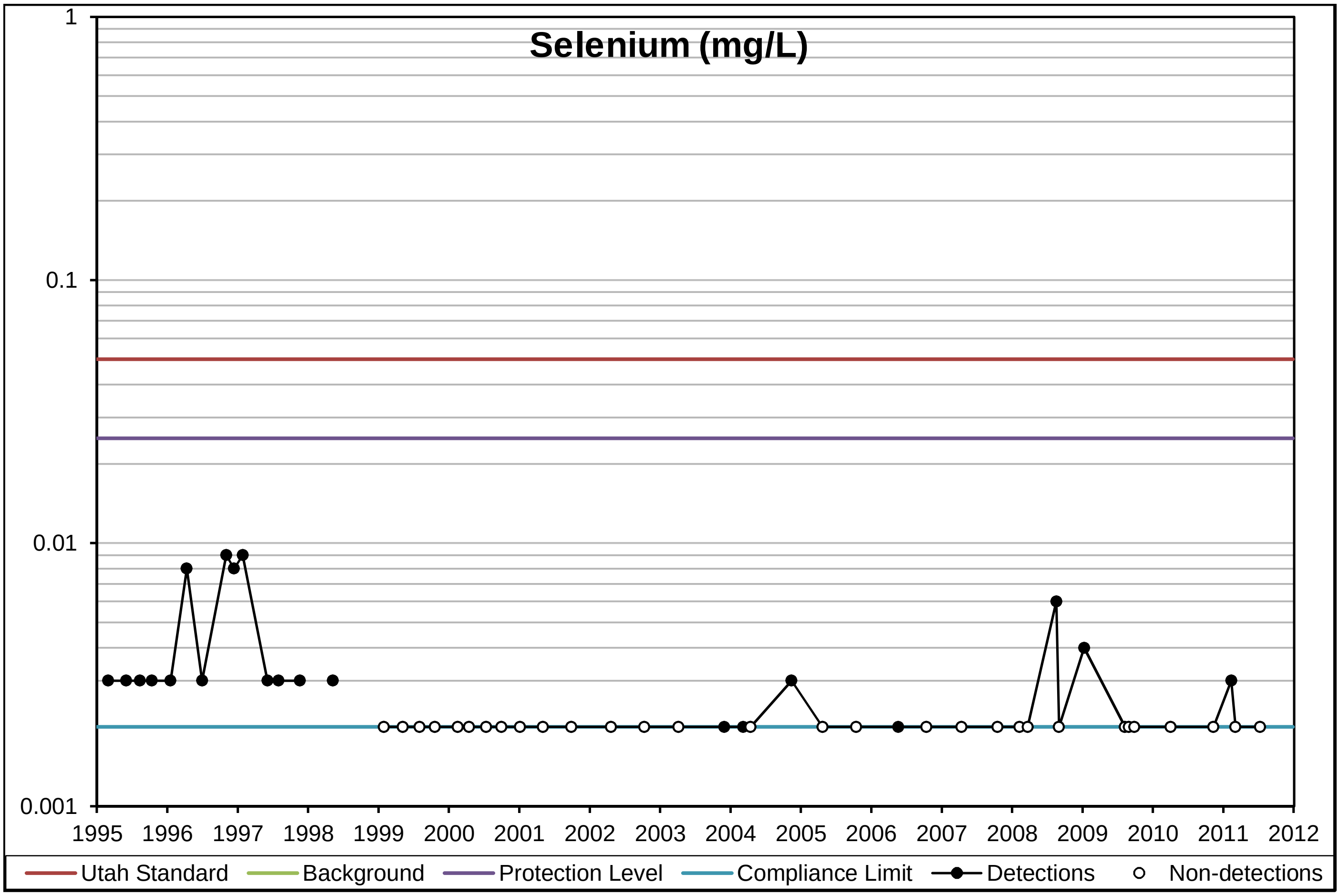


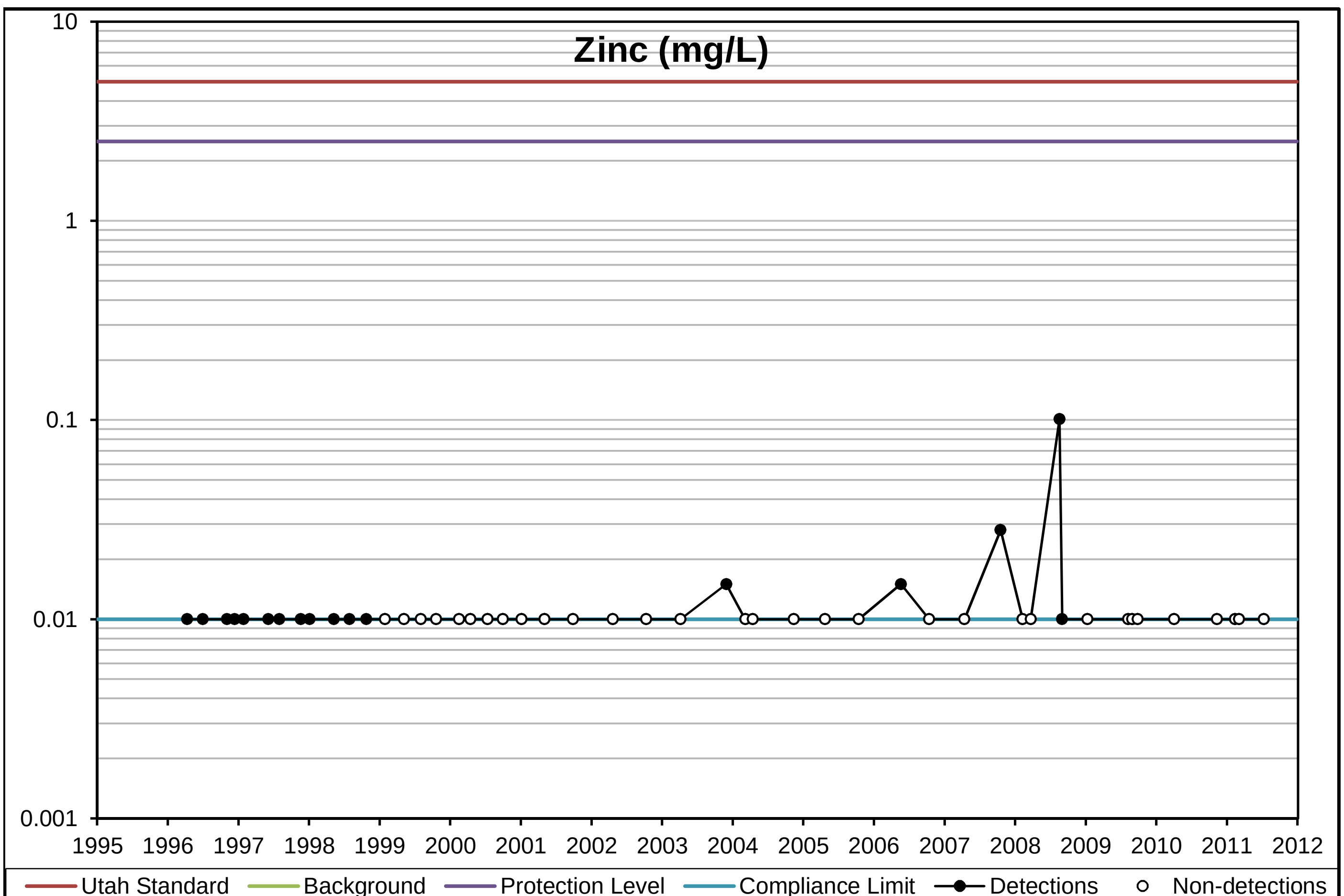


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL532A

Concentration Versus Year



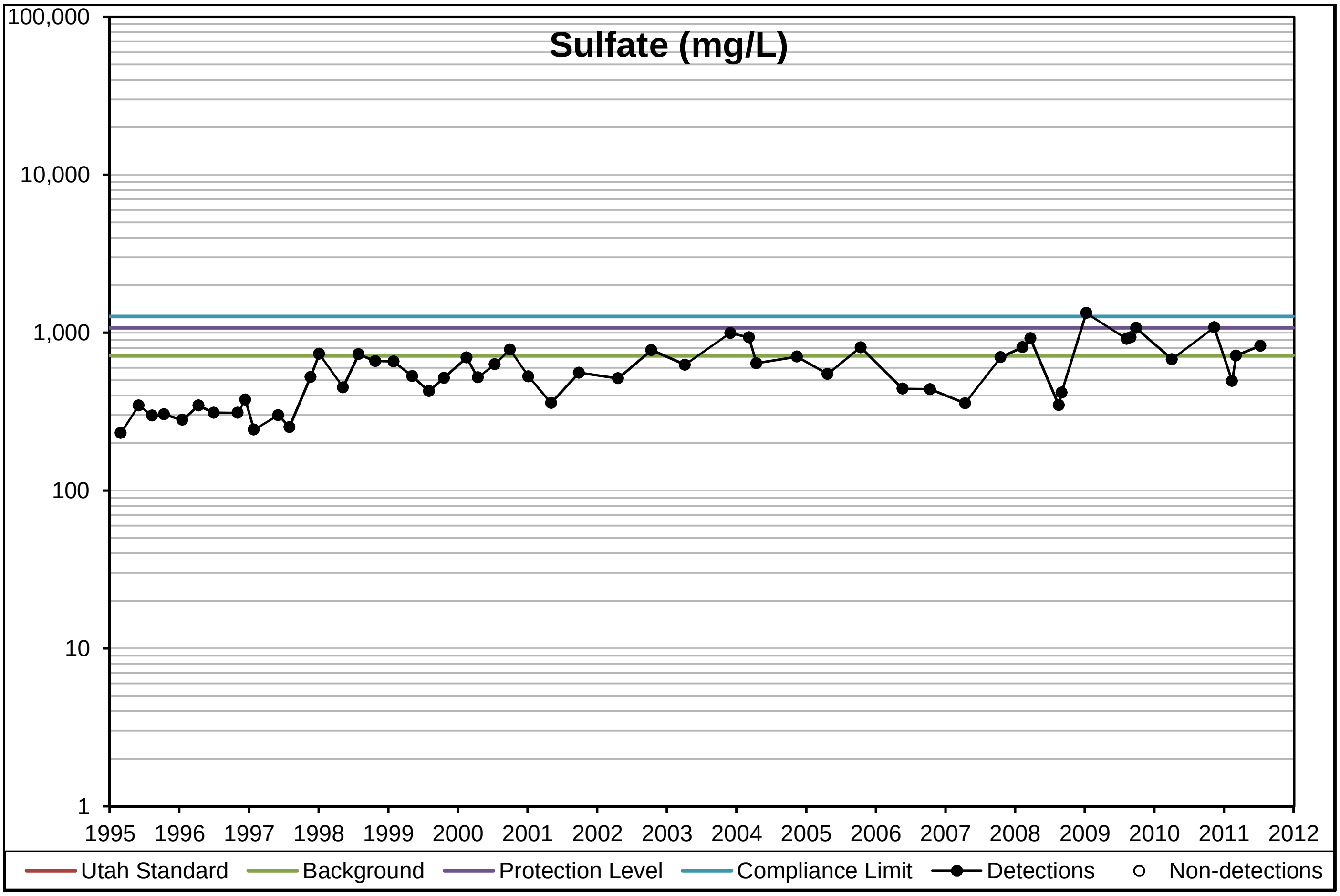


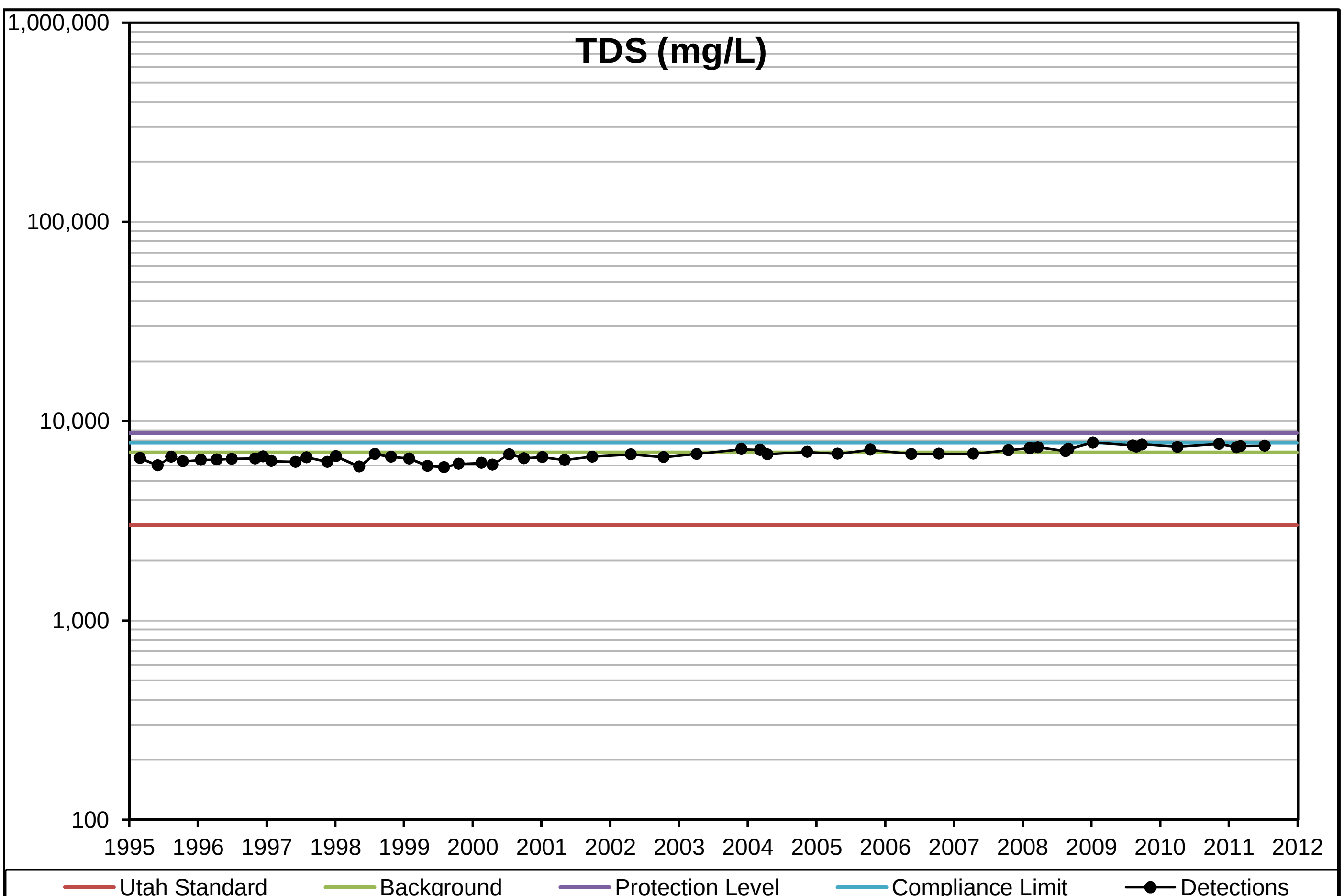
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532A

Concentration Versus Year



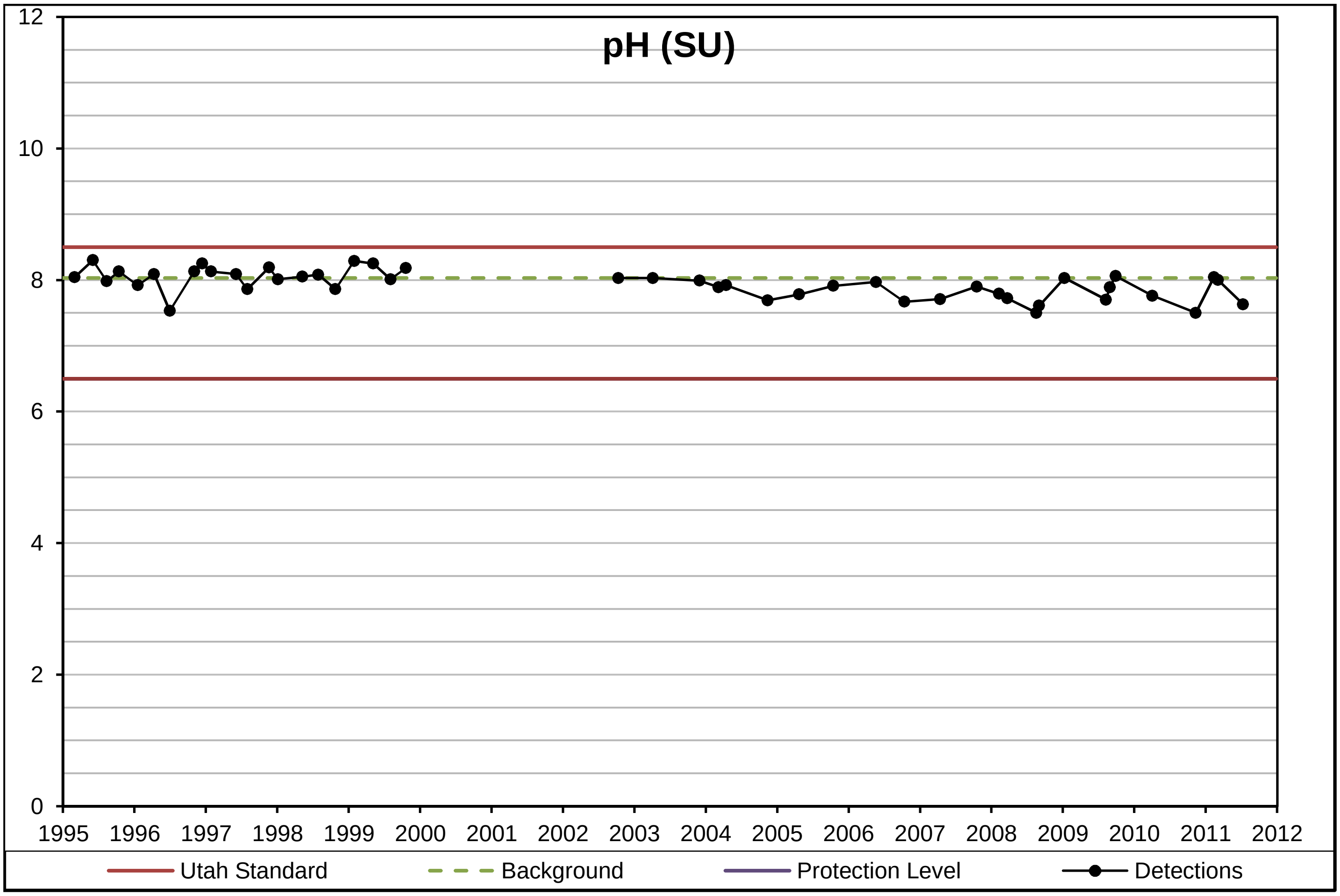


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532A

Concentration Versus Year

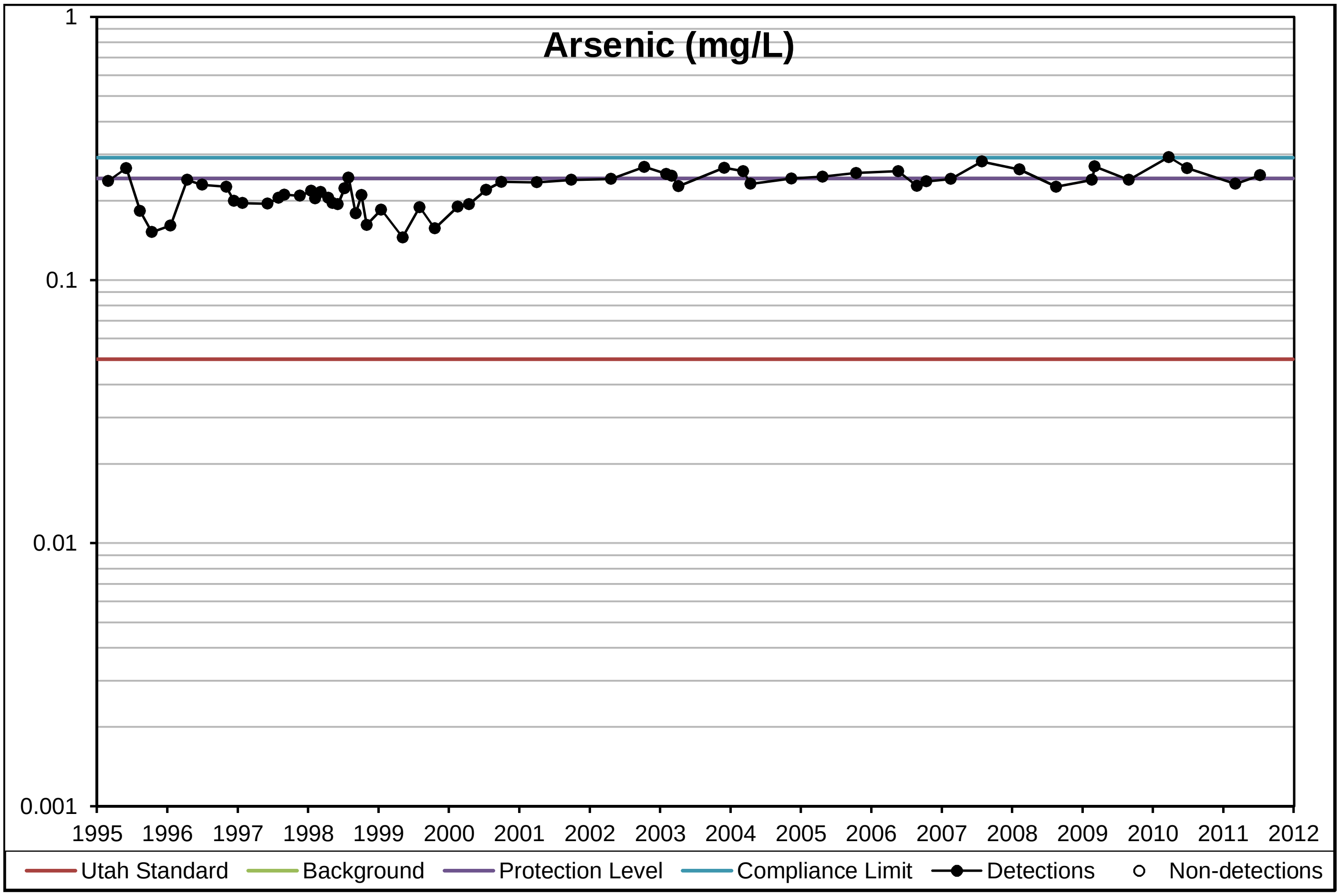


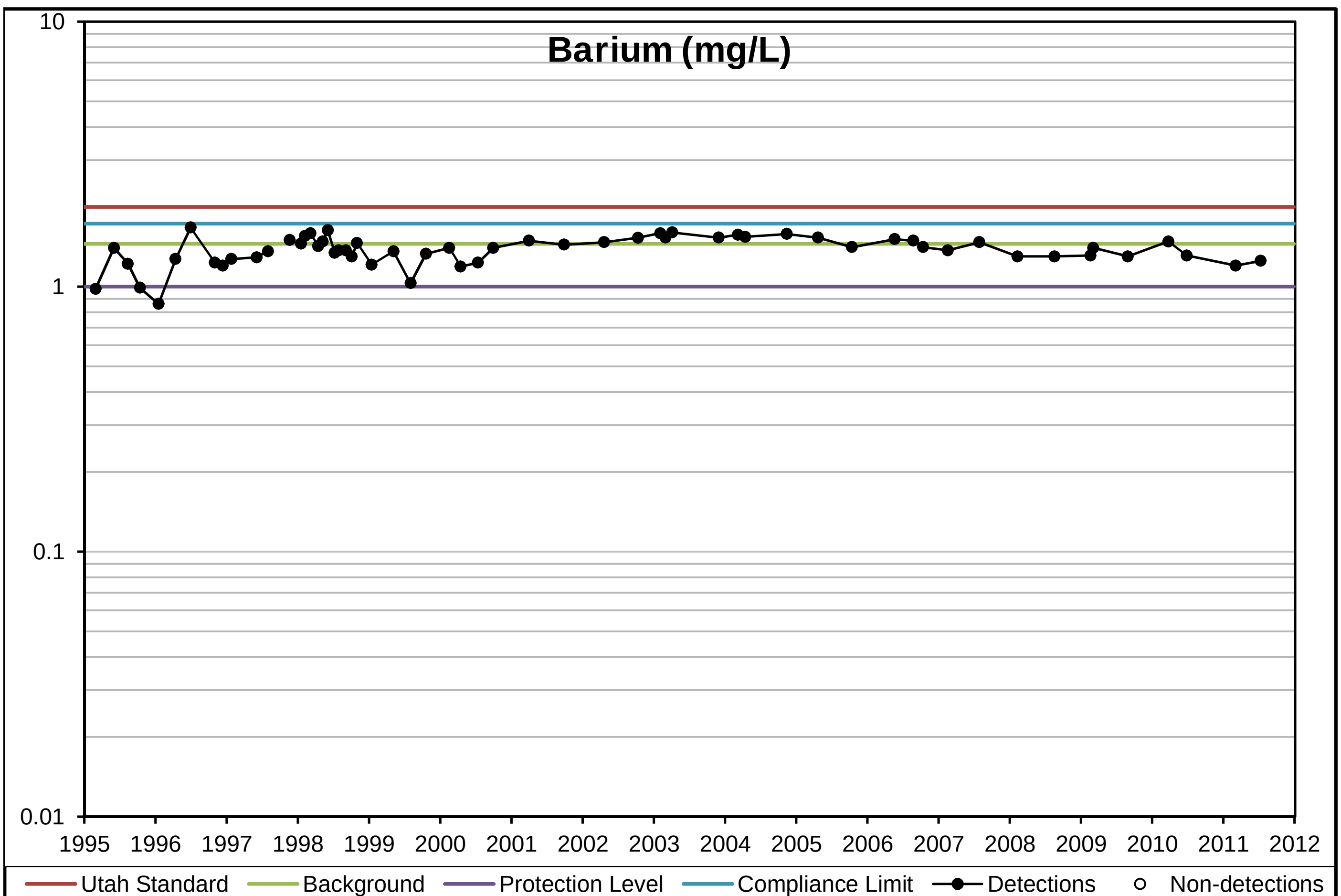
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

Concentration Versus Year



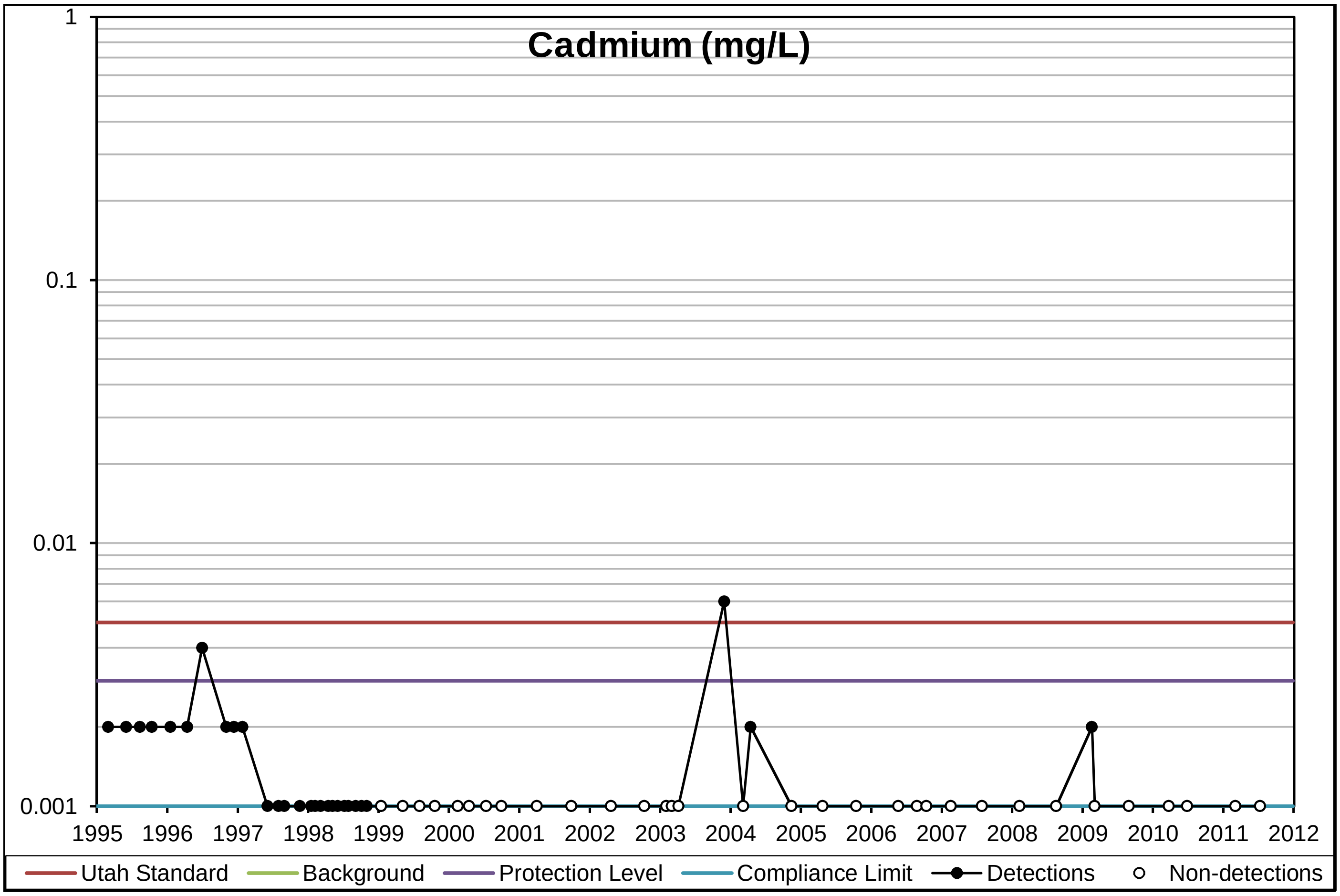


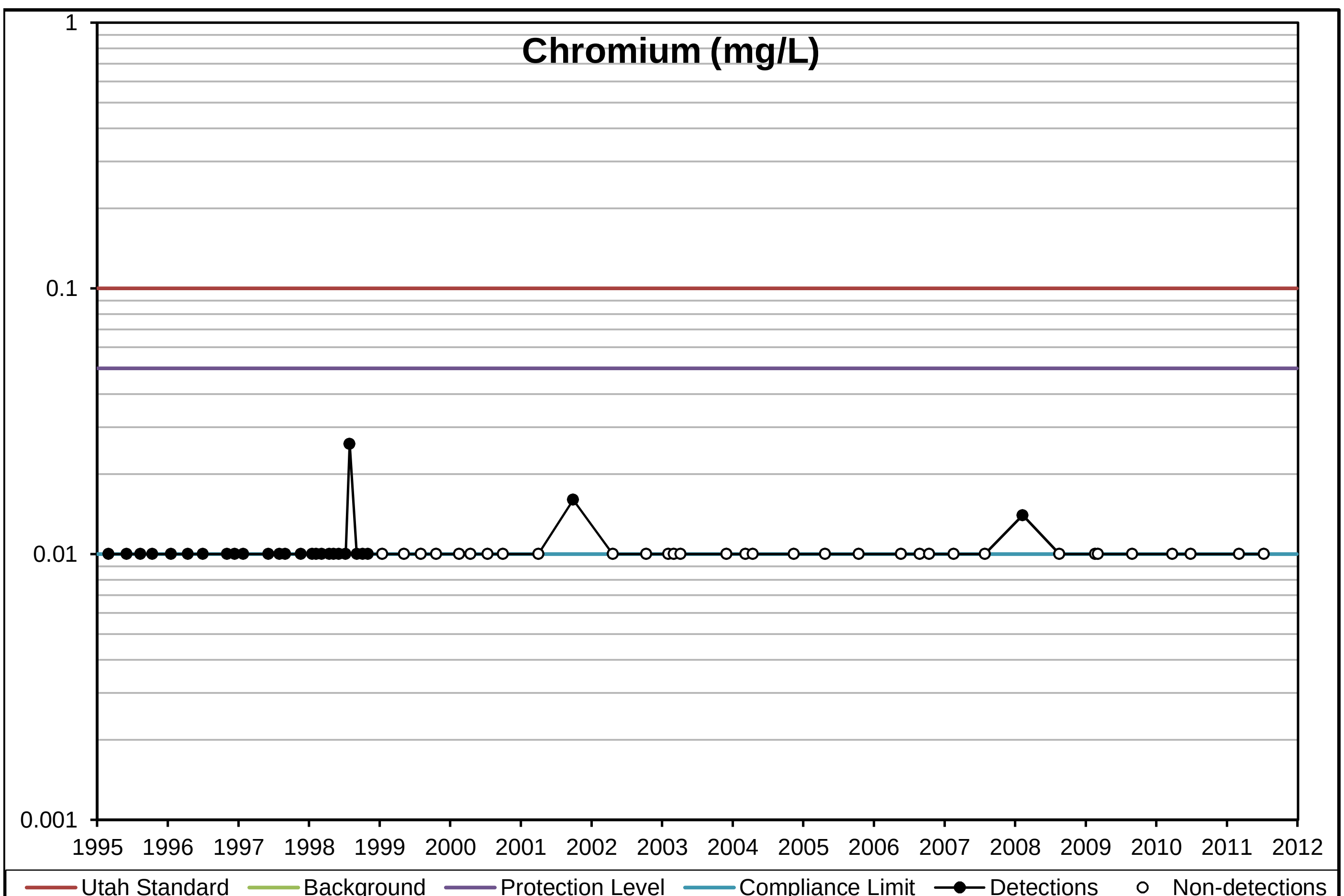
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

Concentration Versus Year



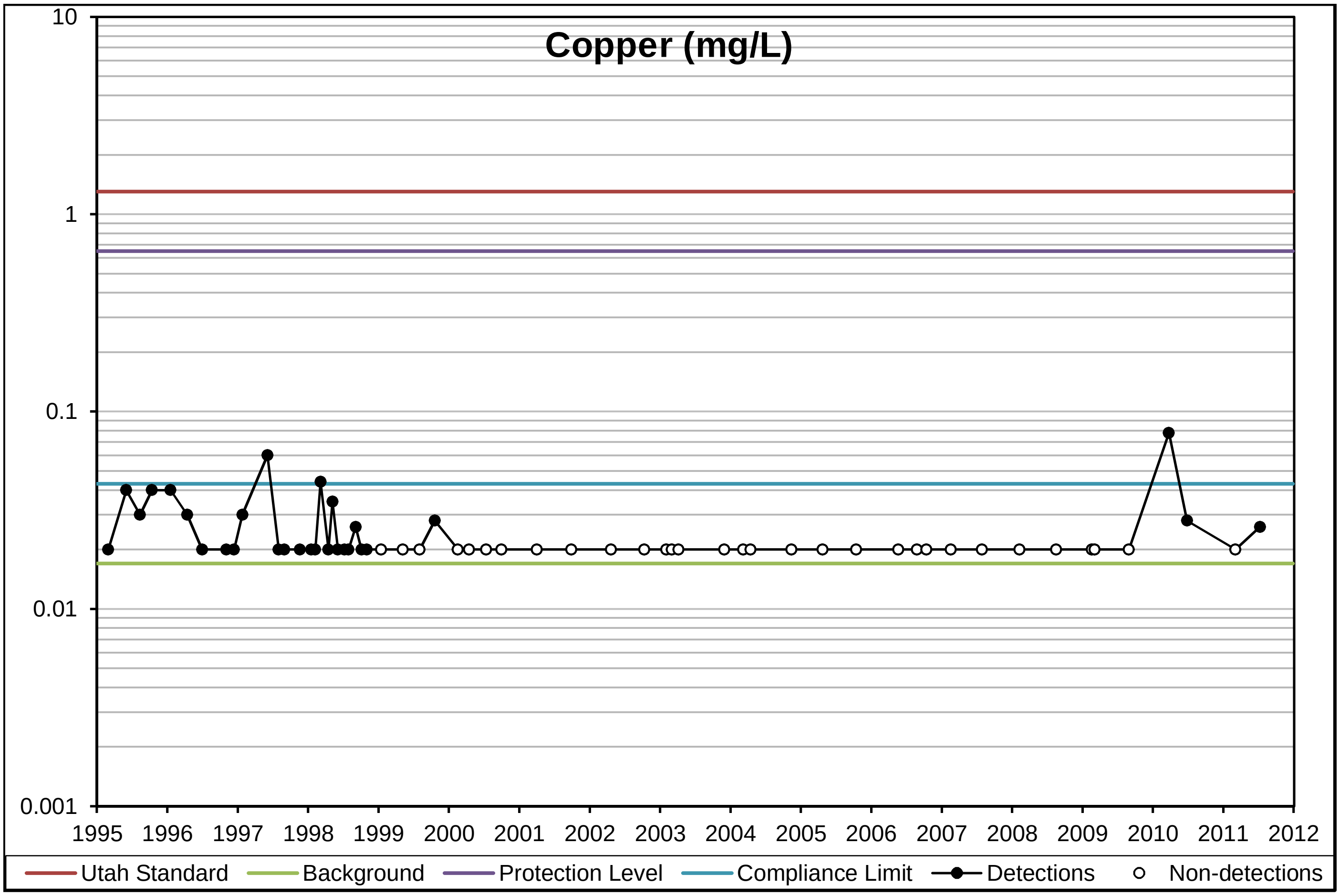


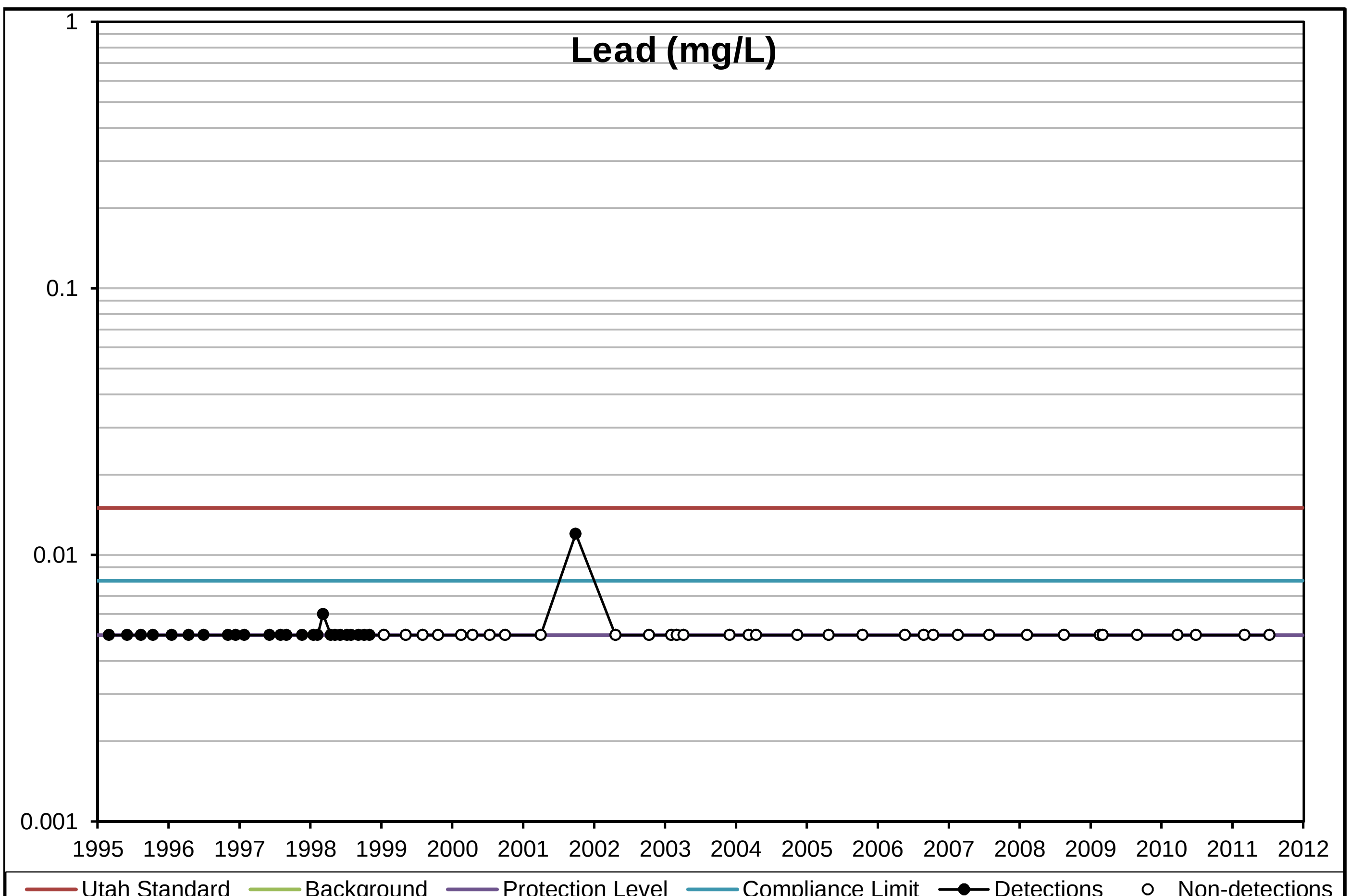
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

Concentration Versus Year



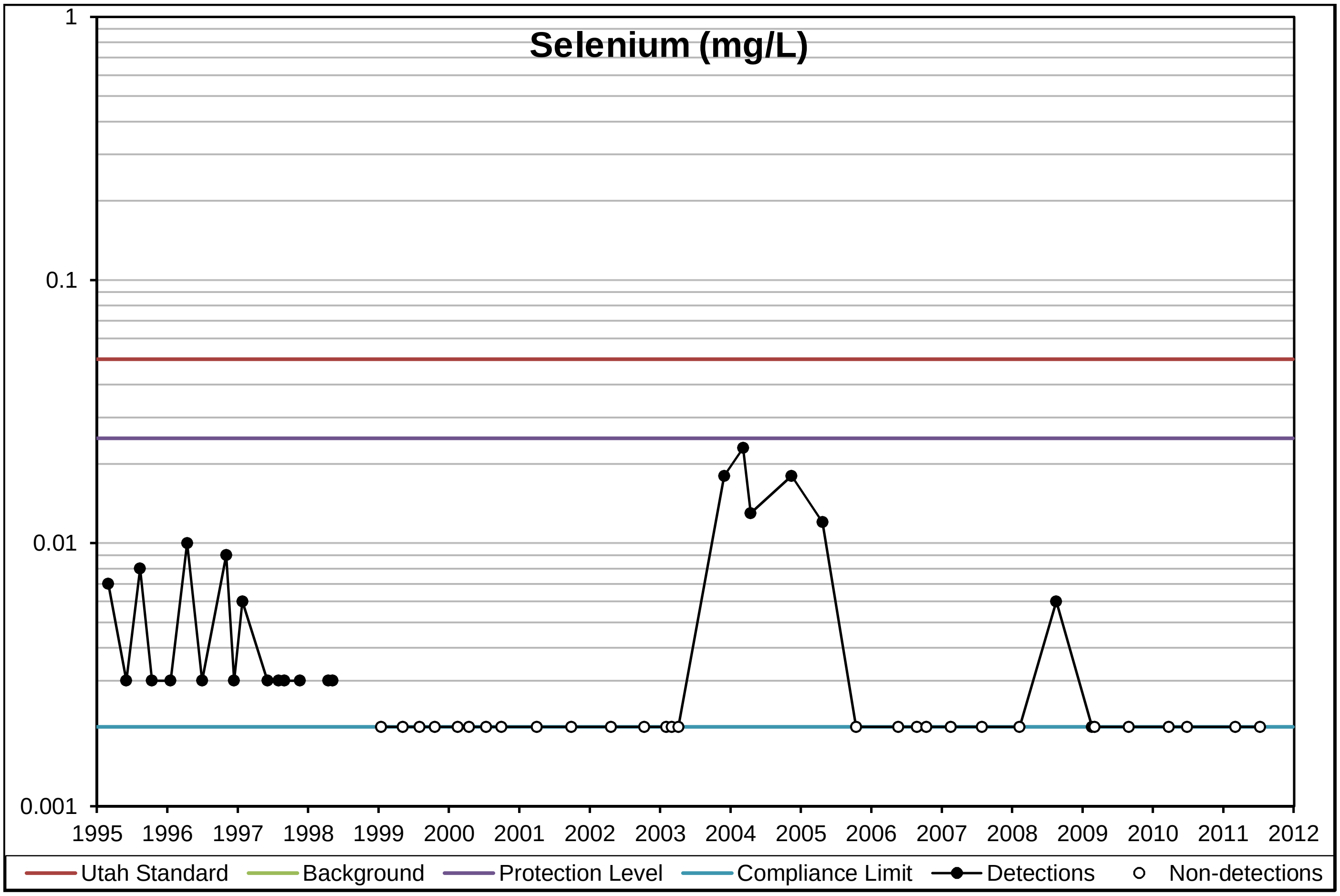


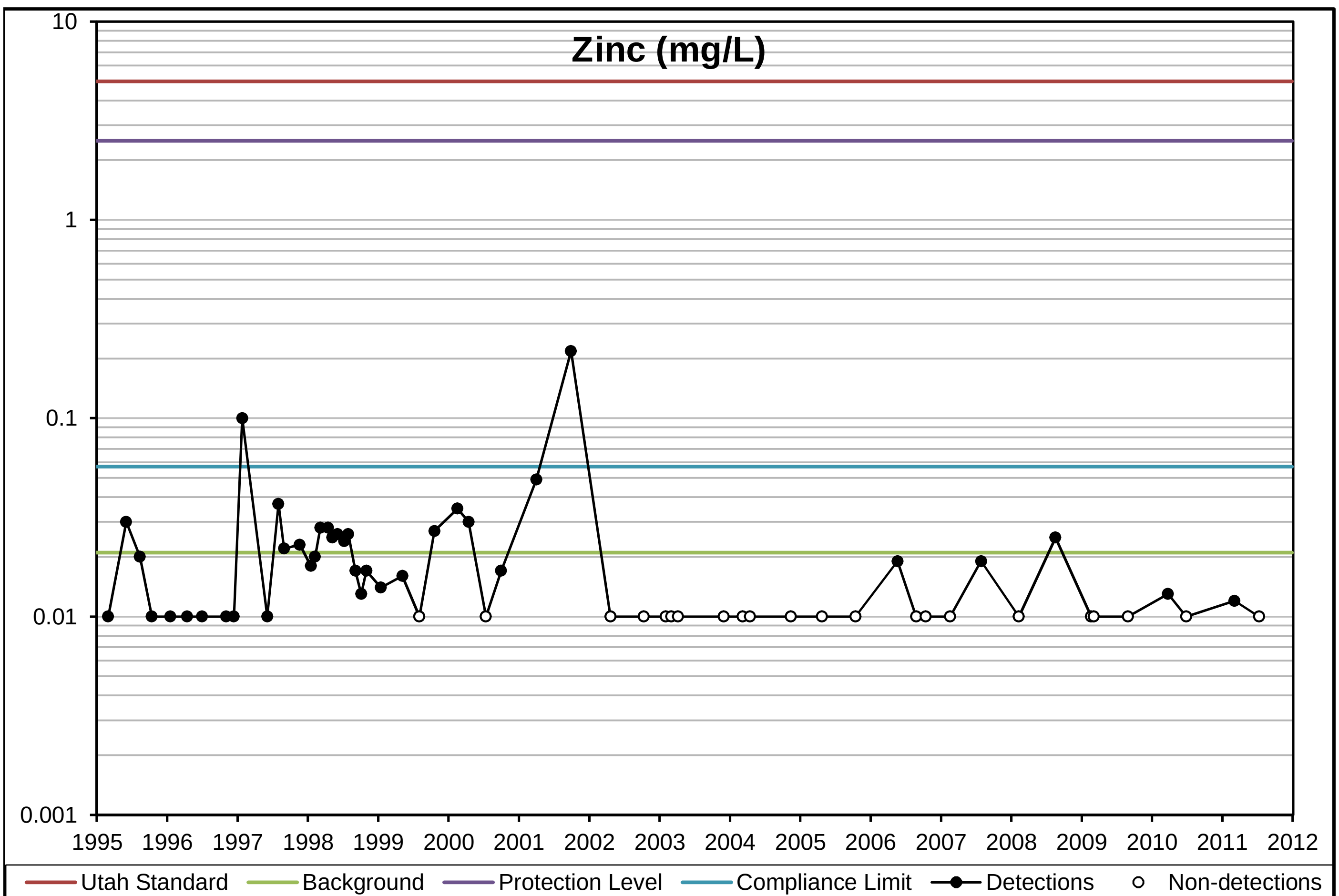
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

Concentration Versus Year



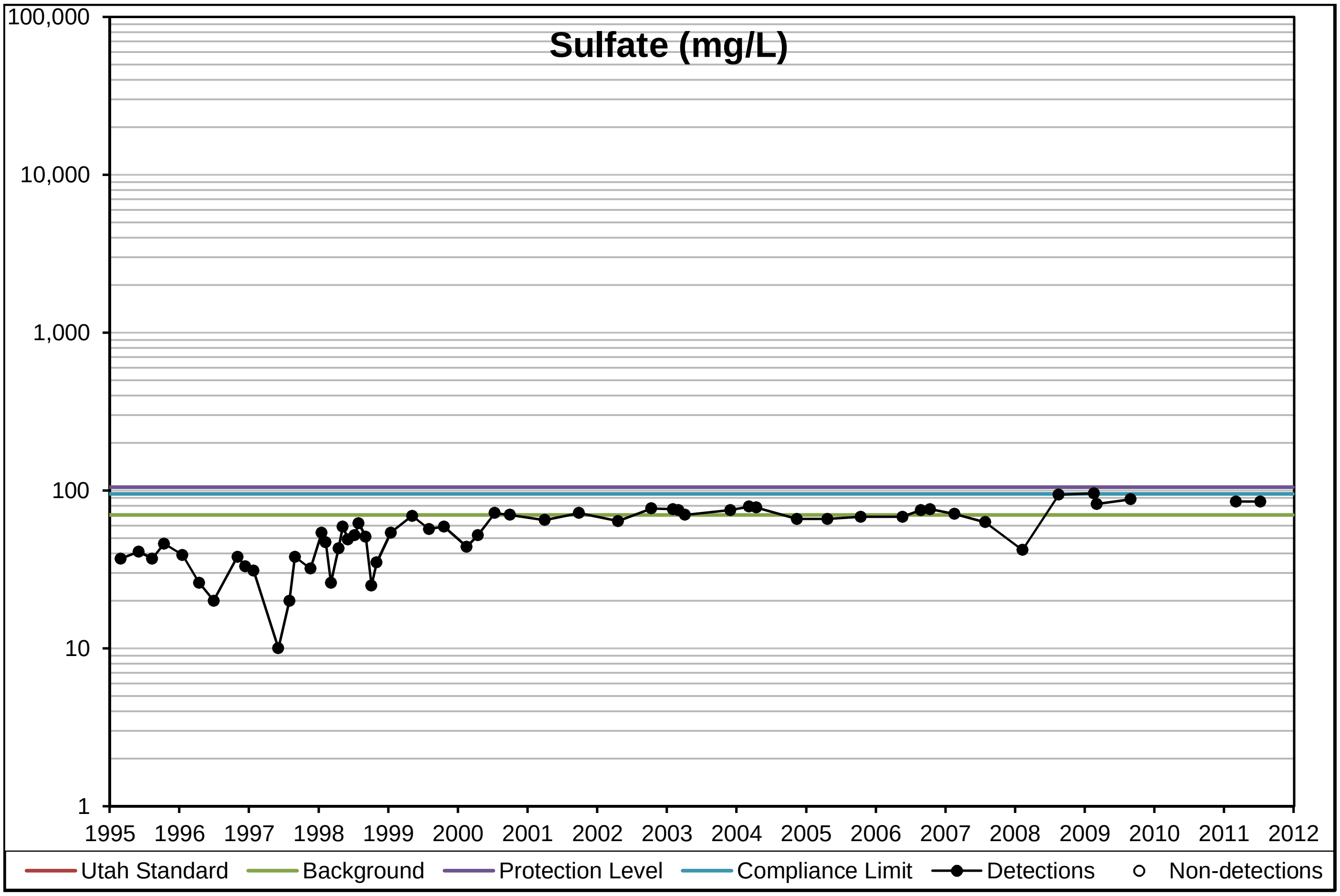


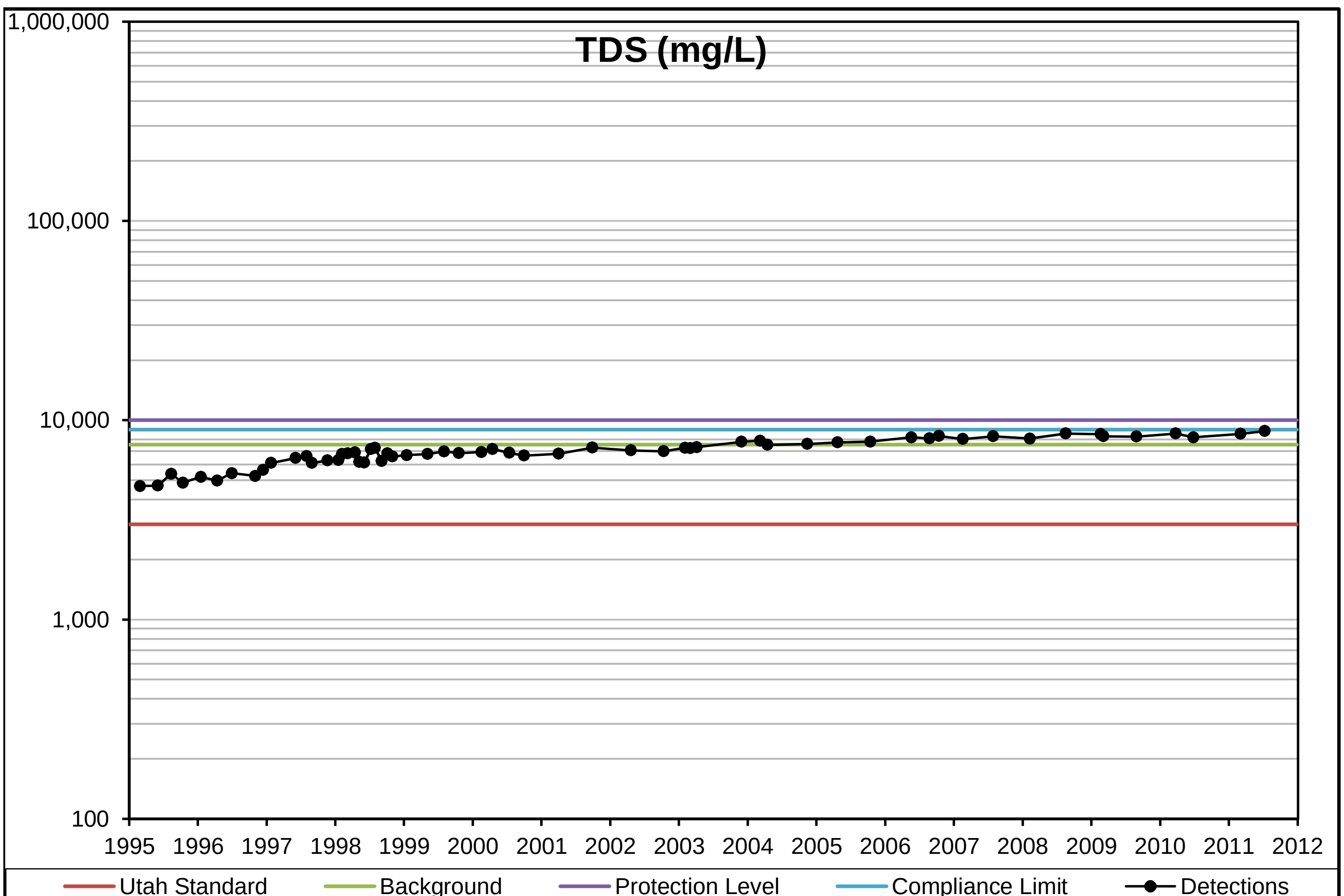
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

Concentration Versus Year



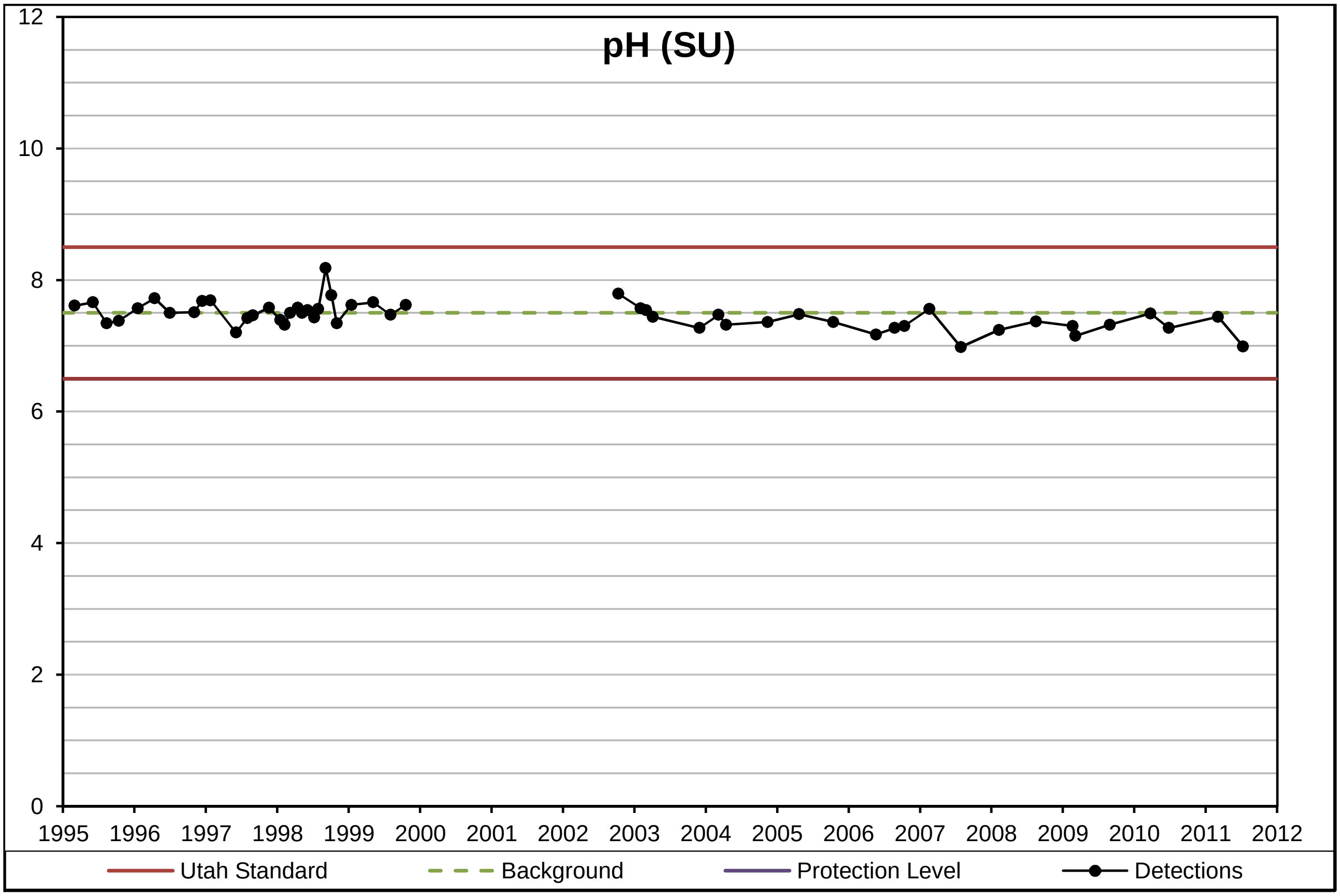


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL532B

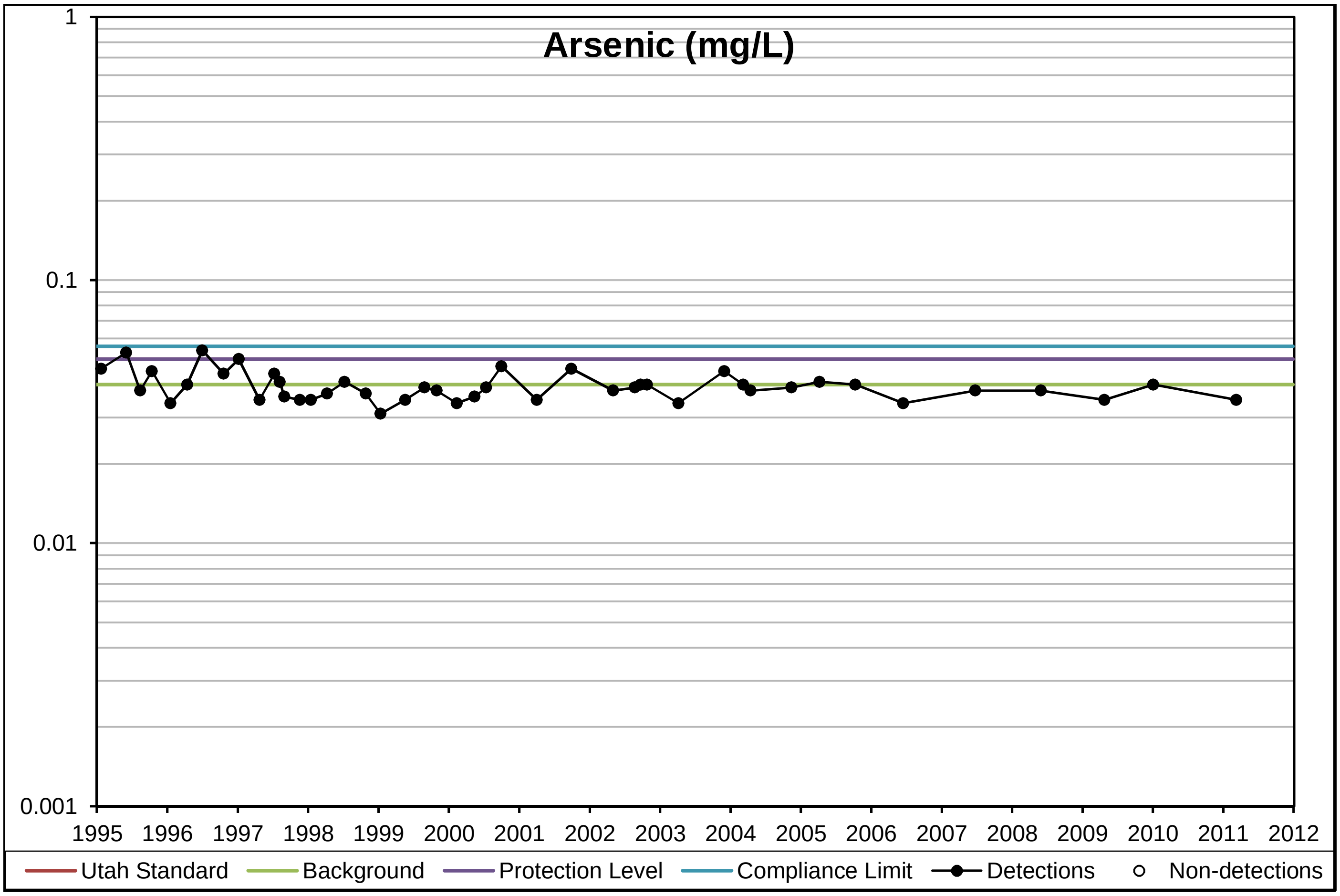
Concentration Versus Year

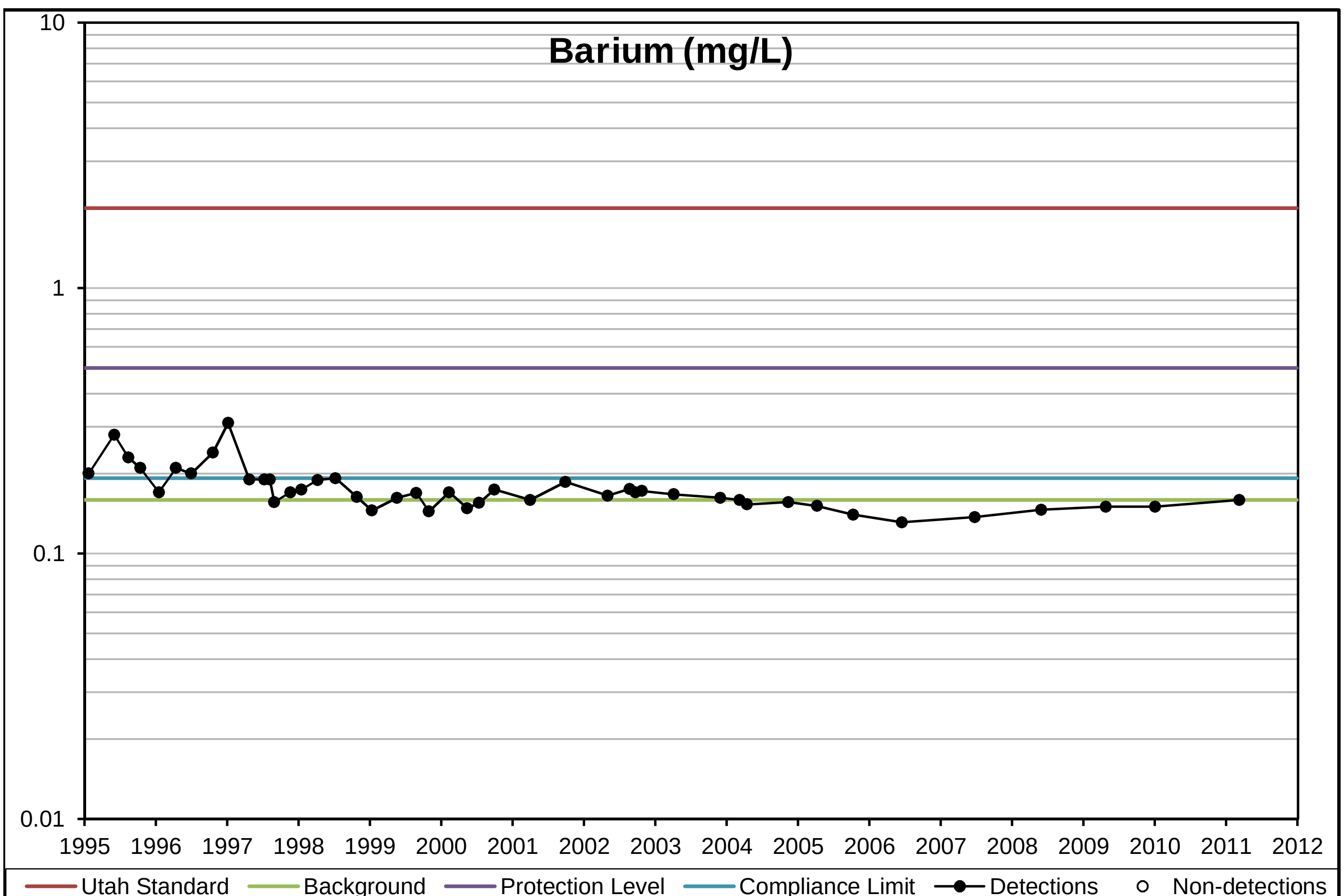


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

Concentration Versus Year

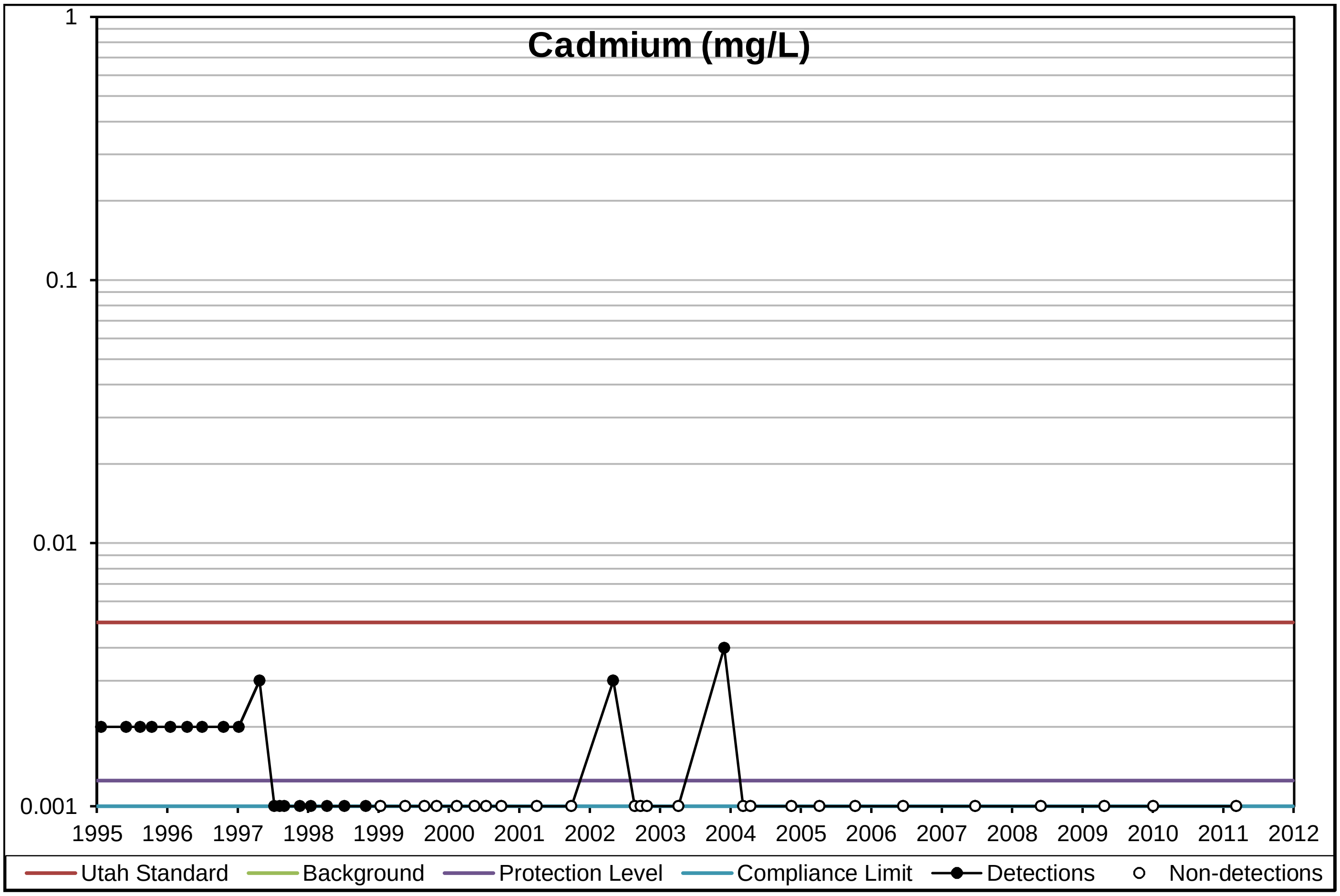


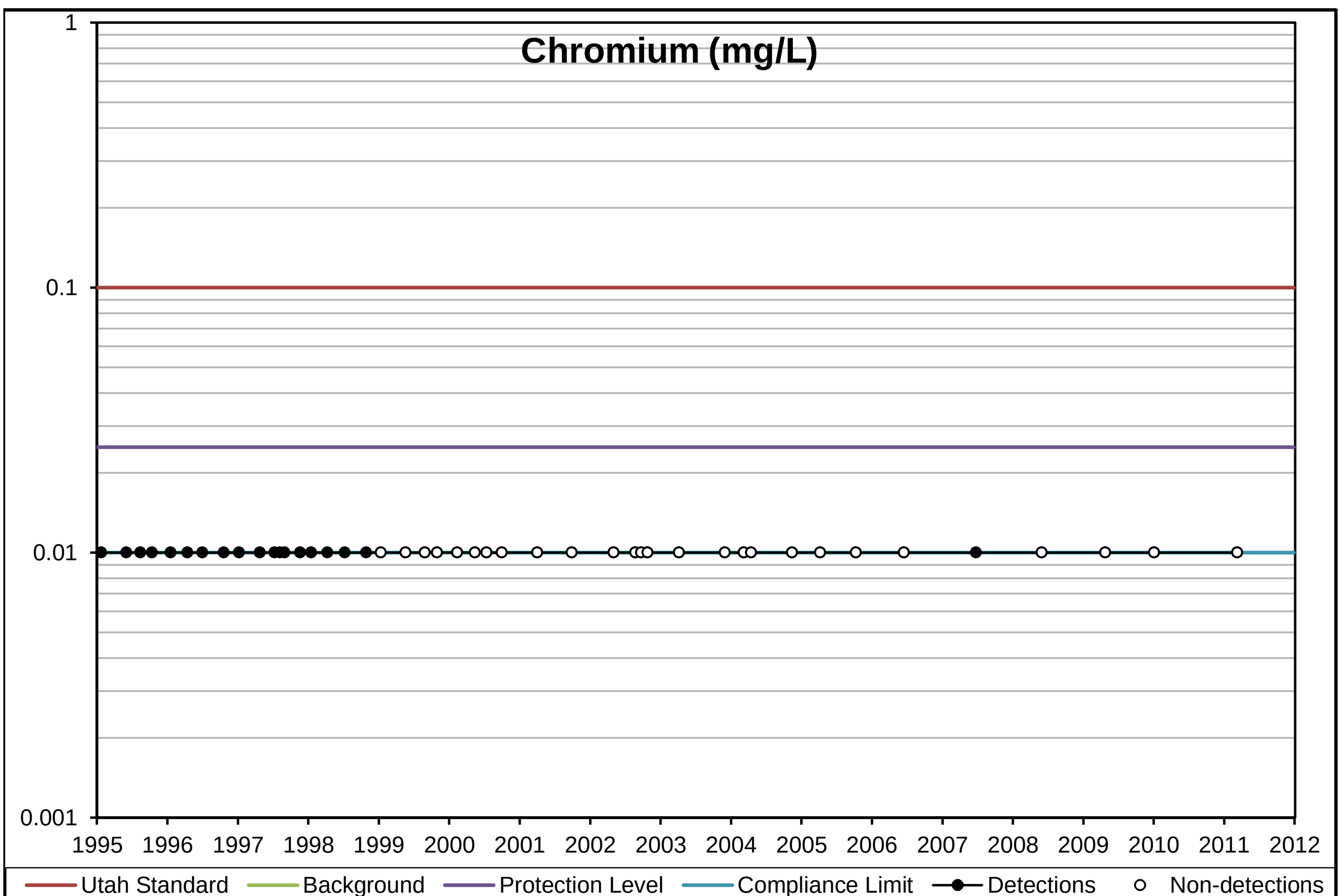


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

Concentration Versus Year



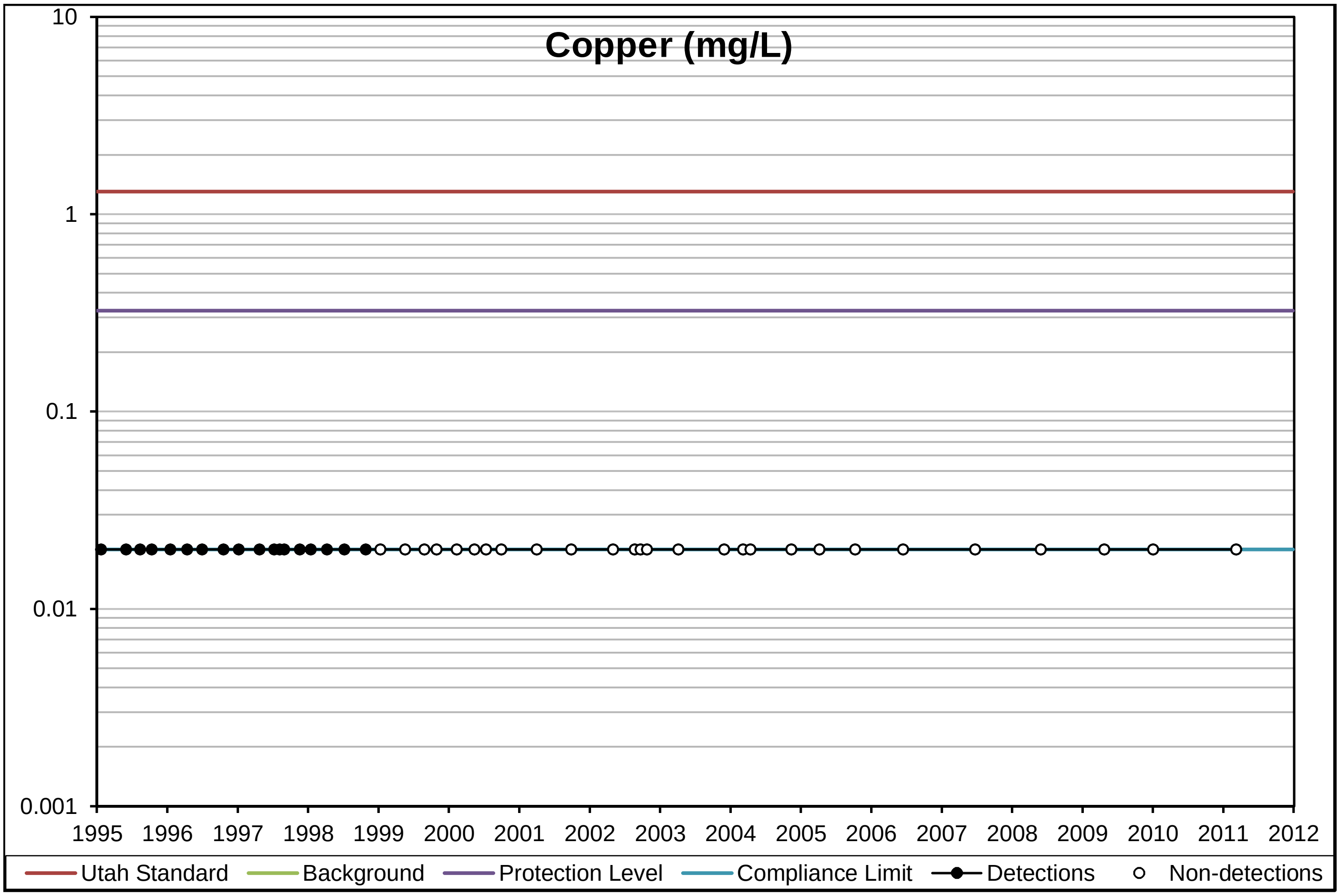


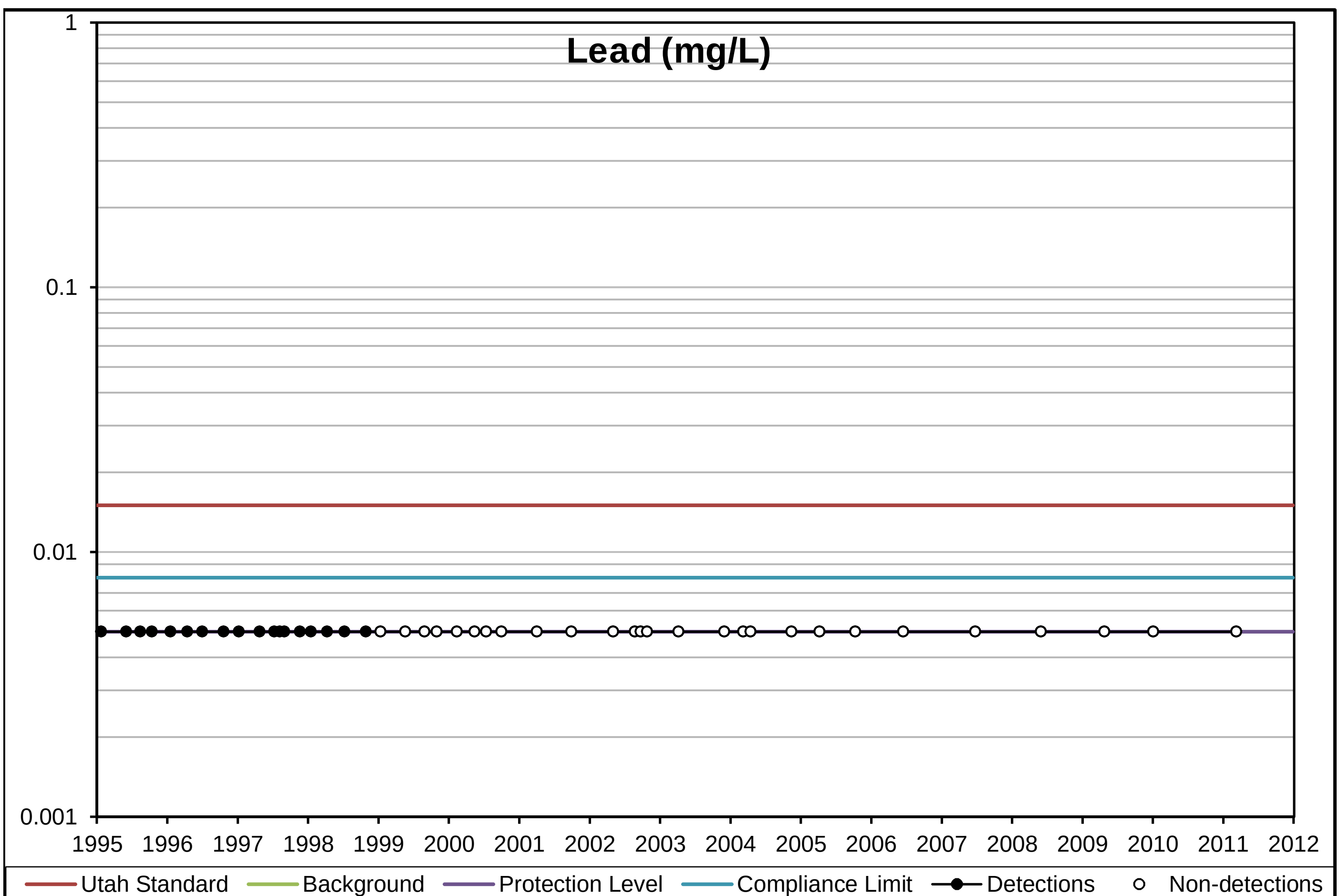
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

Concentration Versus Year



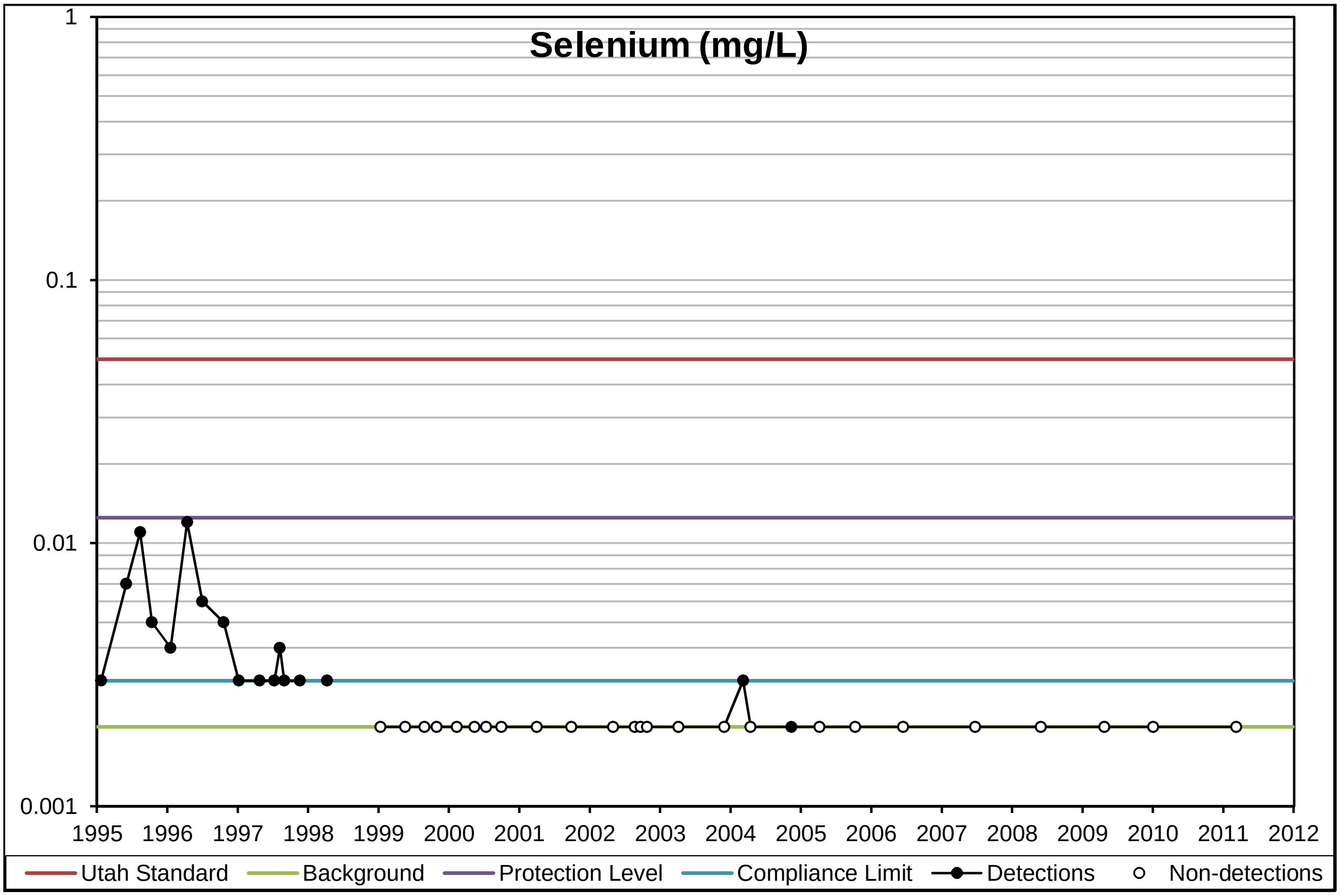


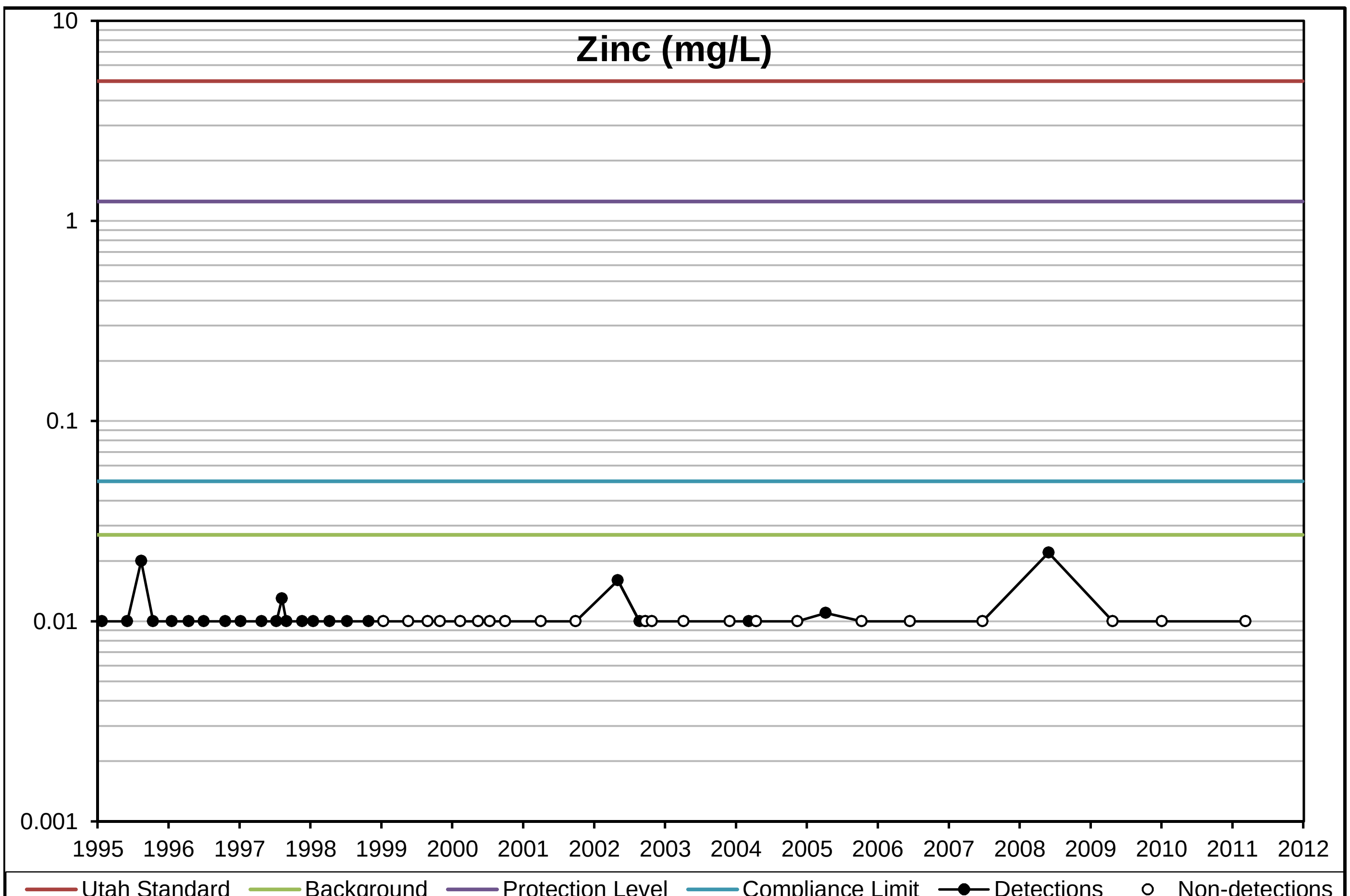
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

Concentration Versus Year



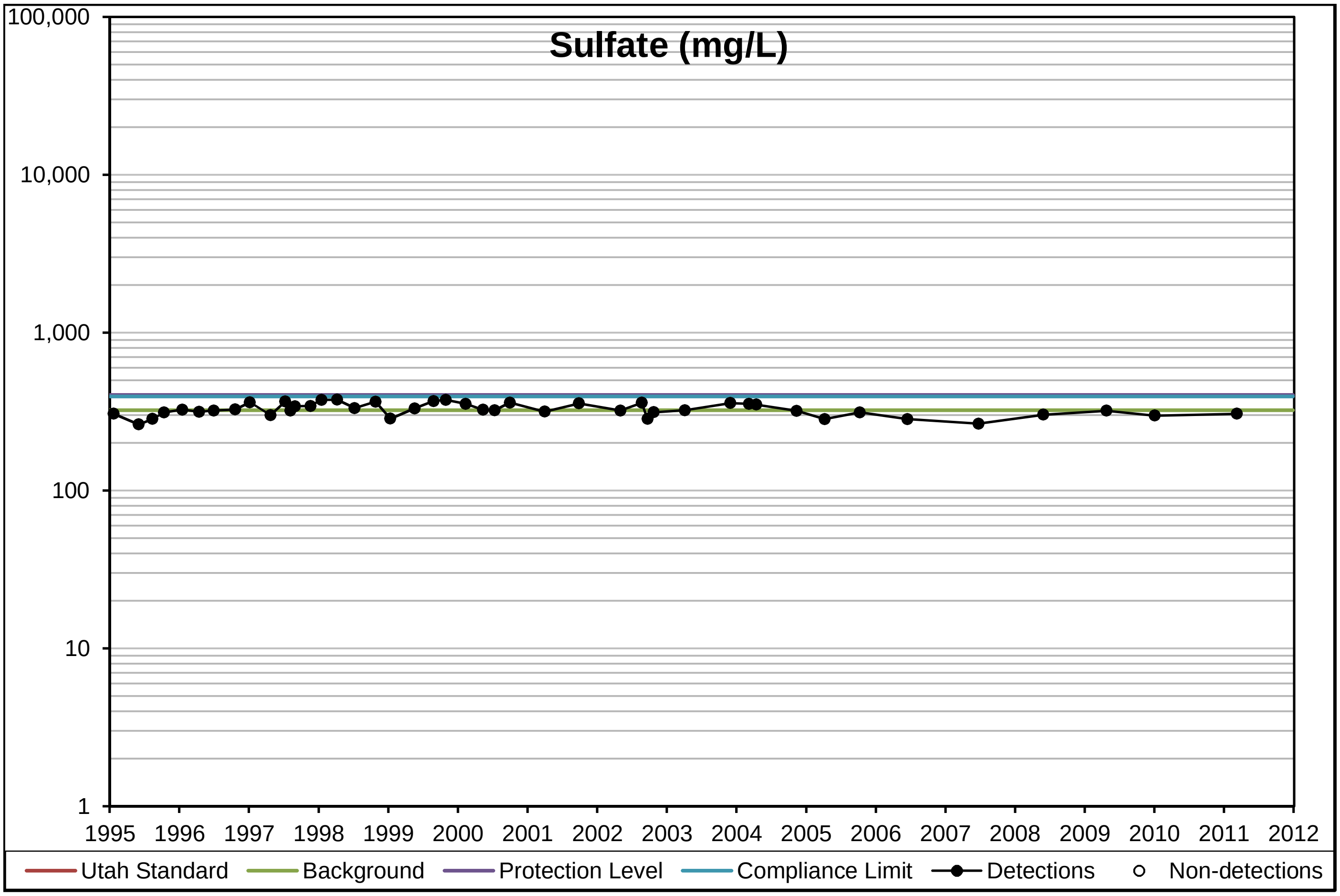


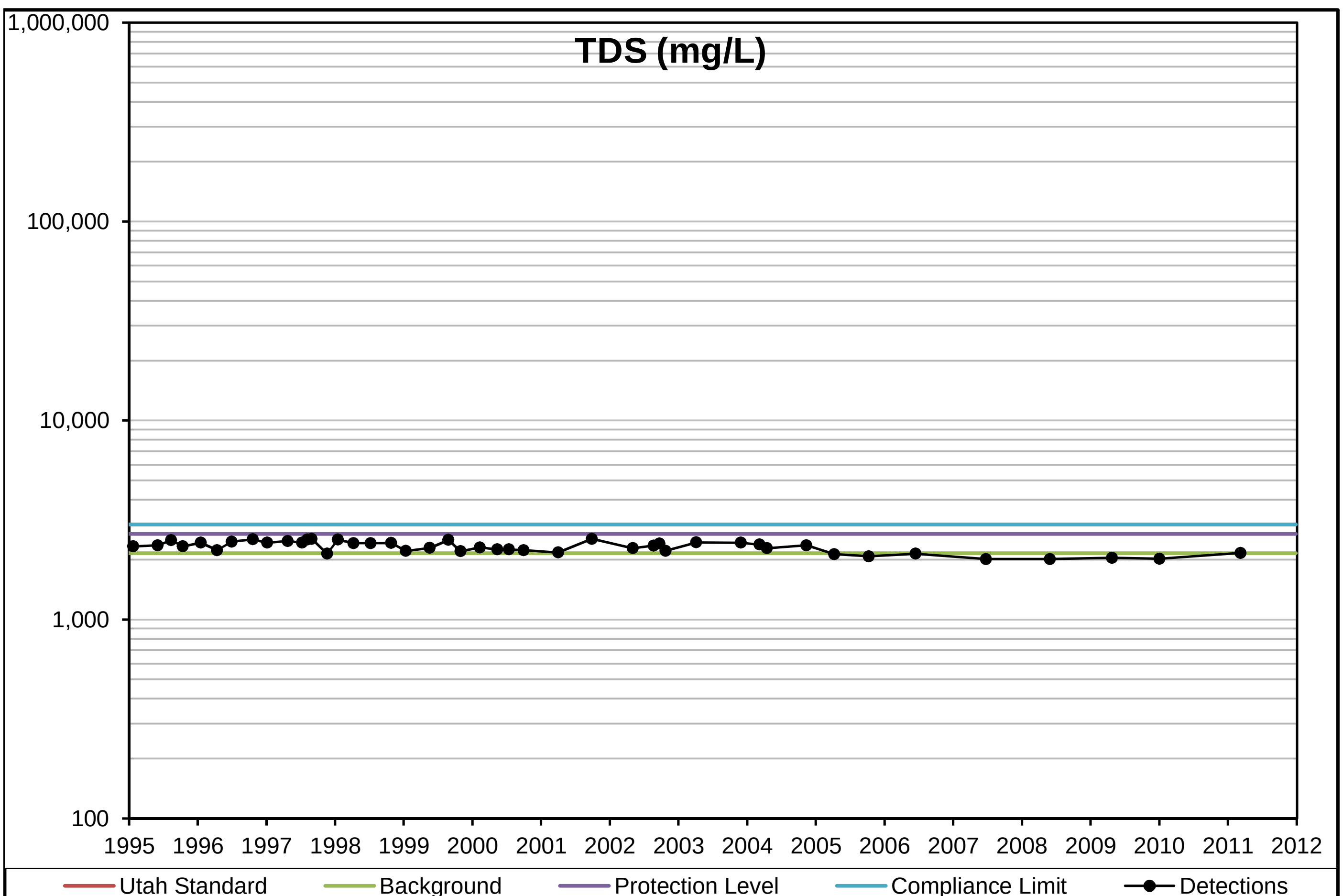
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

Concentration Versus Year



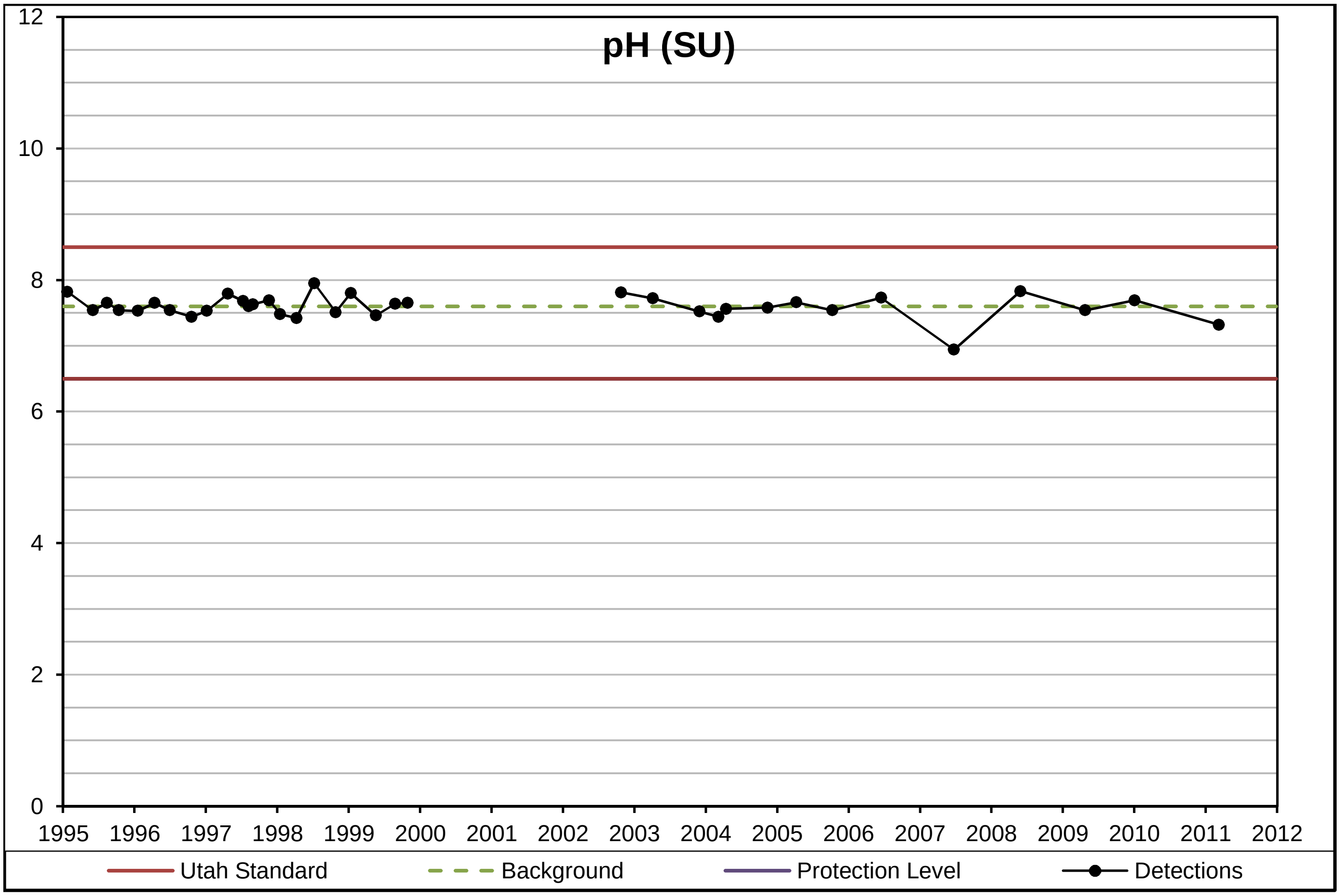


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536A

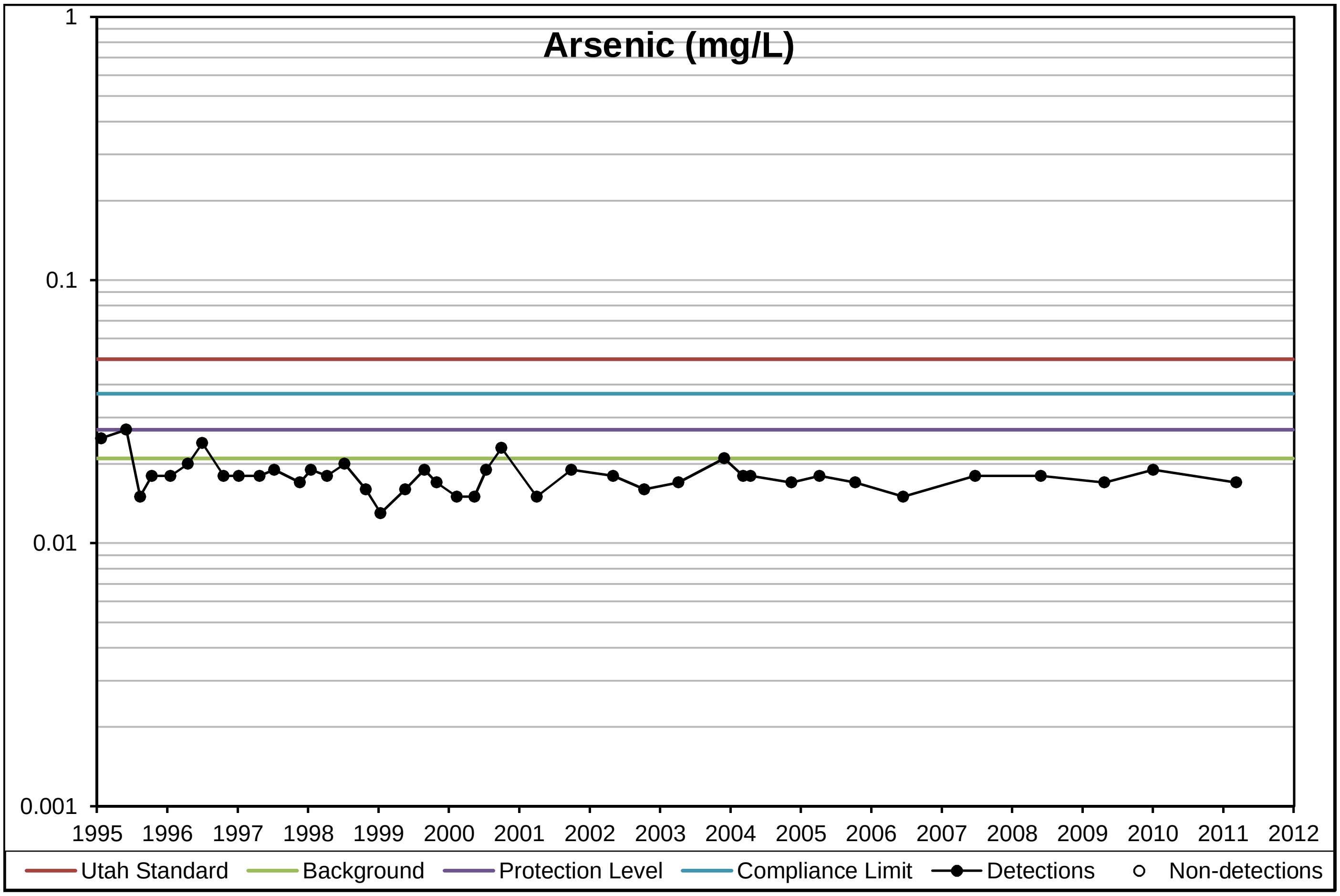
Concentration Versus Year

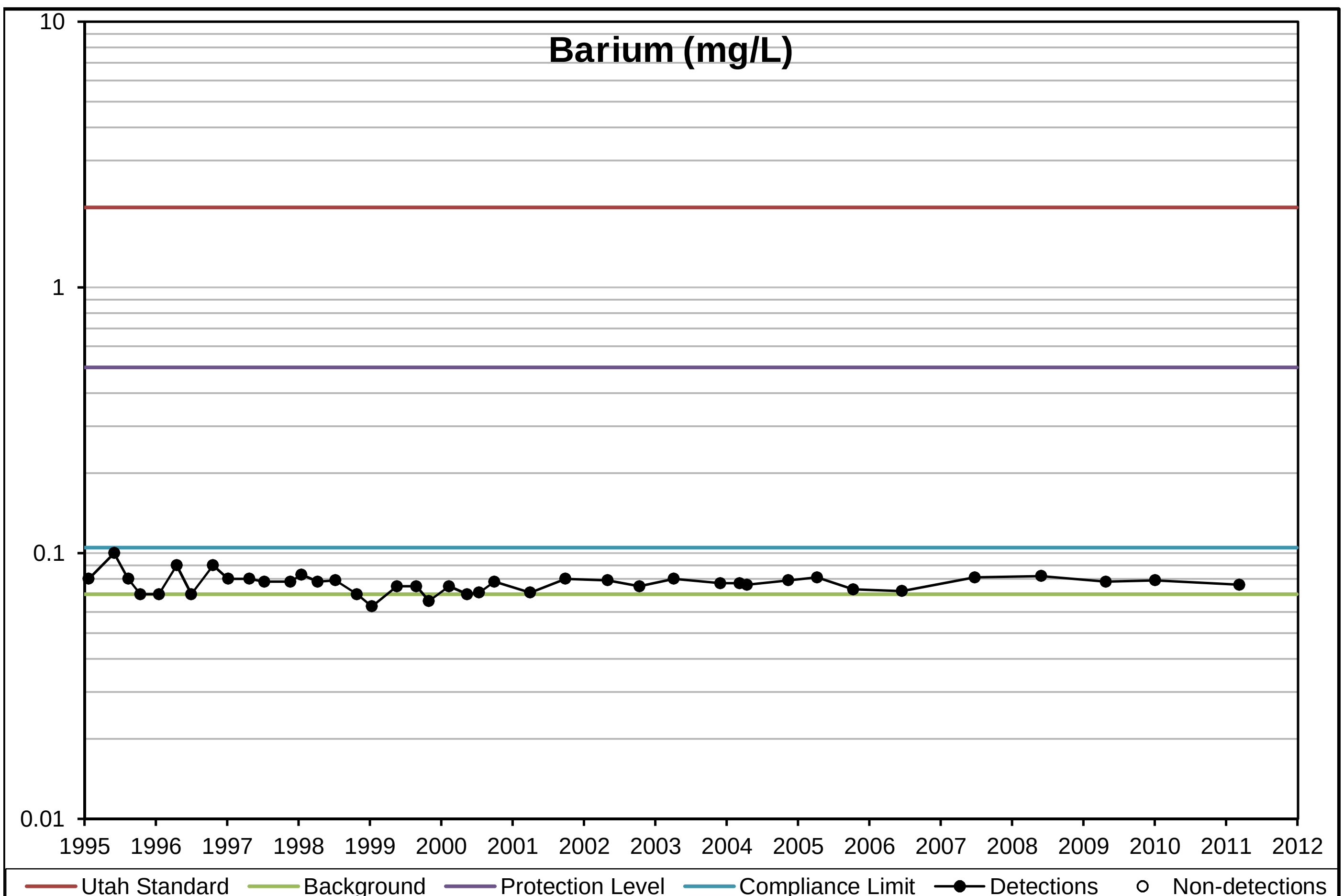


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

Concentration Versus Year



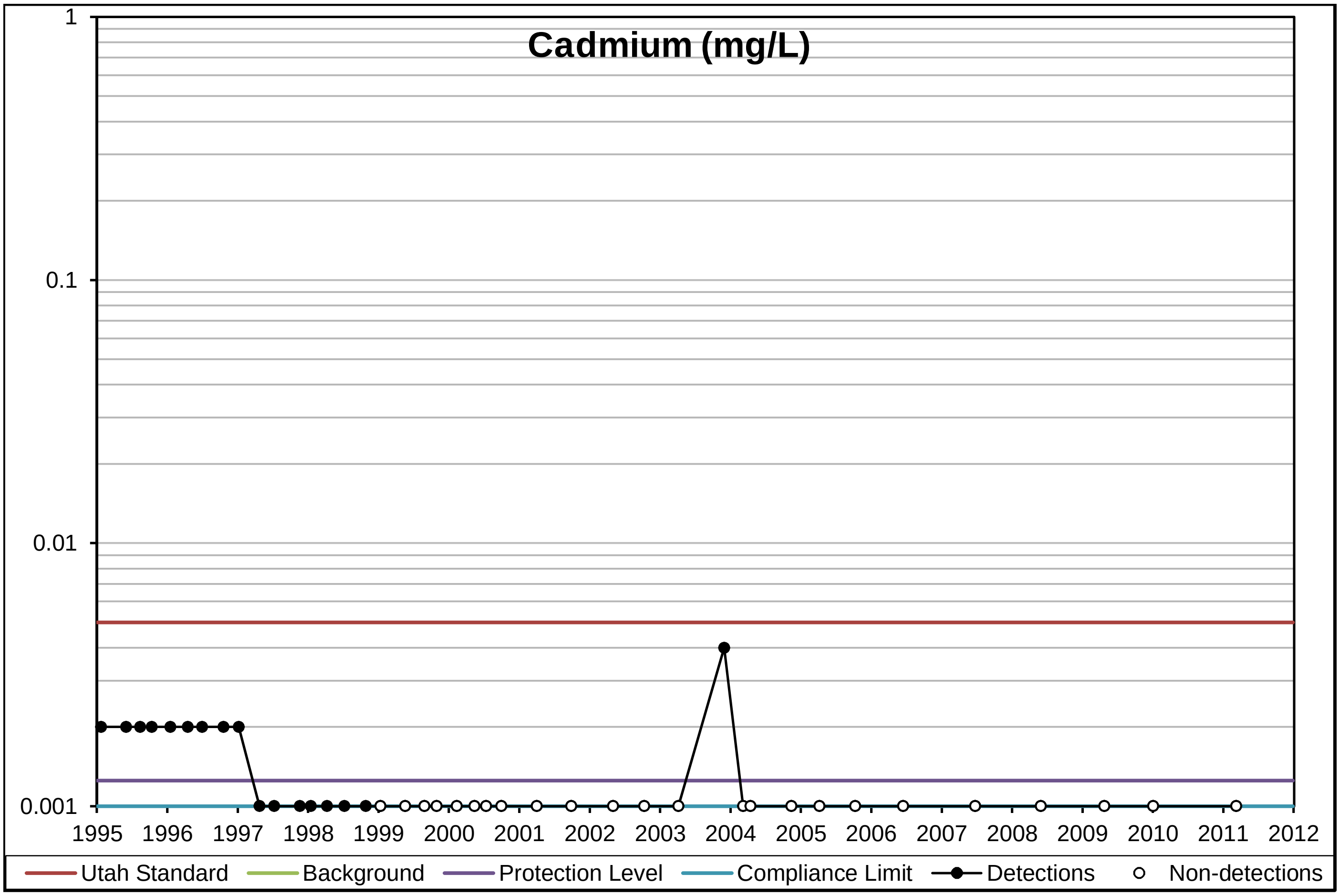


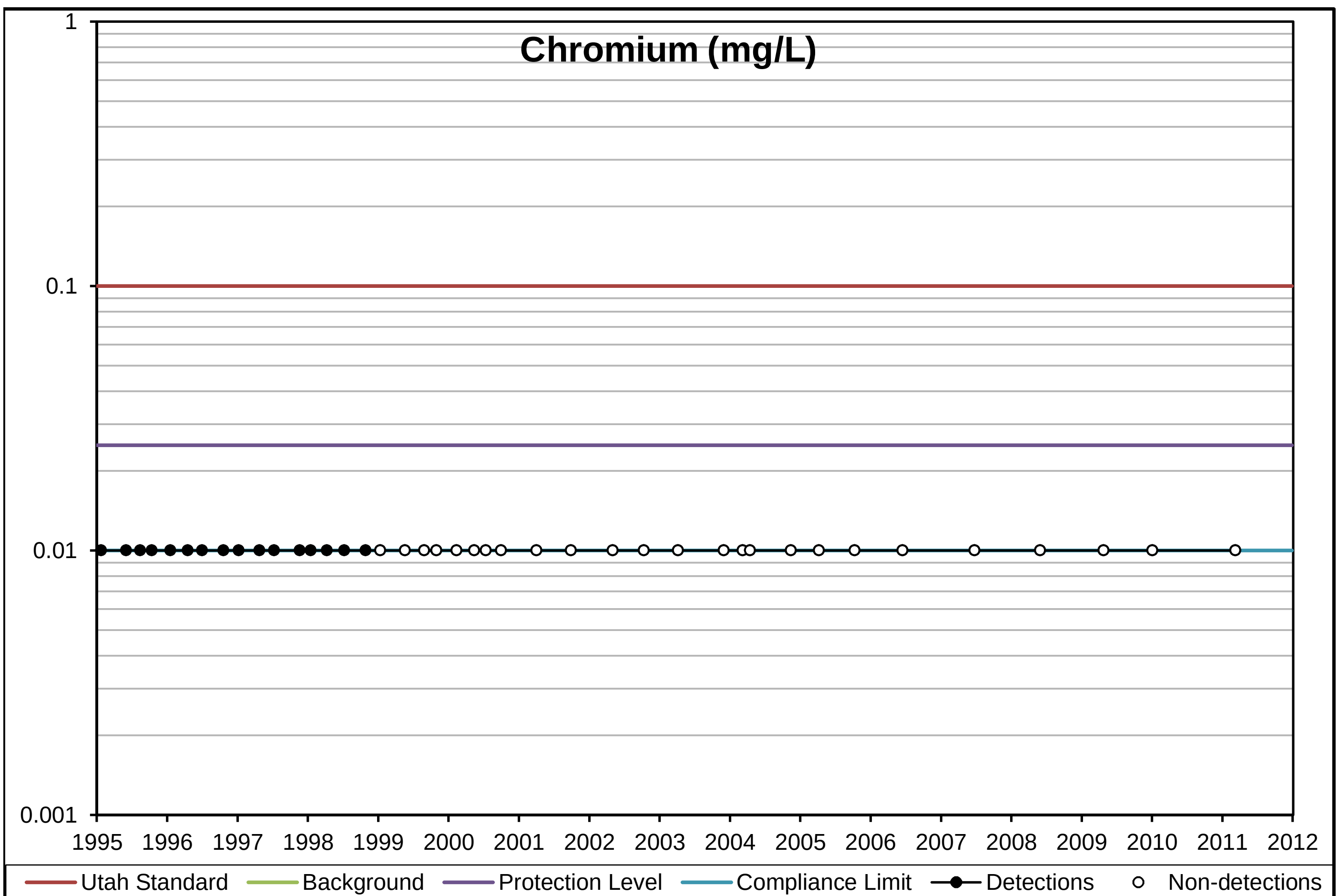
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

Concentration Versus Year



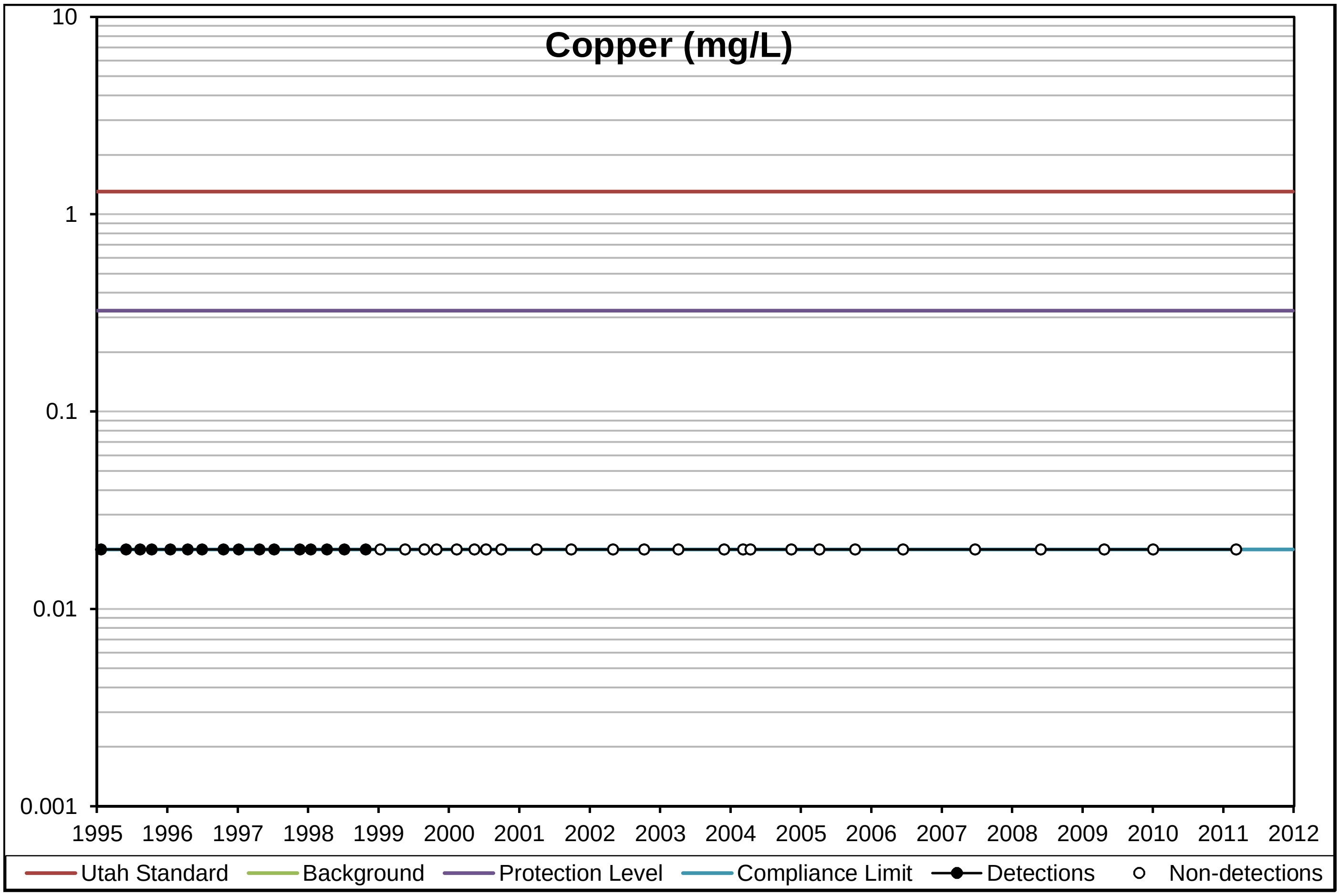


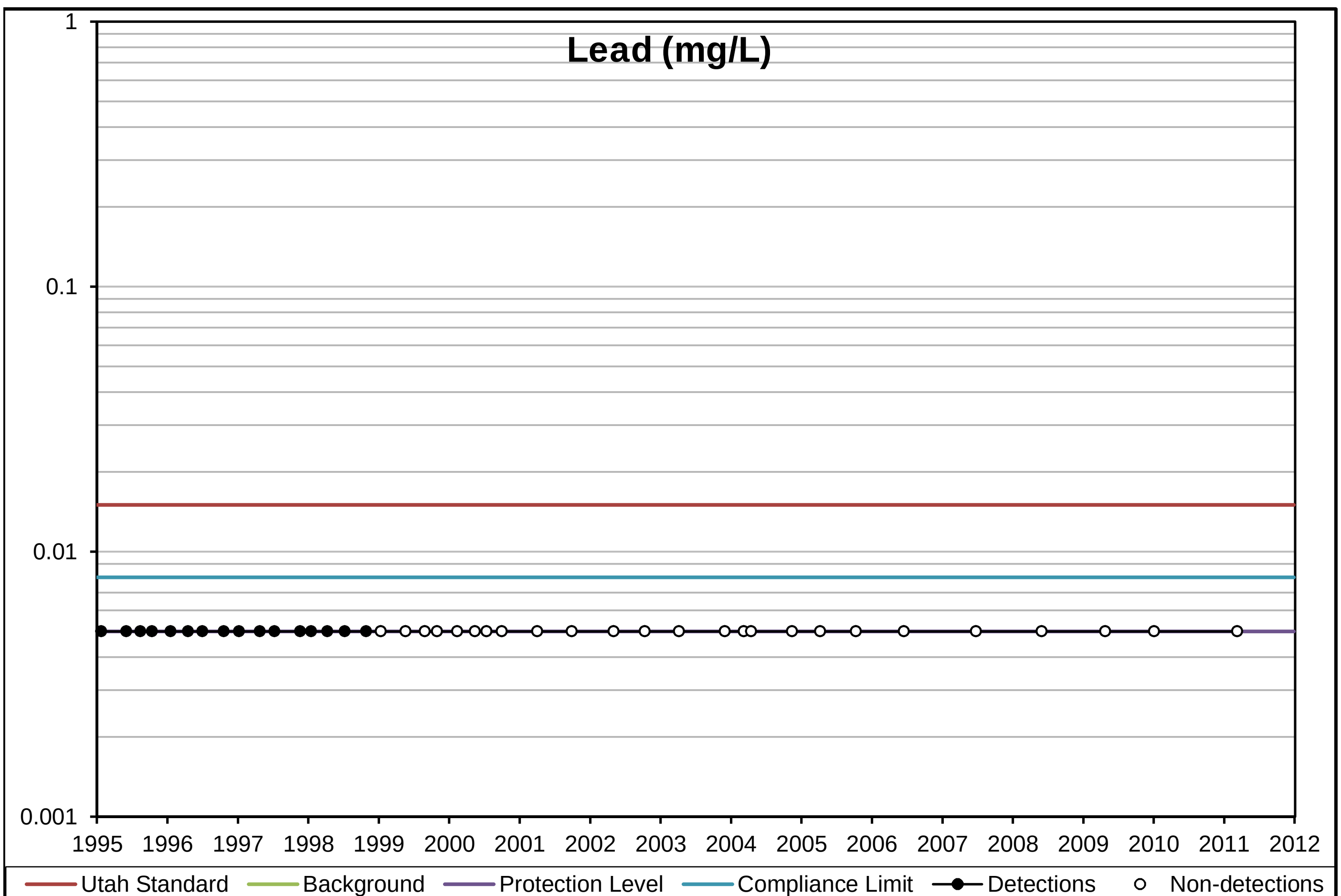
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

Concentration Versus Year



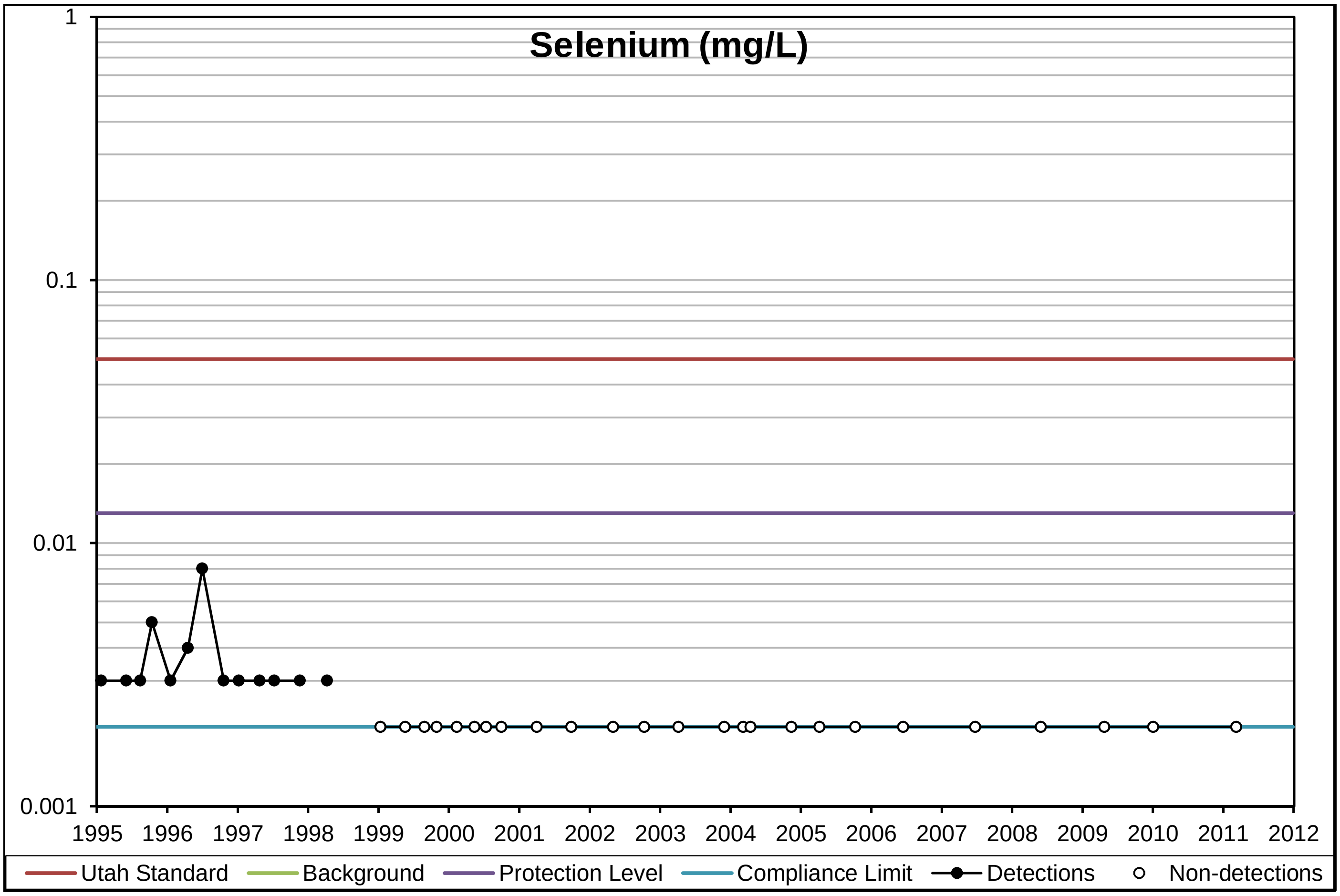


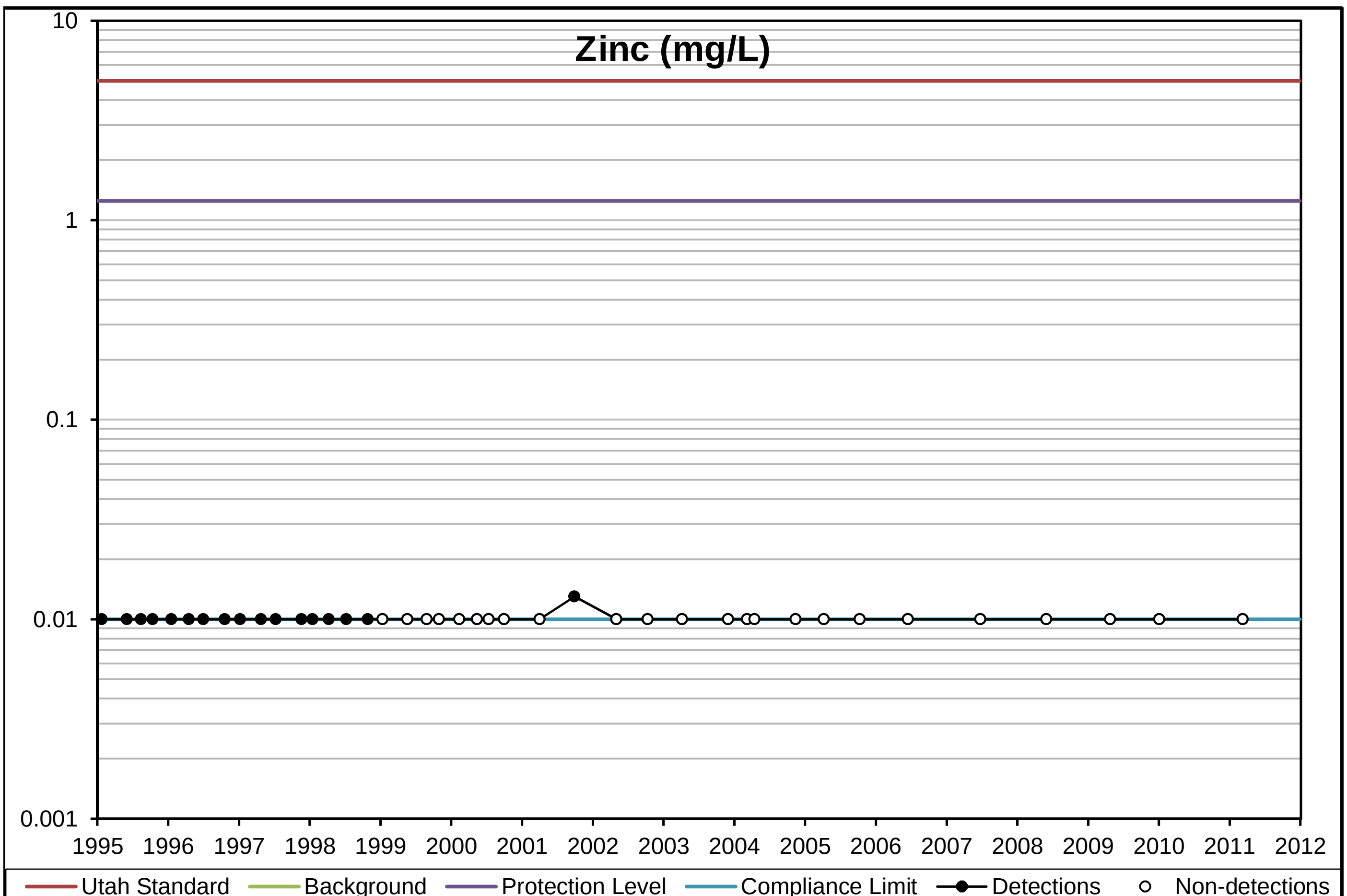
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

Concentration Versus Year



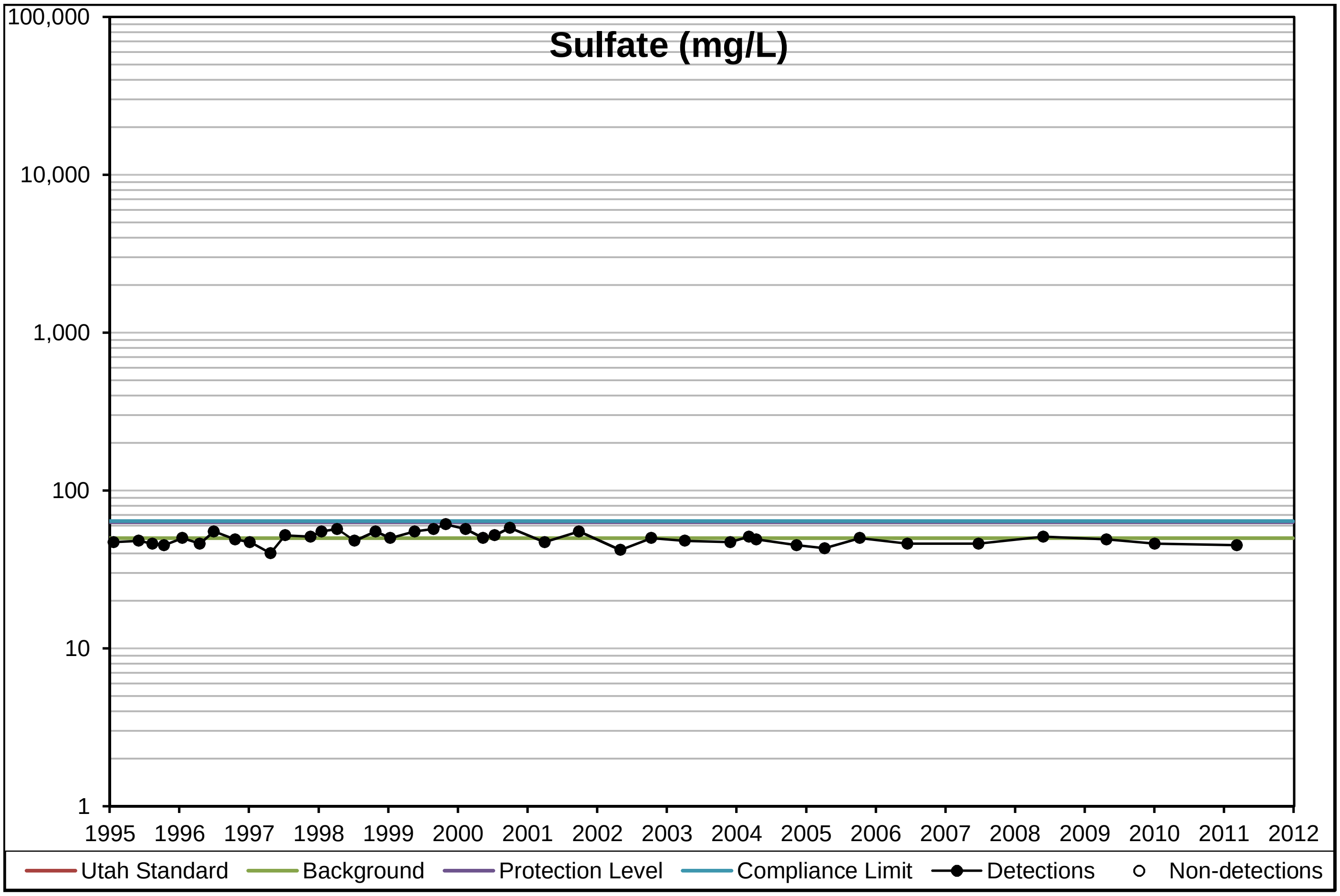


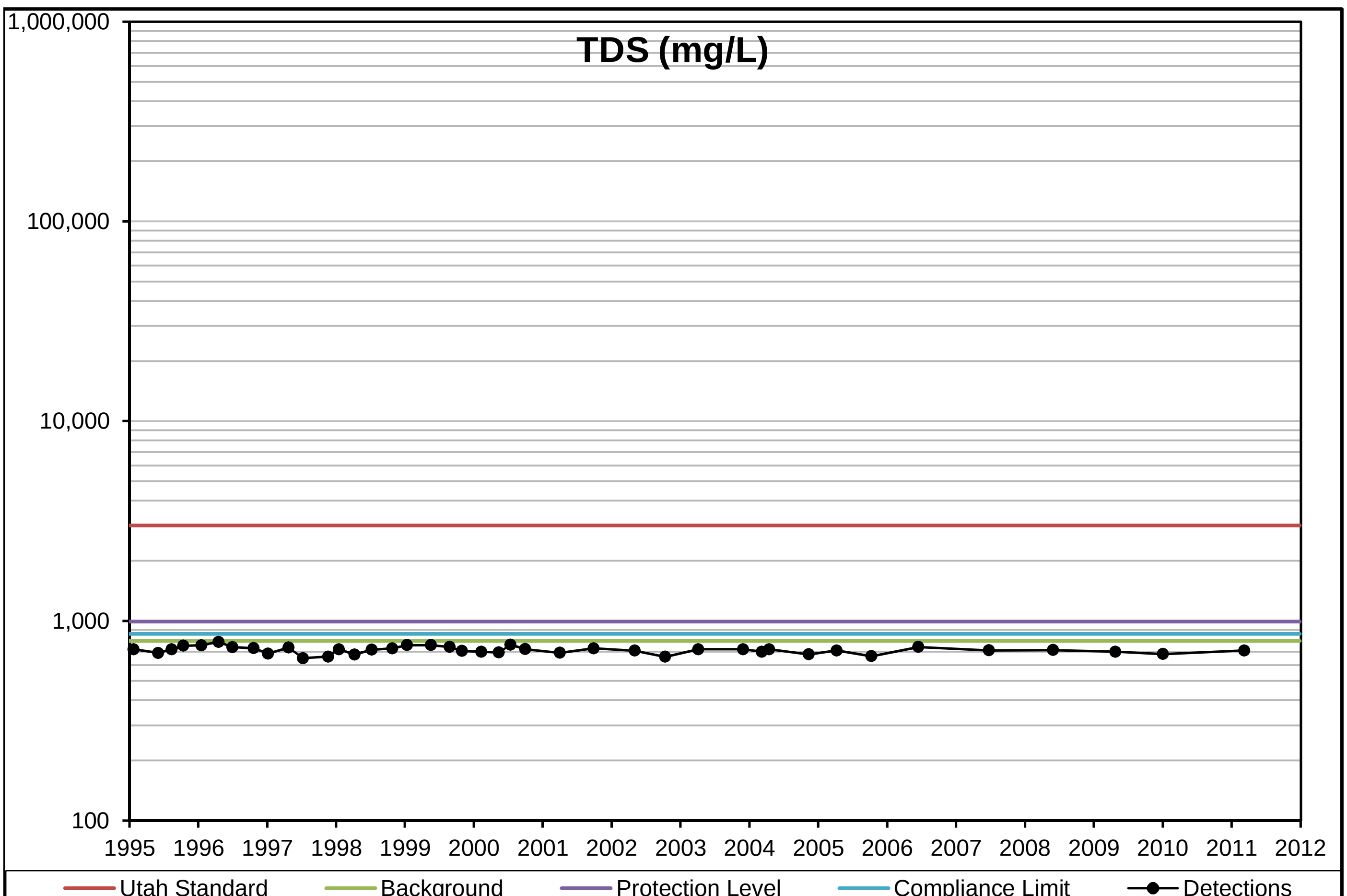
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

Concentration Versus Year



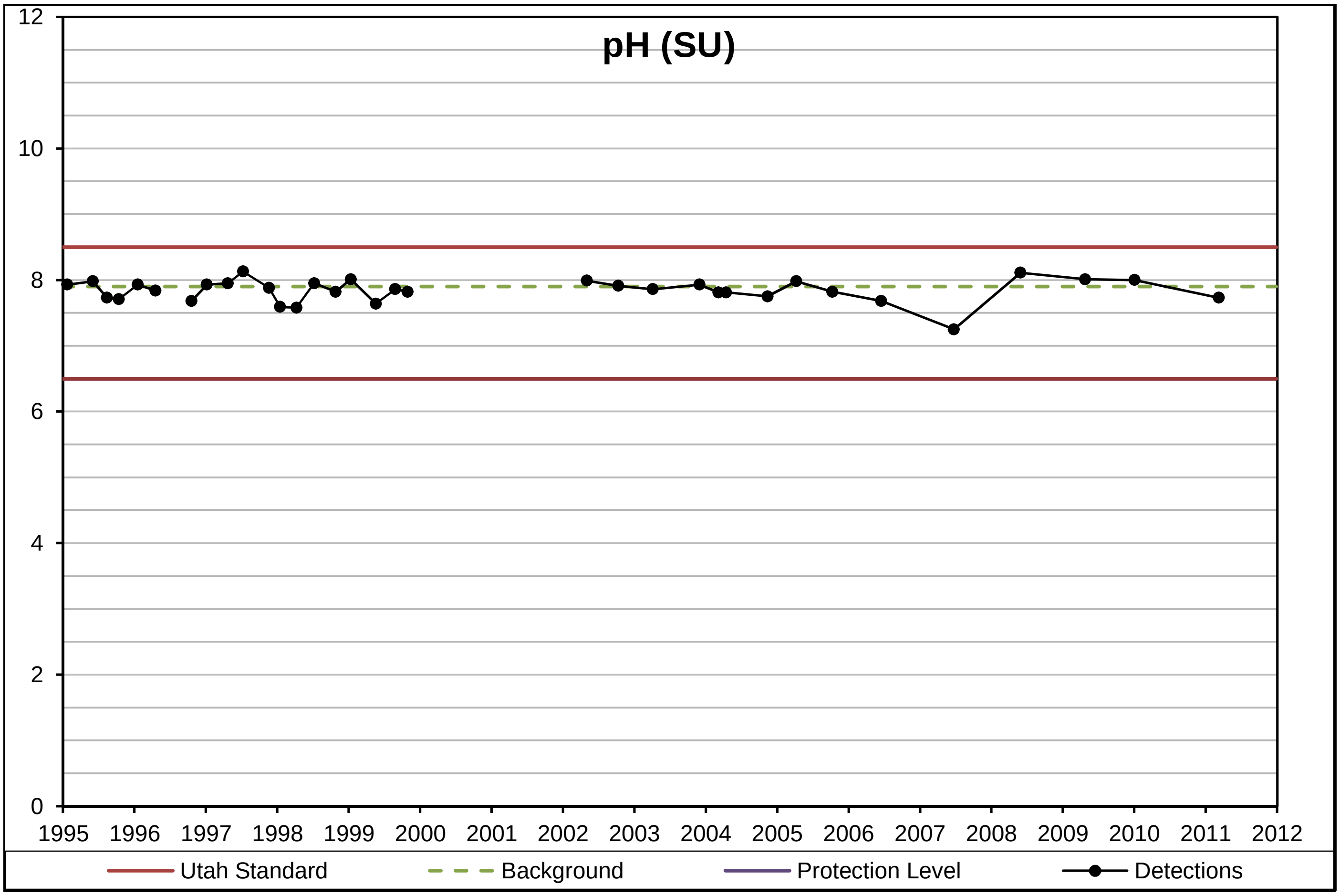


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL536B

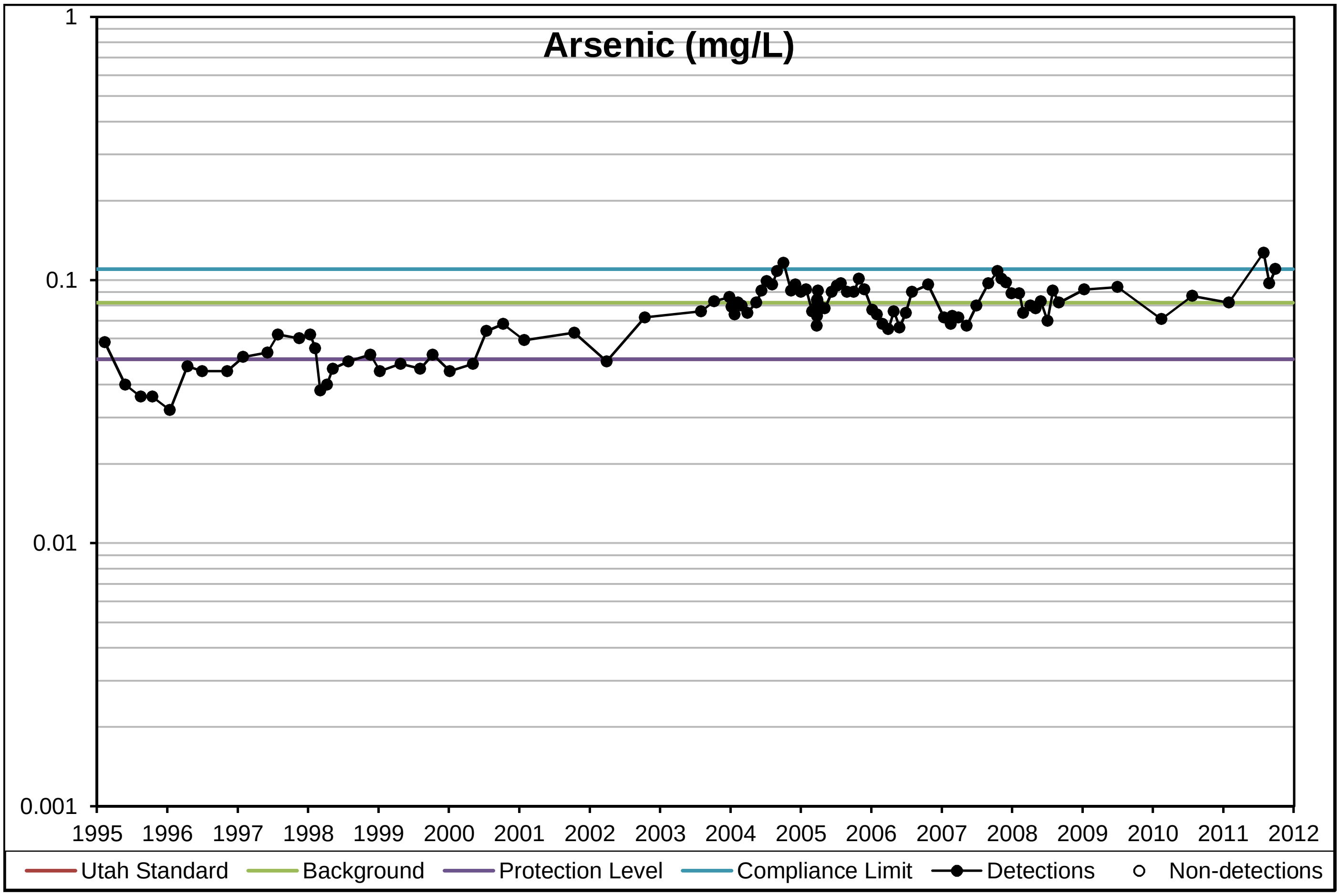
Concentration Versus Year

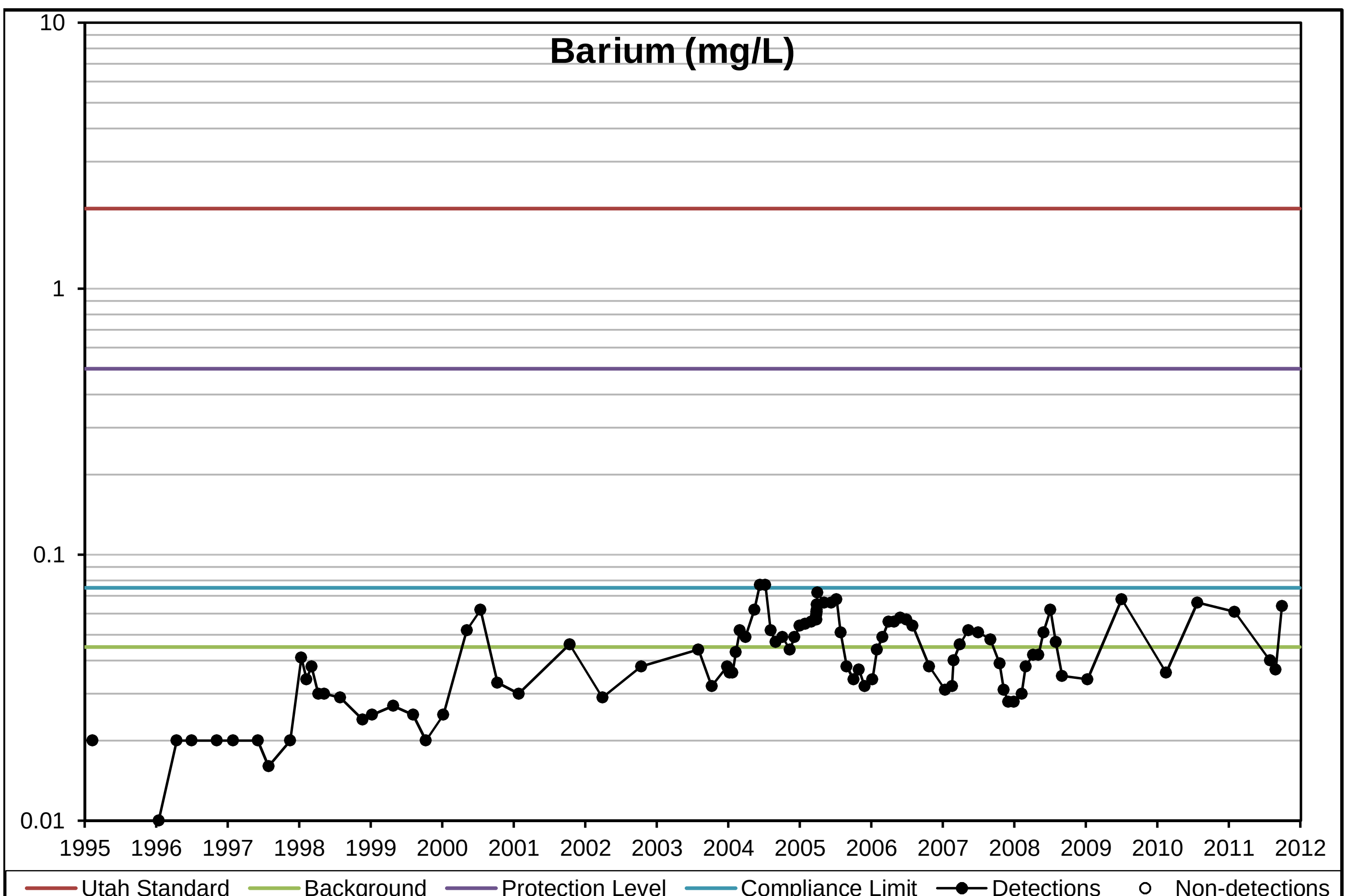


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



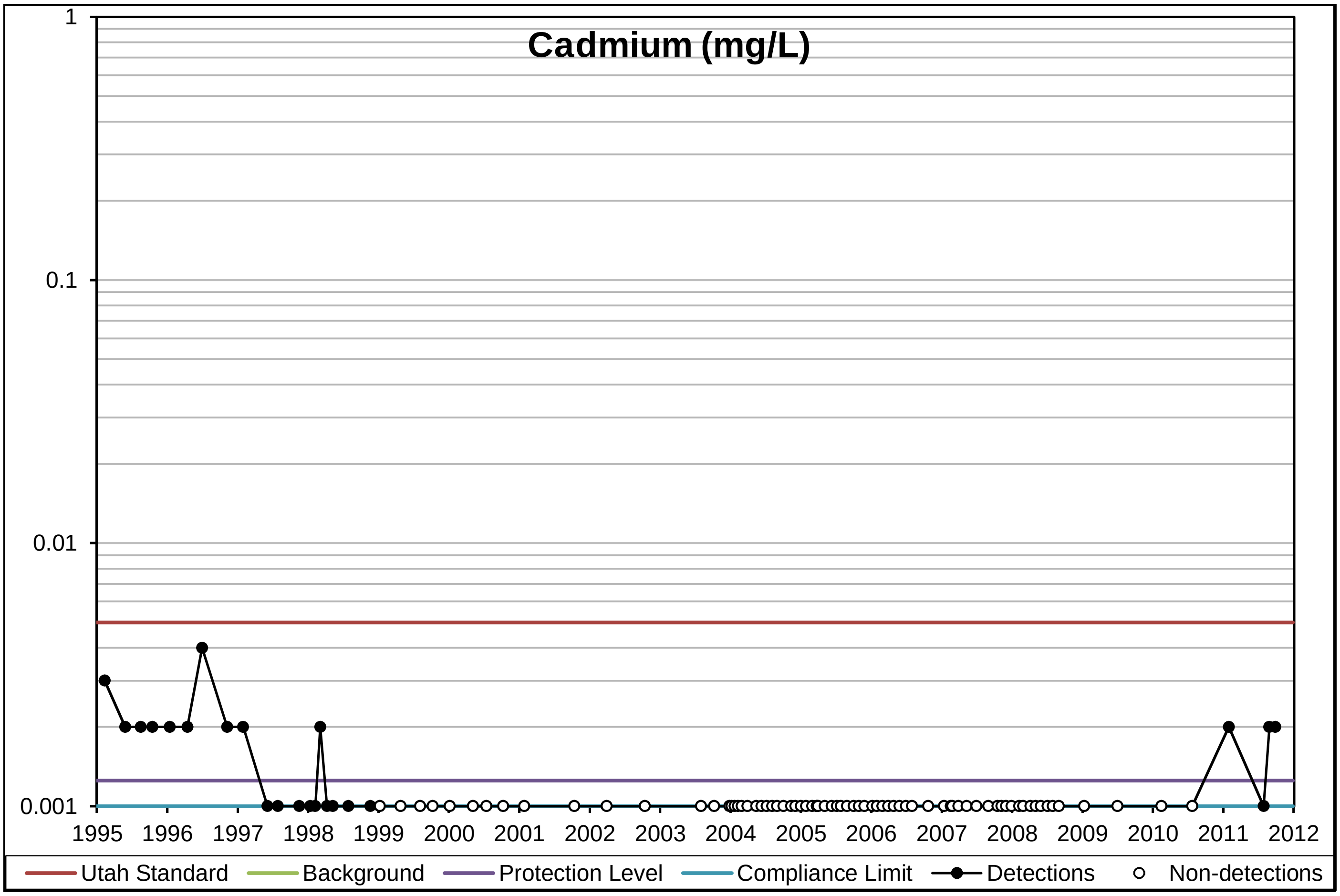


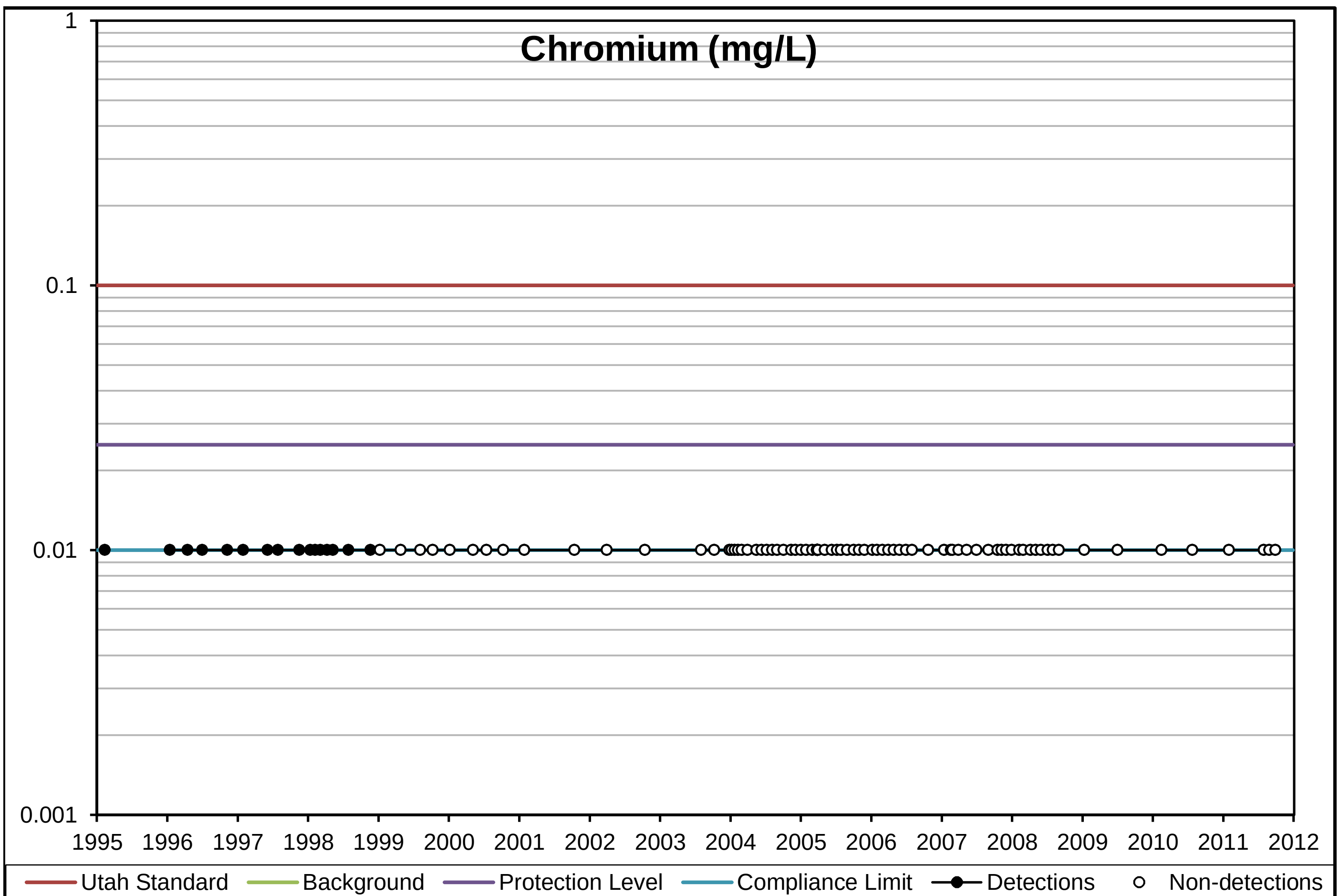
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



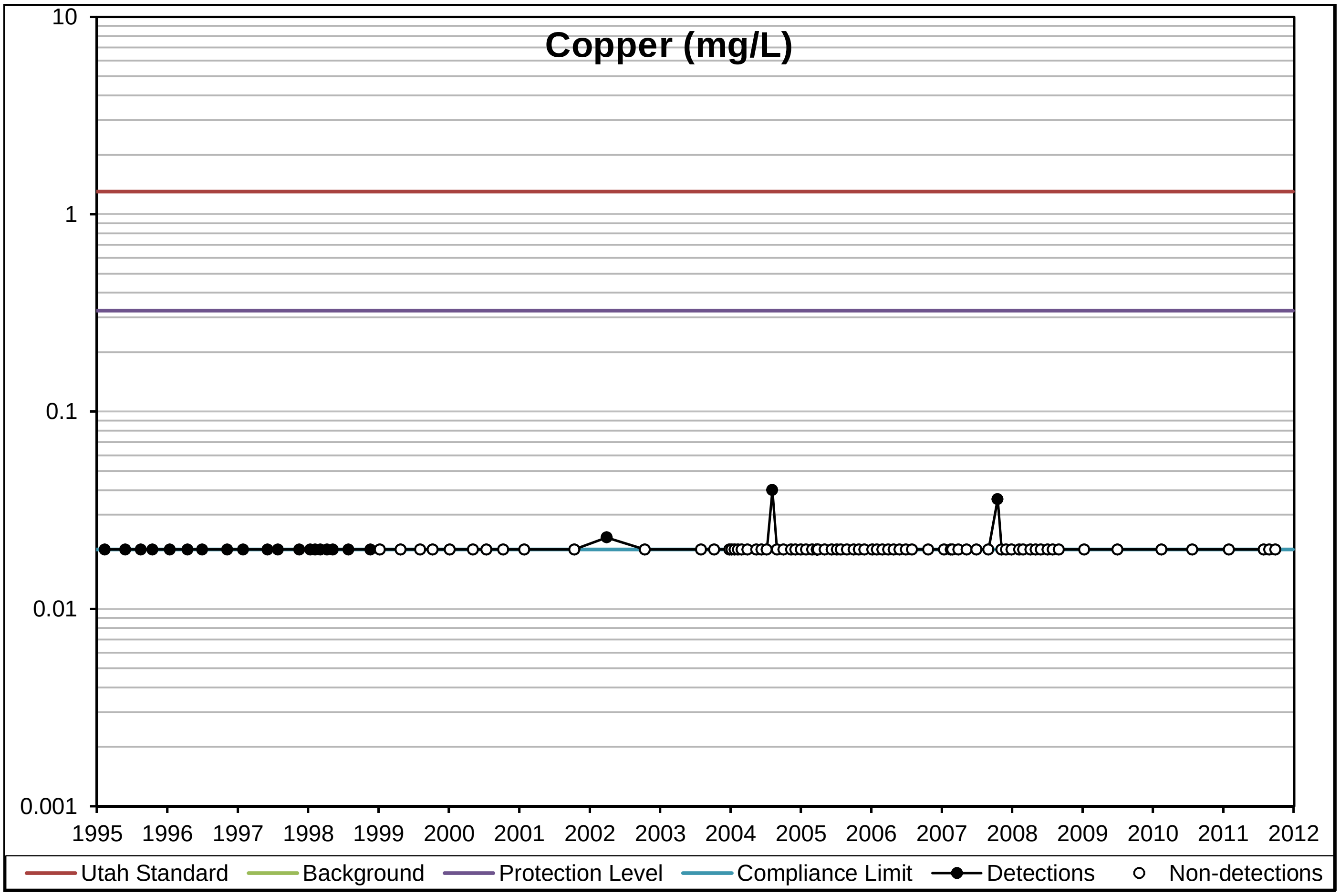


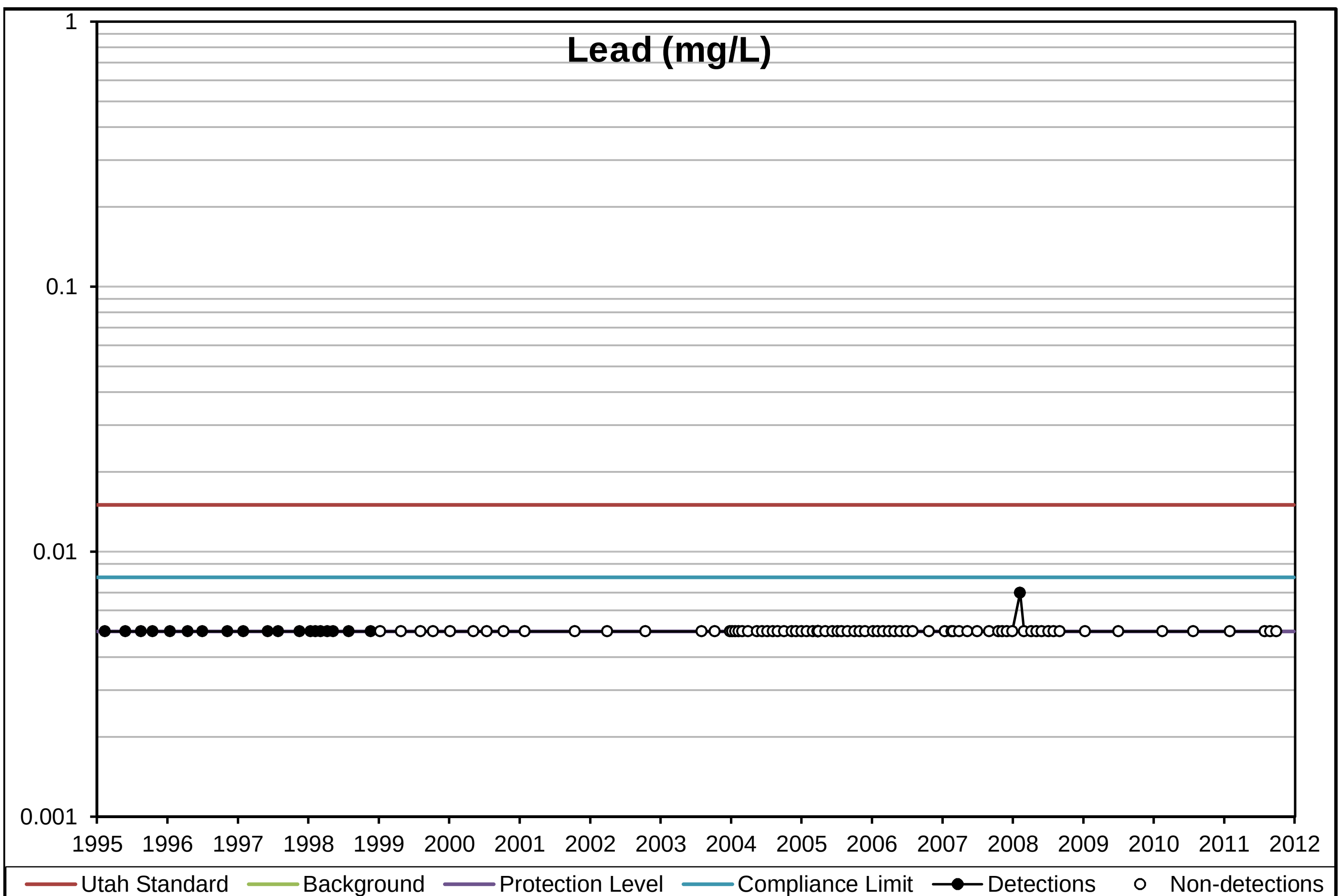
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



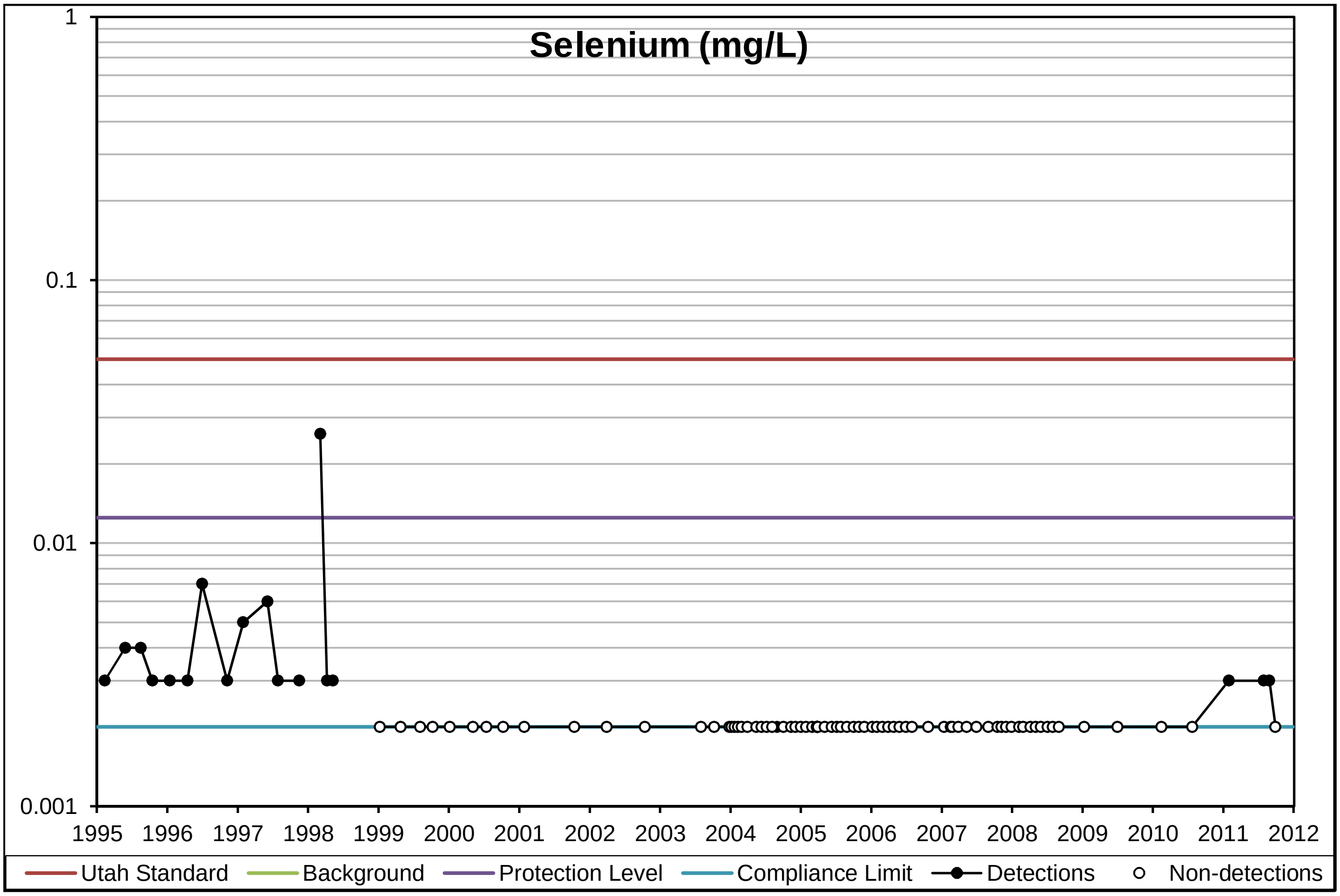


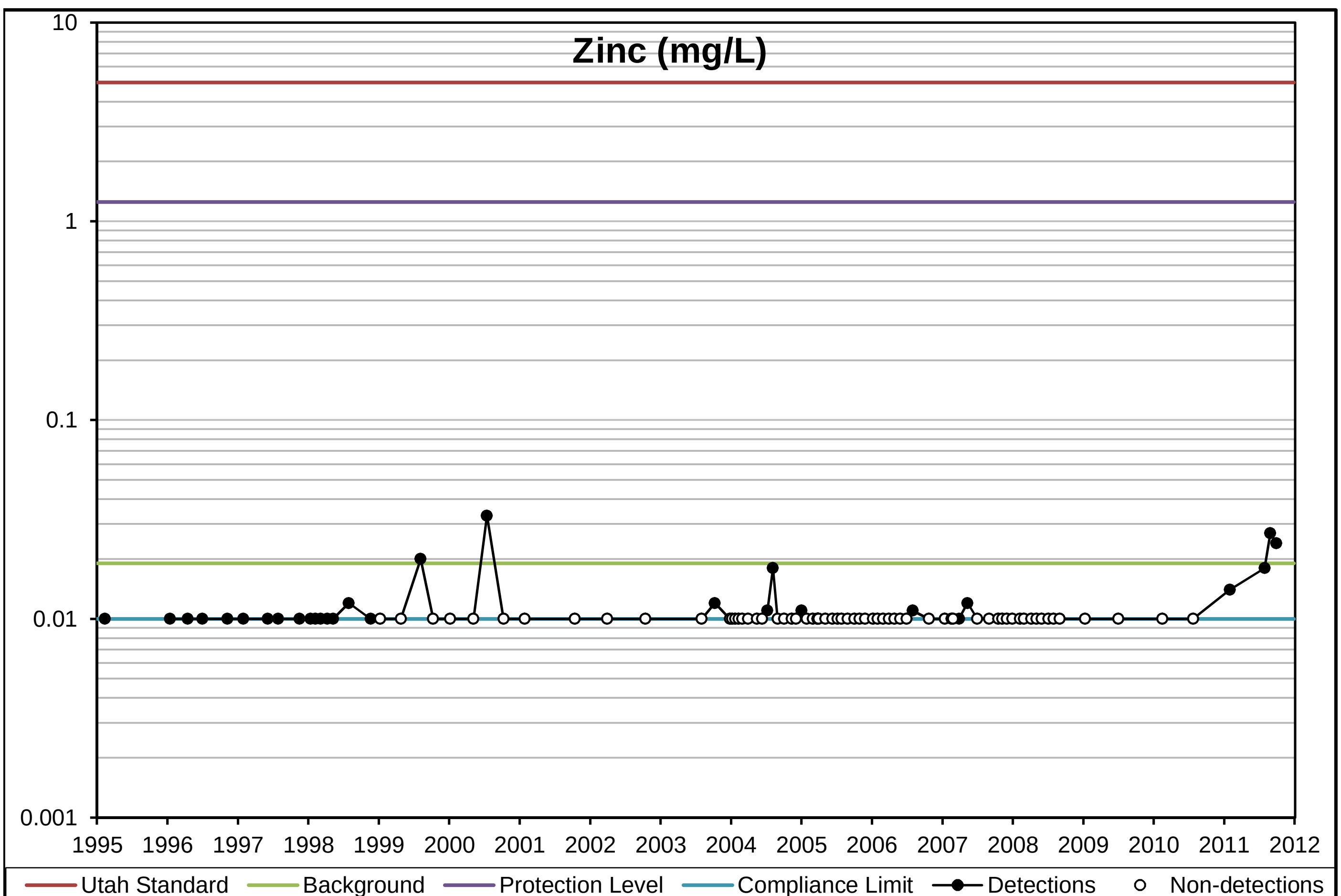
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



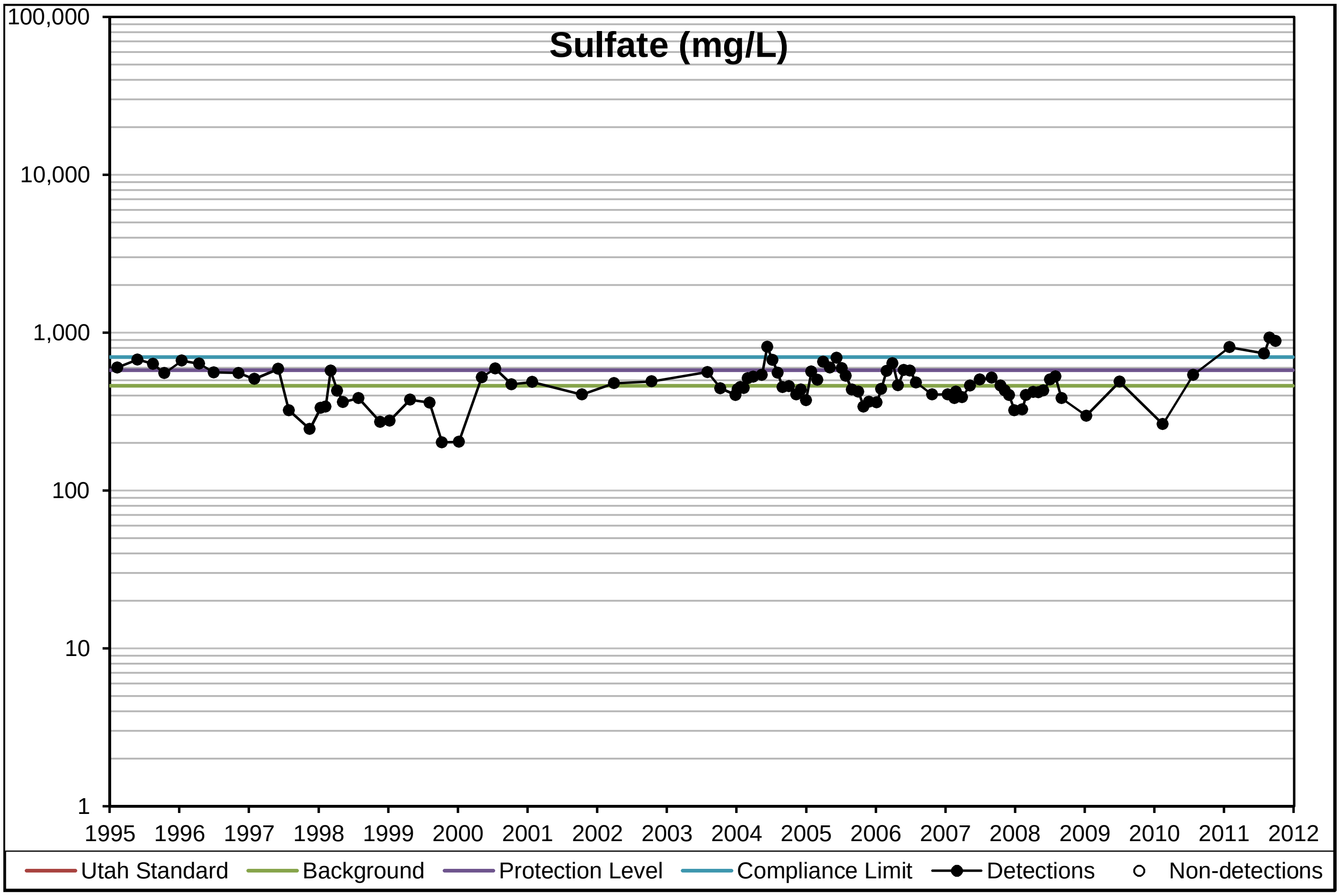


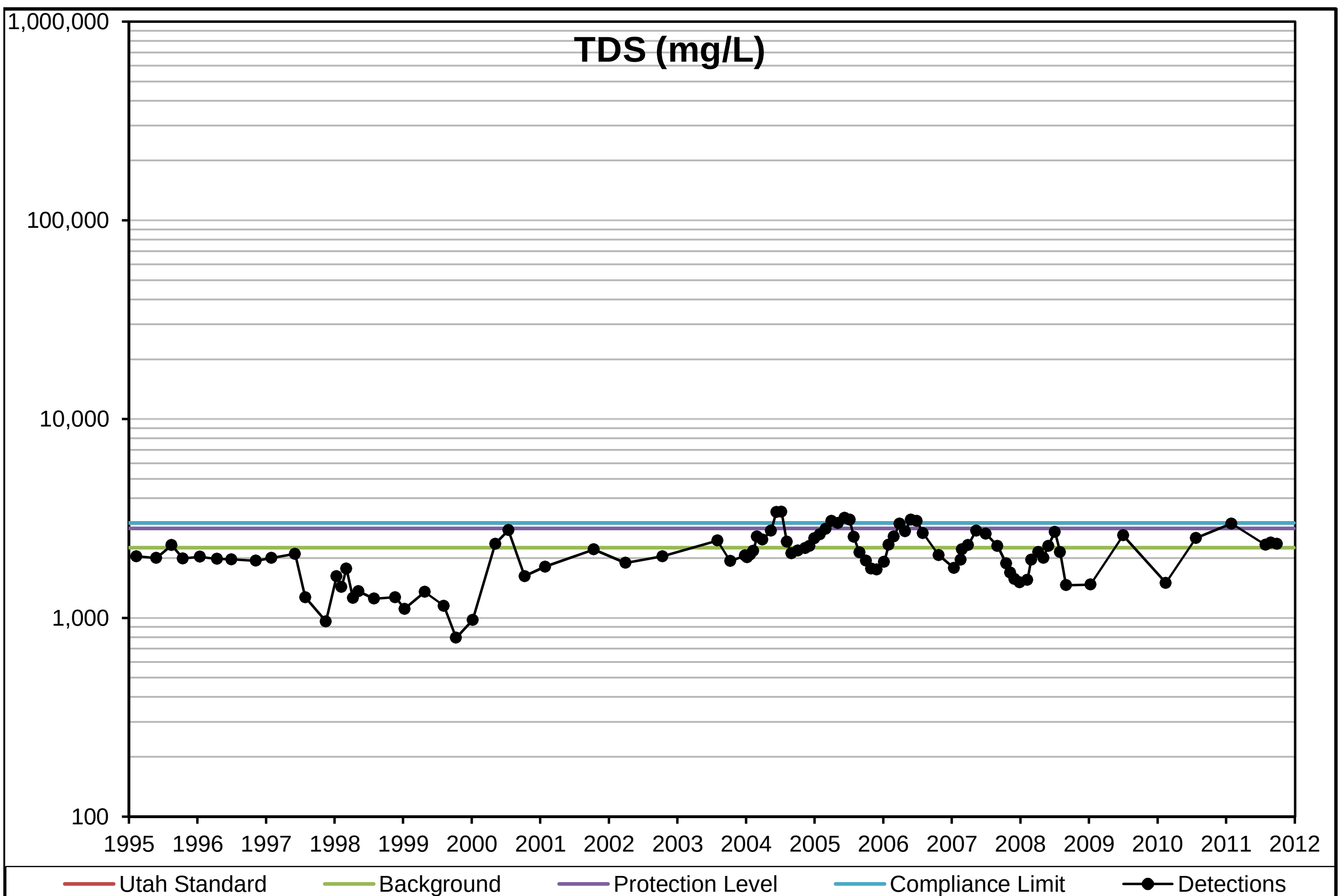
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



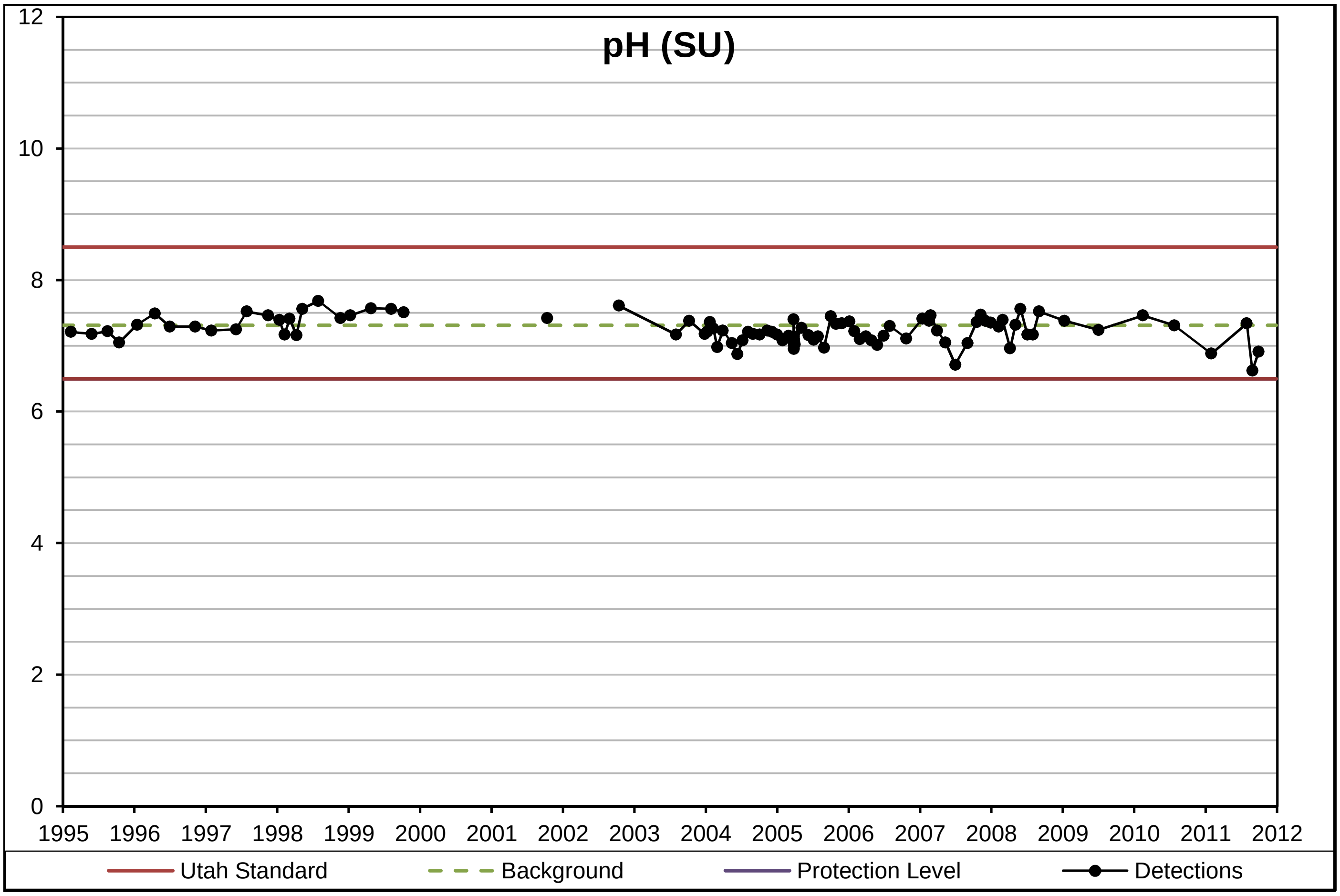


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604A

Concentration Versus Year



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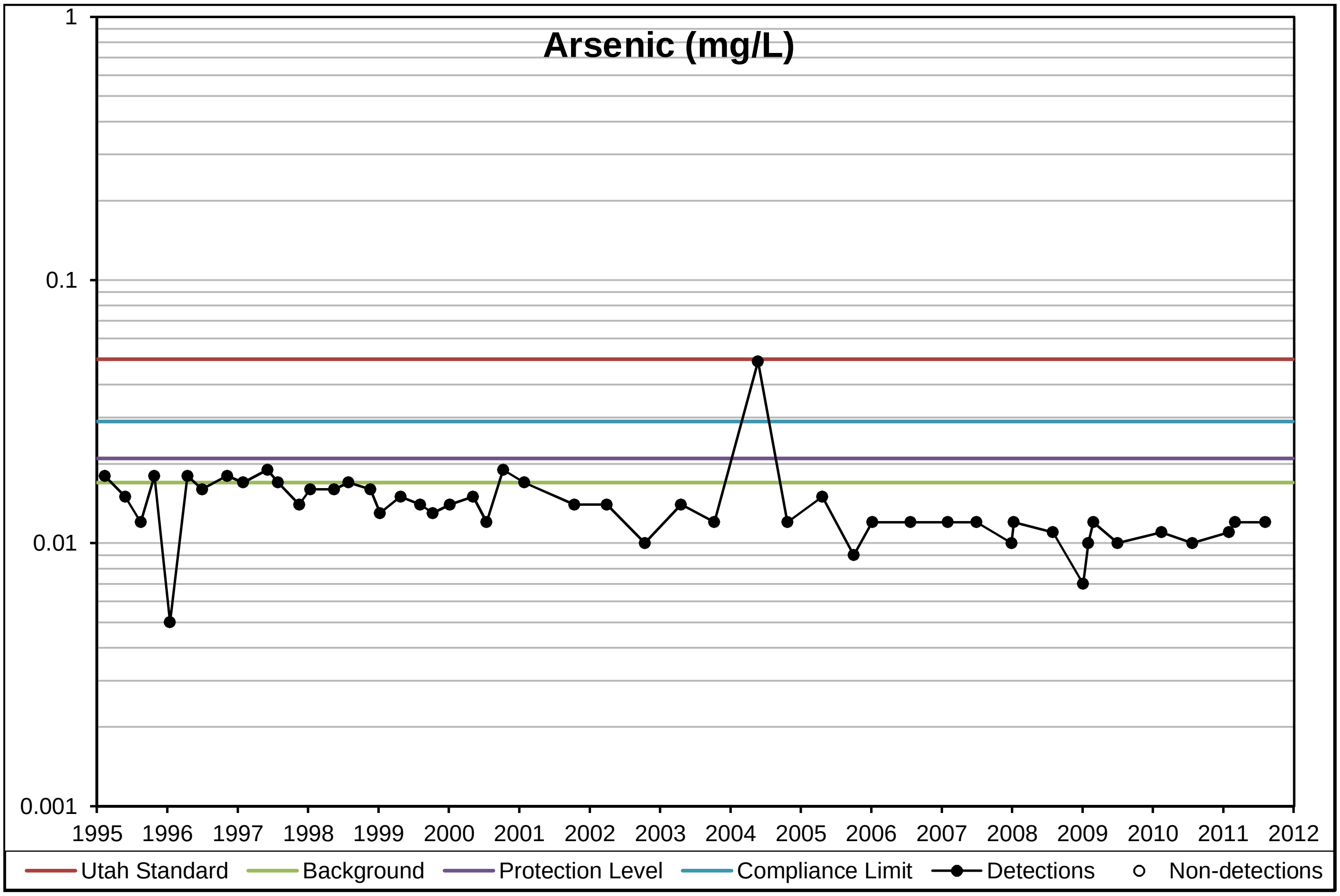
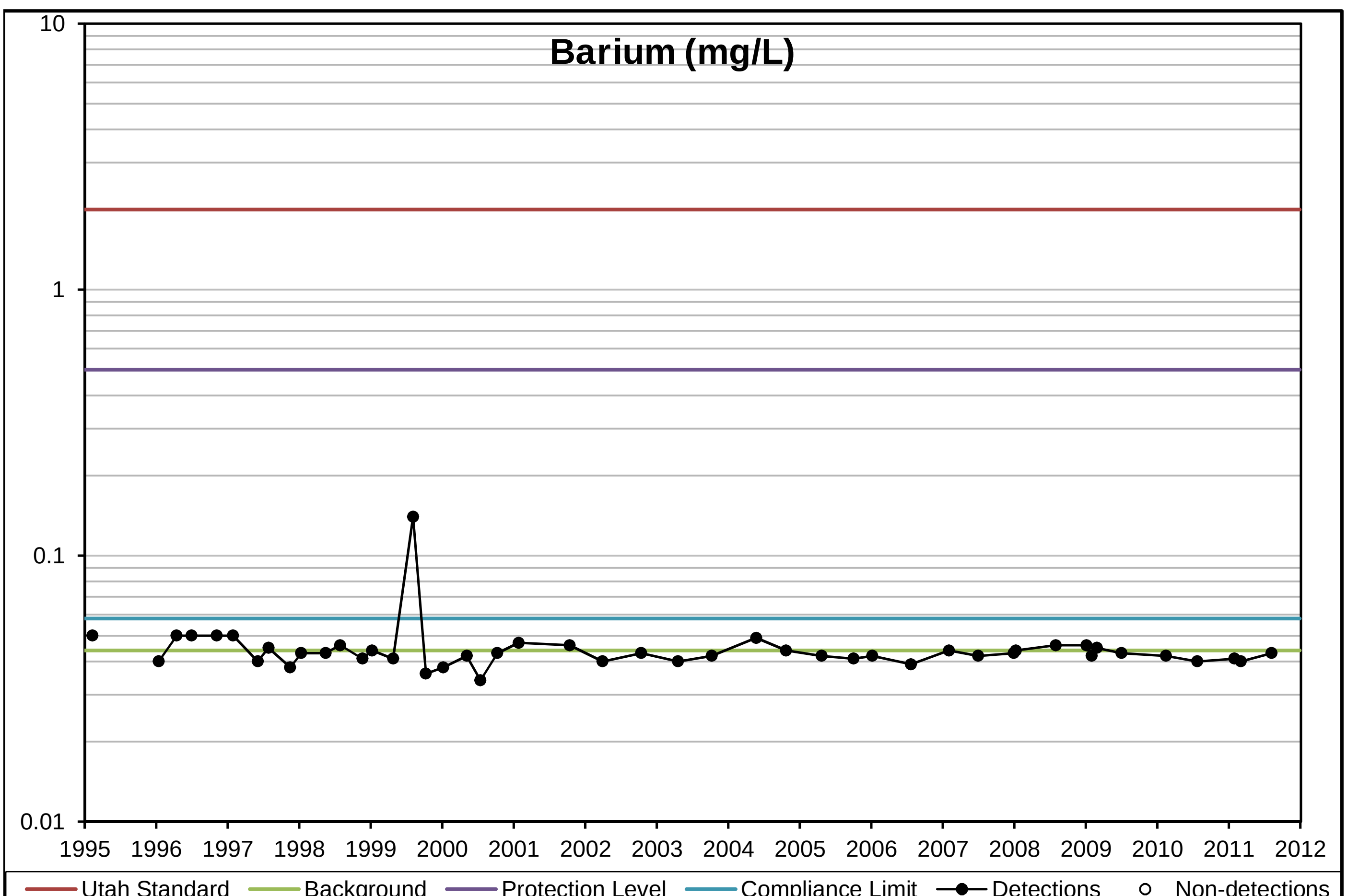
Constituent range includes minimum and maximum concentrations for all wells considered

NED604B

Concentration Versus Year





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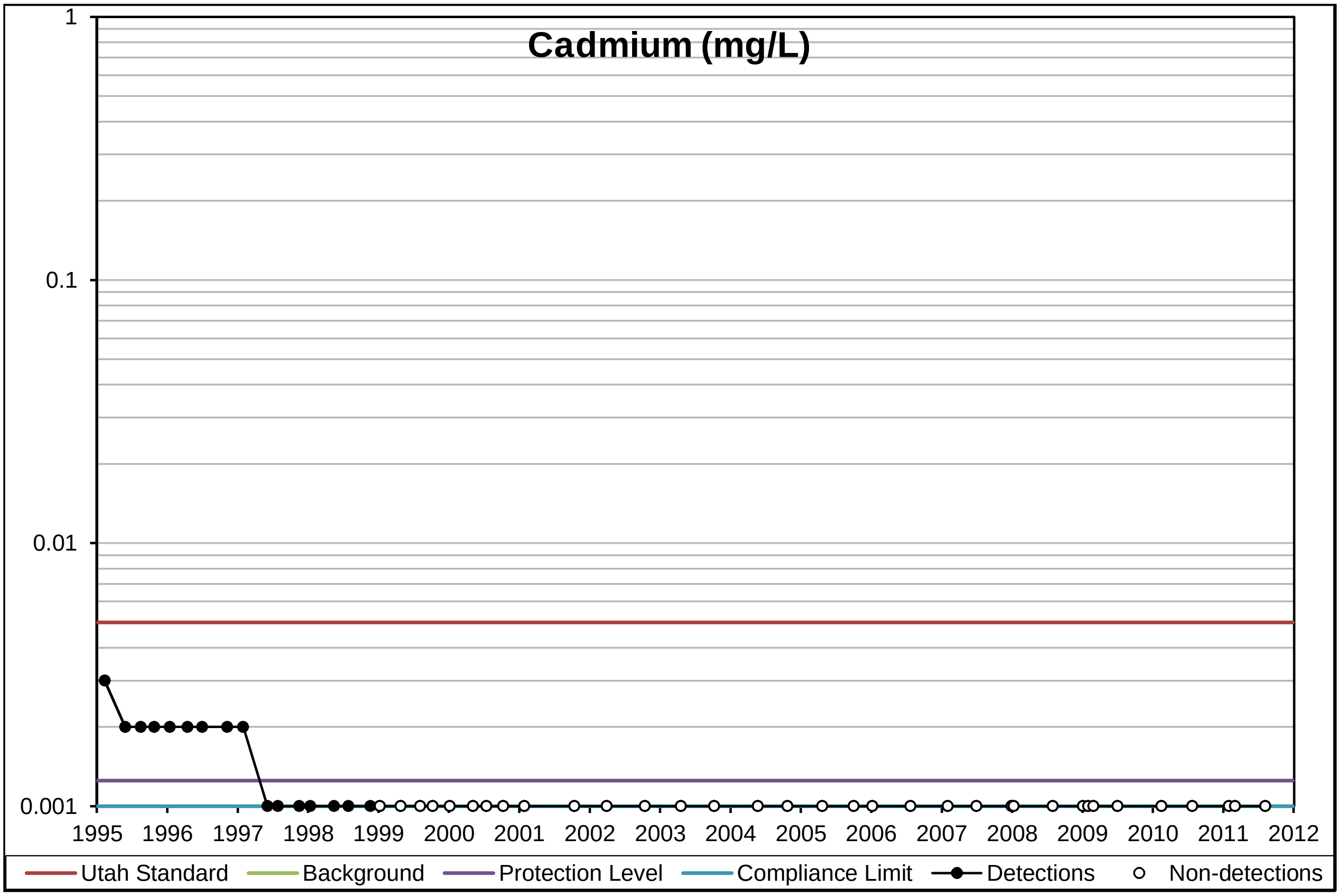
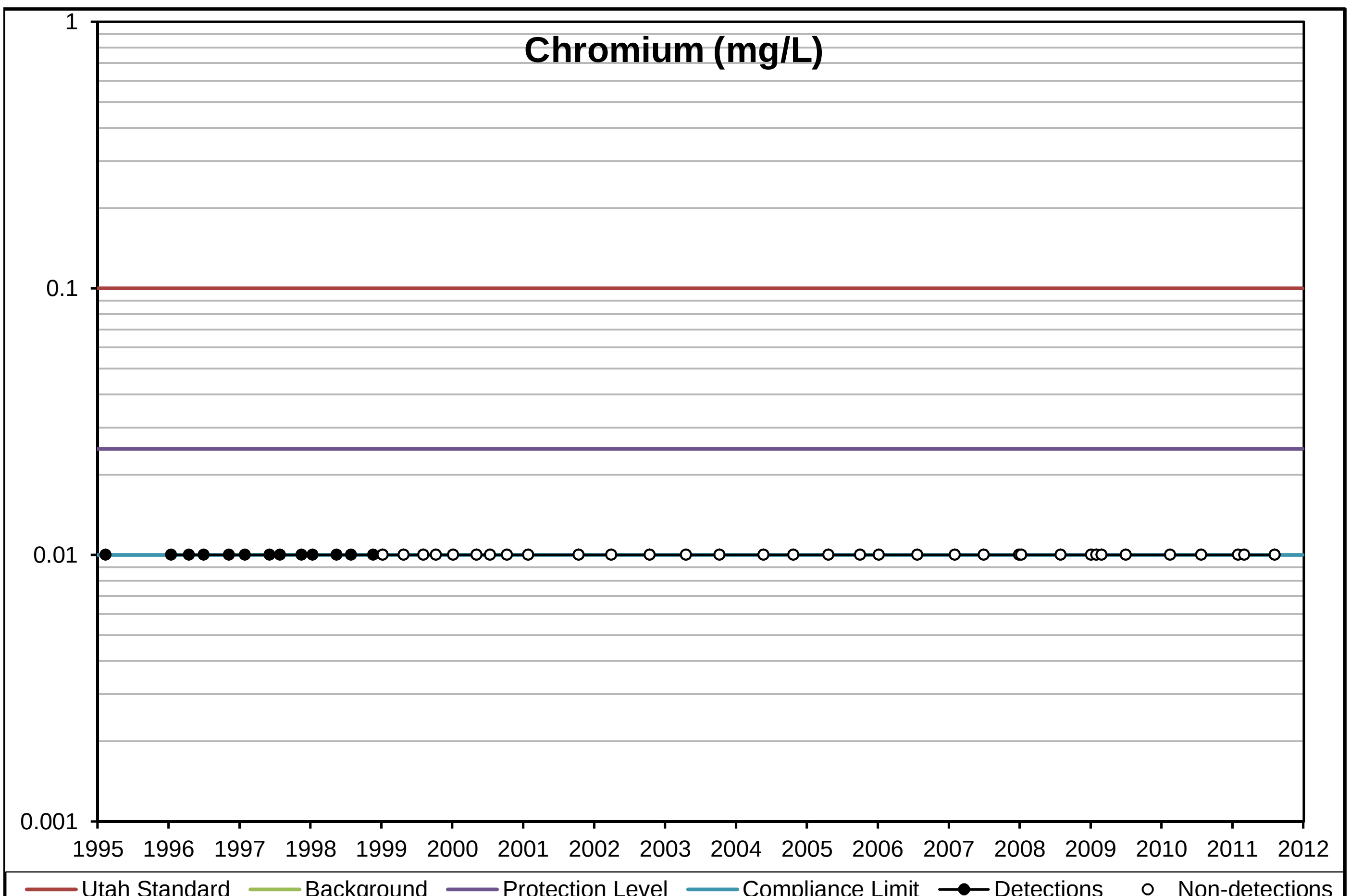
Constituent range includes minimum and maximum concentrations for all wells considered





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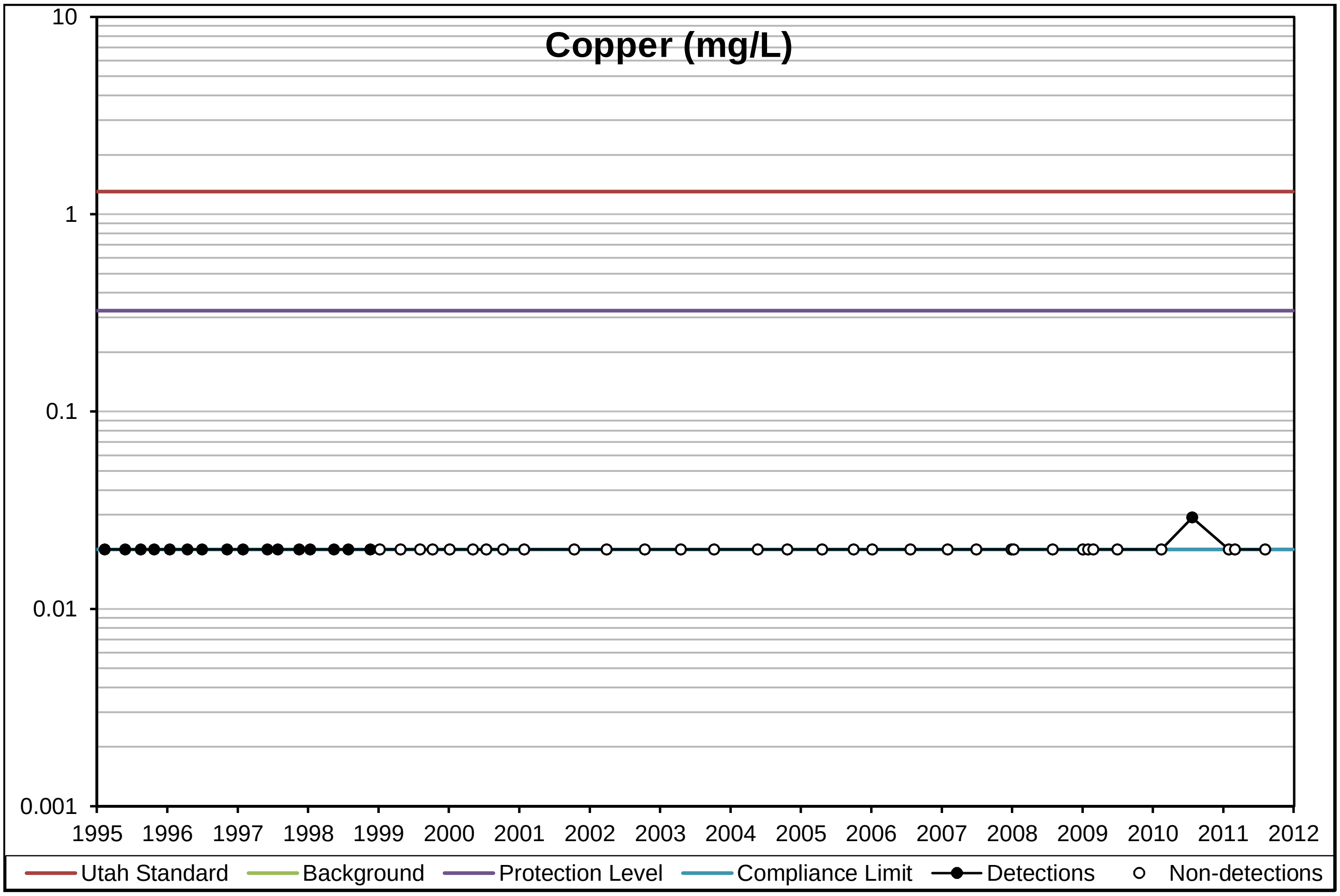
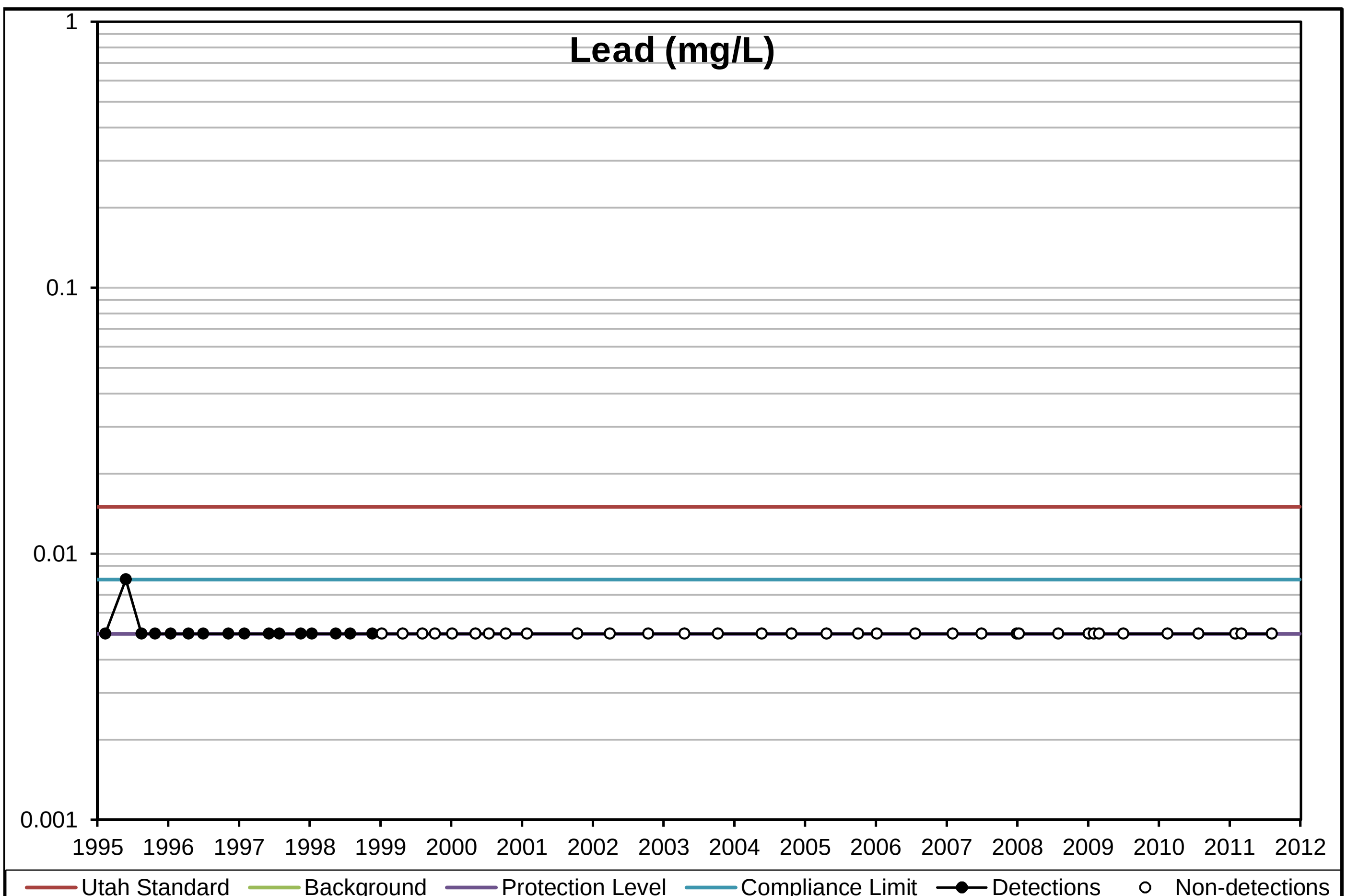
Constituent range includes minimum and maximum concentrations for all wells considered

NED604B

Concentration Versus Year



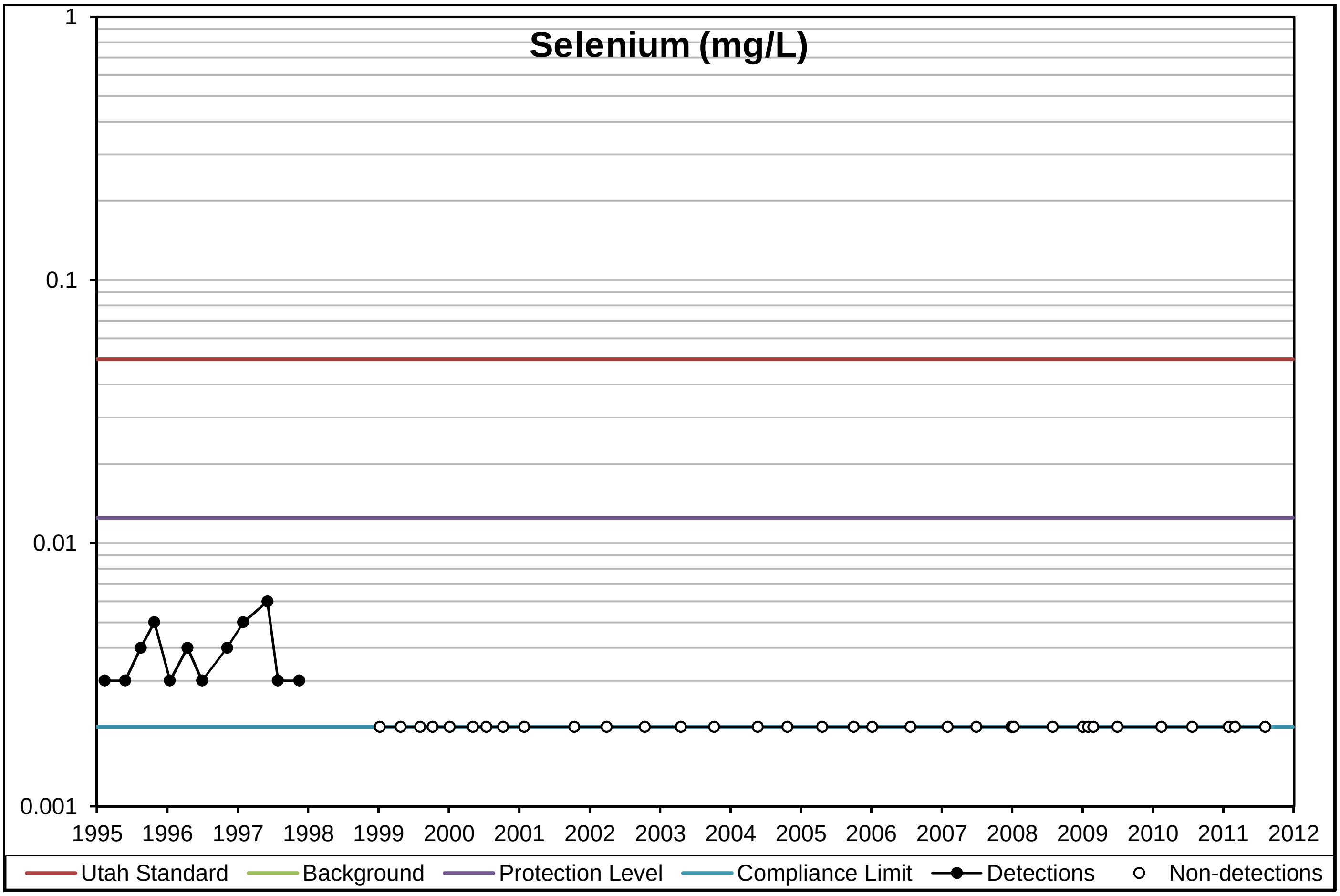


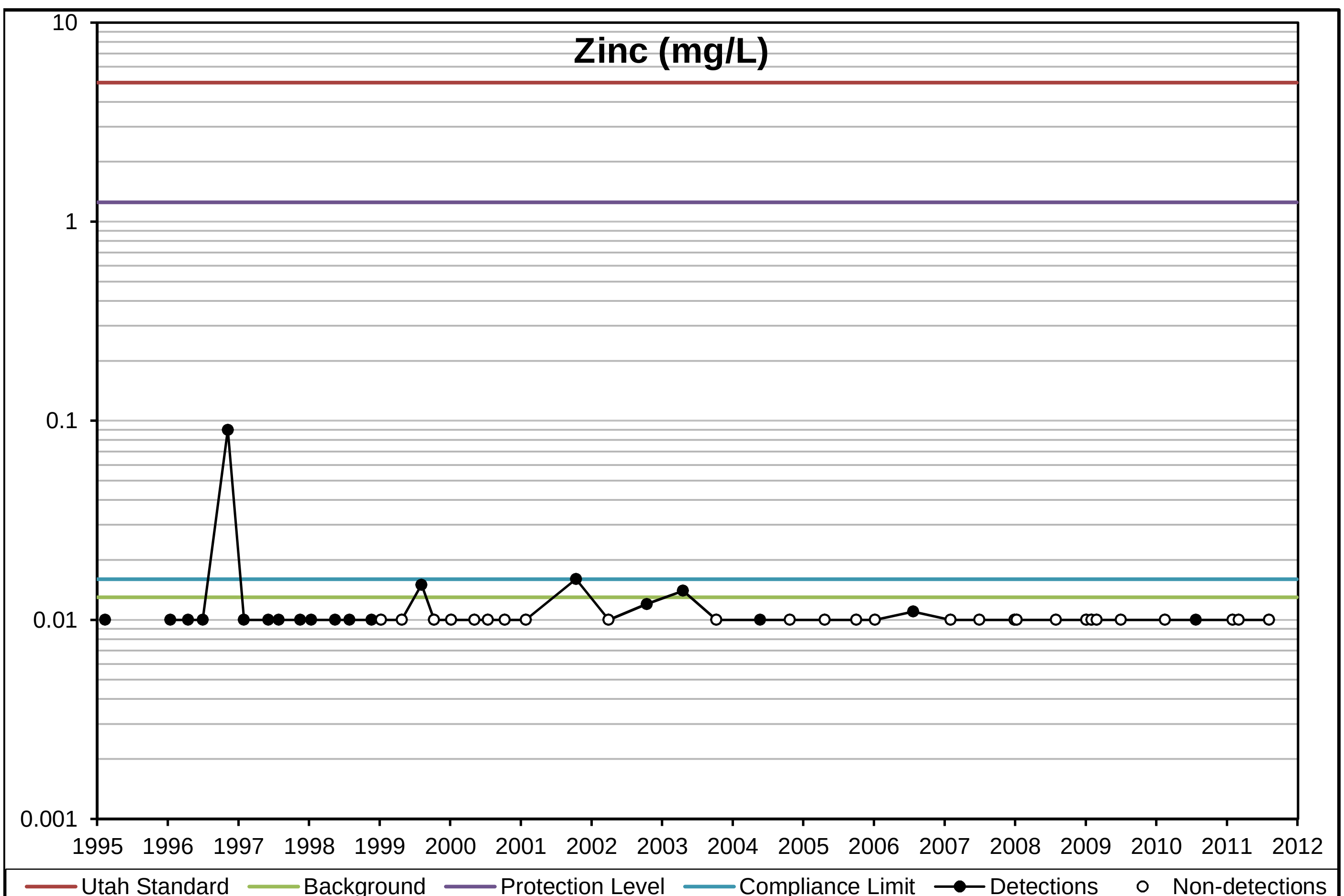
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NED604B

Concentration Versus Year





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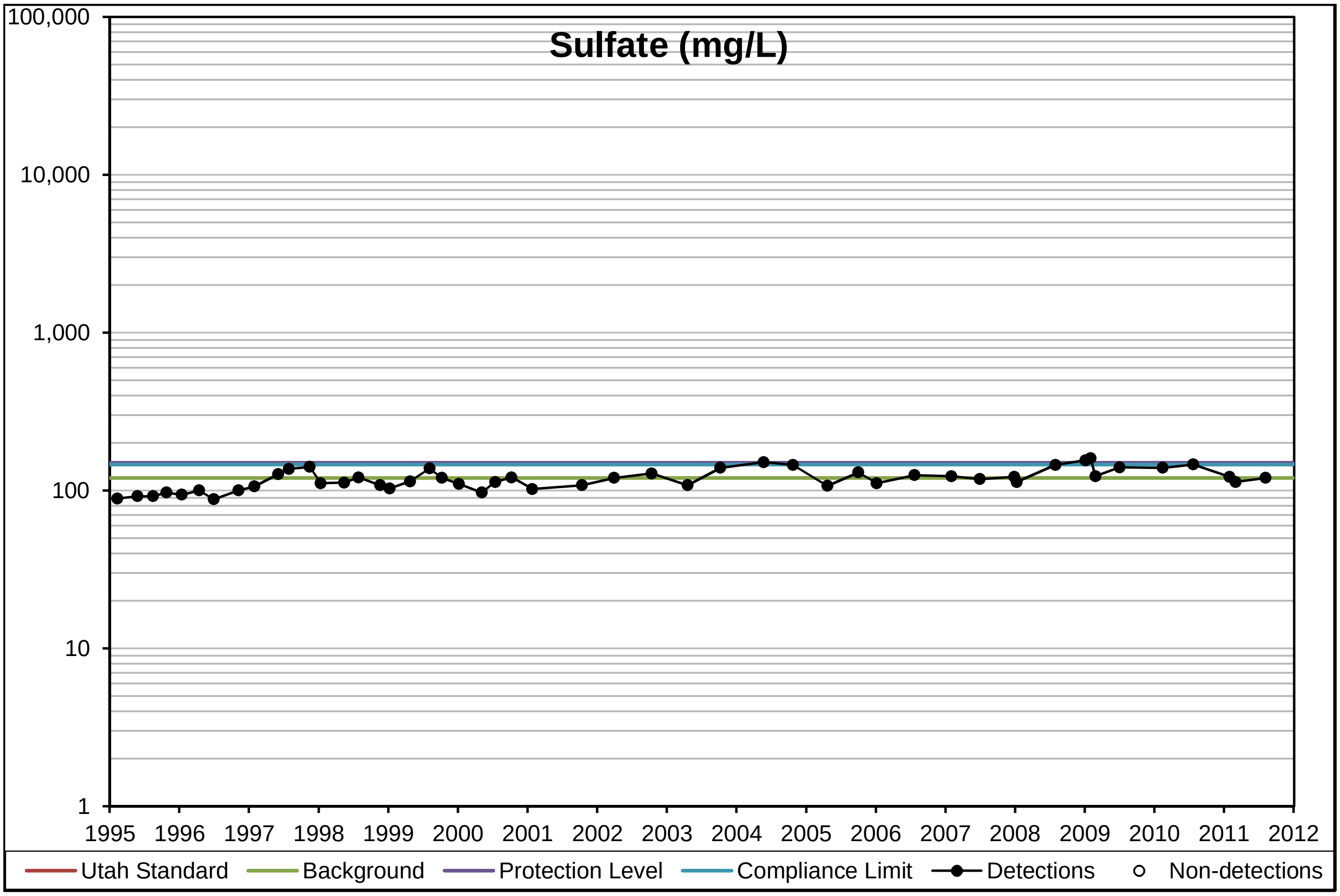
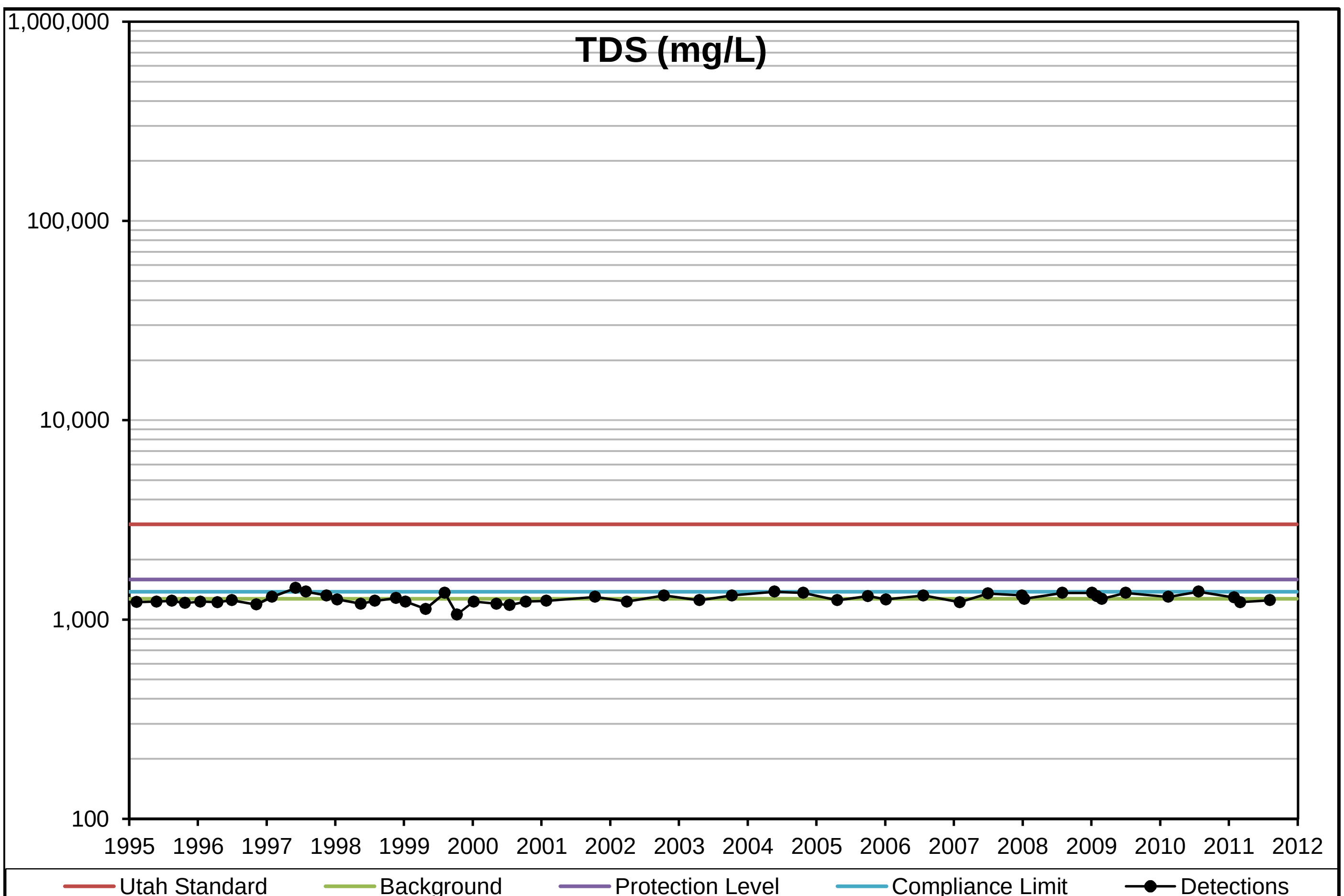
Constituent range includes minimum and maximum concentrations for all wells considered

NED604B

Concentration Versus Year





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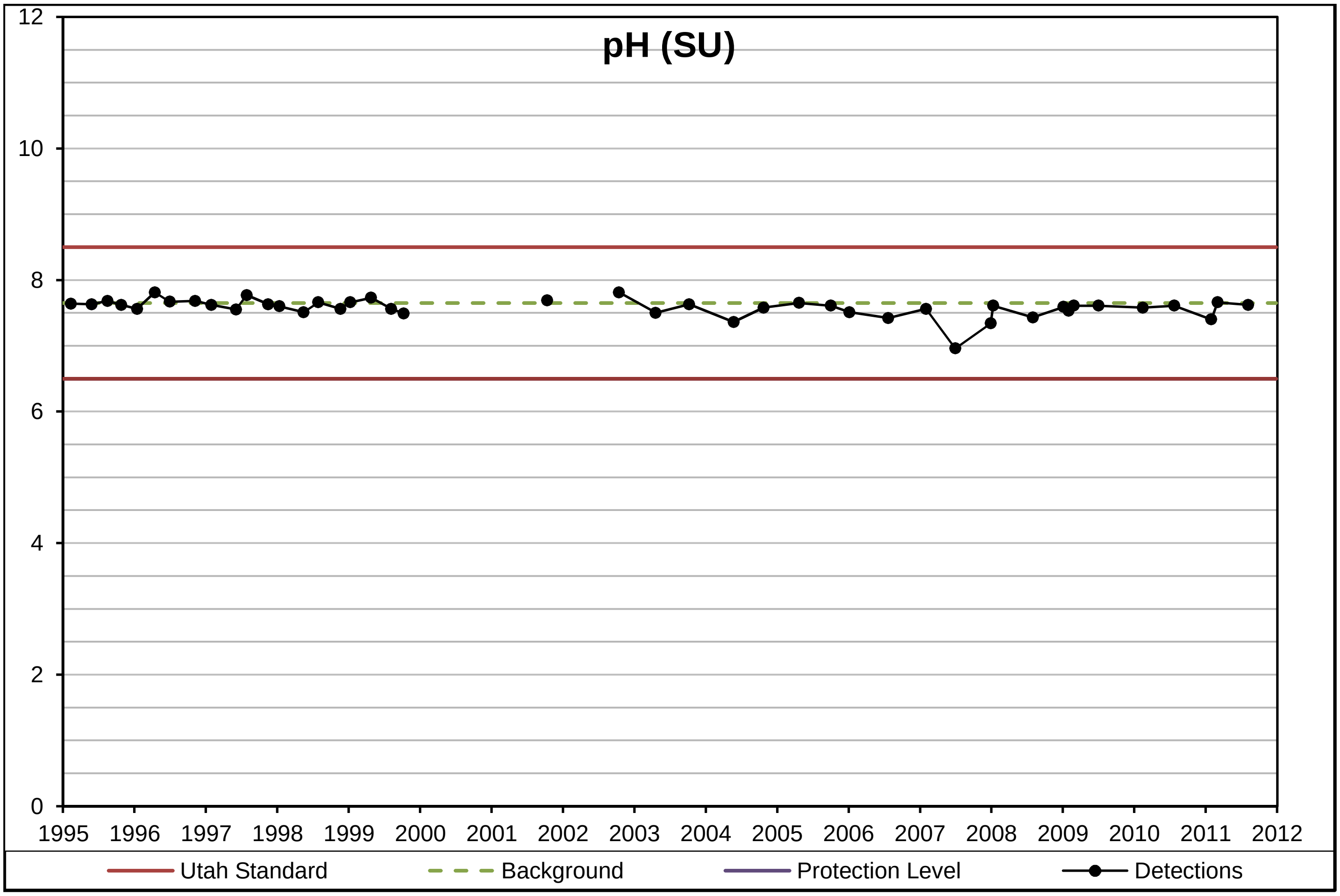
Constituent range includes minimum and maximum concentrations for all wells considered

NED604B

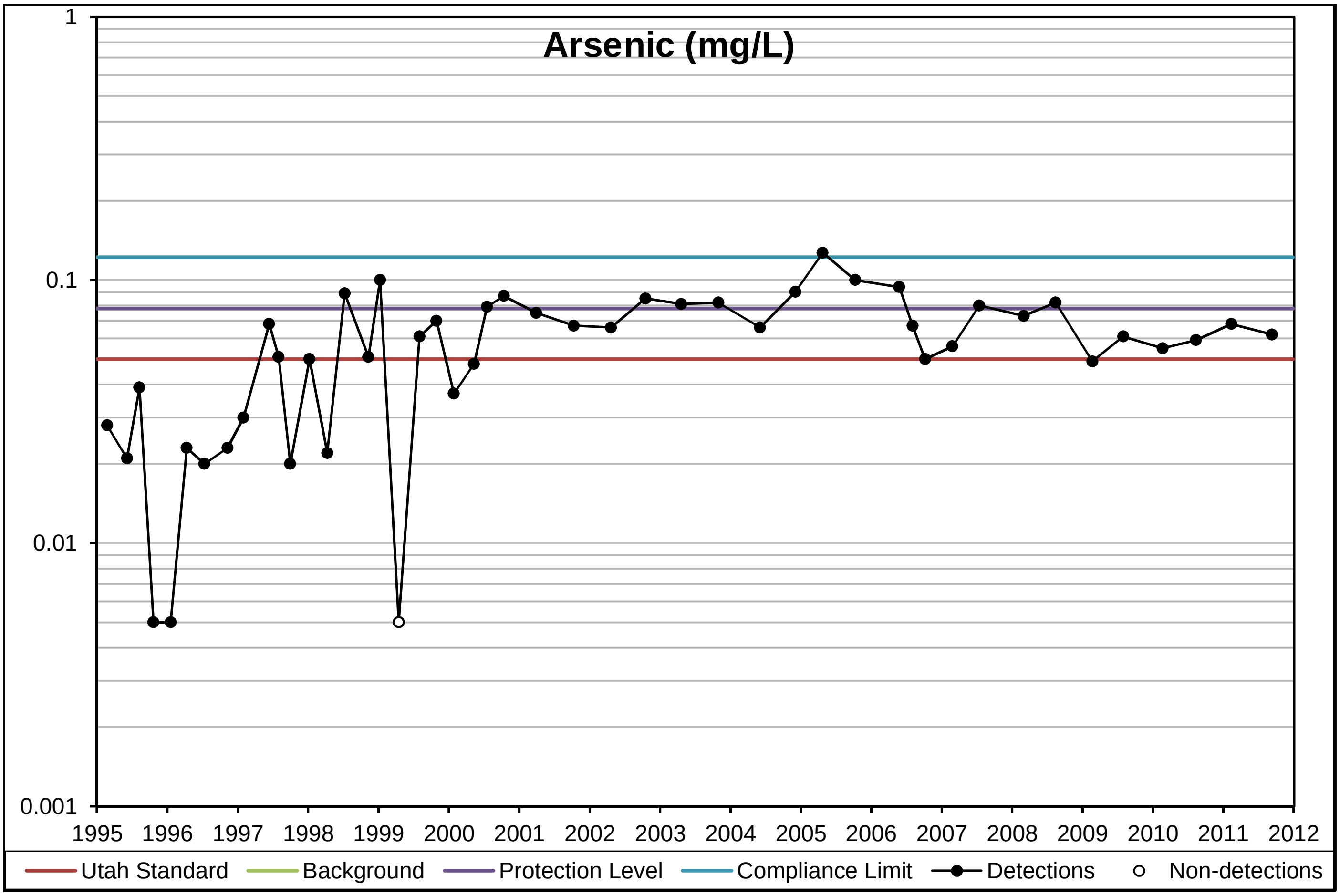
Concentration Versus Year

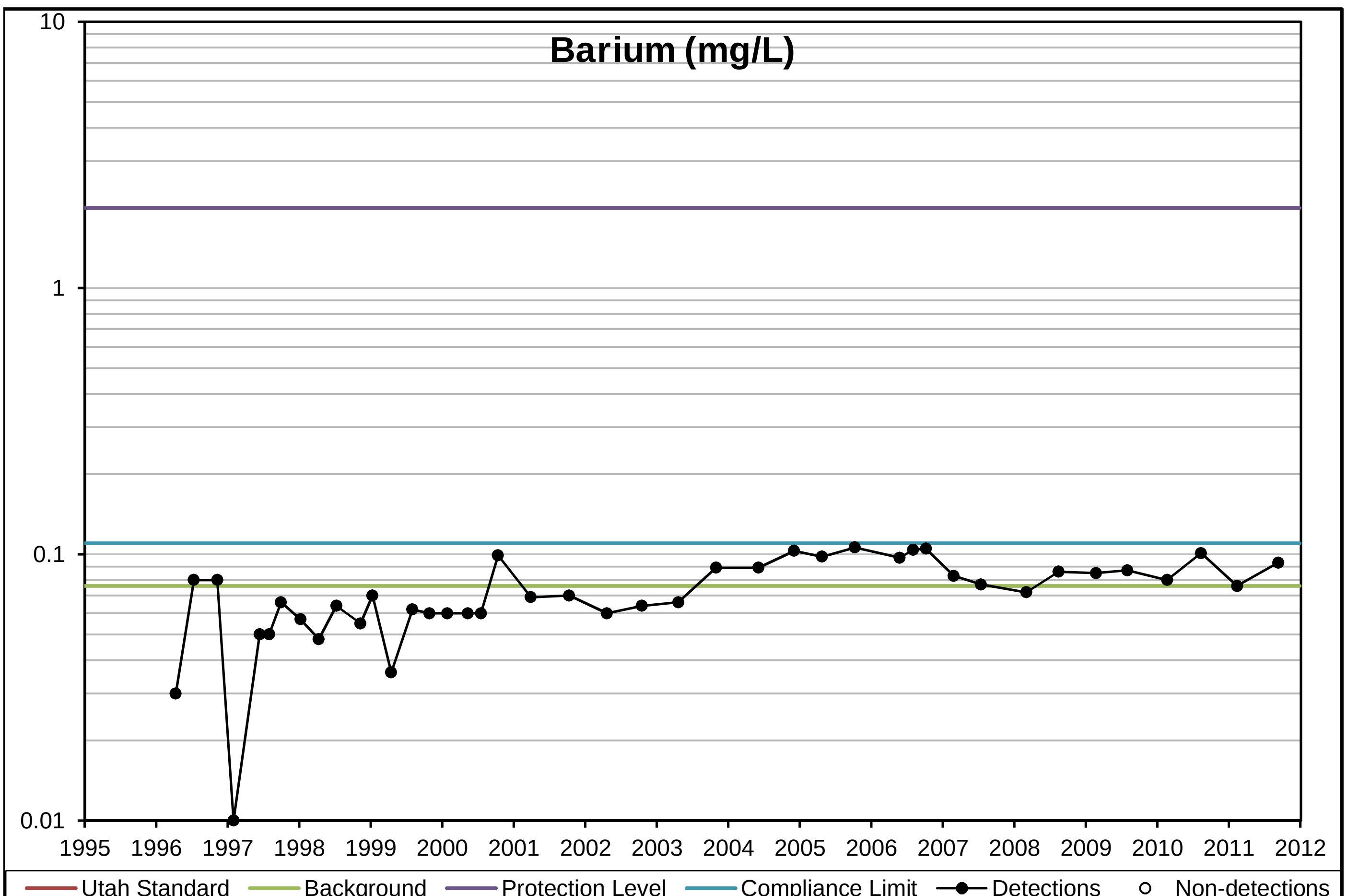


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year





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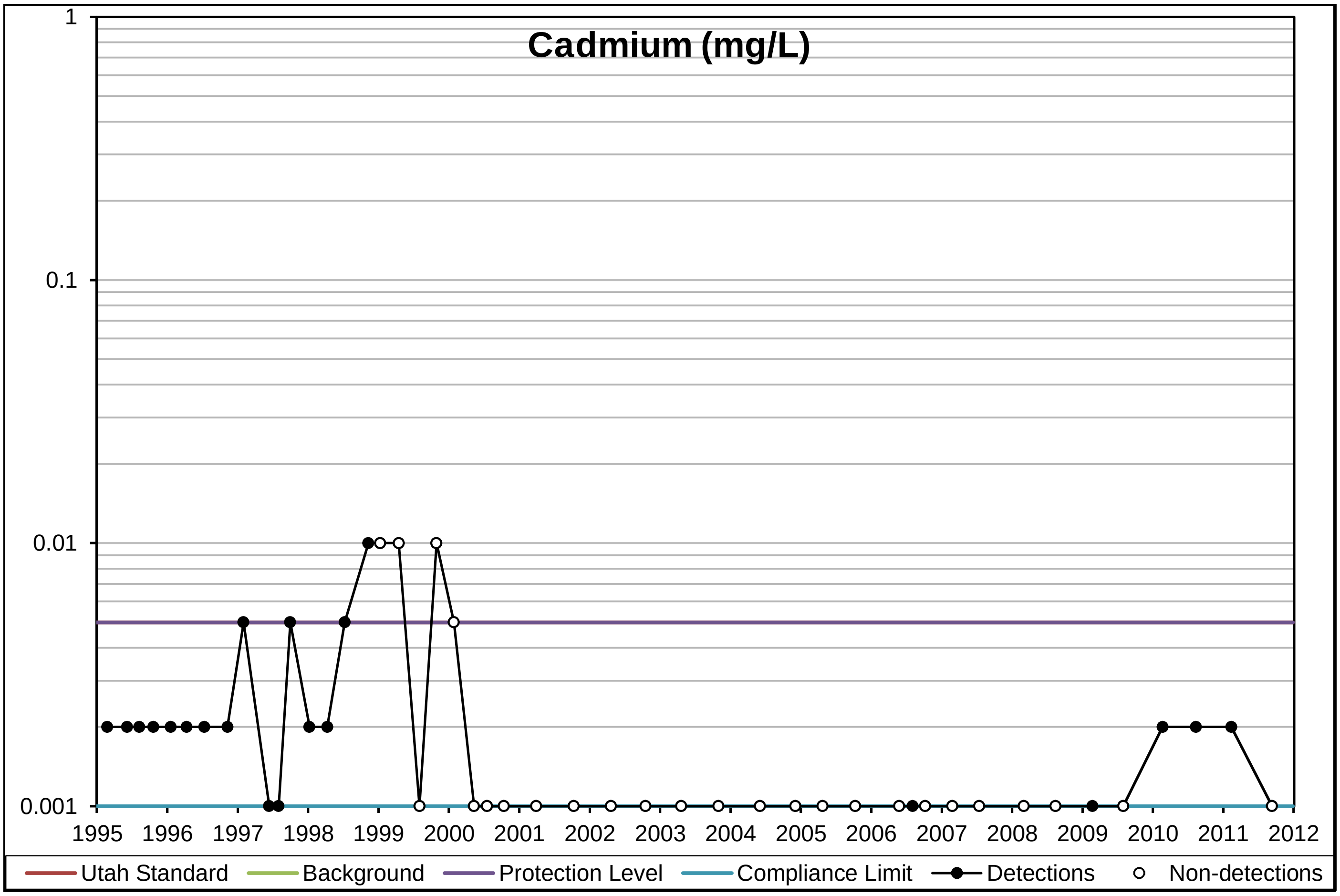
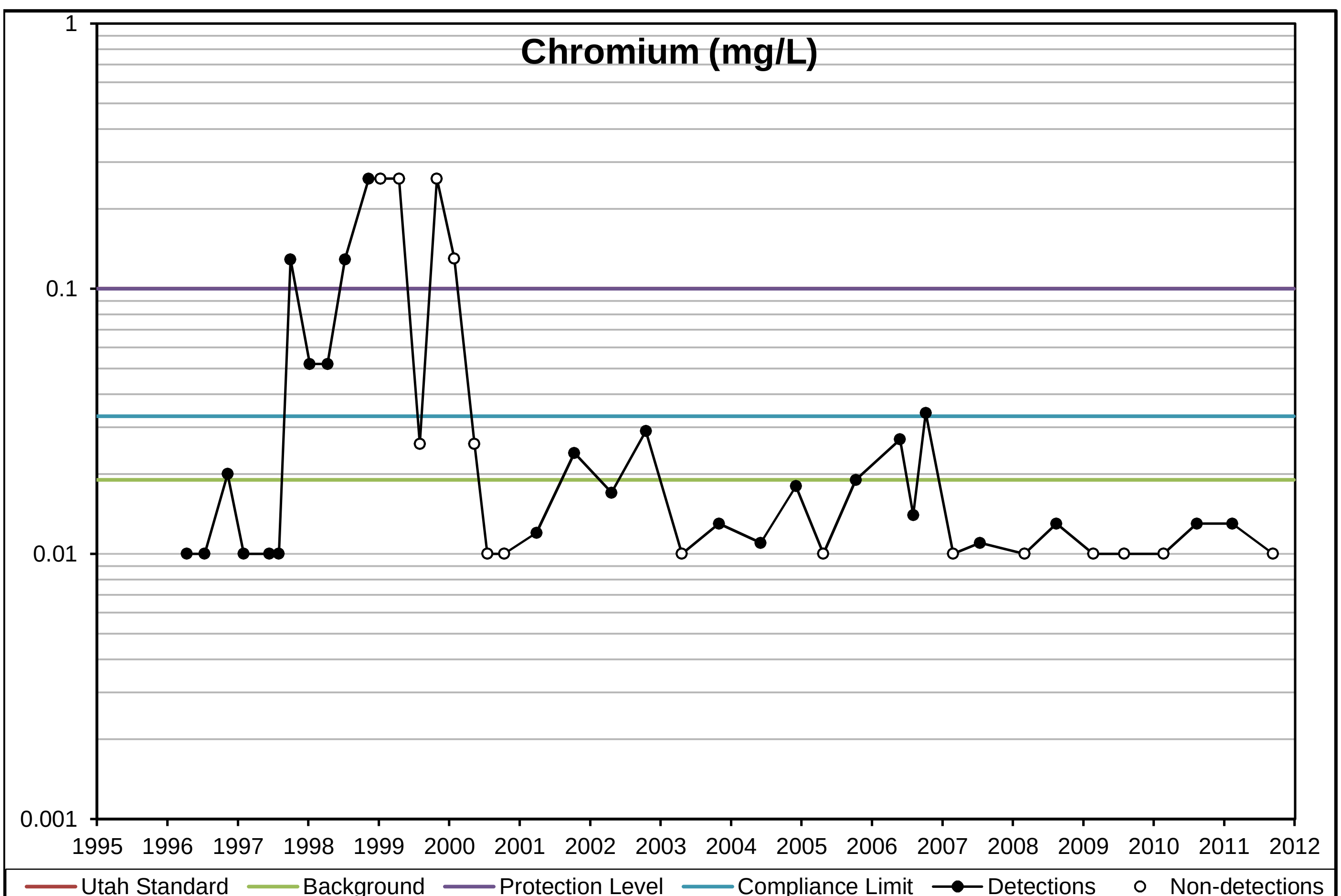
Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year





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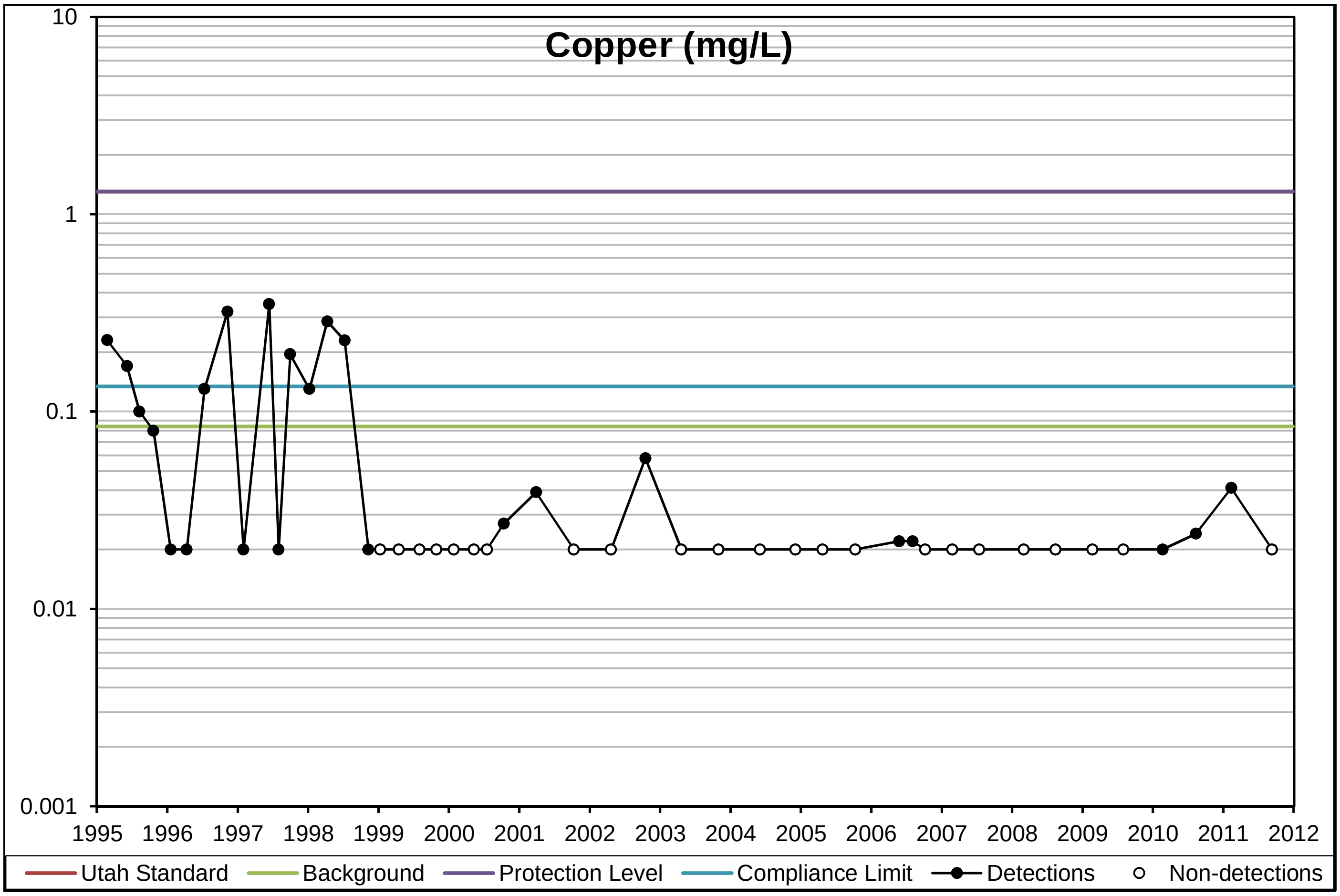
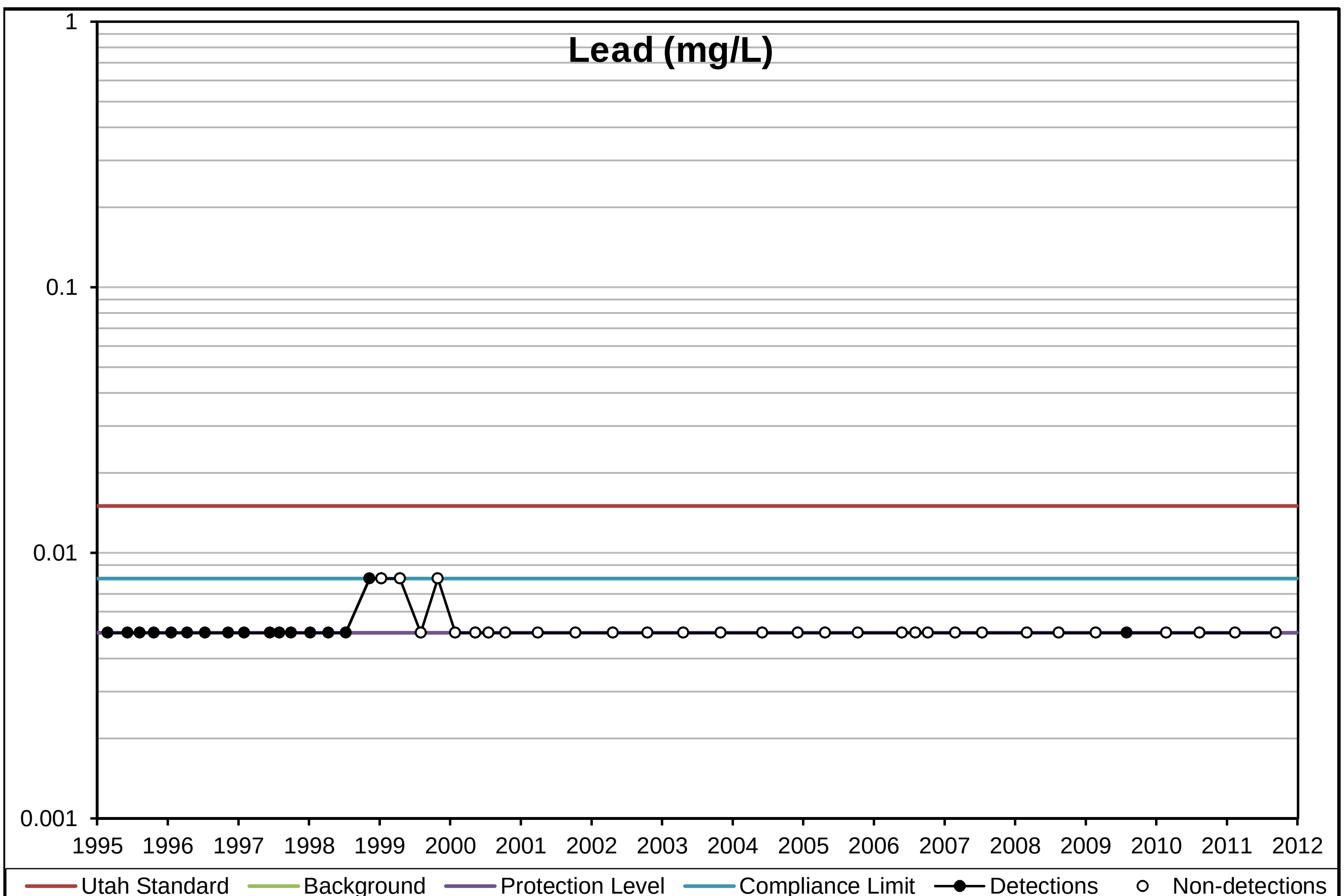
Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year



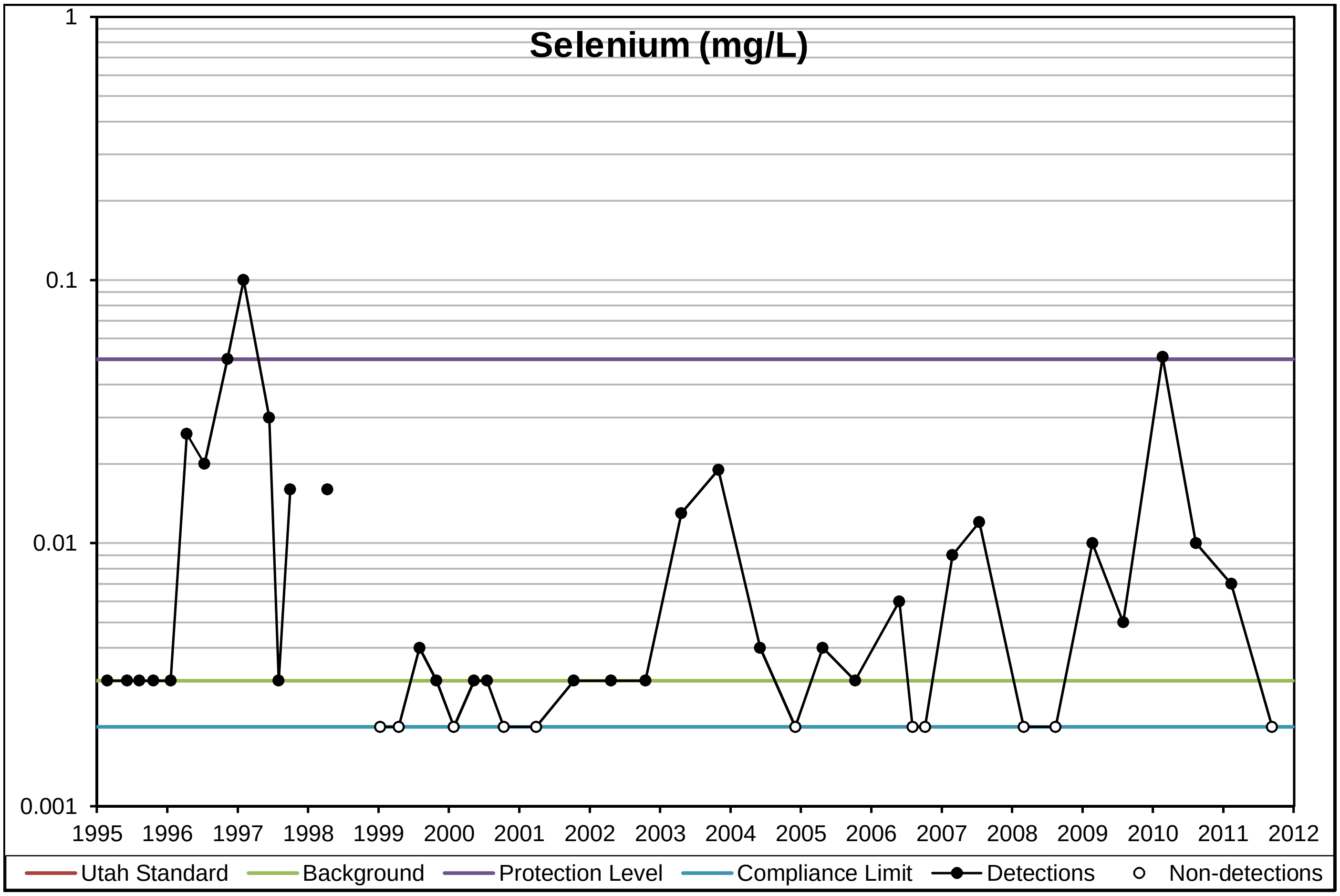


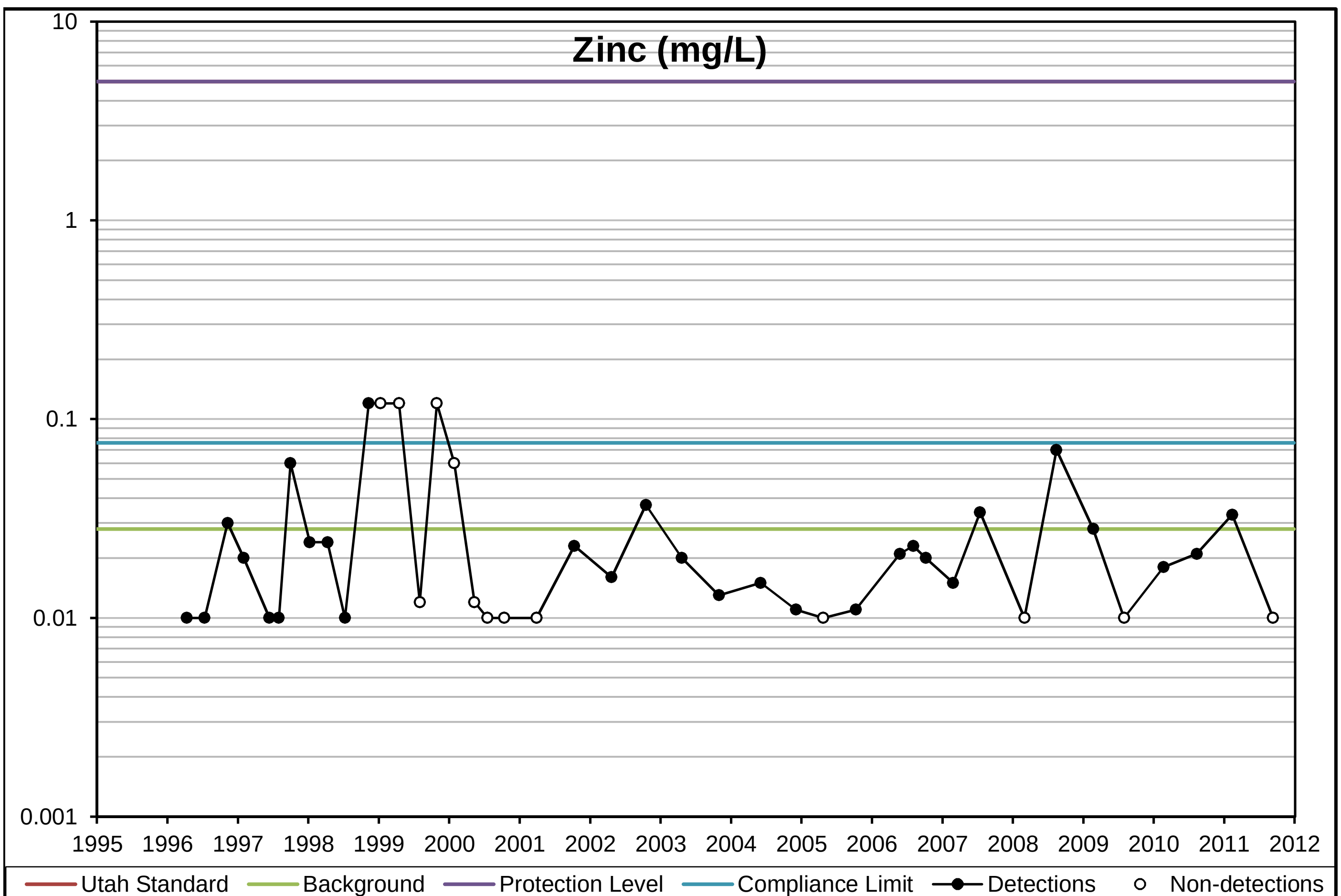
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year



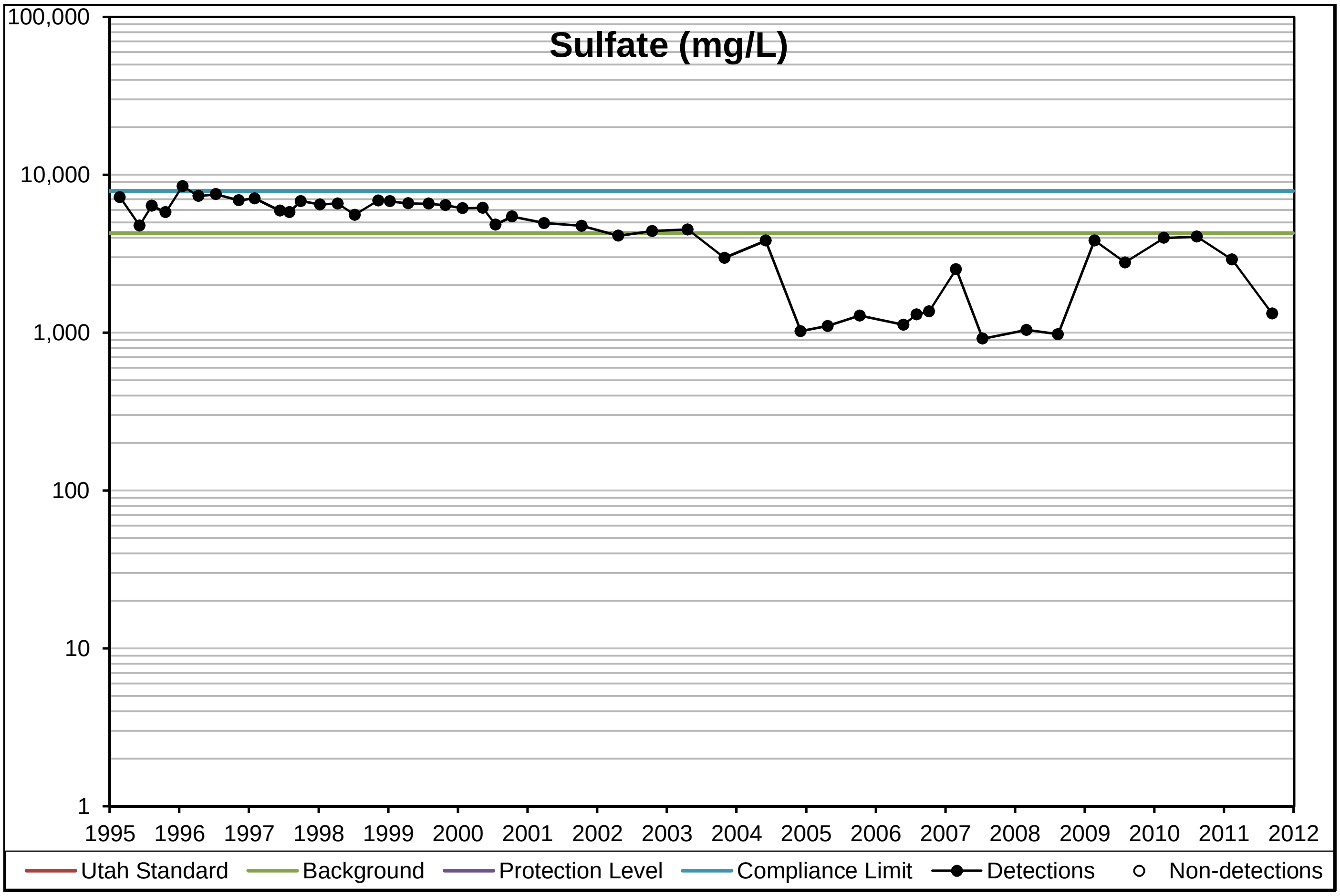


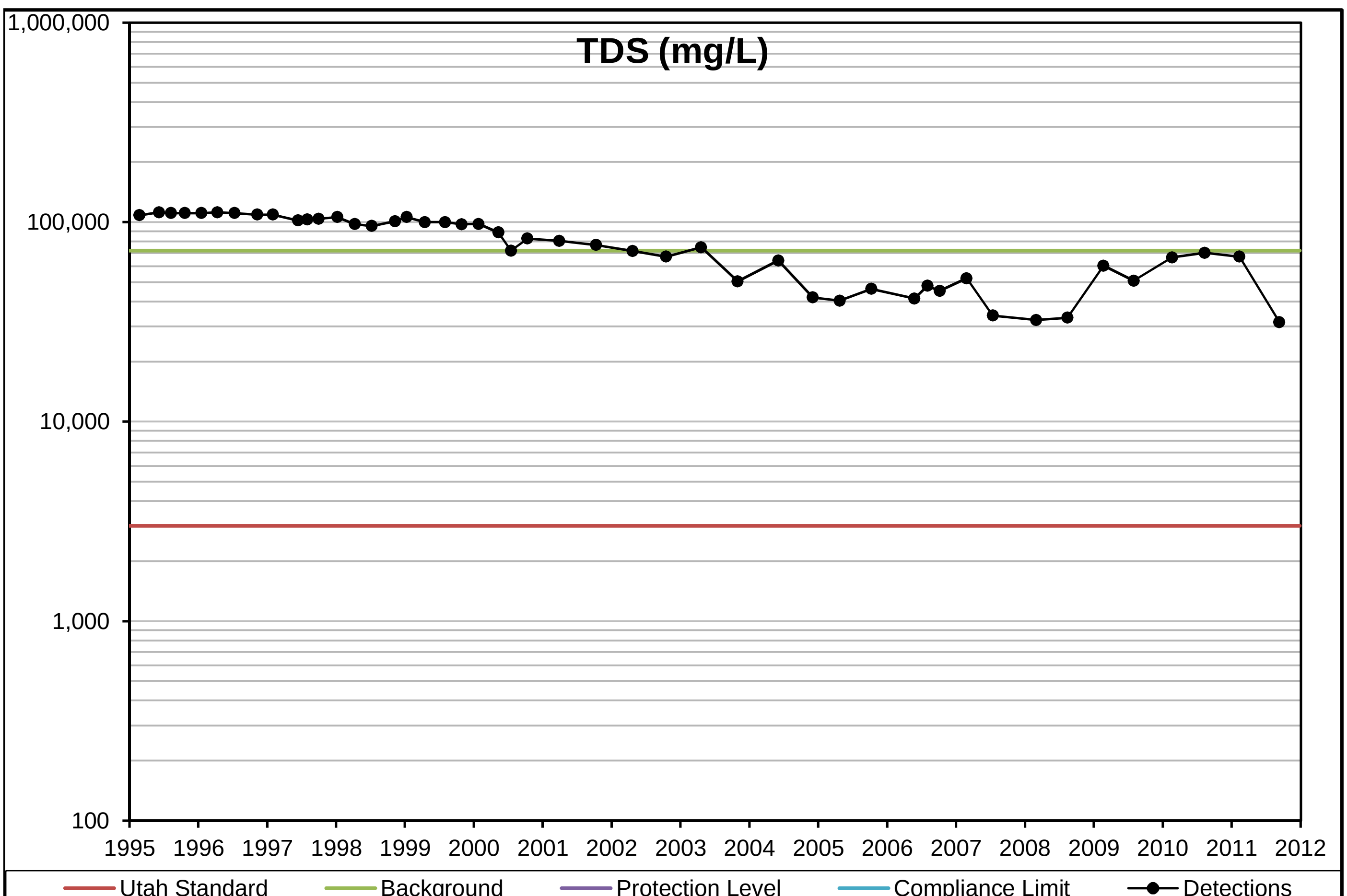
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year



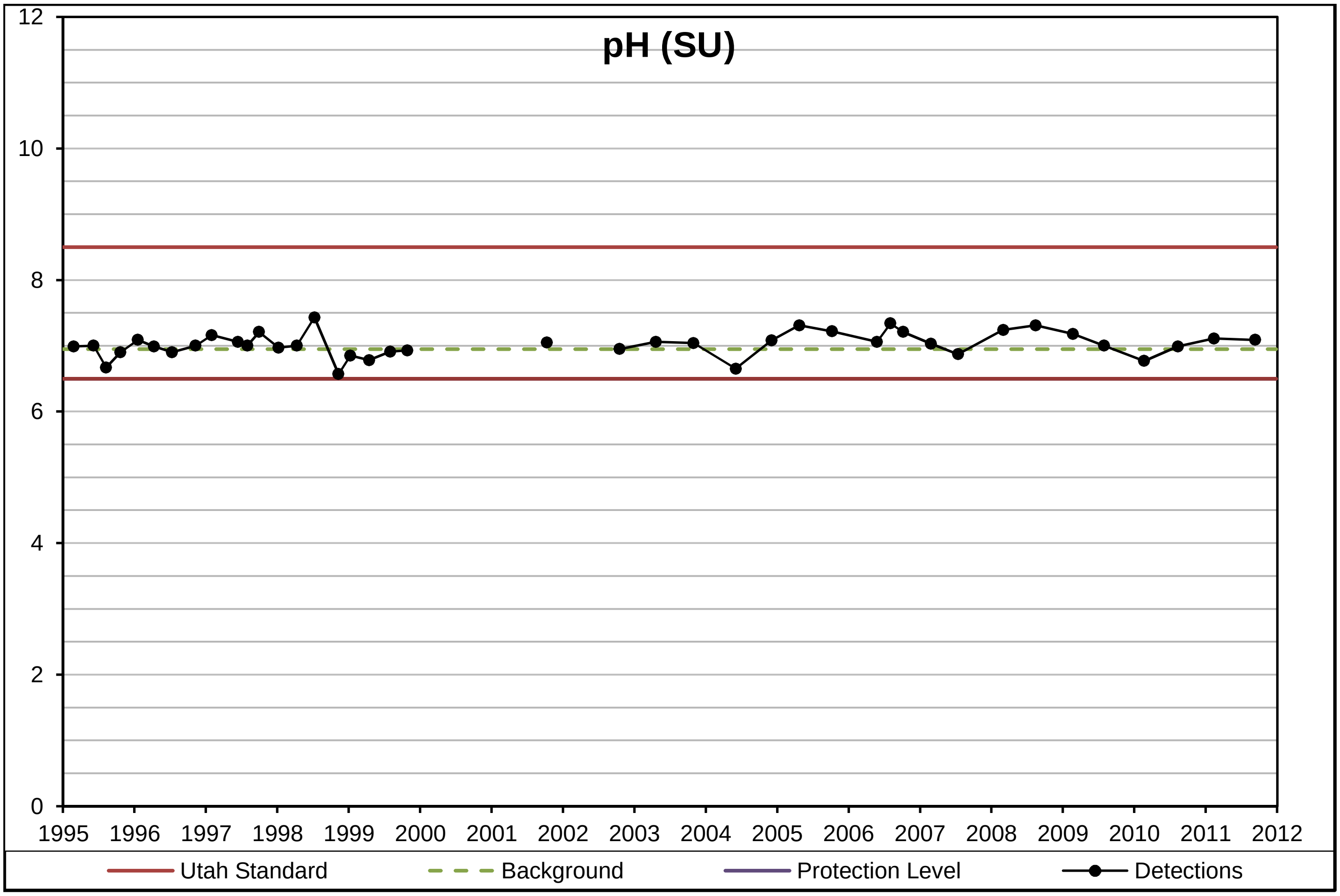


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646A

Concentration Versus Year

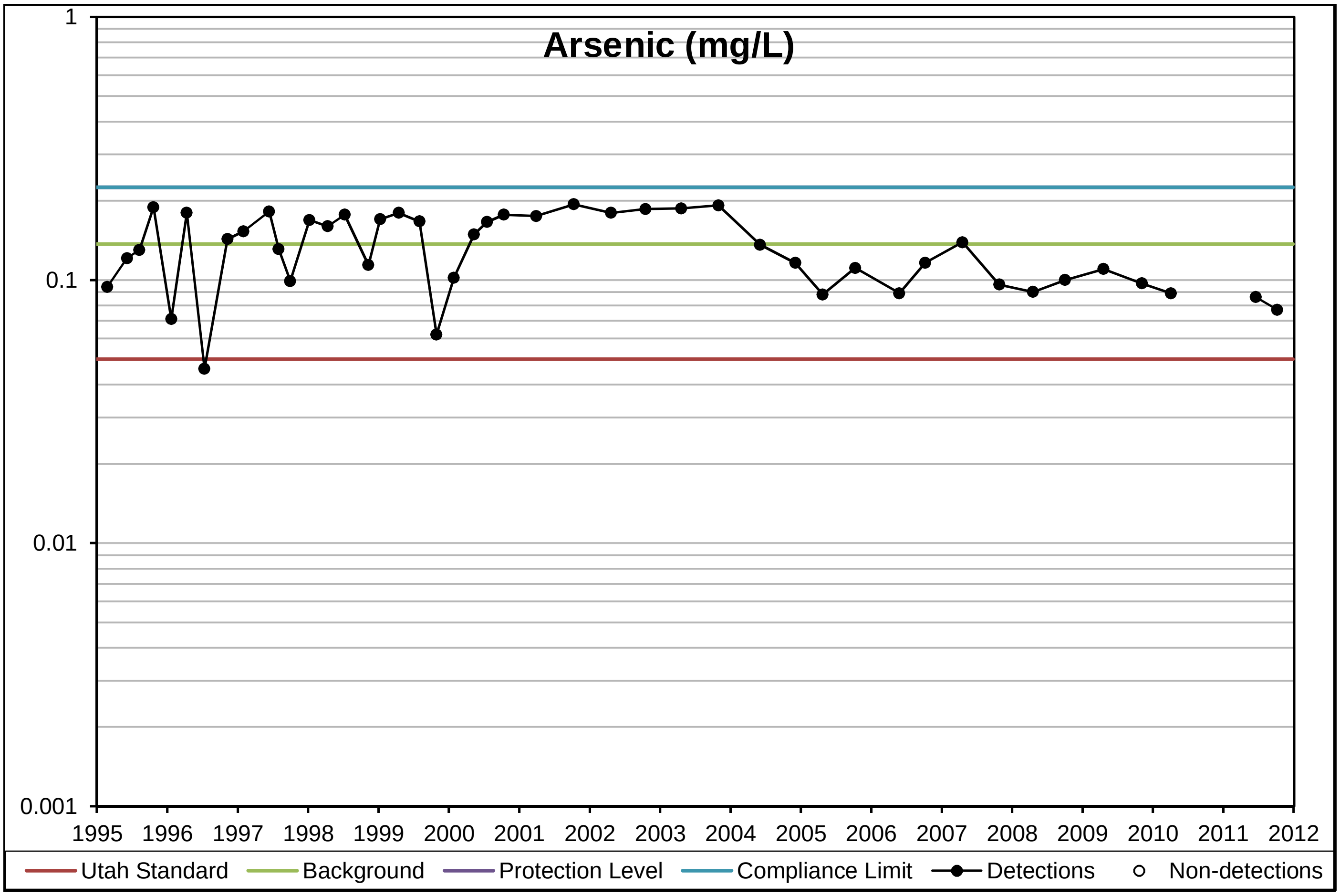


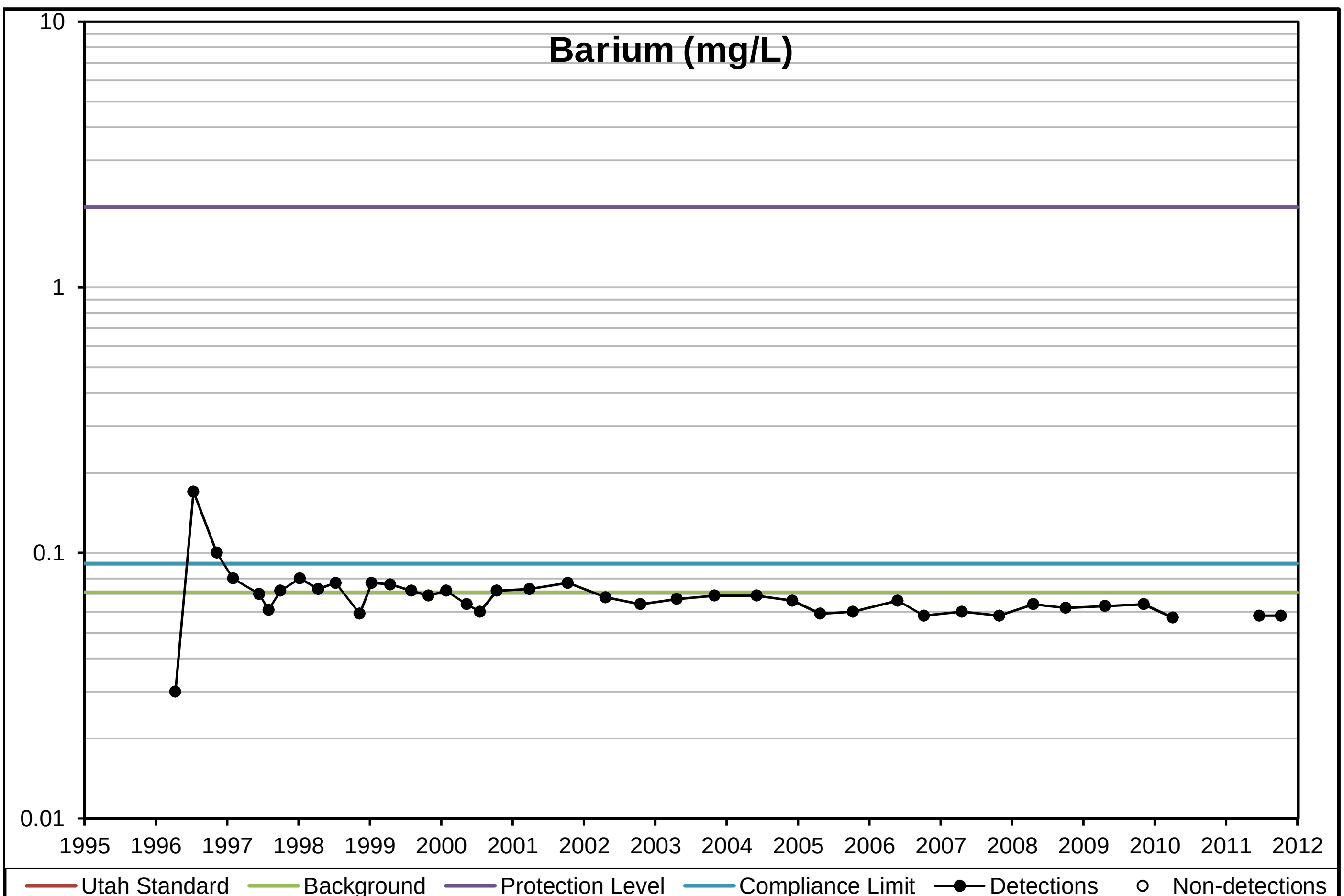
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

Concentration Versus Year



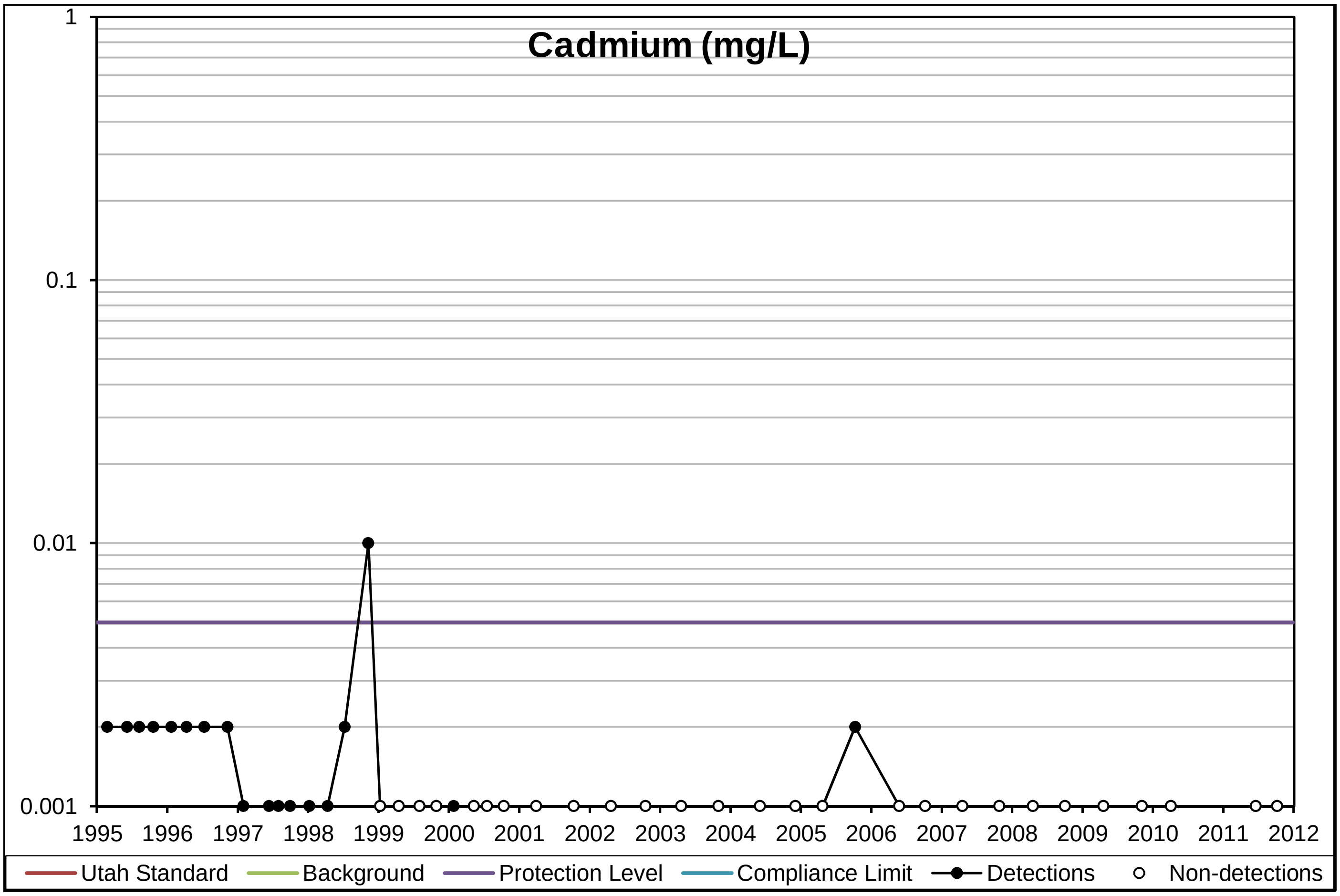


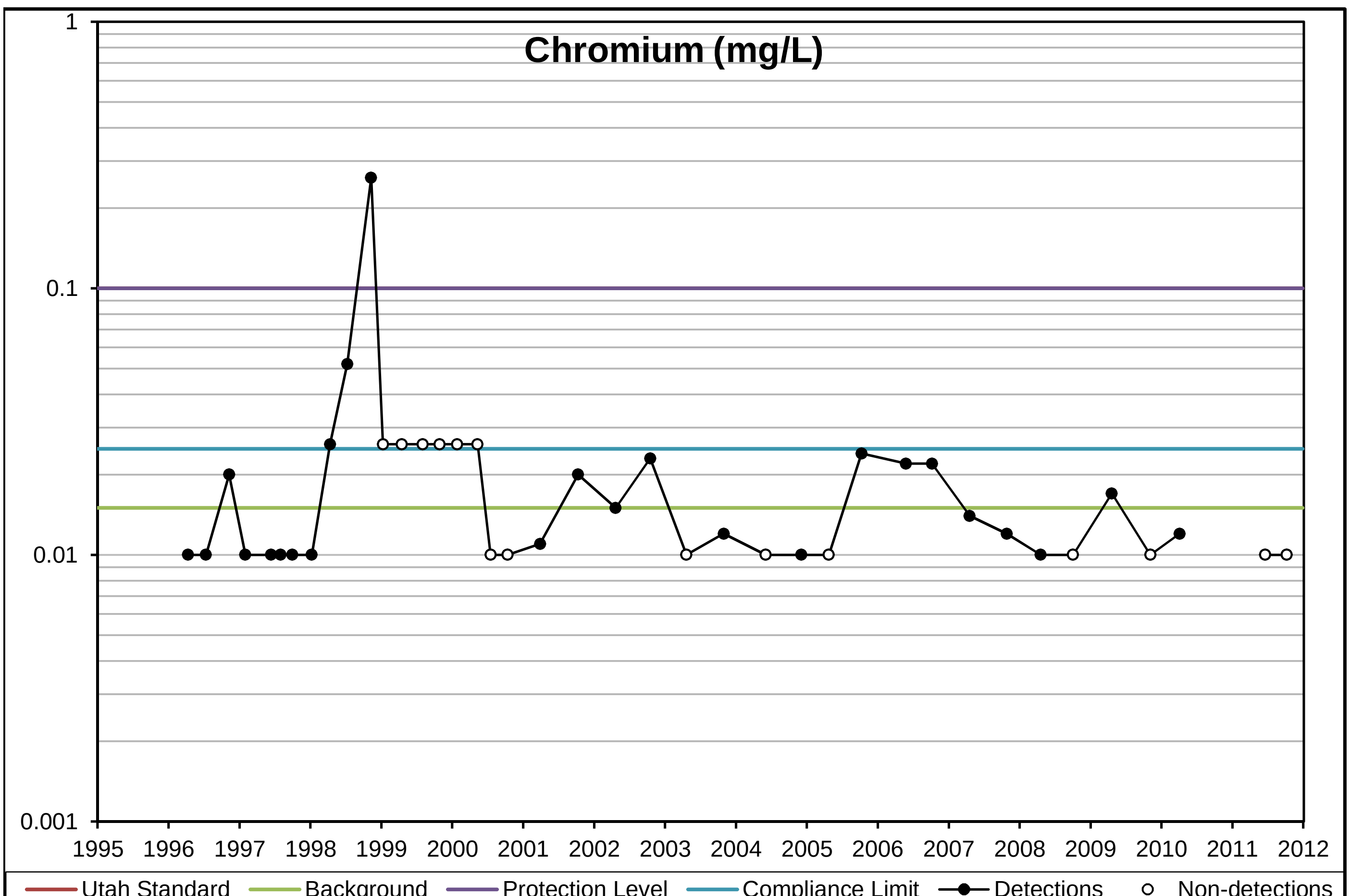
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

Concentration Versus Year



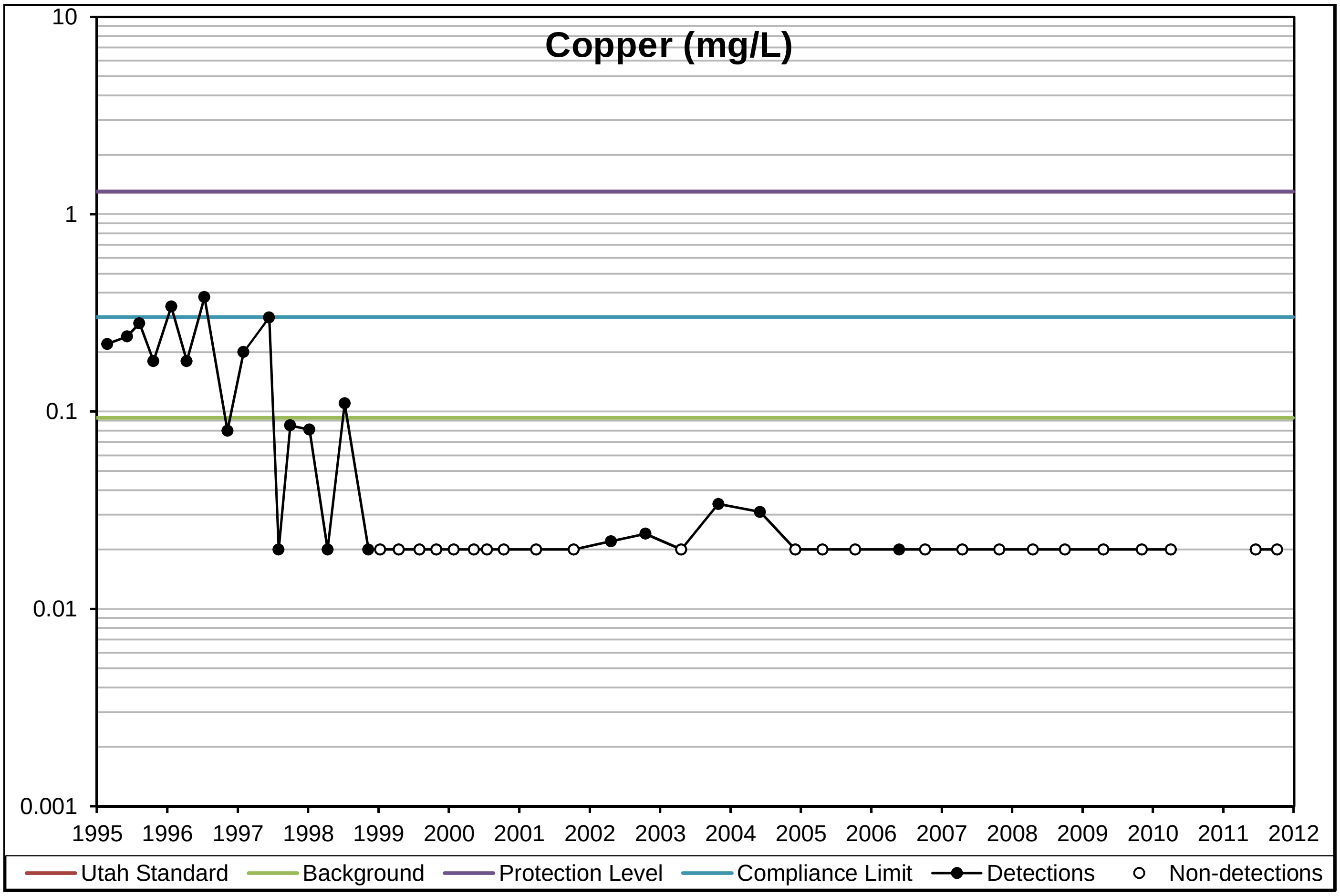


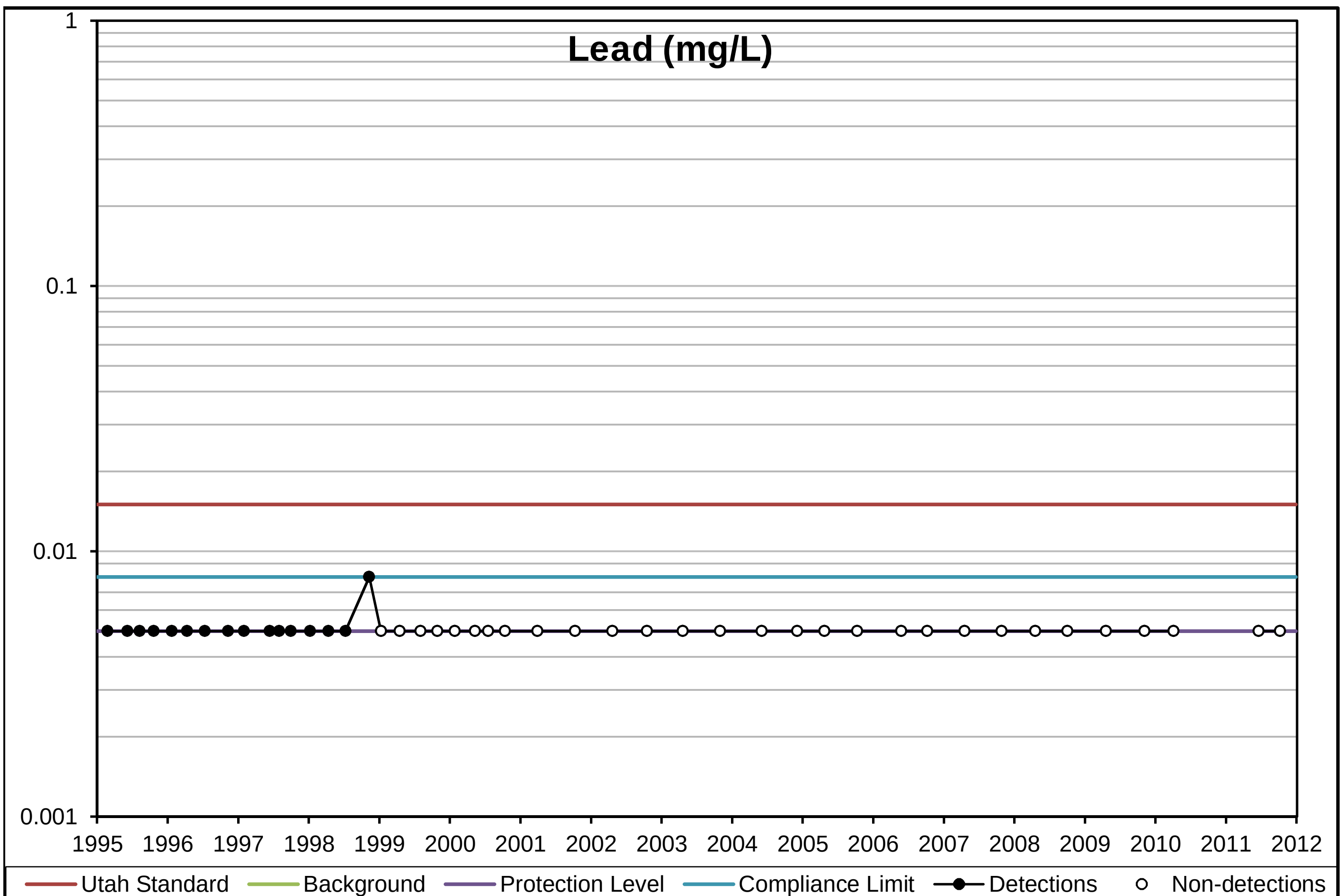
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

Concentration Versus Year





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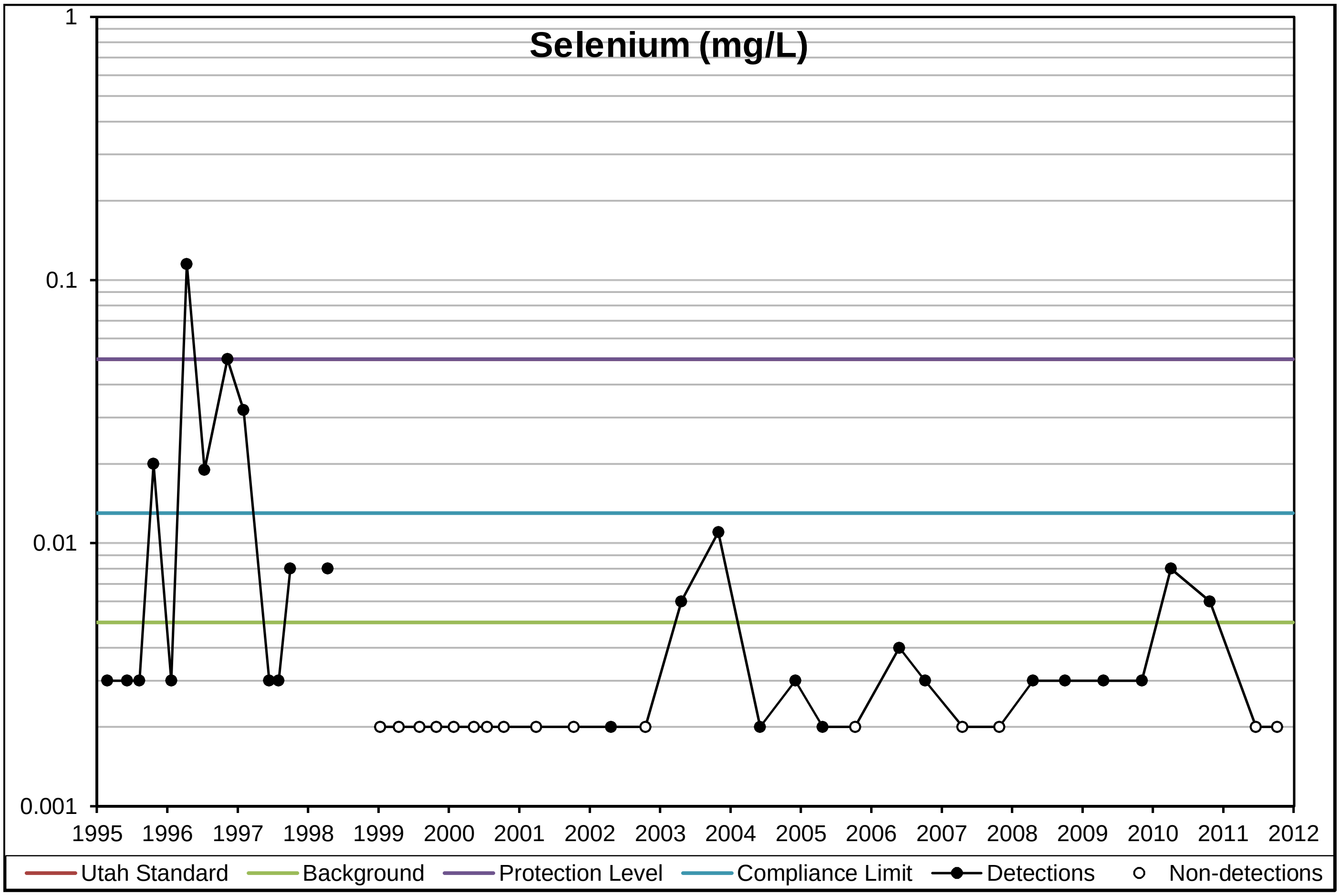
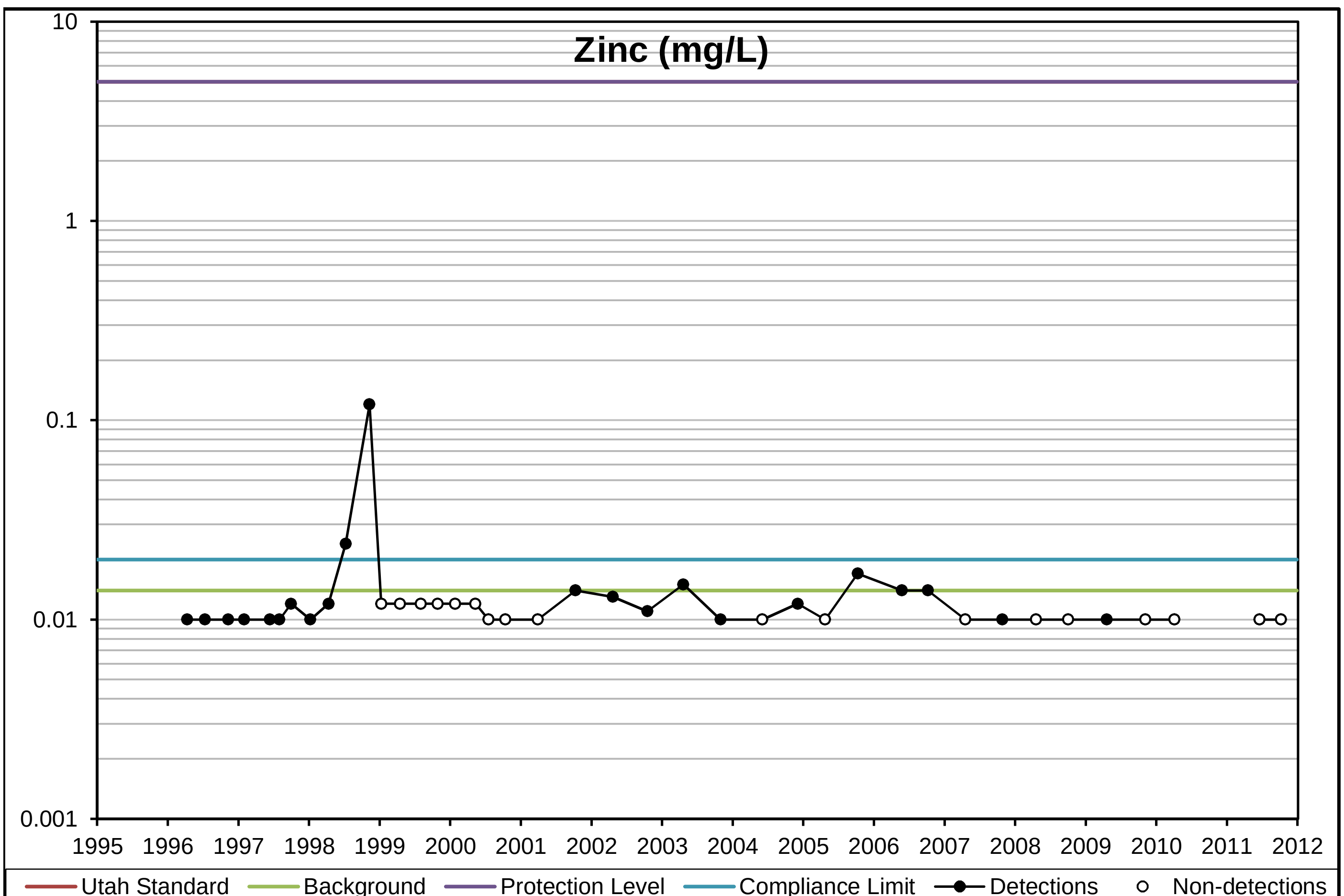
Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

Concentration Versus Year





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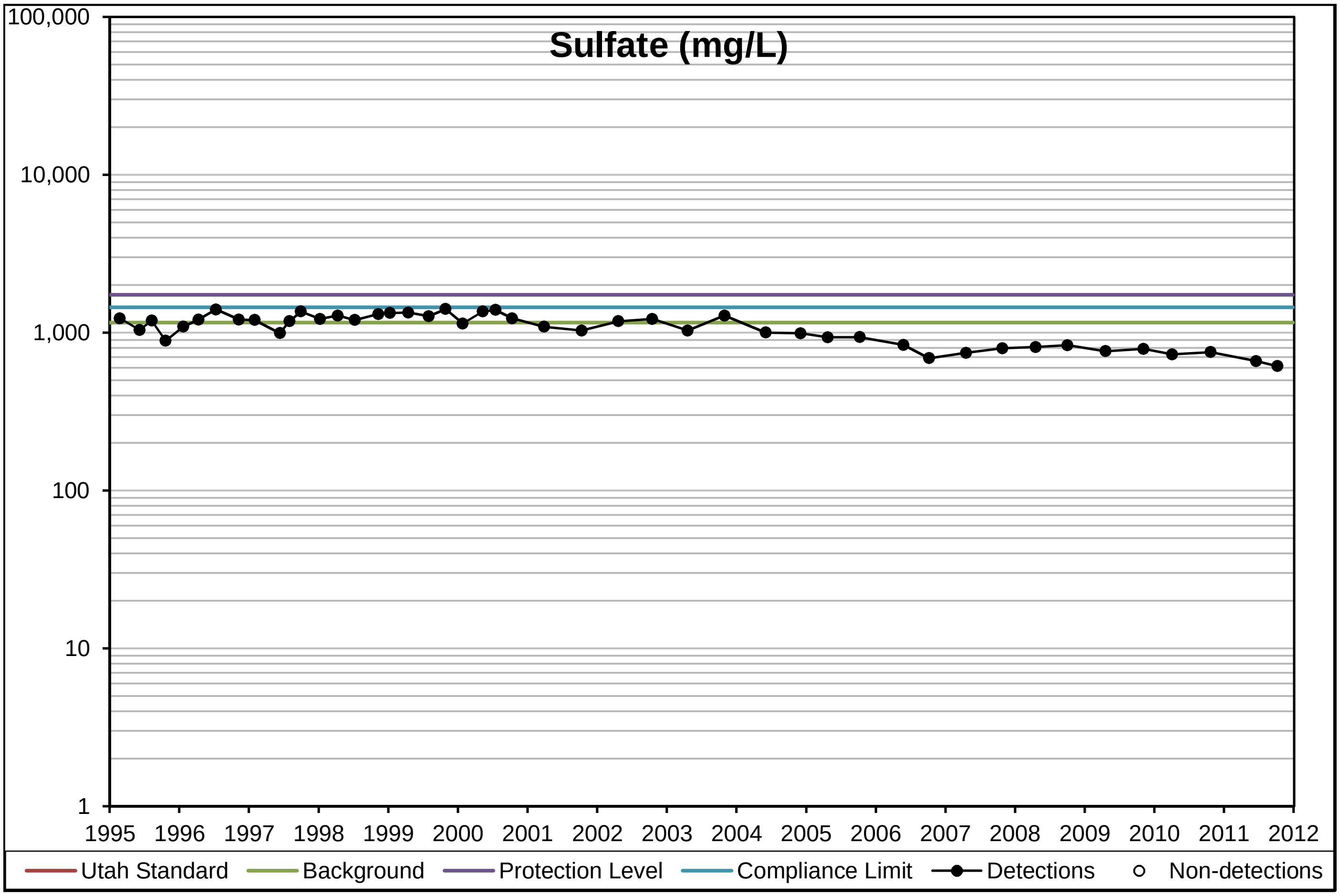
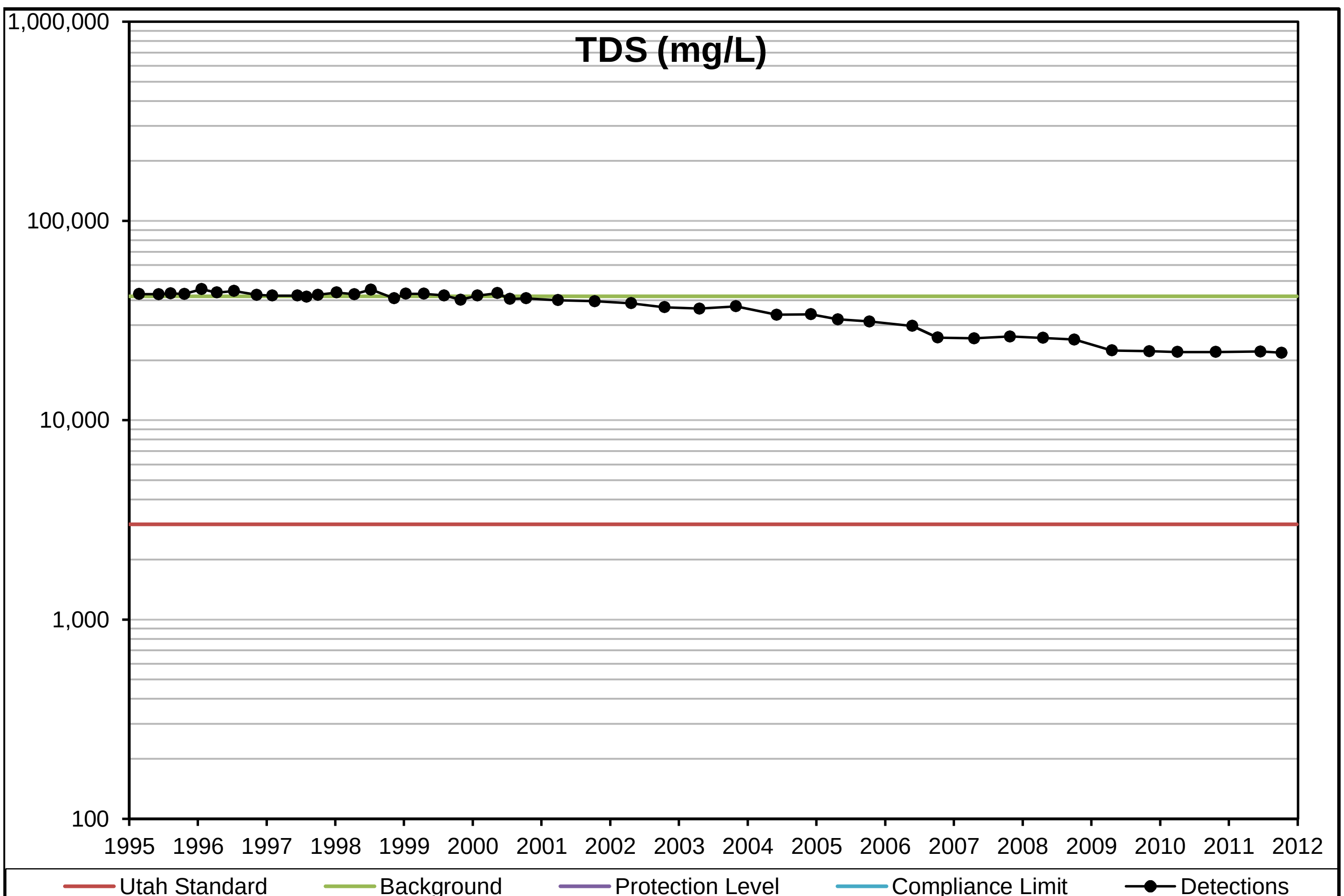
Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

Concentration Versus Year



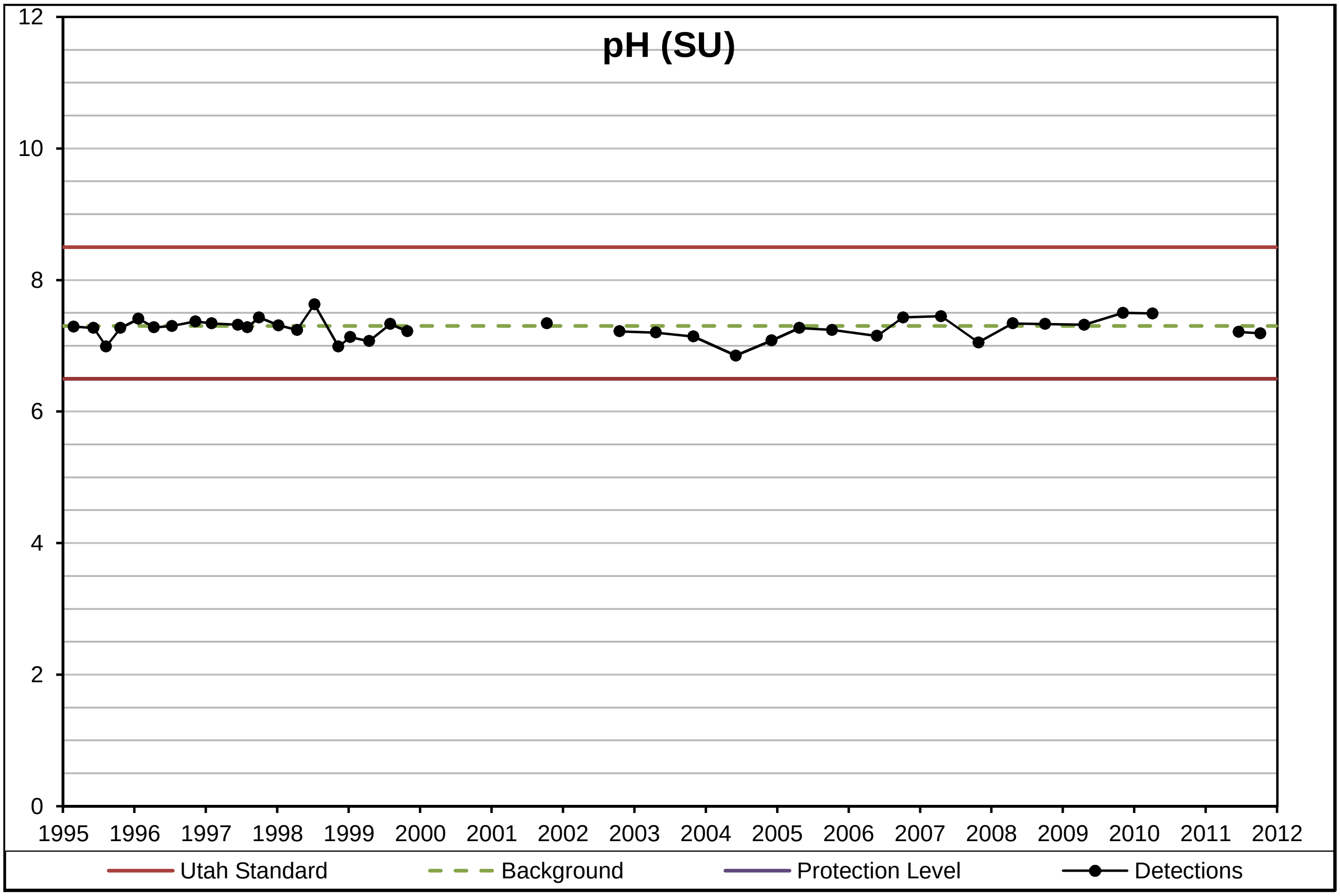


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET646B

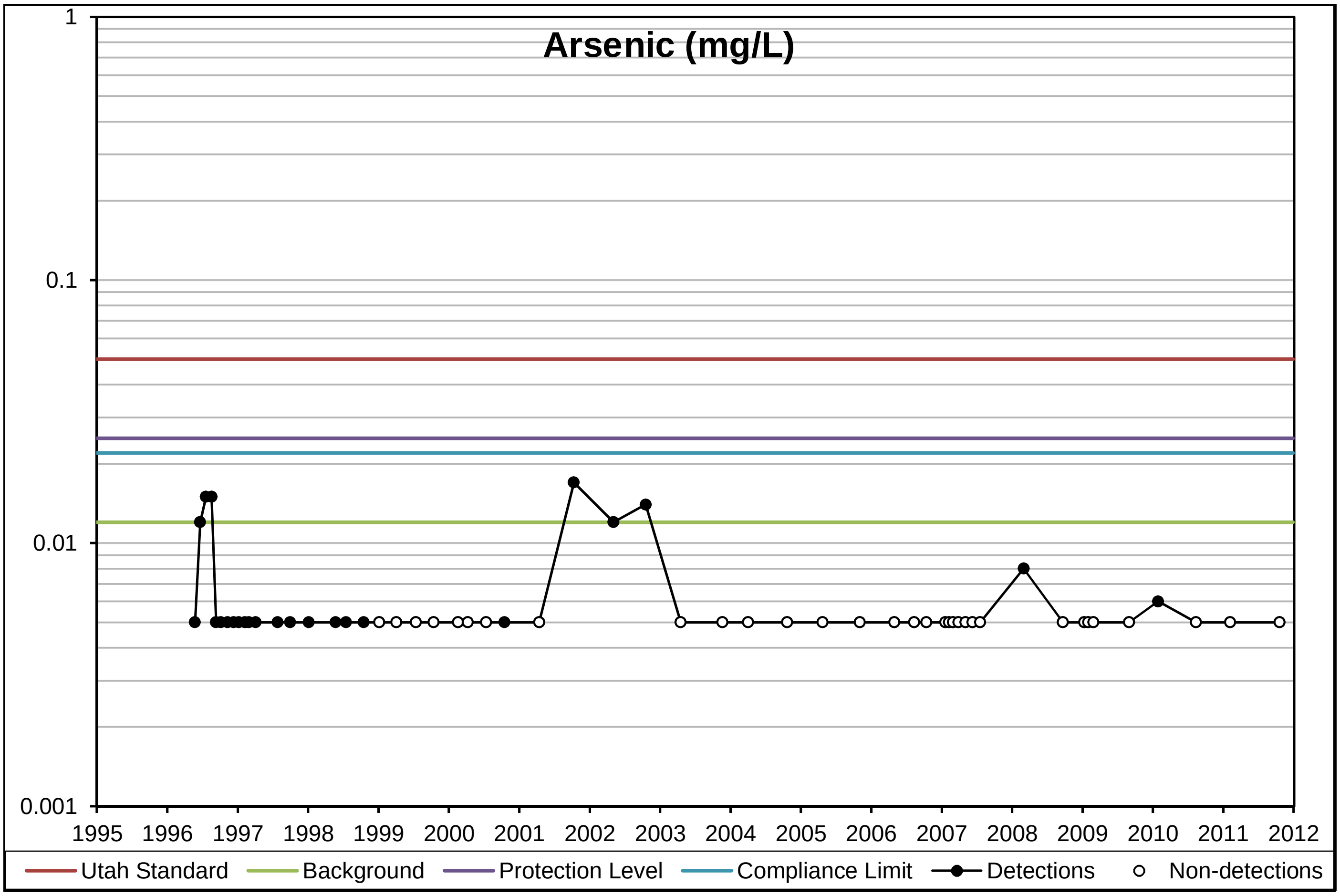
Concentration Versus Year

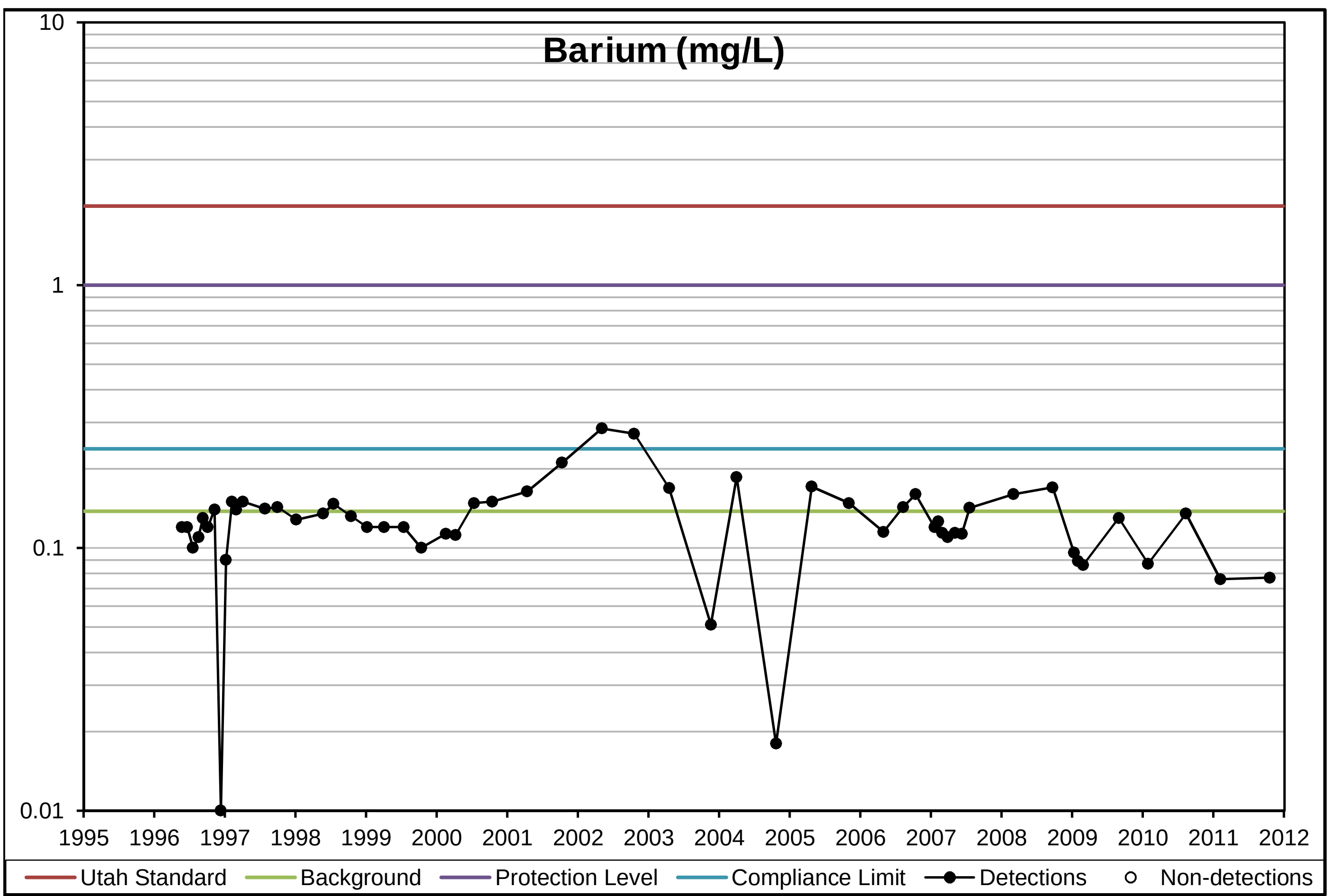


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year



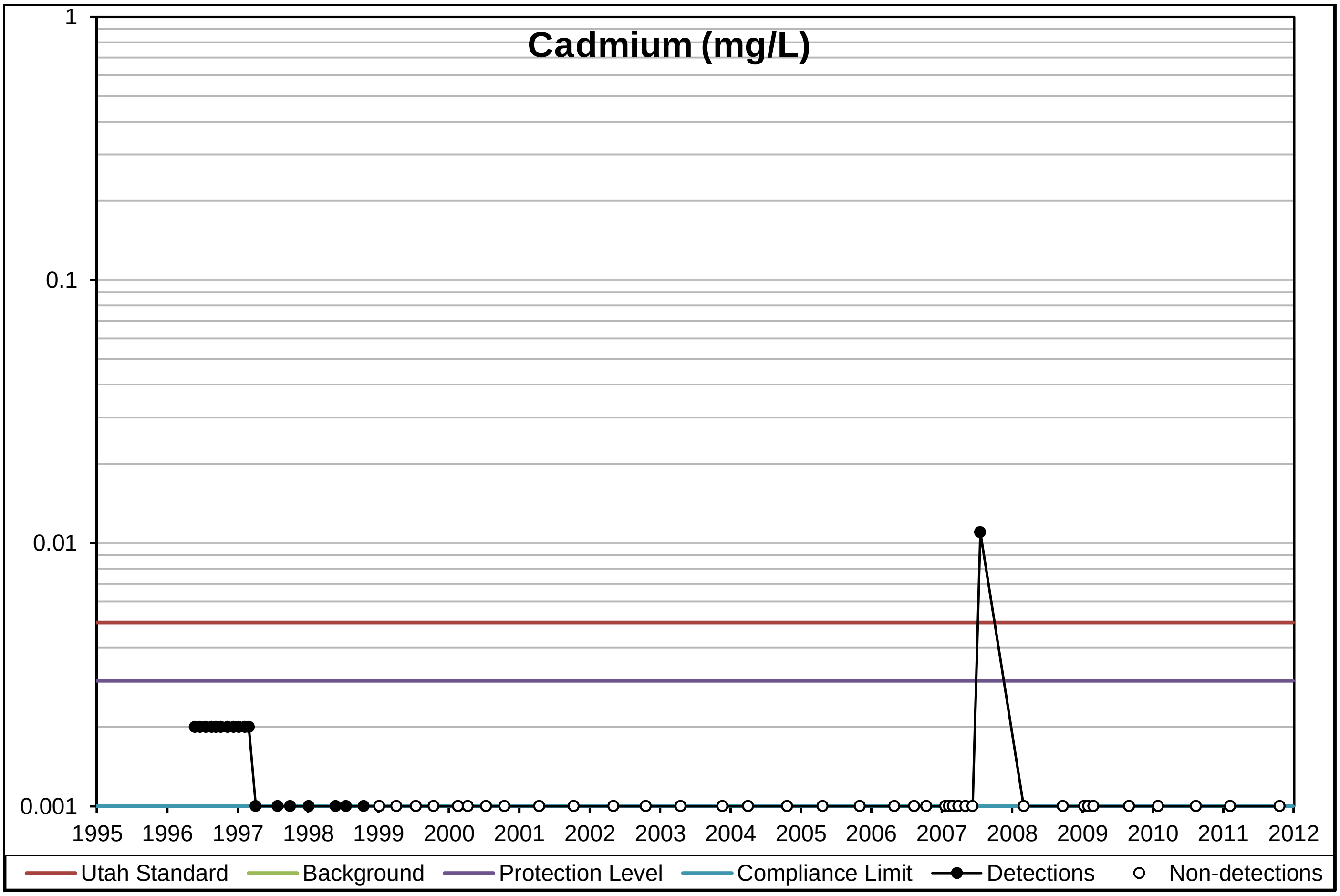


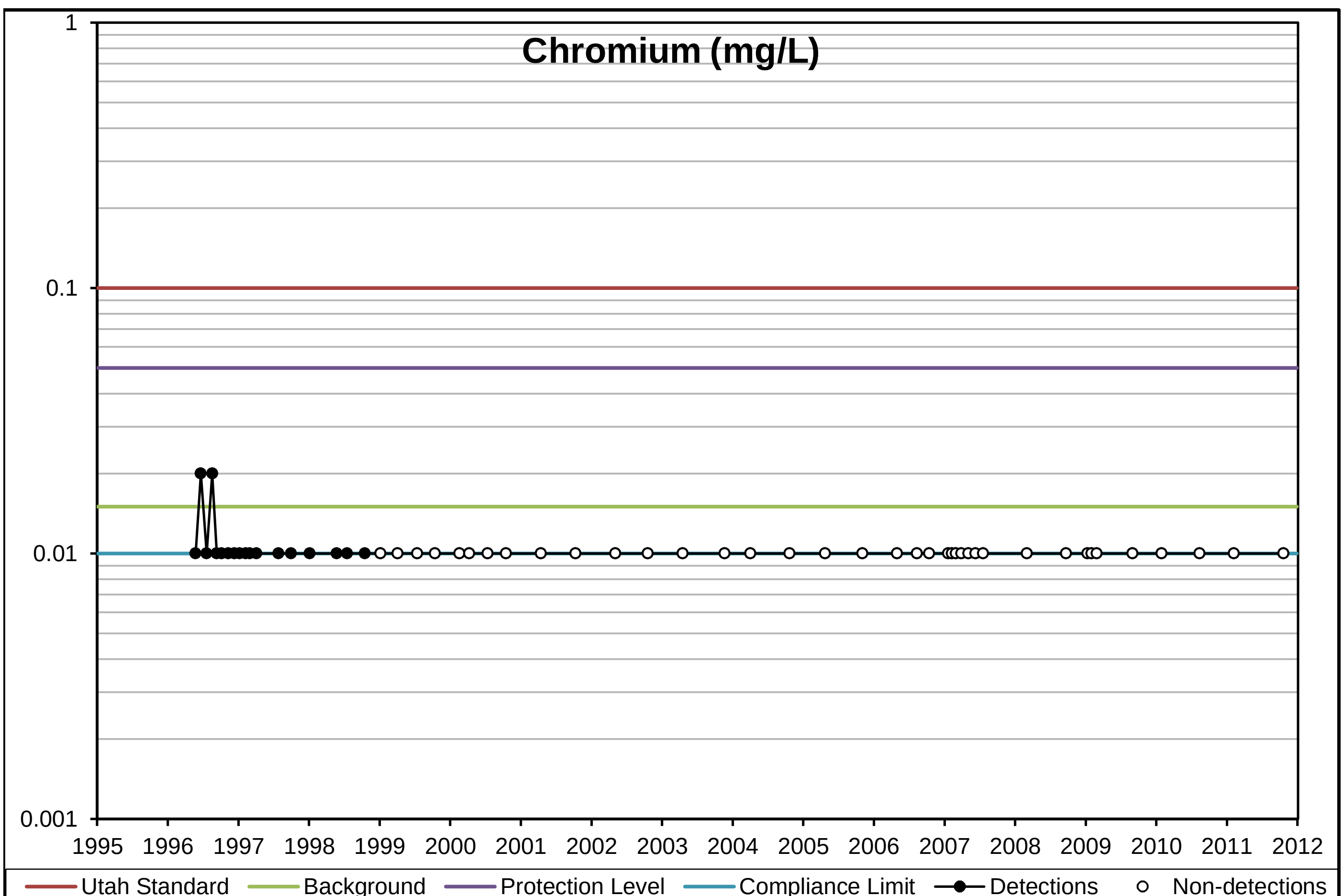
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year



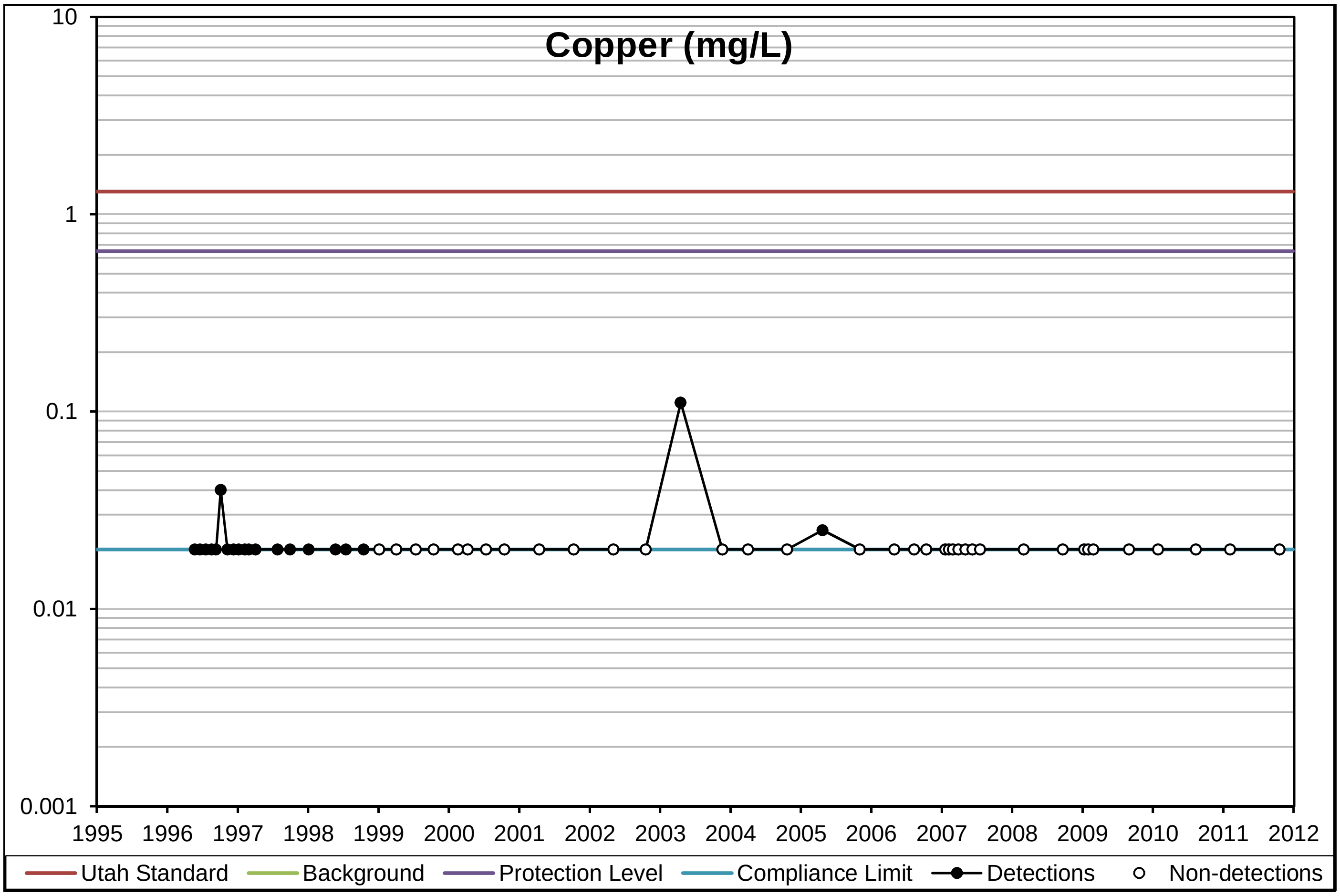


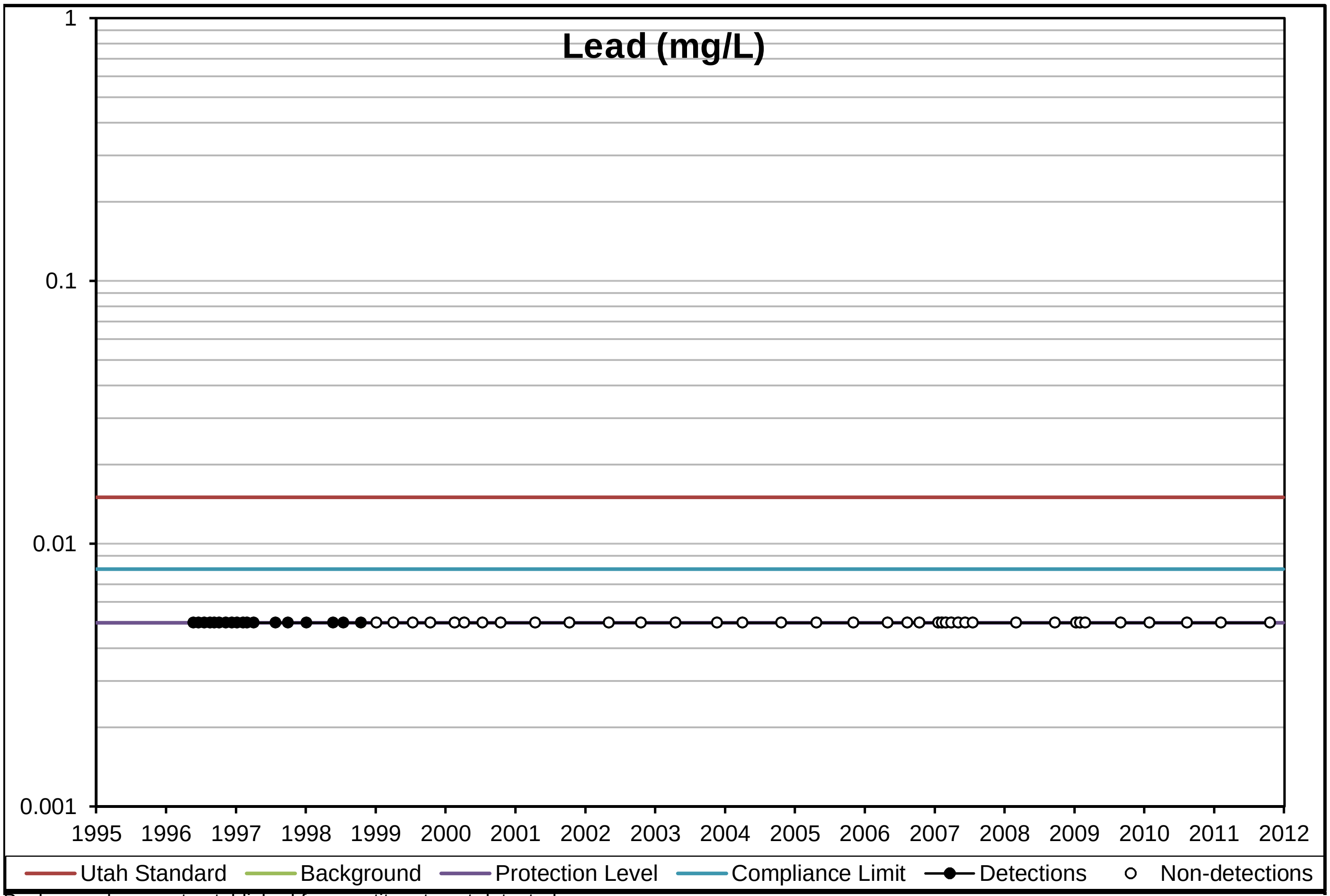
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year



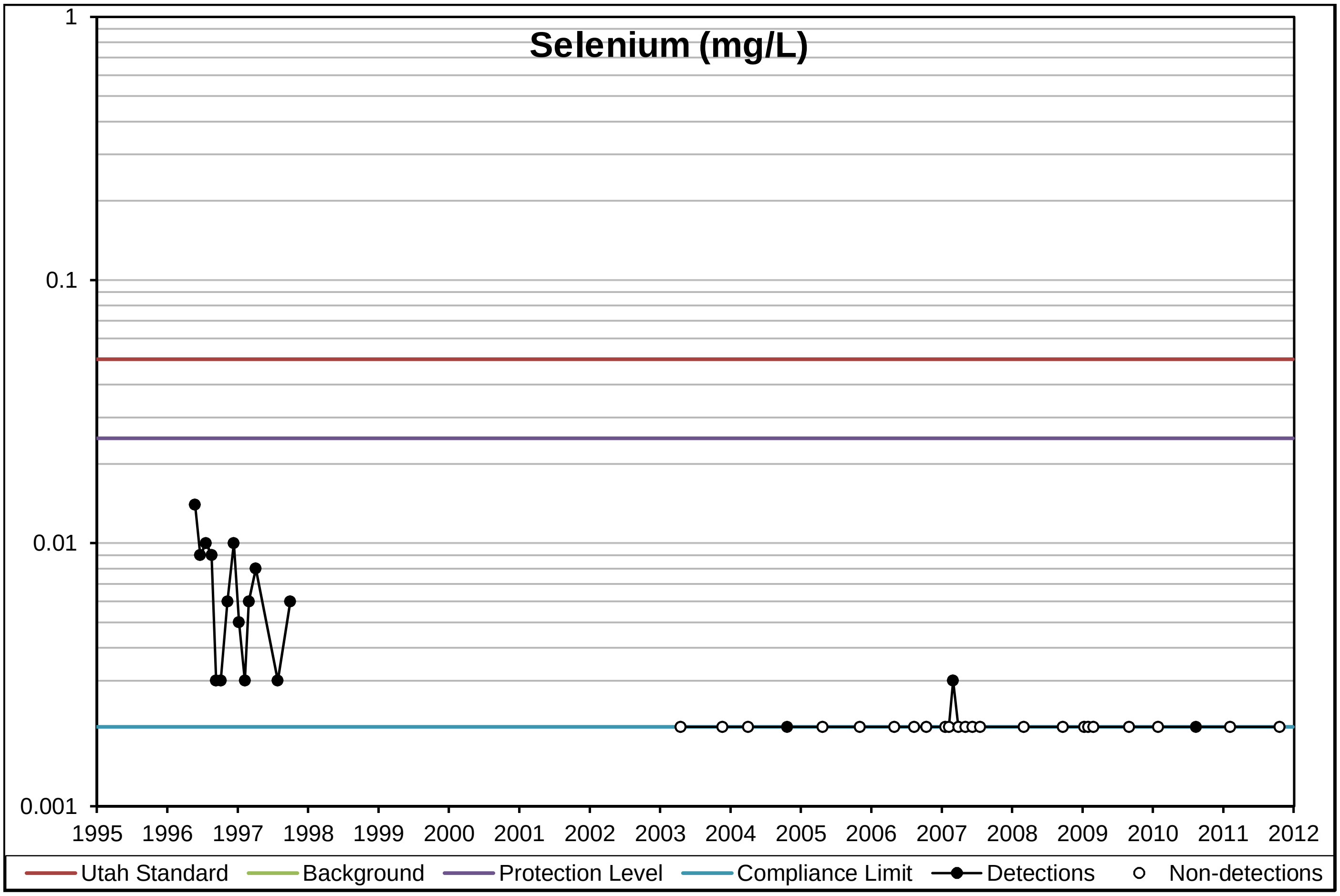


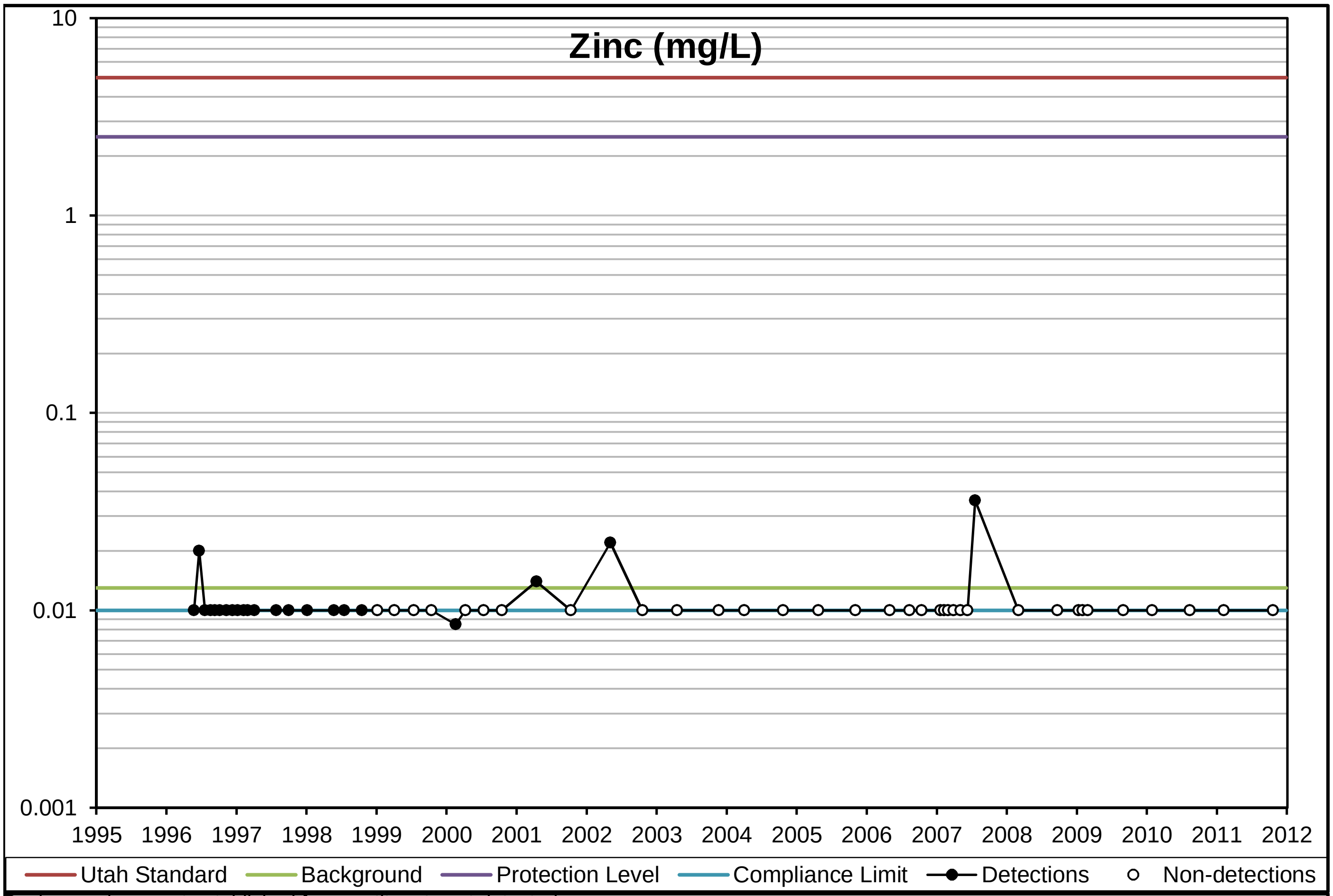
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year



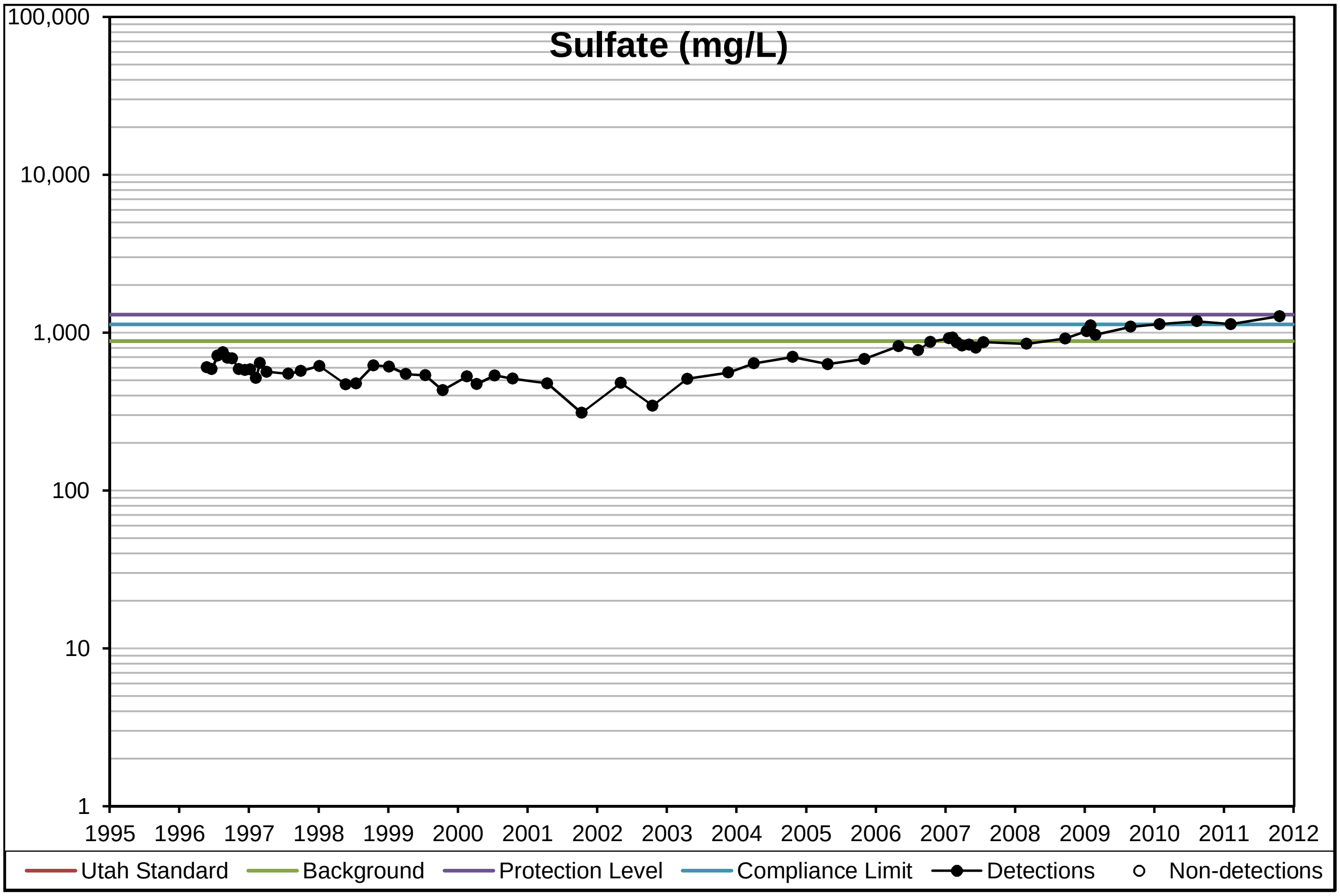


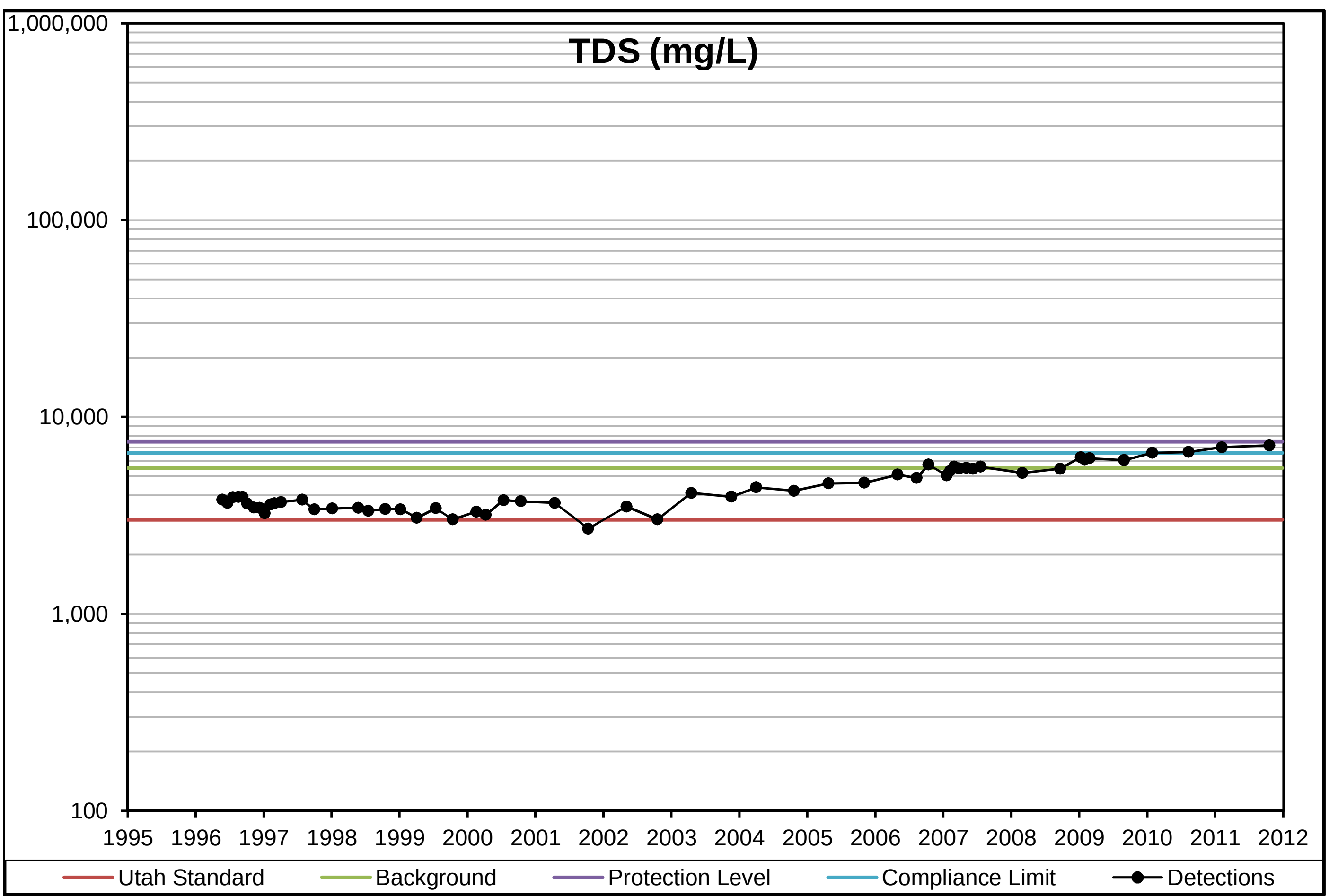
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year



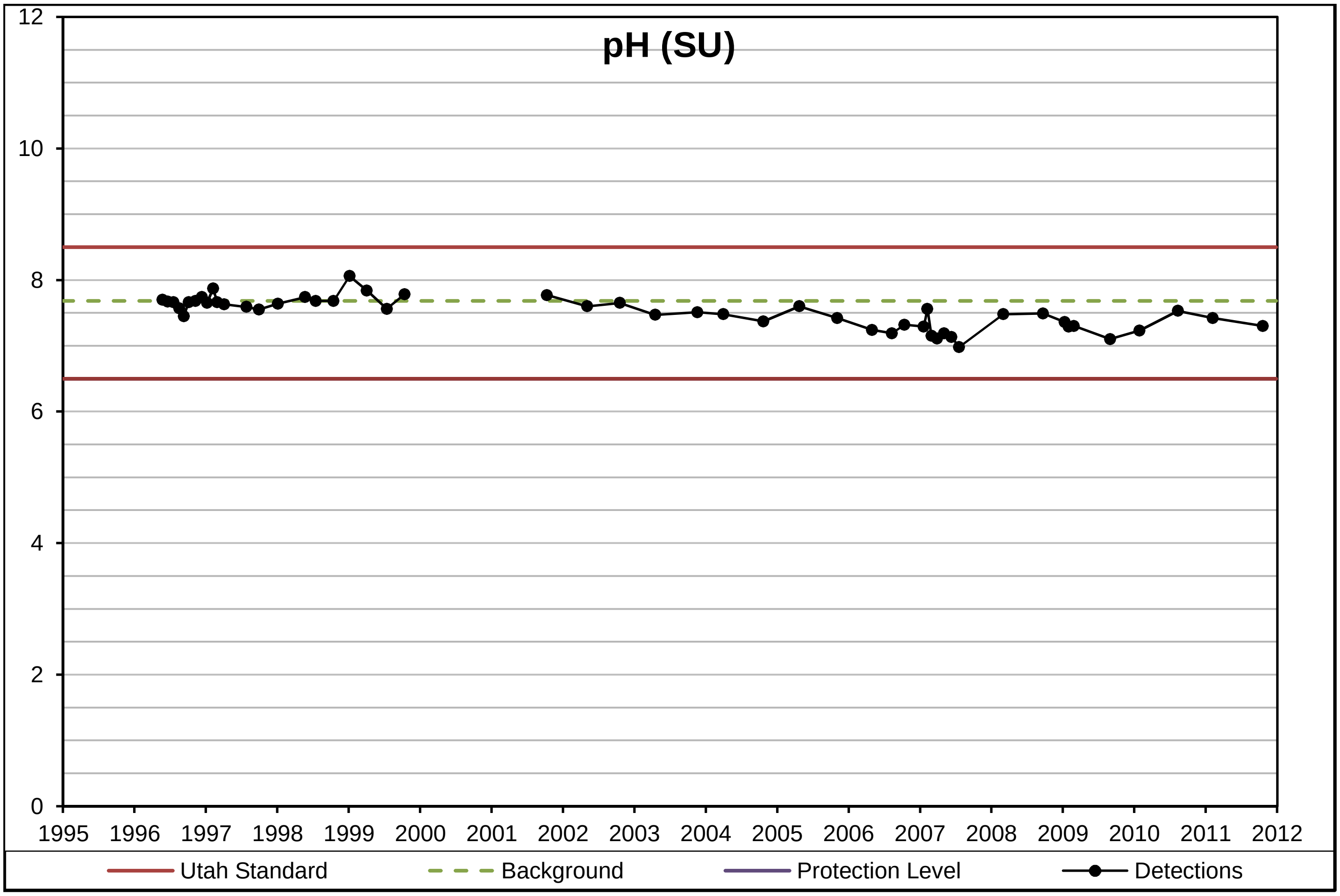


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380A

Concentration Versus Year

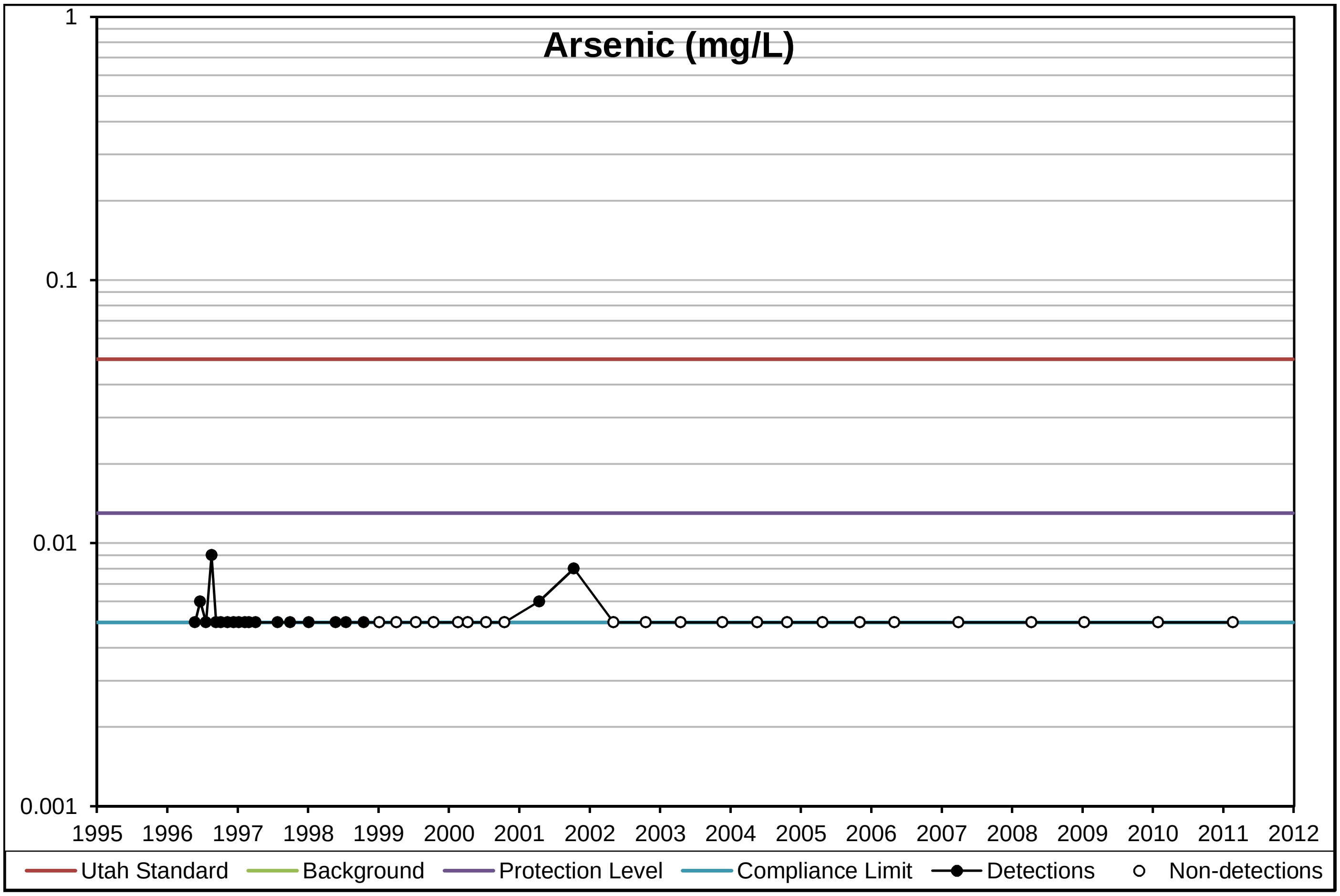


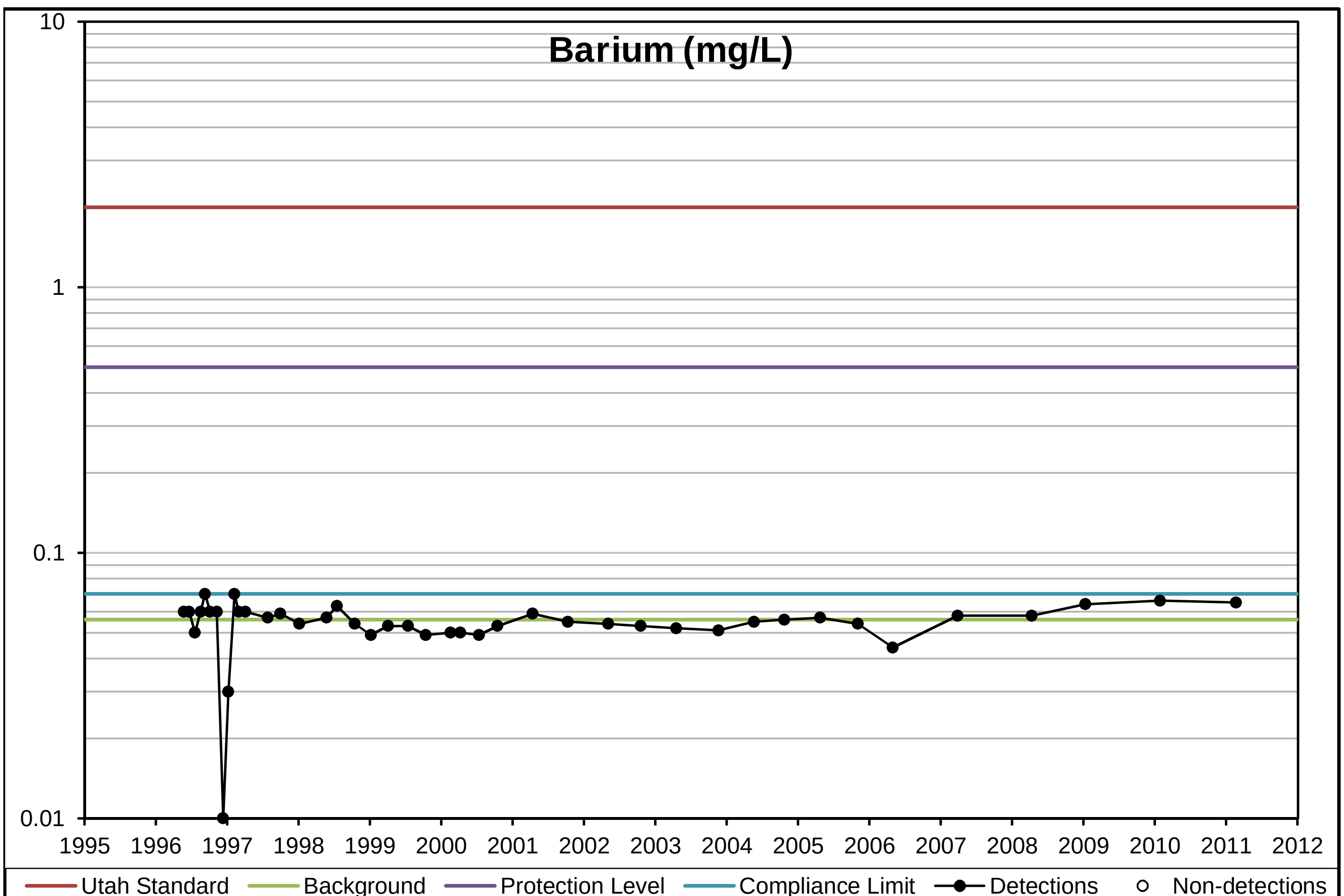
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

Concentration Versus Year



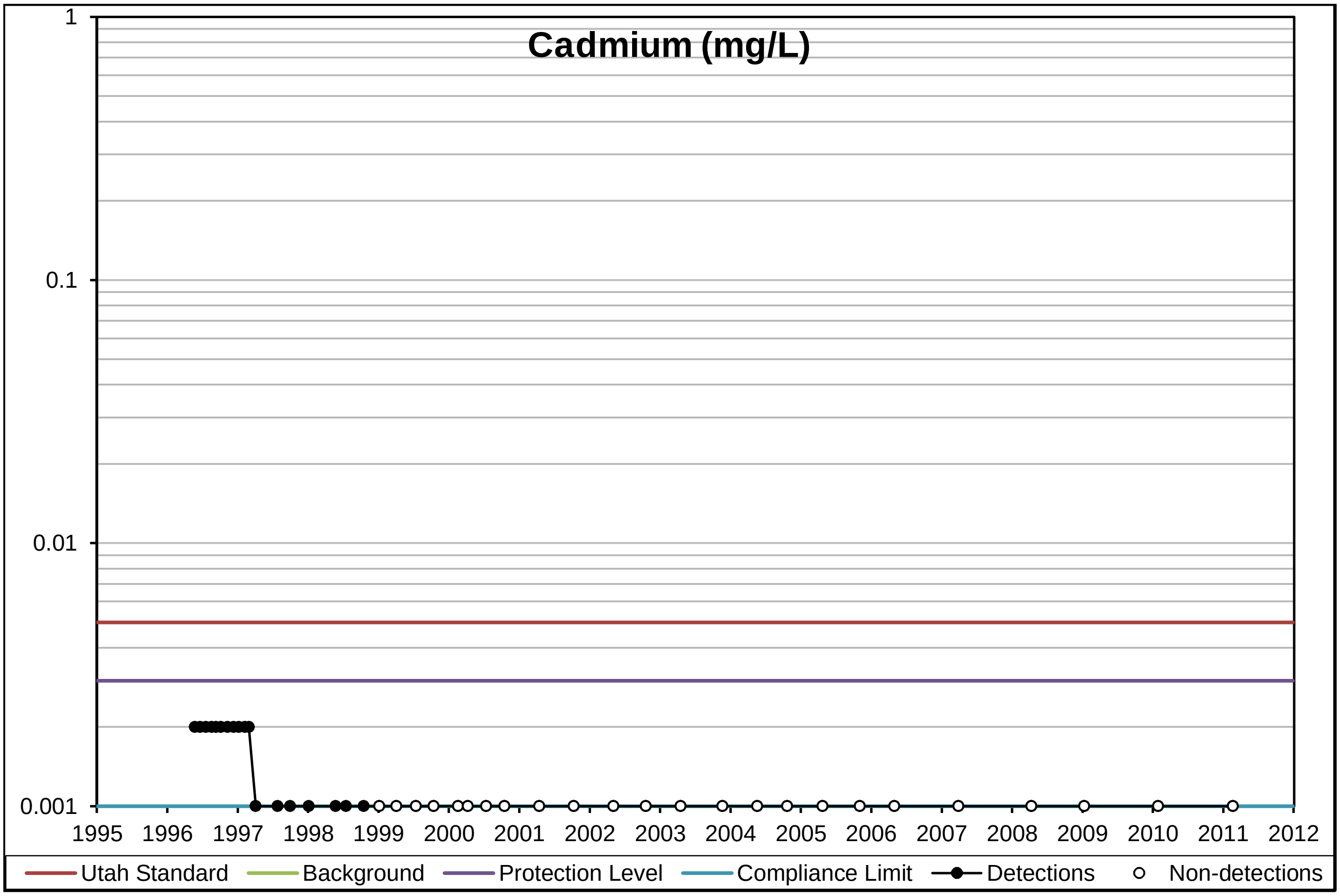


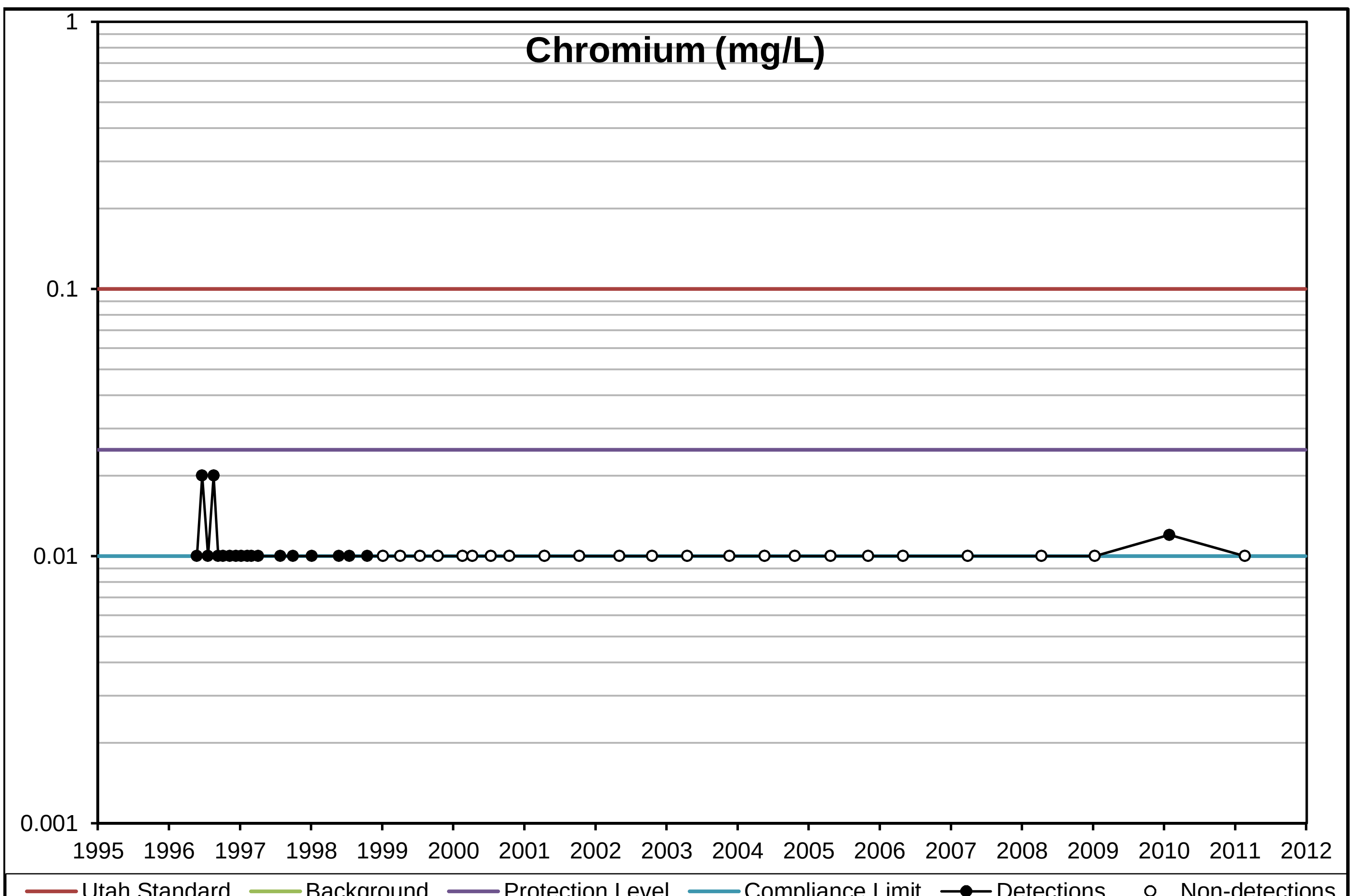
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

Concentration Versus Year



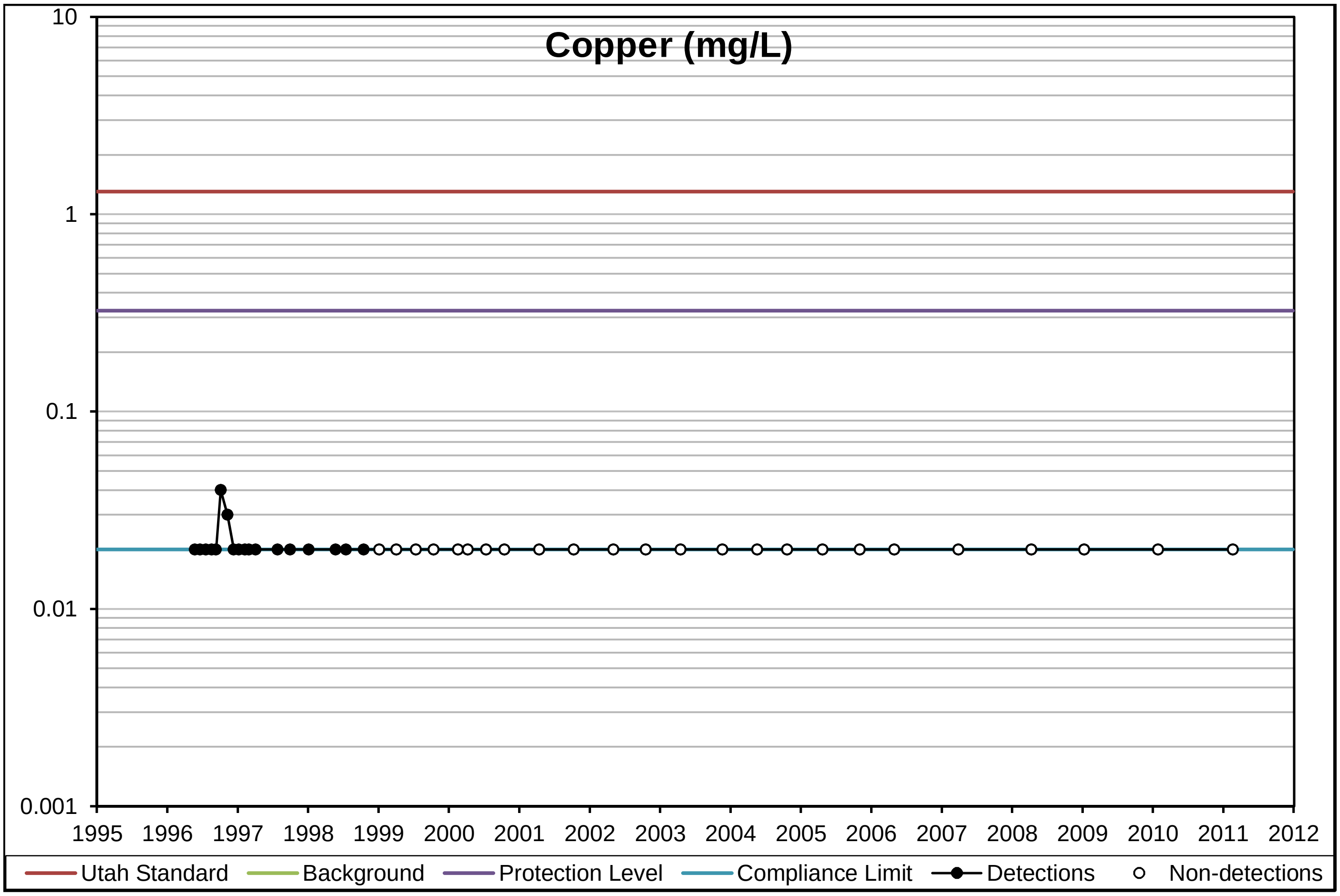


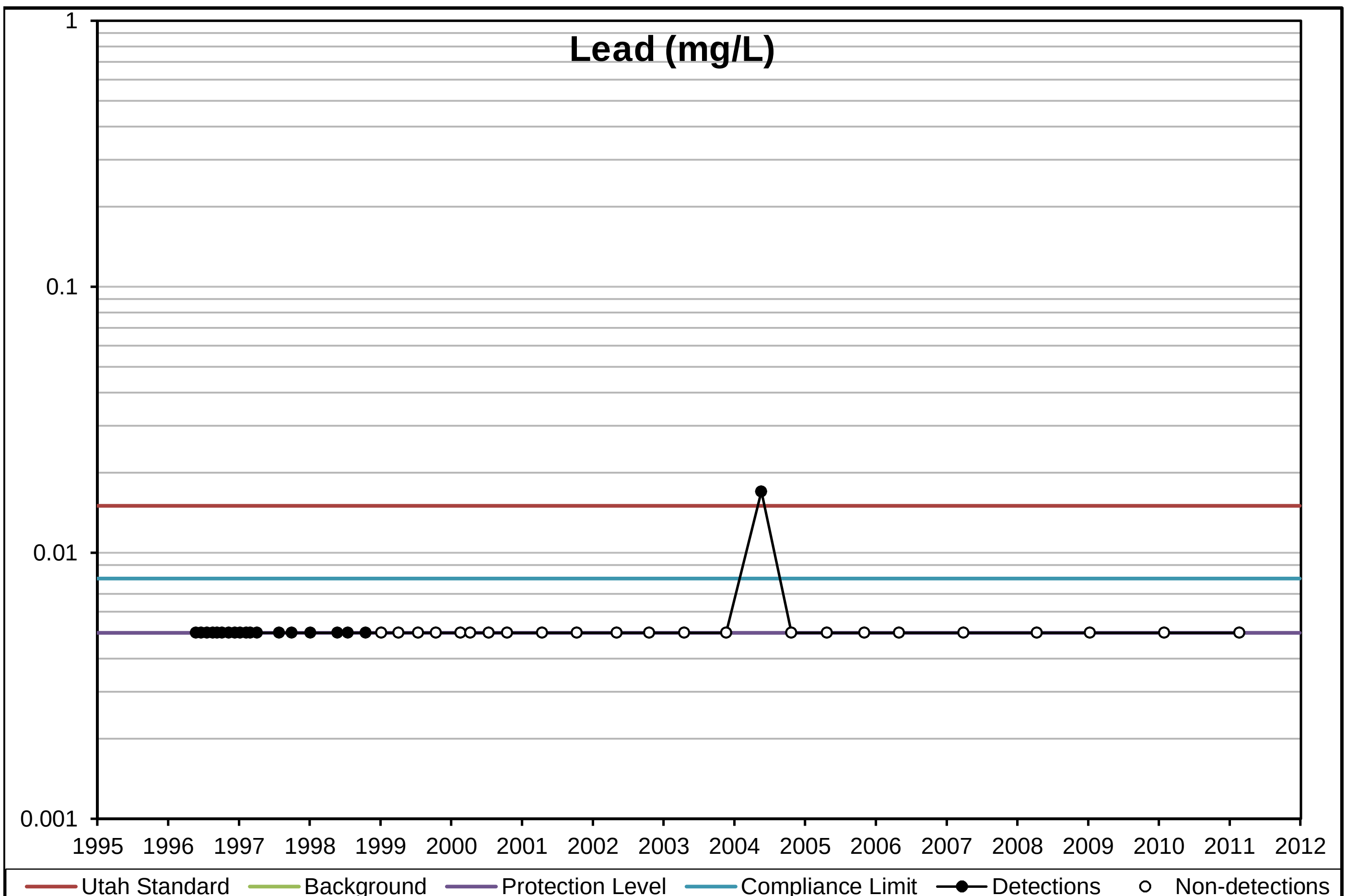
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

Concentration Versus Year



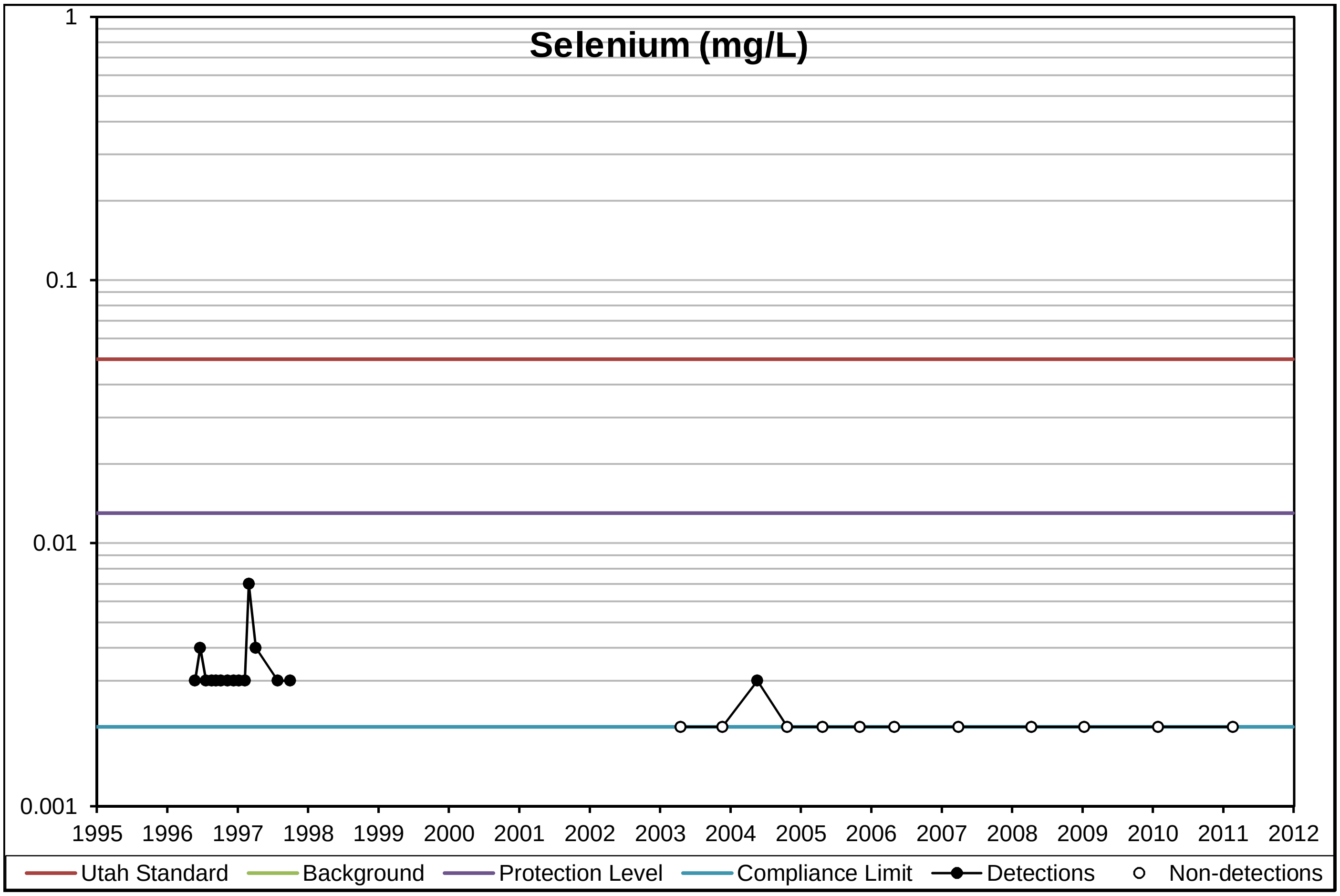


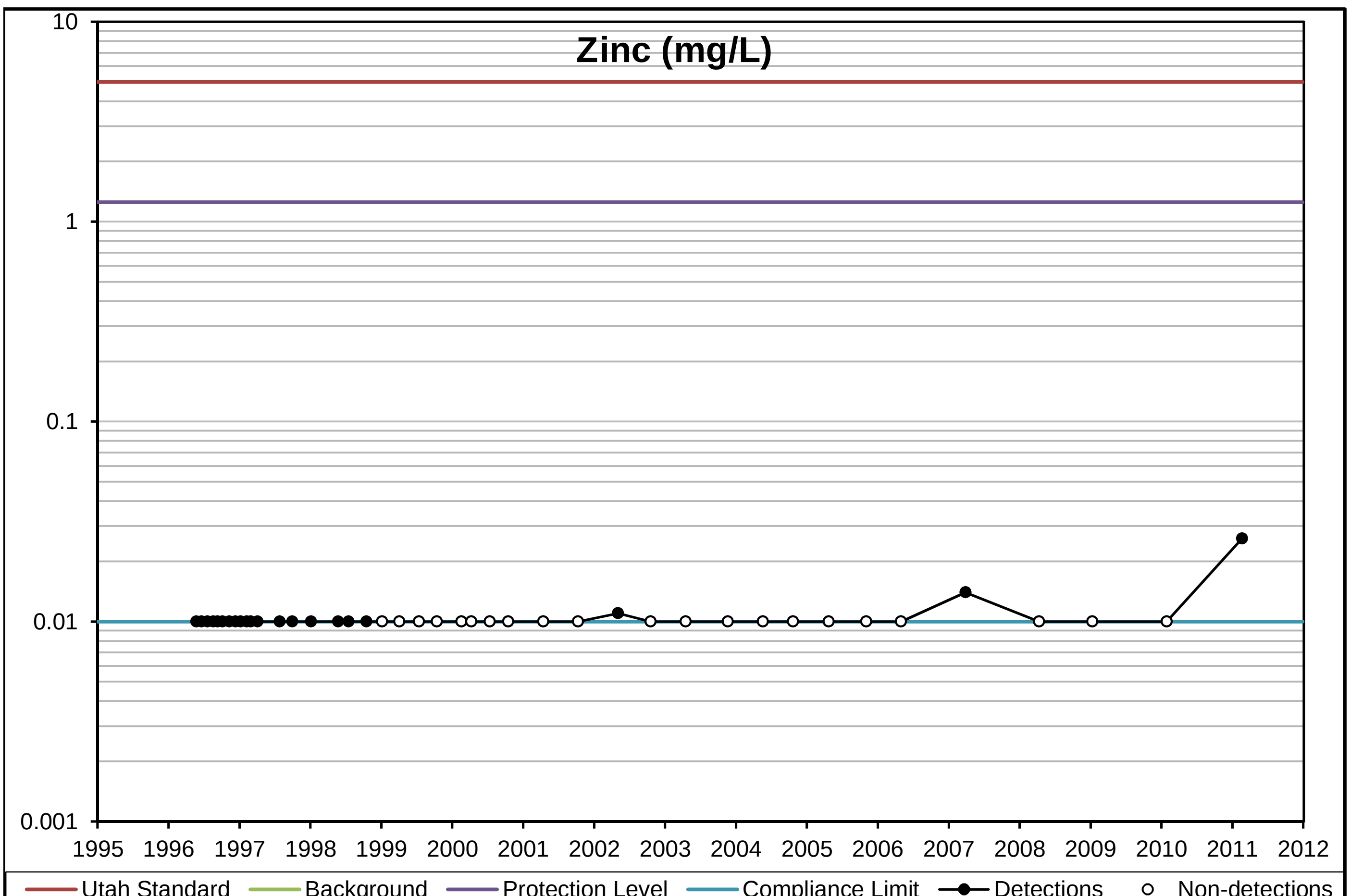
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

Concentration Versus Year



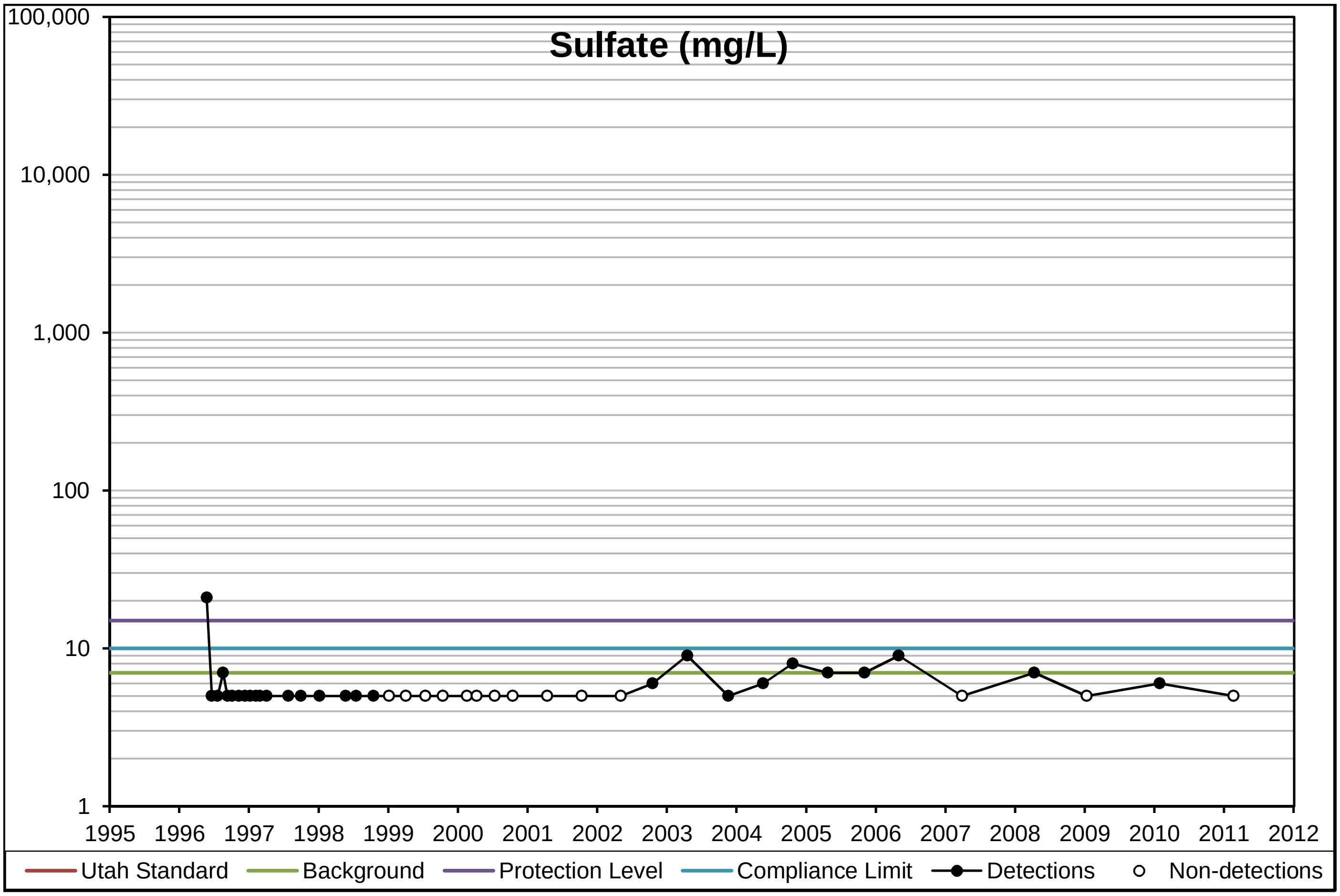


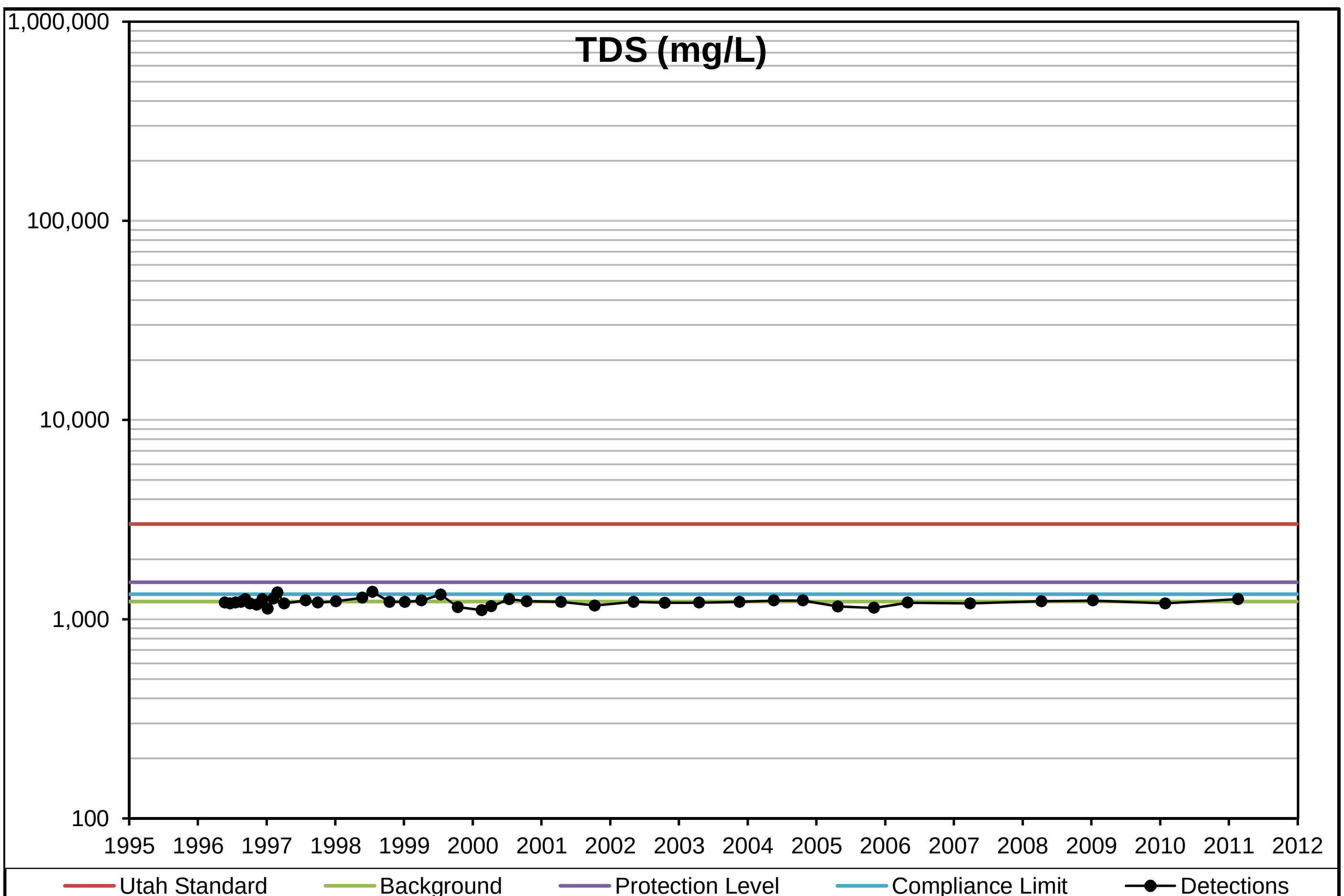
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

Concentration Versus Year



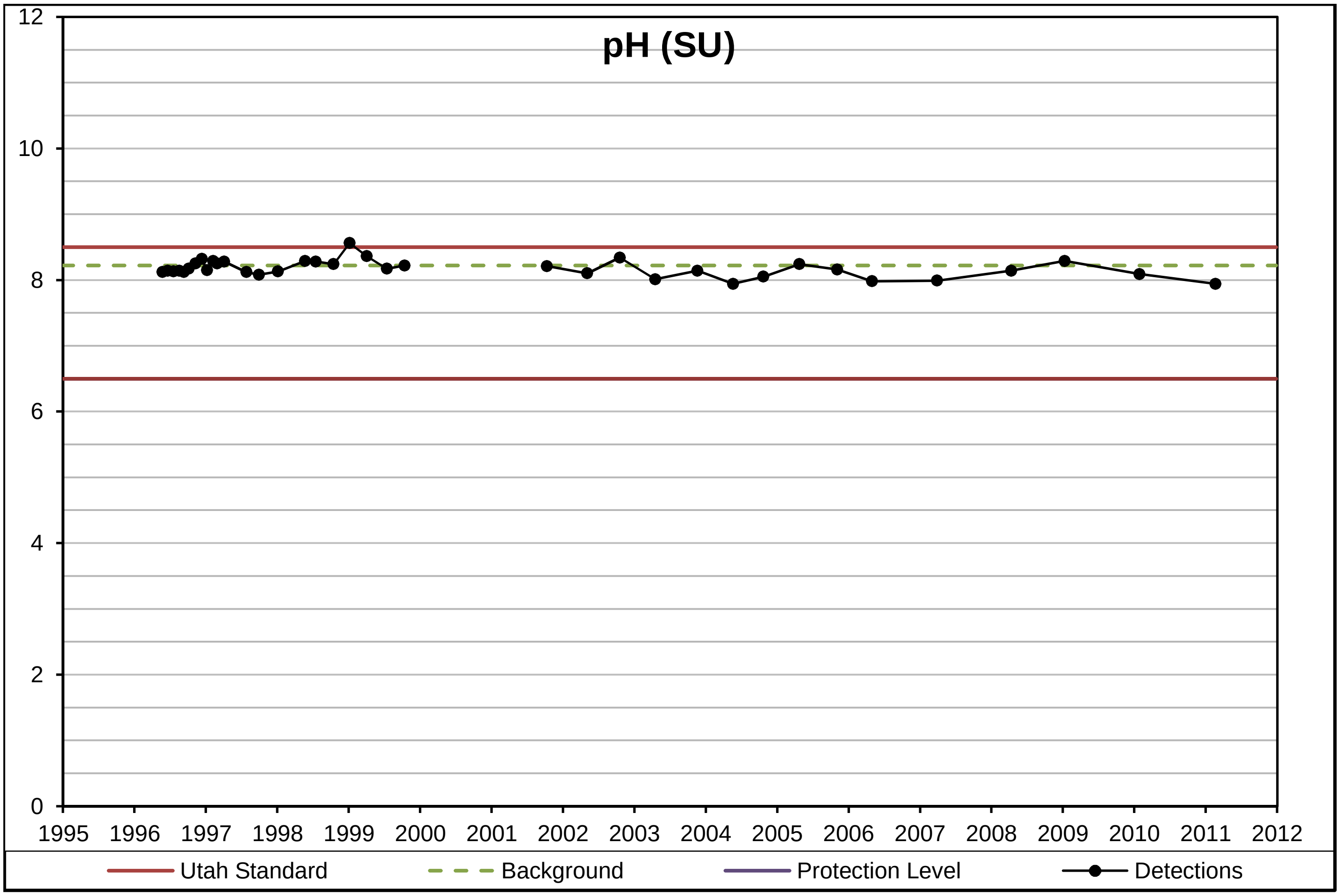


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1380B

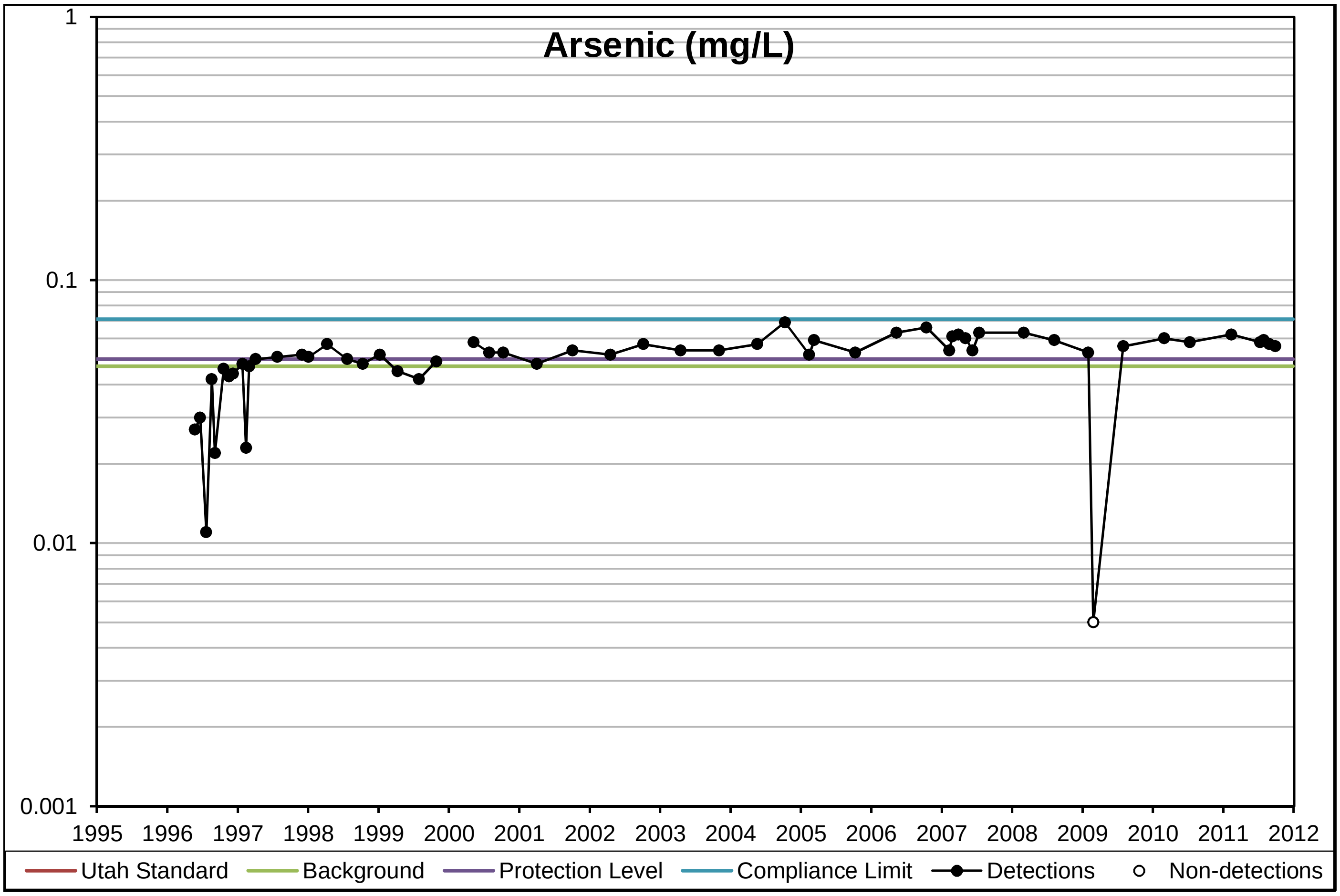
Concentration Versus Year

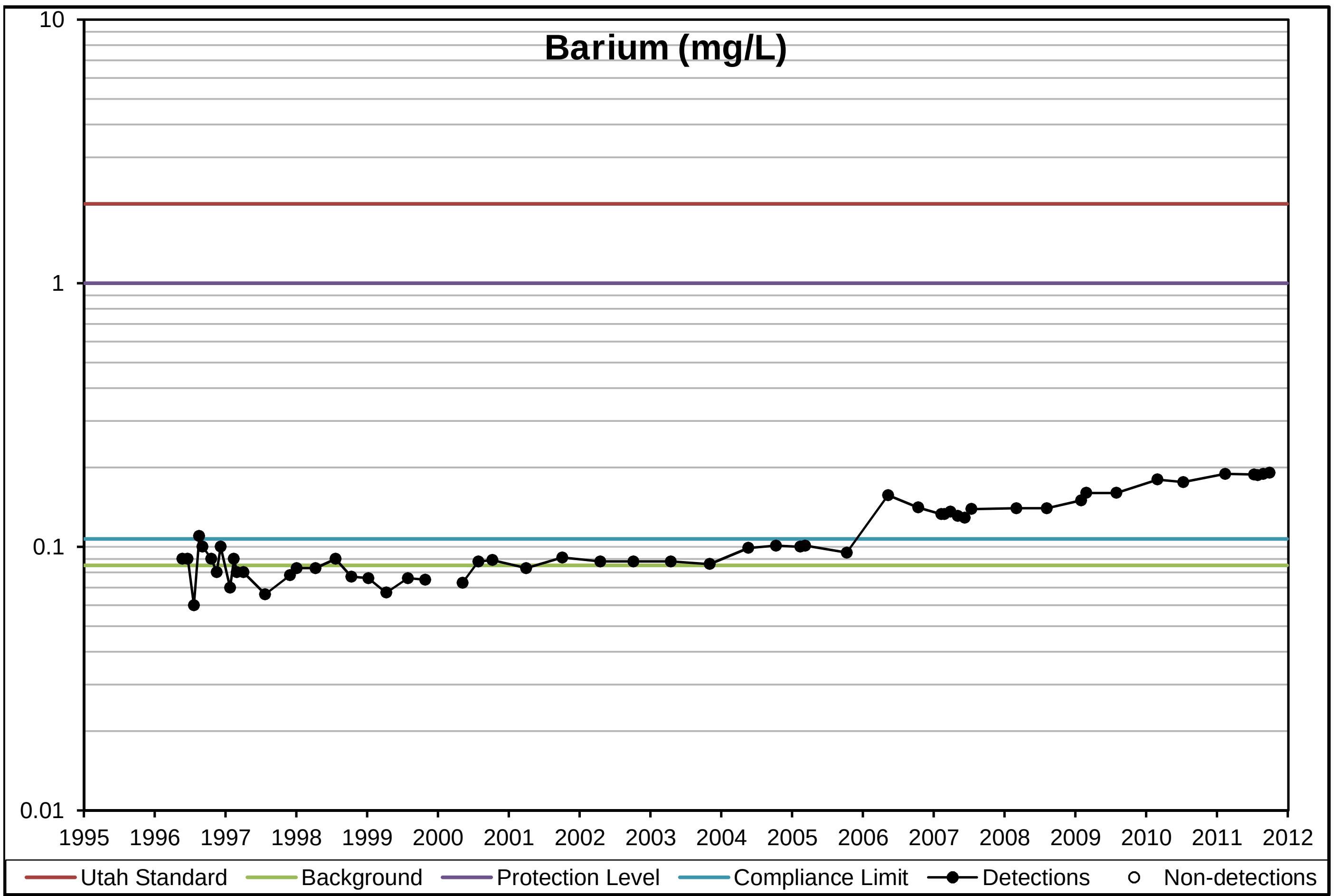


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381A

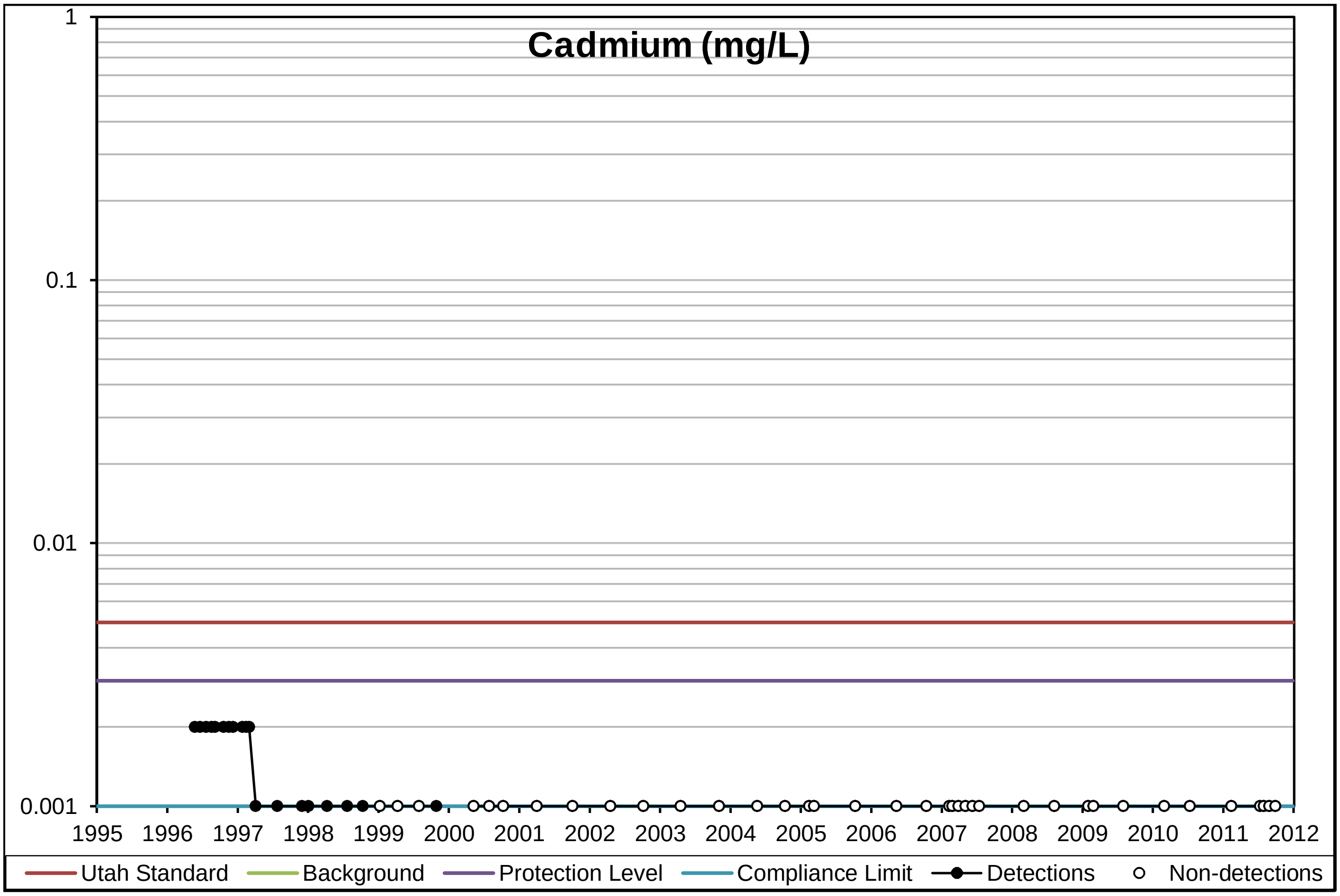
Concentration Versus Year

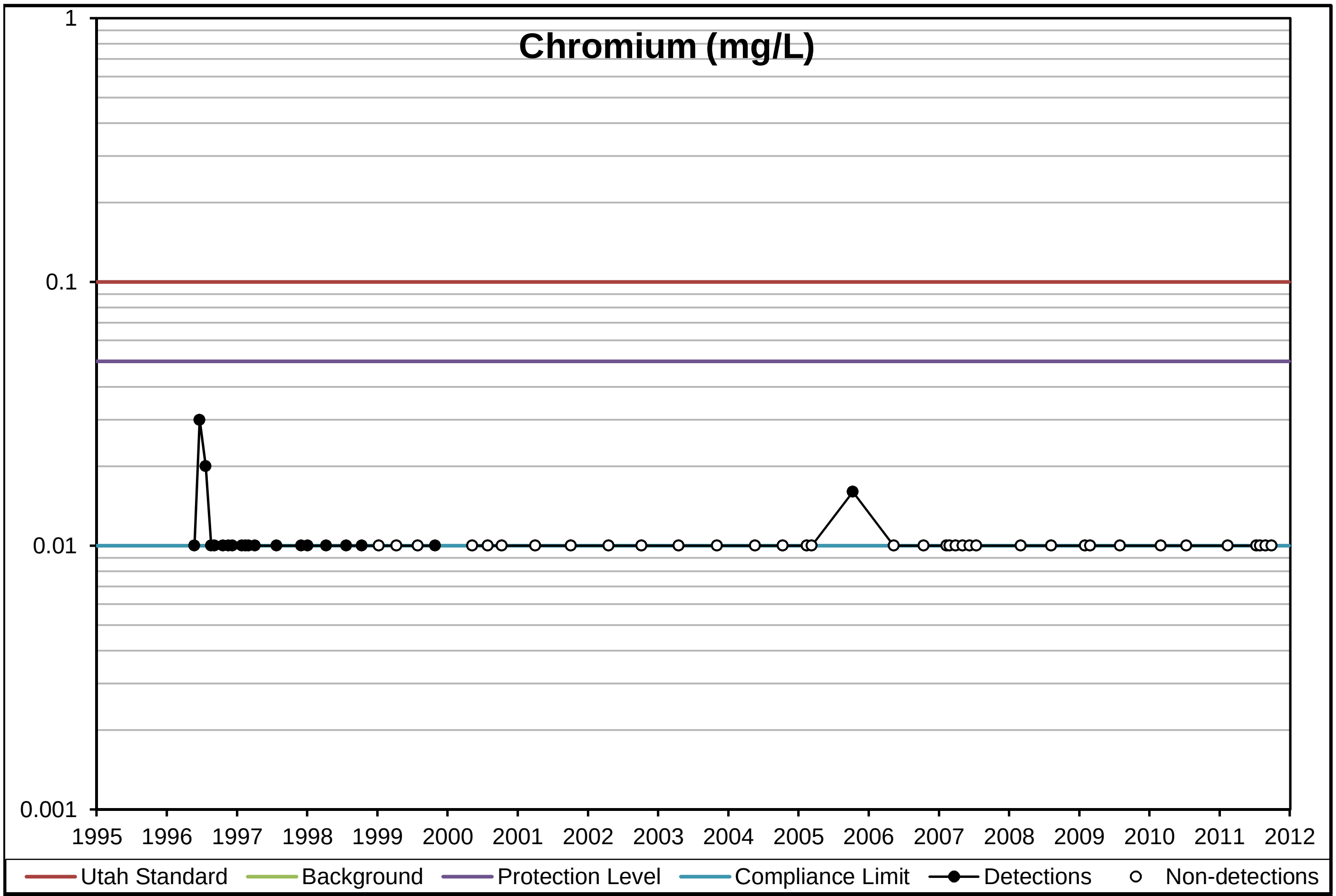




Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

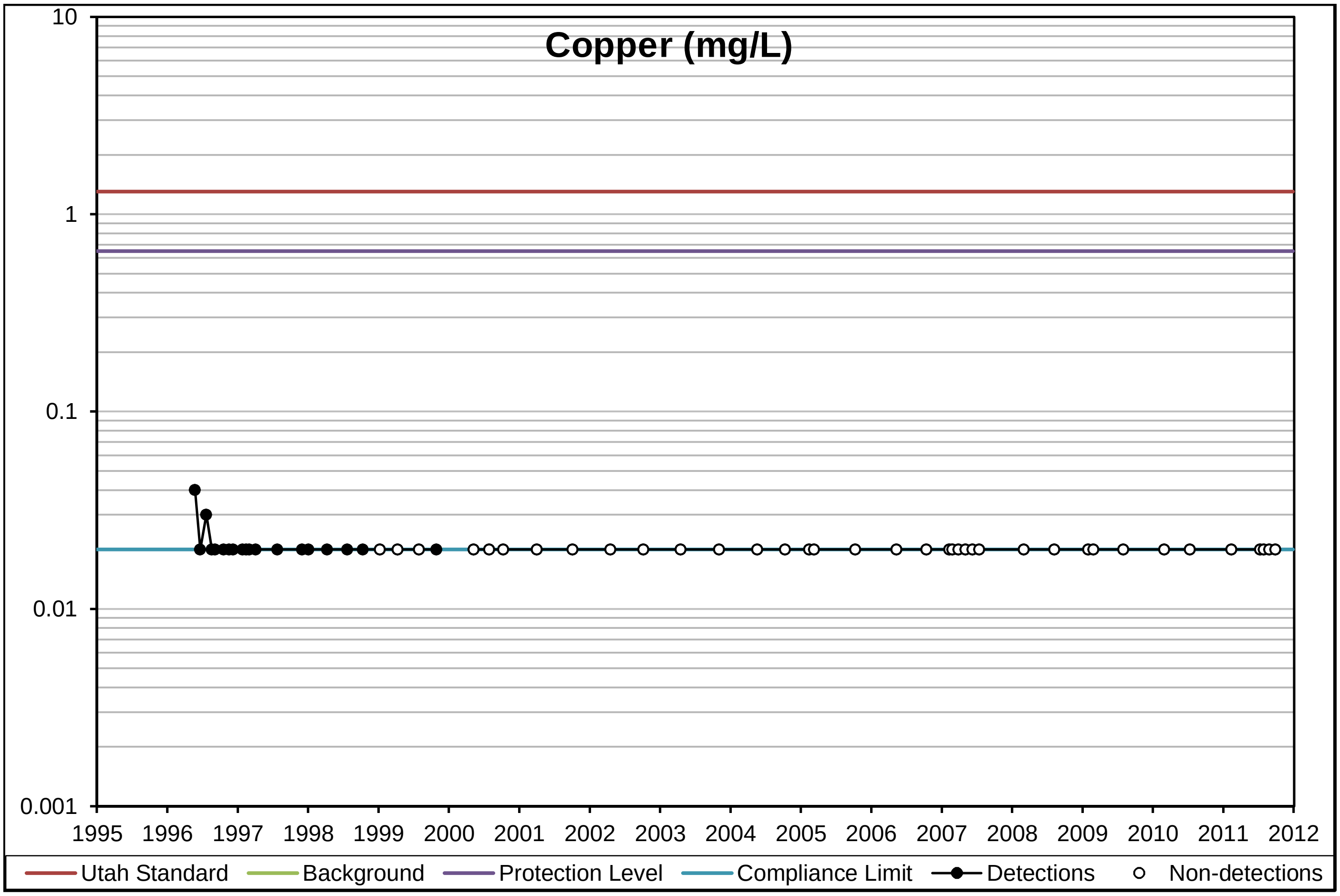


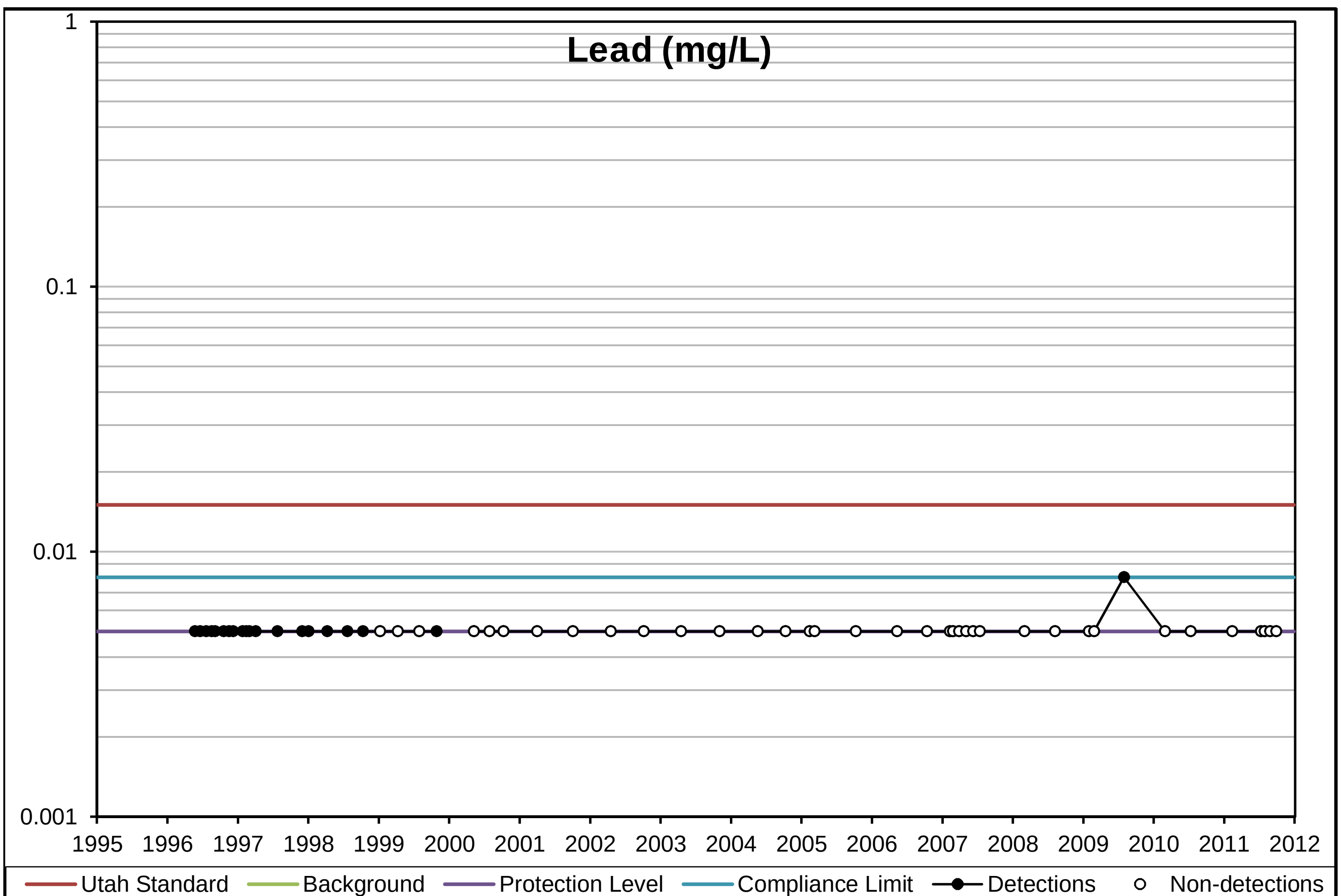


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381A

Concentration Versus Year



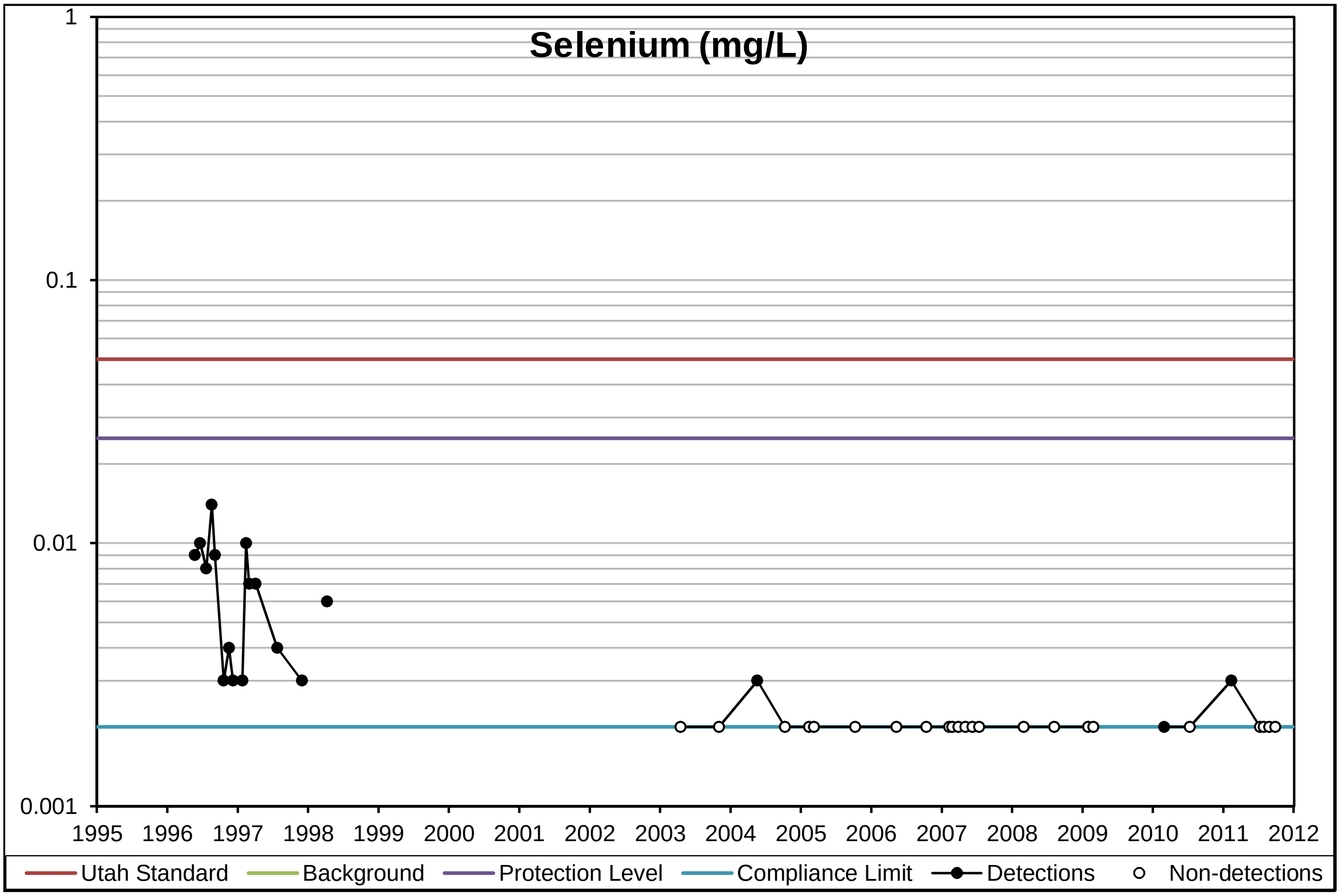


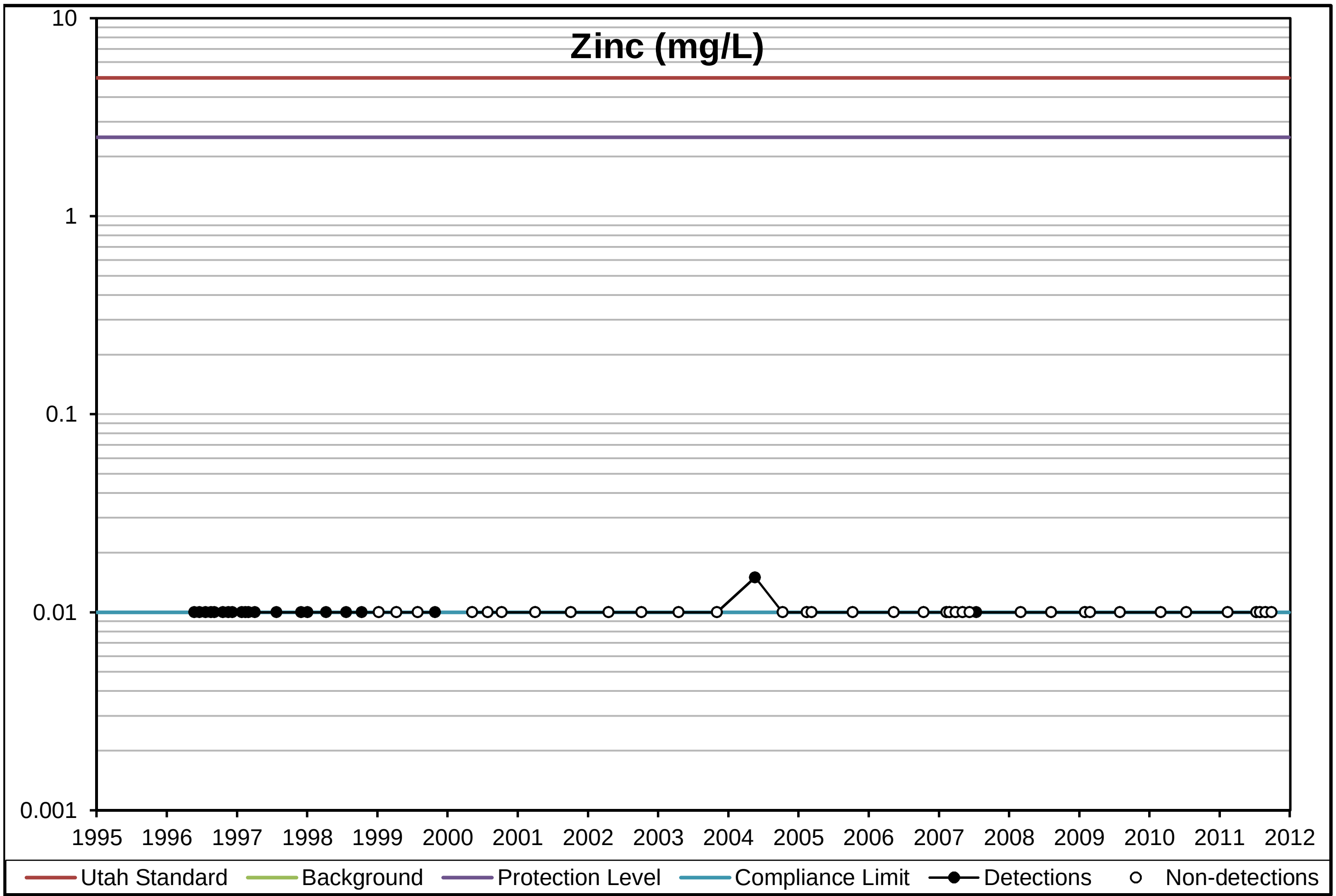
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1381A

Concentration Versus Year



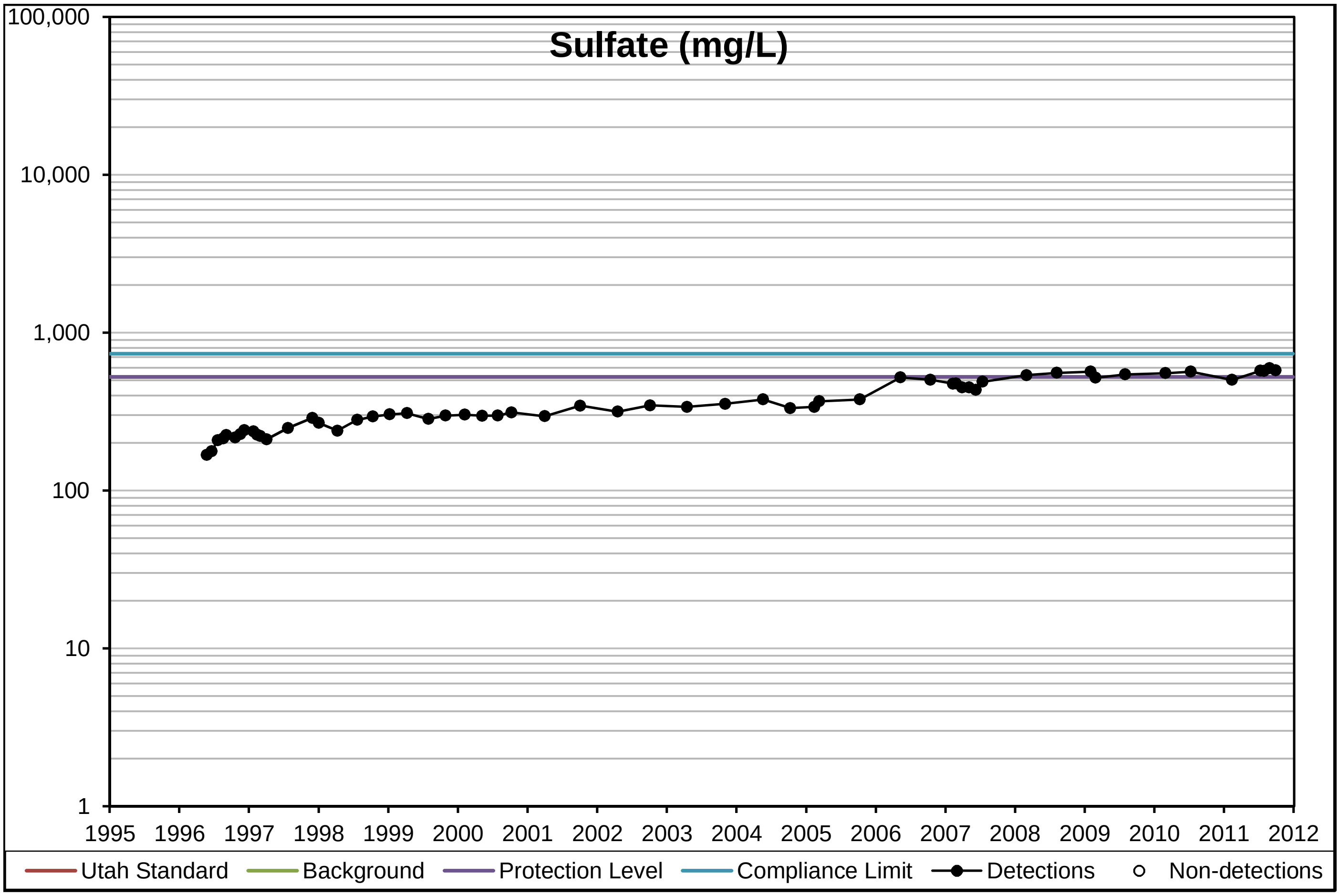


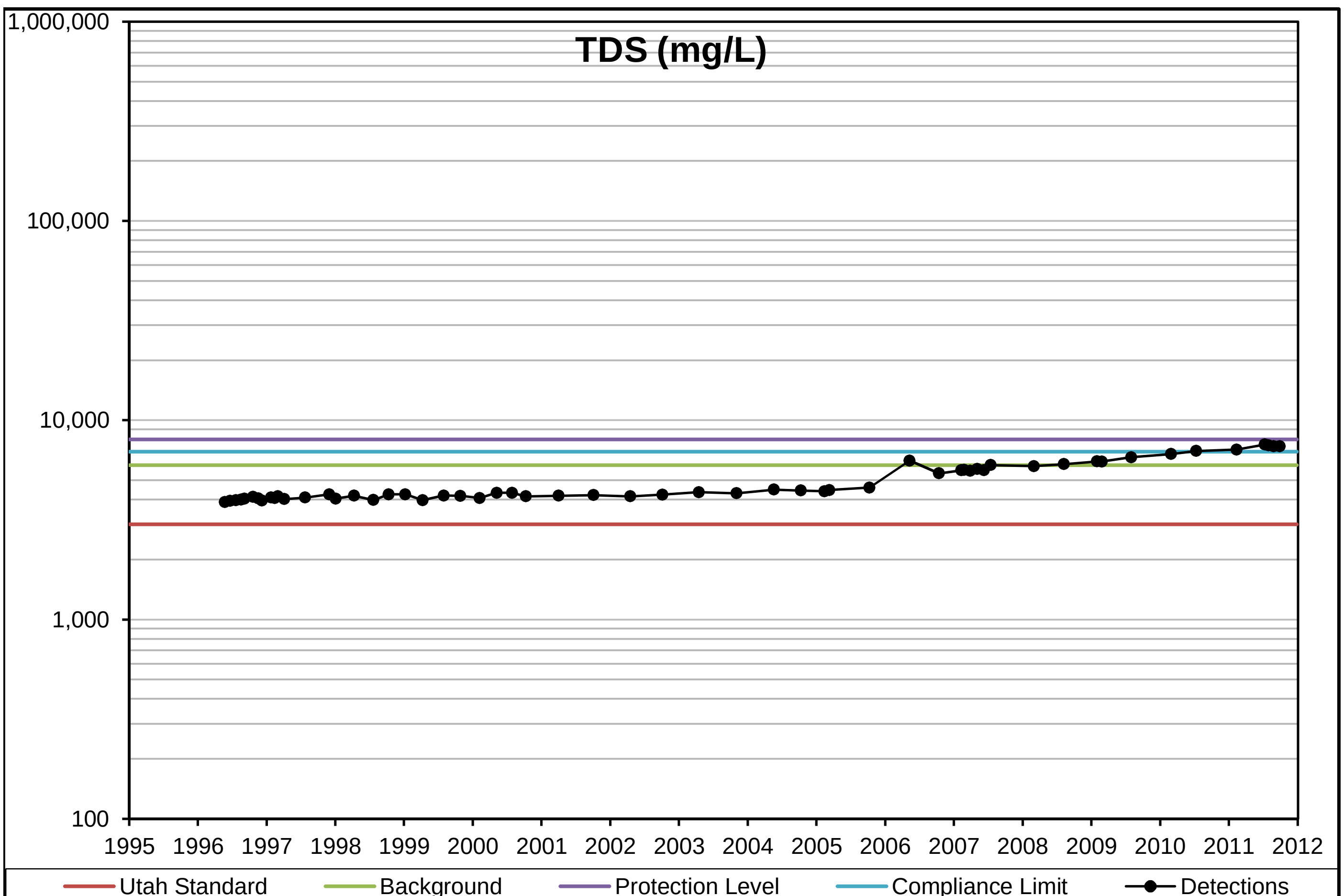
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1381A

Concentration Versus Year



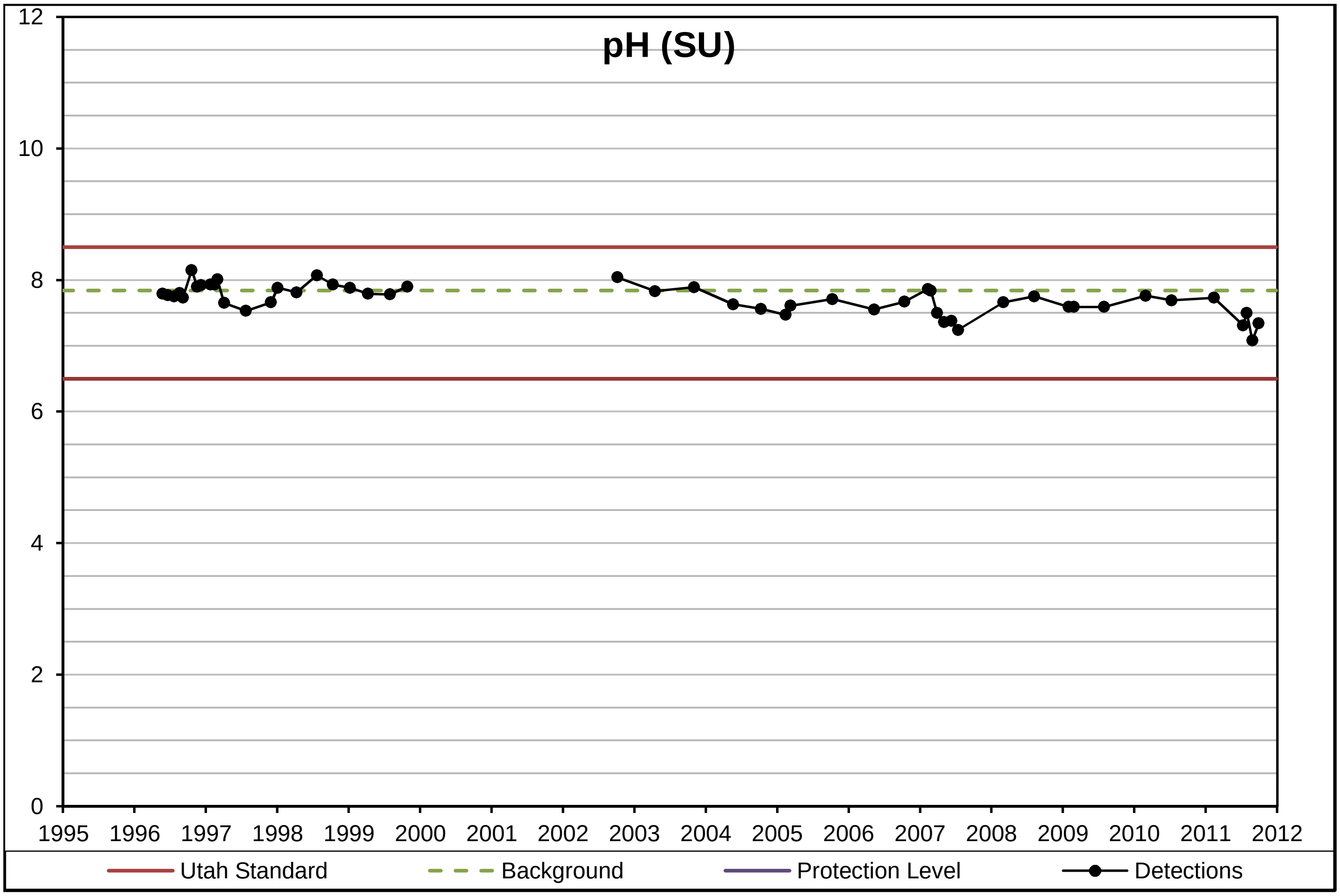


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1381A

Concentration Versus Year



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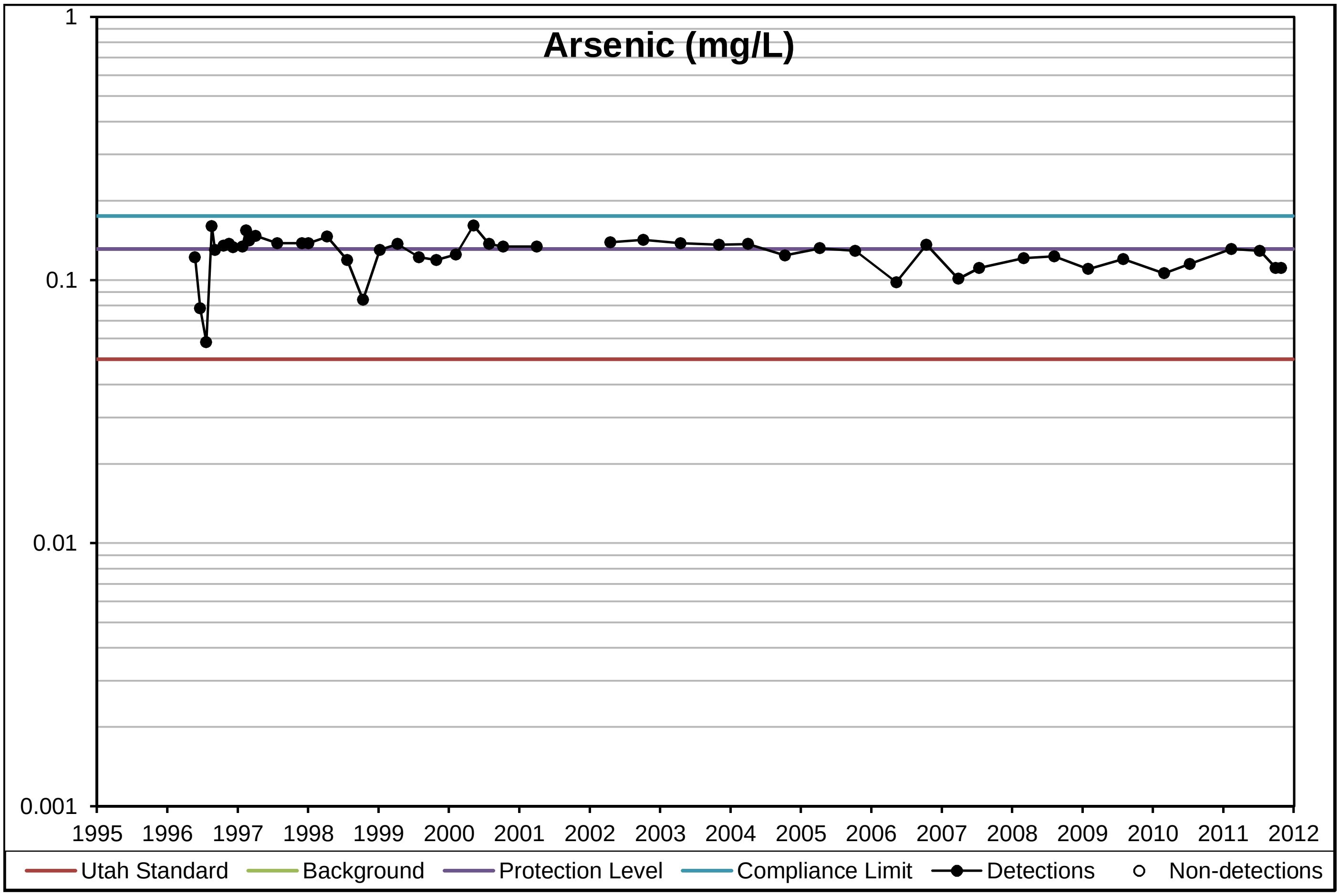
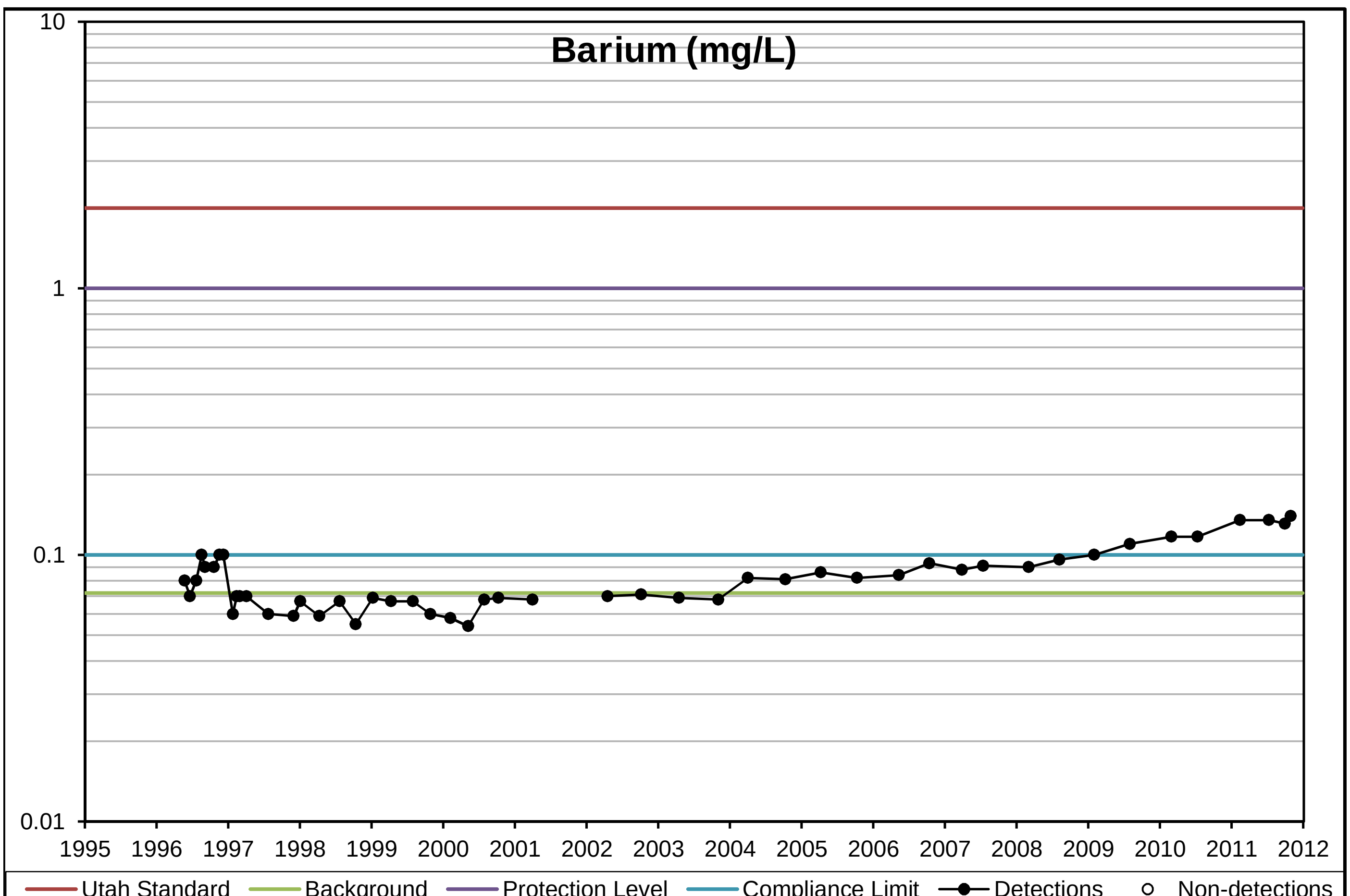
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

Concentration Versus Year



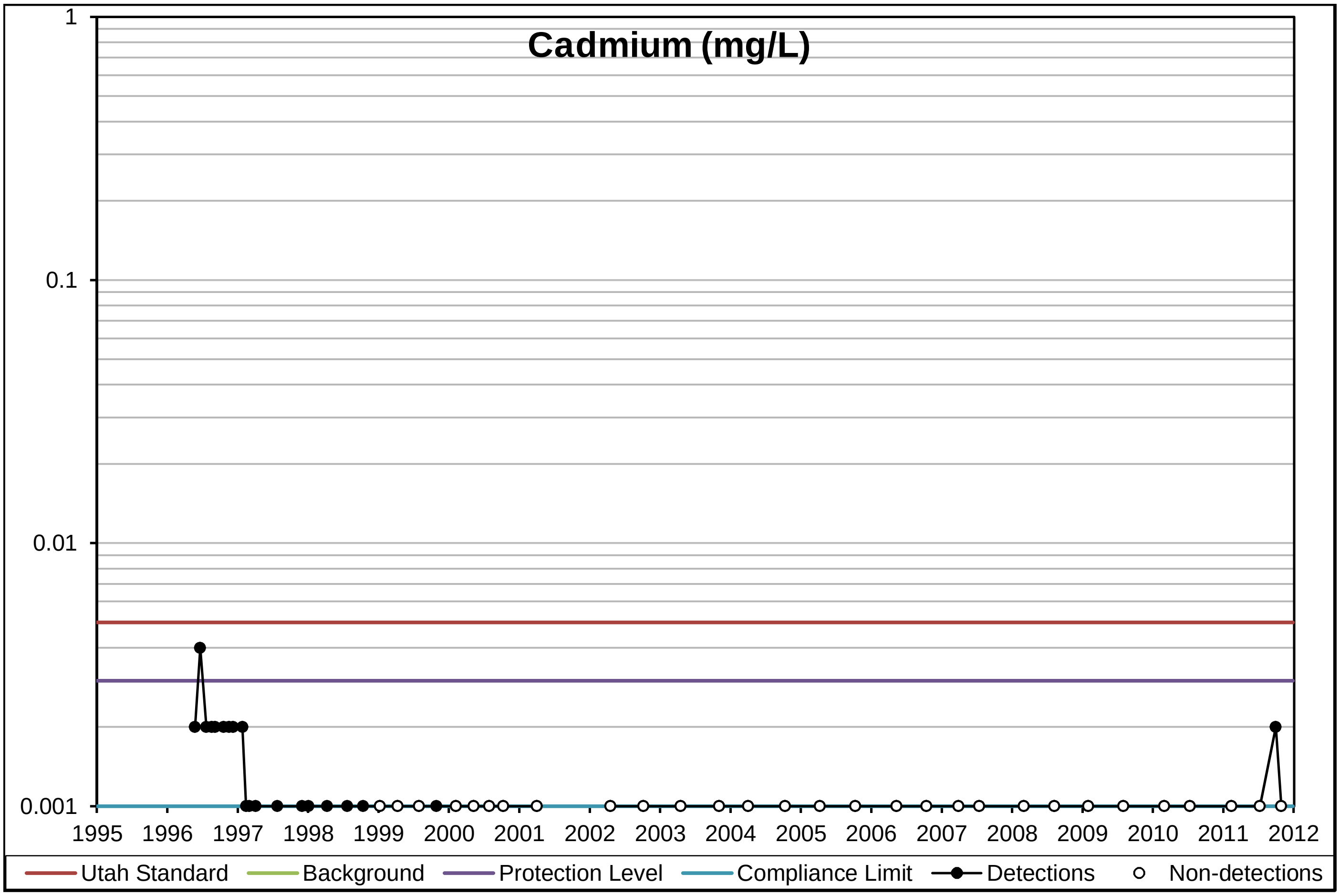


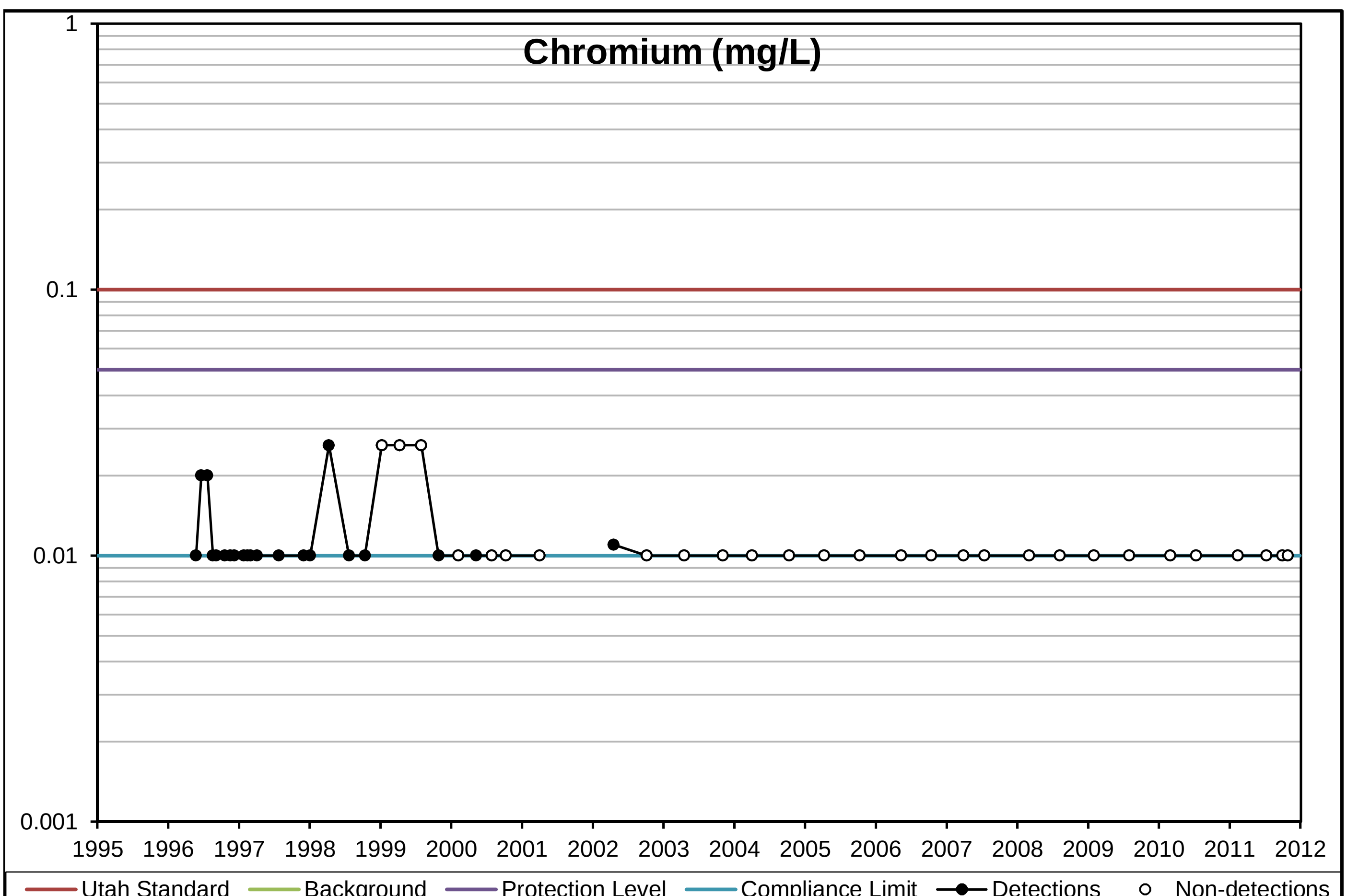
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

Concentration Versus Year

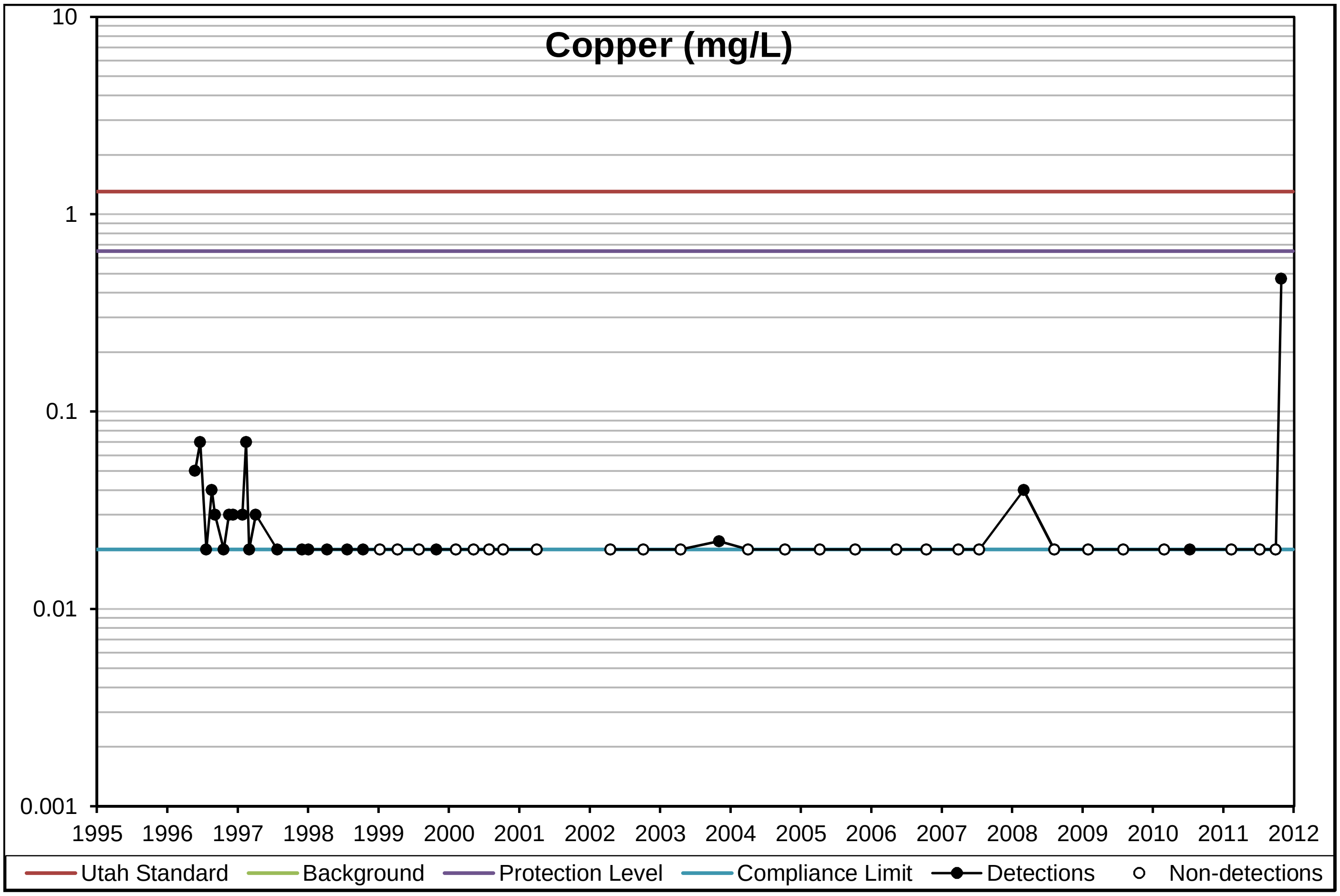


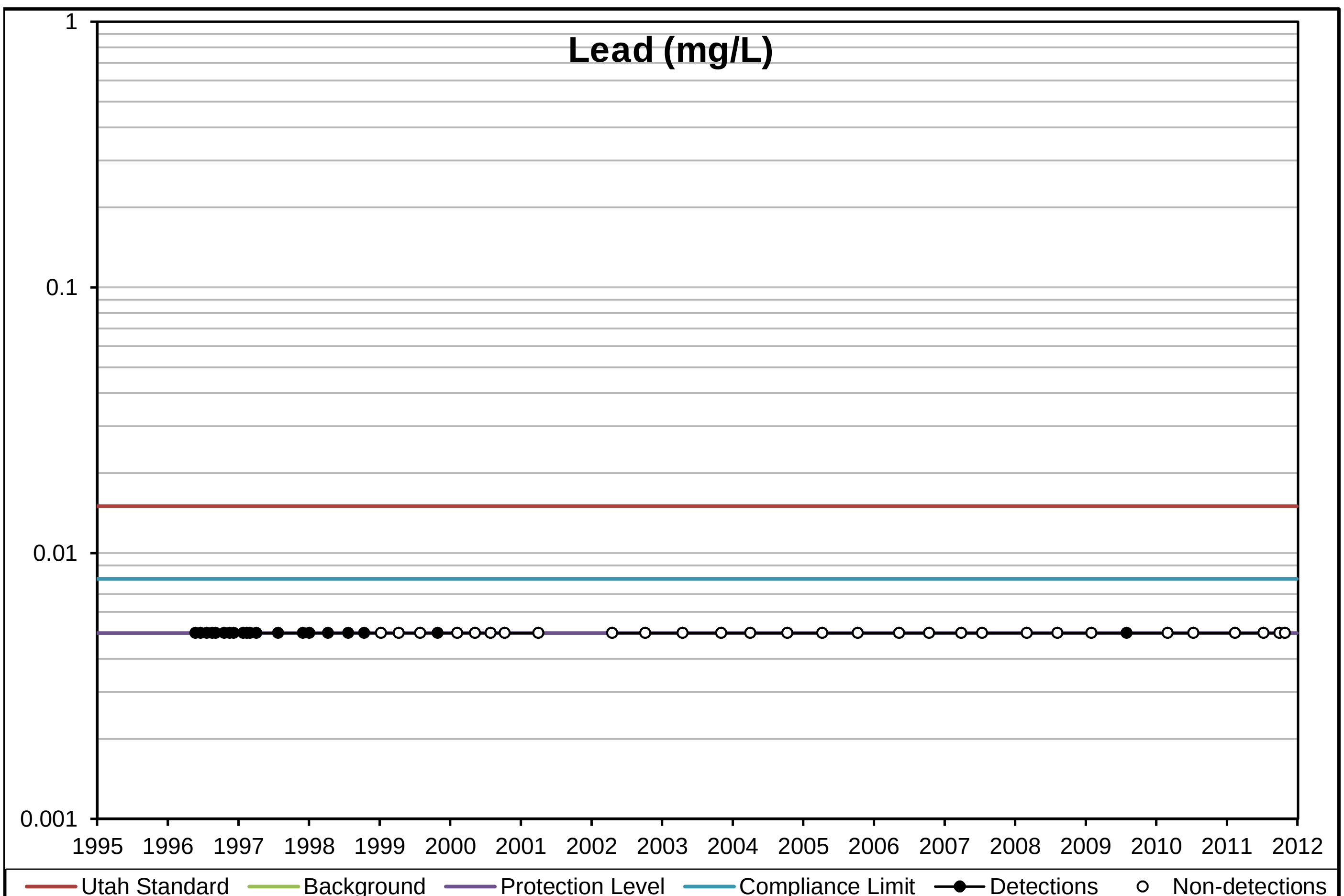


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

Concentration Versus Year

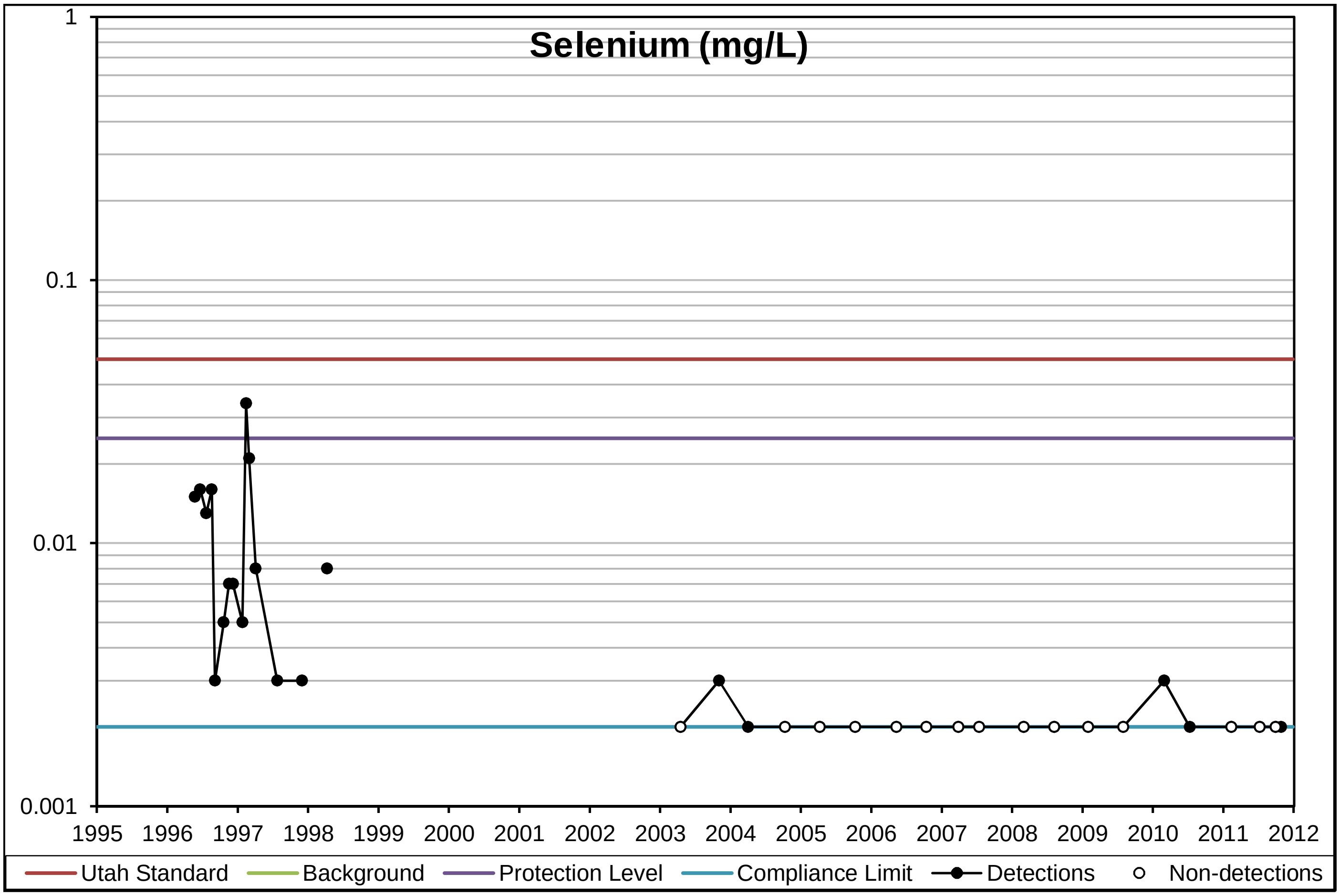


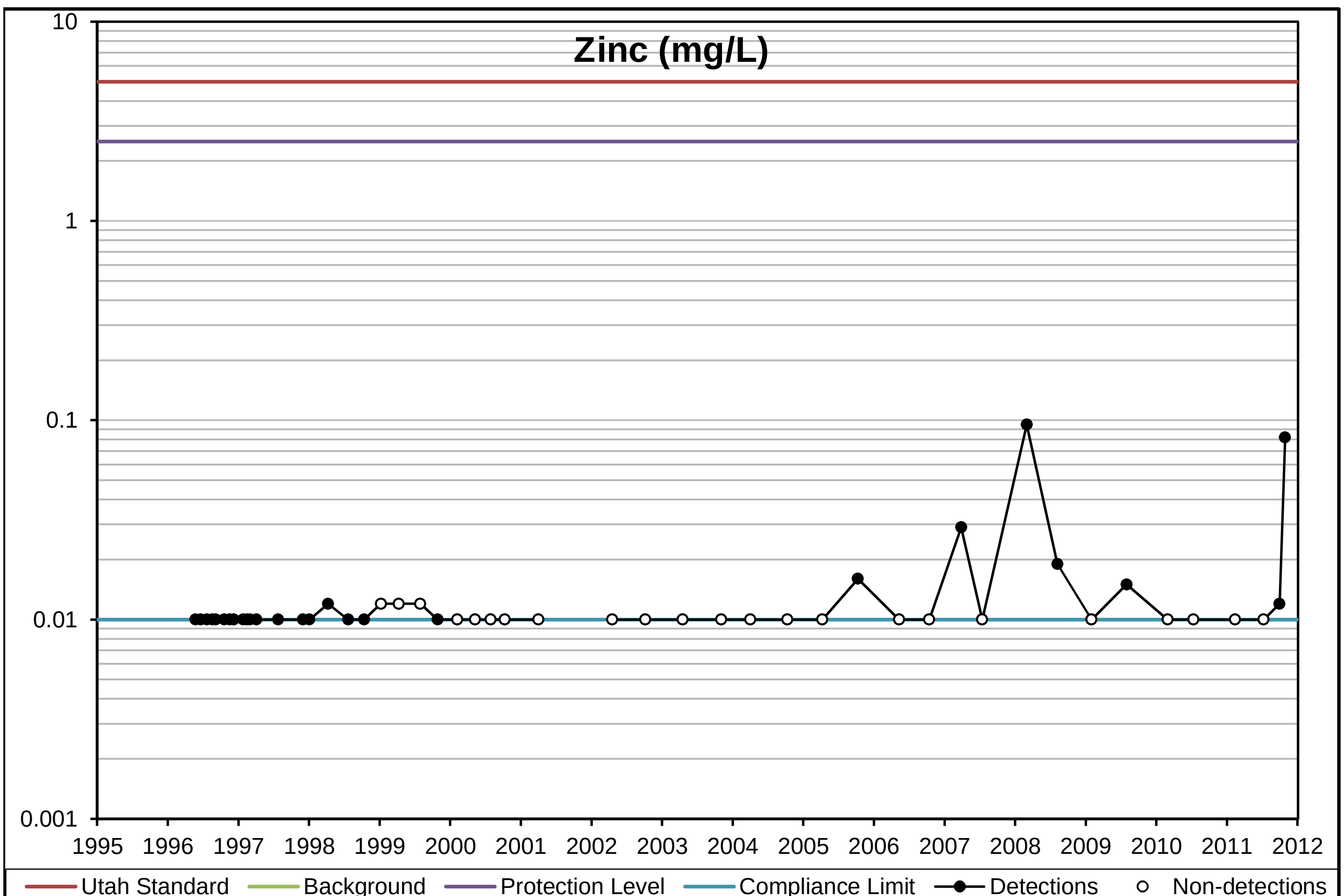


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

Concentration Versus Year

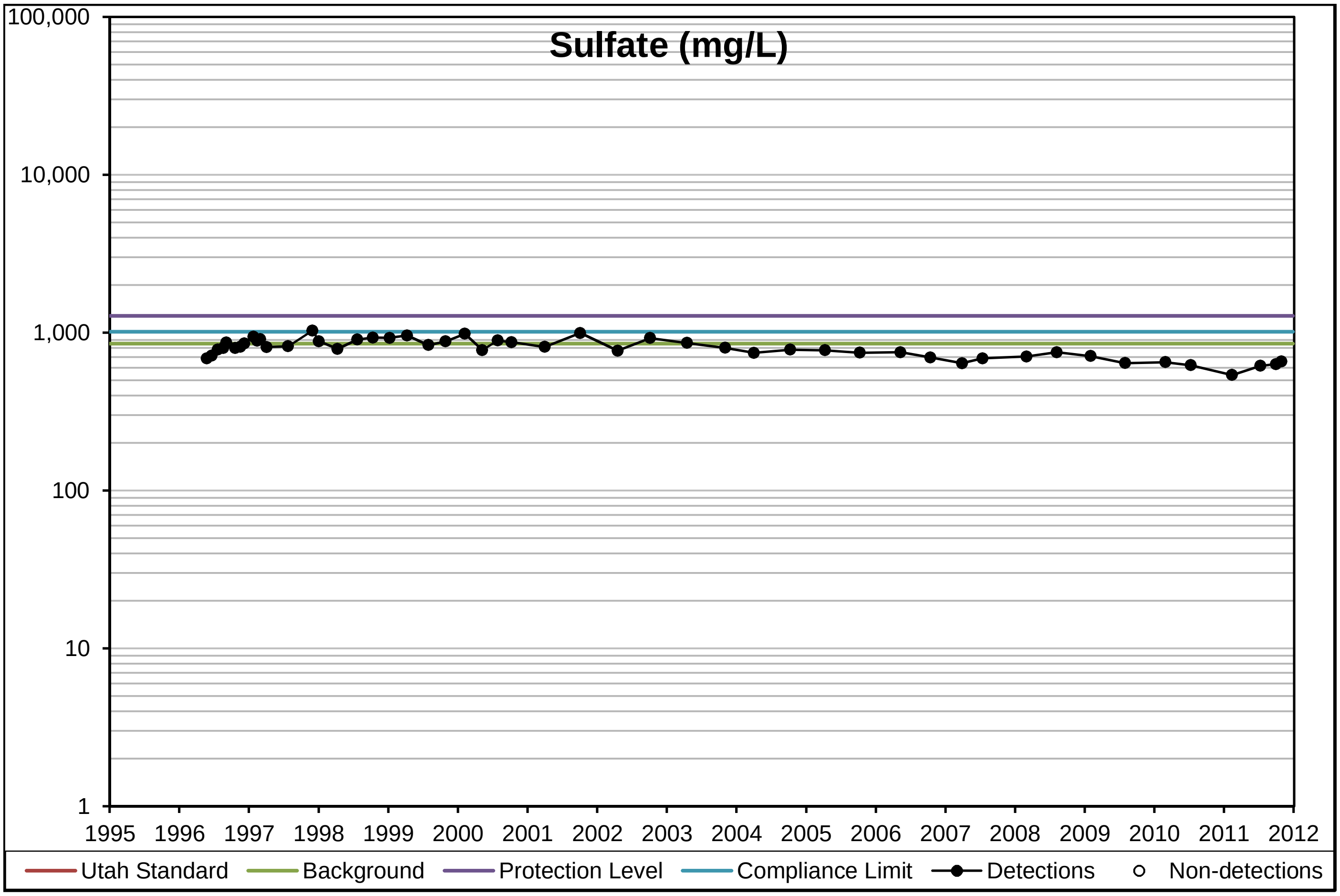


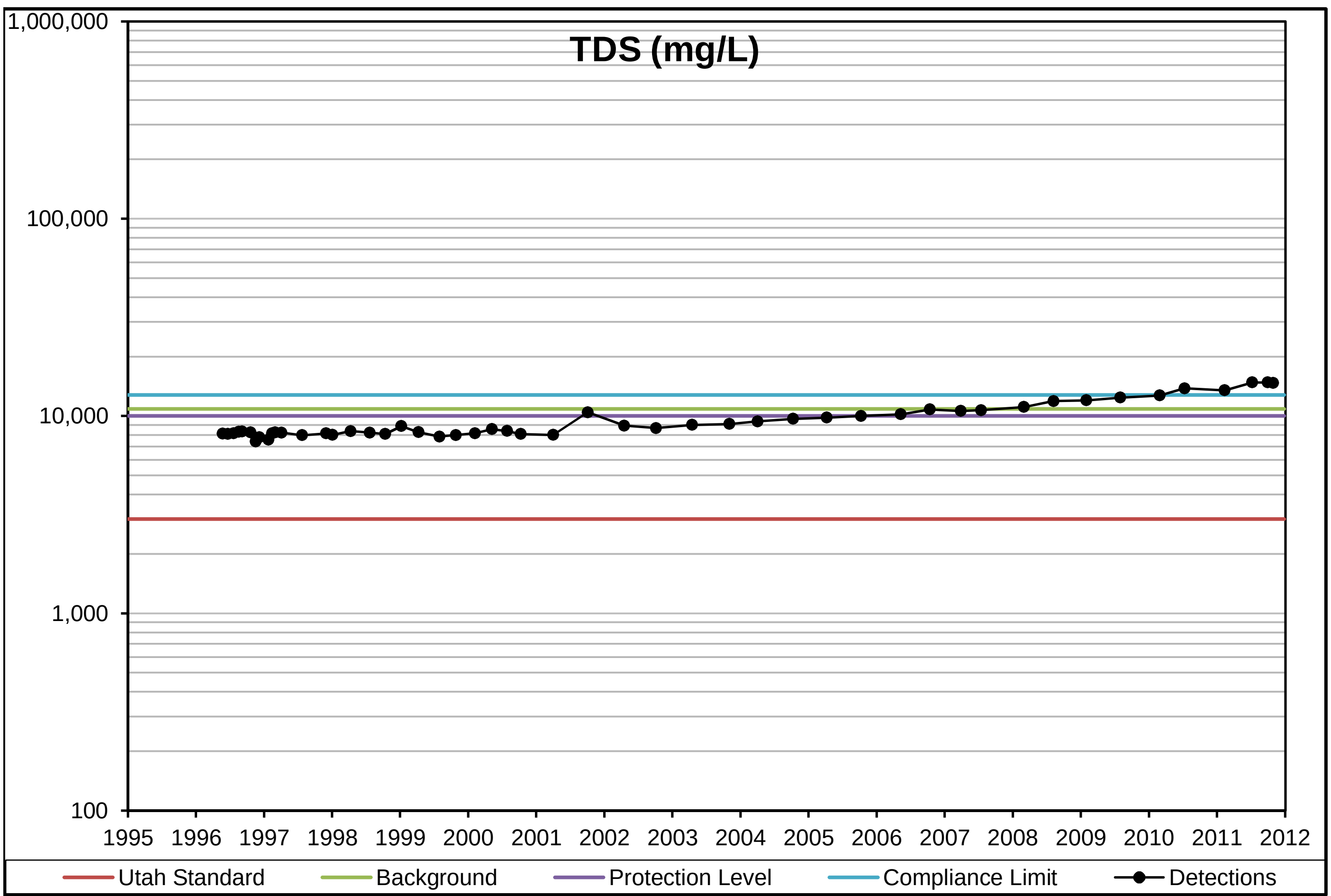


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

Concentration Versus Year



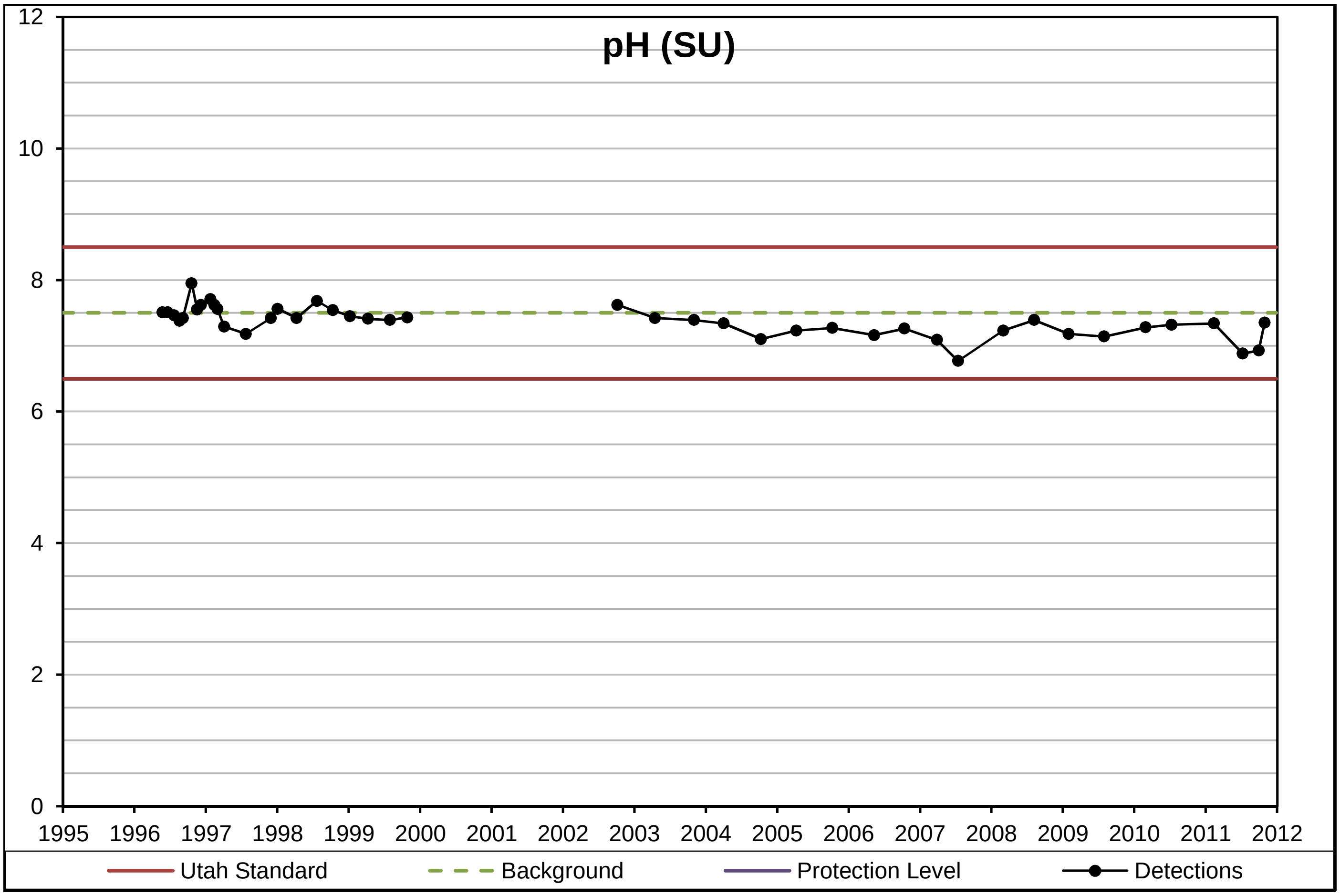


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1381B

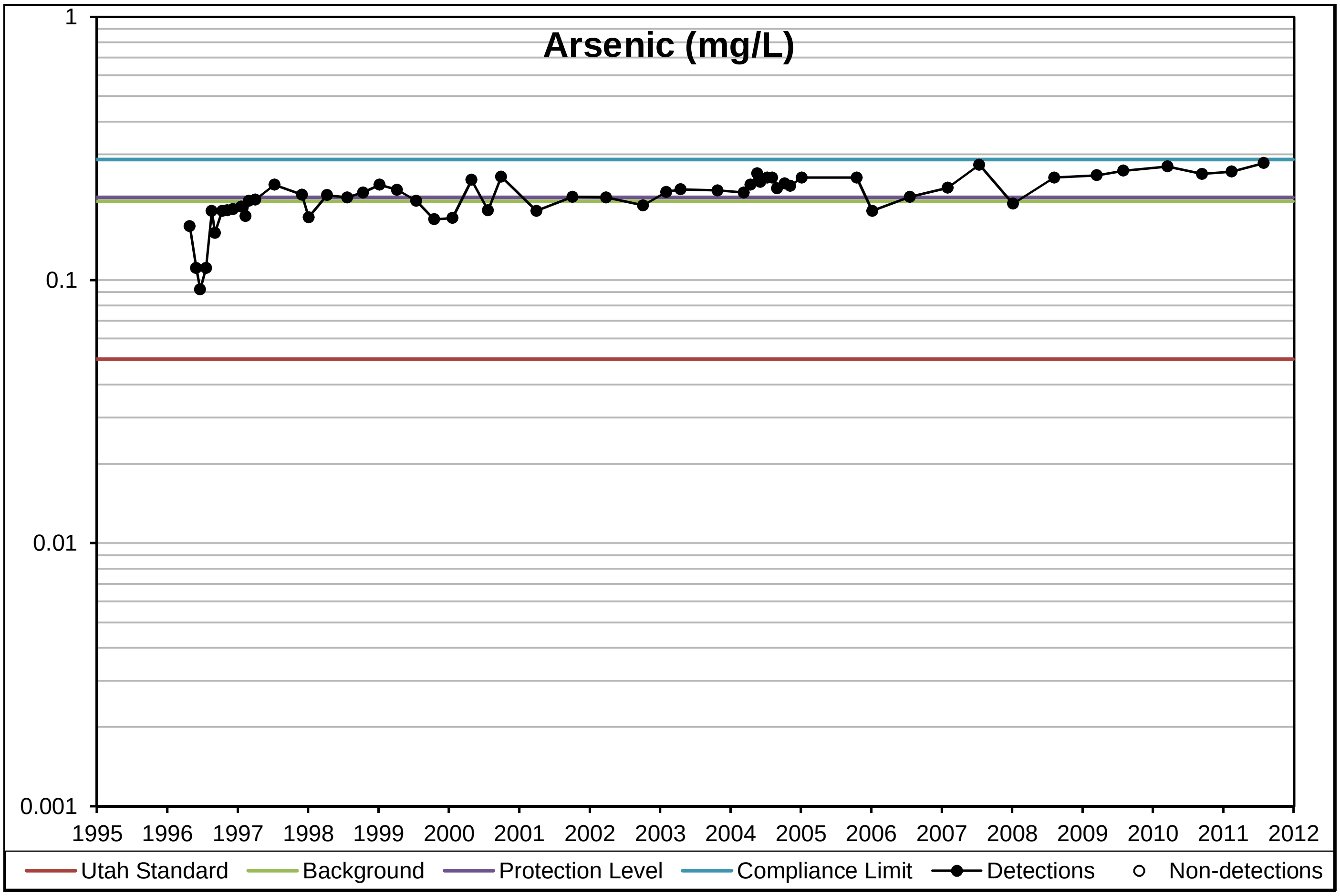
Concentration Versus Year

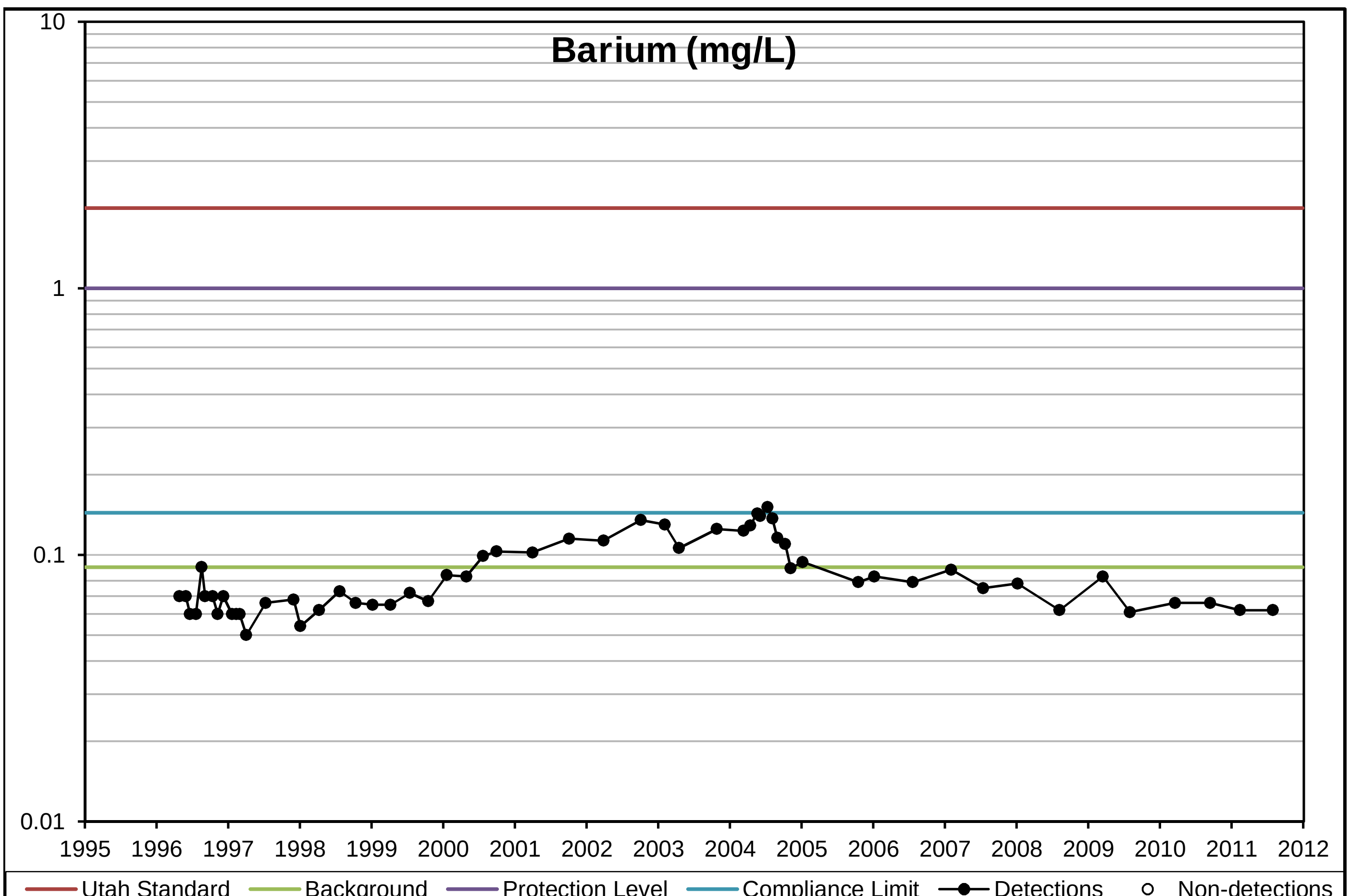


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year



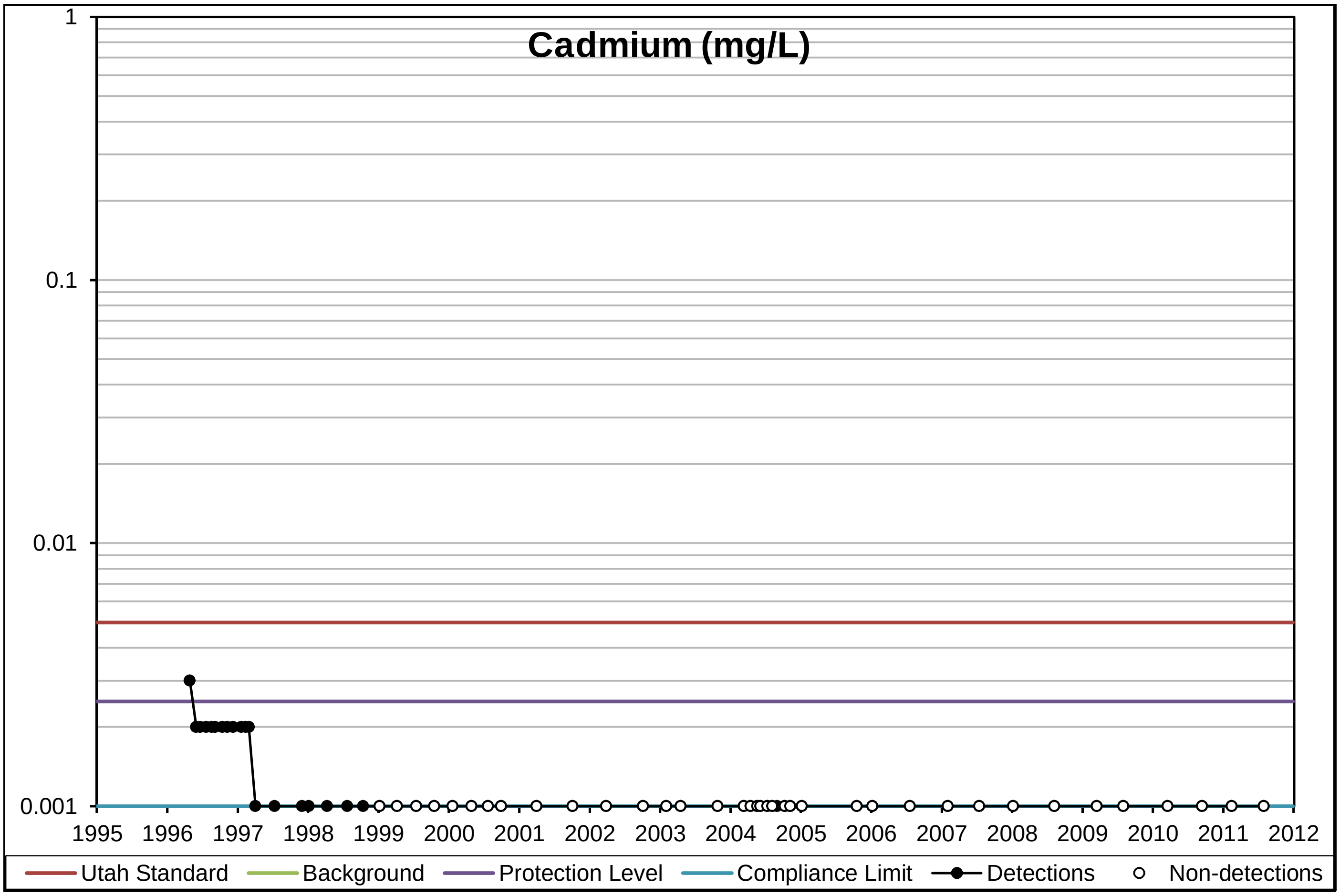


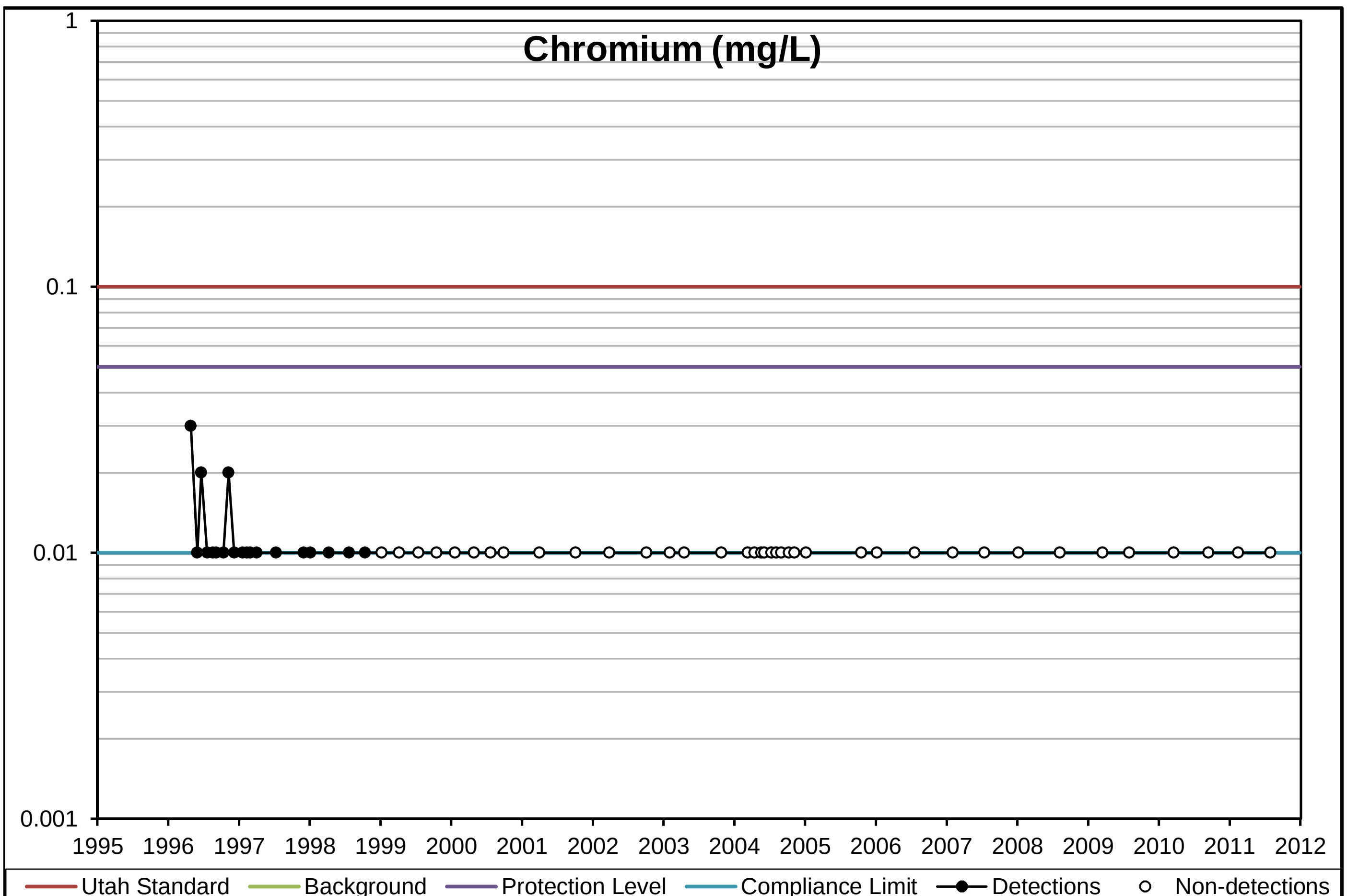
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year



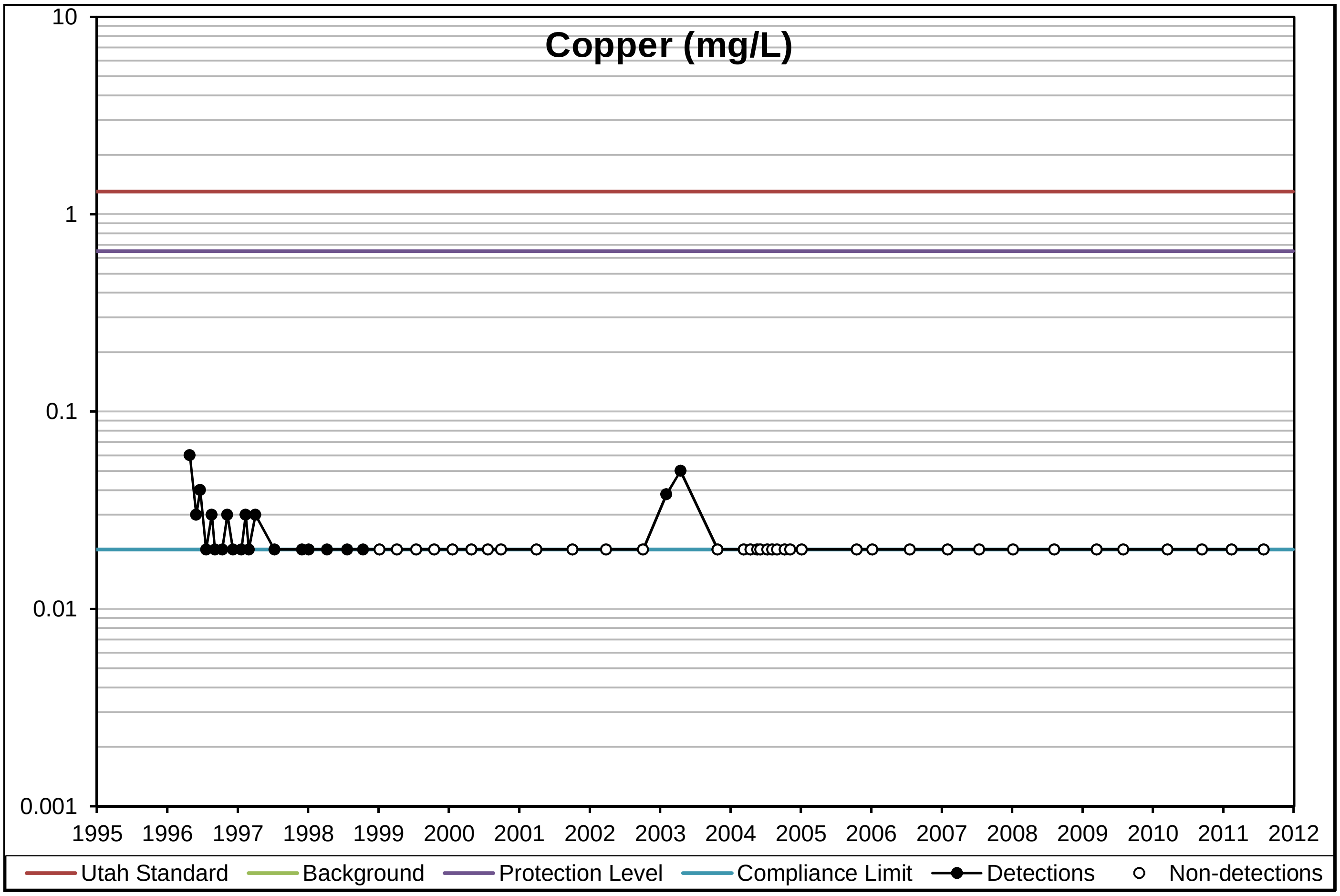


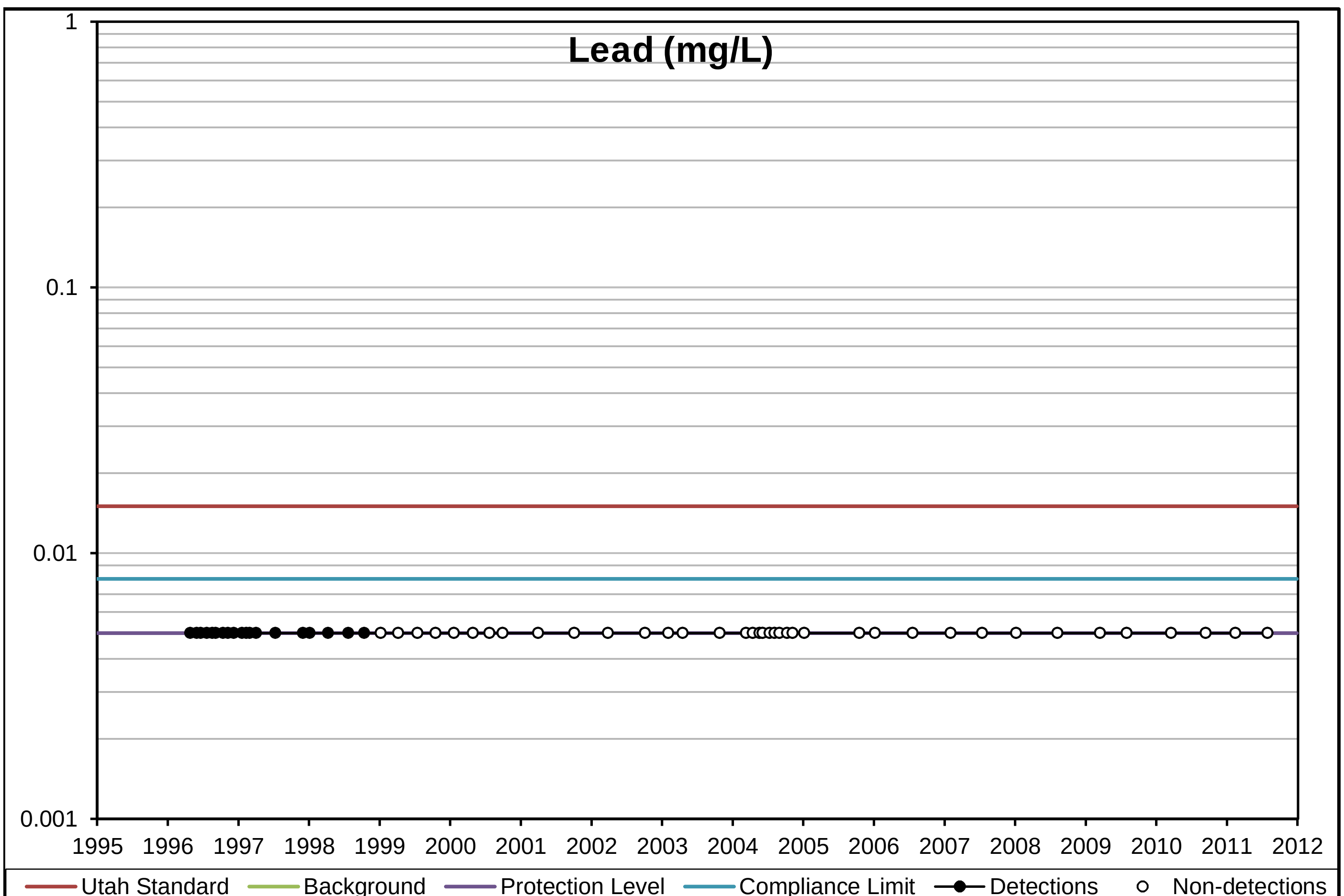
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year

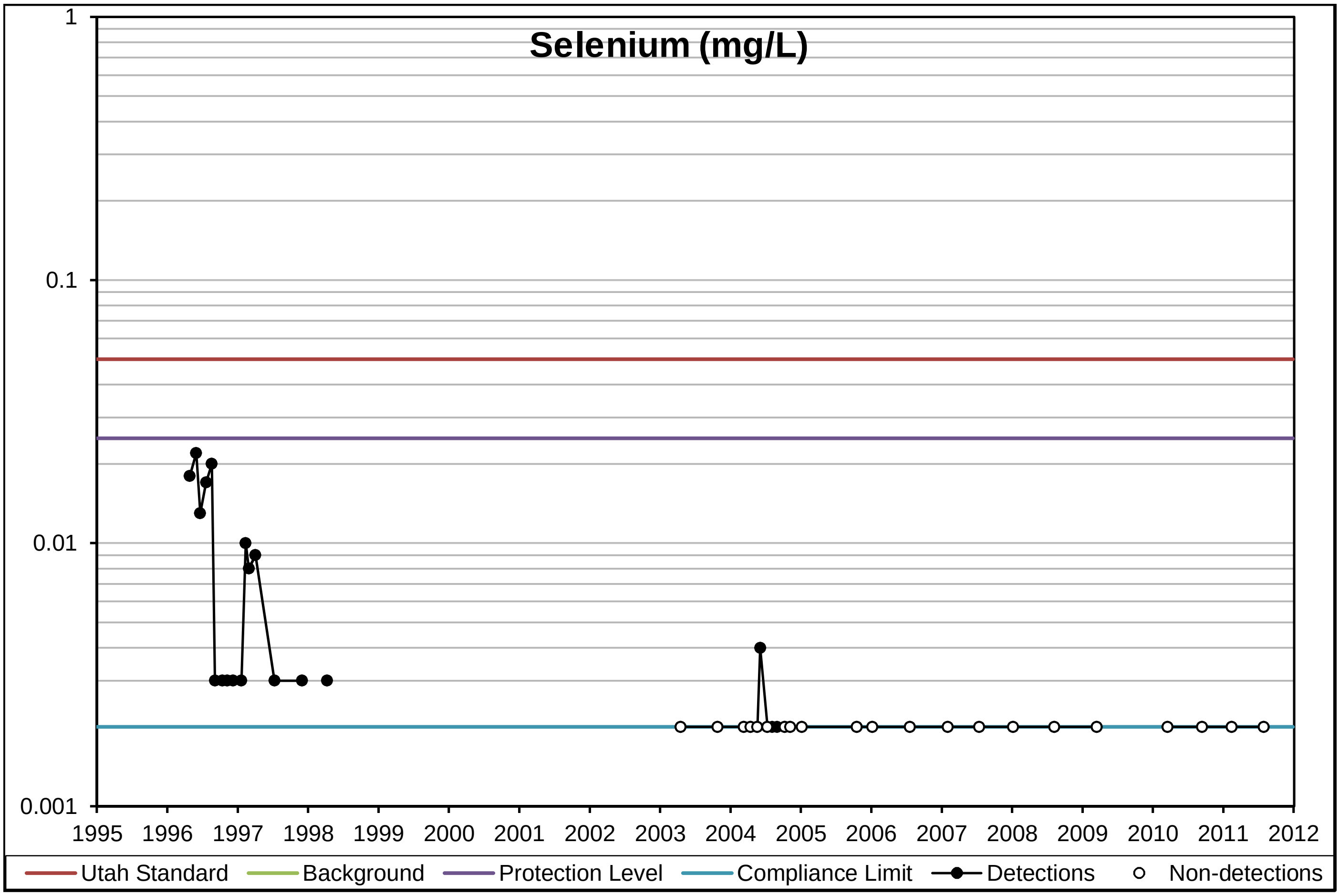


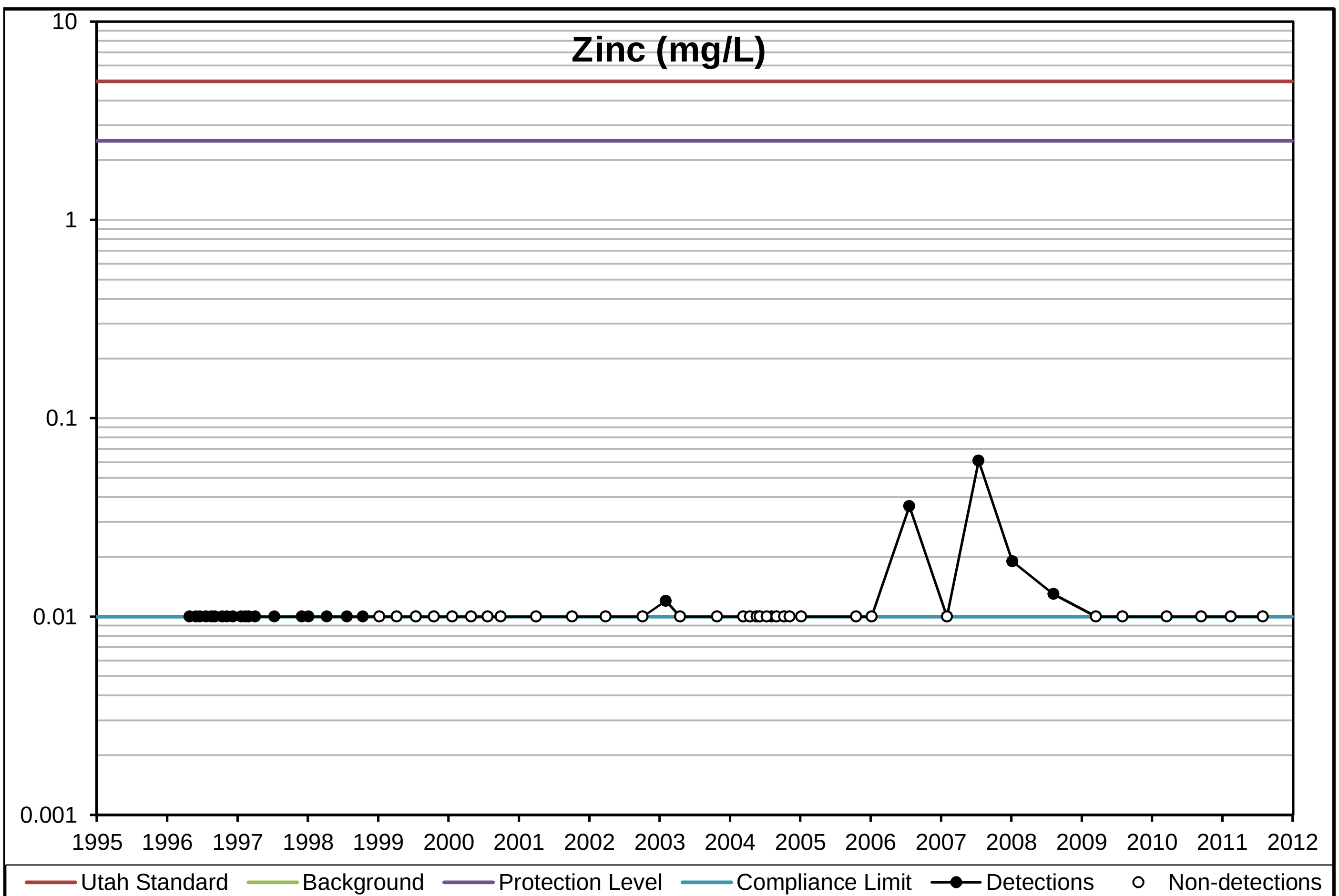


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year



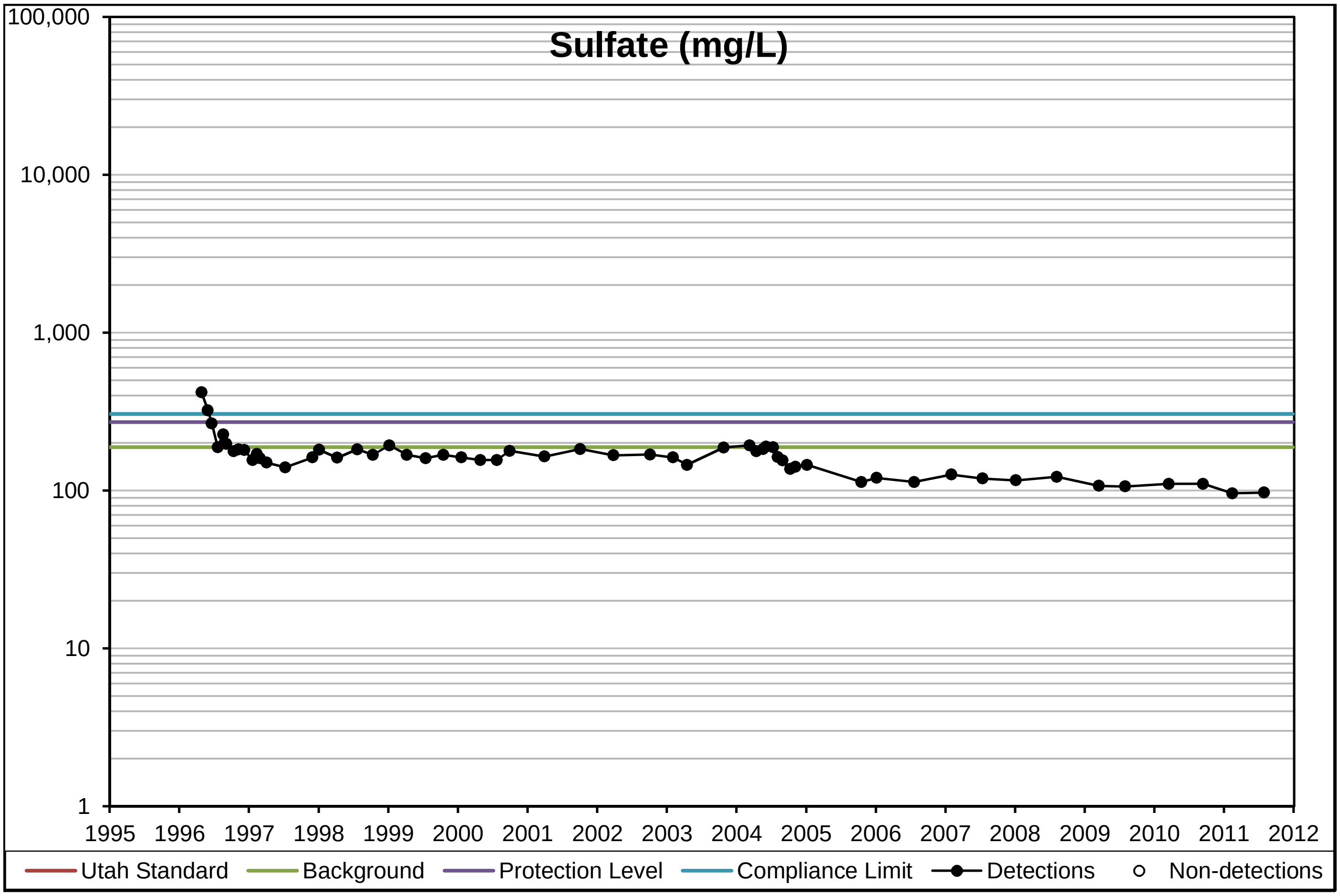


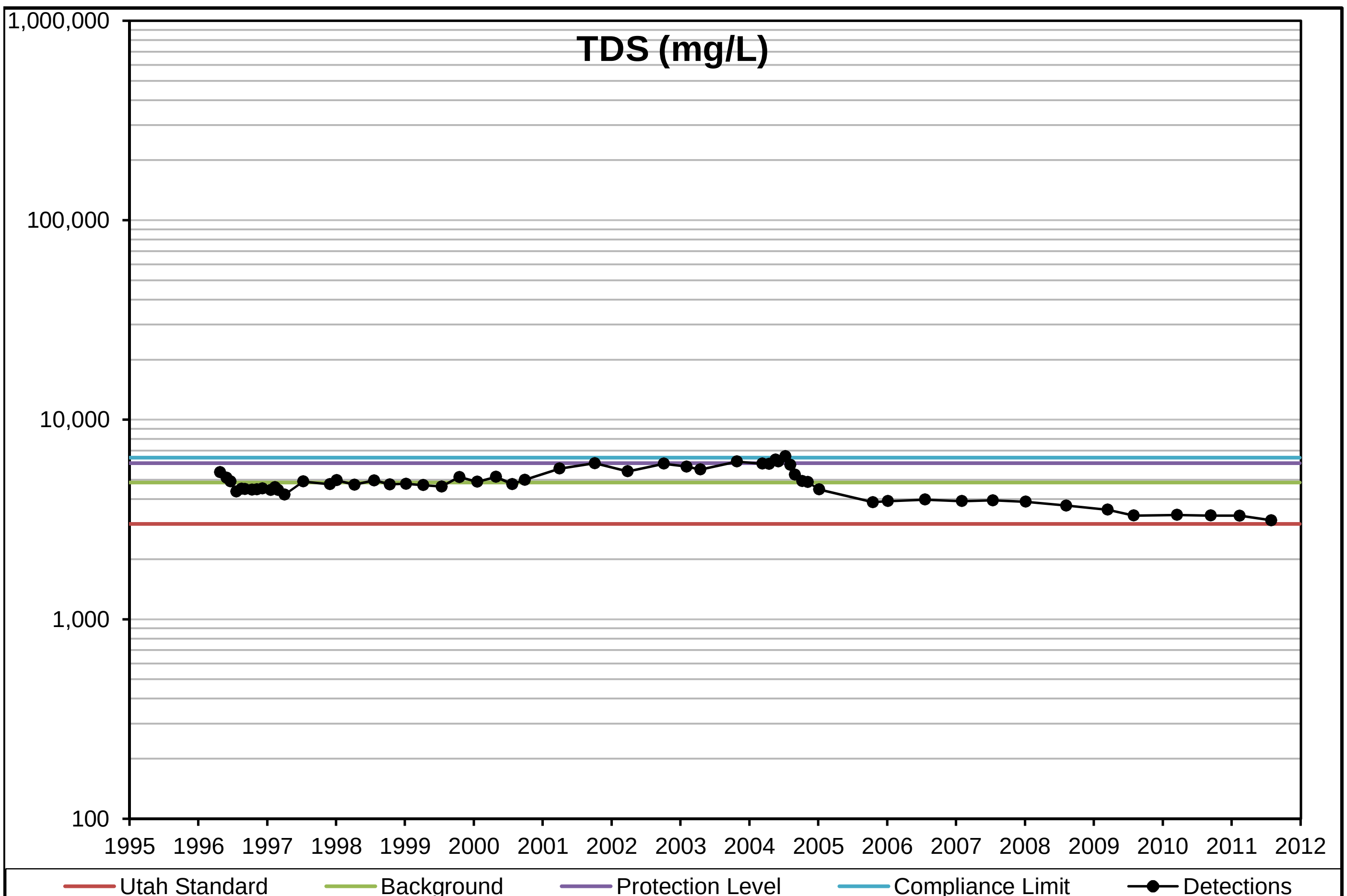
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year



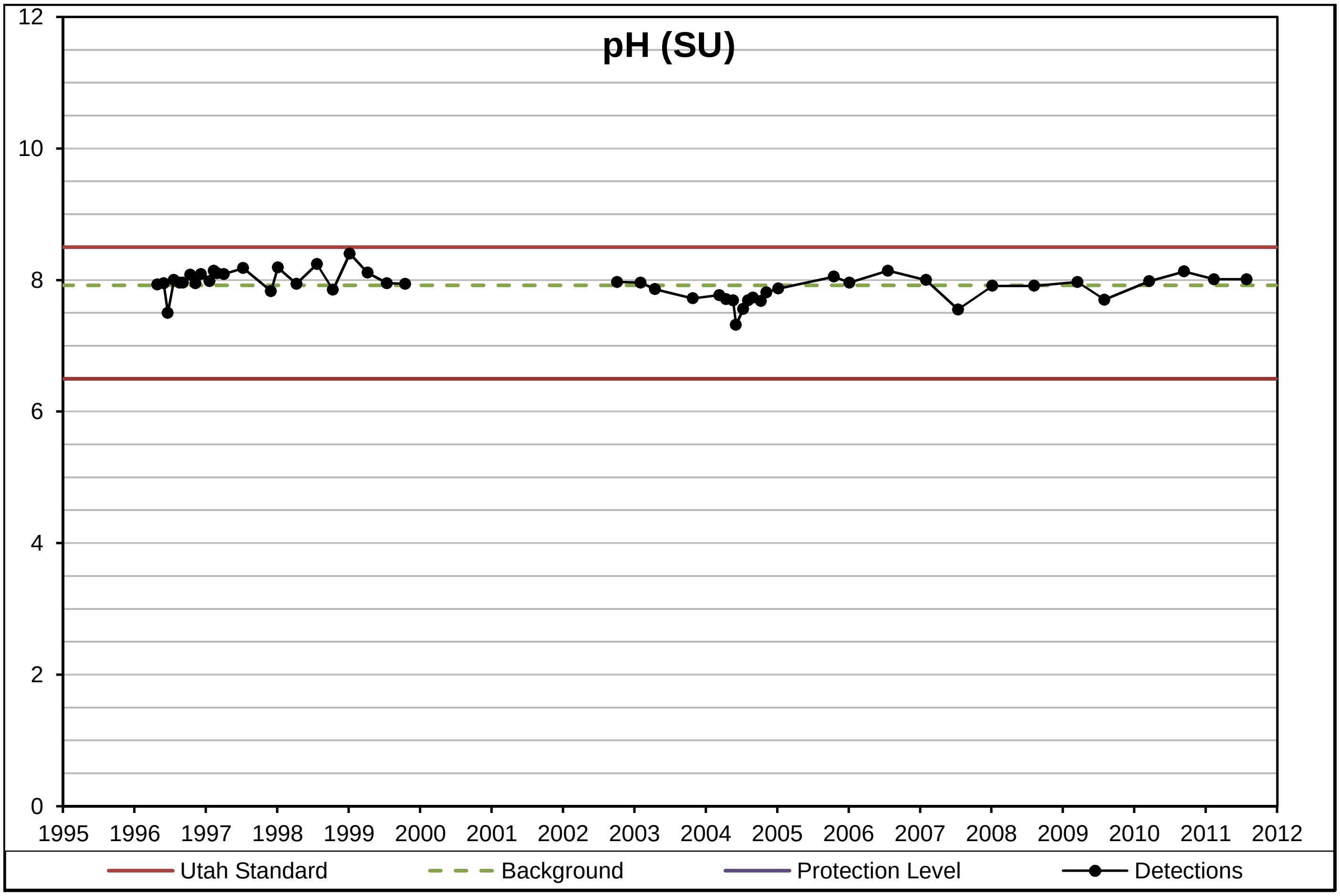


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382A

Concentration Versus Year

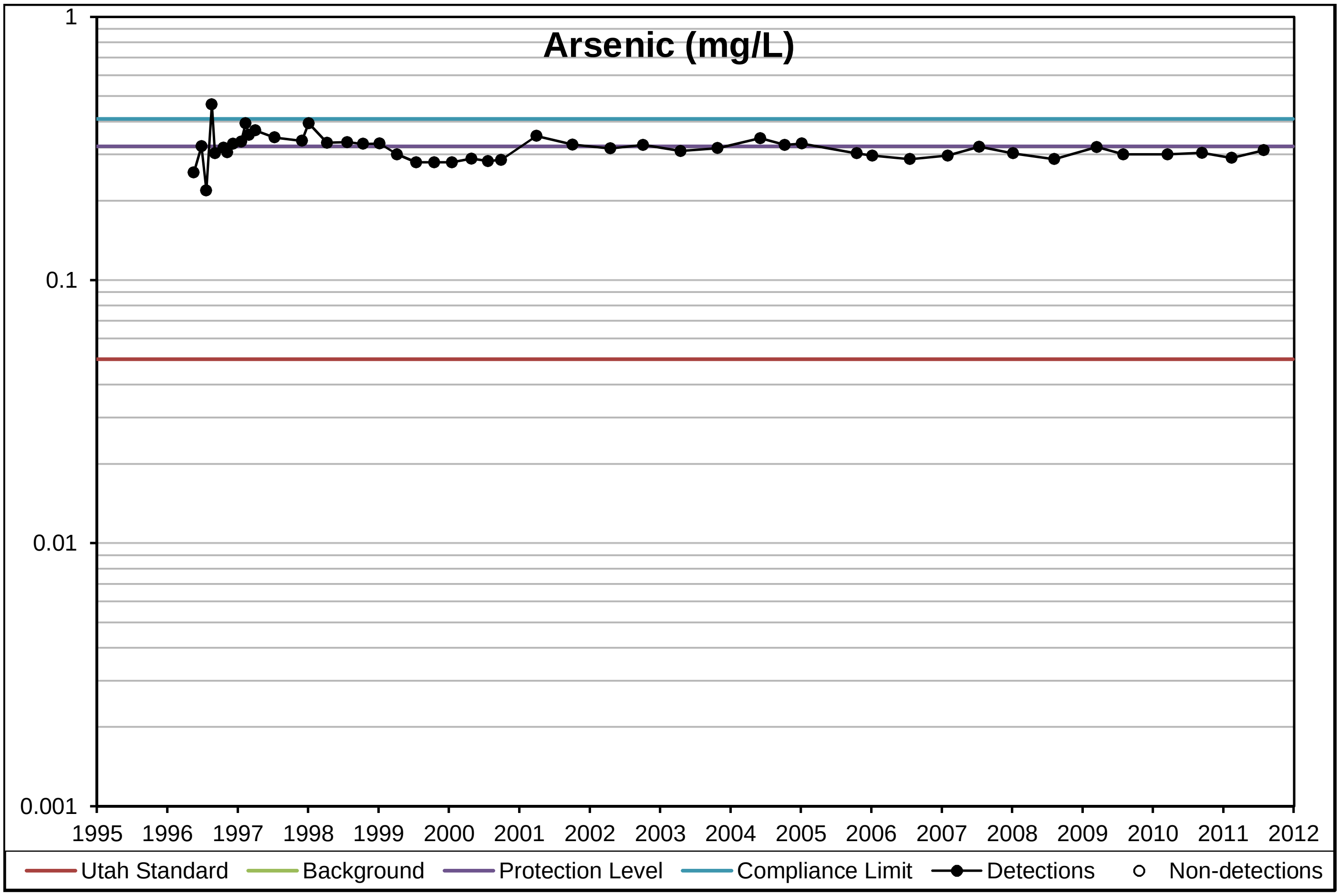


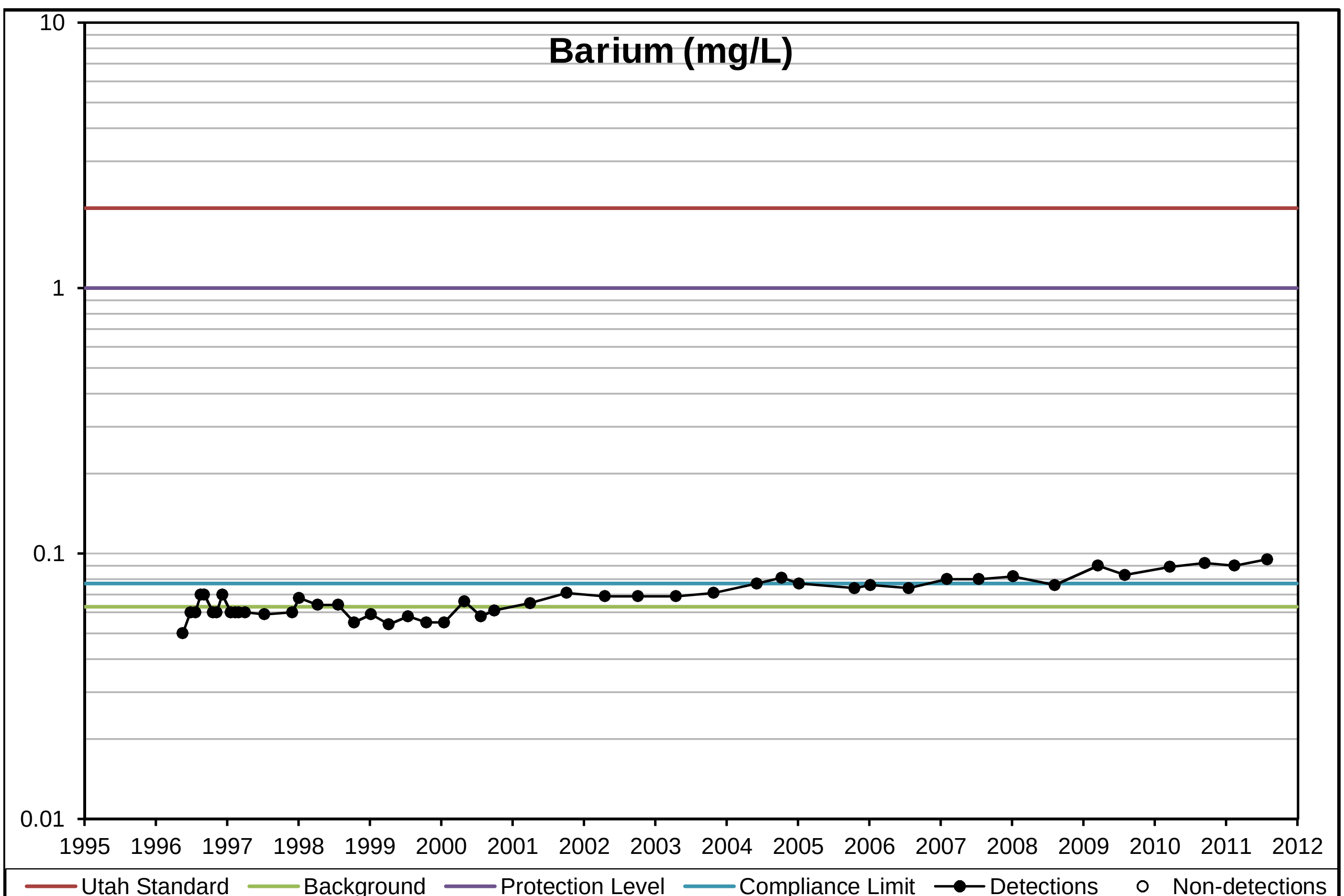
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

Concentration Versus Year



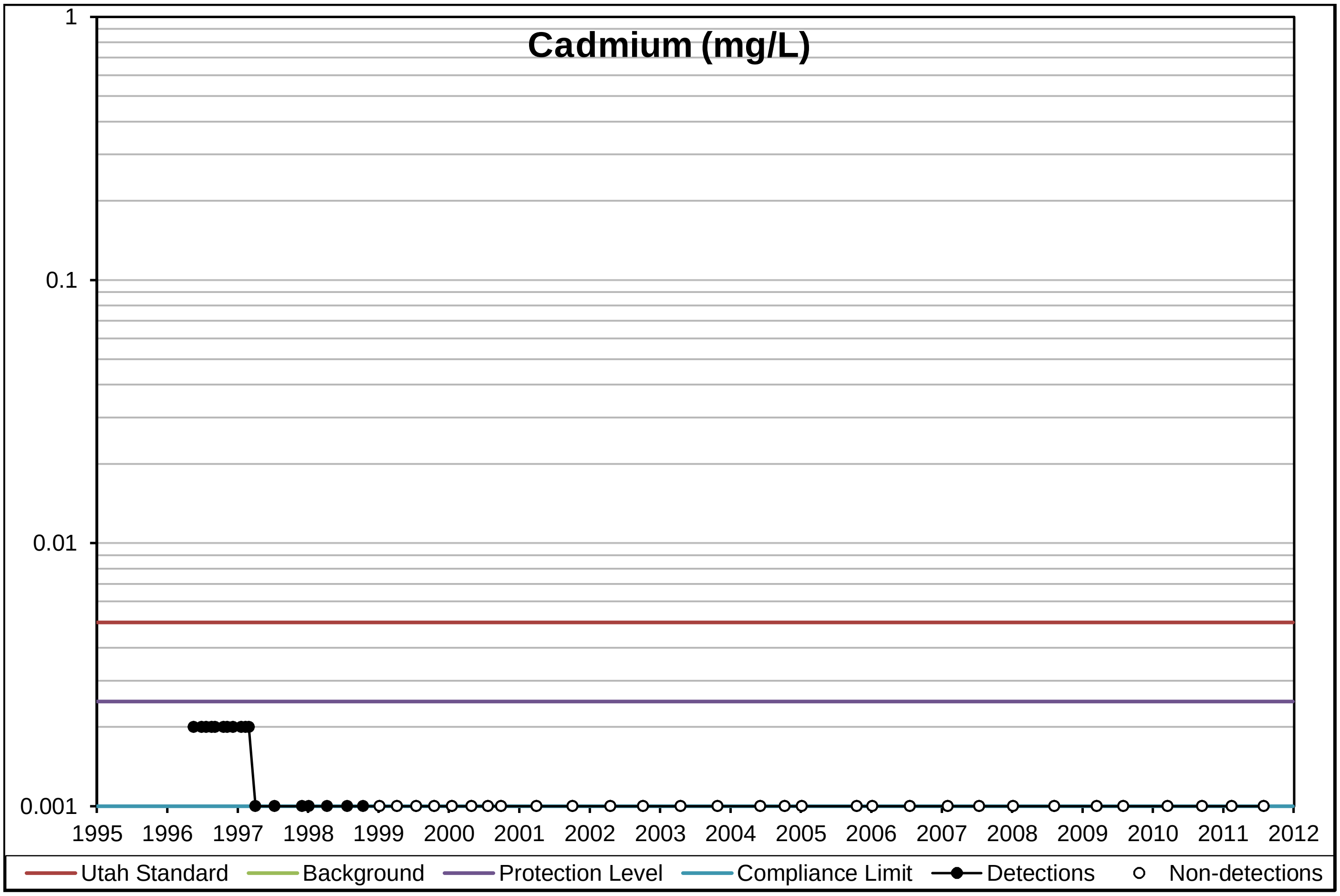


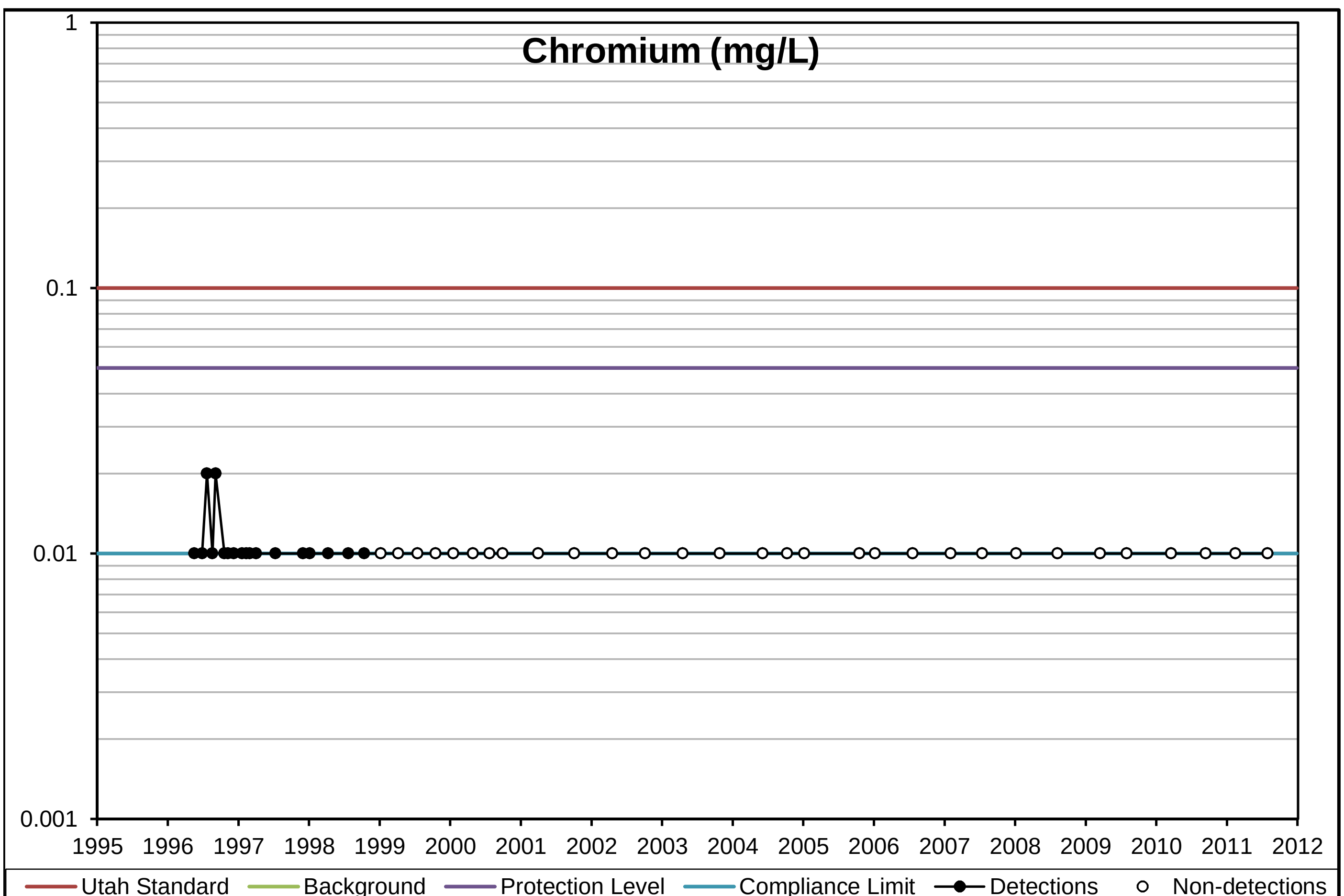
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

Concentration Versus Year



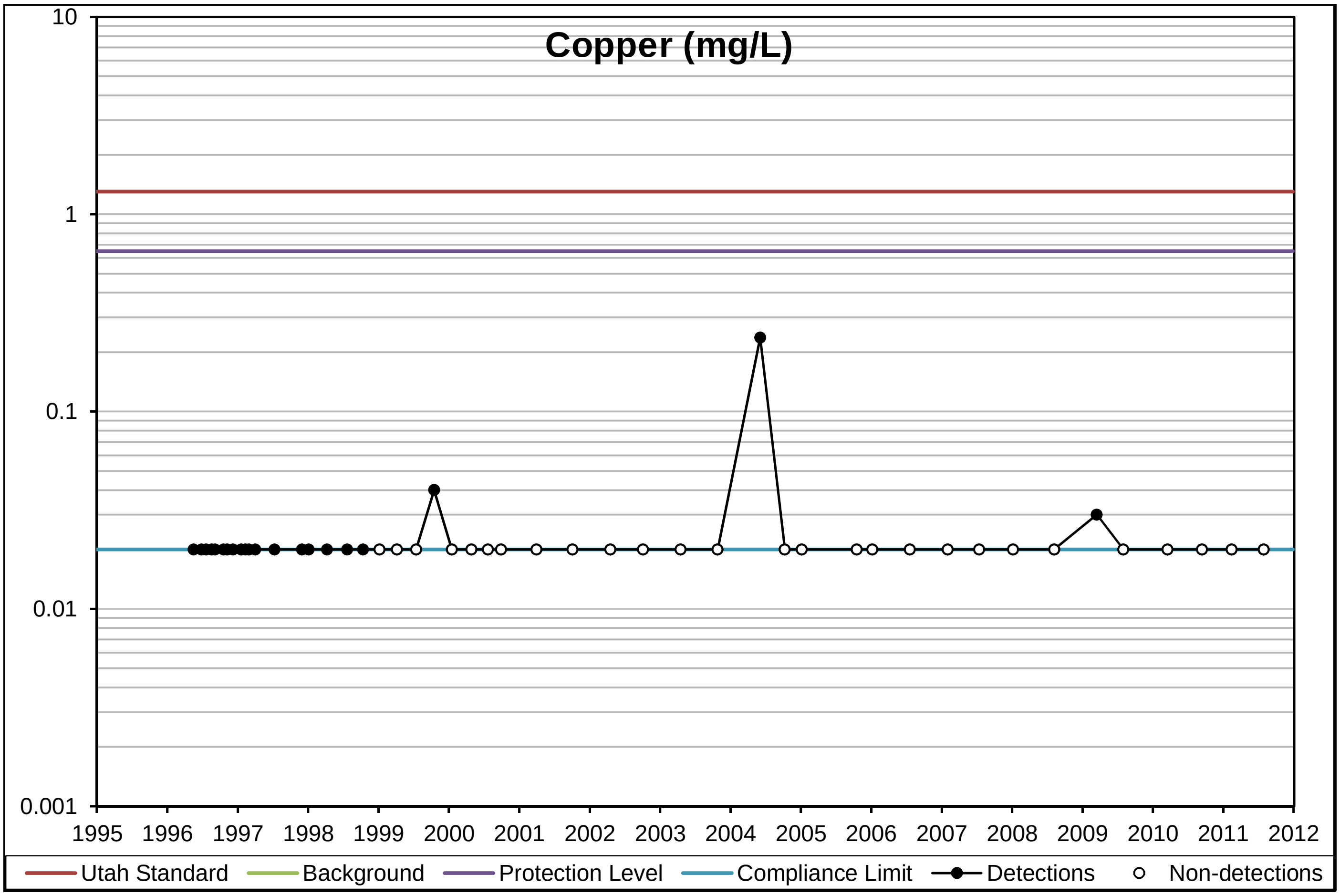


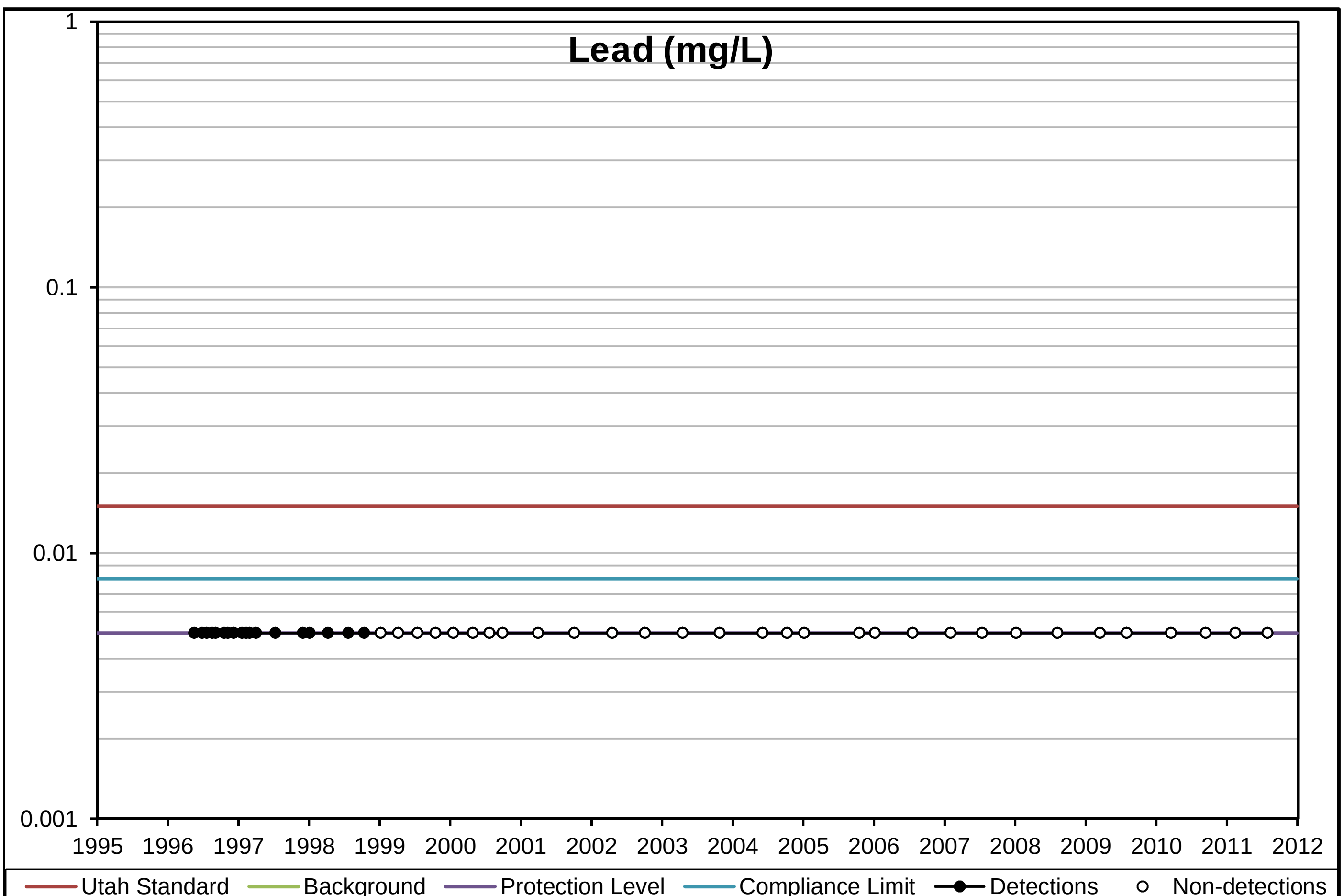
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

Concentration Versus Year



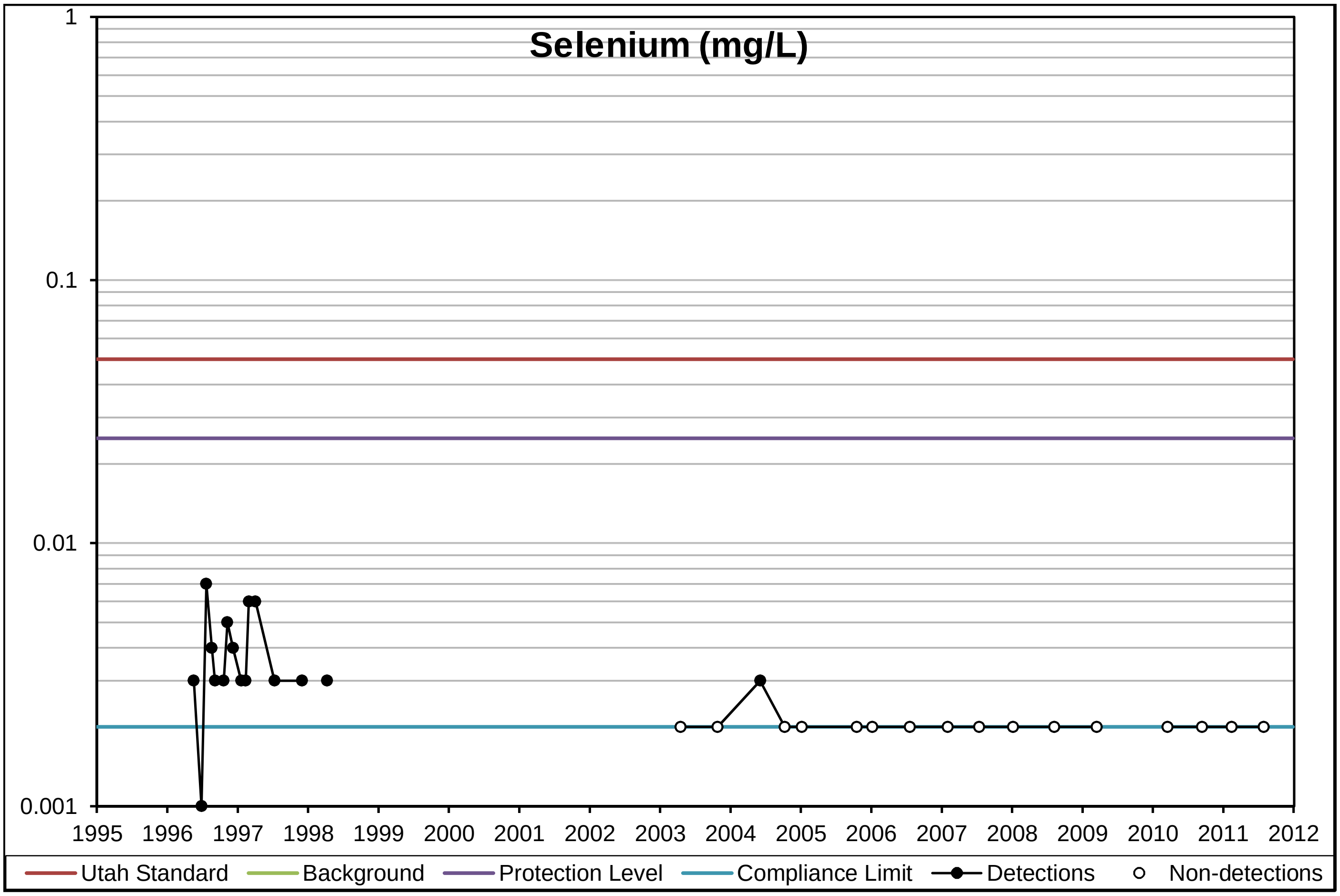


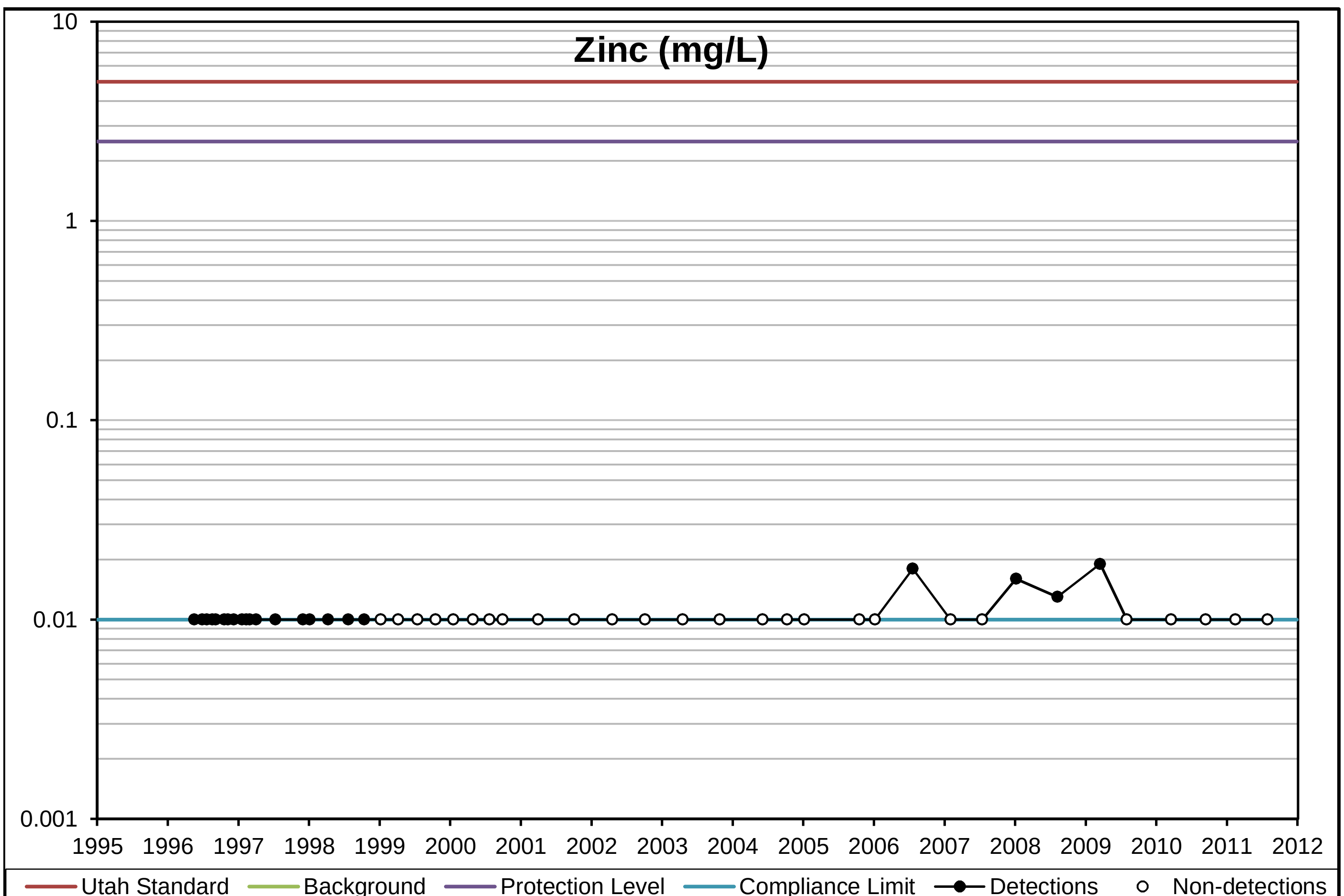
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

Concentration Versus Year



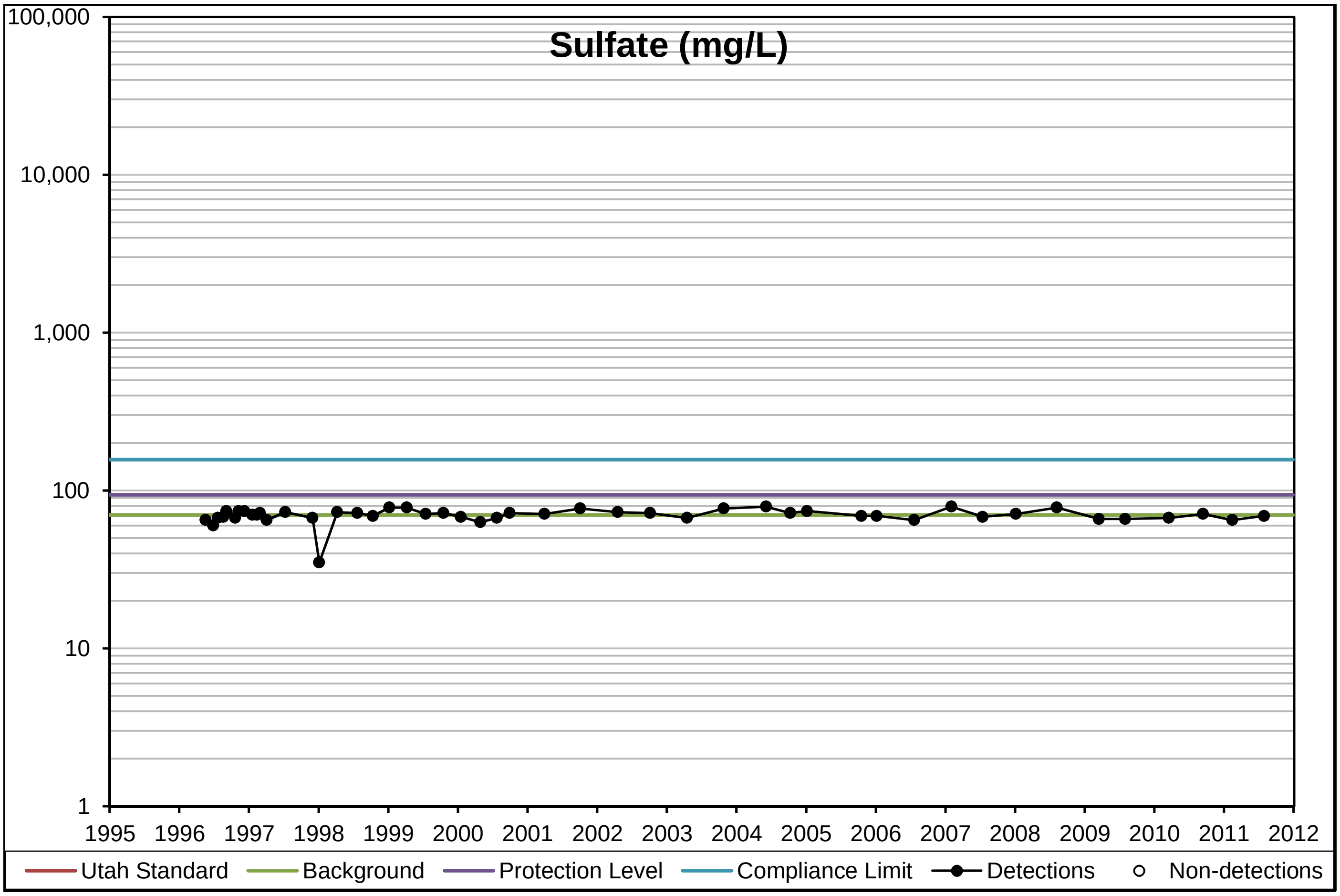


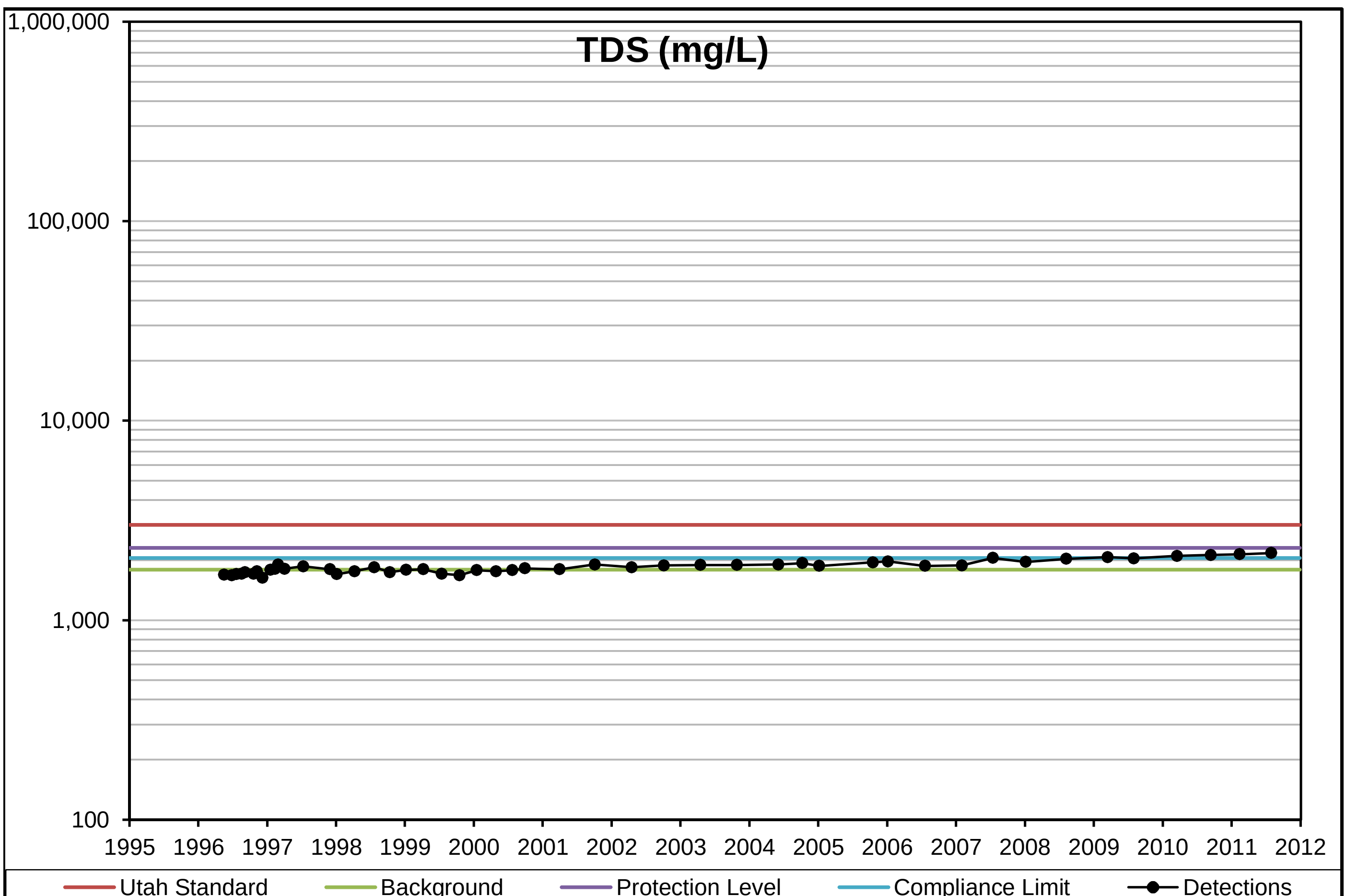
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

Concentration Versus Year



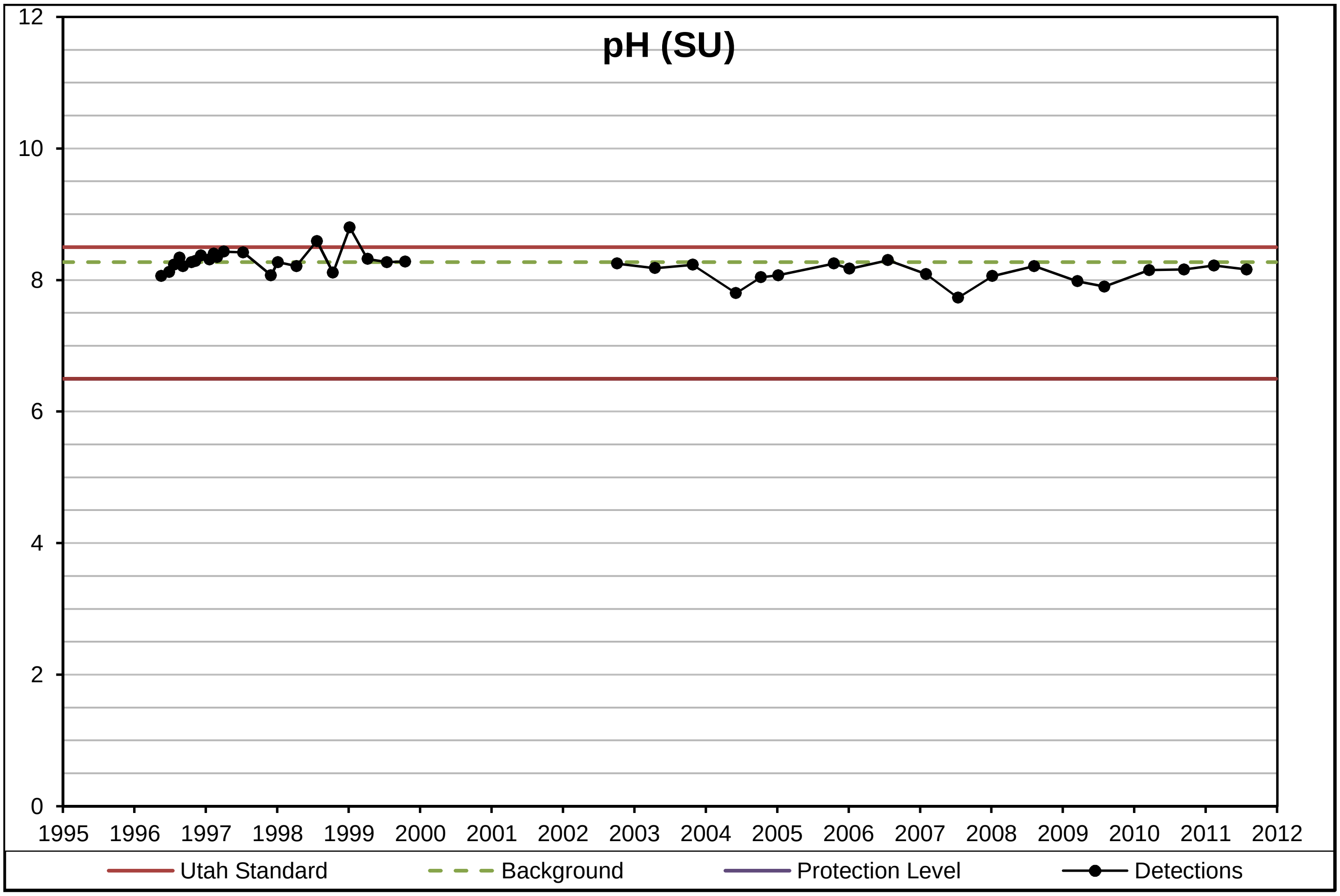


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382B

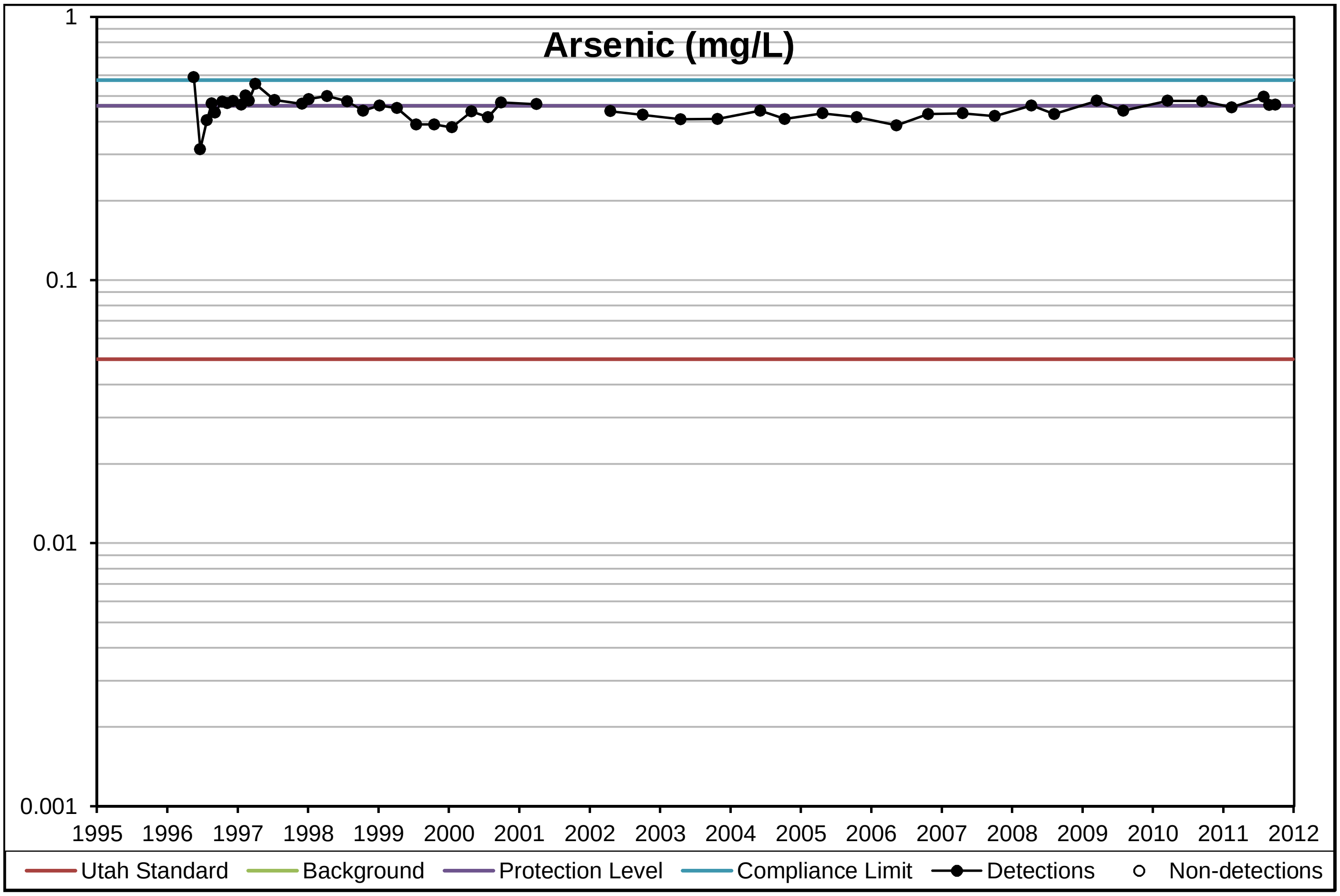
Concentration Versus Year

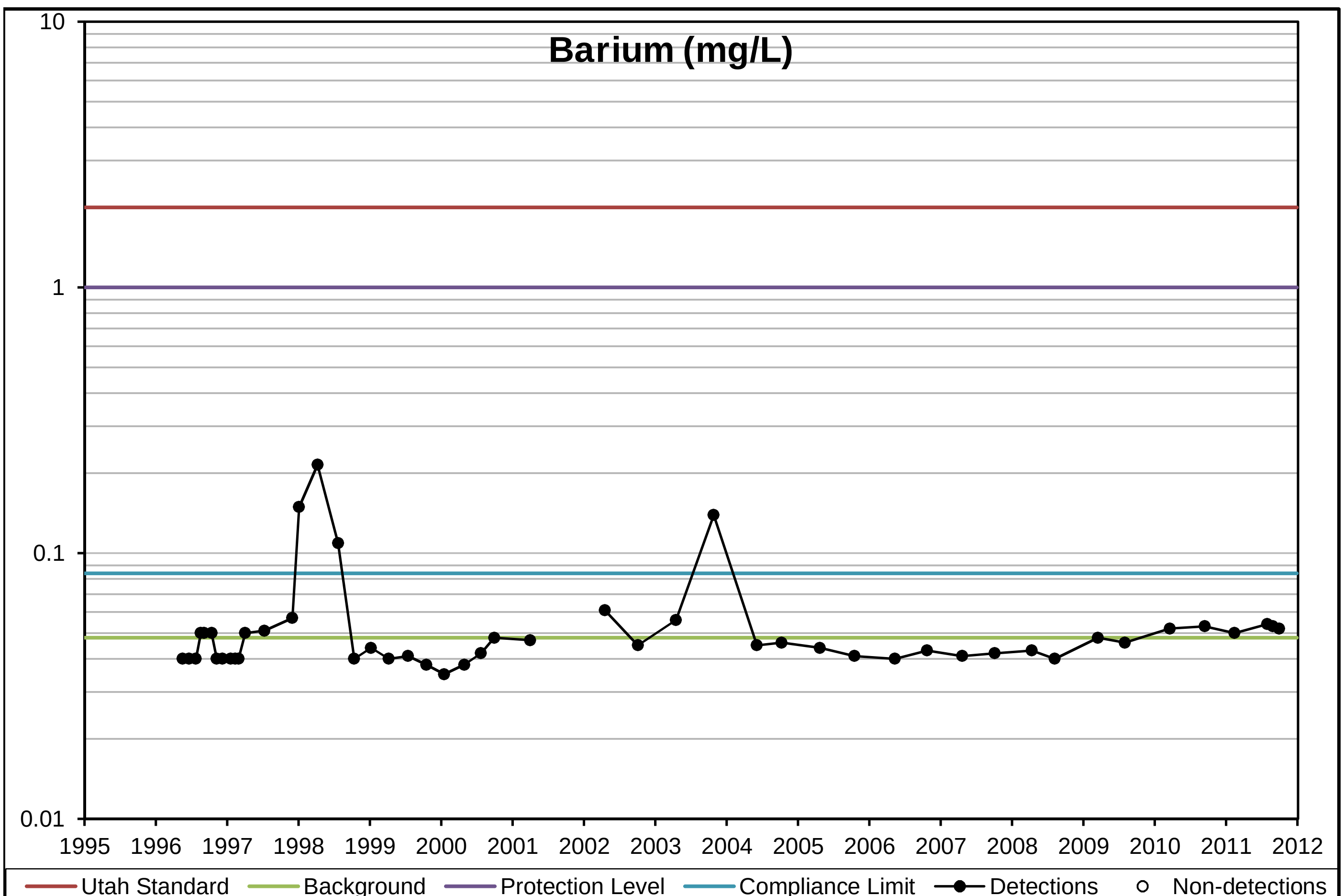


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

Concentration Versus Year



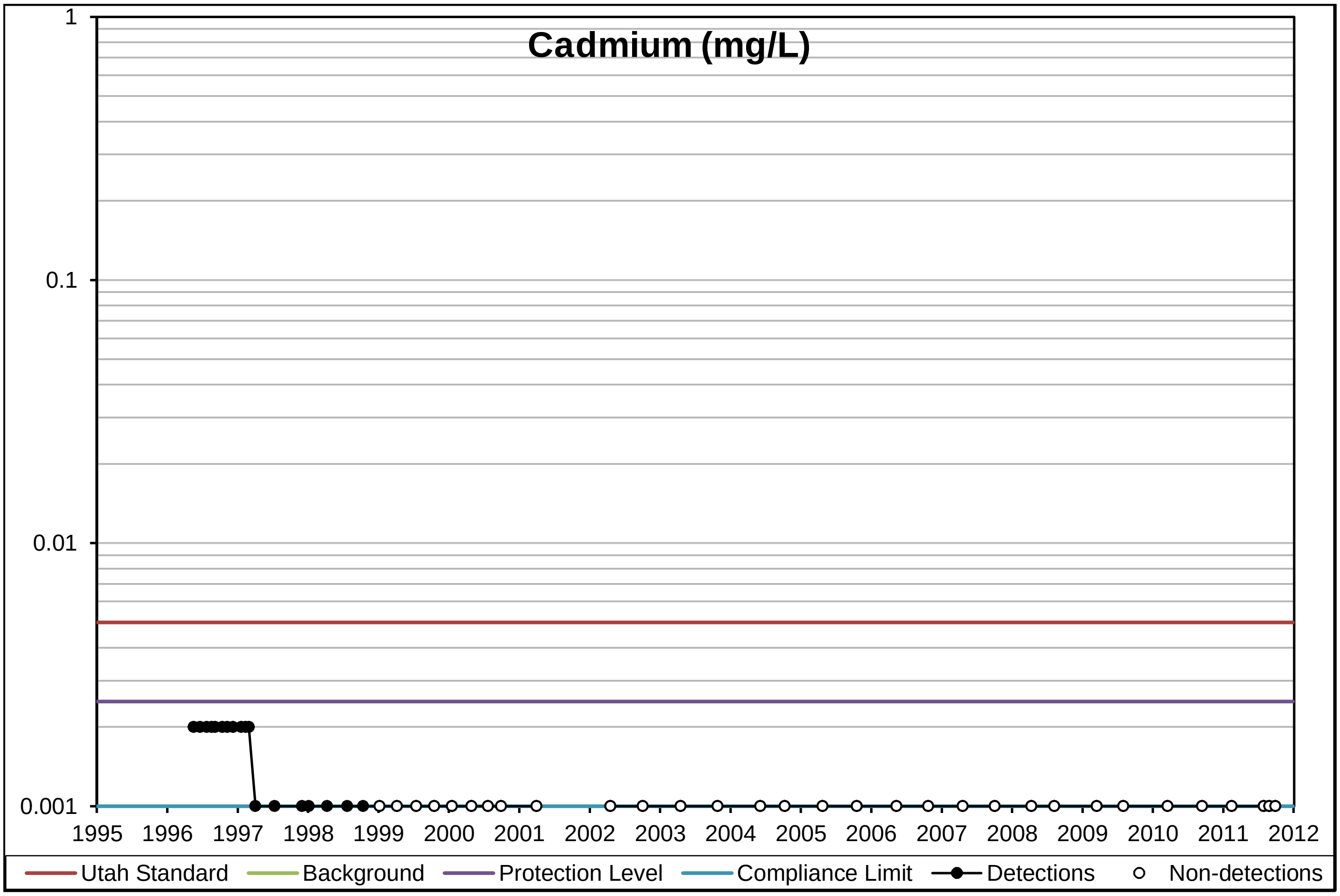


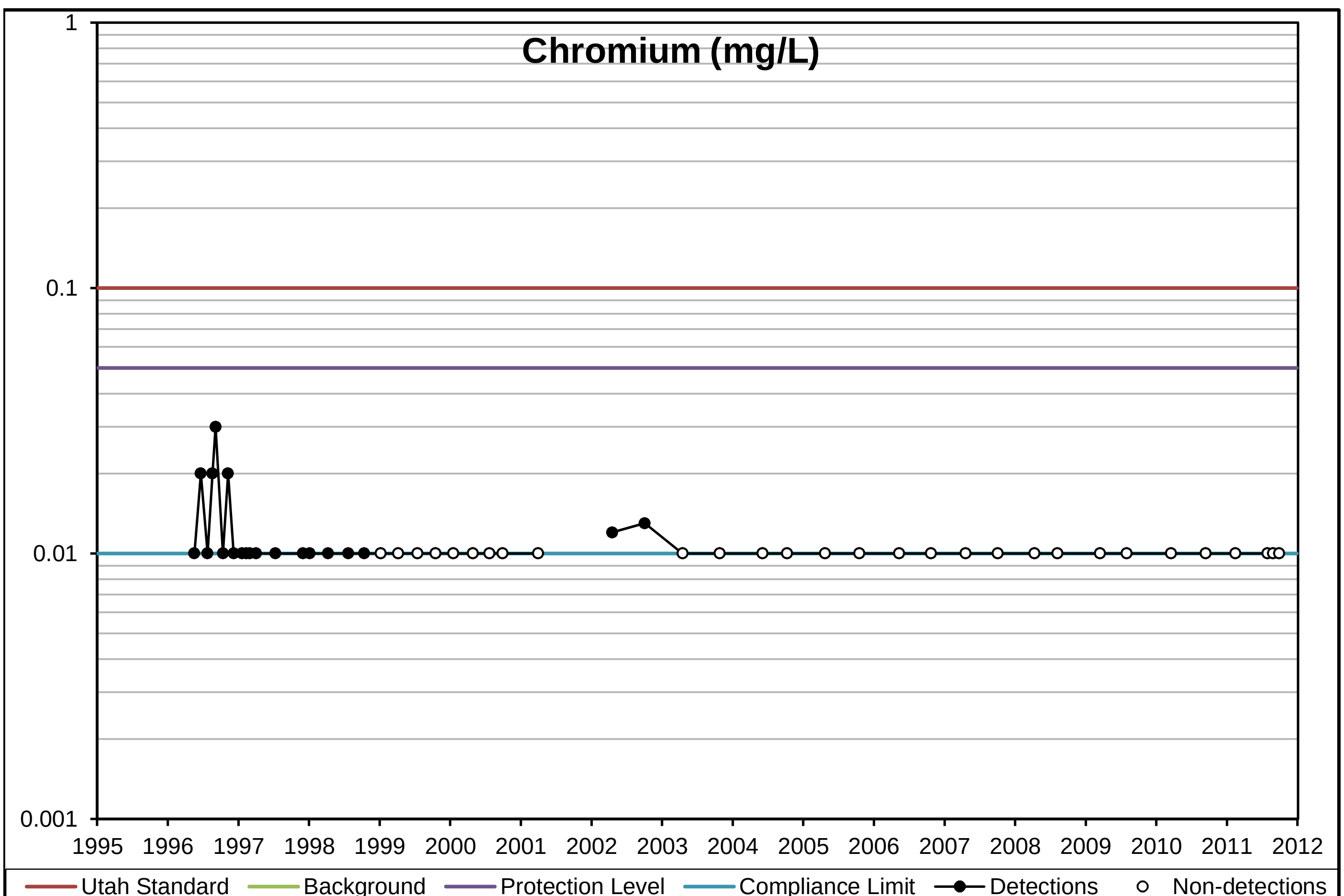
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

Concentration Versus Year

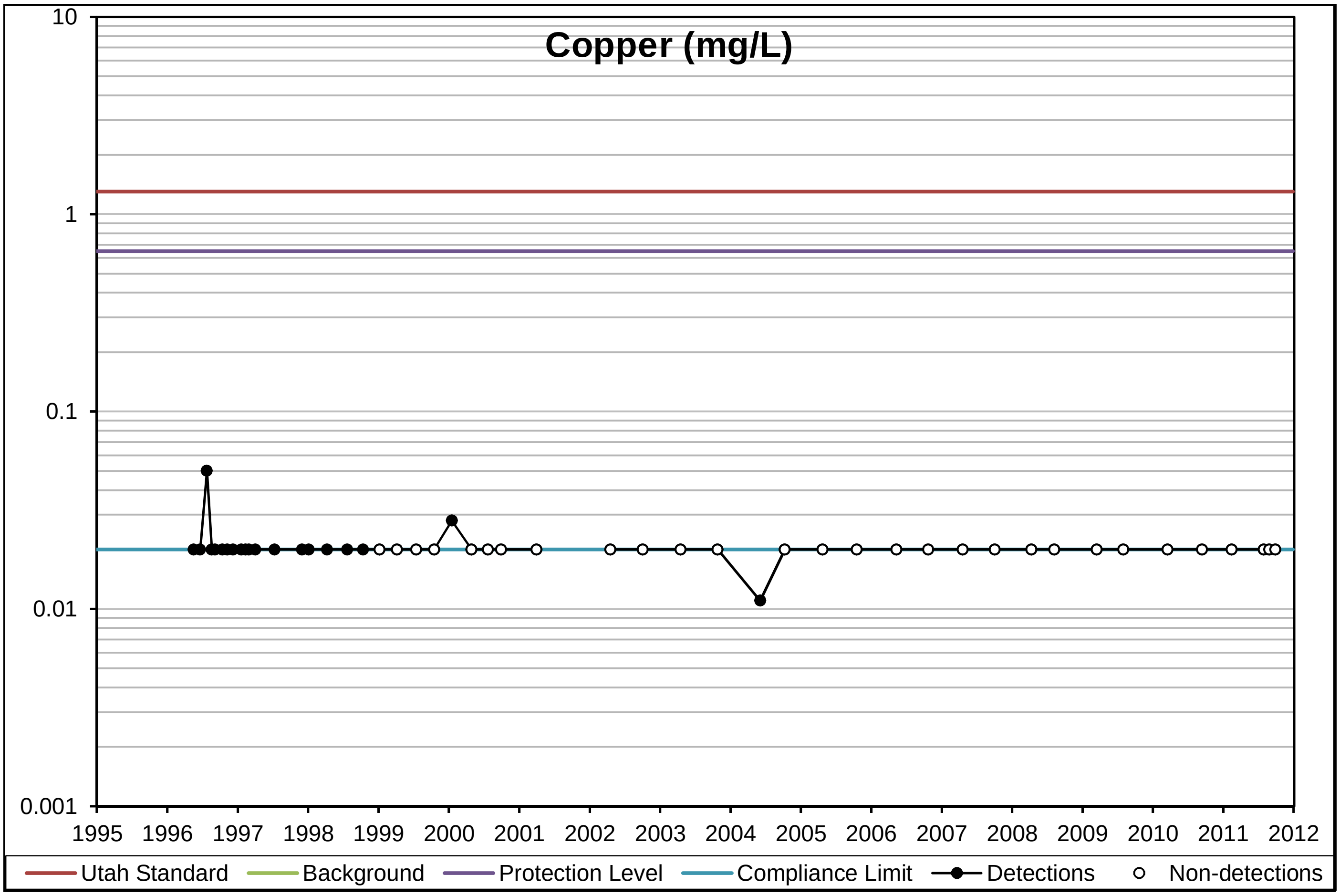


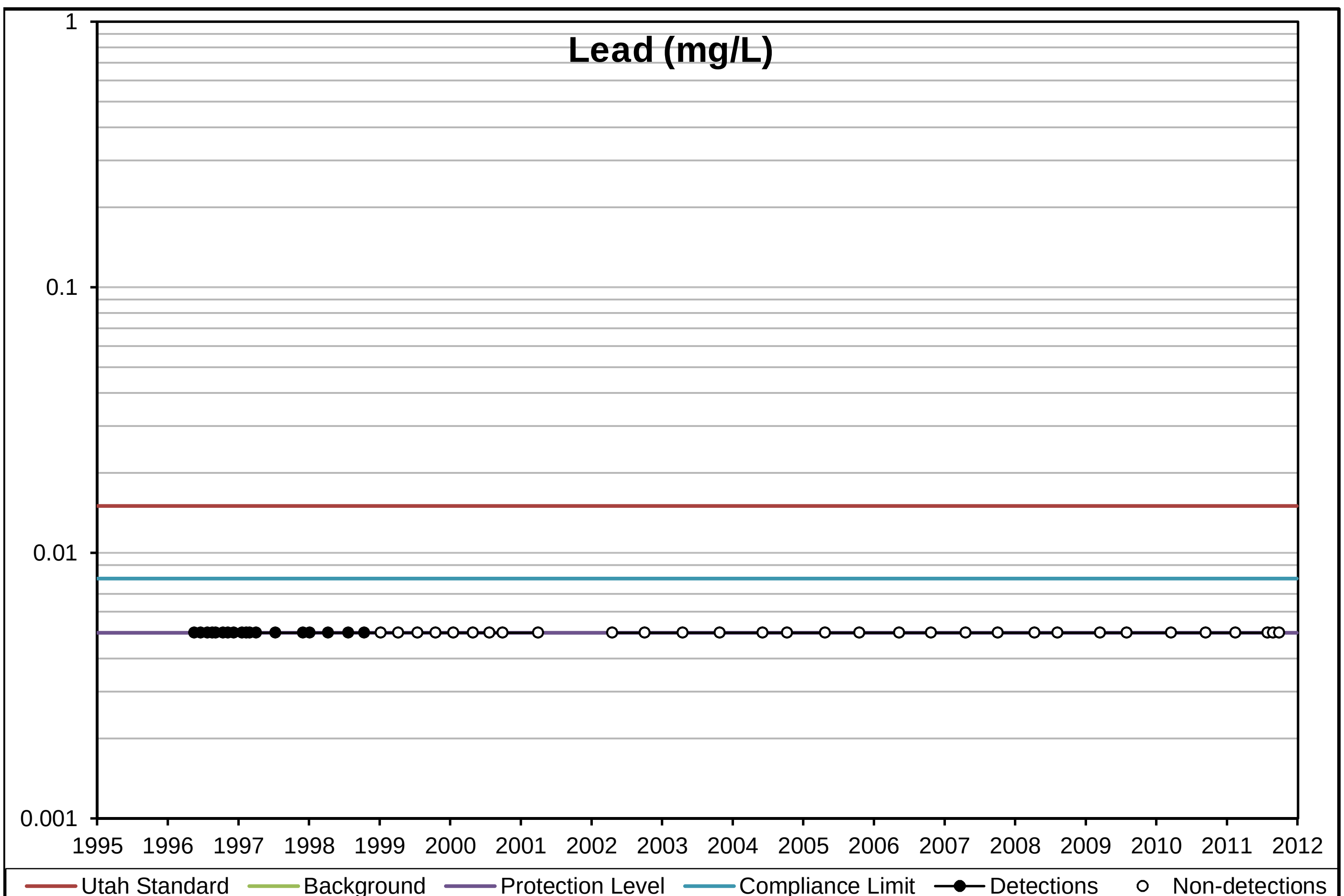


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

Concentration Versus Year



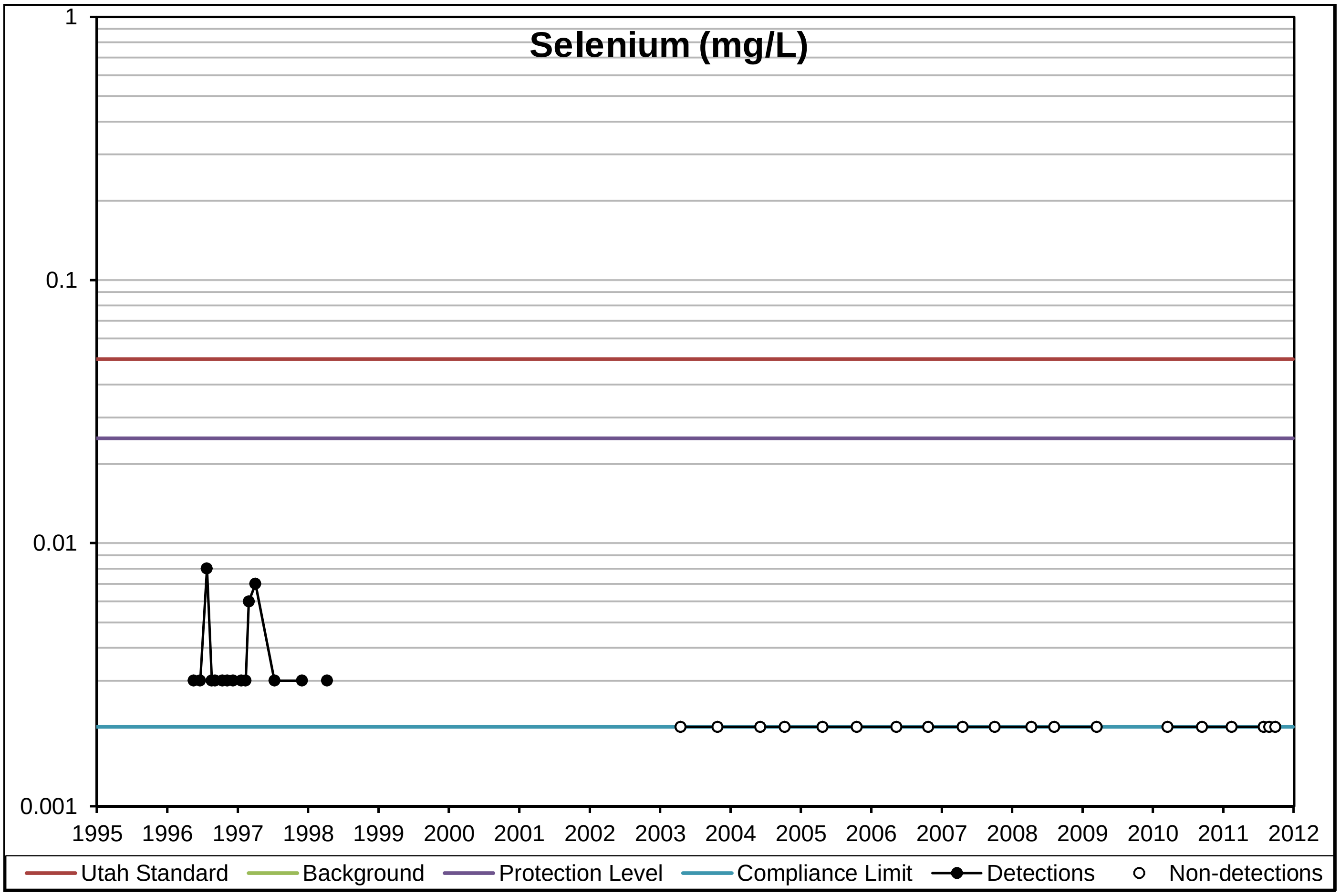


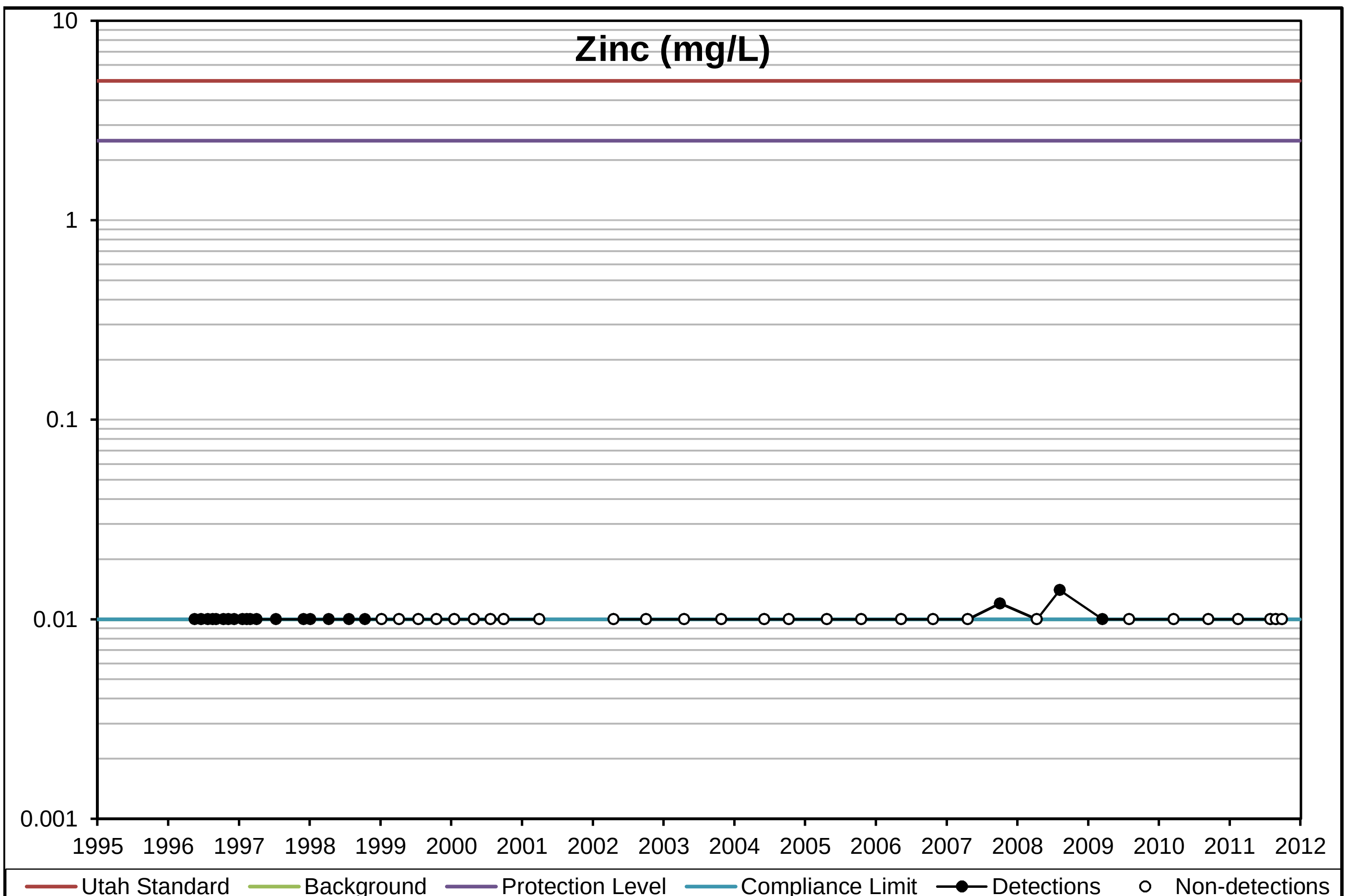
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

Concentration Versus Year



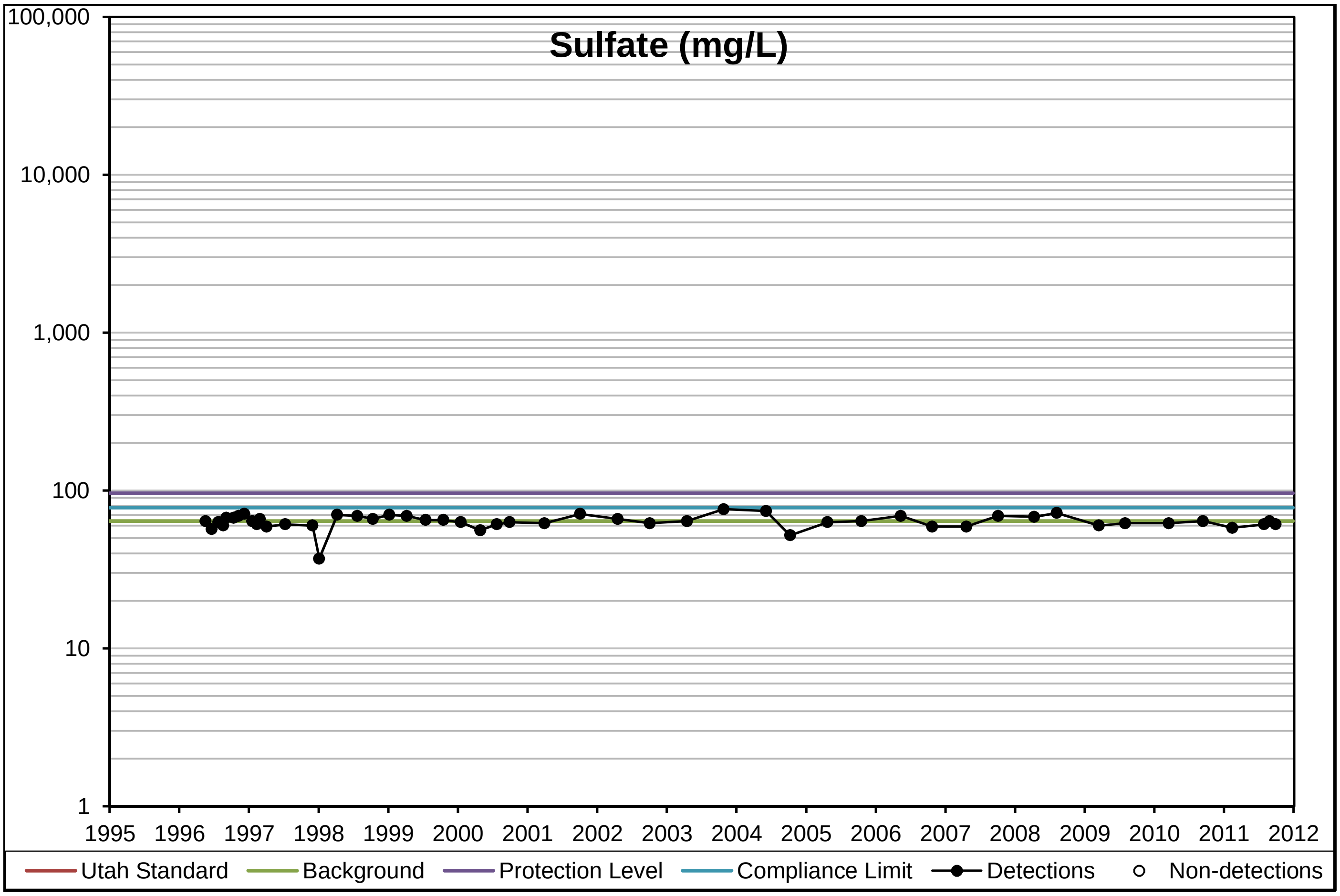


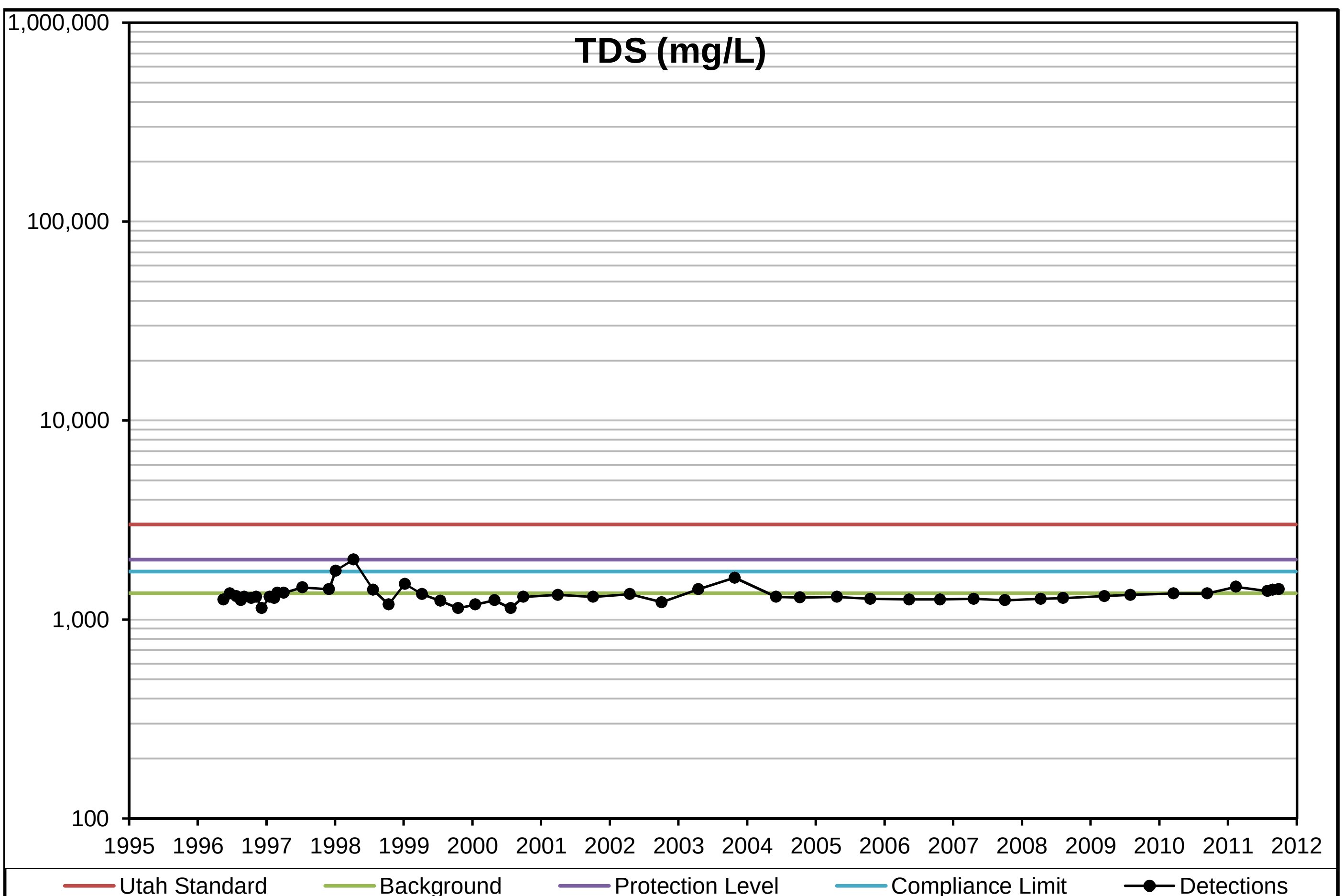
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

Concentration Versus Year



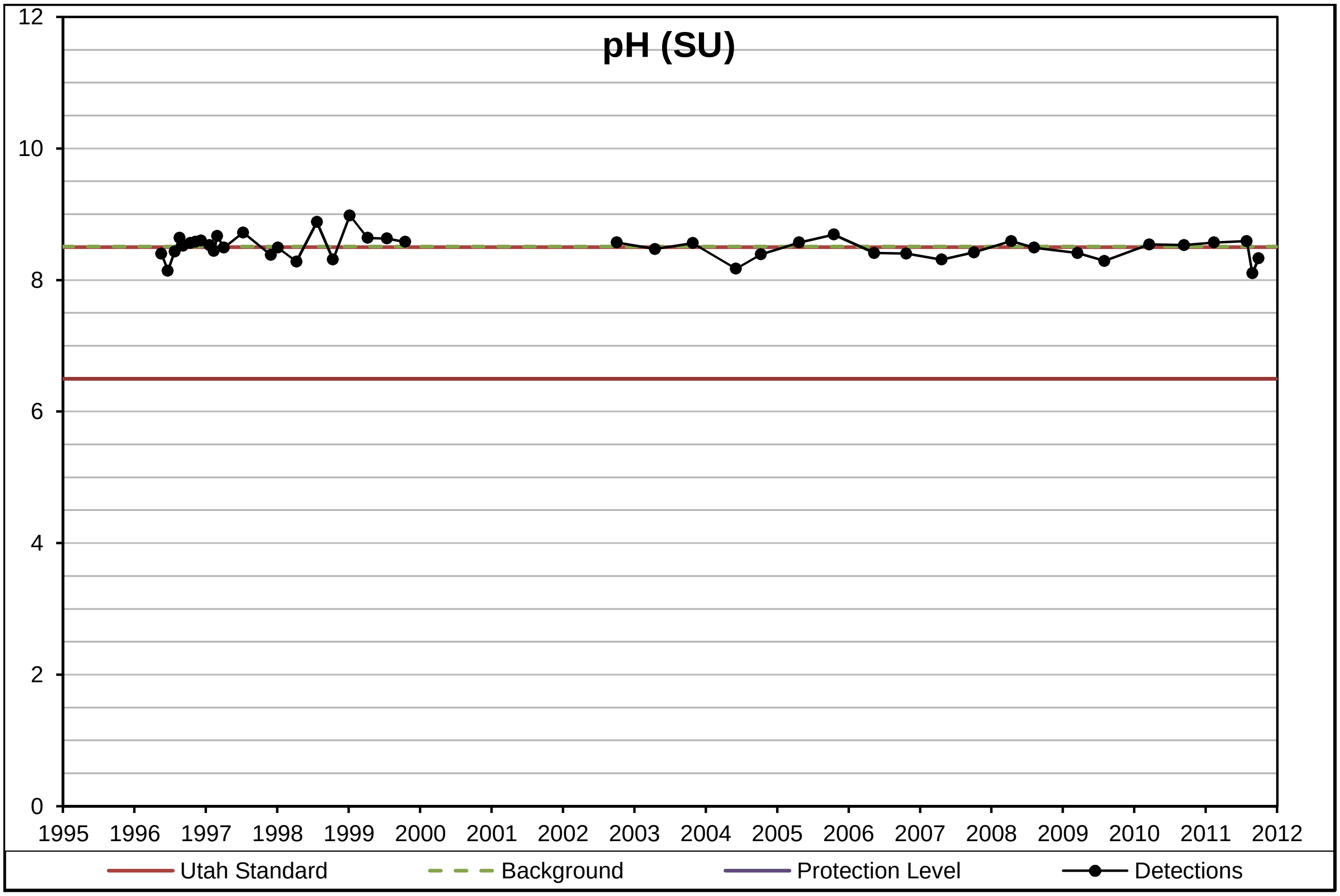


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEL1382C

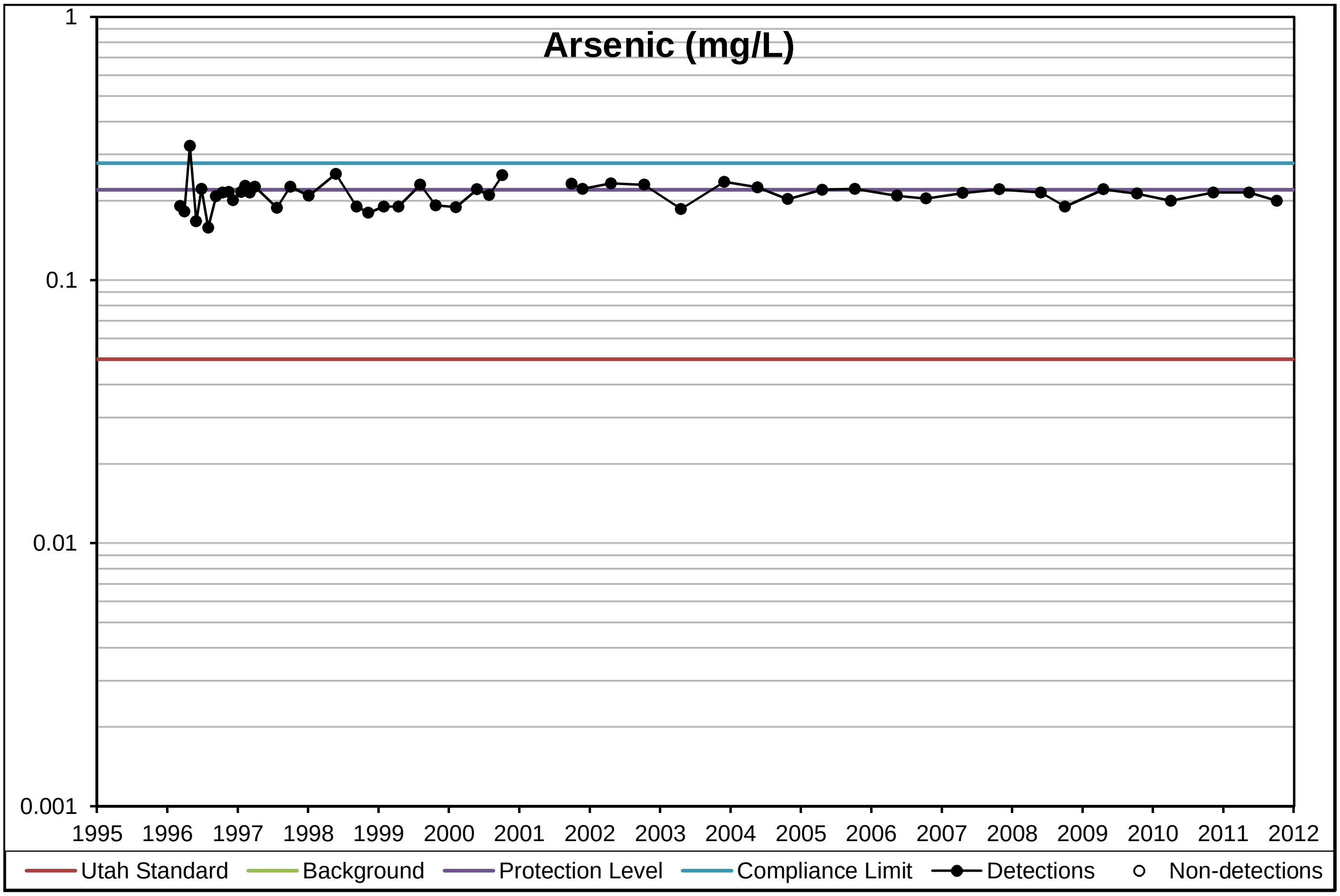
Concentration Versus Year

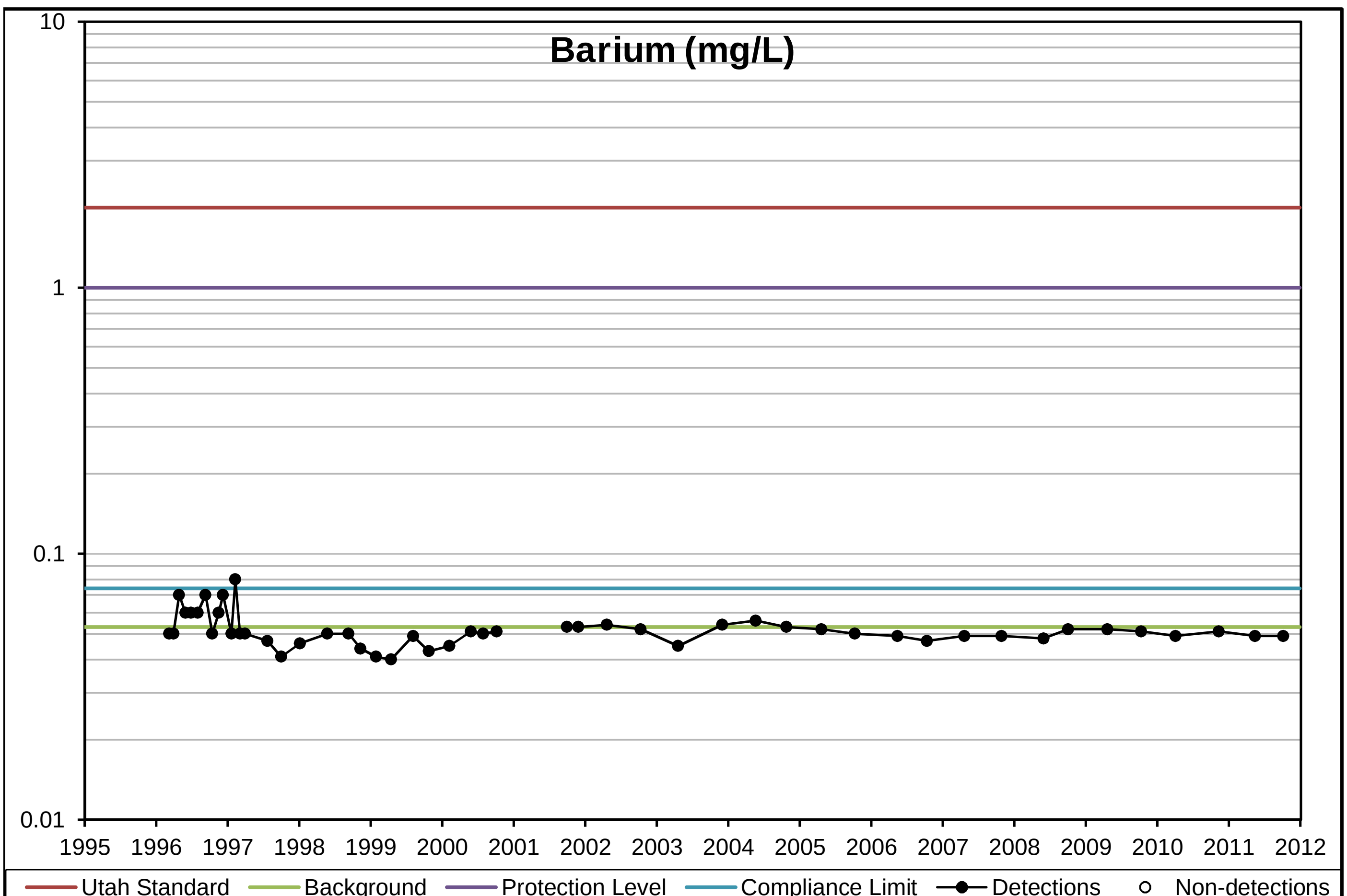


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

Concentration Versus Year



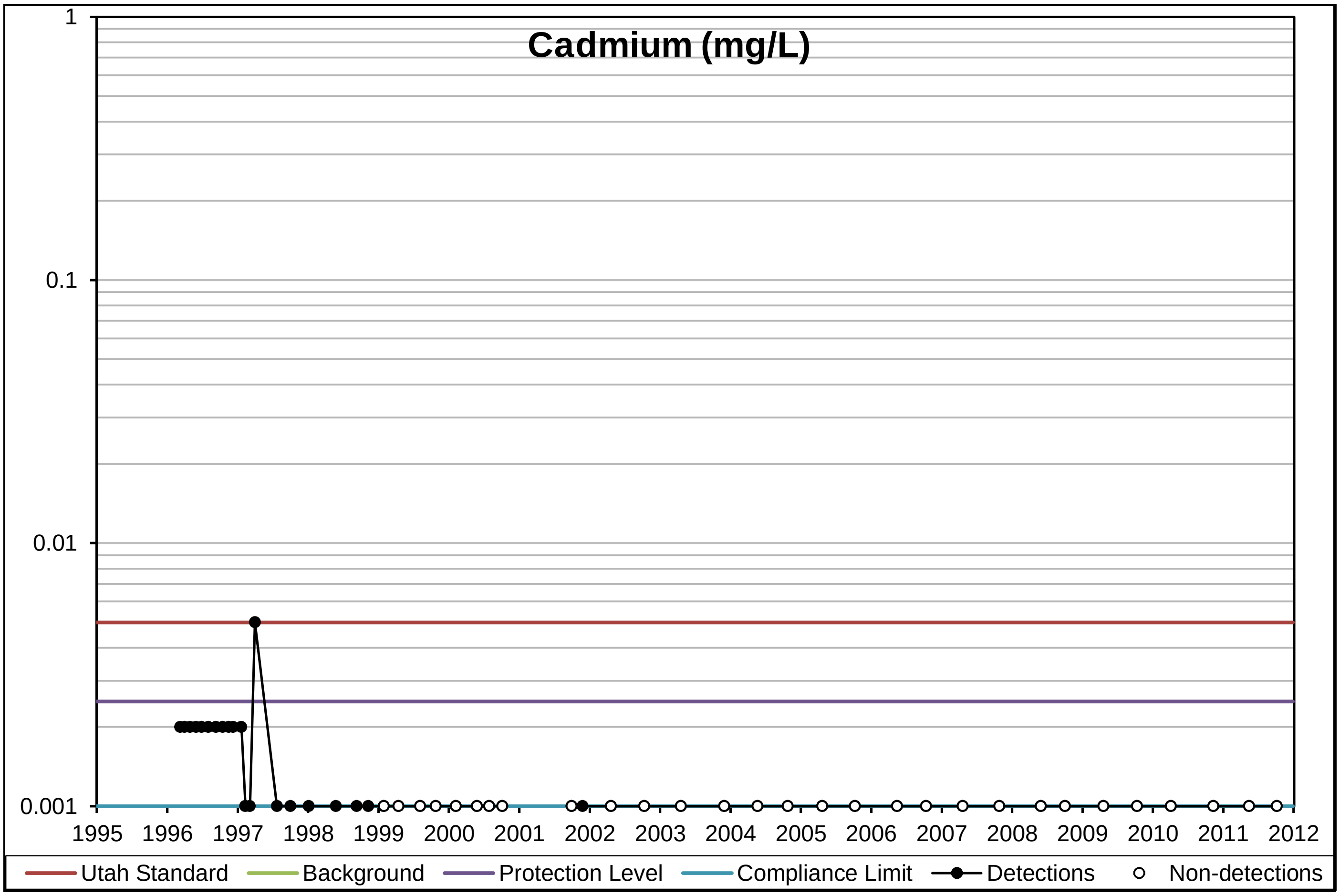


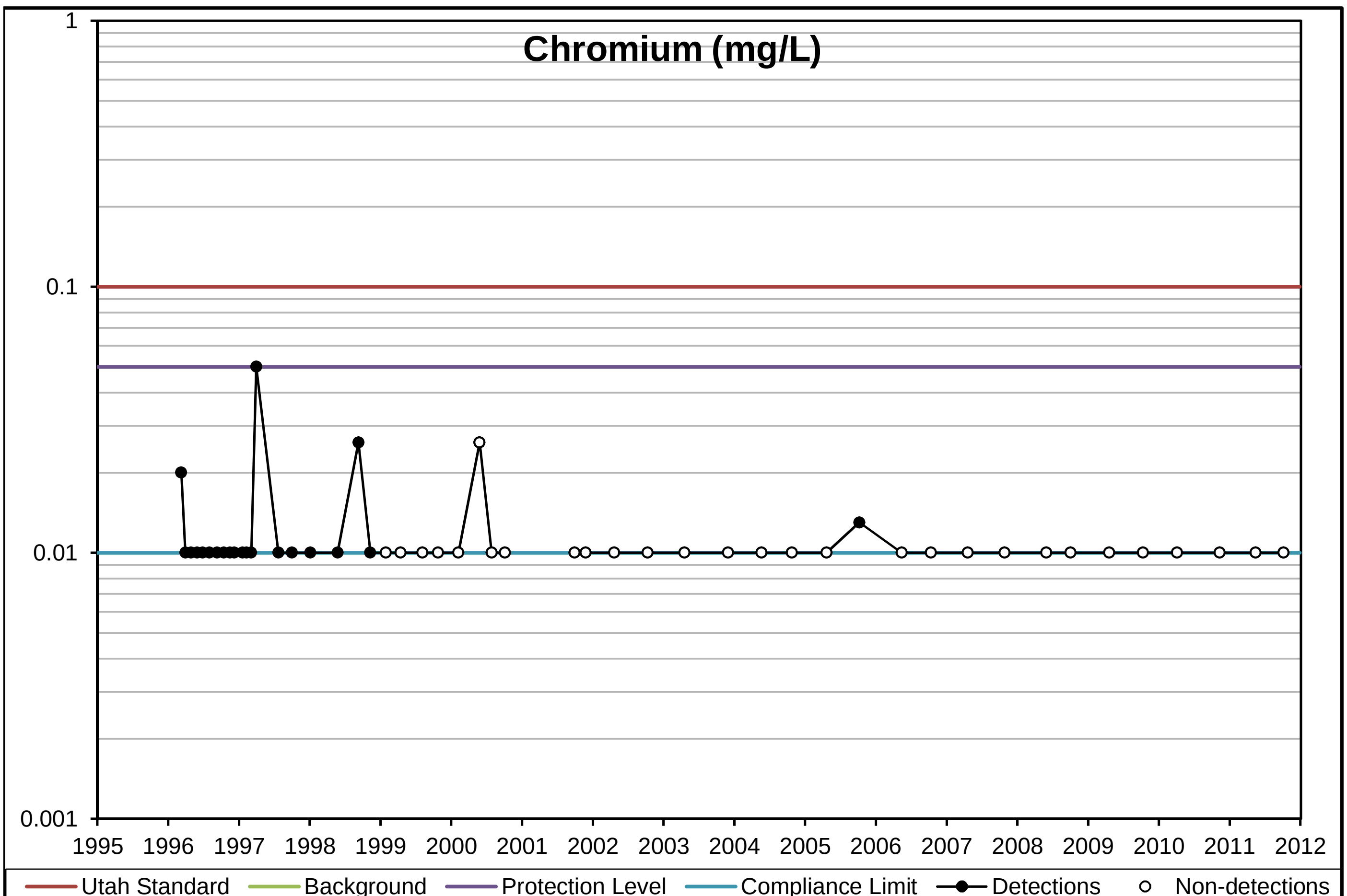
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

Concentration Versus Year



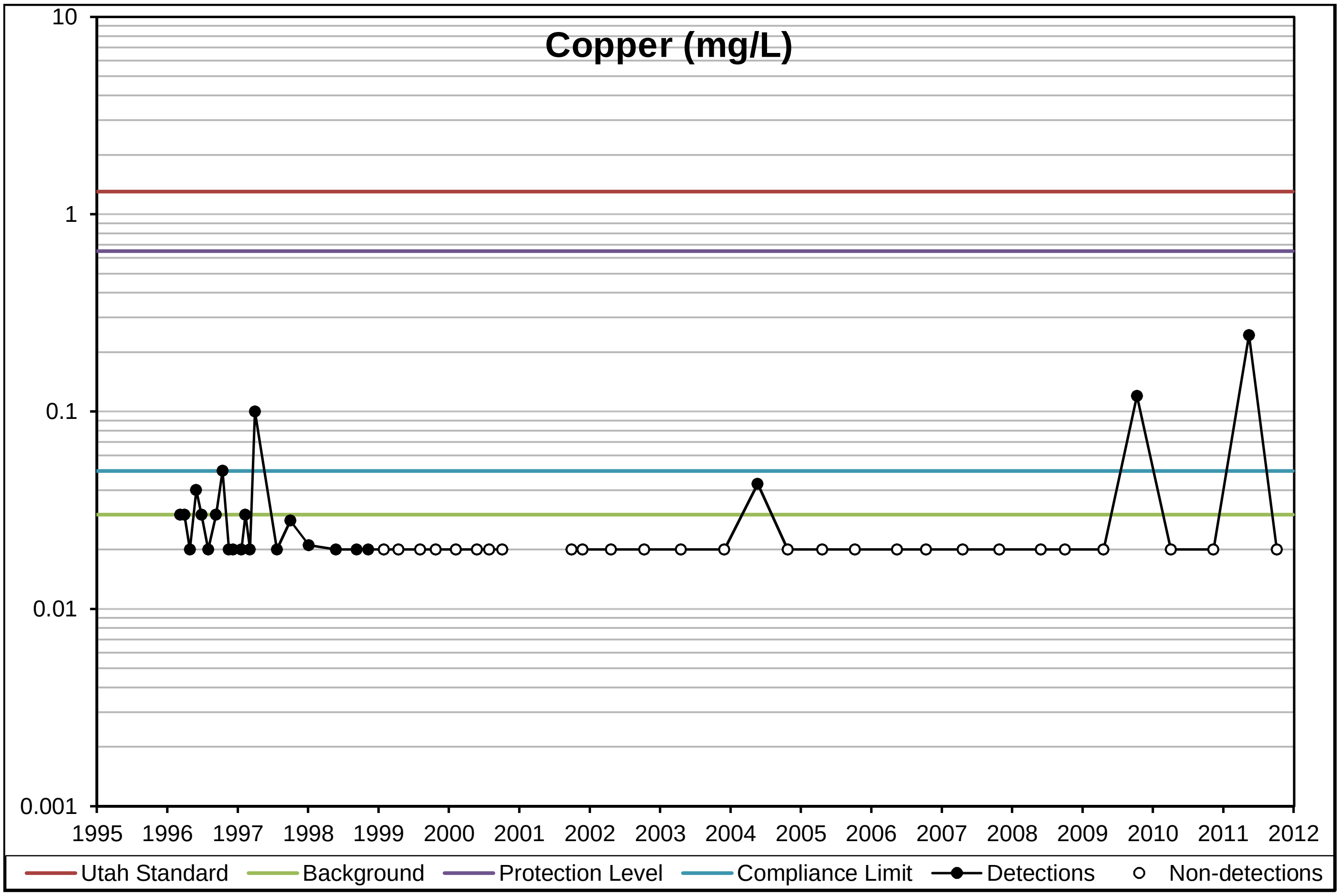


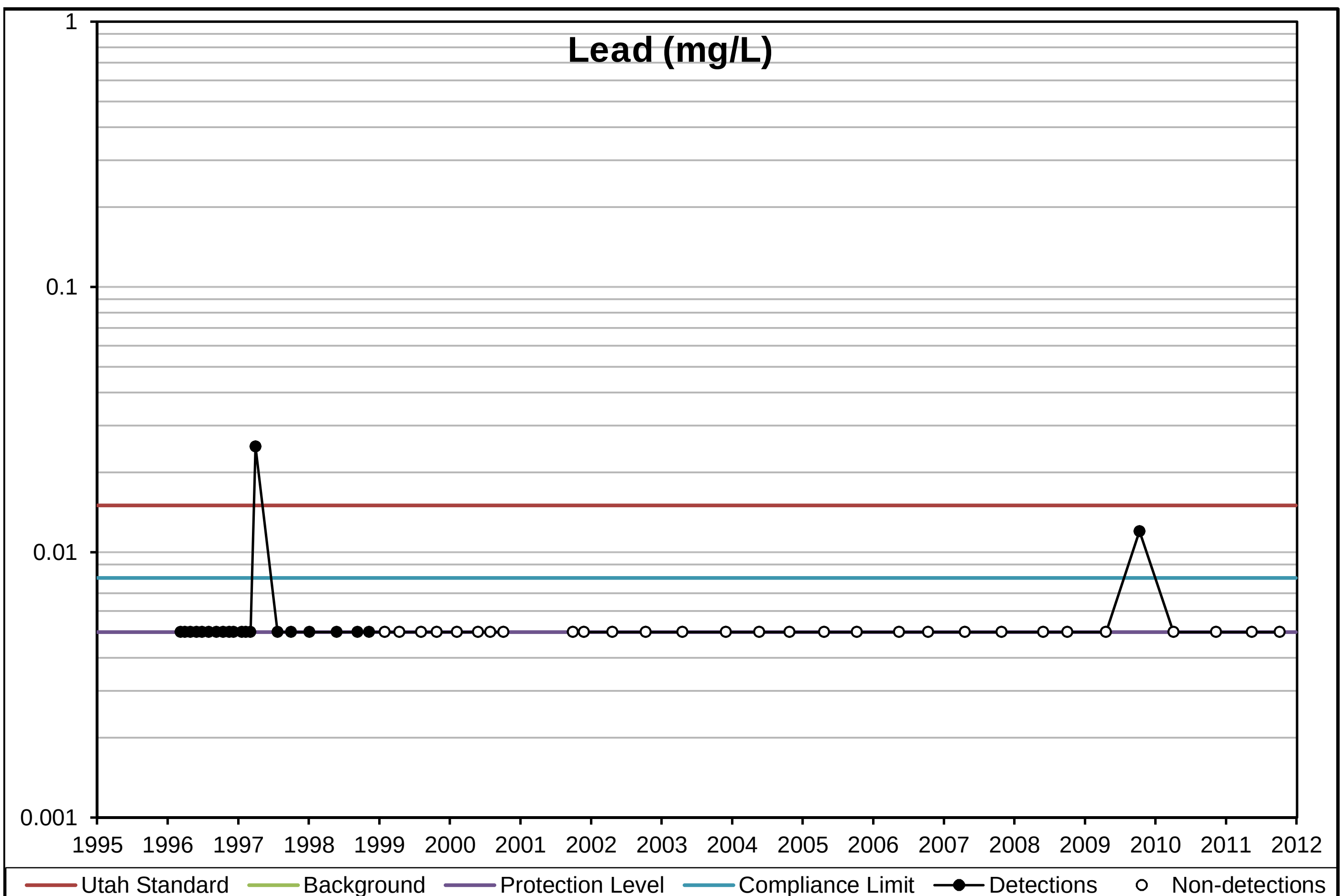
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

Concentration Versus Year



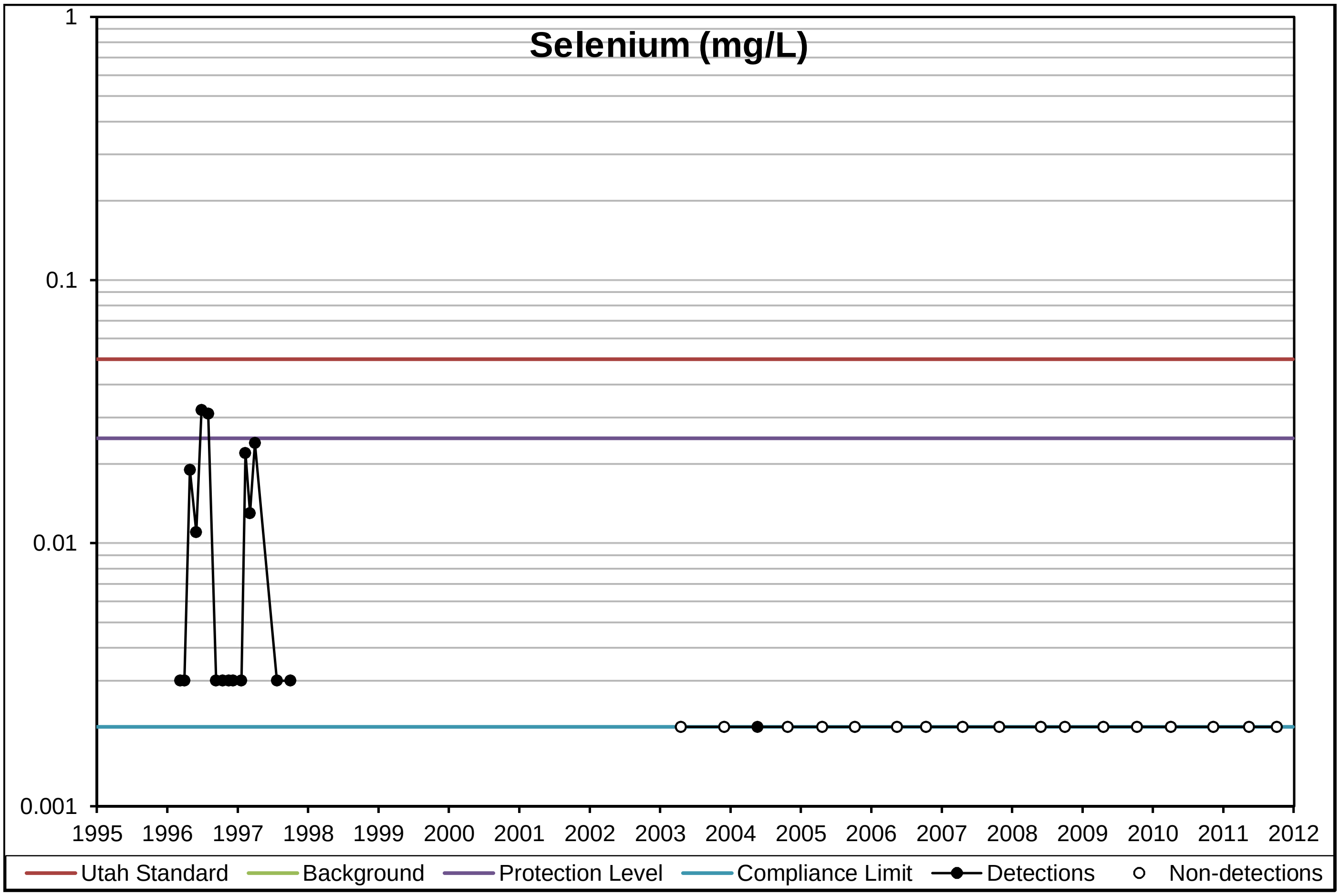


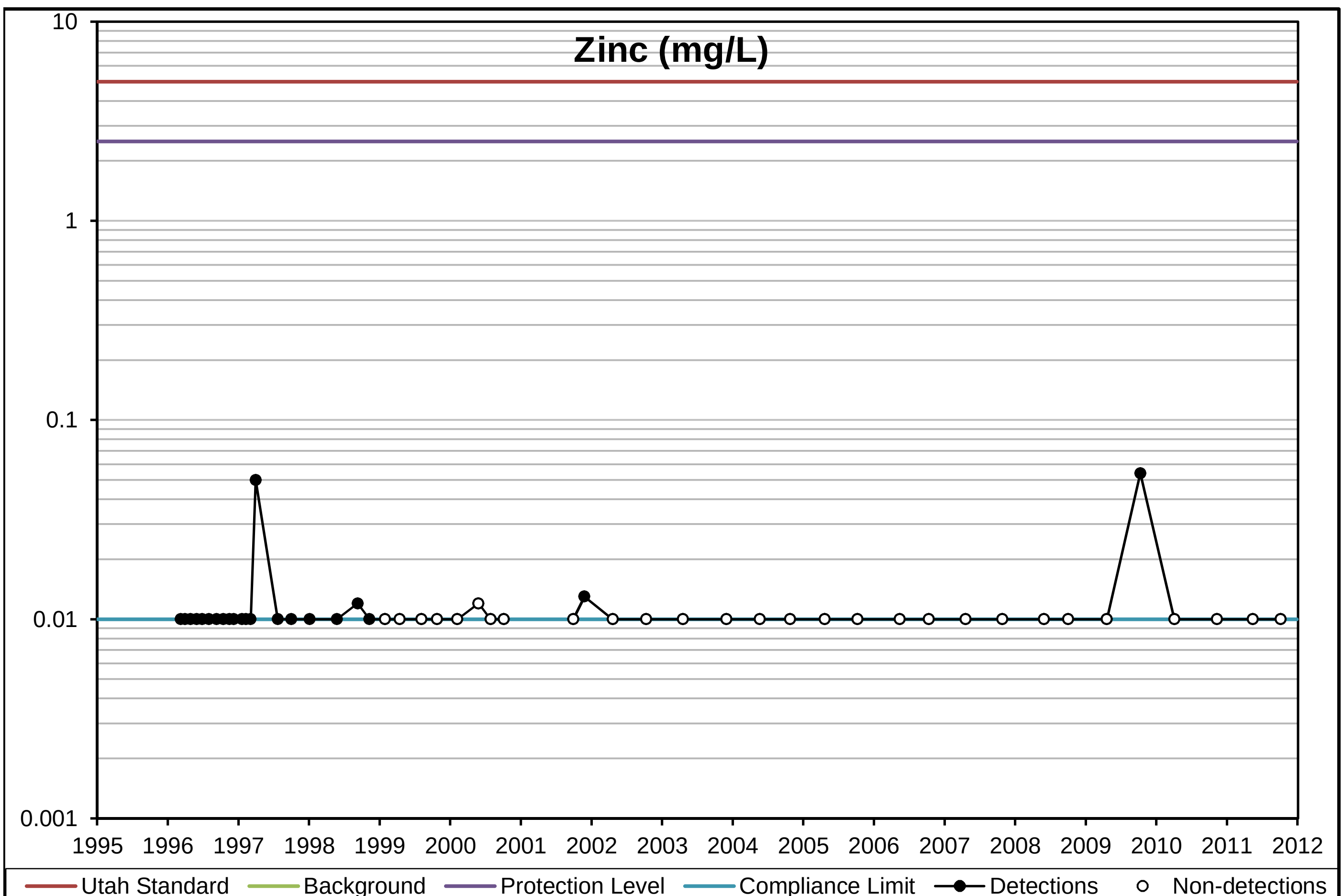
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

Concentration Versus Year



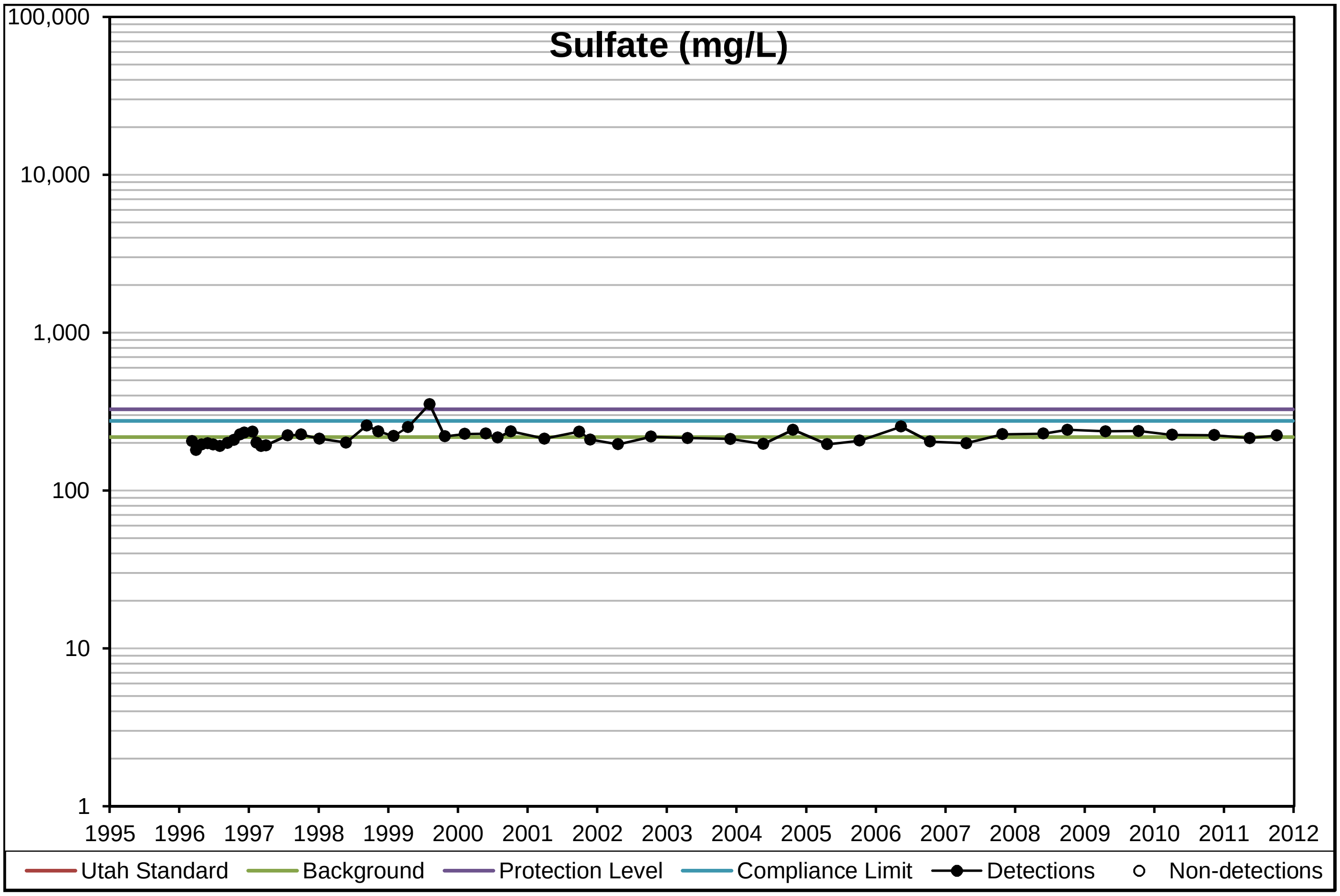


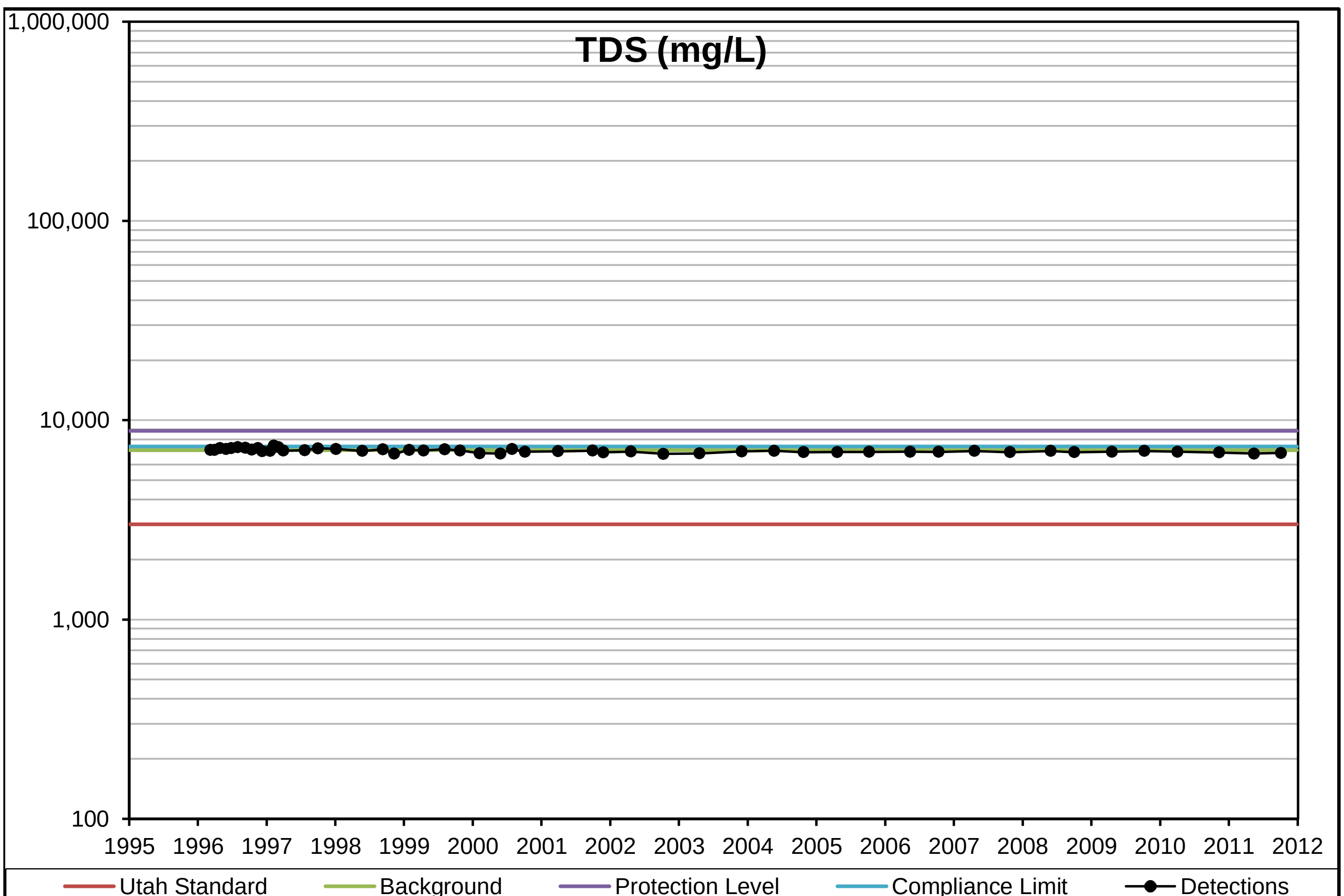
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

Concentration Versus Year



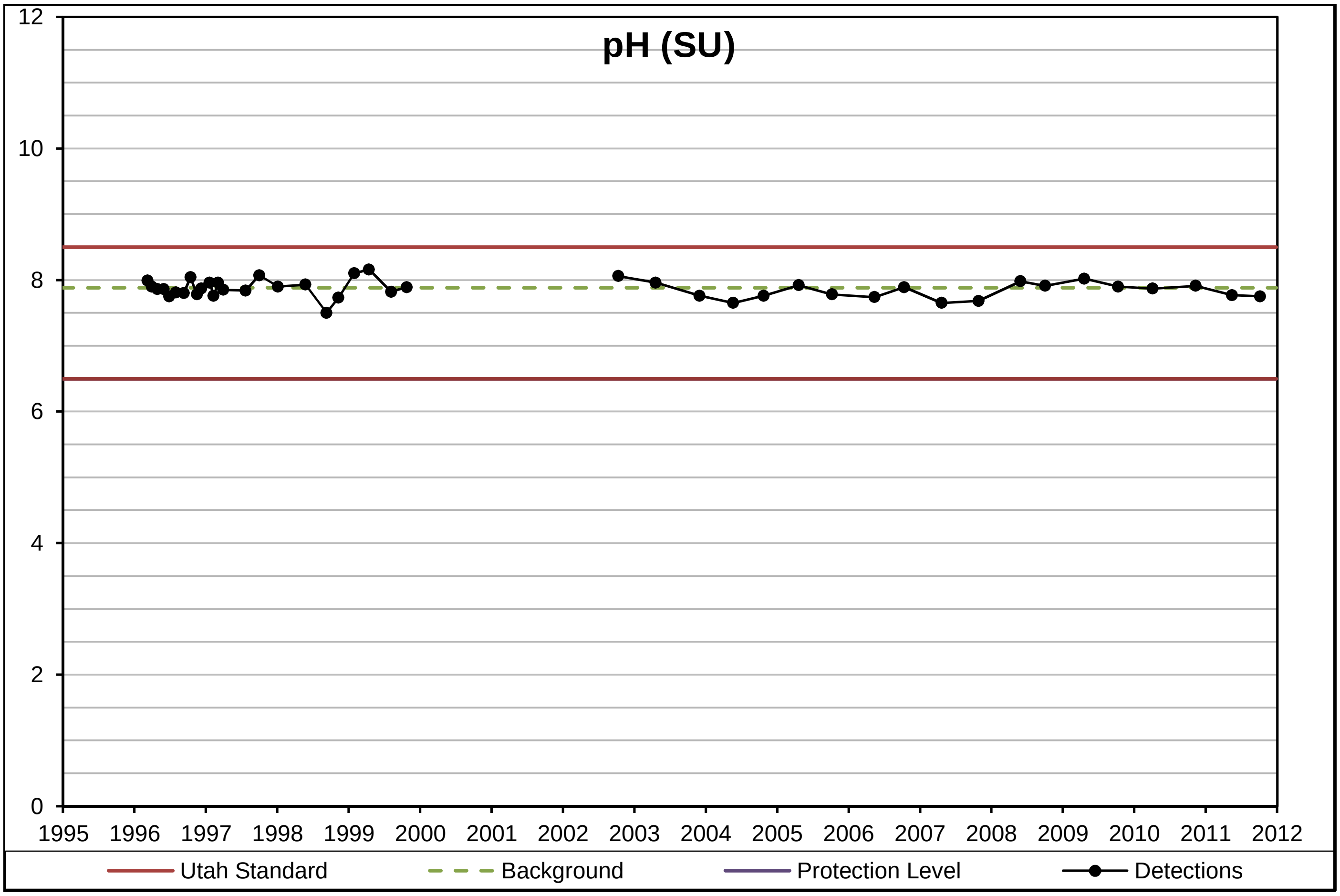


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383A

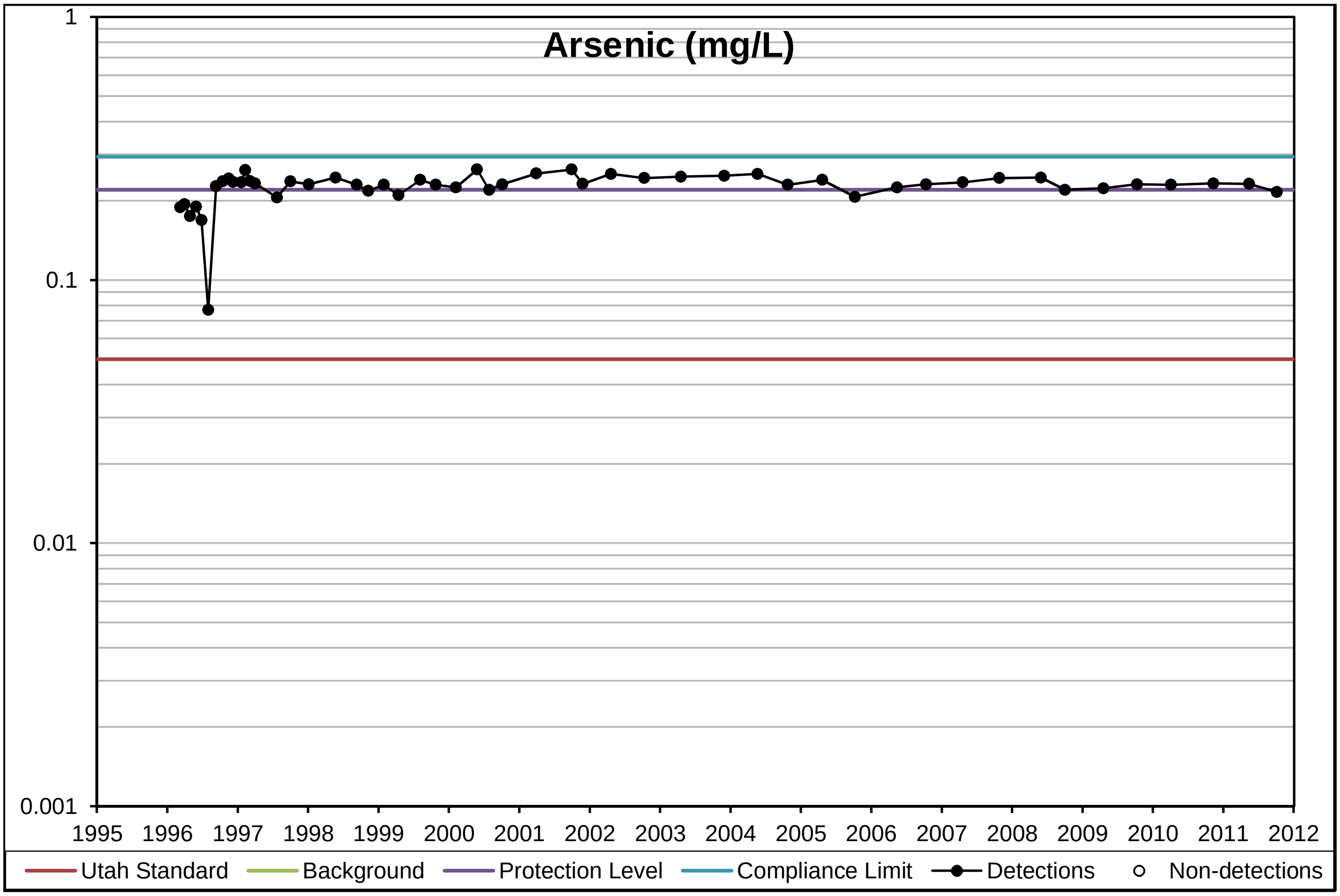
Concentration Versus Year

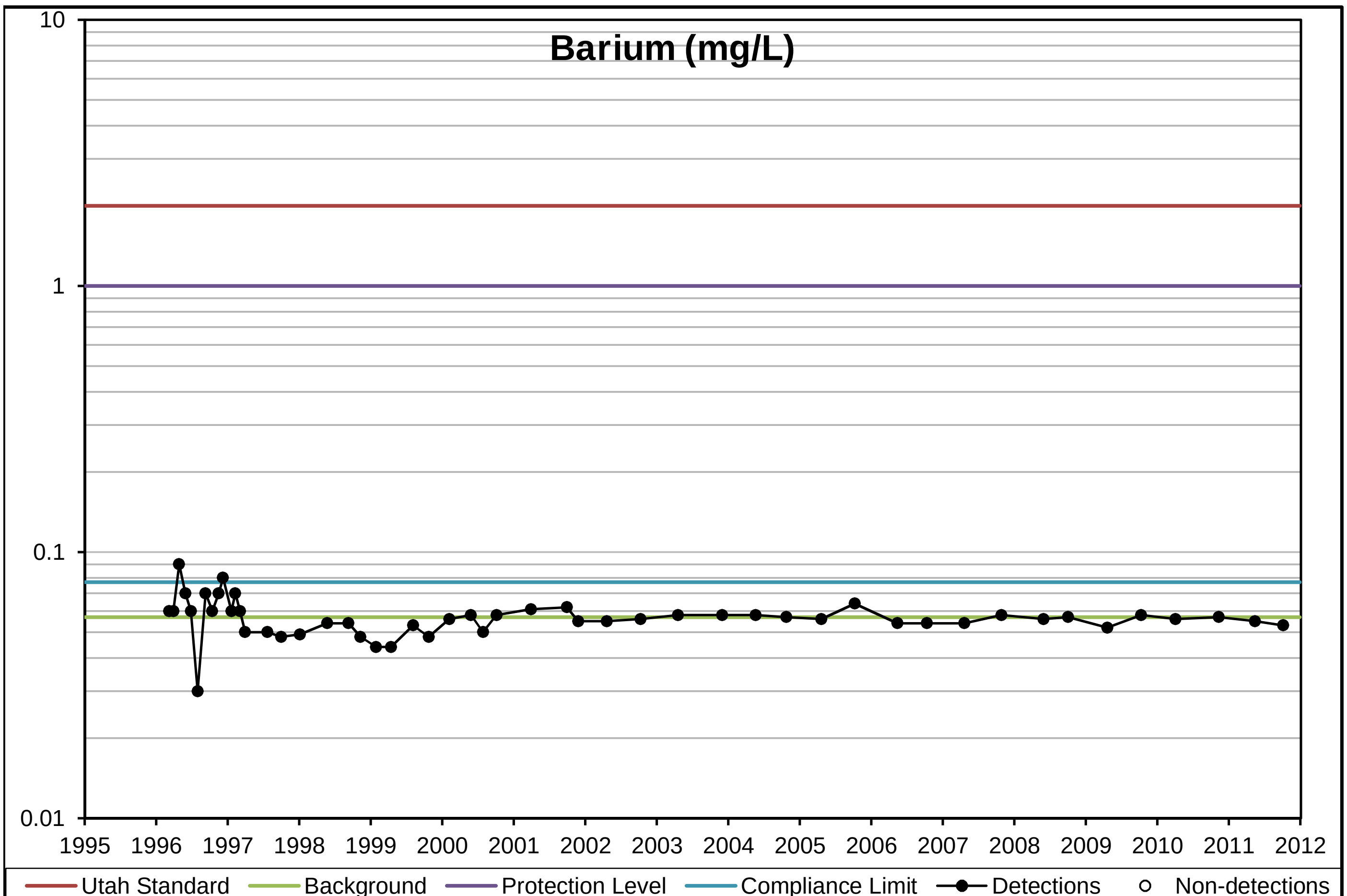


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year

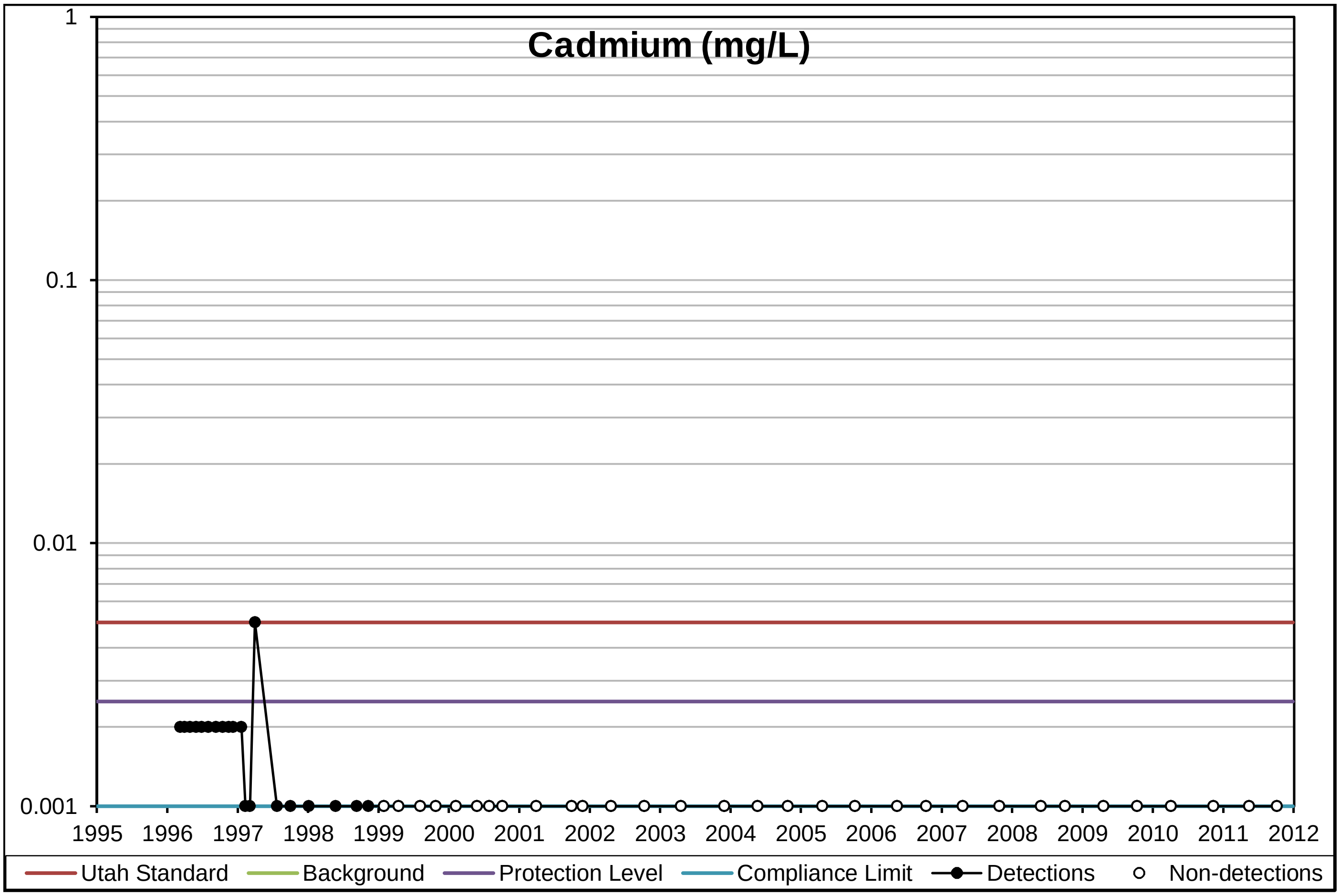


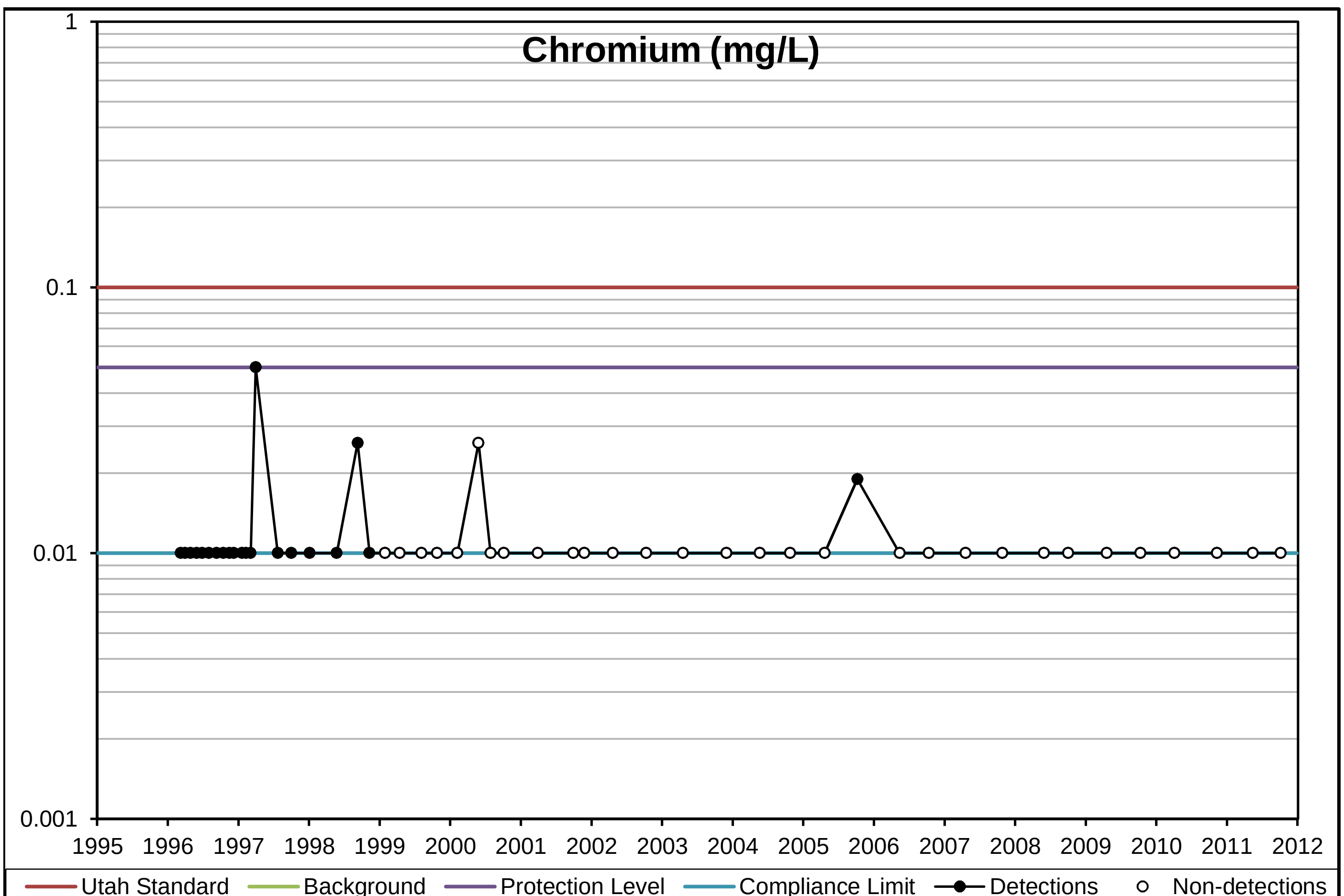


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year

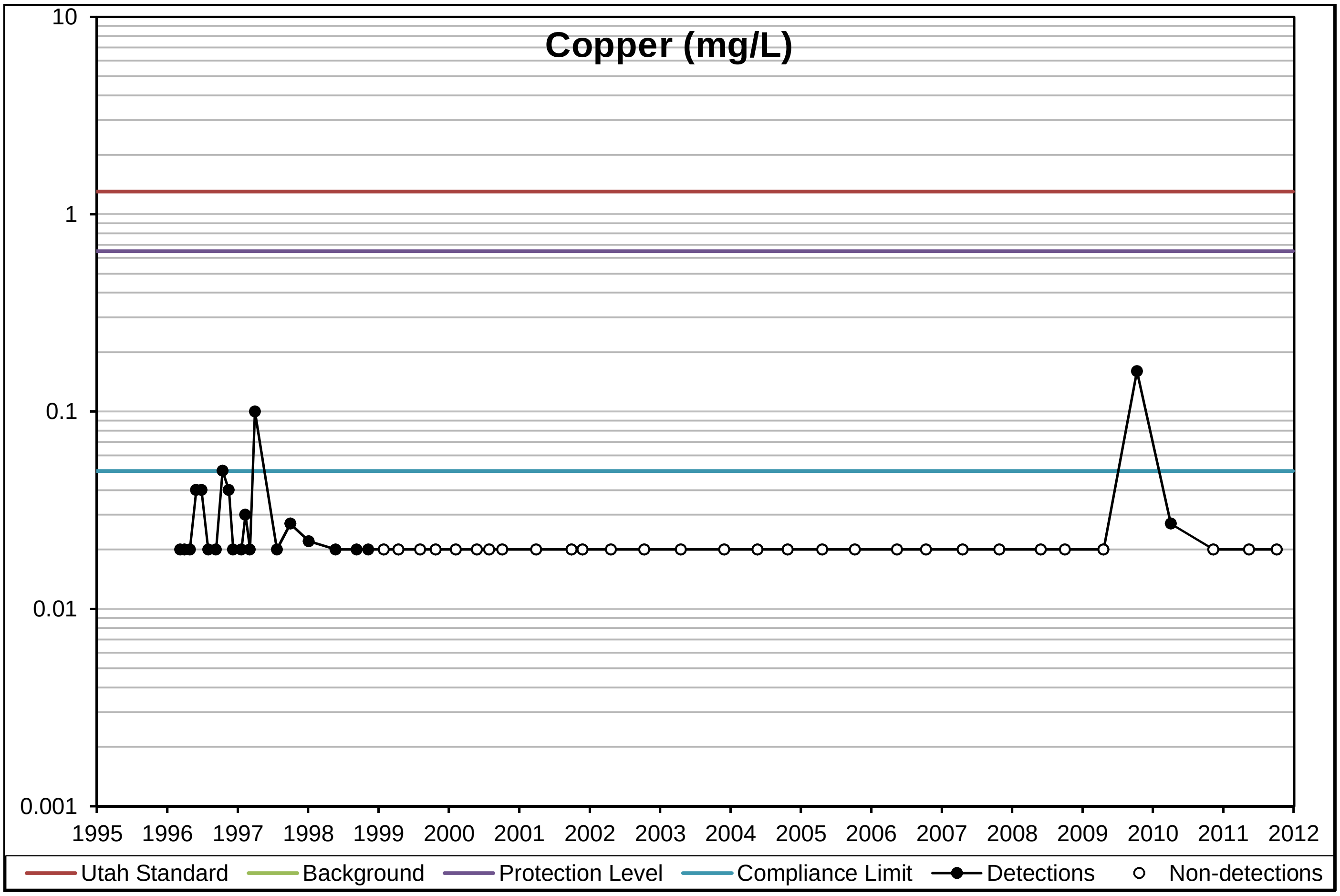


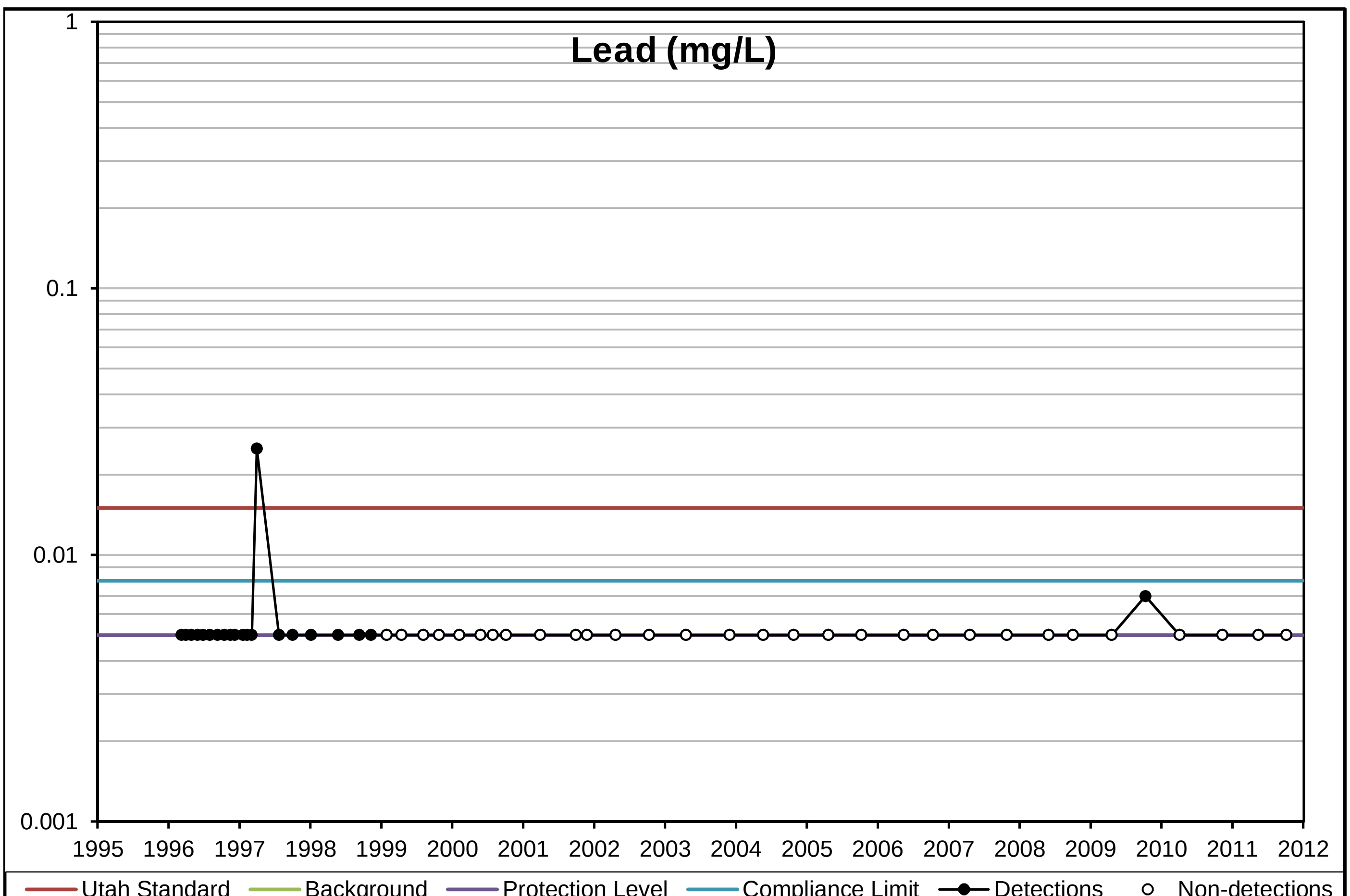


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year



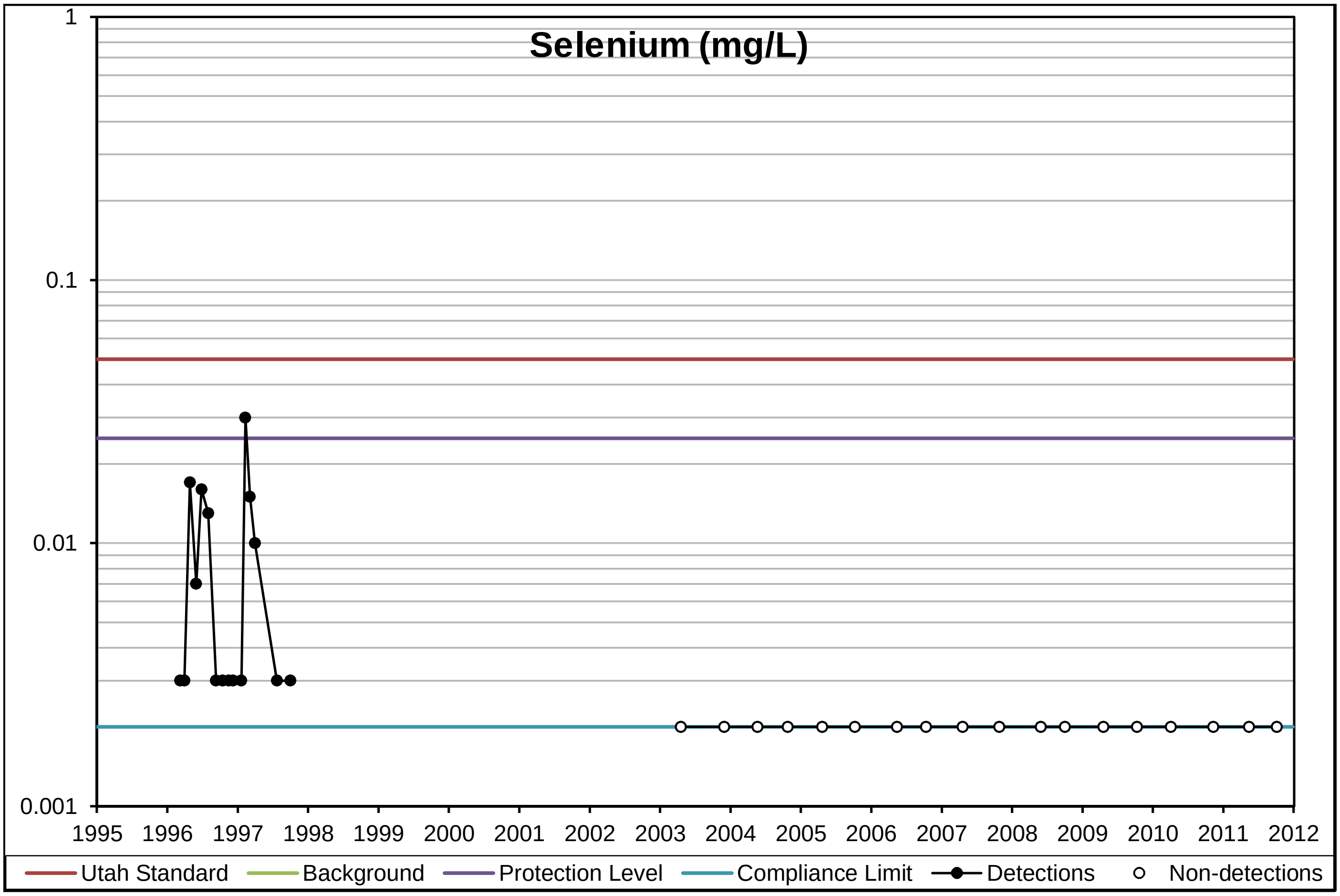


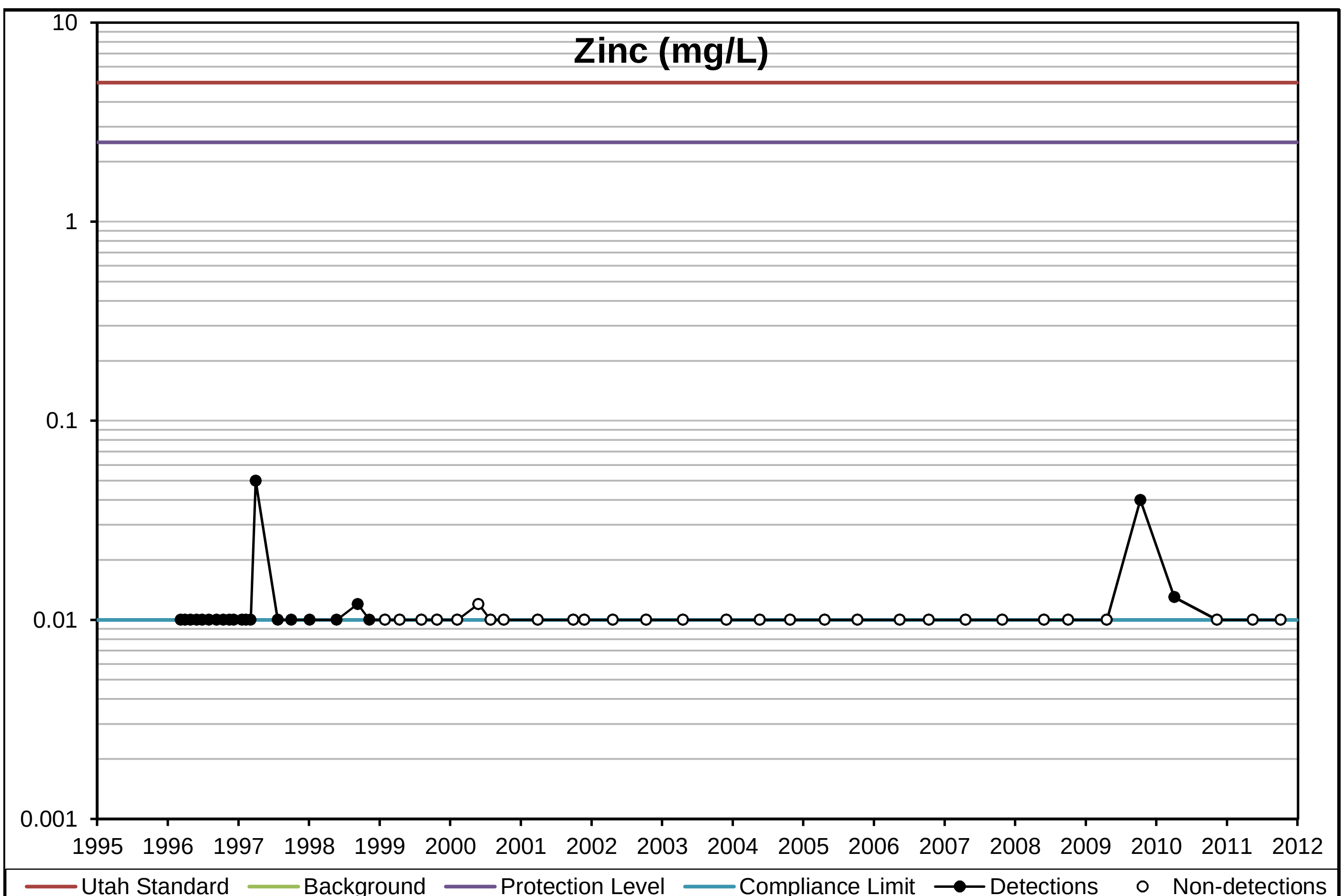
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year





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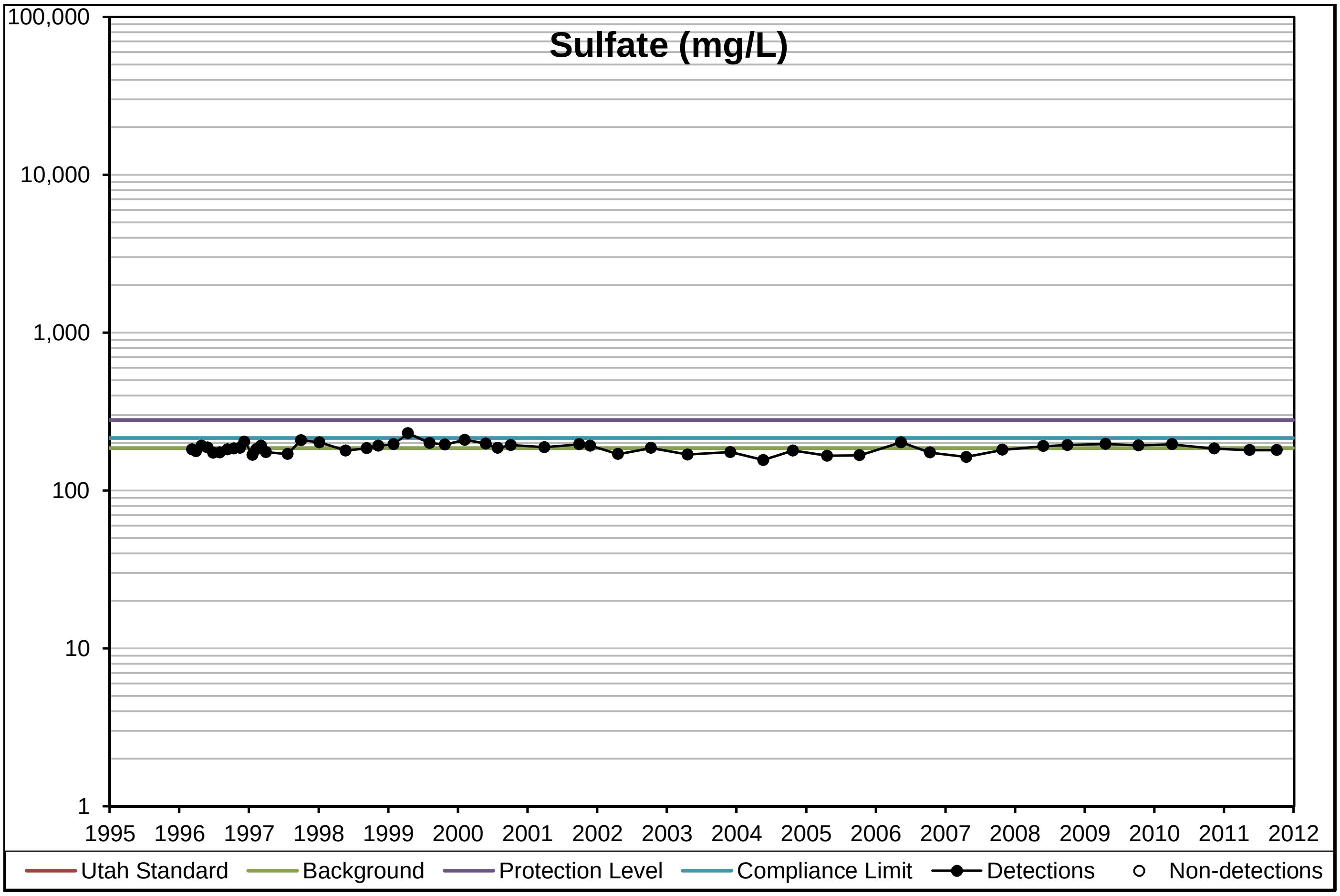
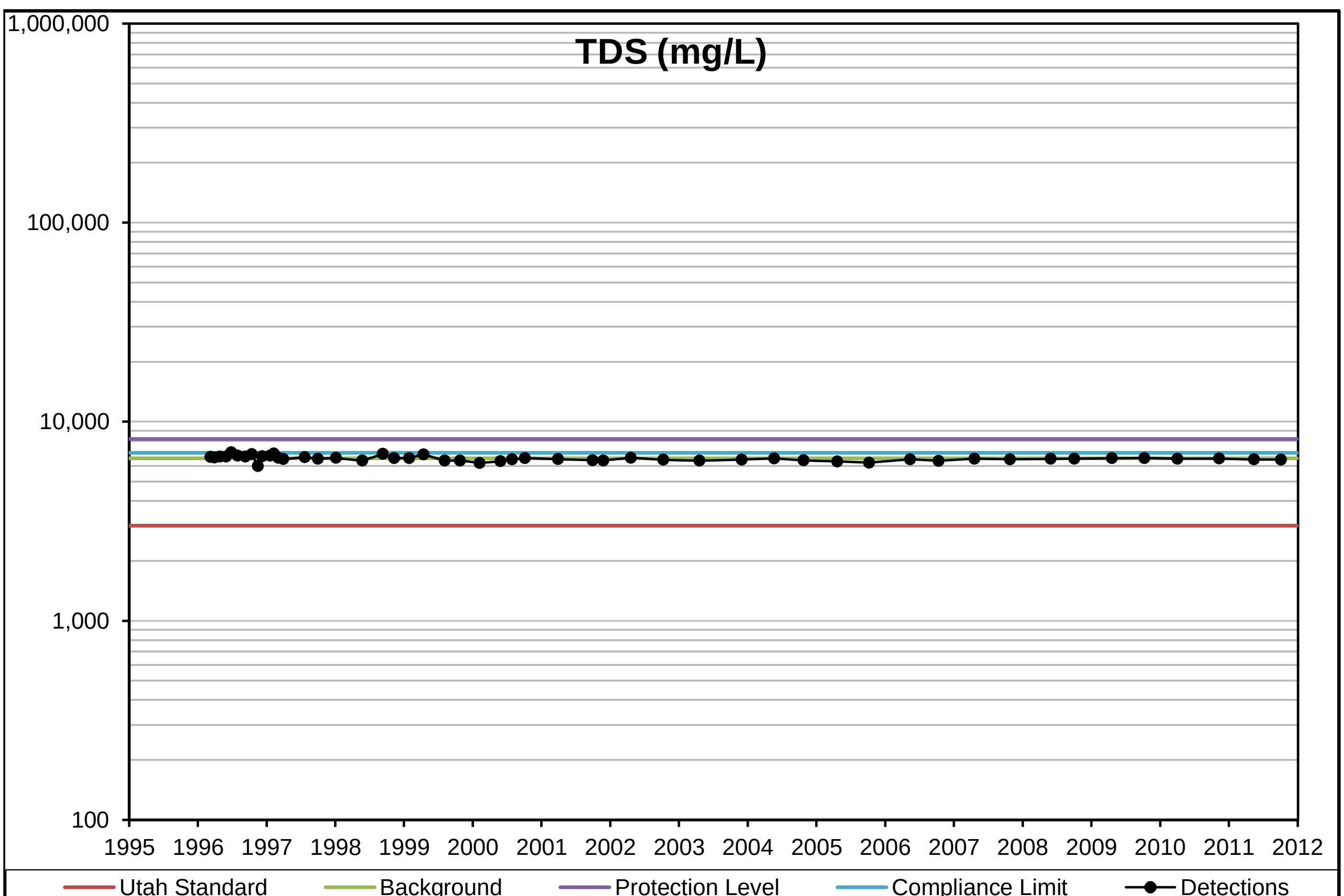
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year





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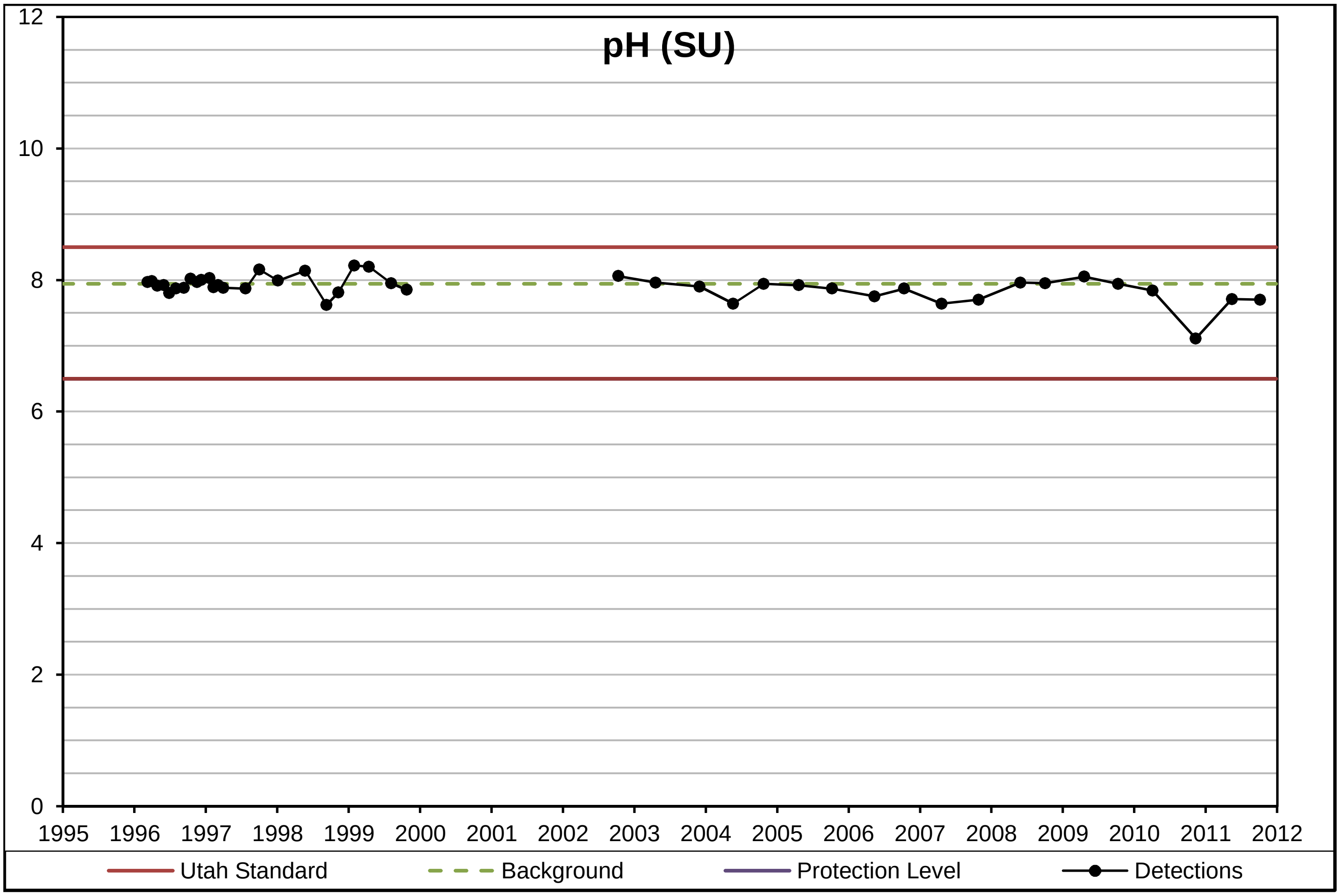
Constituent range includes minimum and maximum concentrations for all wells considered

NET1383B

Concentration Versus Year

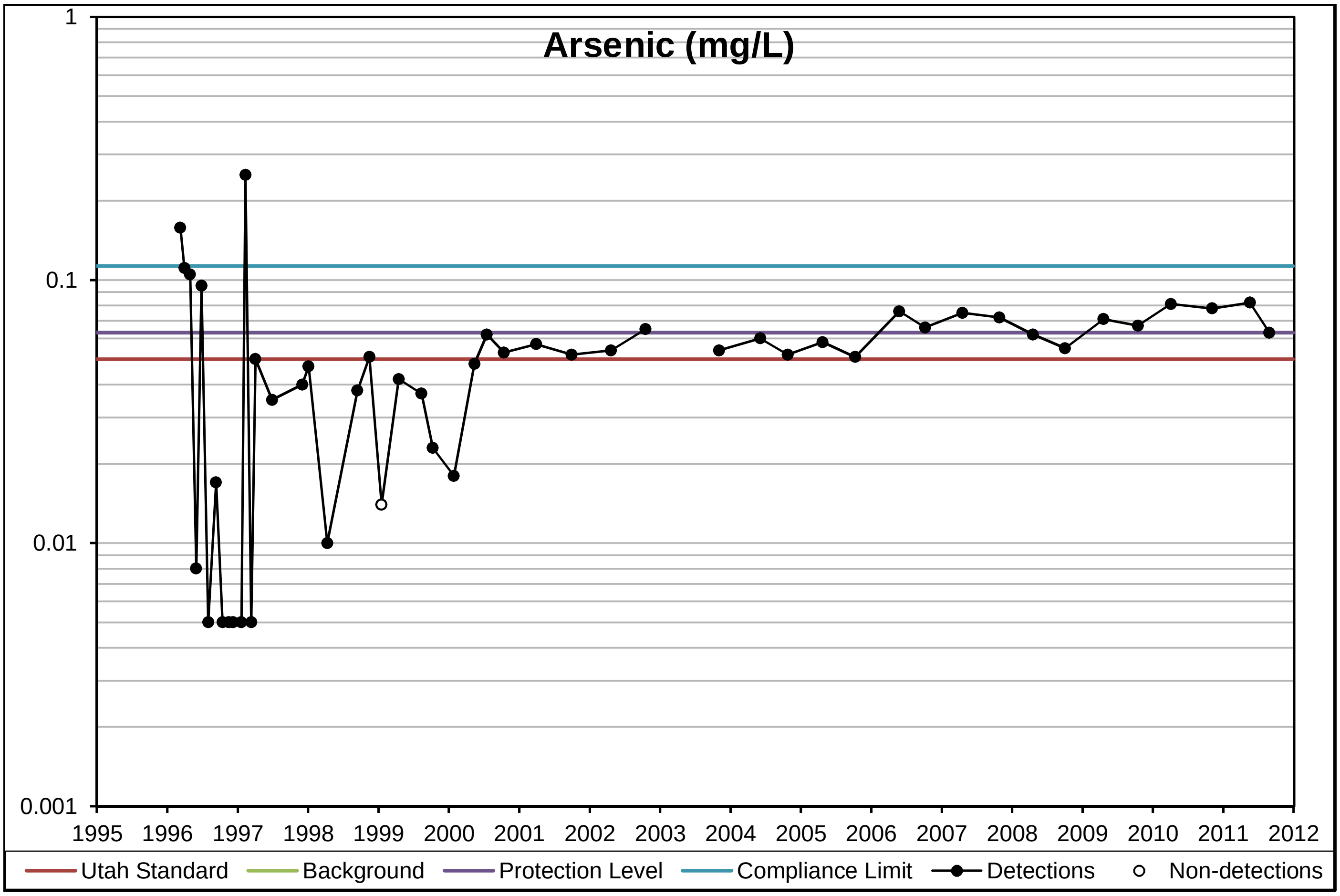


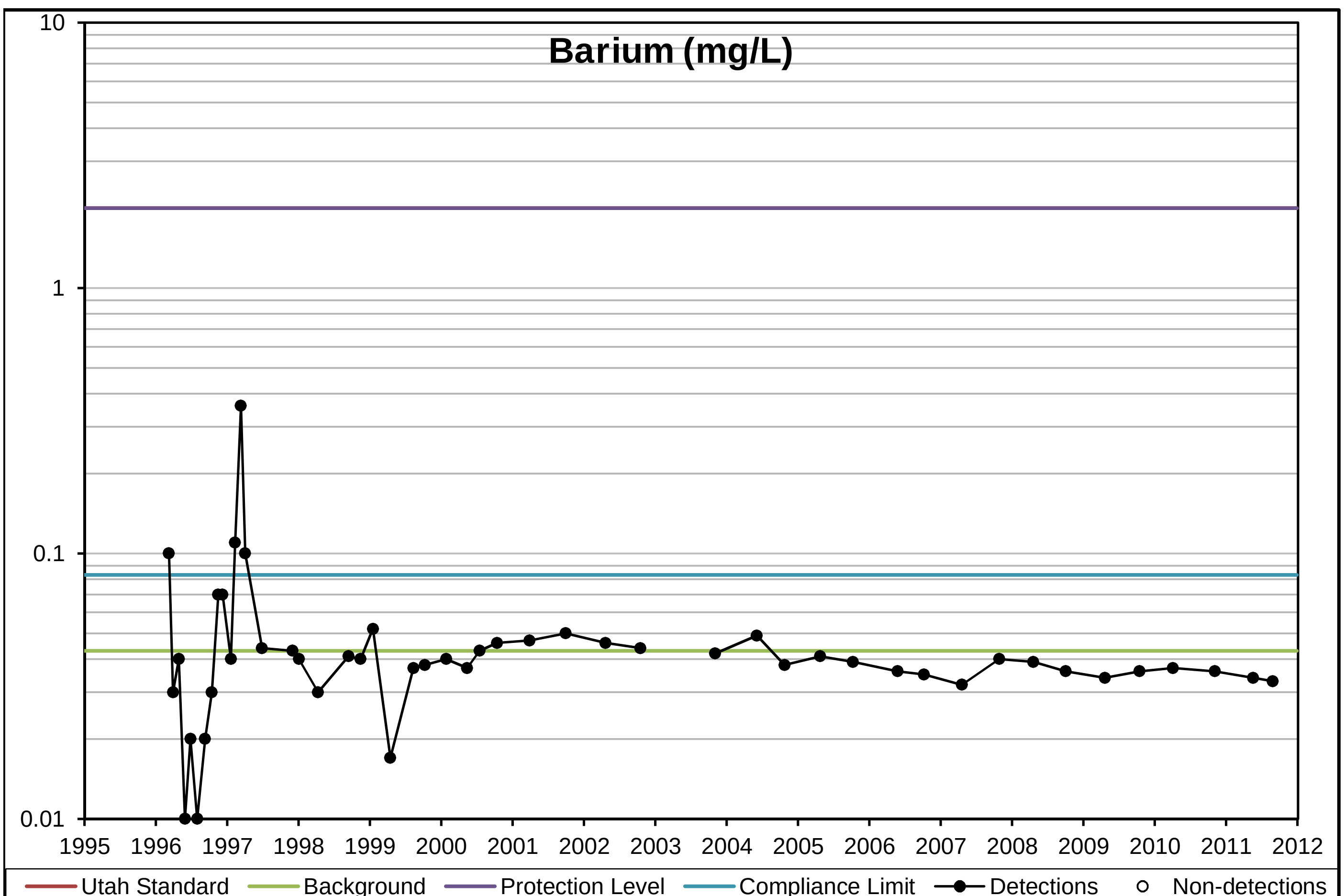
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

Concentration Versus Year





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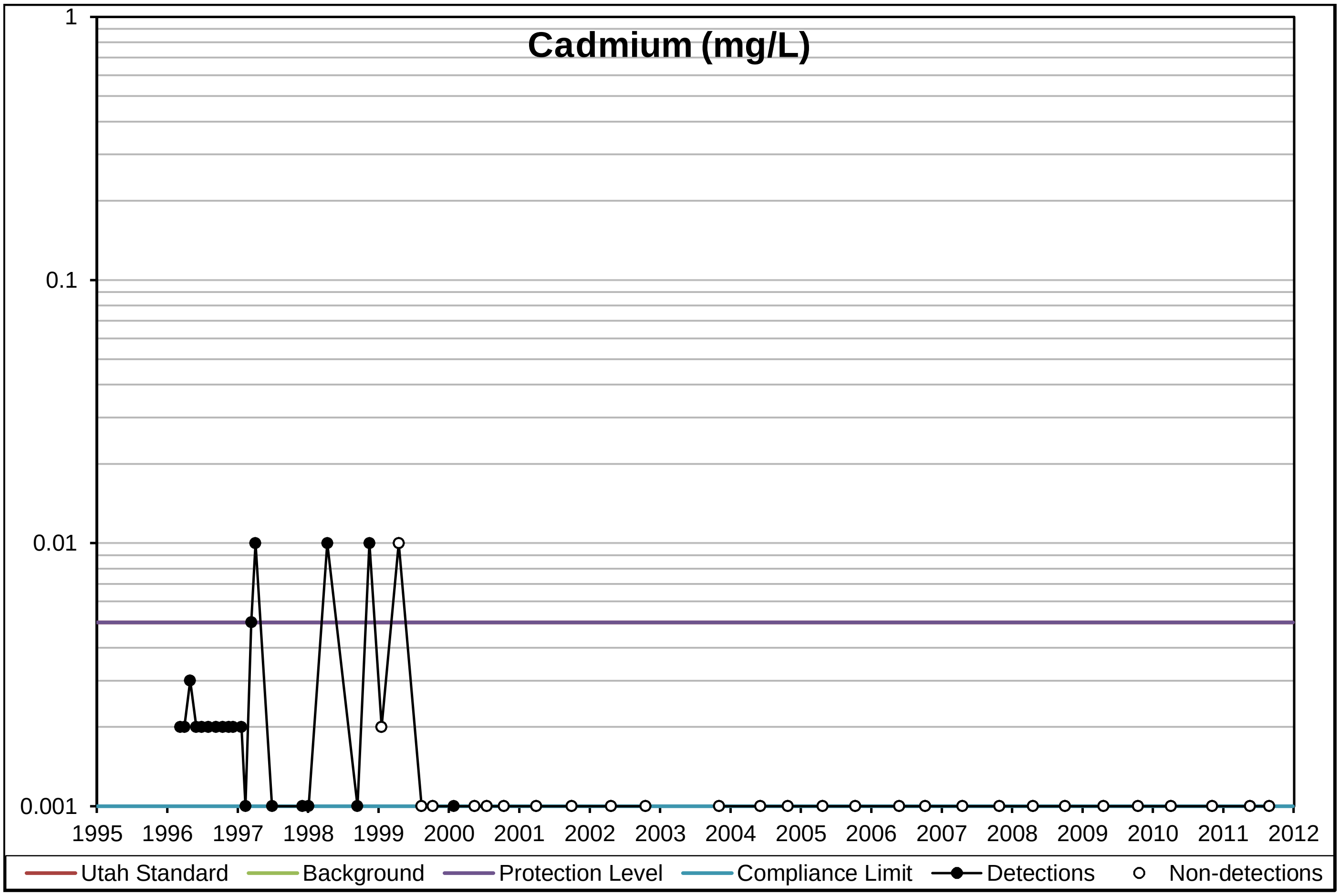
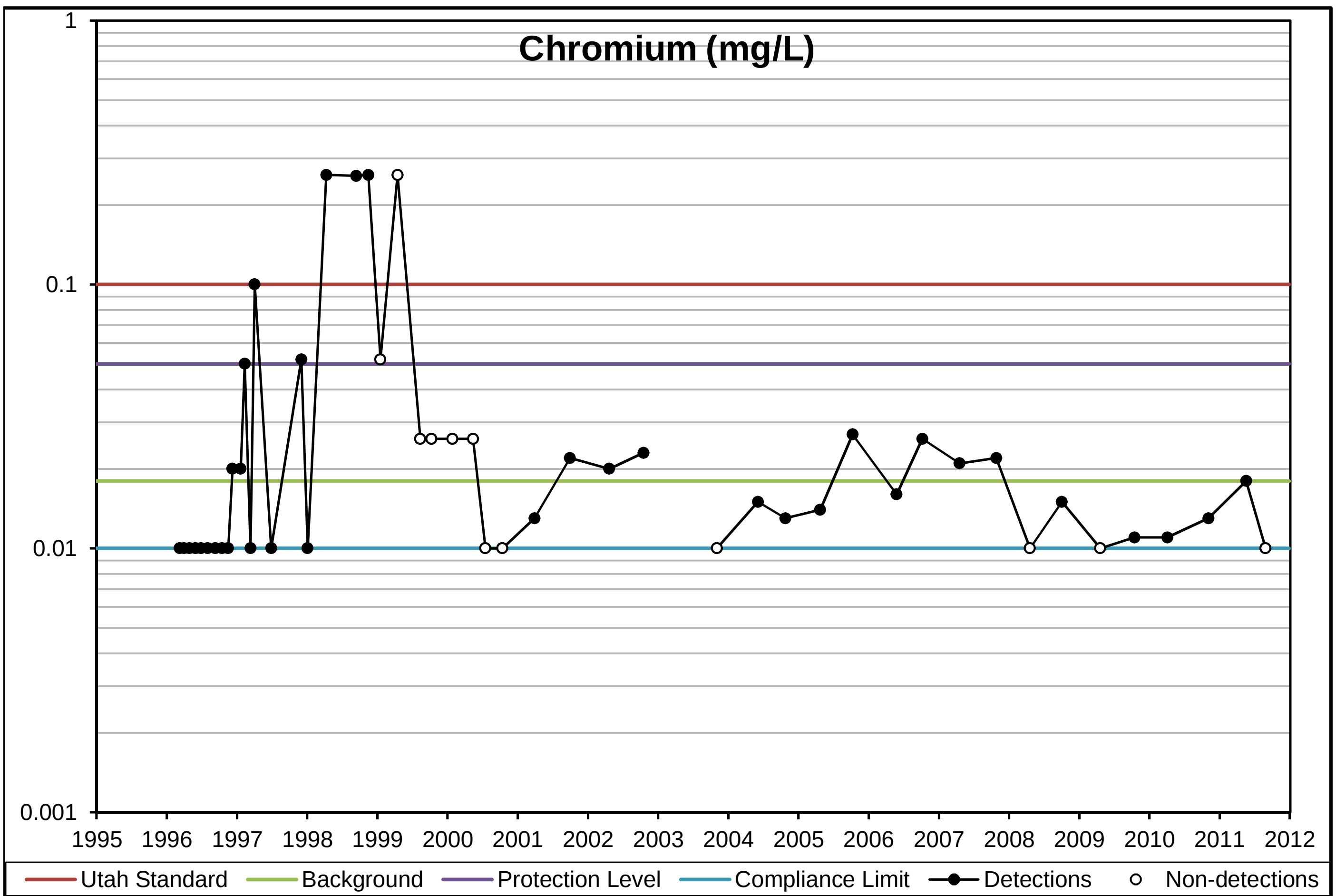
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

Concentration Versus Year



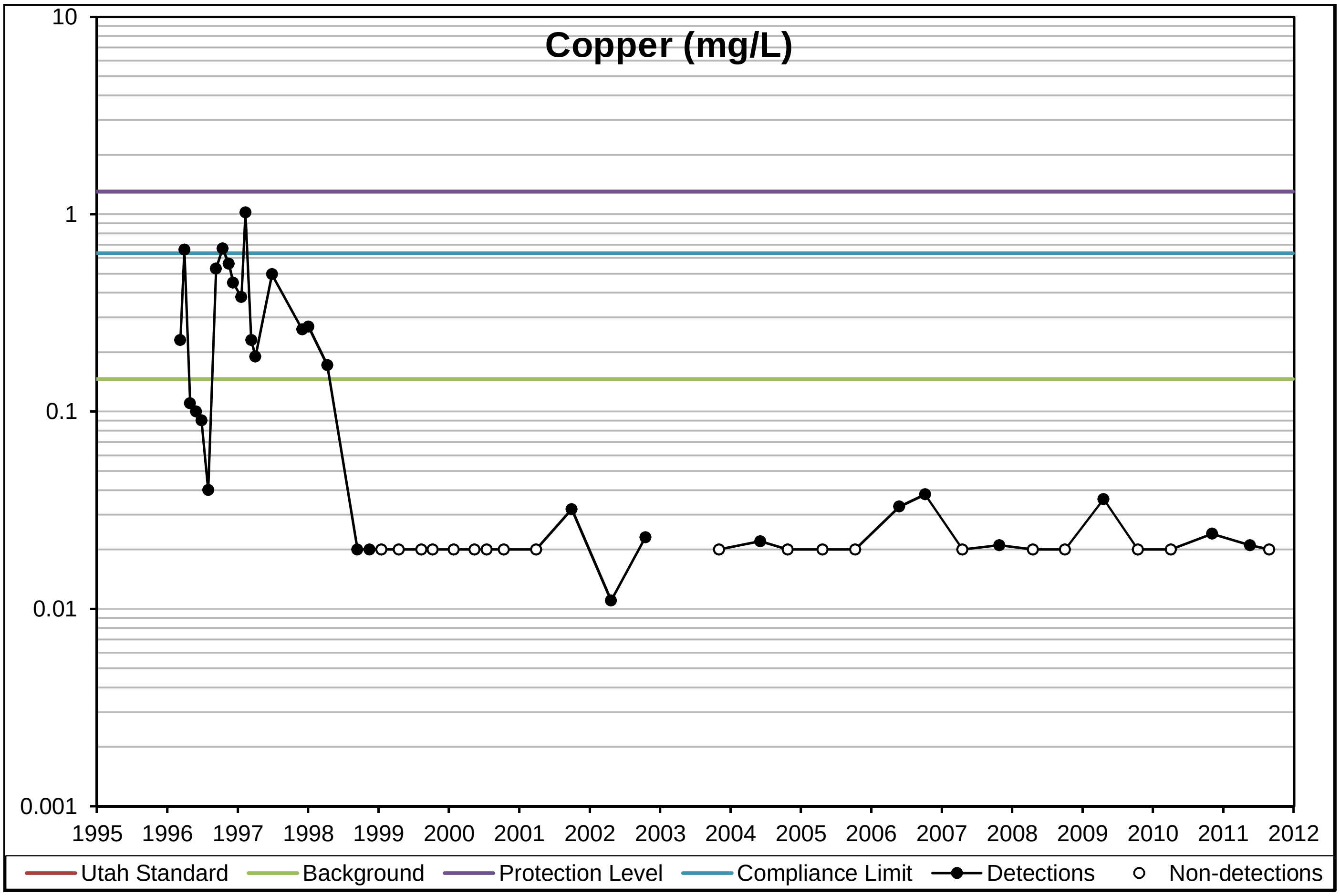


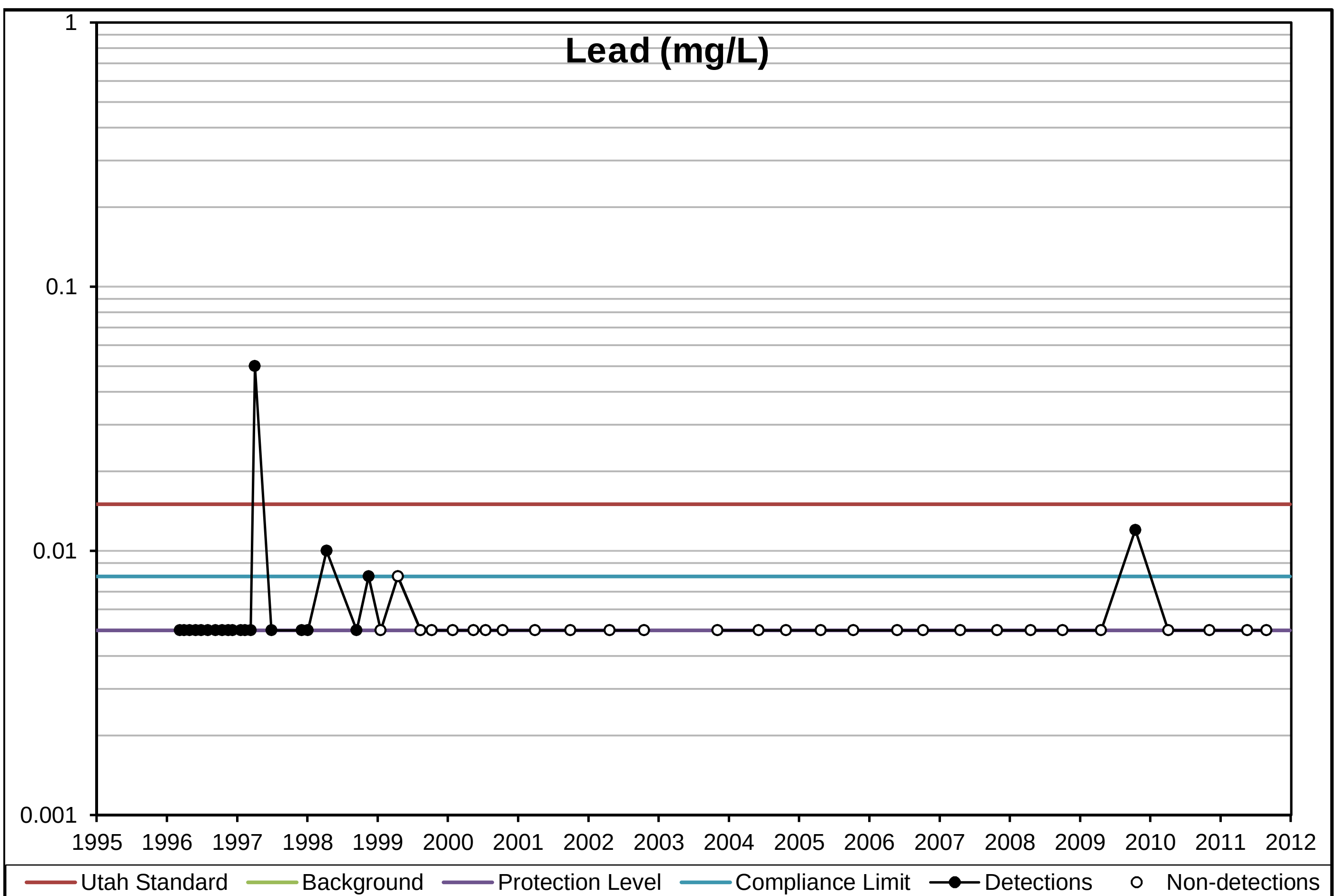
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

Concentration Versus Year





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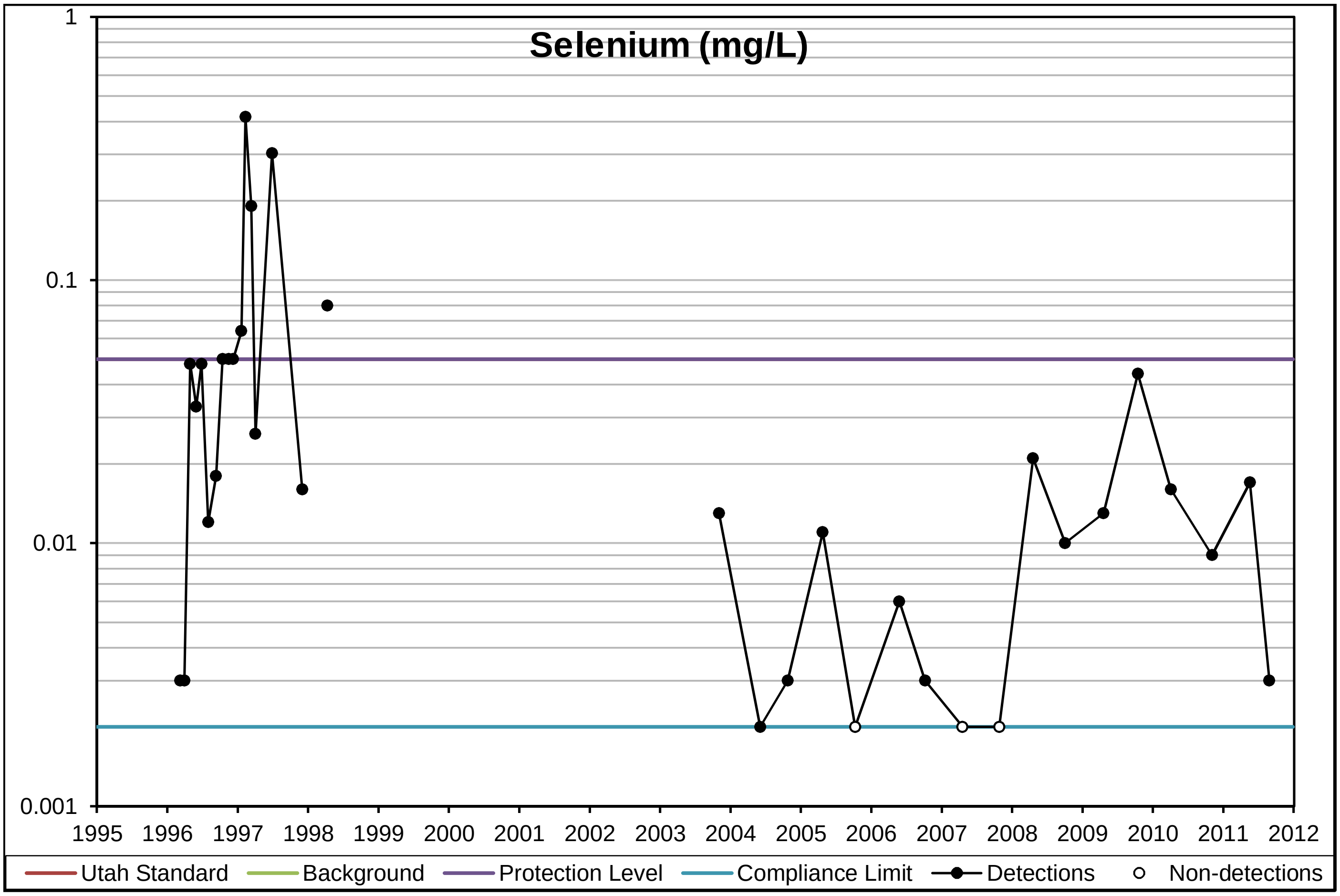
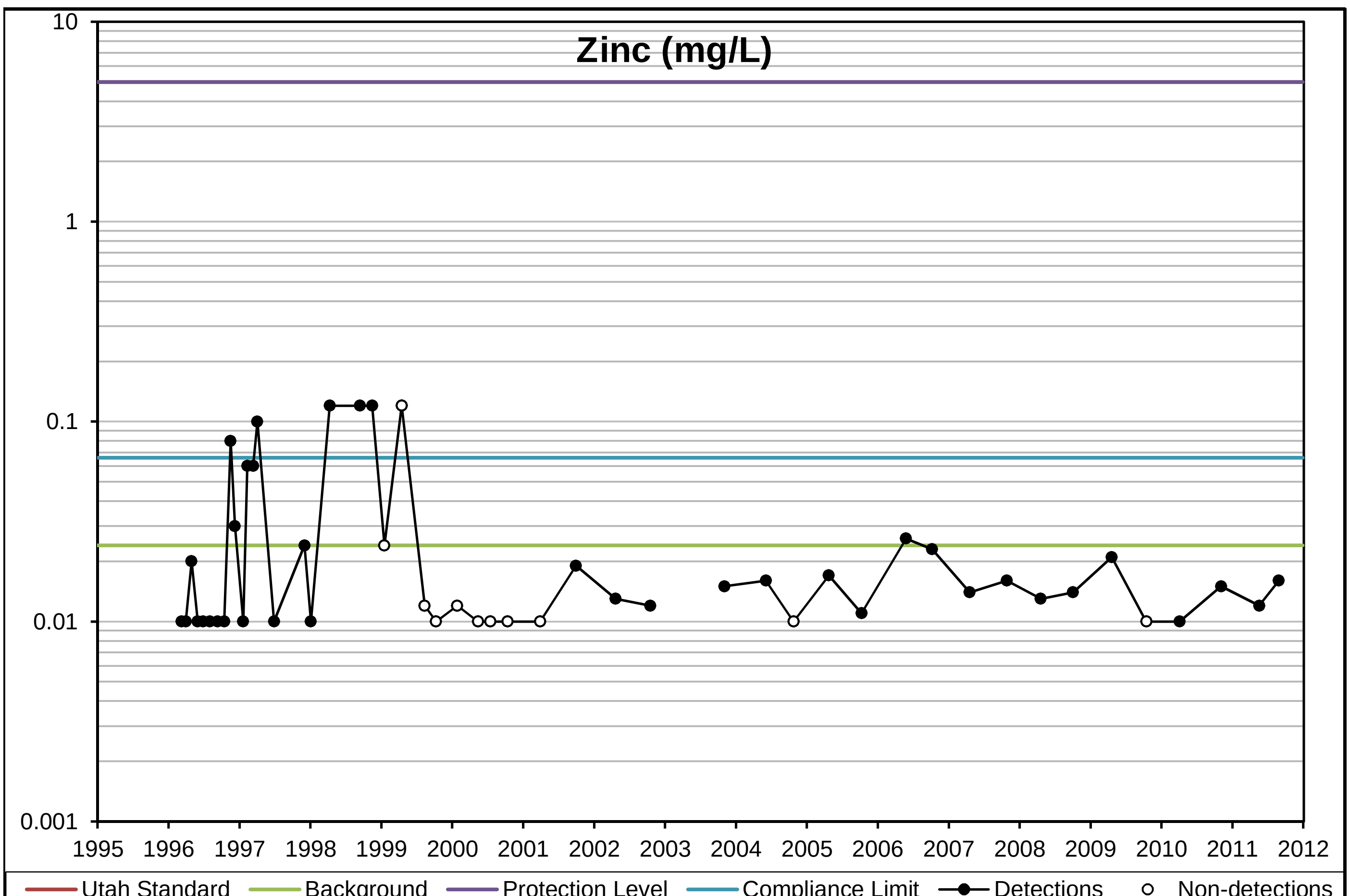
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

Concentration Versus Year





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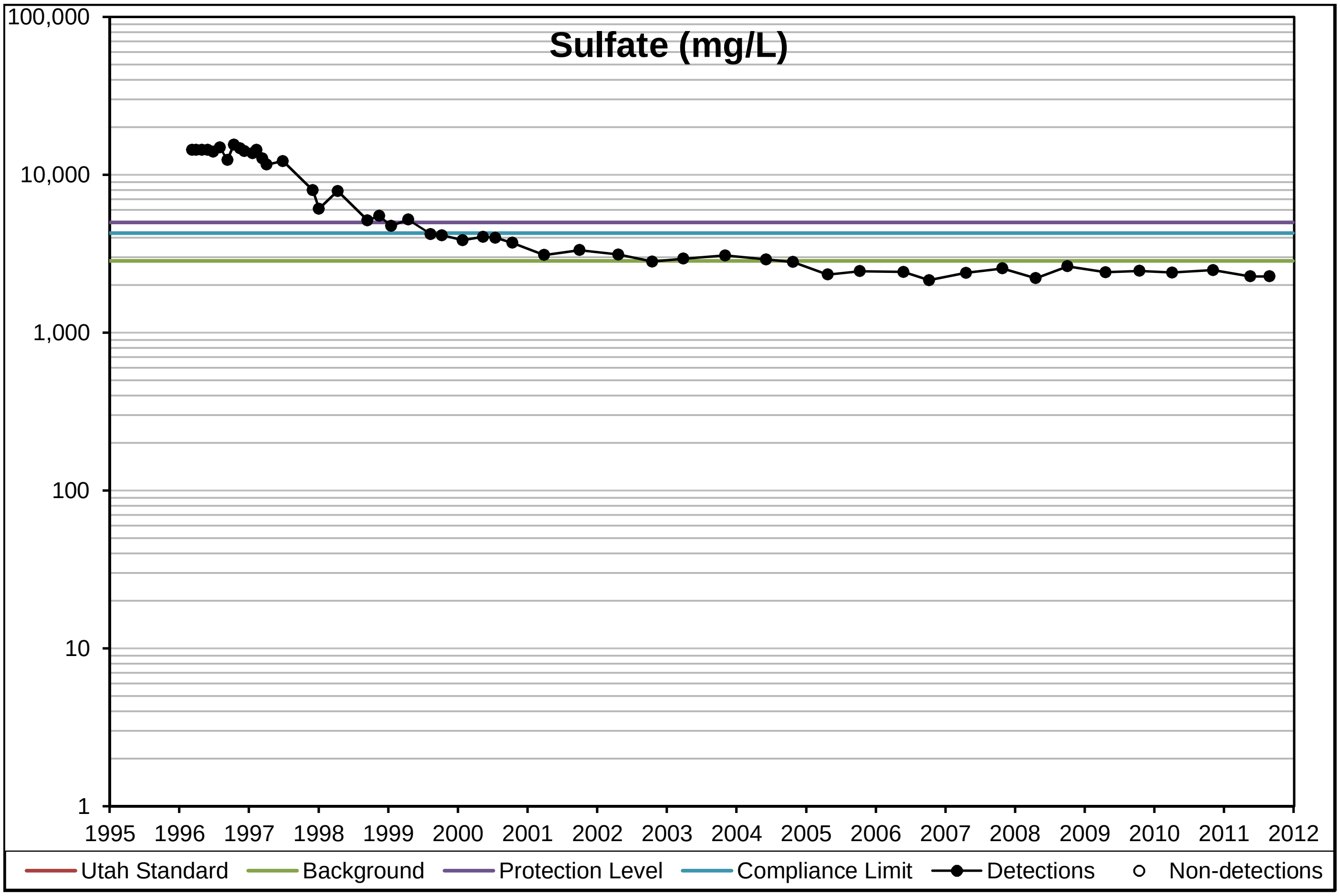
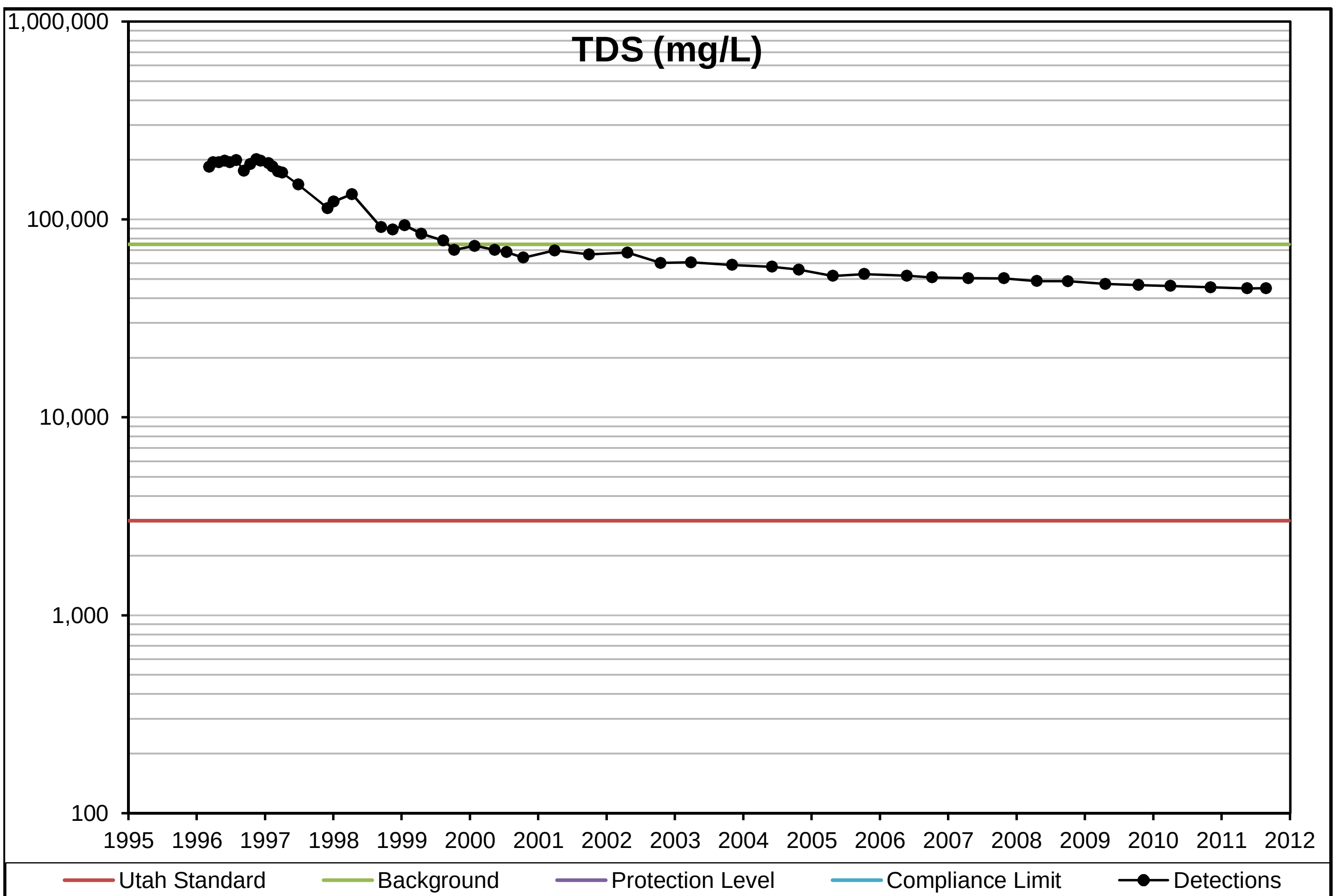
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

Concentration Versus Year



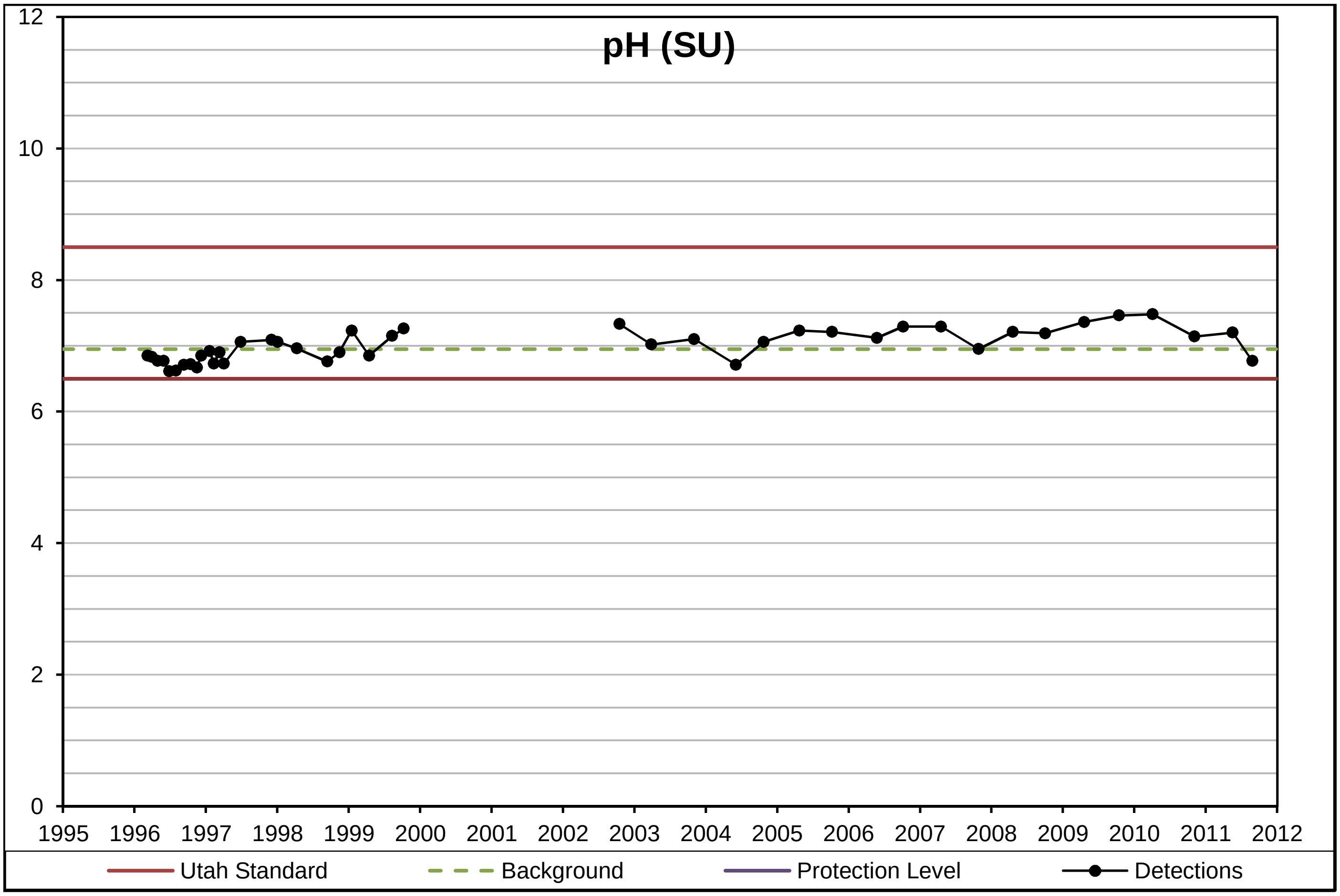


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384A

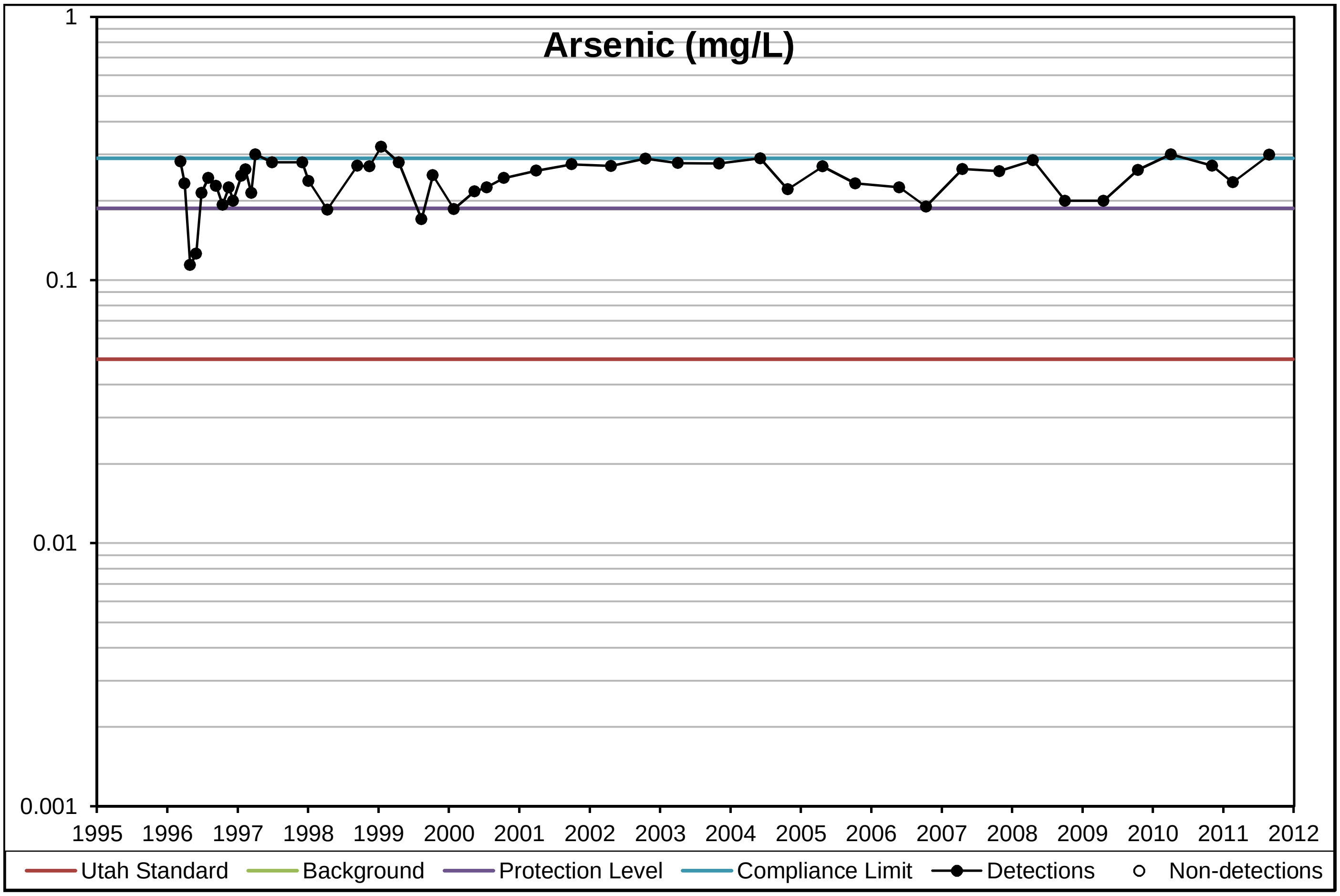
Concentration Versus Year

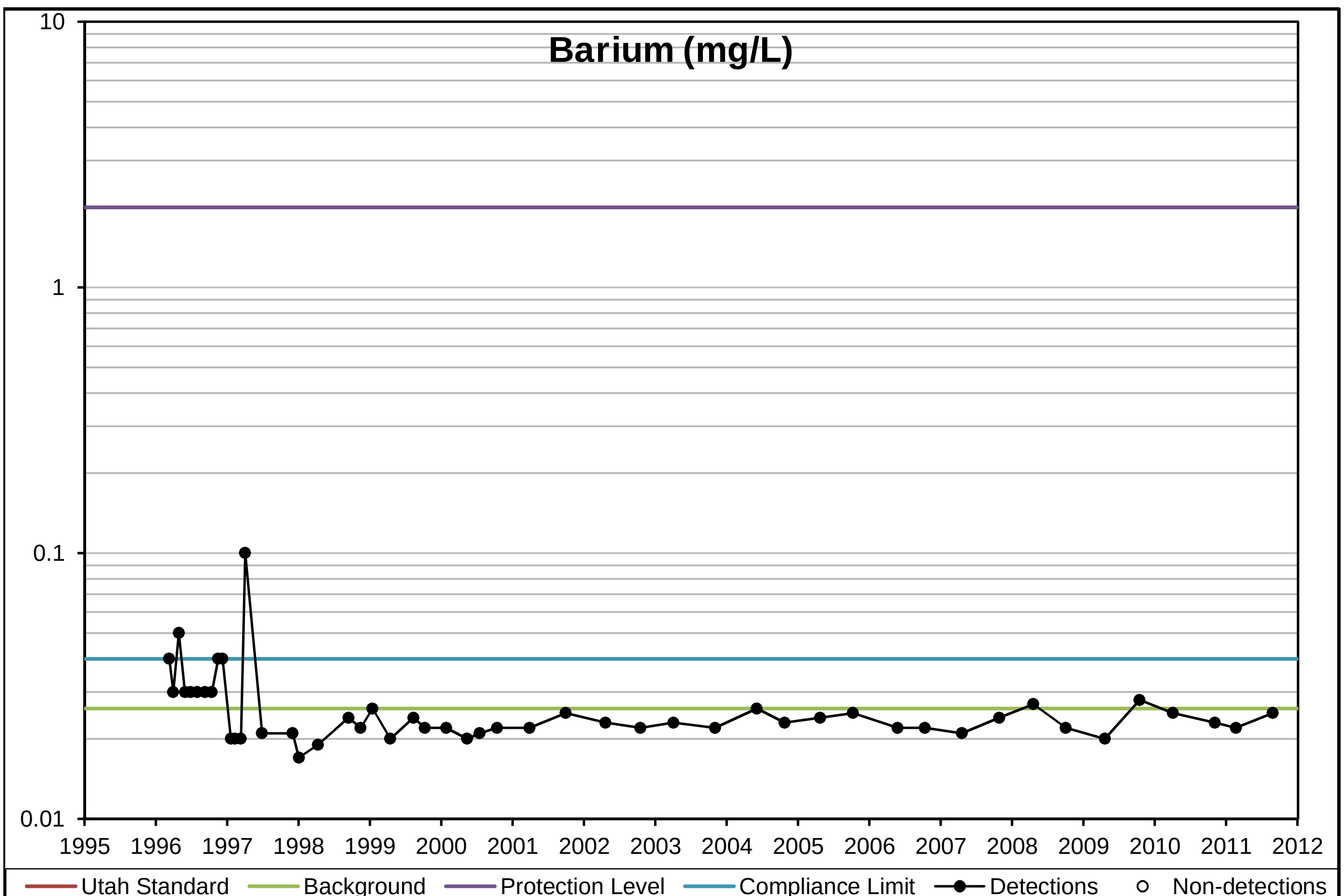


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year

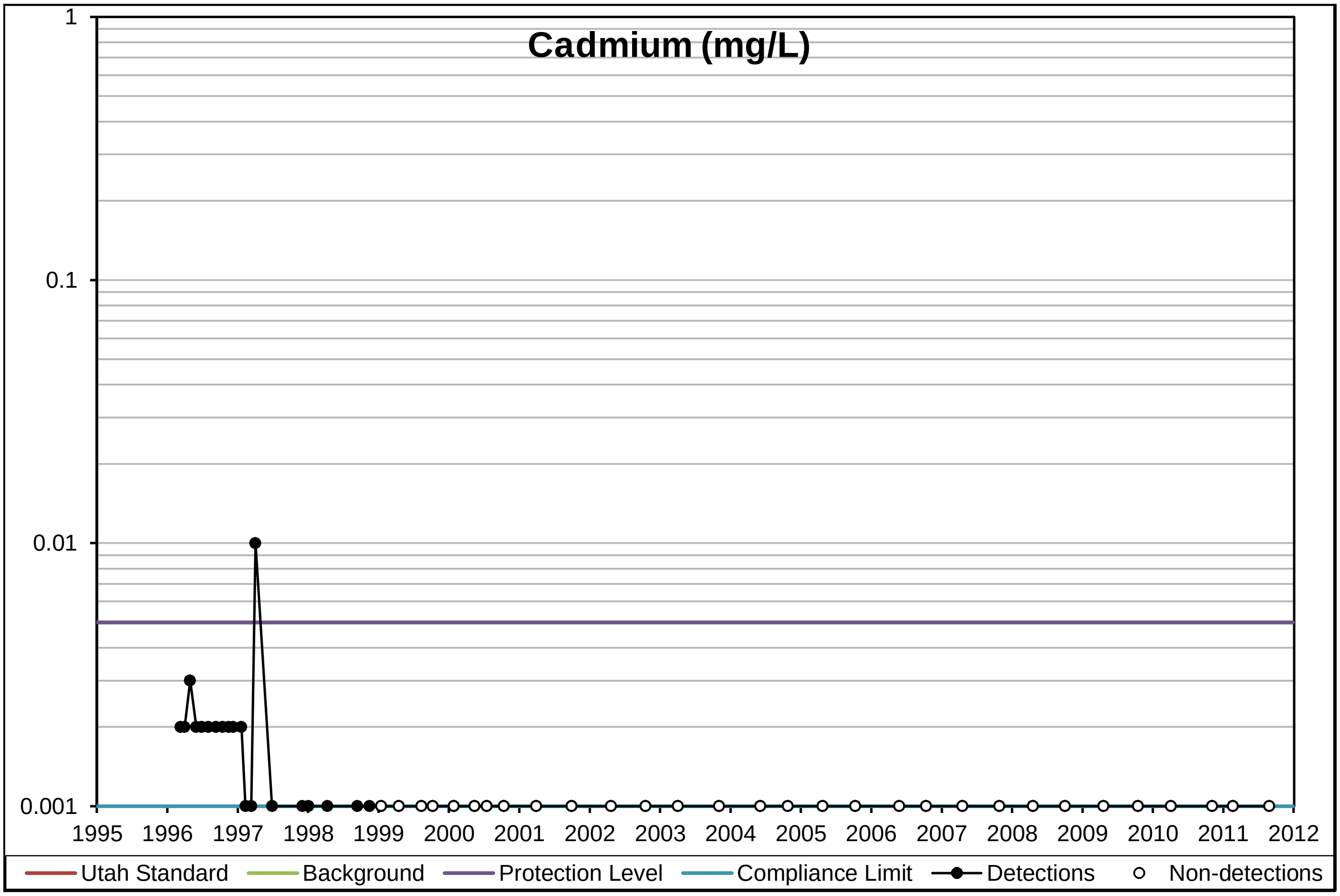


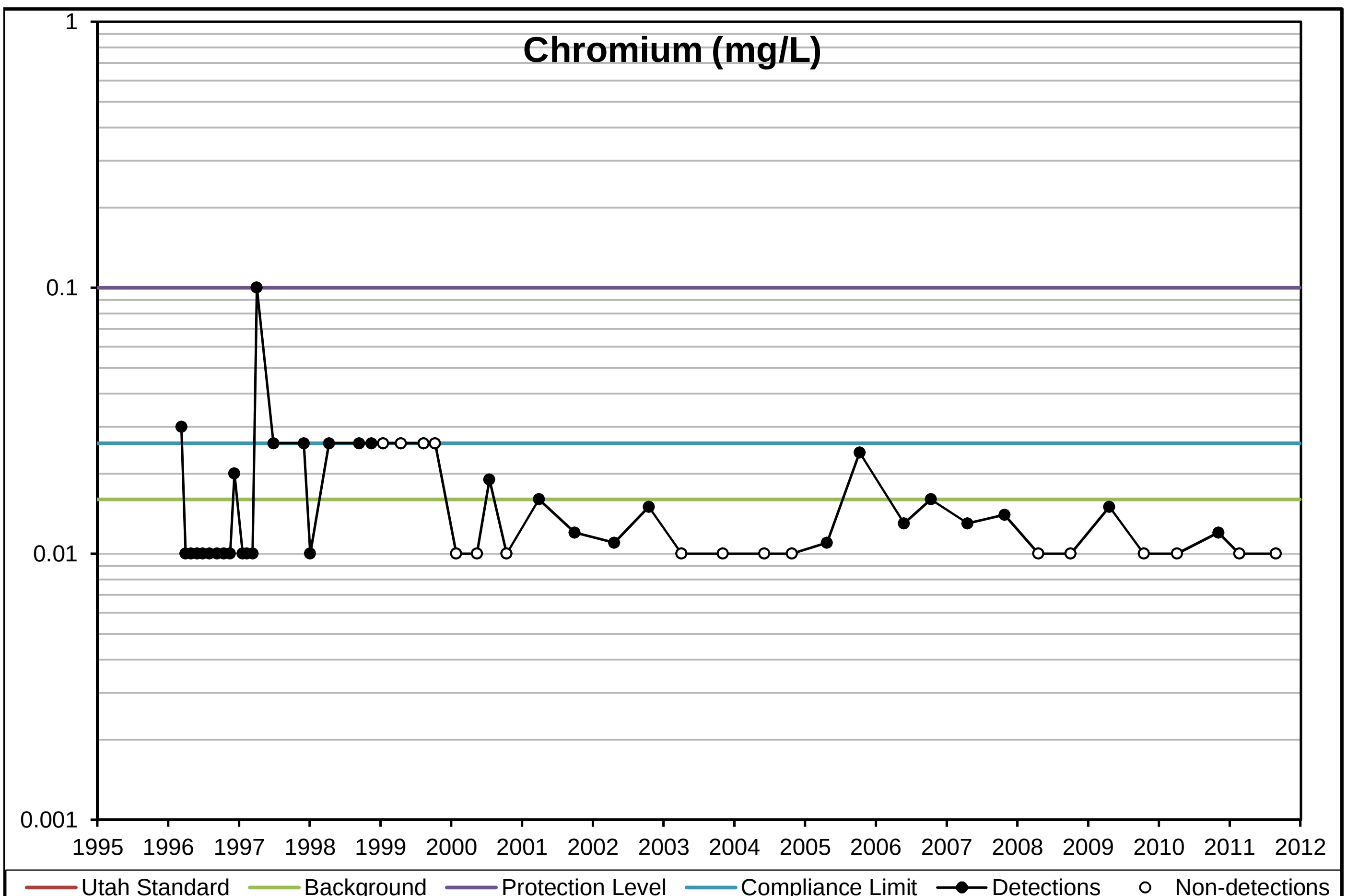


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year



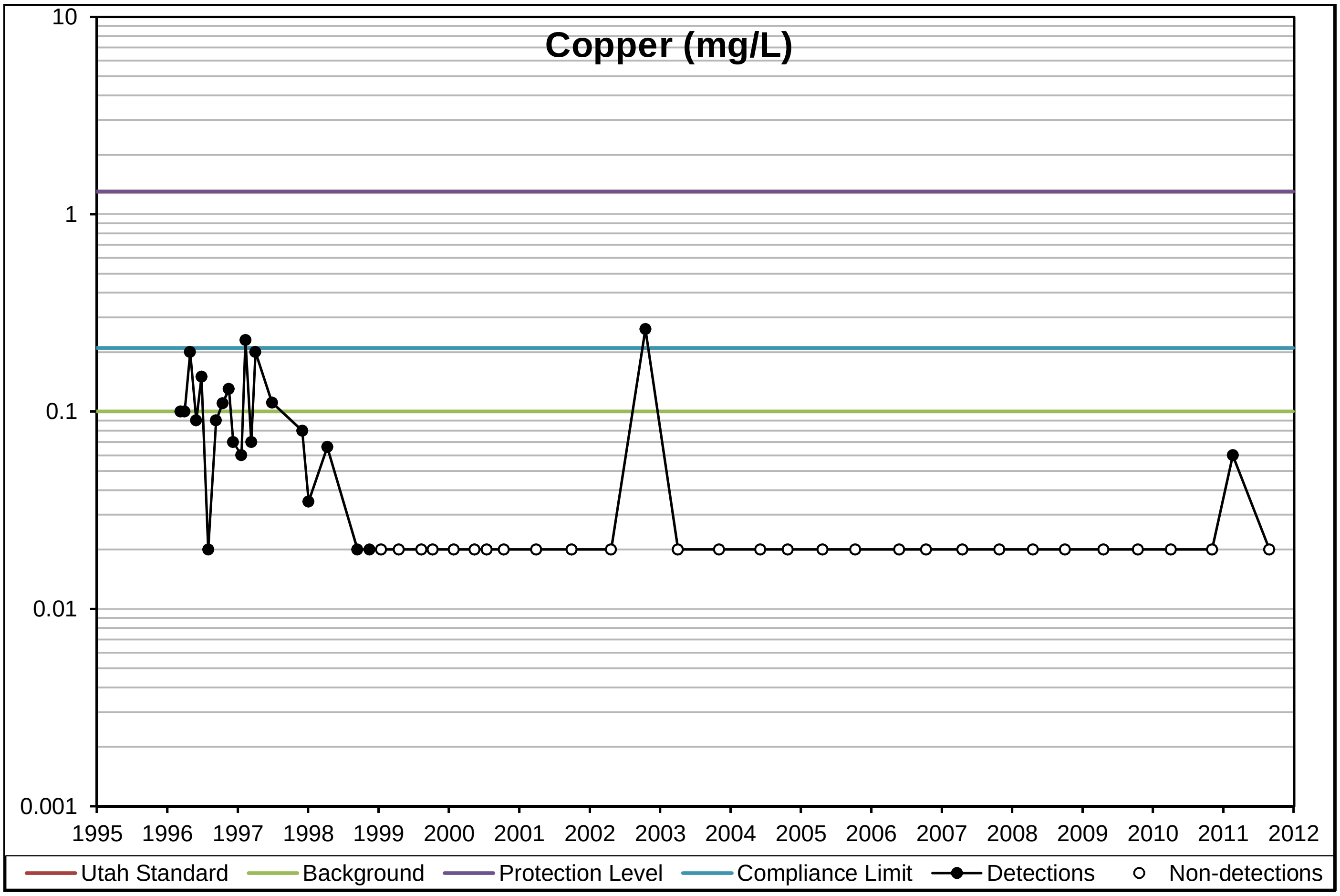


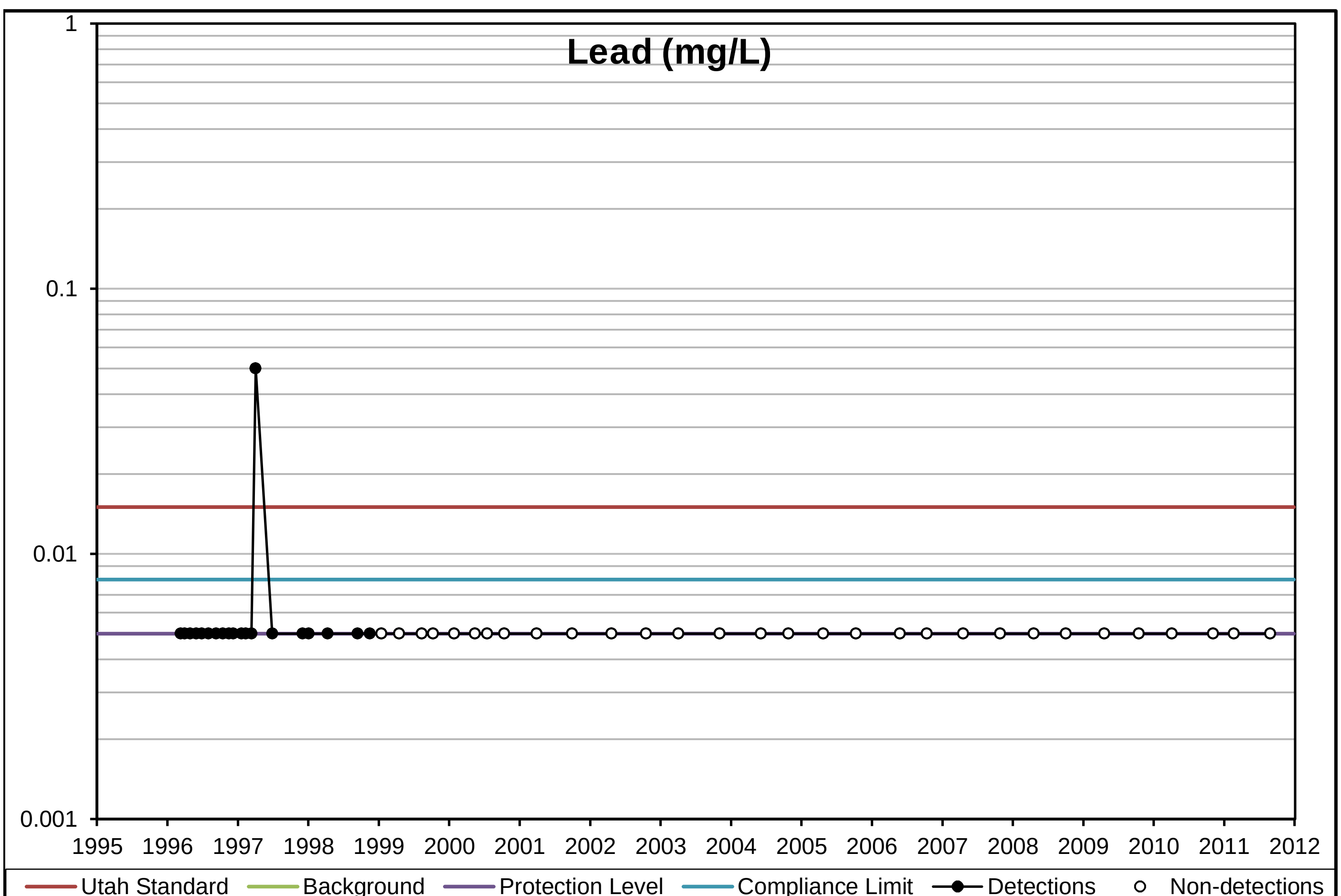
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year



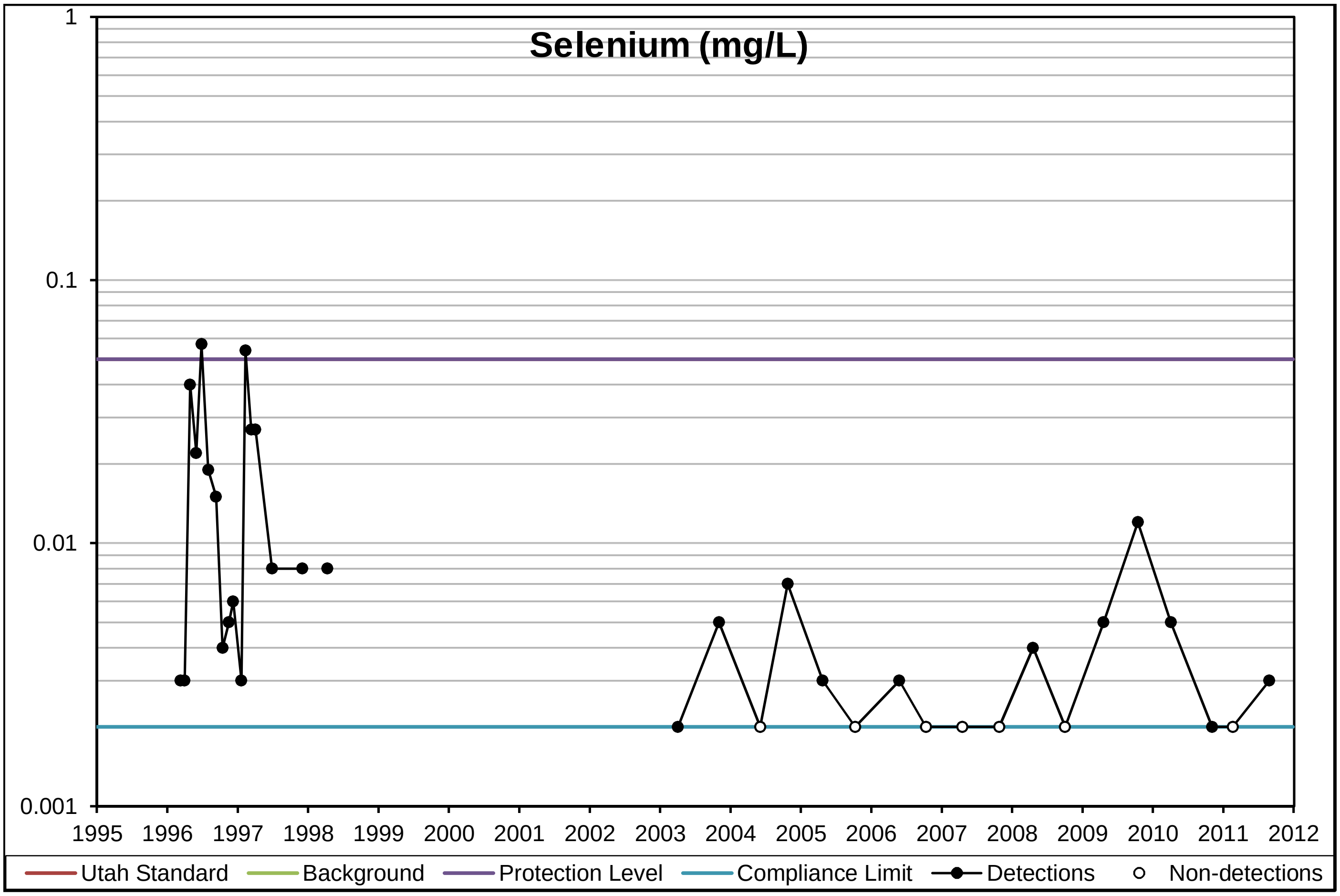


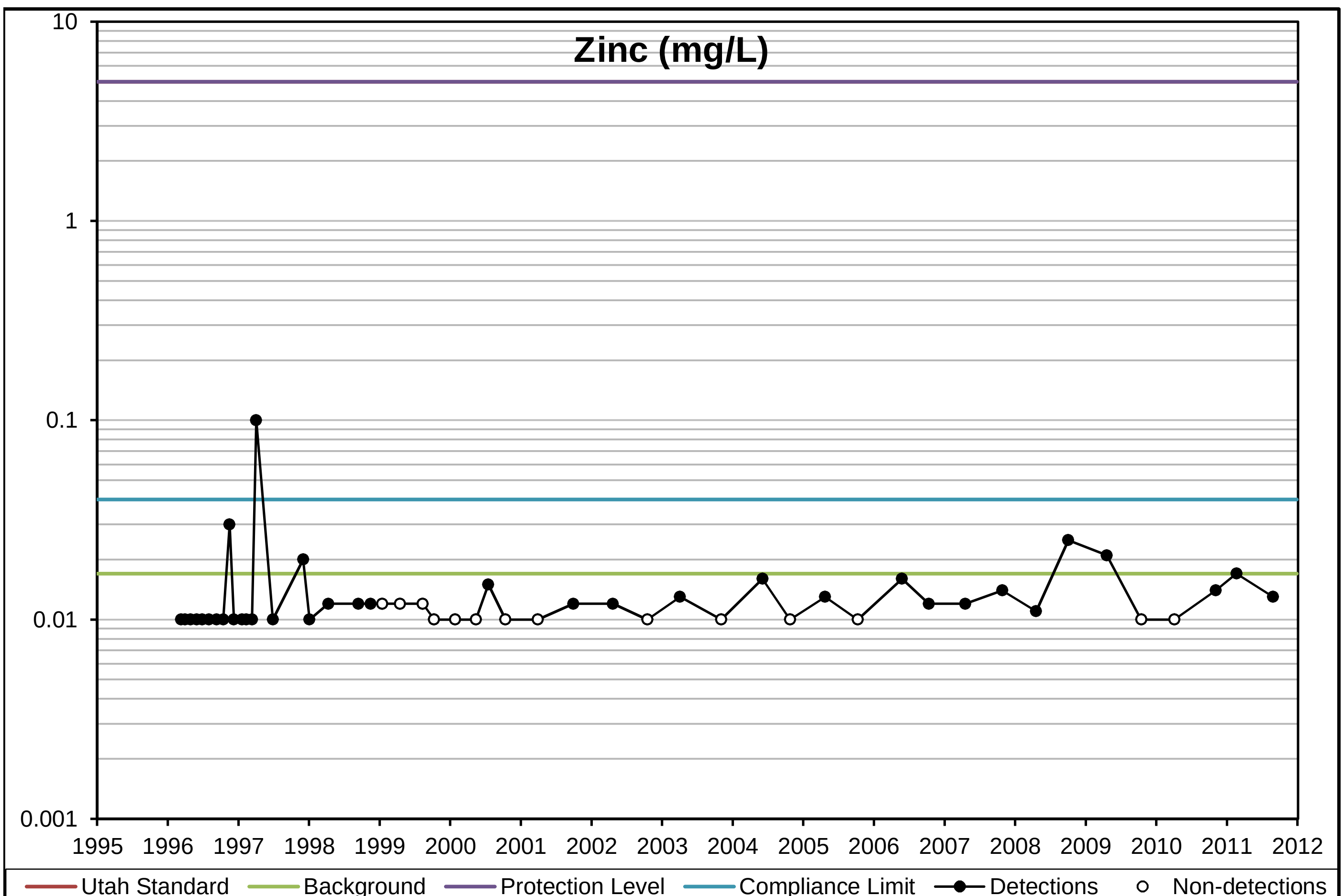
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year





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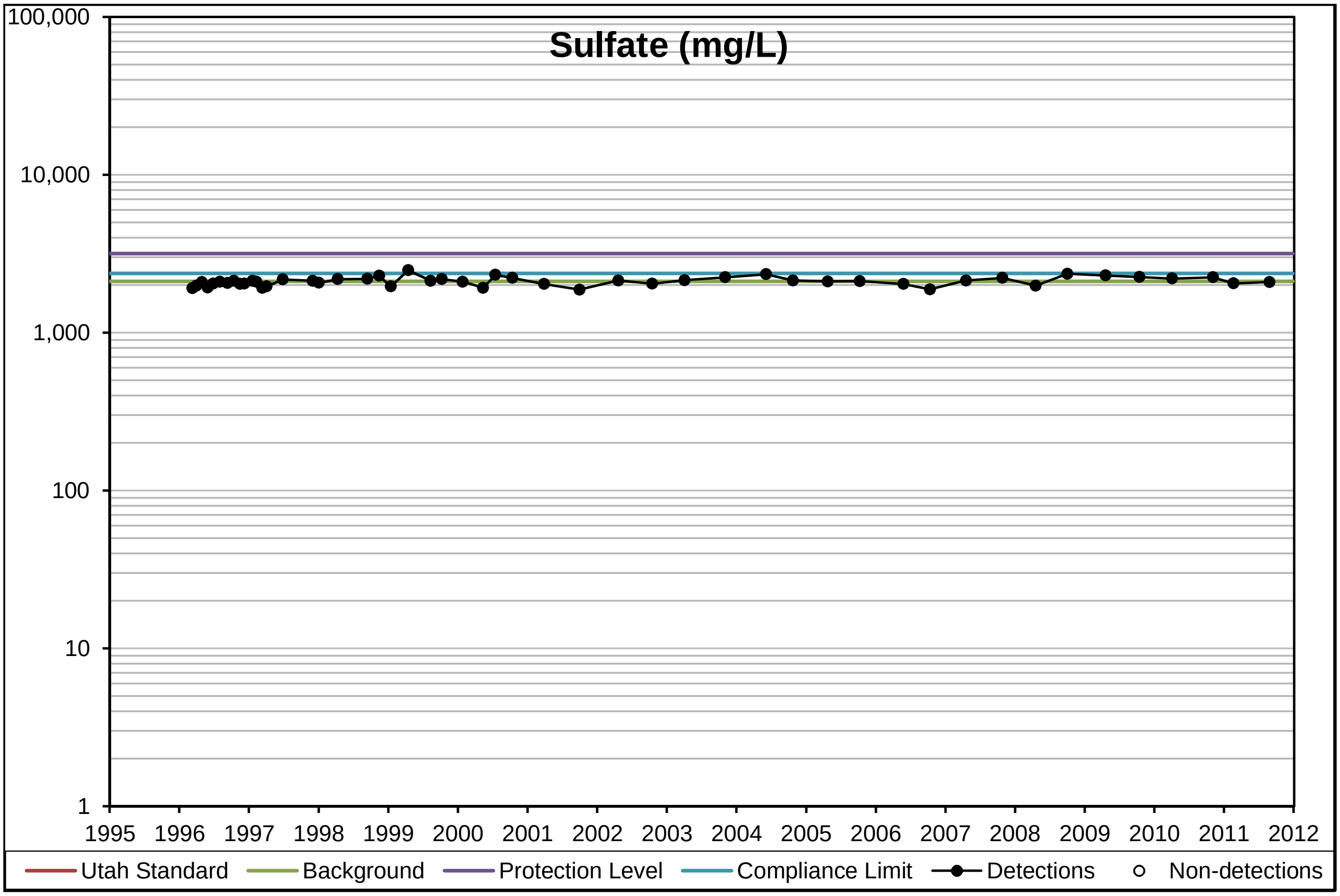
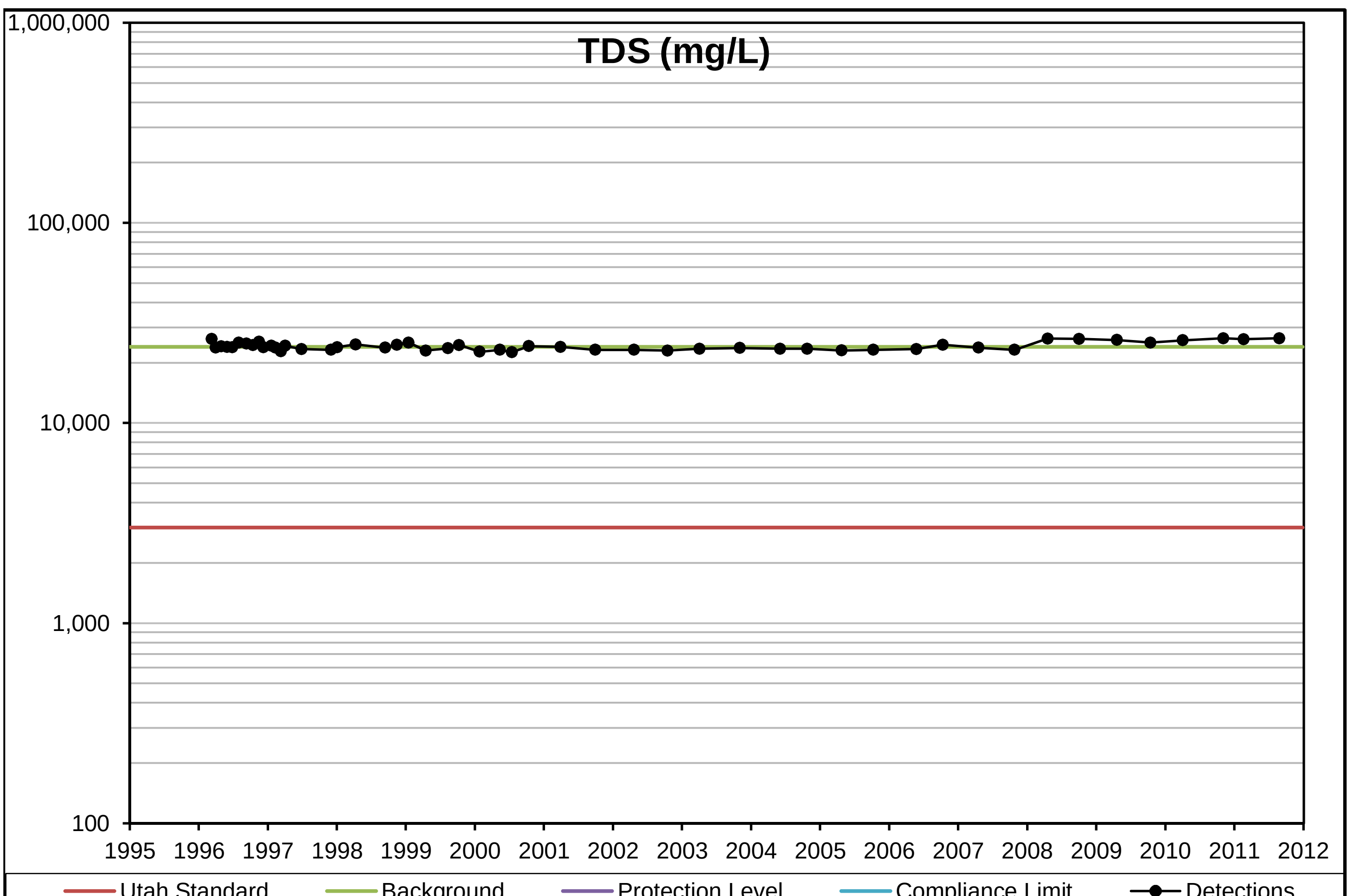
Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year



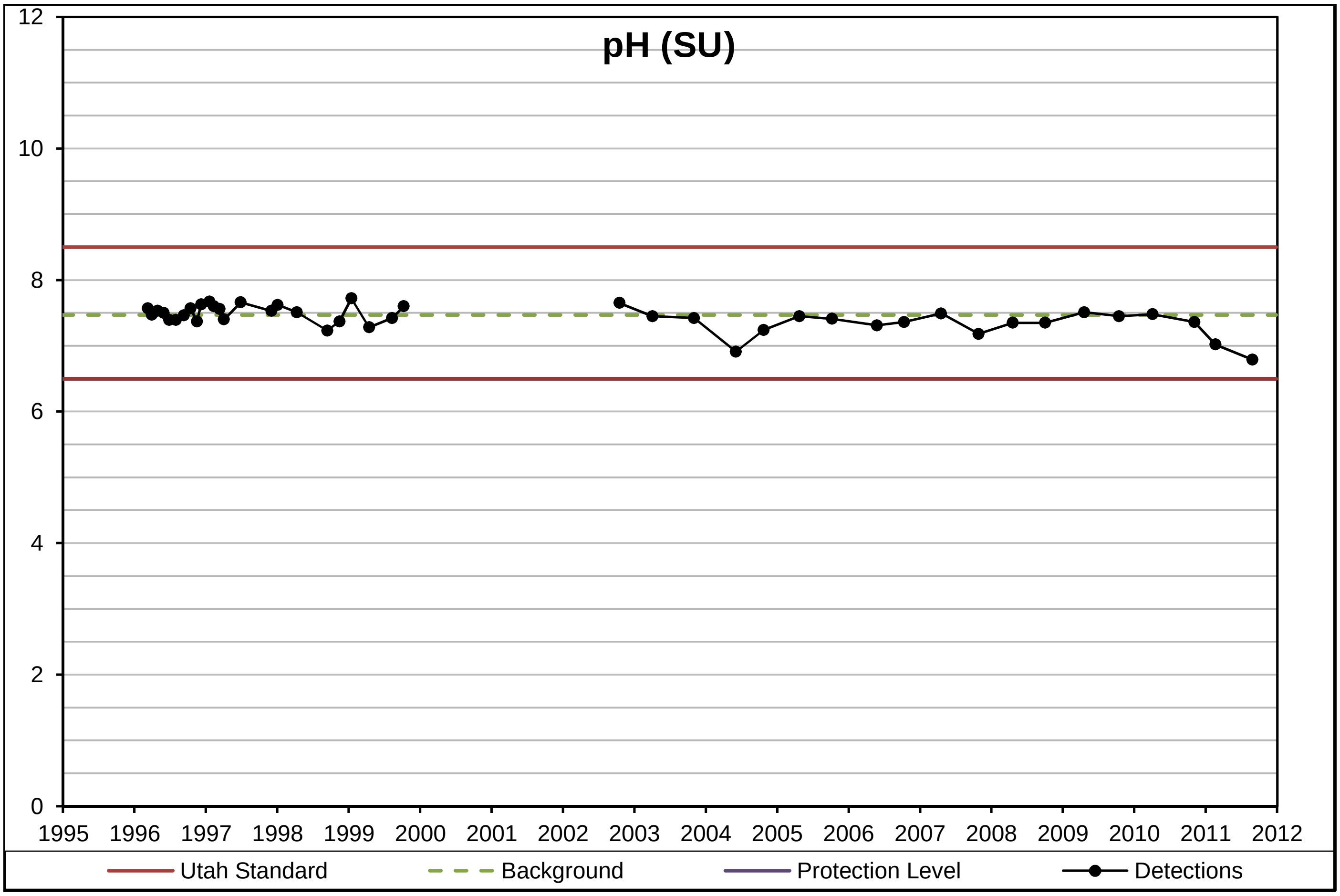


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1384B

Concentration Versus Year



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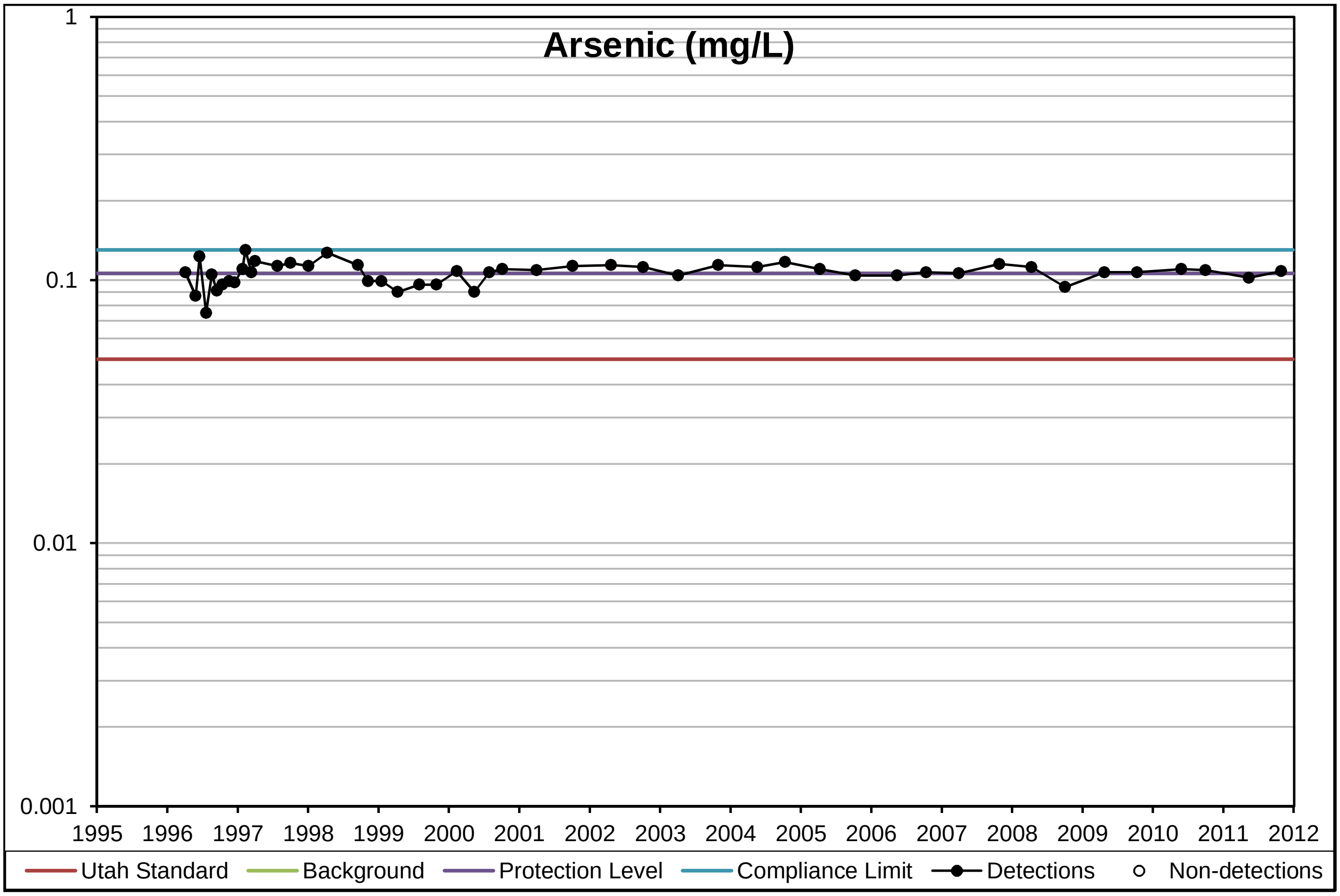
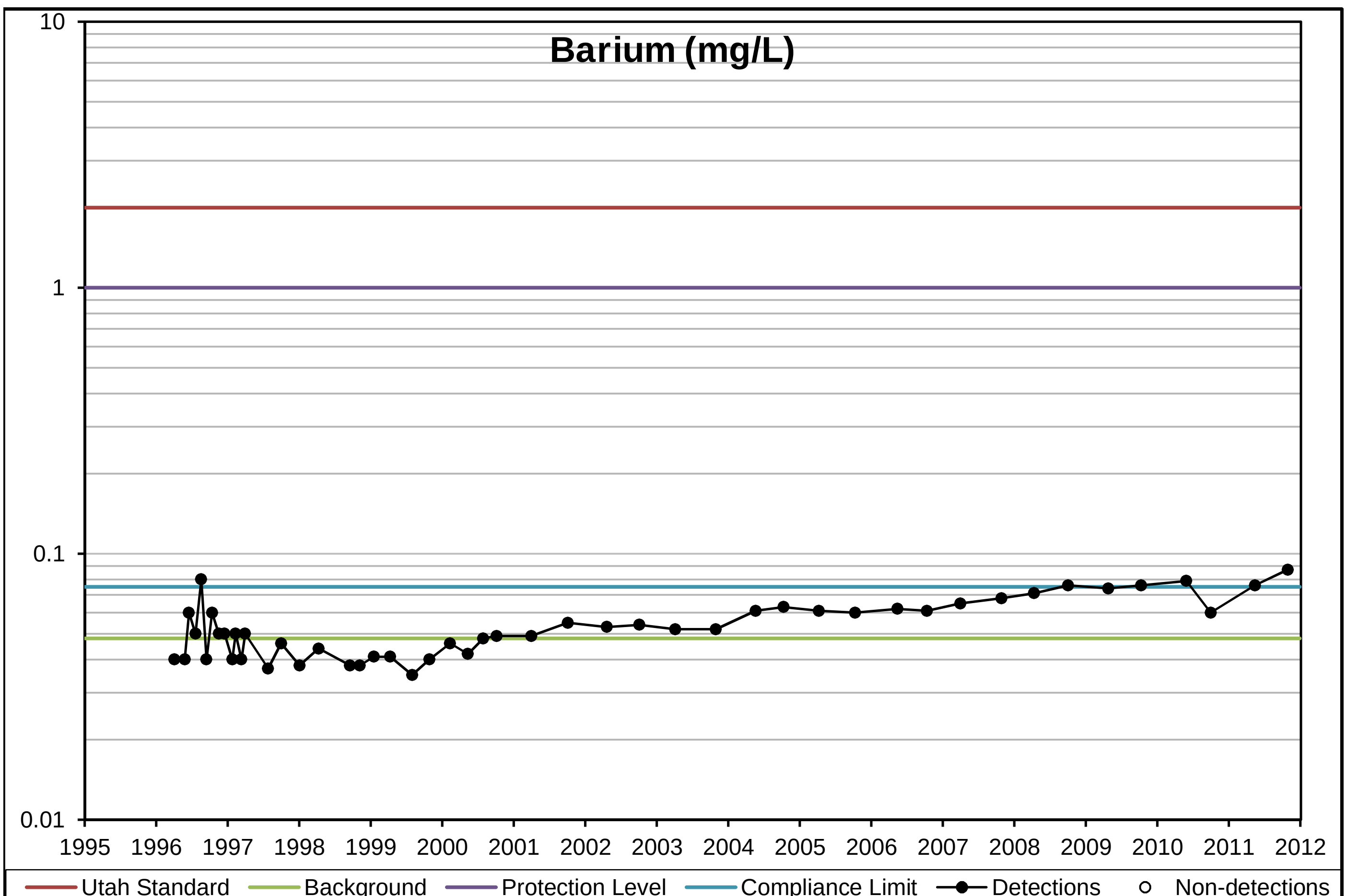
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385A

Concentration Versus Year





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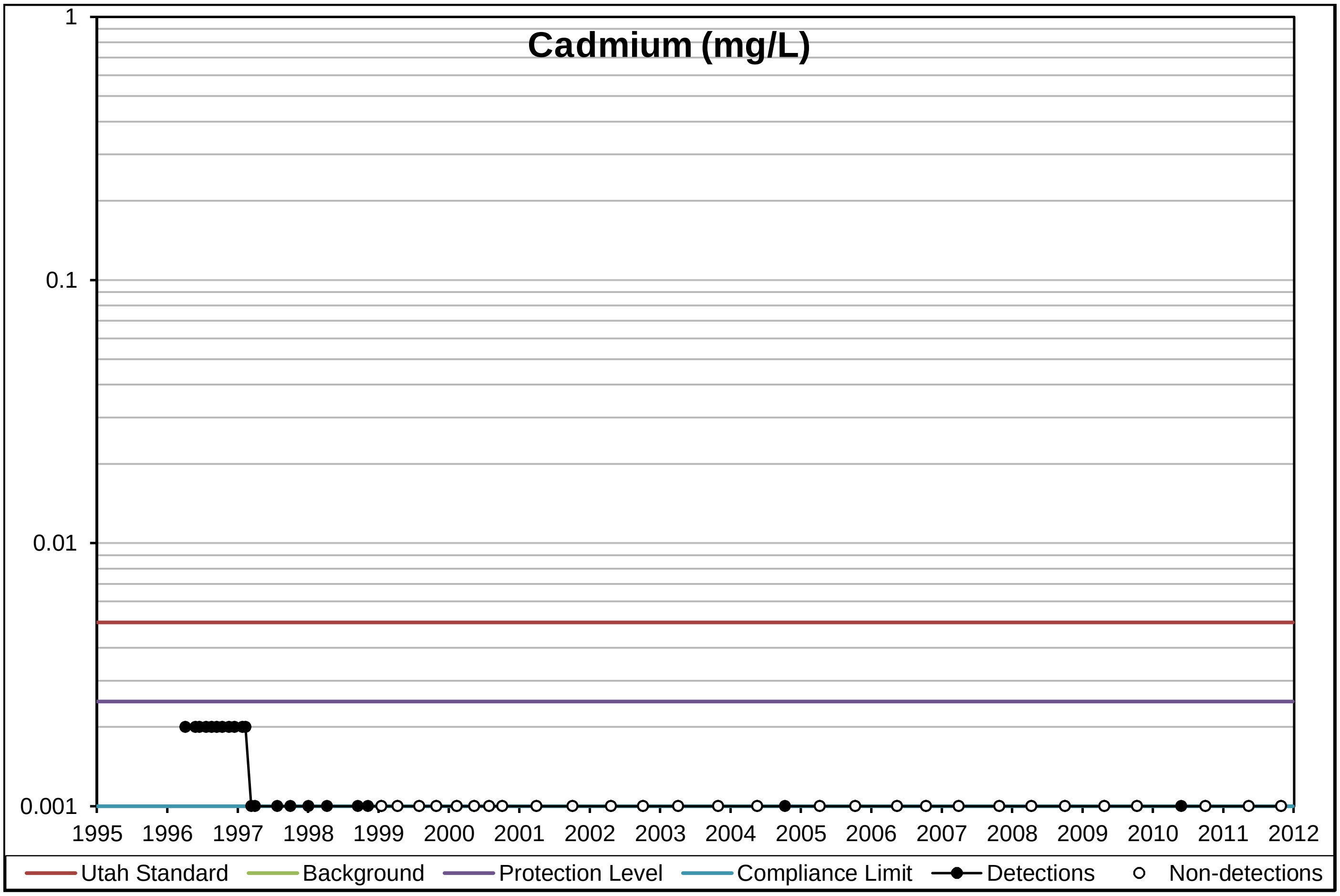
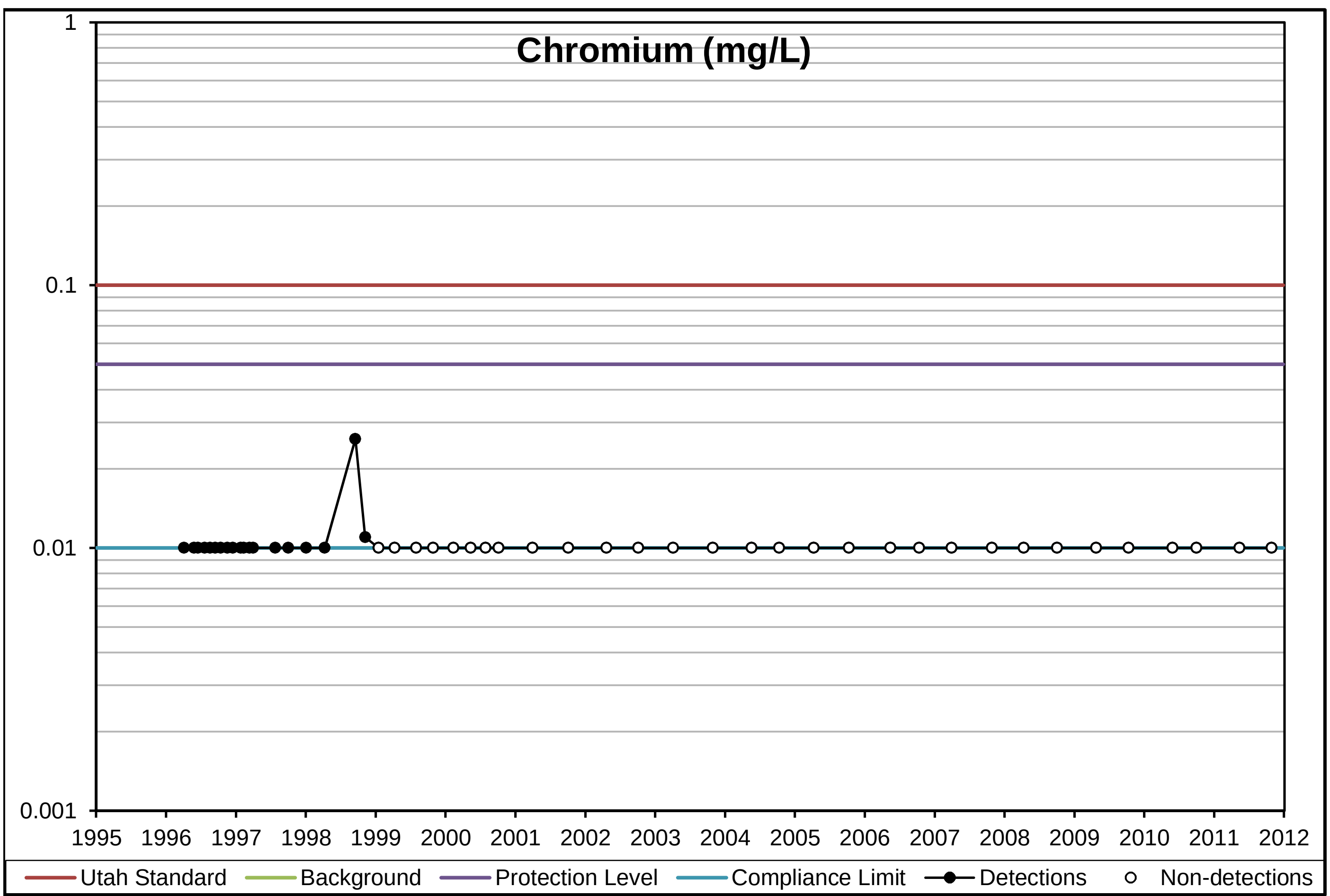
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385A

Concentration Versus Year





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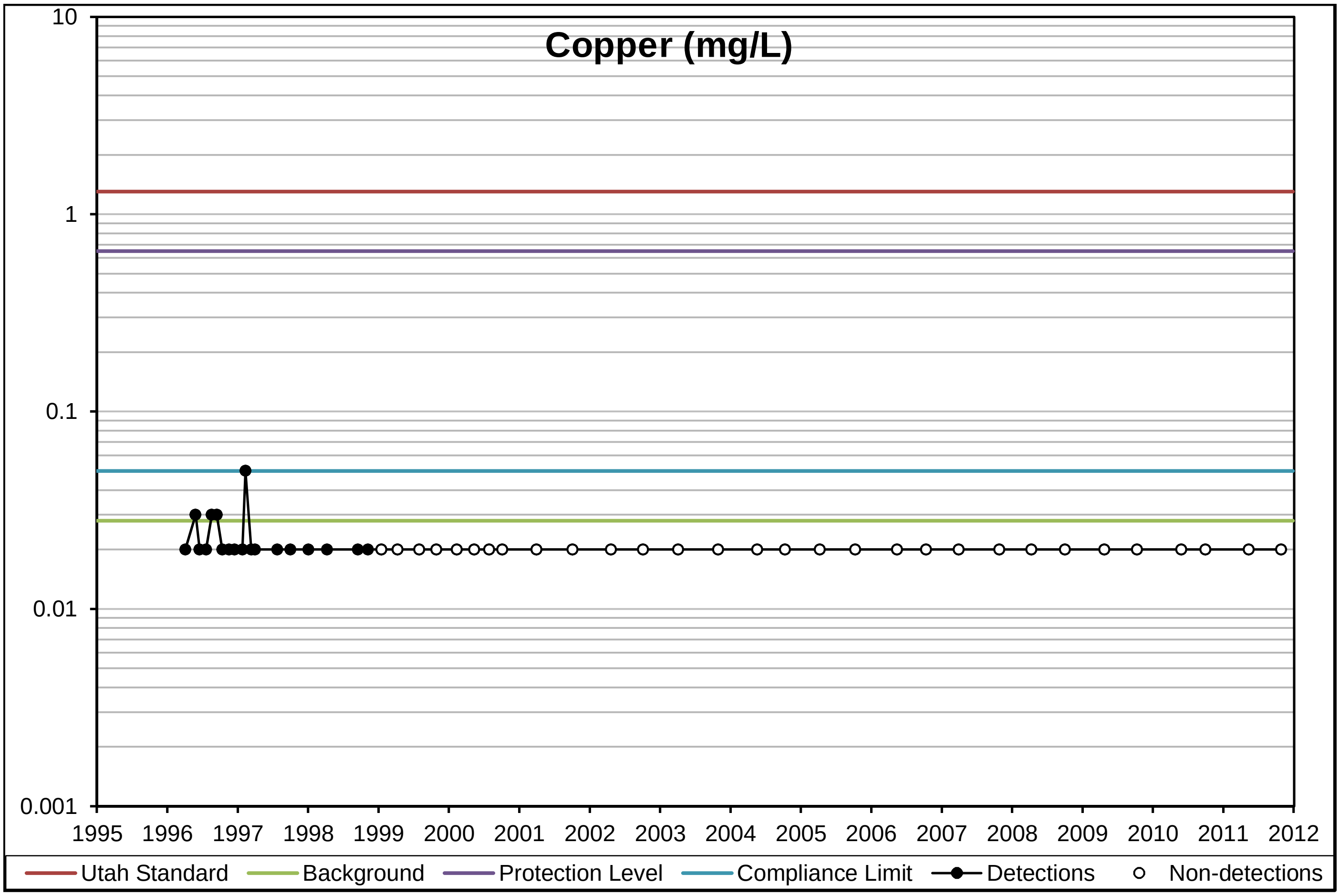
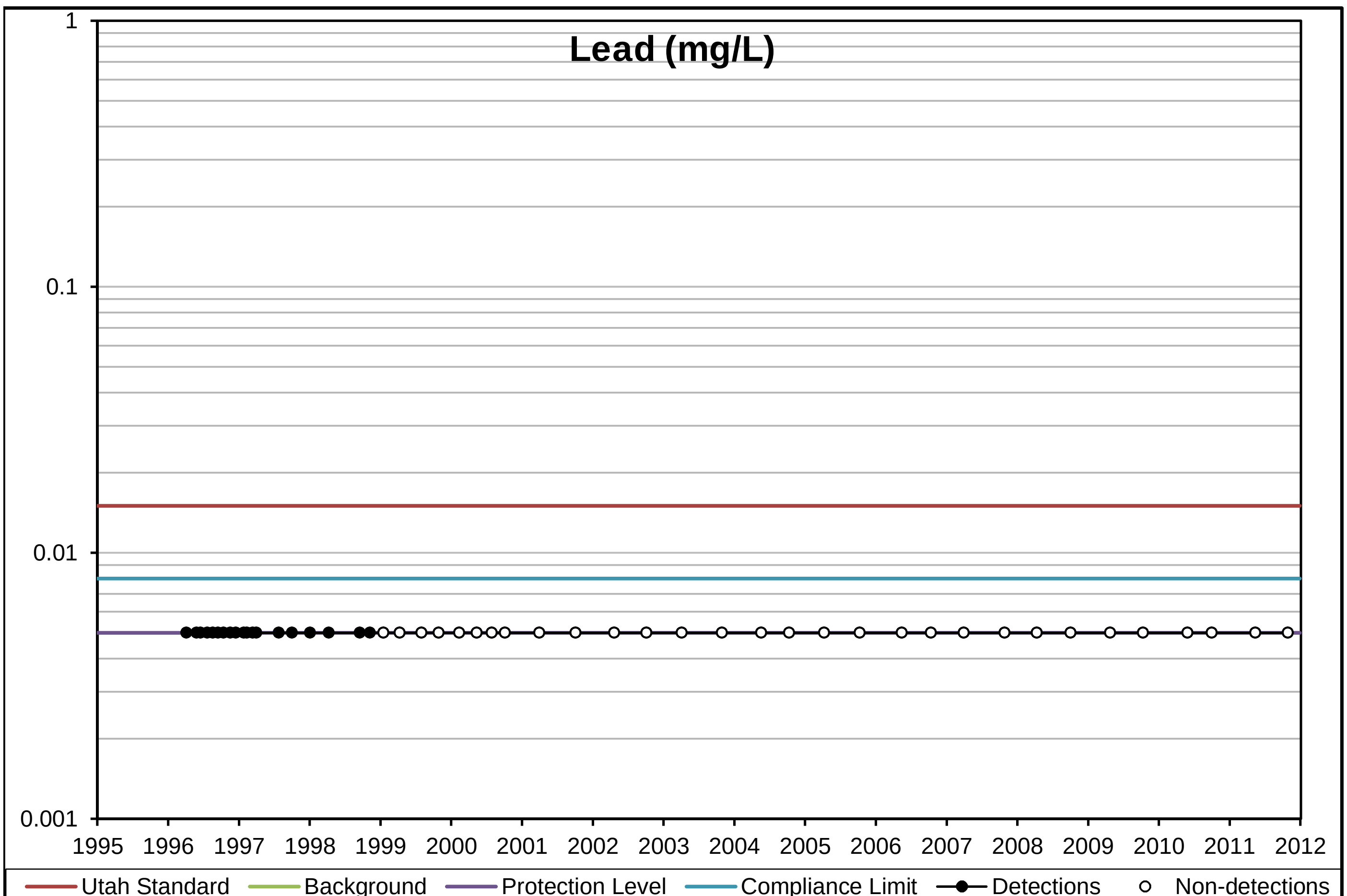
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385A

Concentration Versus Year





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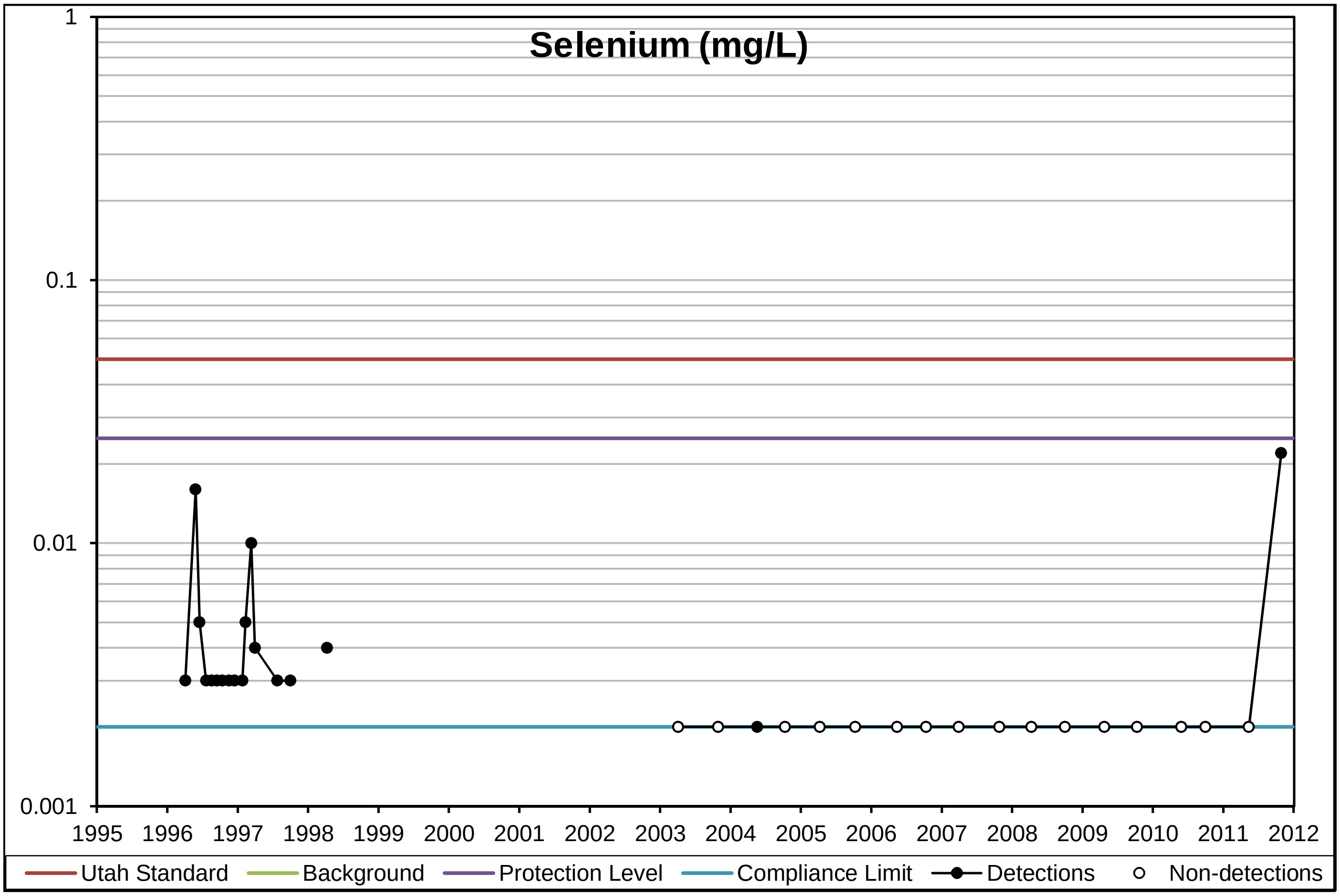
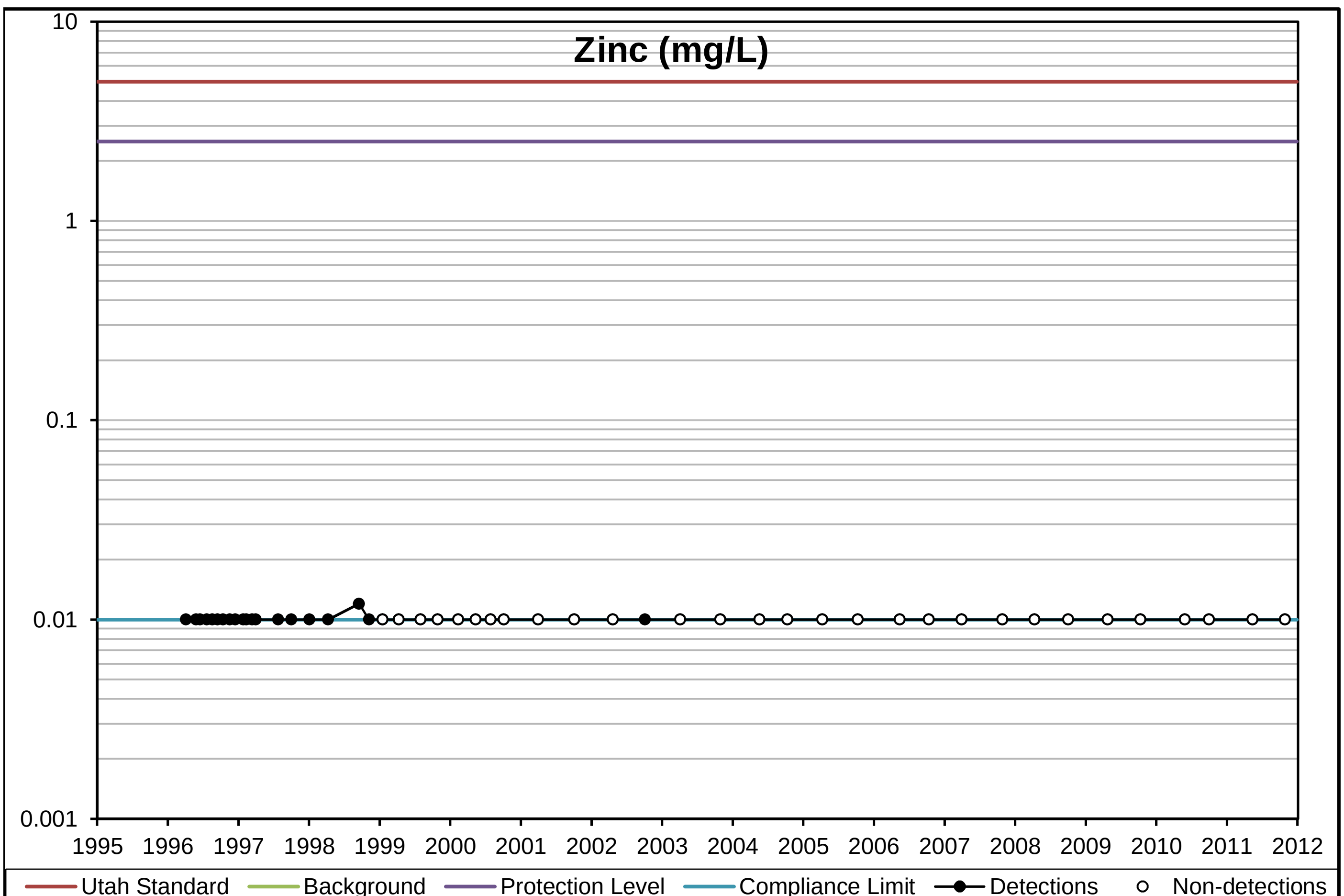
NET1385A

Concentration Versus Year





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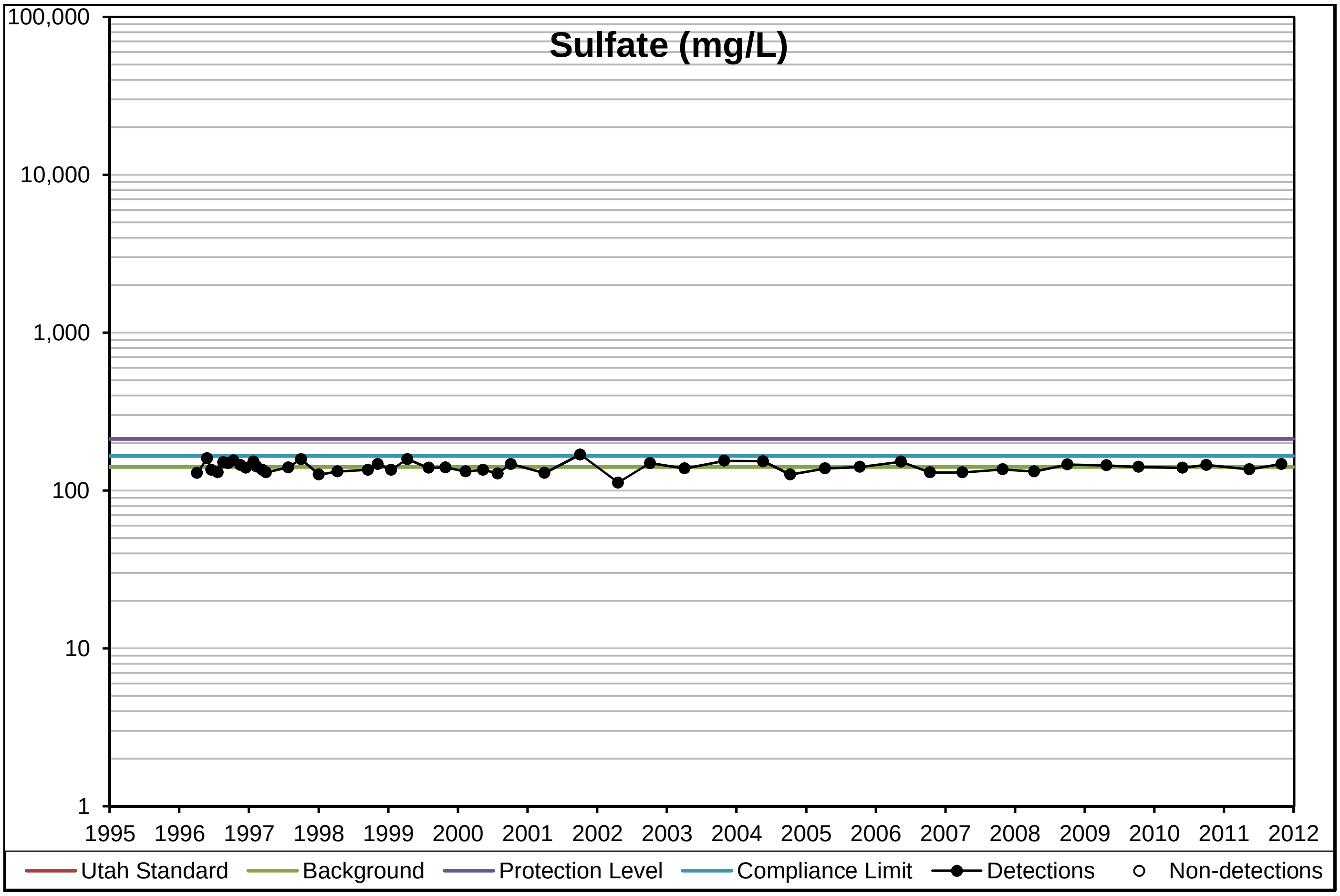

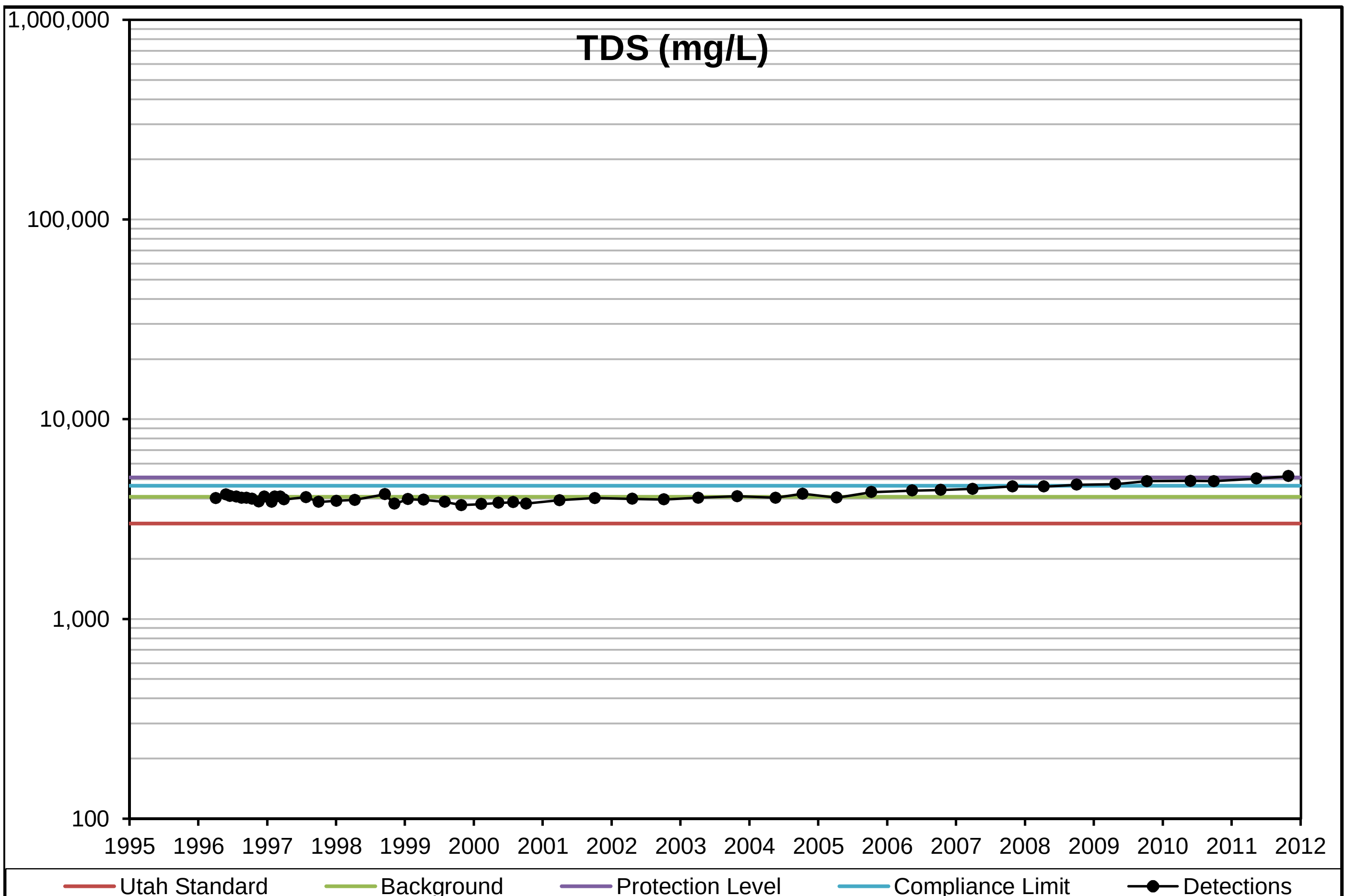

Background was not established for constituents not detected
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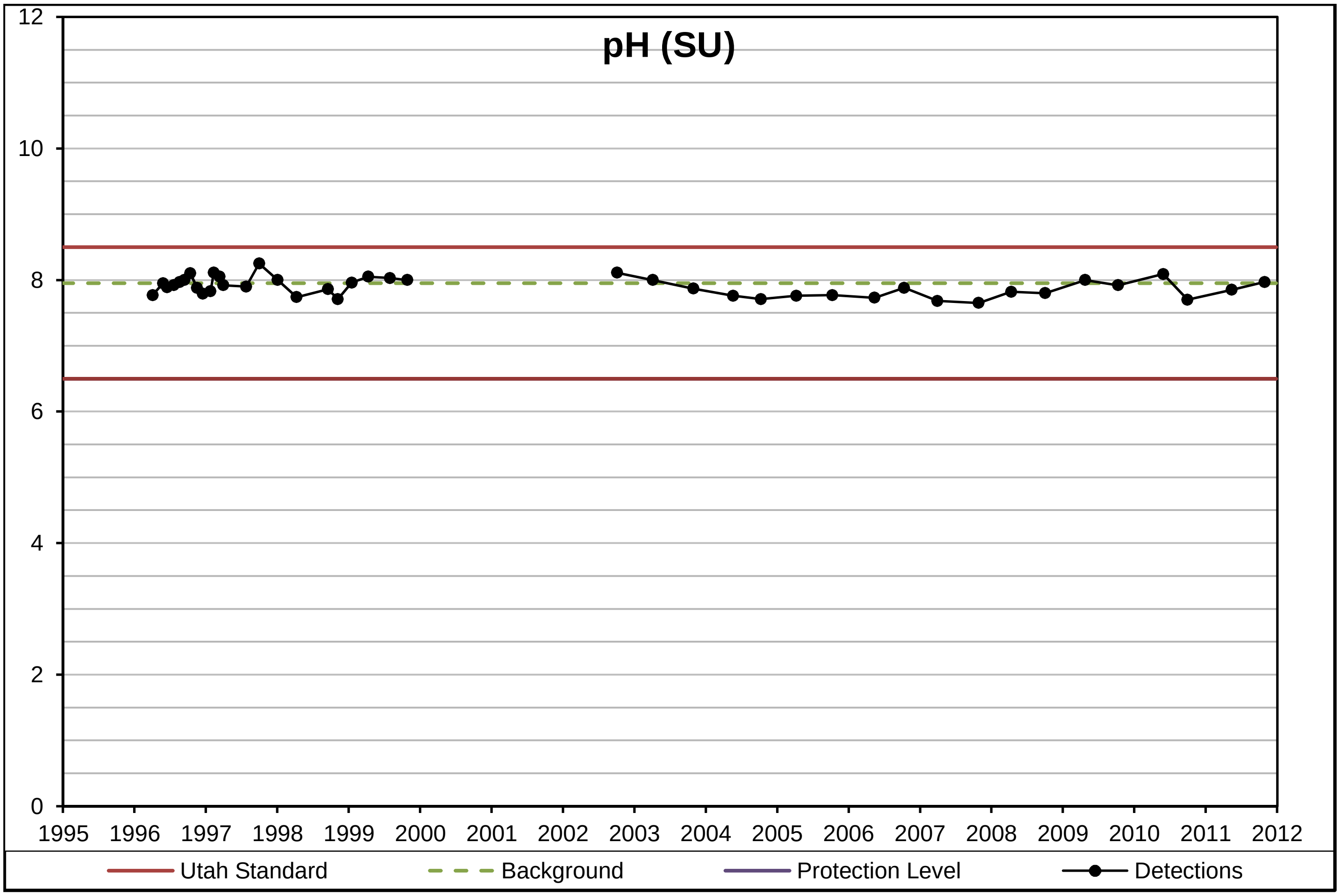
NET1385A

Concentration Versus Year



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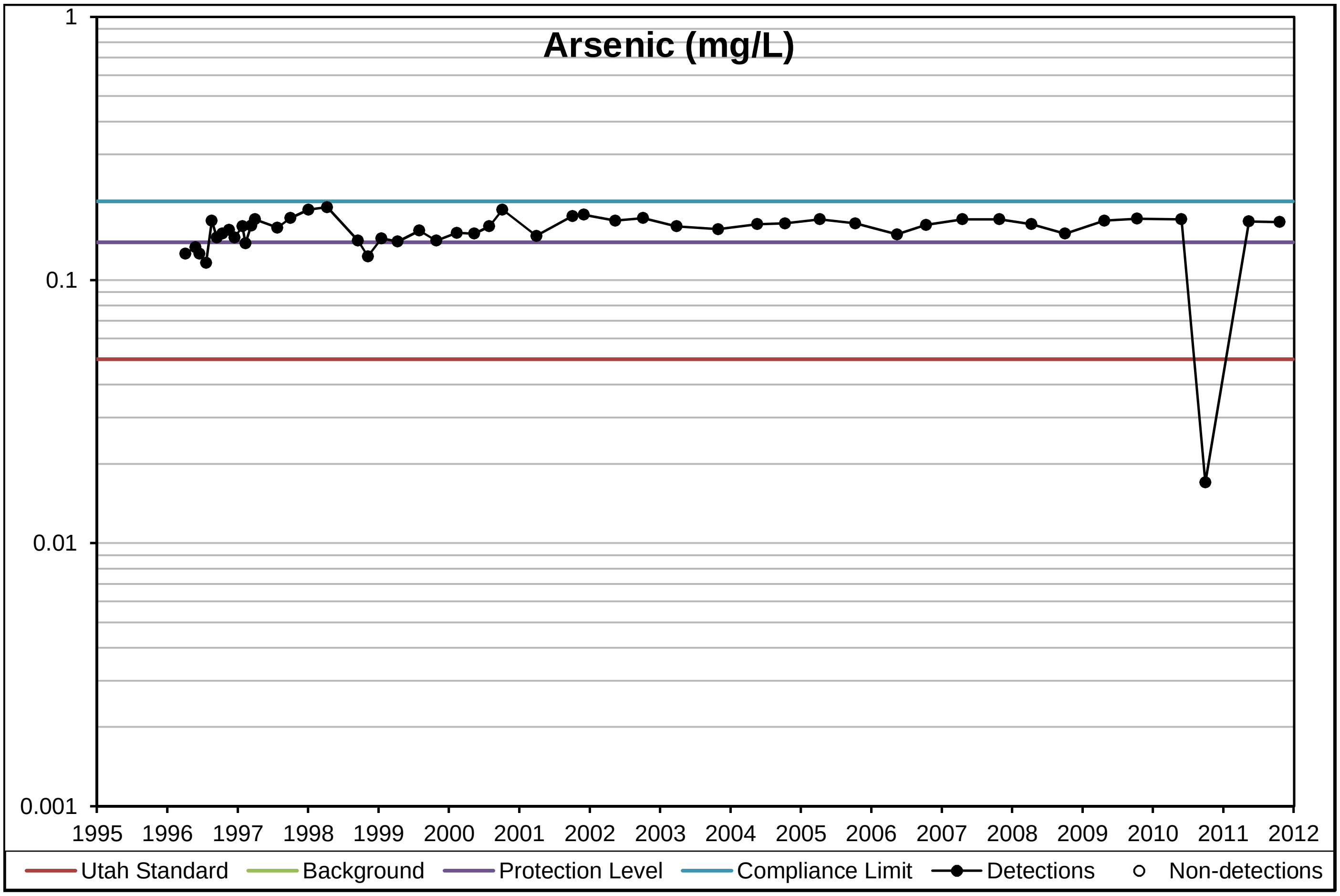
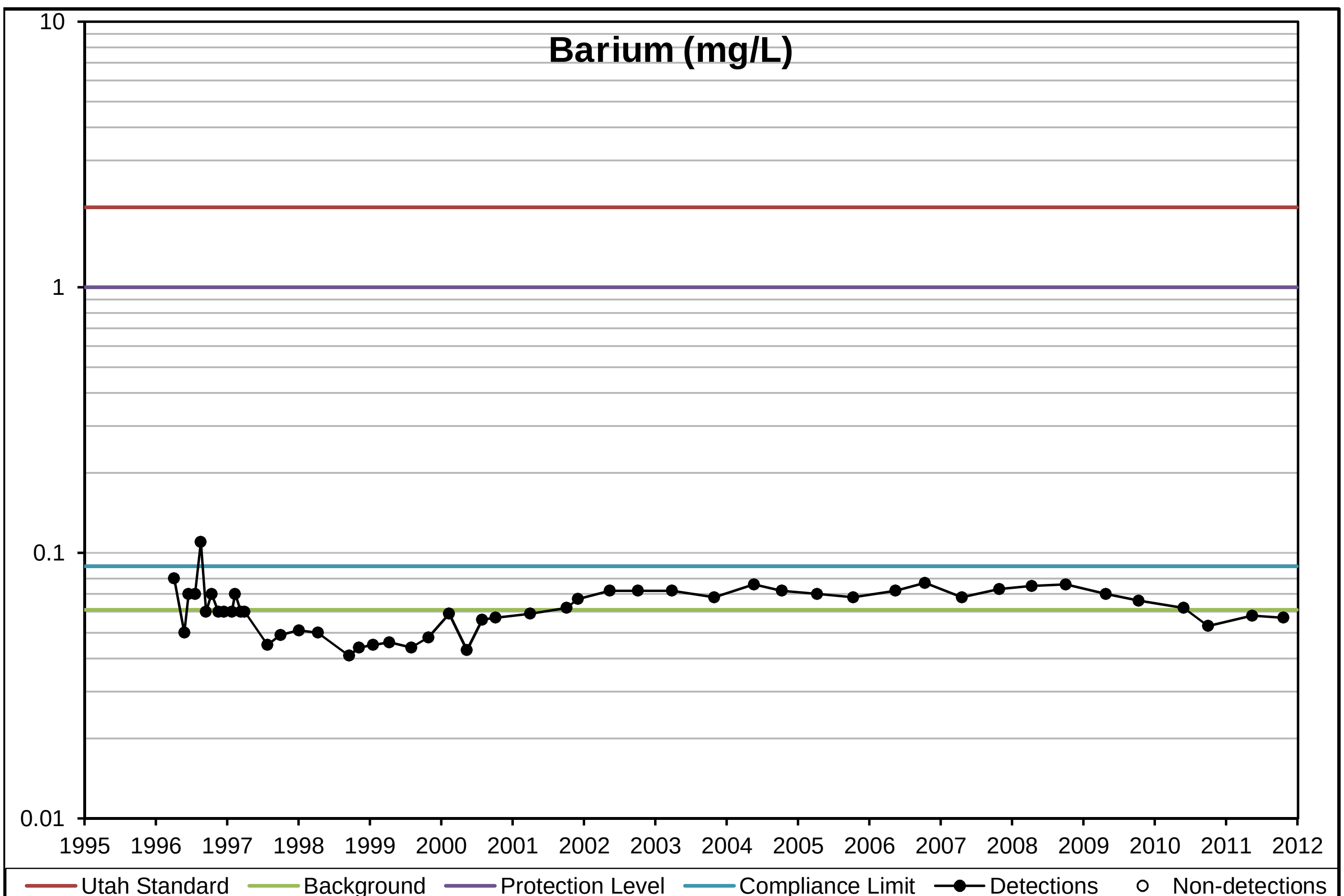
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385B

Concentration Versus Year



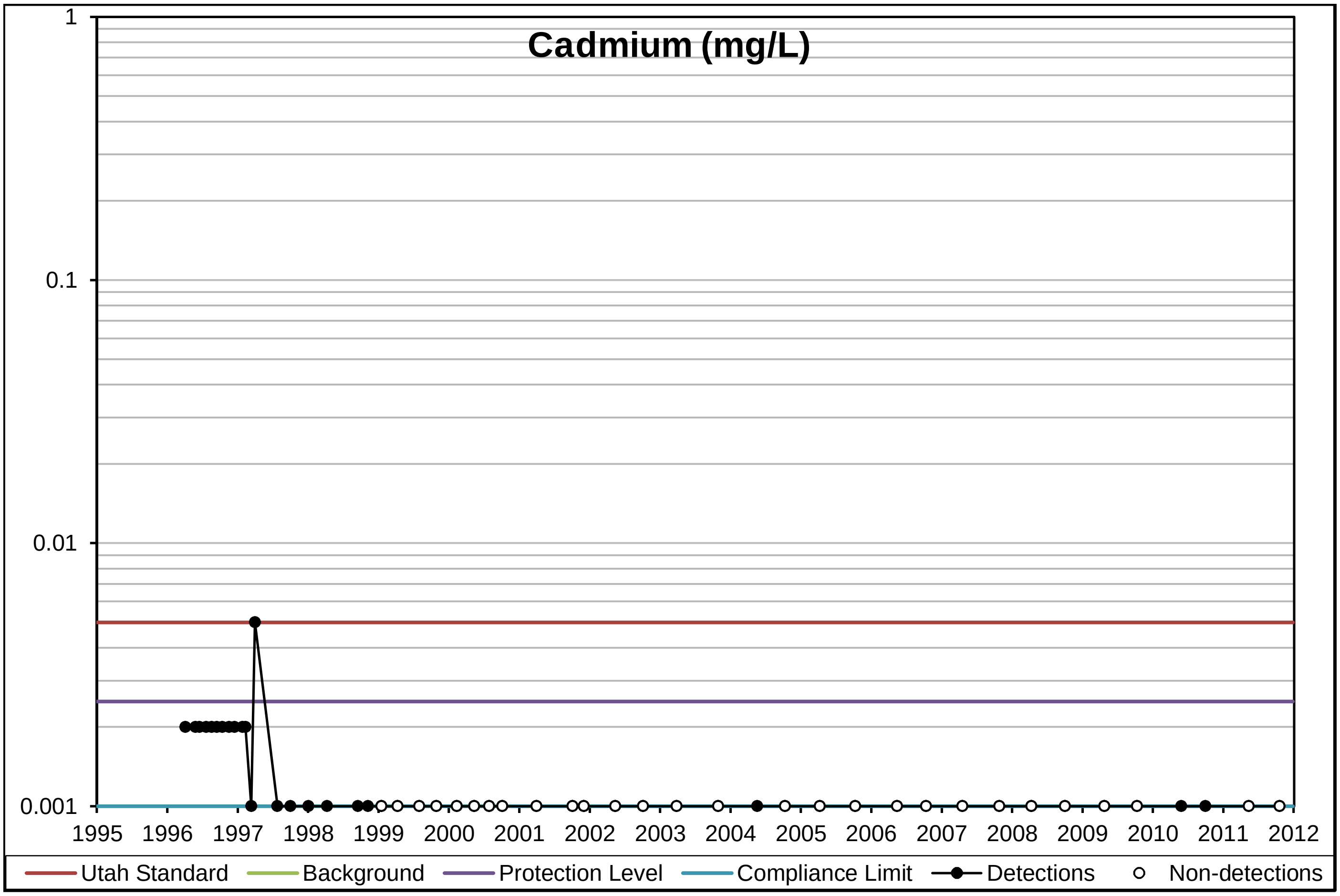


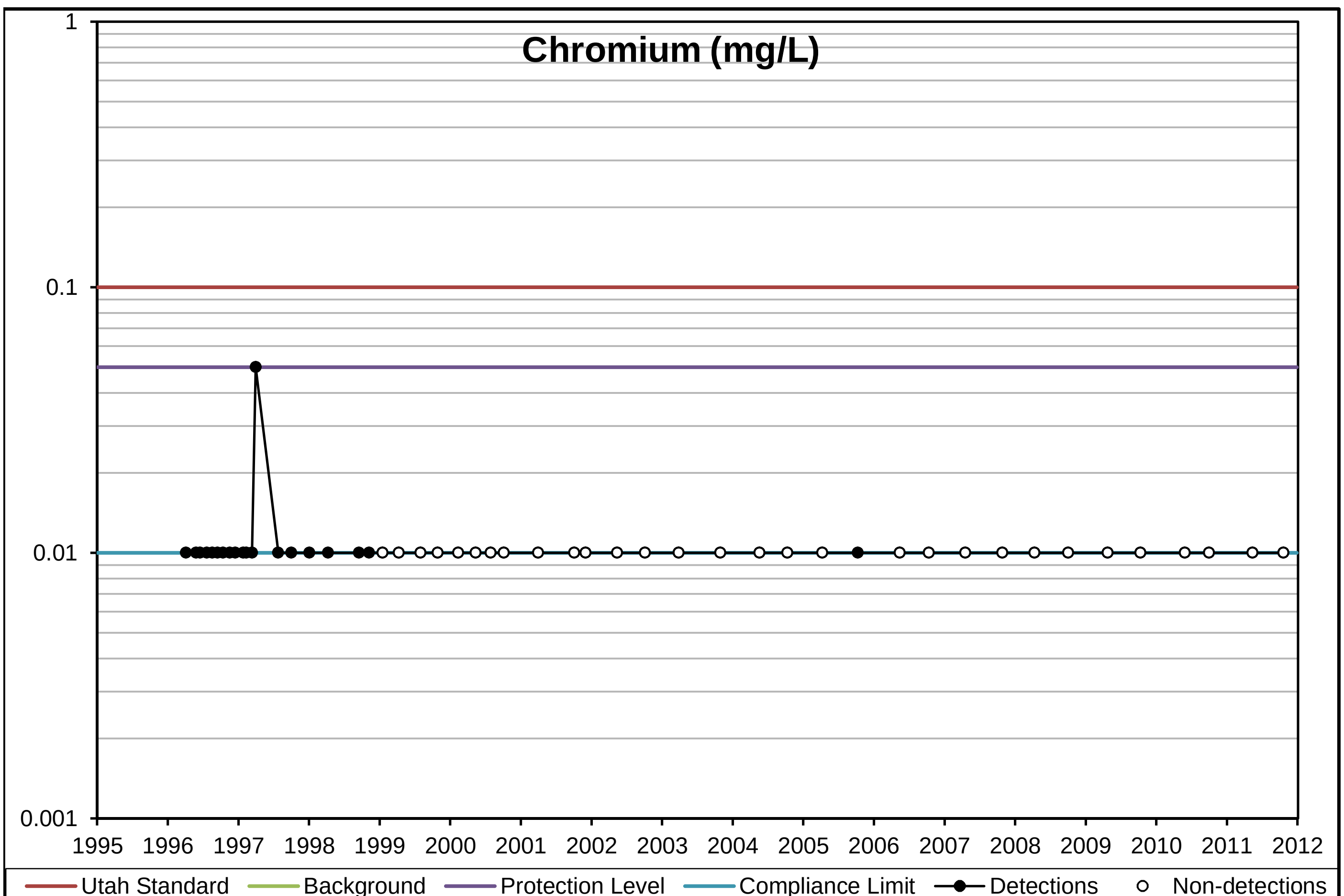
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1385B

Concentration Versus Year





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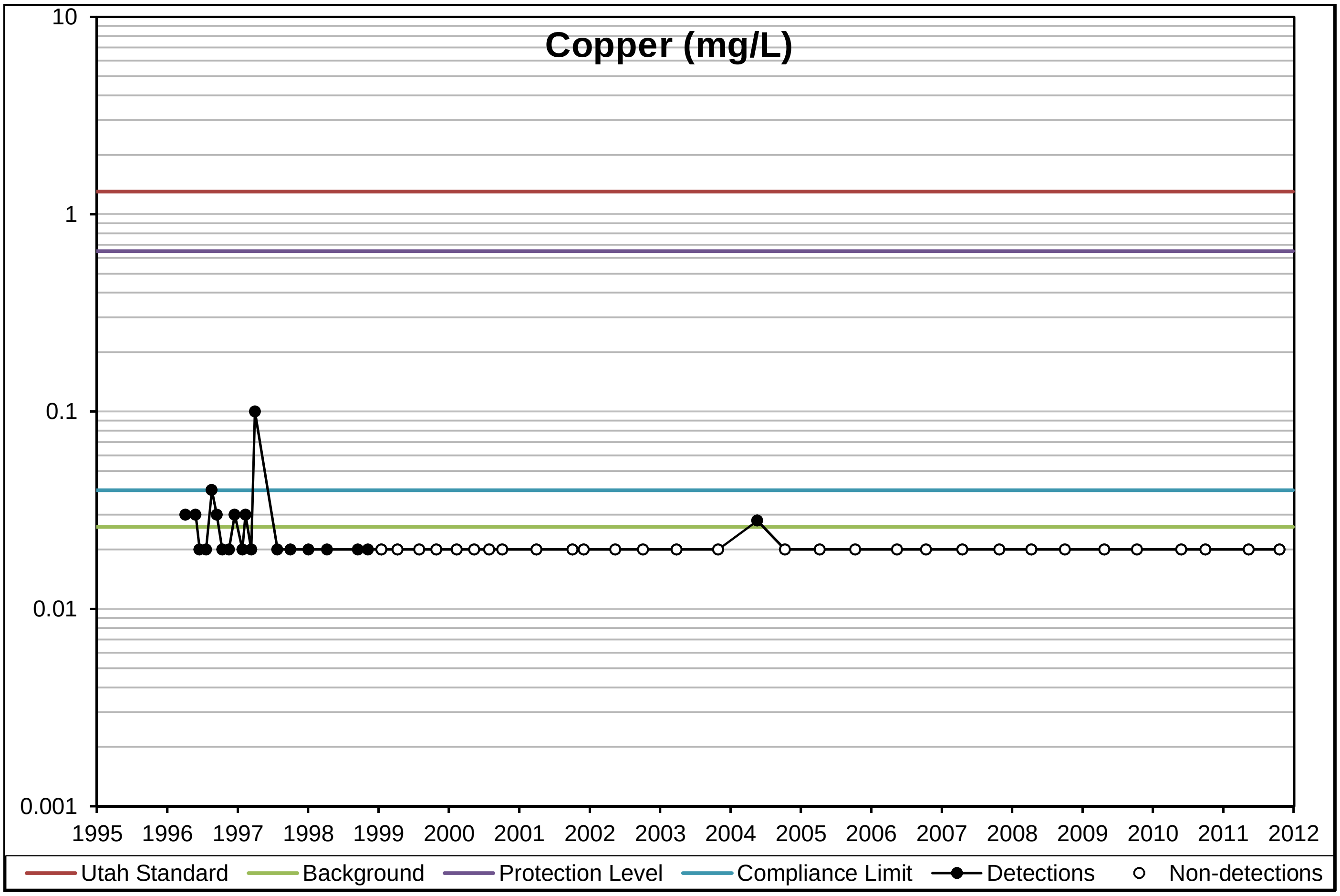
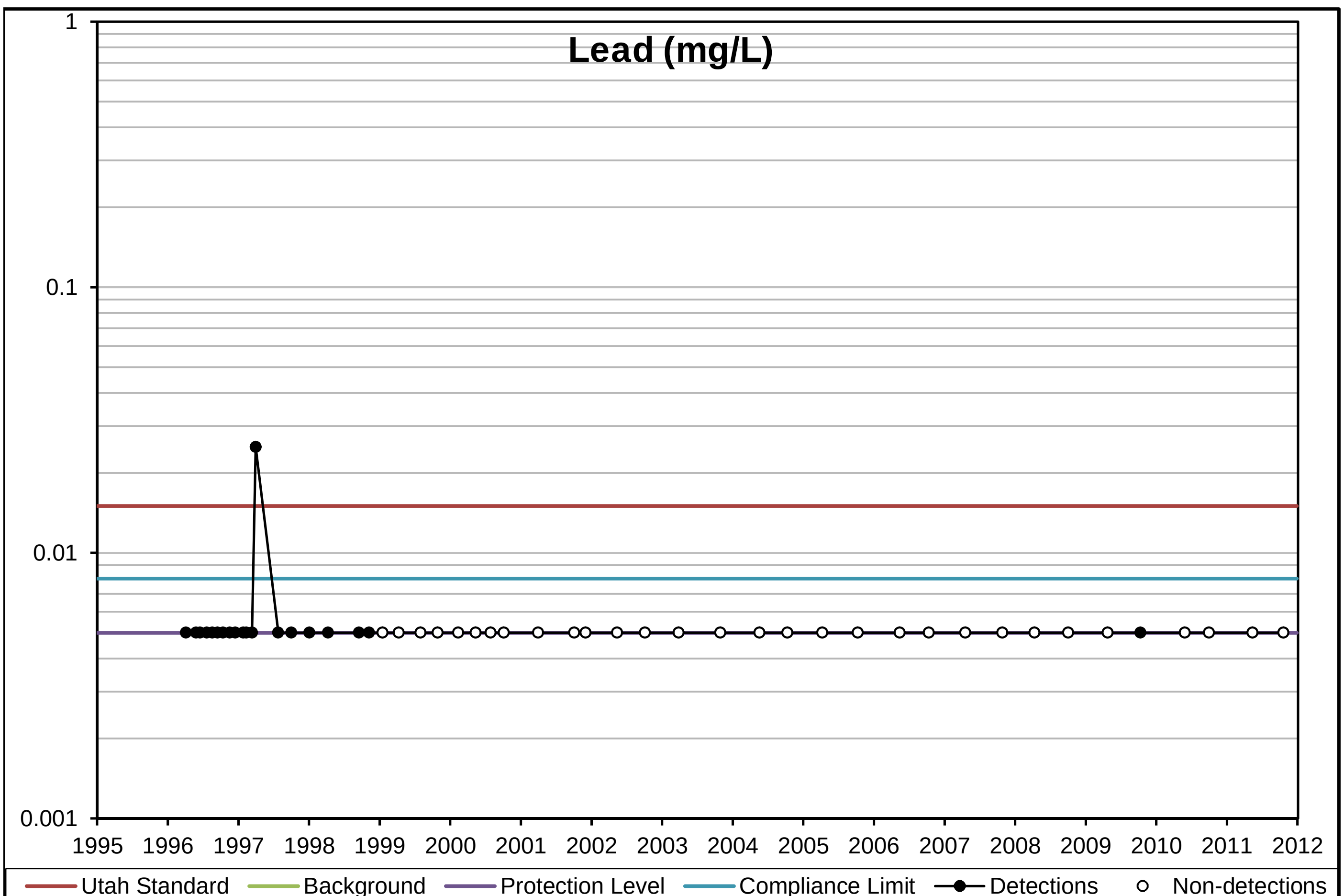
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385B

Concentration Versus Year

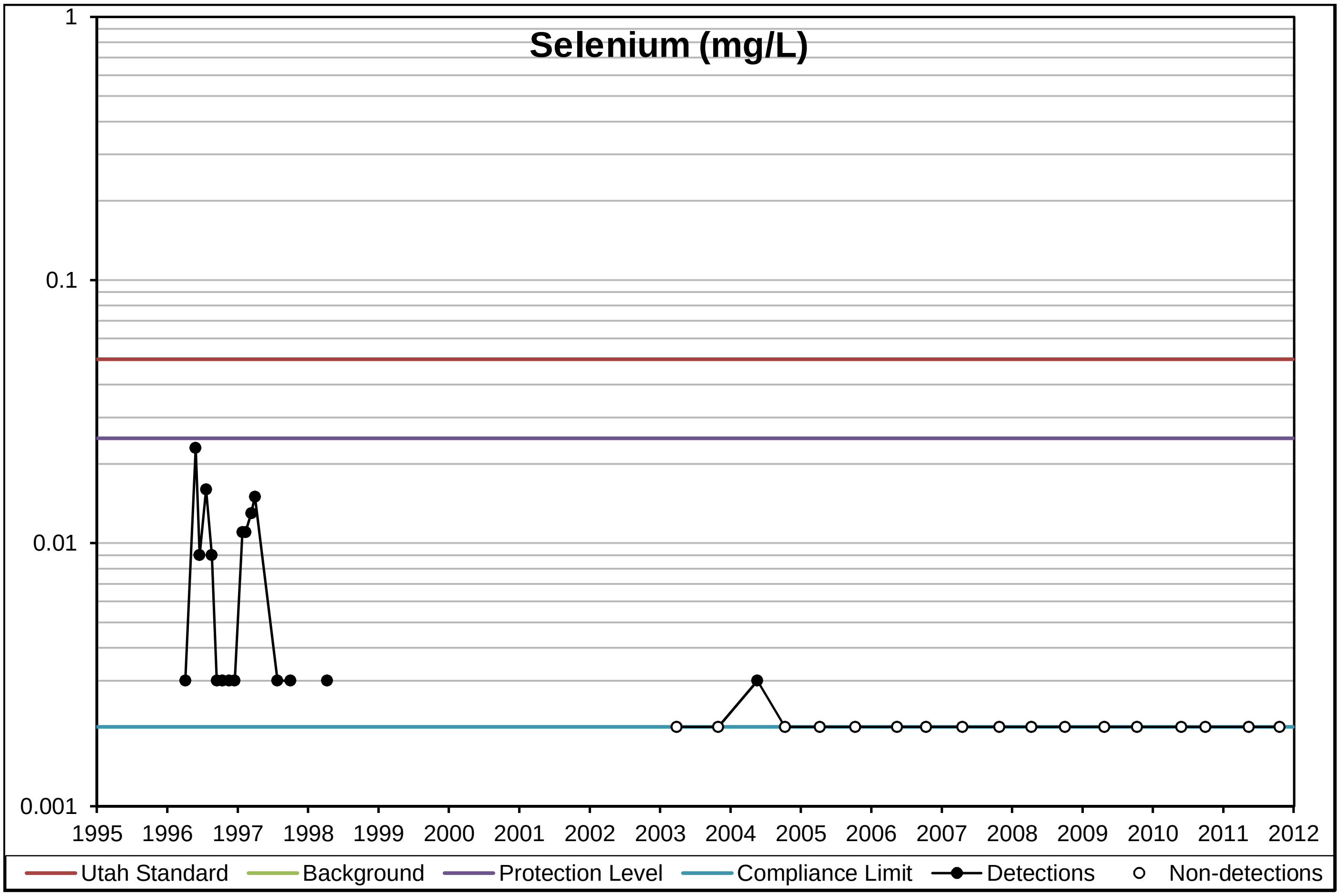


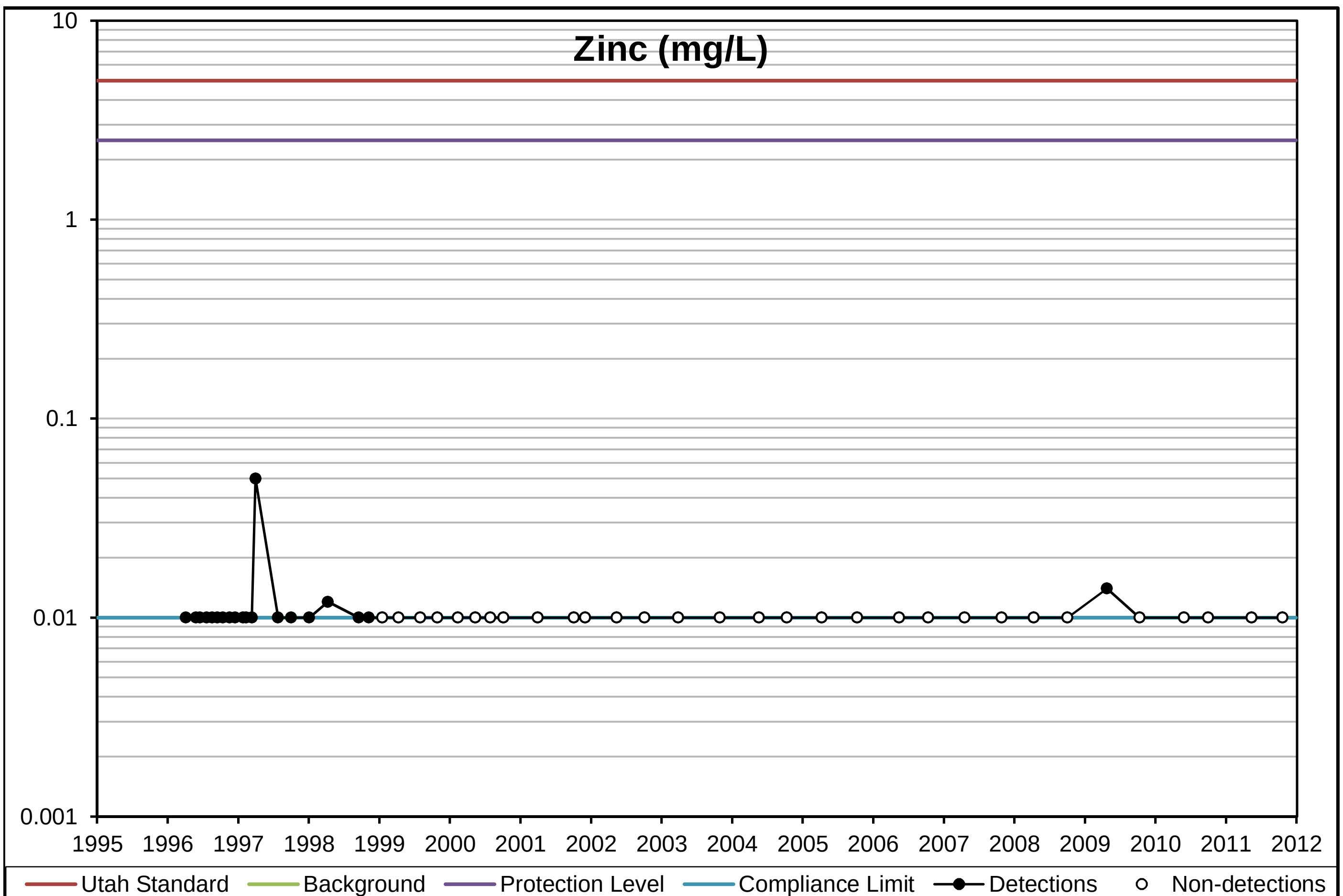


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1385B

Concentration Versus Year





Background was not established for constituents not detected

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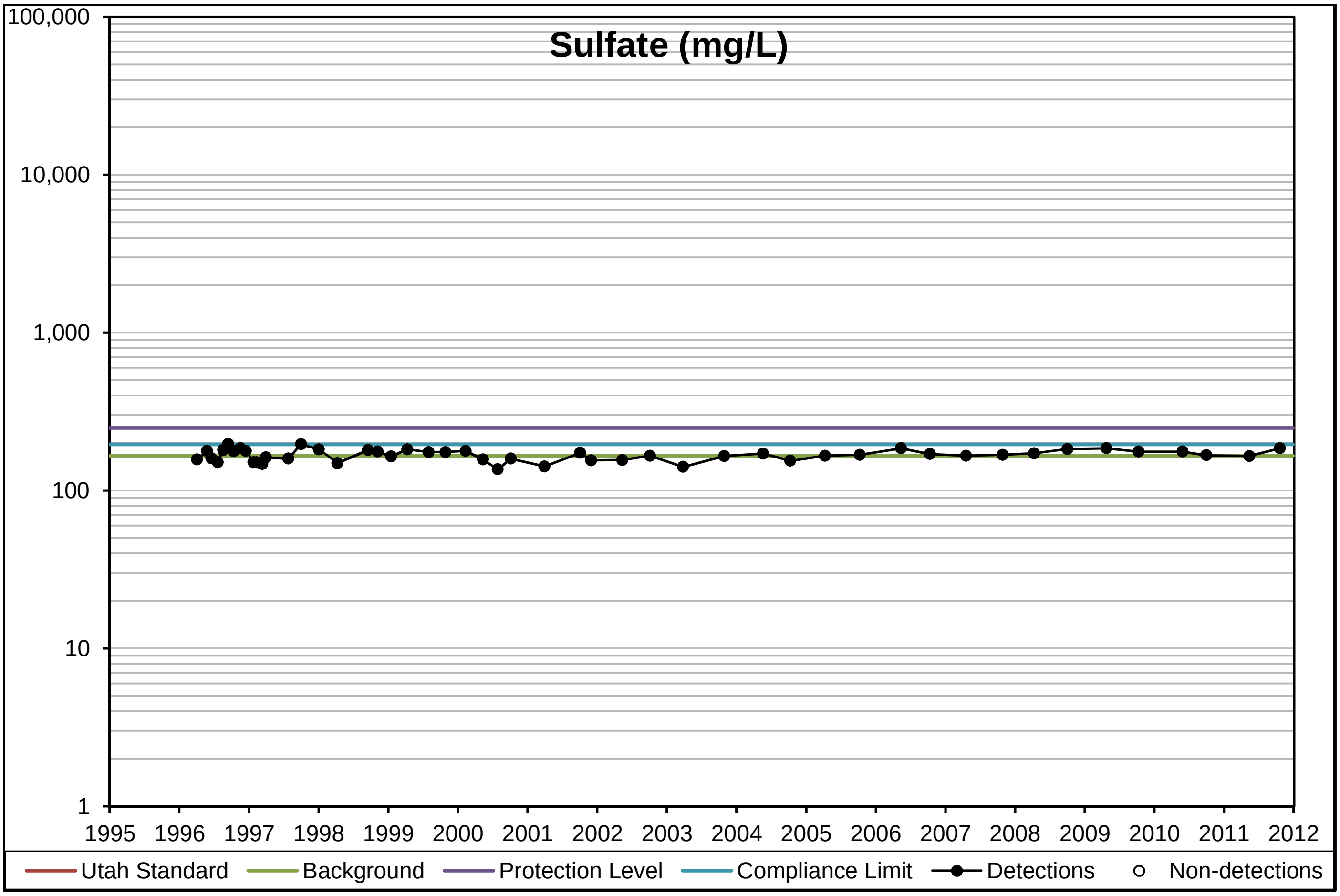
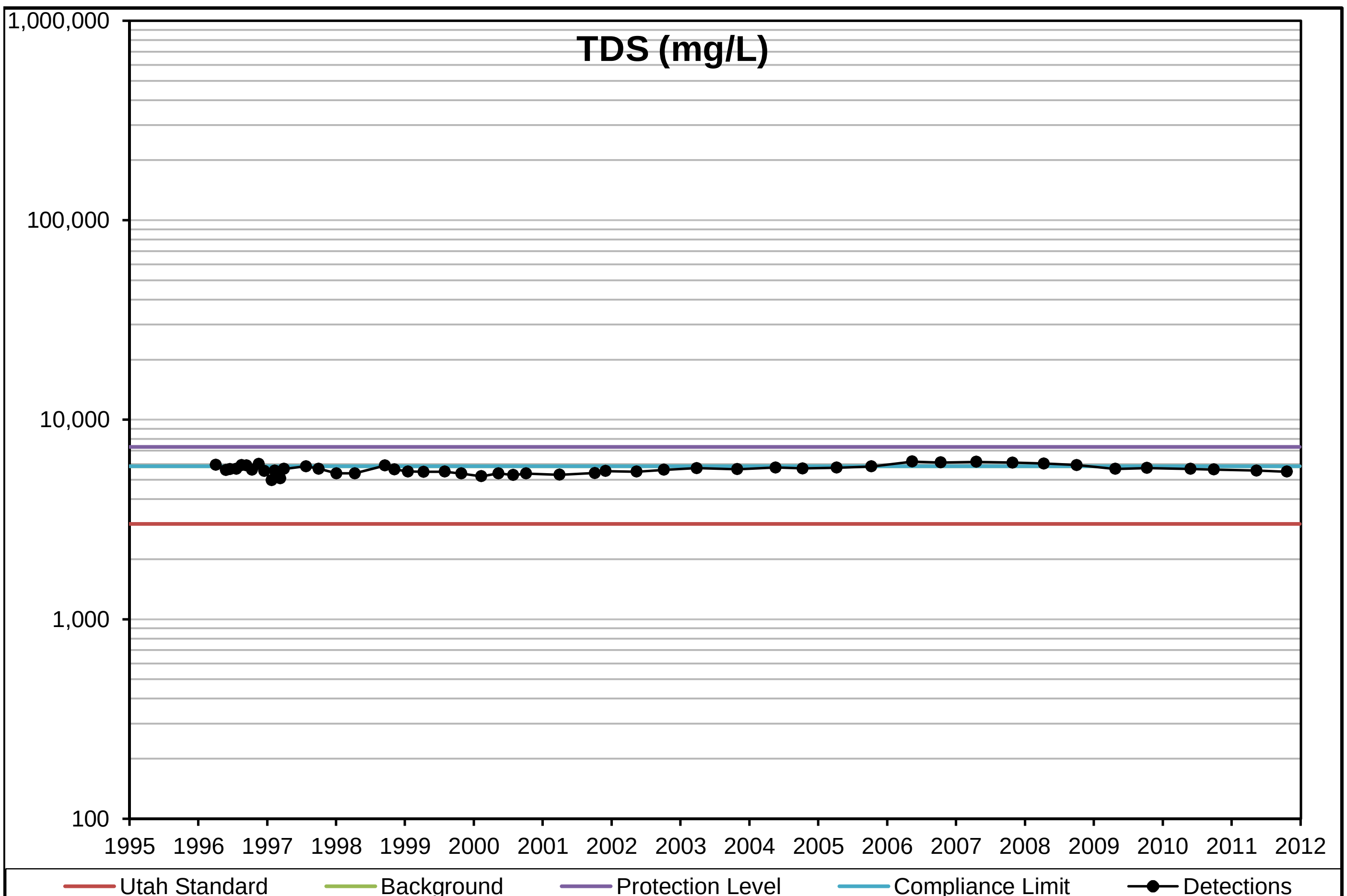
NET1385B

Concentration Versus Year



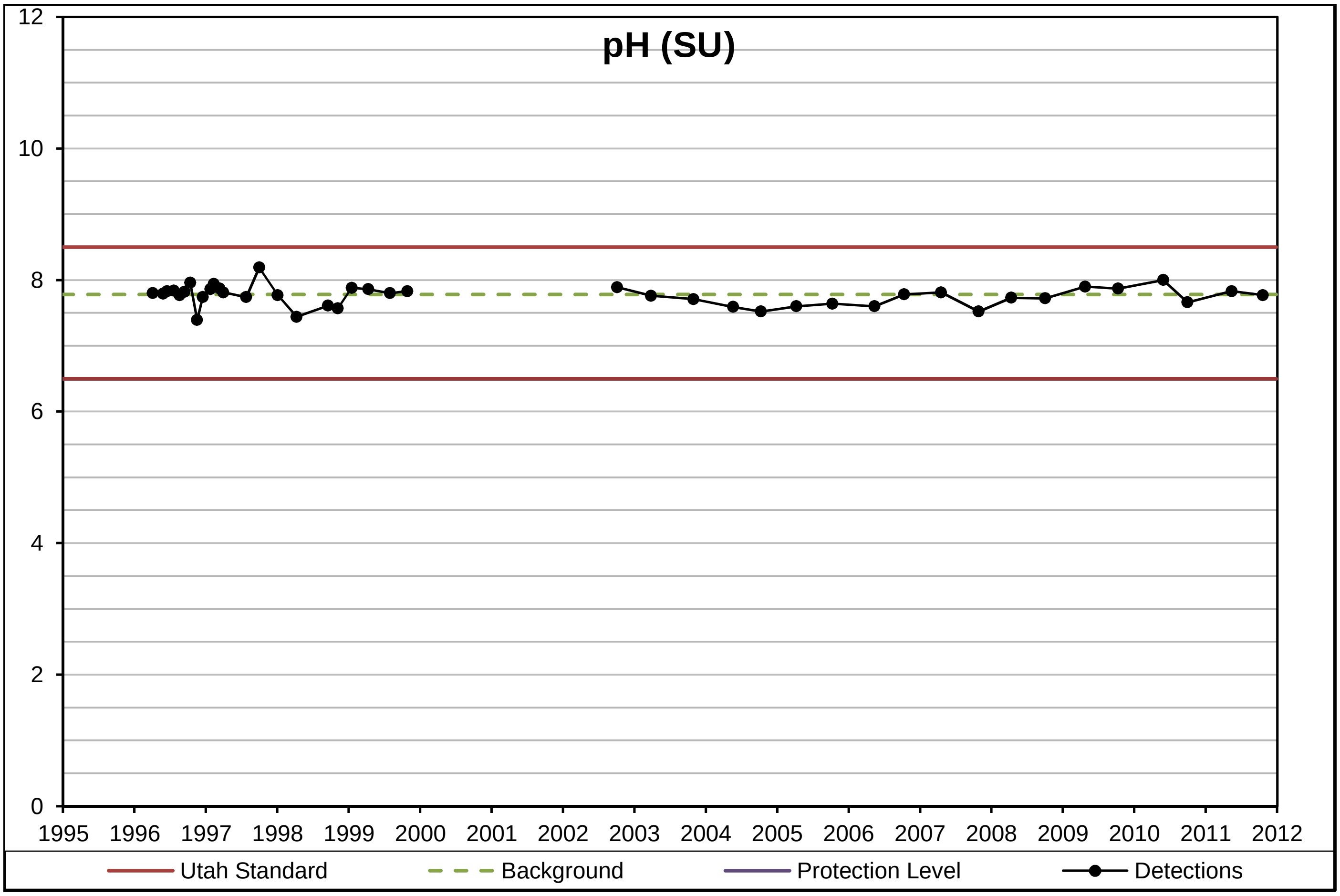


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1385B

Concentration Versus Year

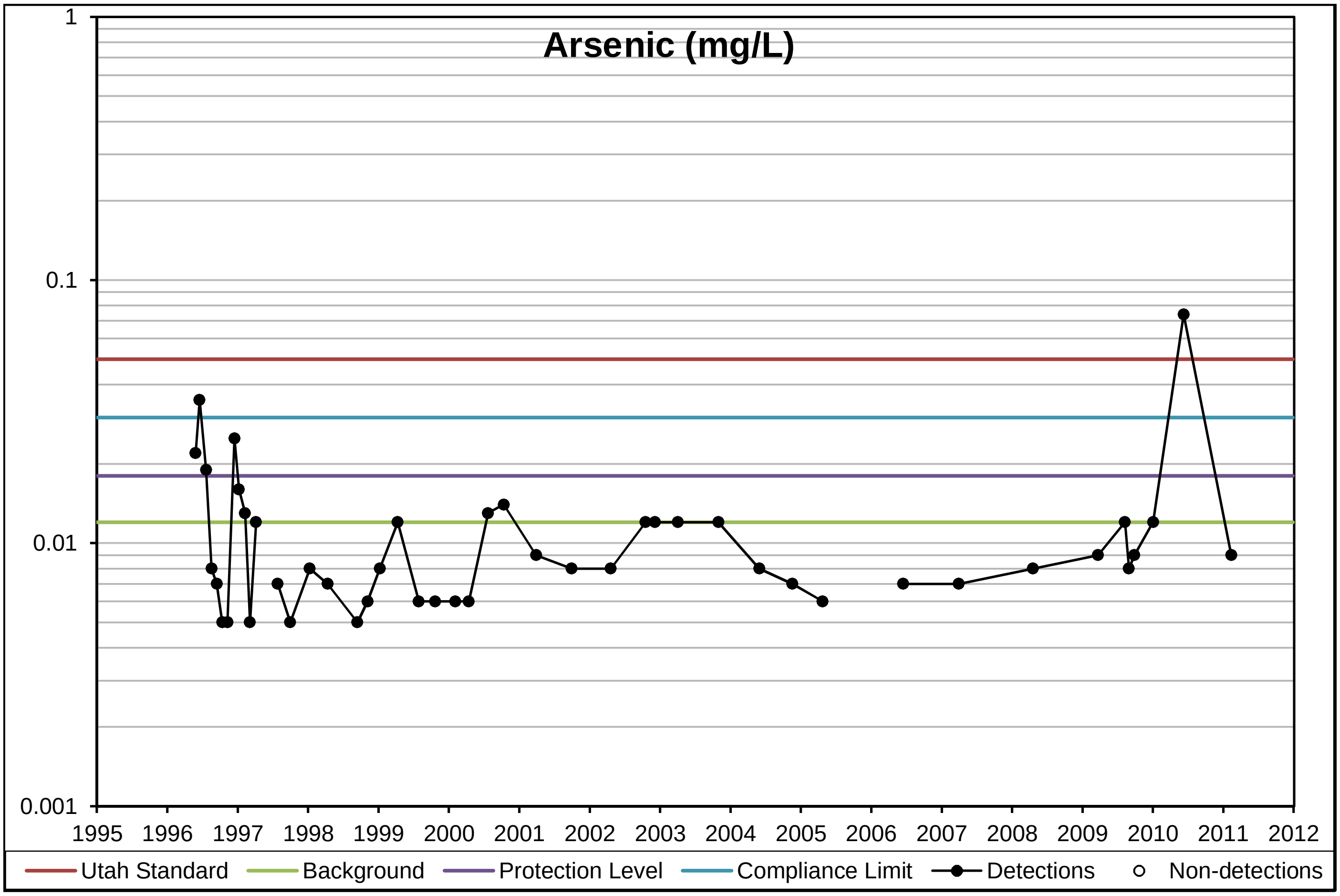


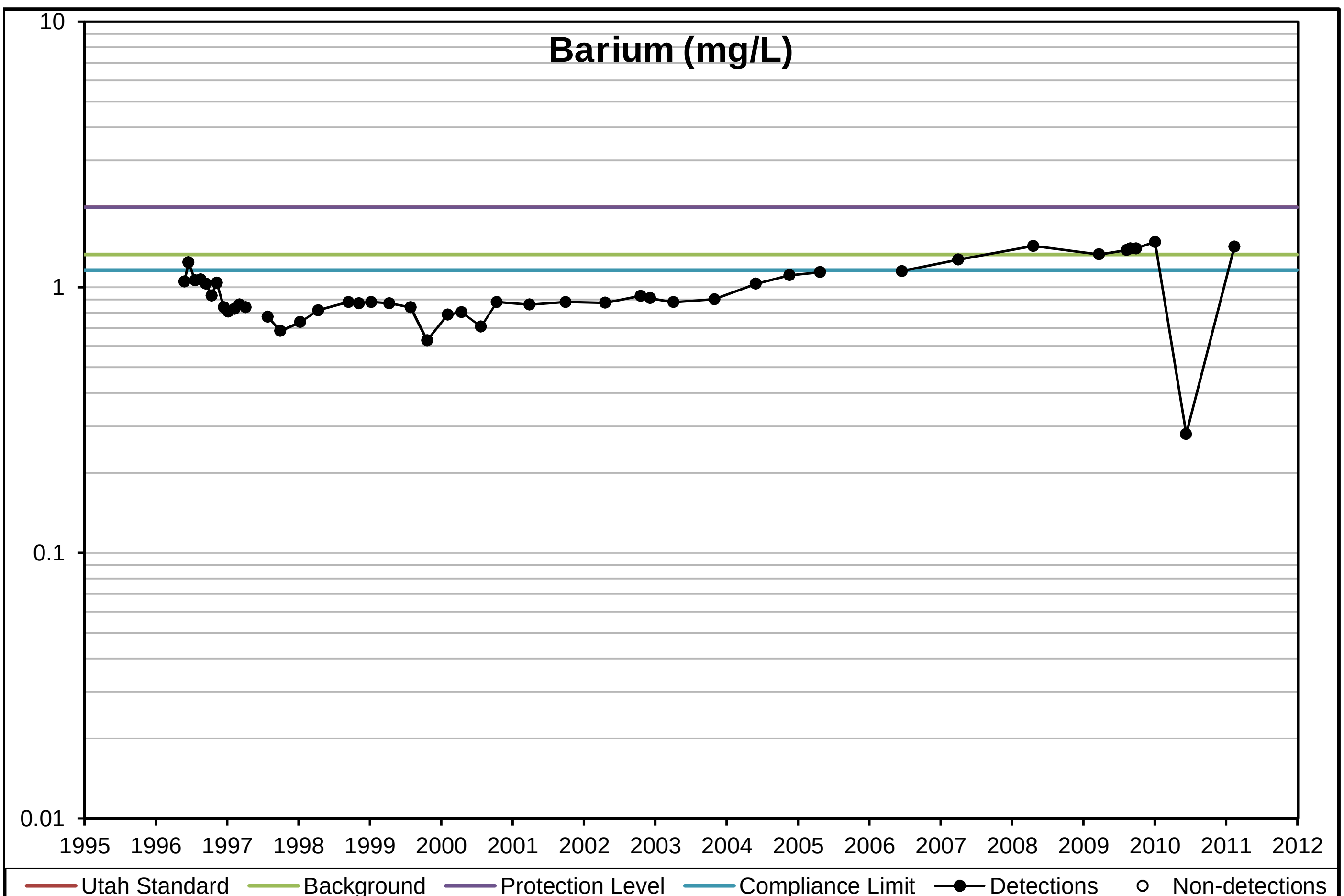
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386A

Concentration Versus Year



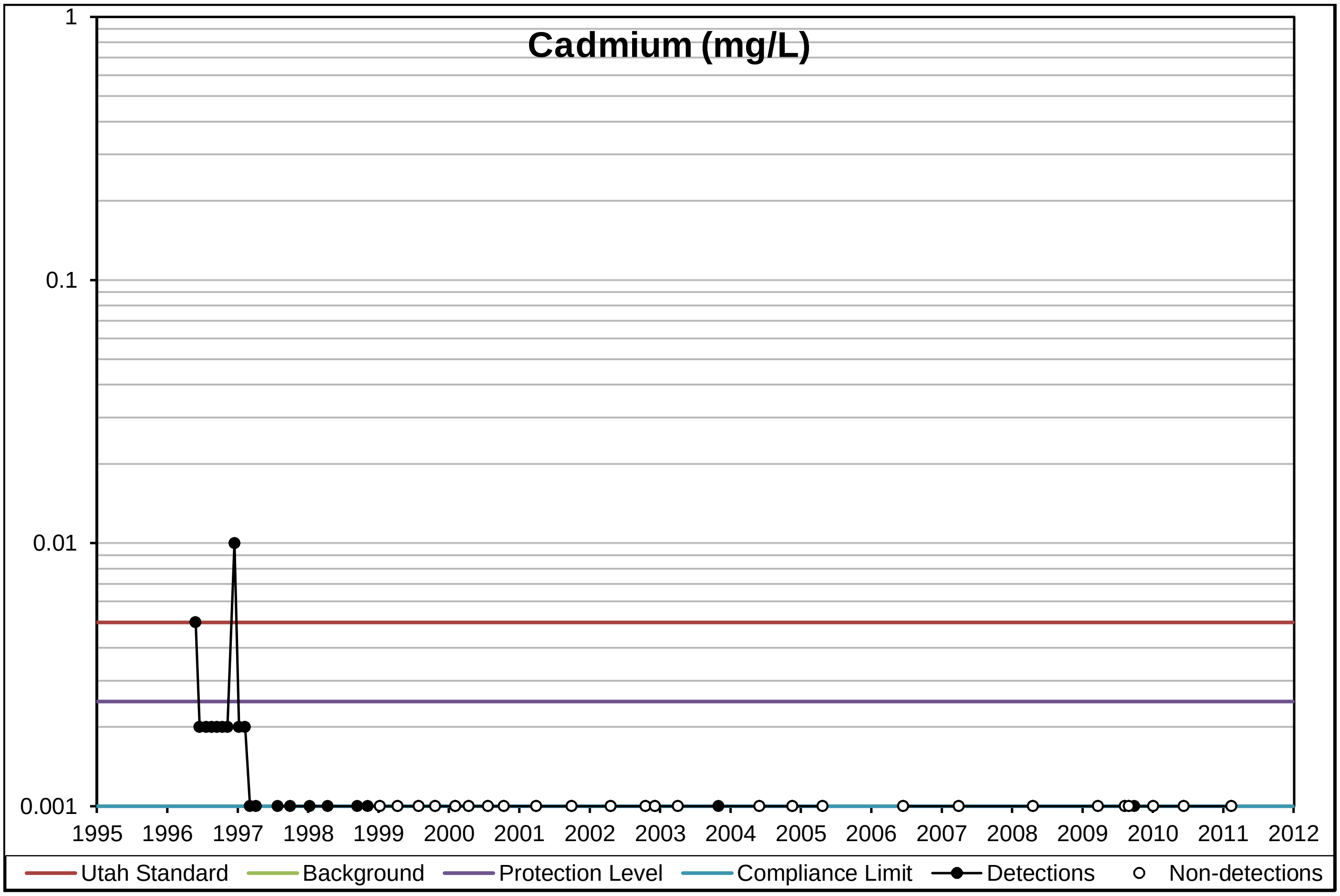


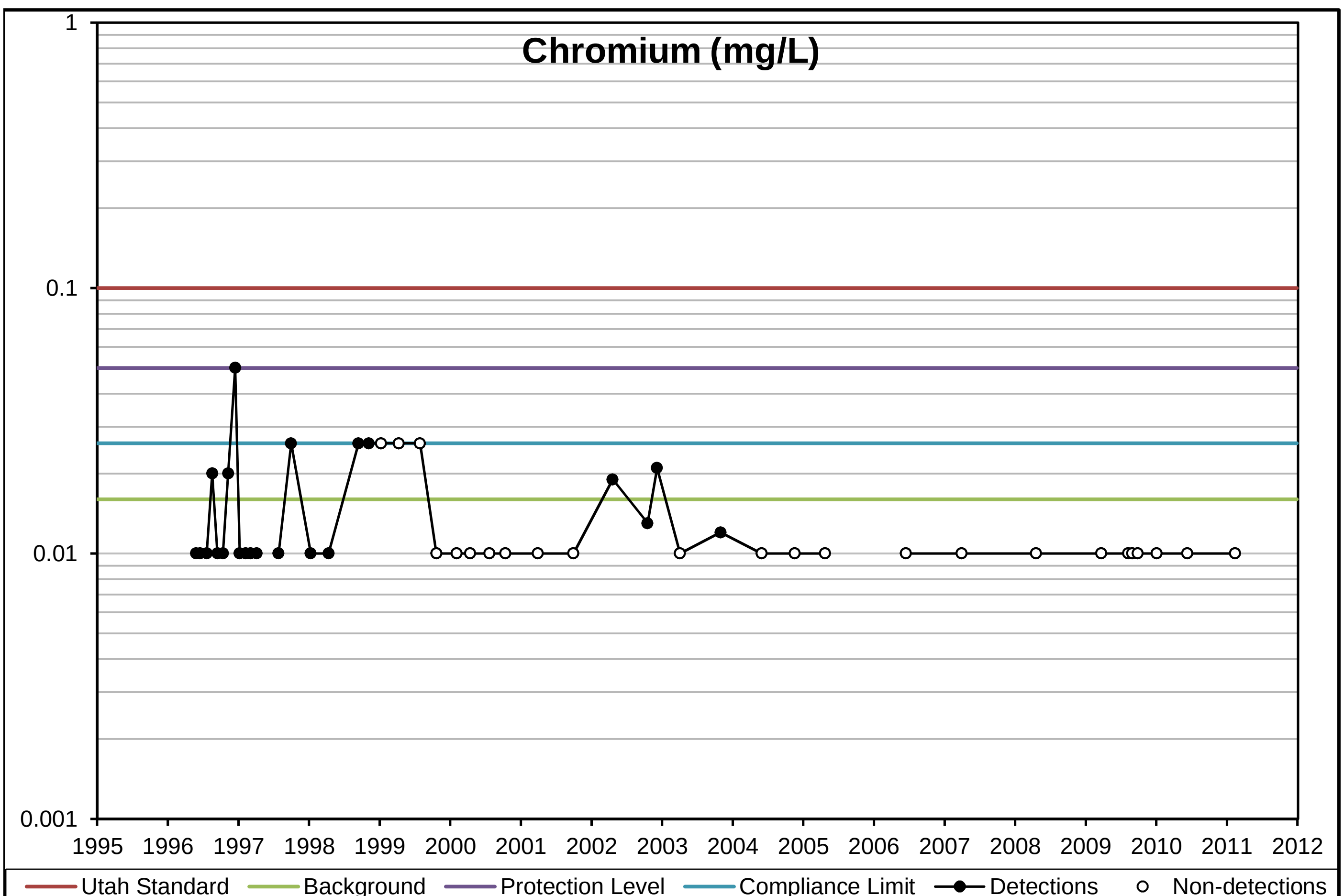
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386A

Concentration Versus Year



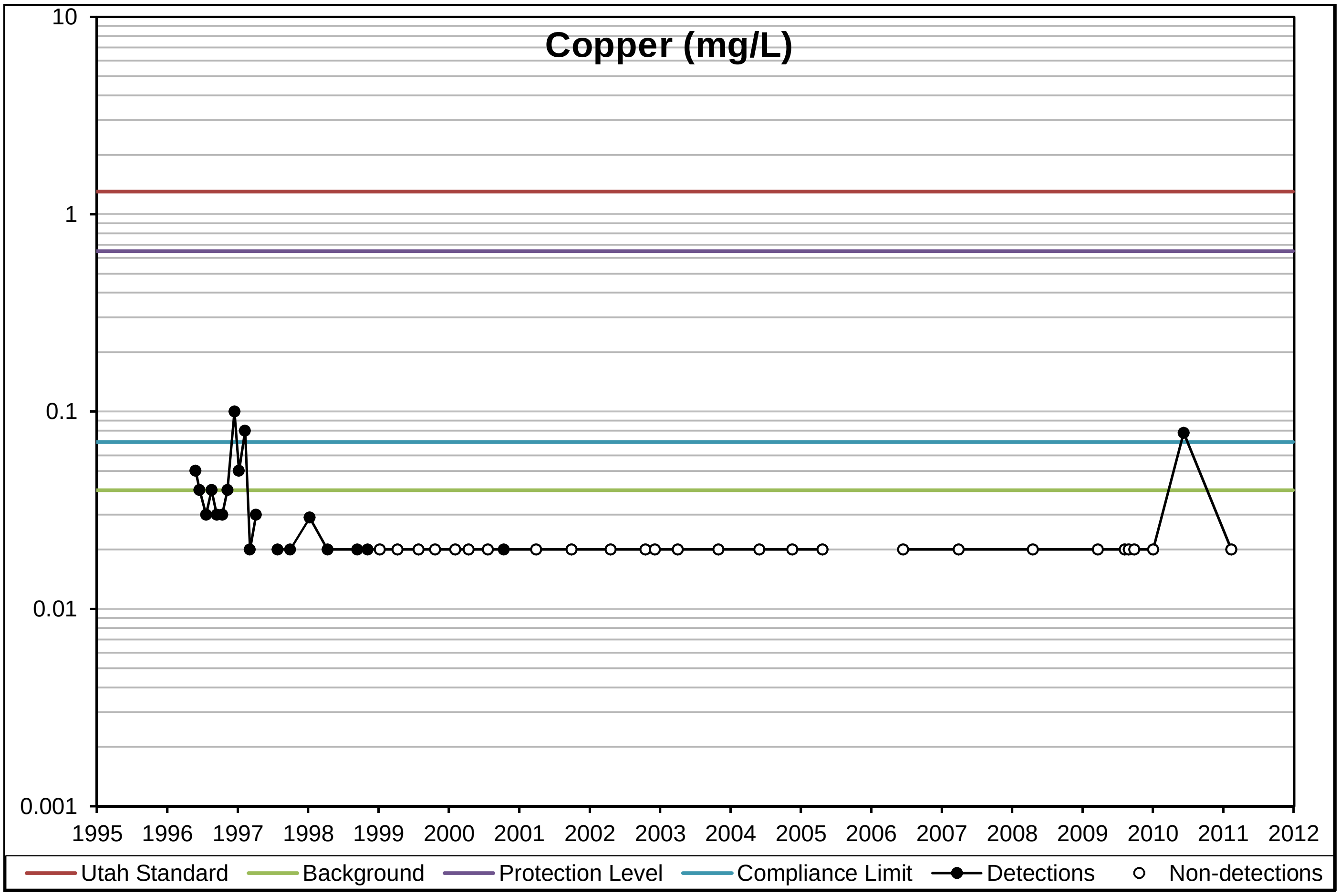


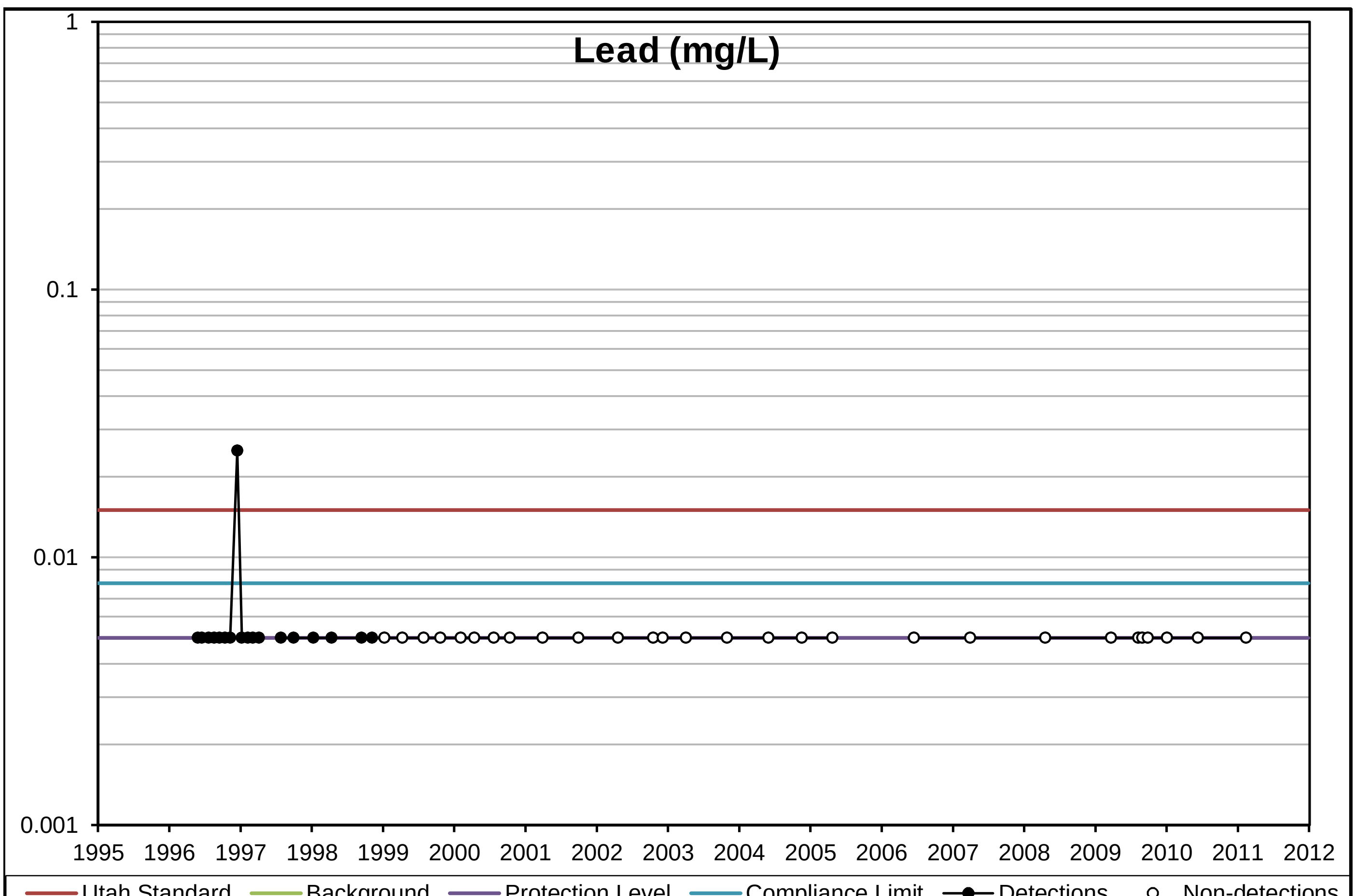
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386A

Concentration Versus Year





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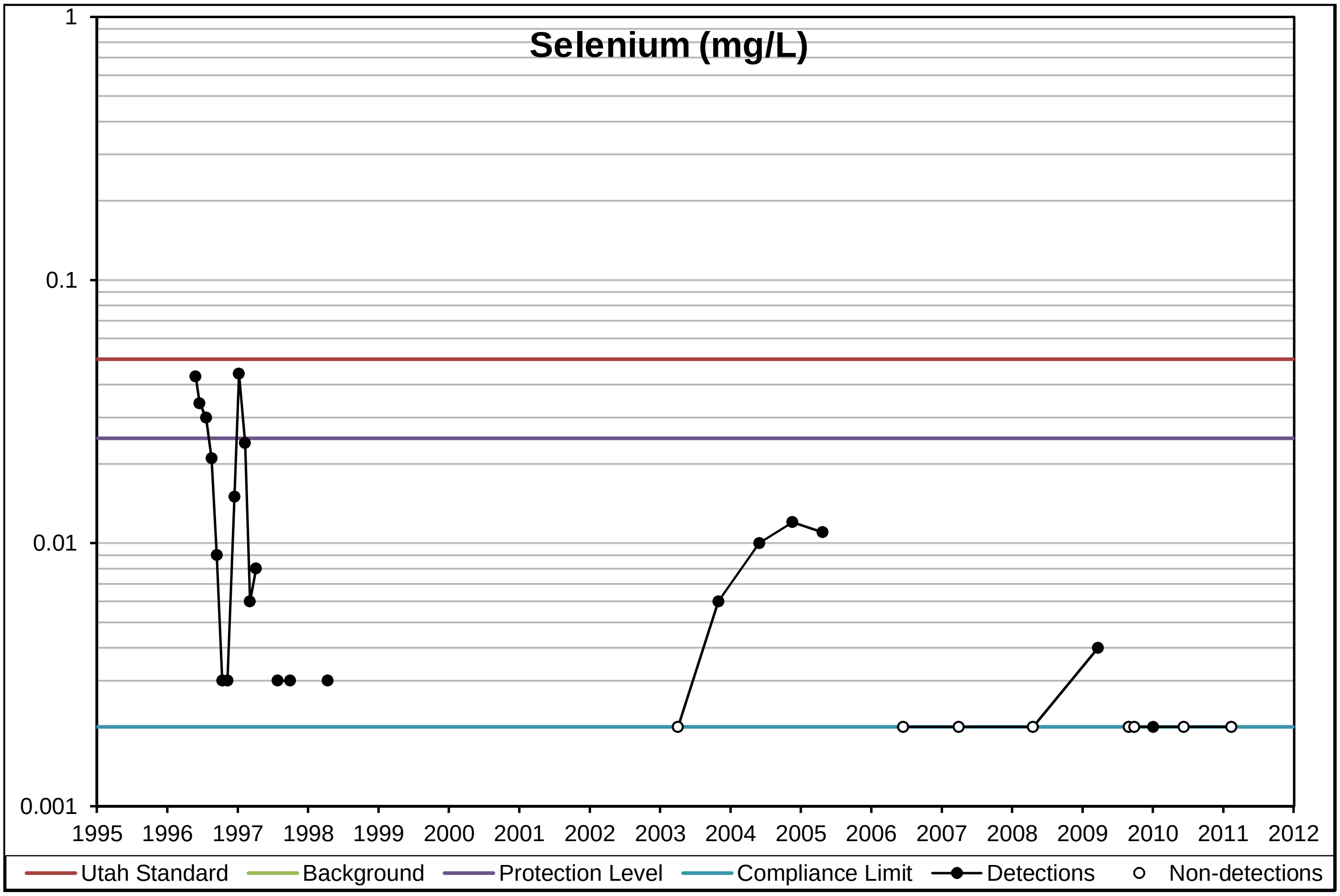
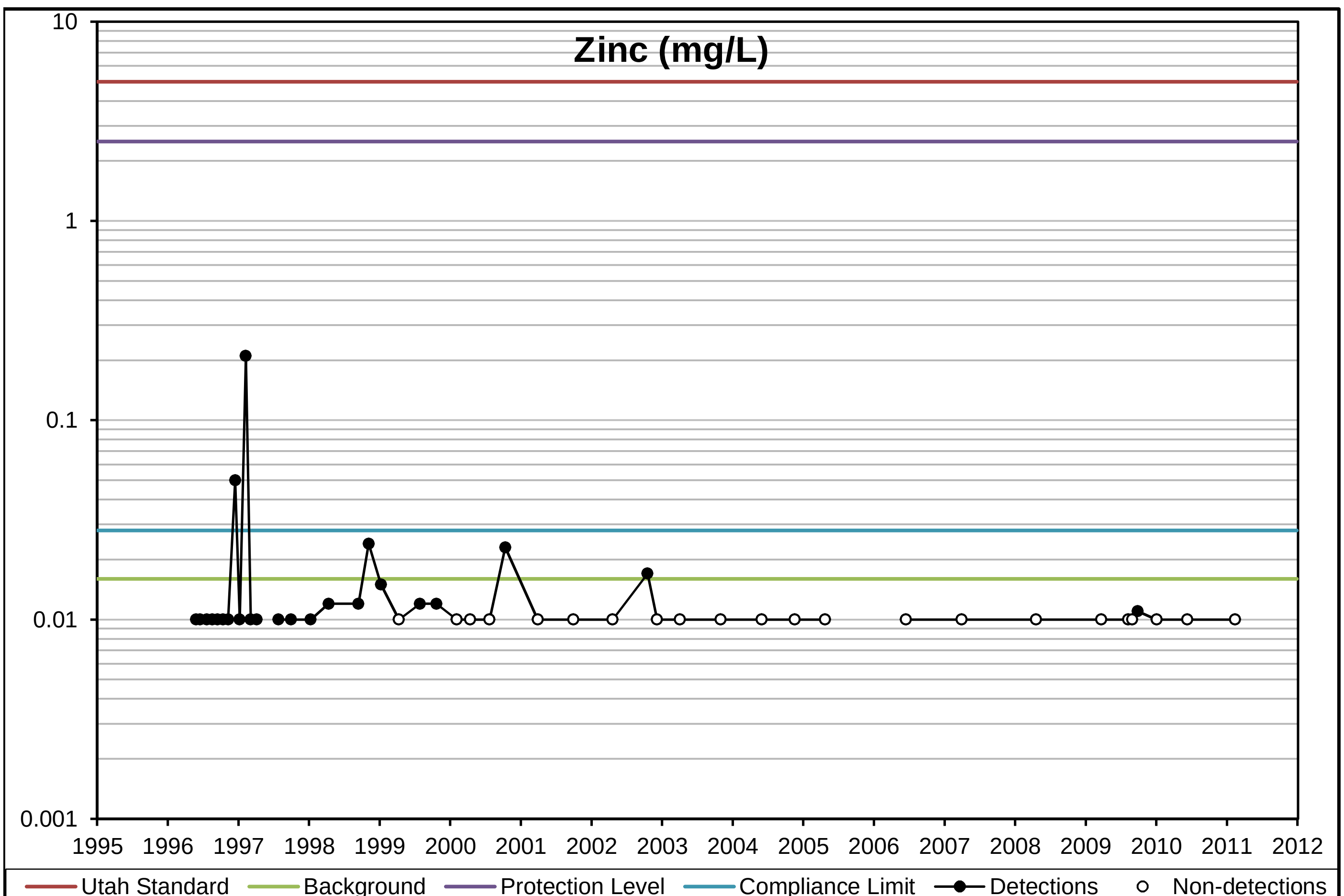
Constituent range includes minimum and maximum concentrations for all wells considered

NET1386A

Concentration Versus Year





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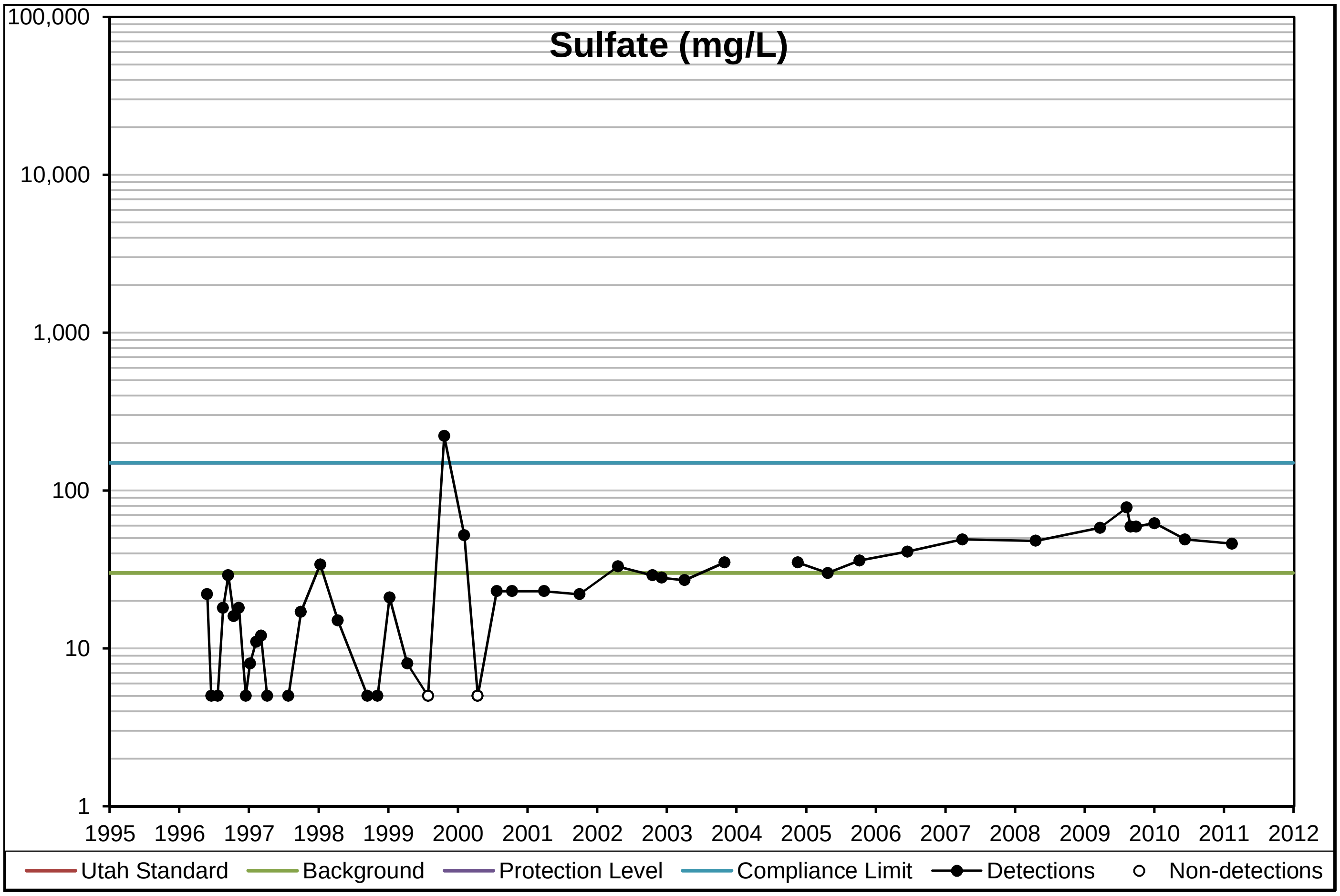
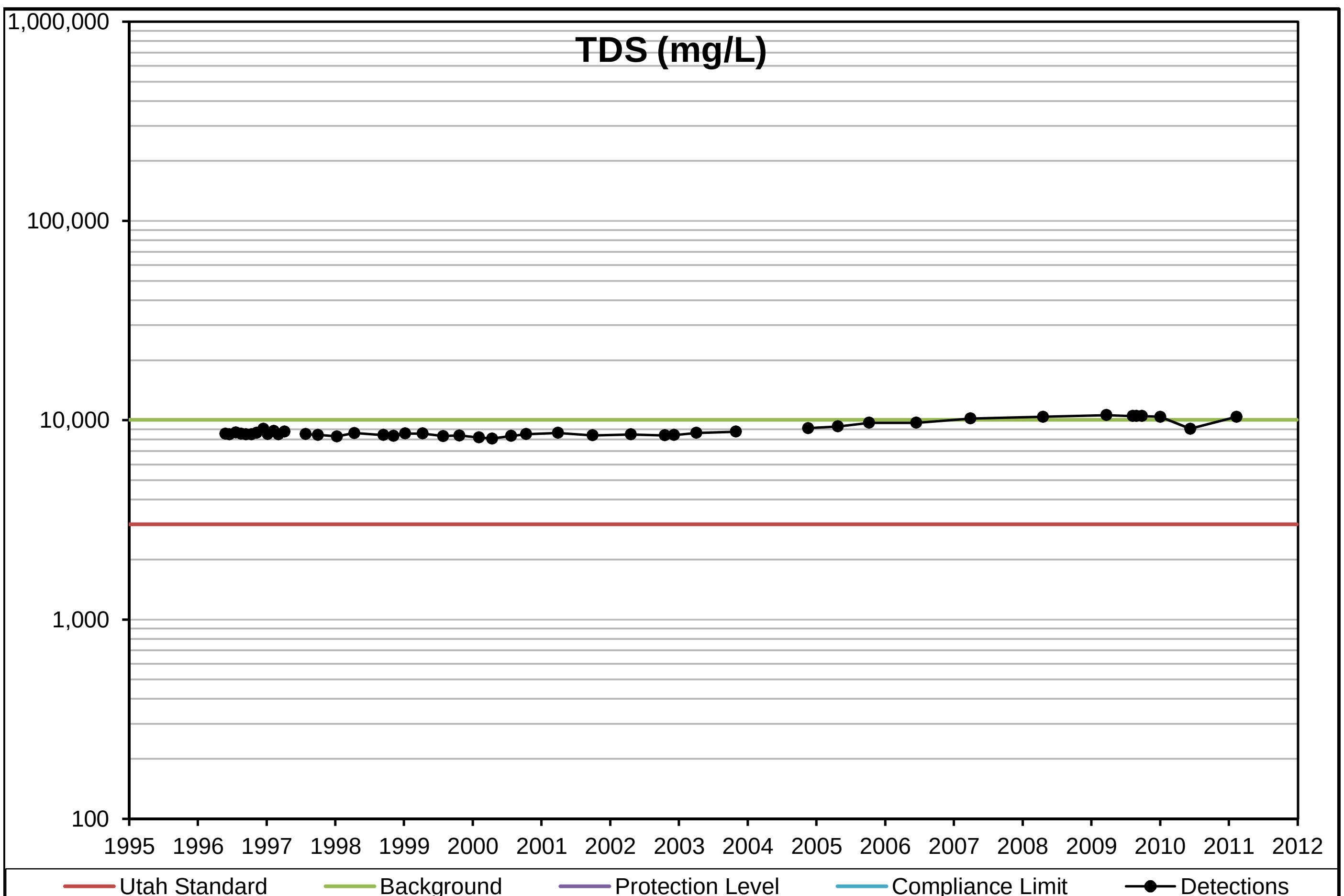
NET1386A

Concentration Versus Year



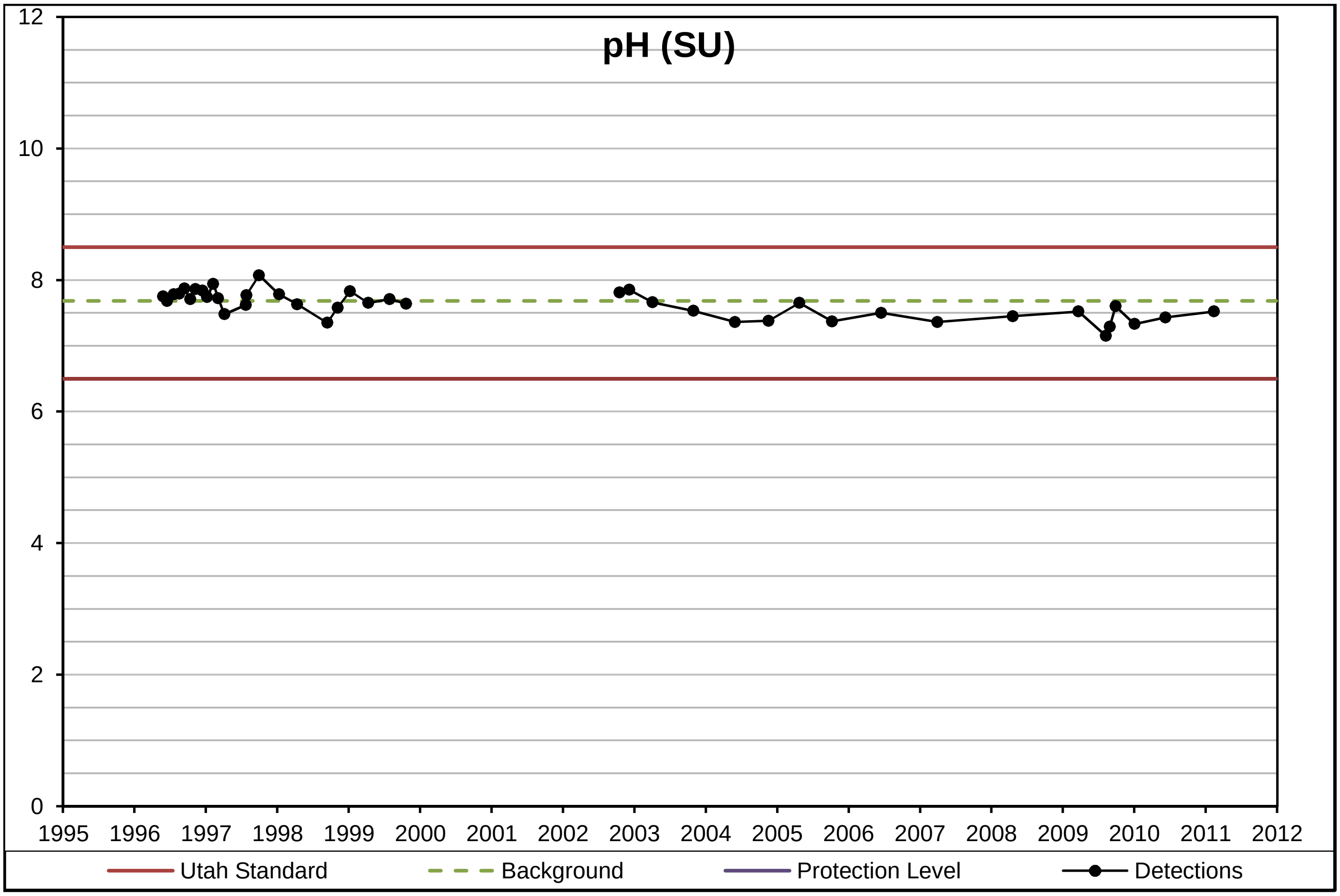


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386A

Concentration Versus Year

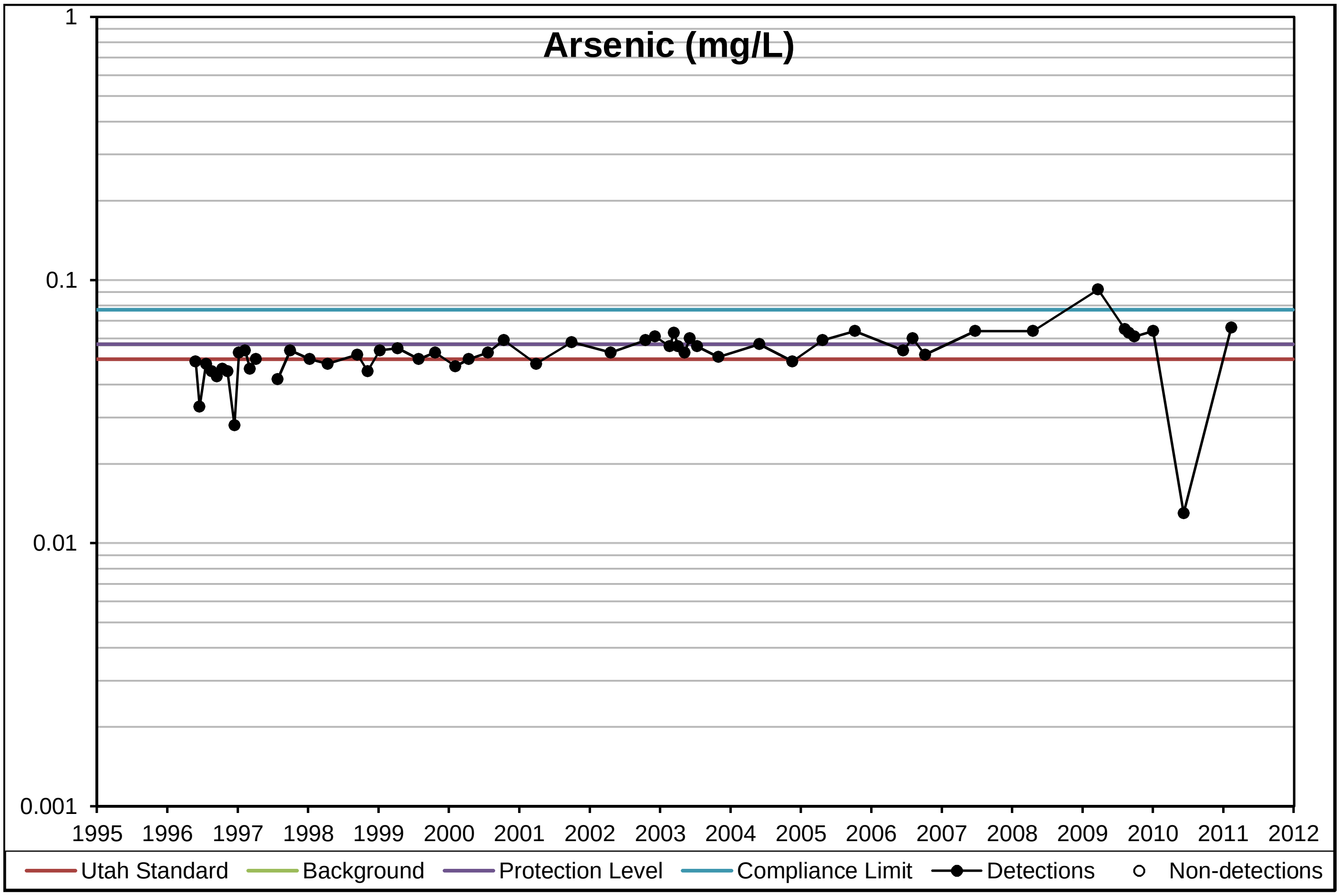


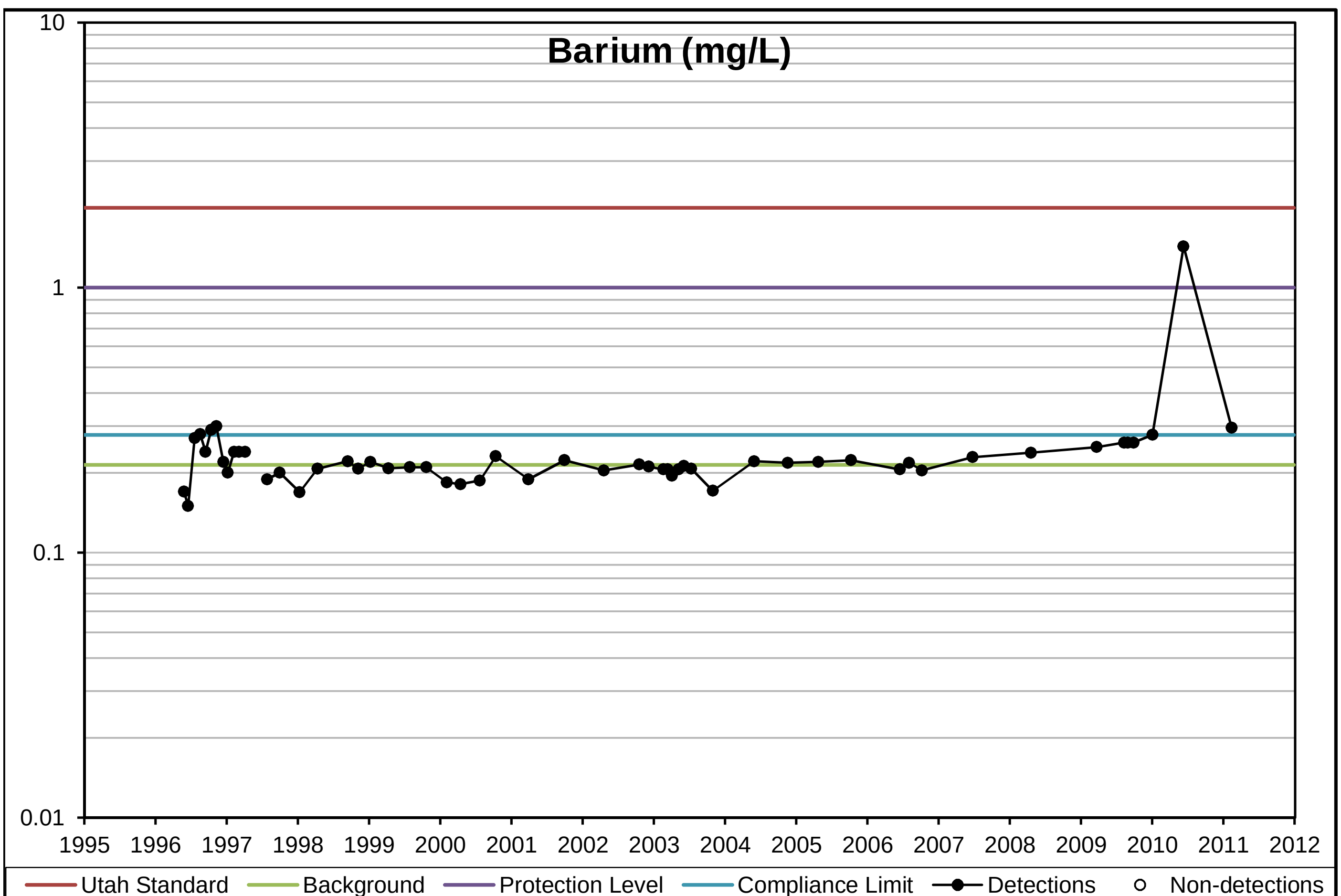
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

Concentration Versus Year

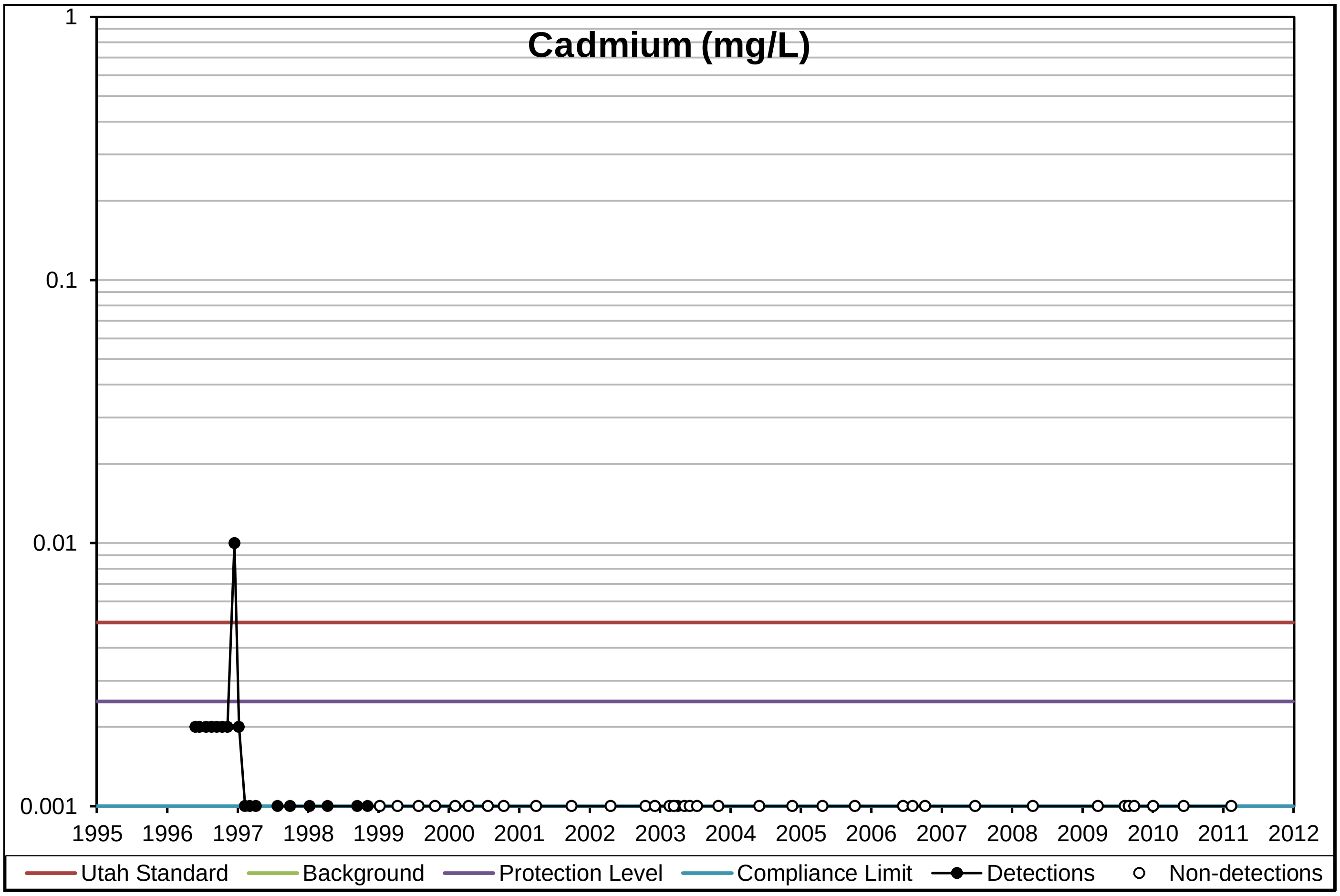


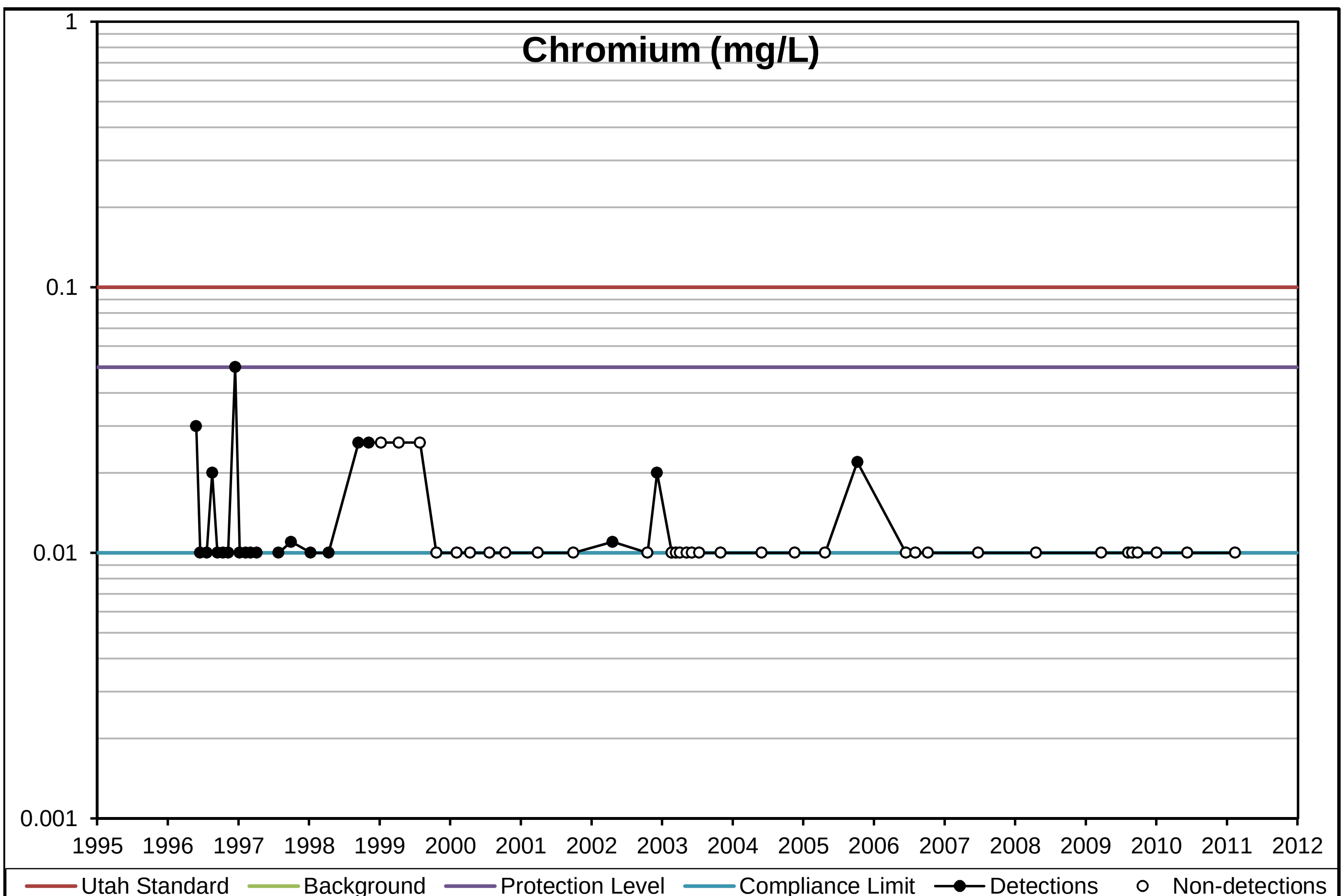


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

Concentration Versus Year



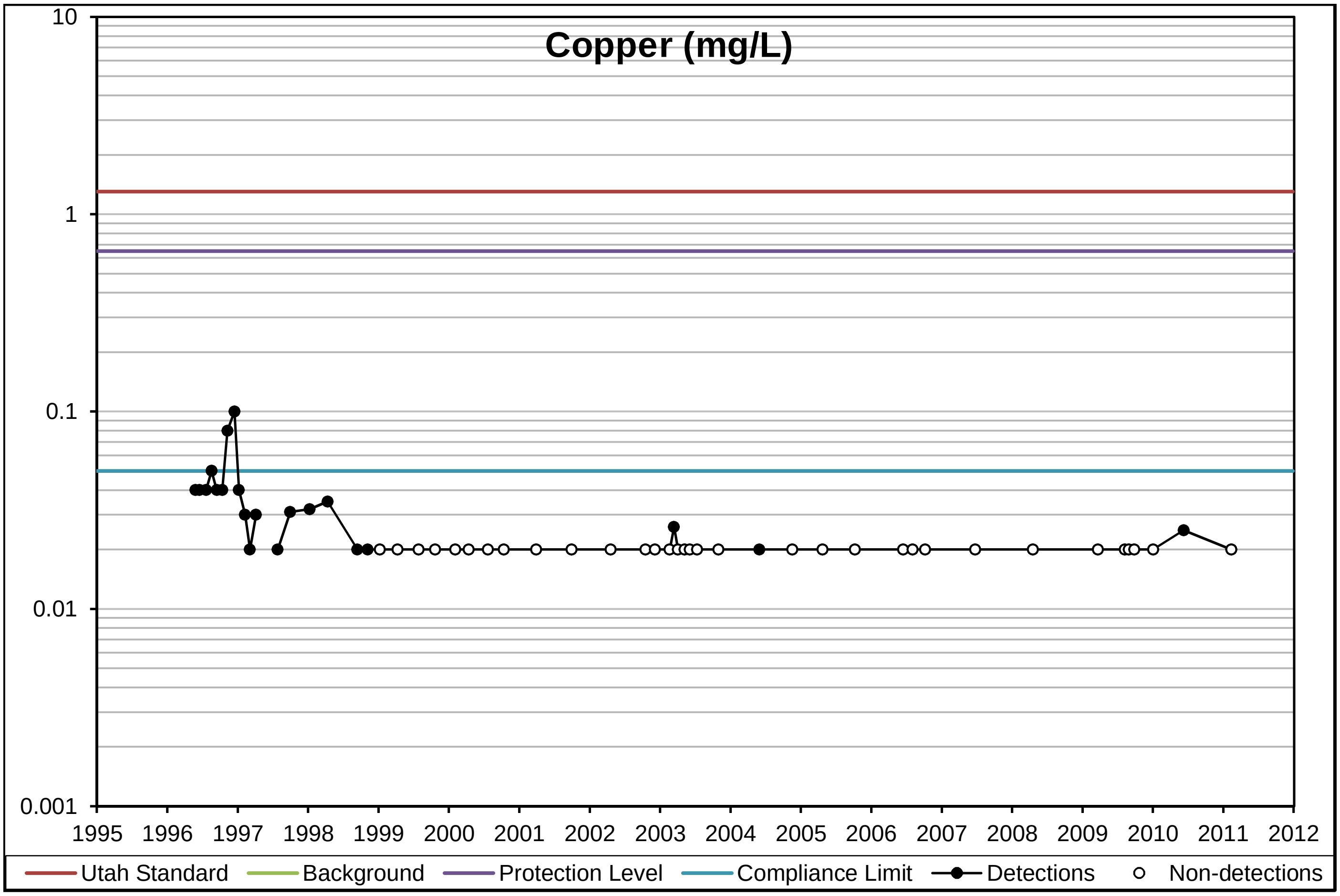


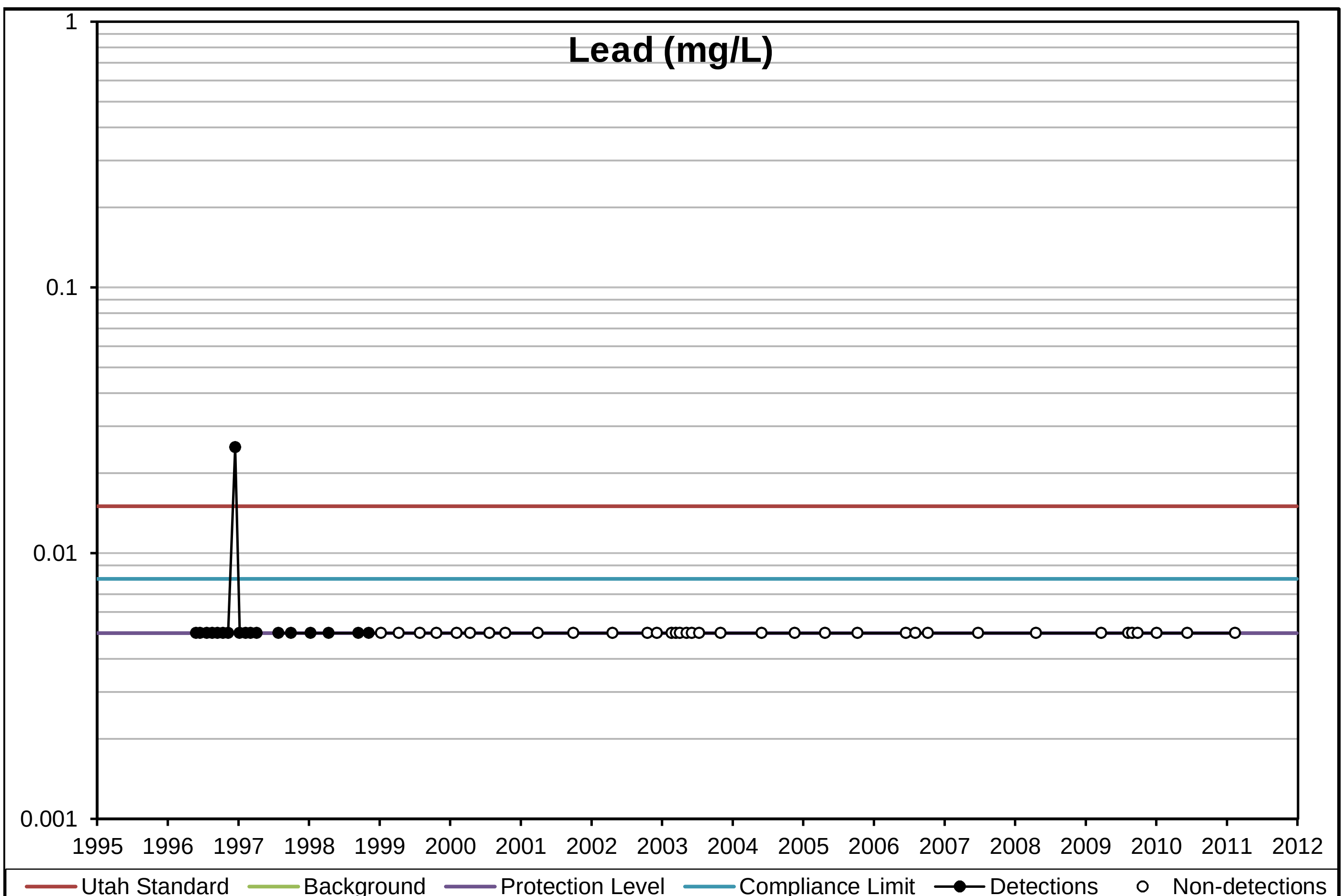
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

Concentration Versus Year



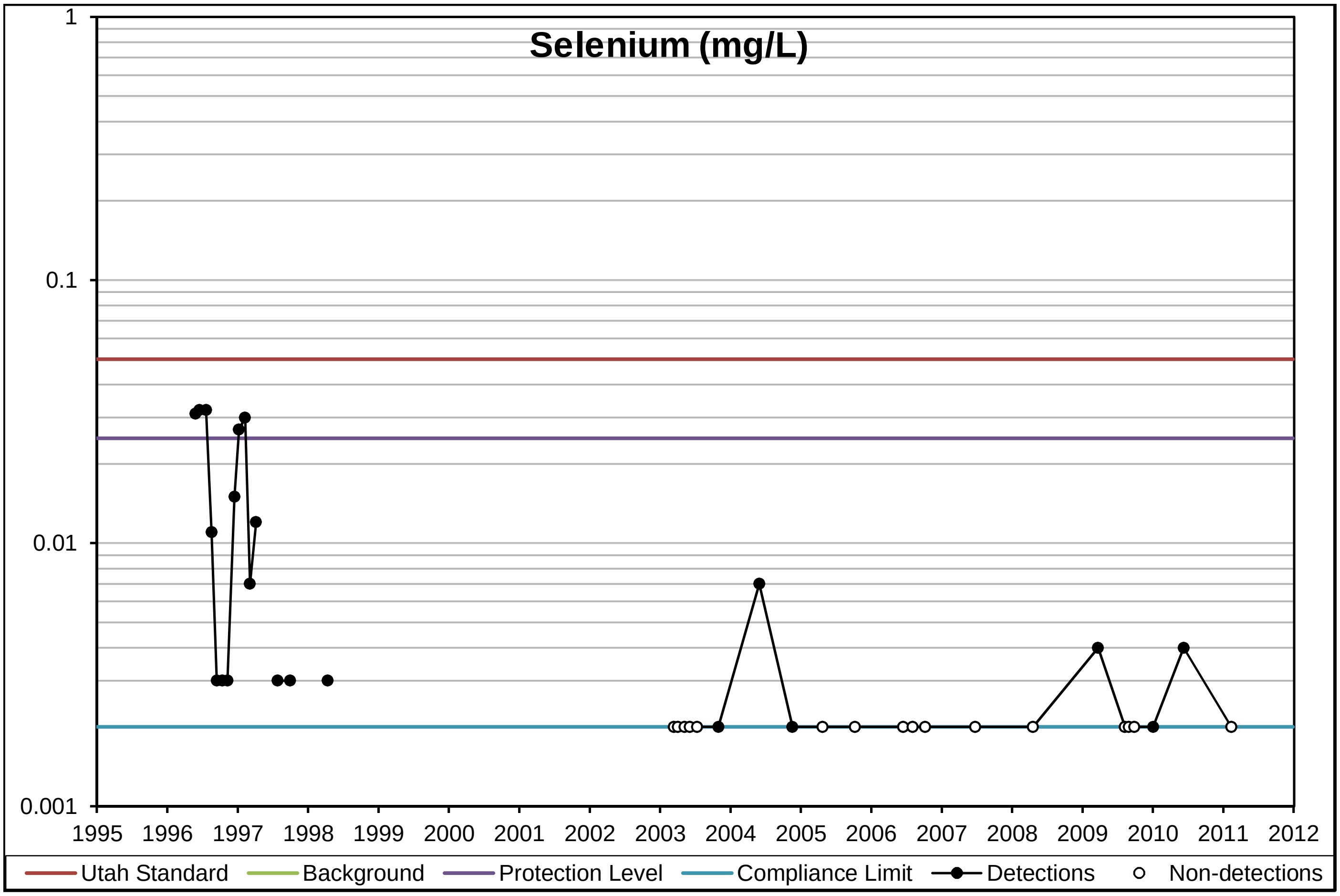


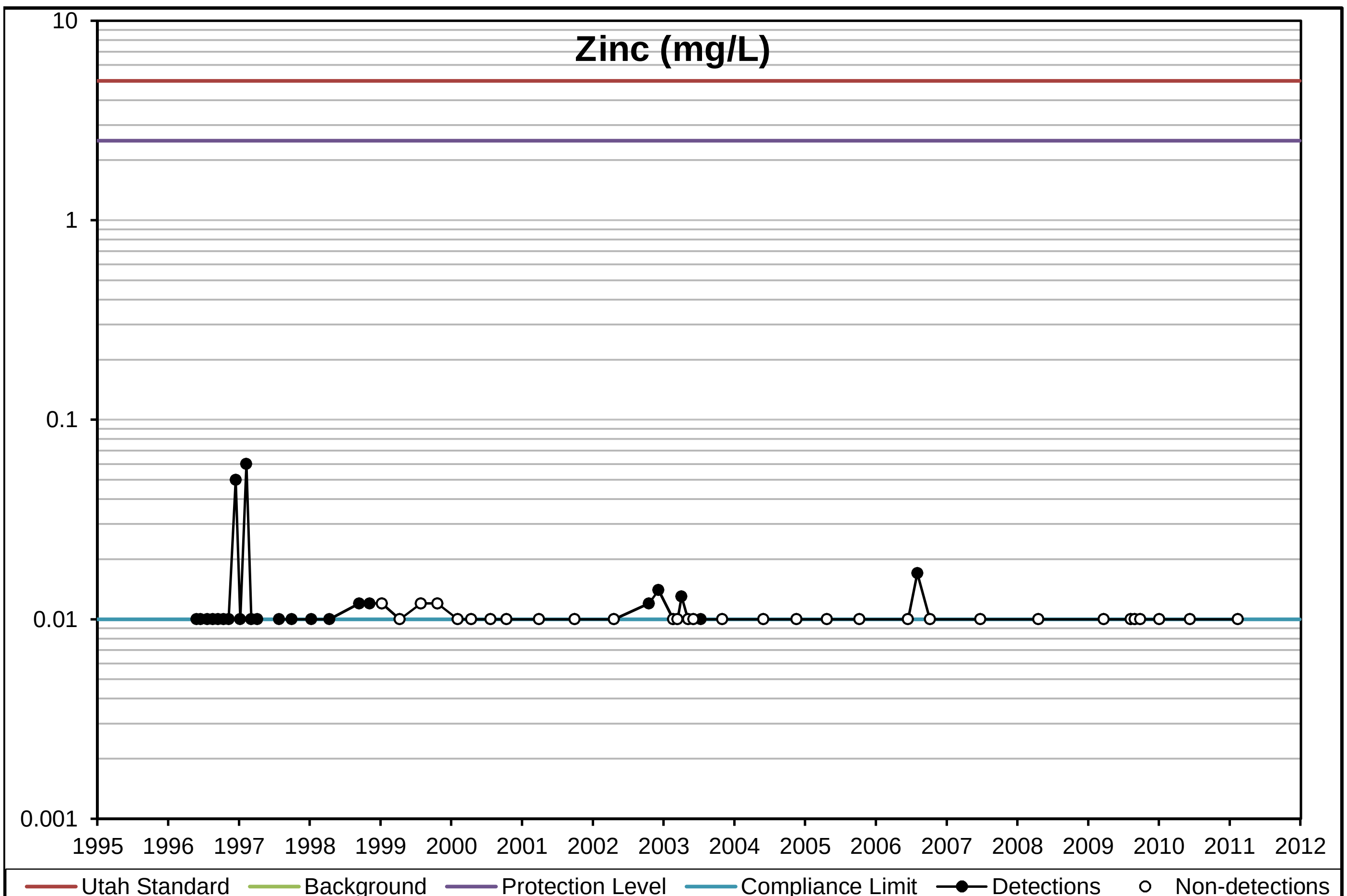
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

Concentration Versus Year



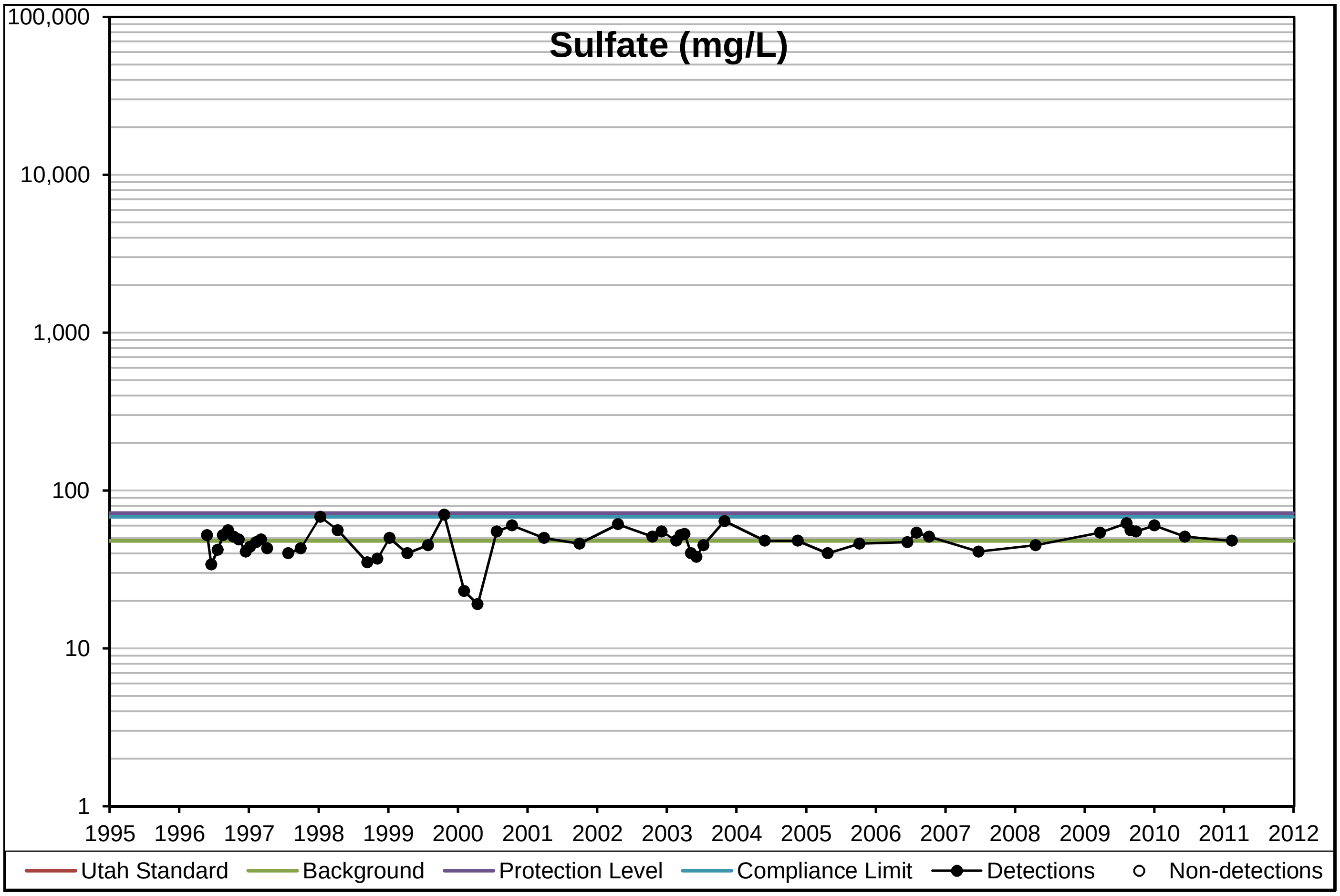


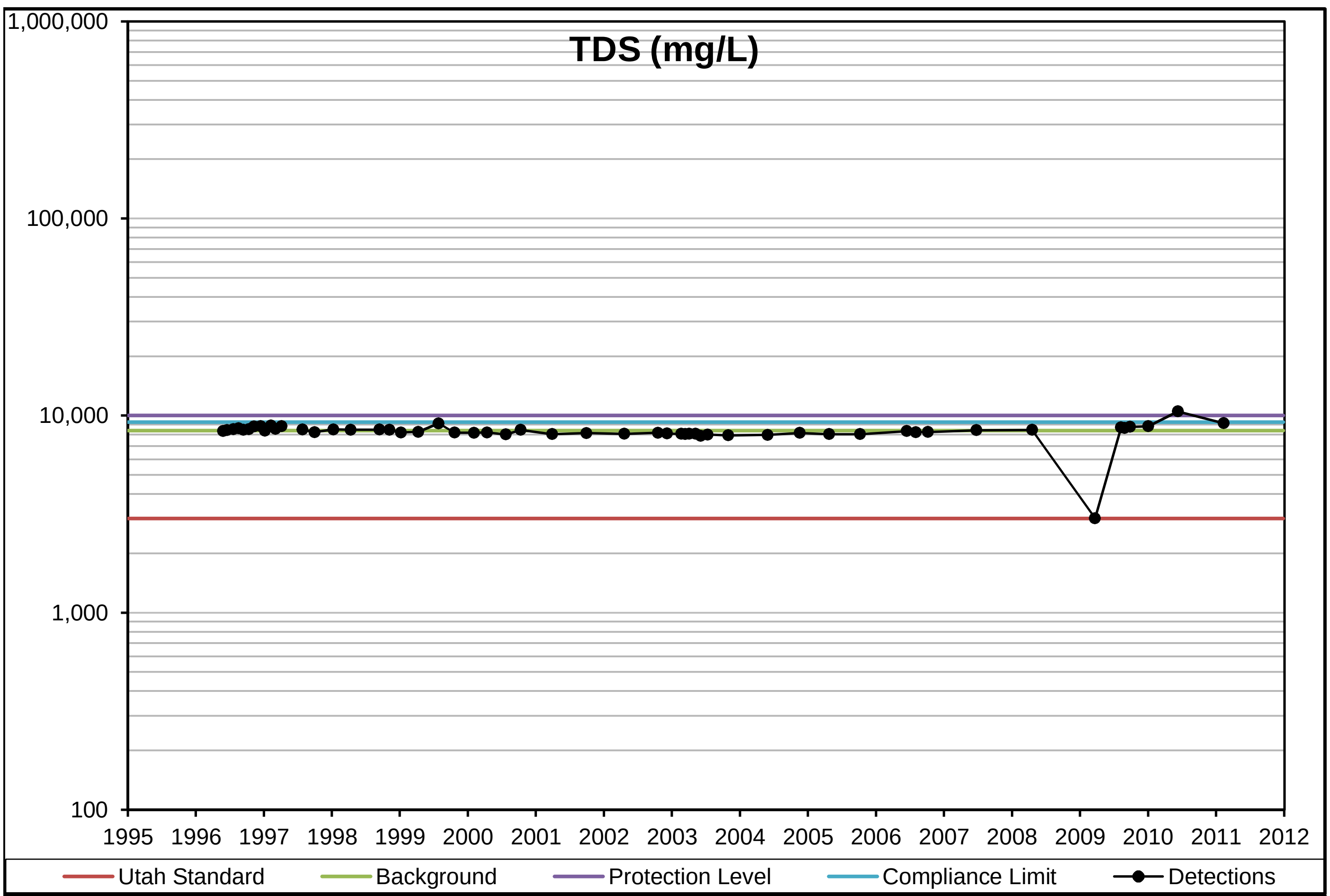
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

Concentration Versus Year



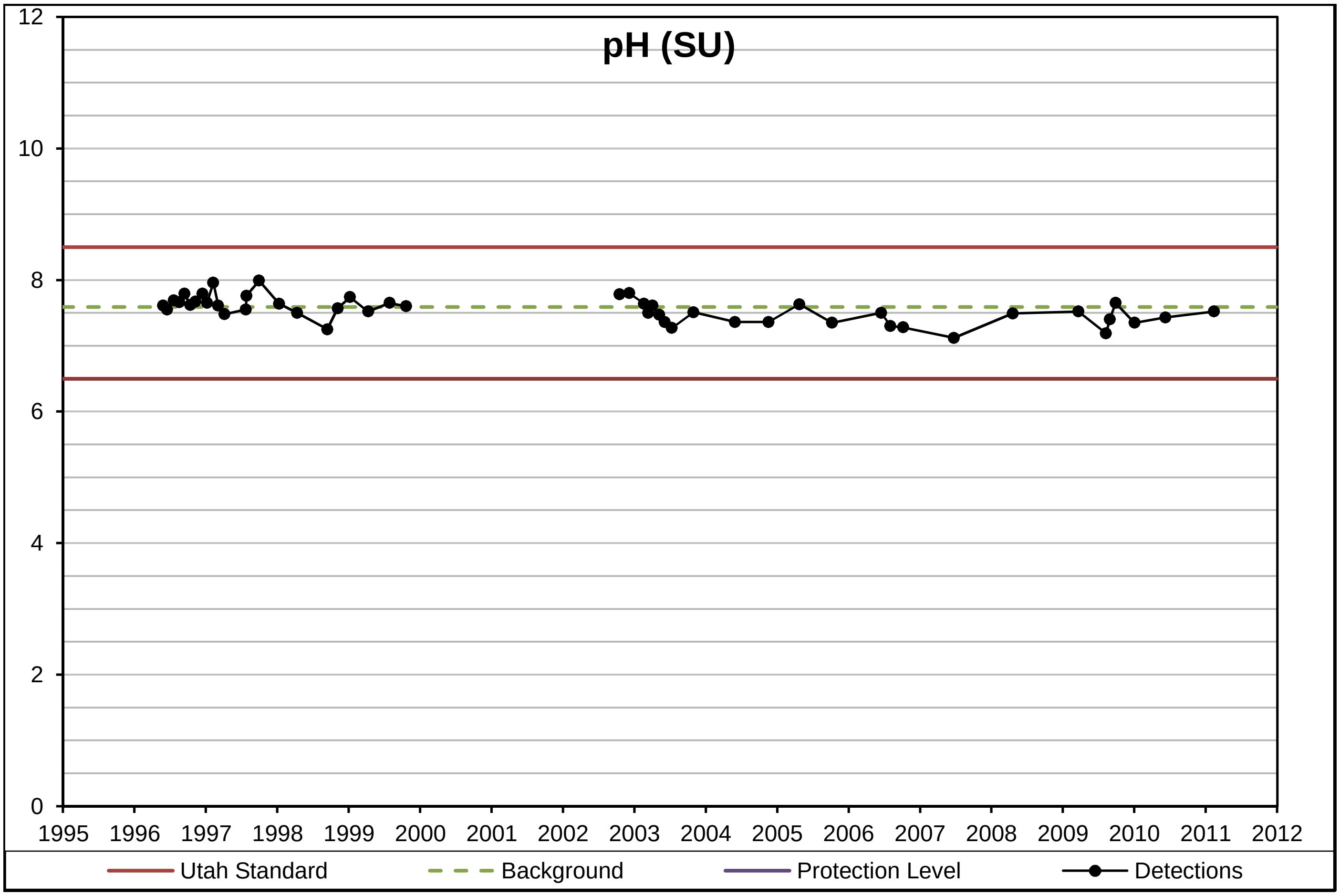


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1386B

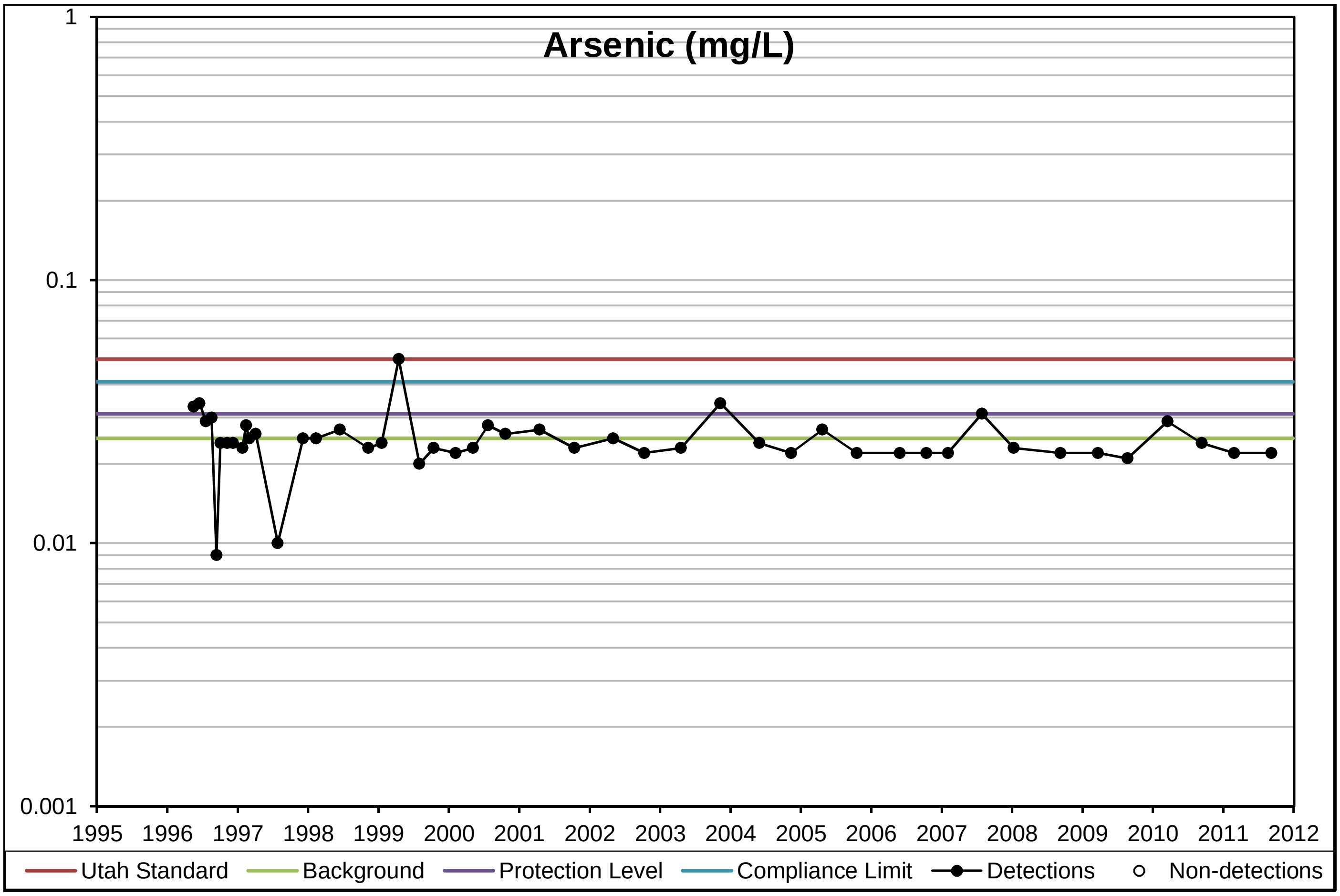
Concentration Versus Year

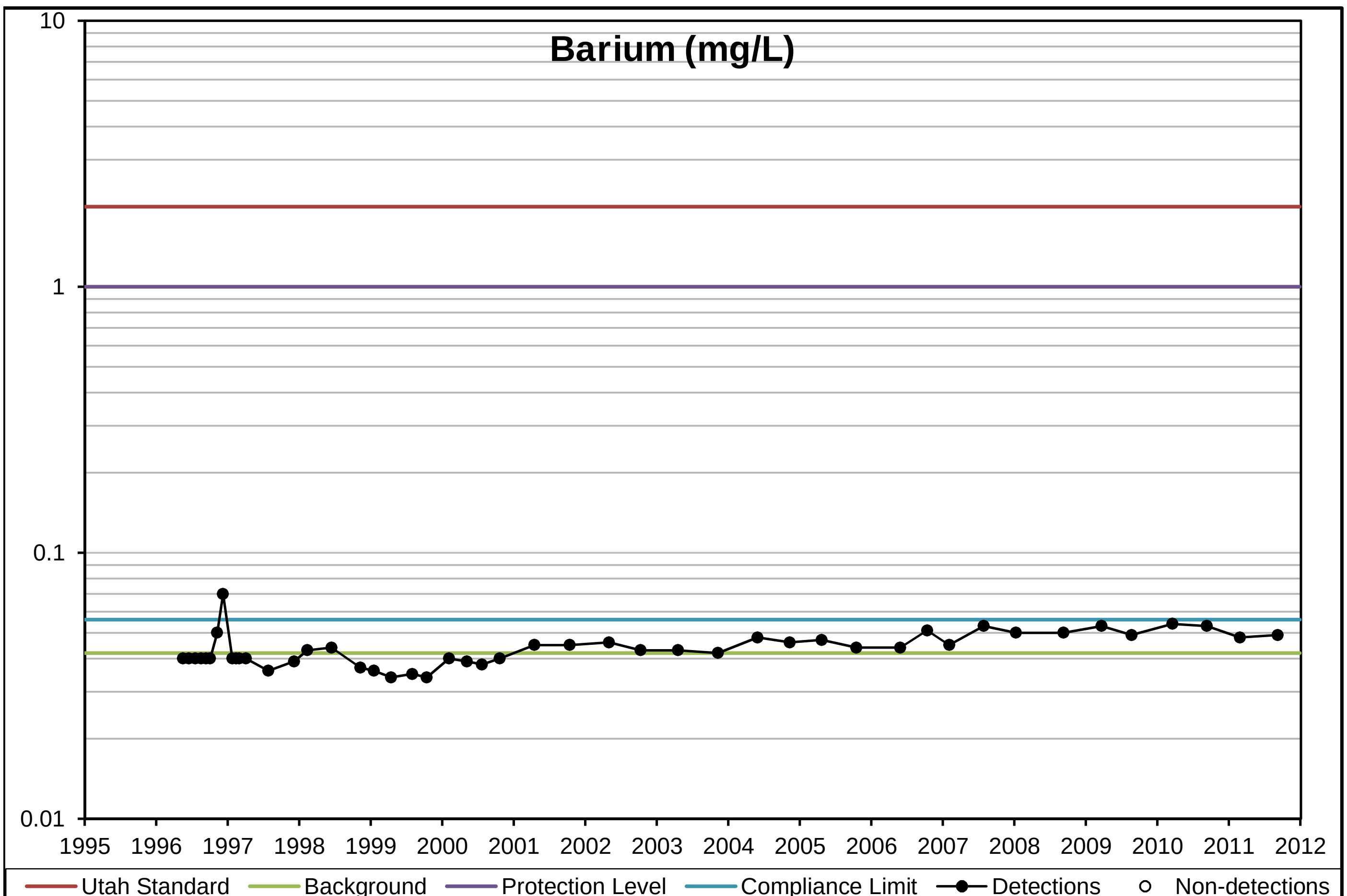


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEM1387

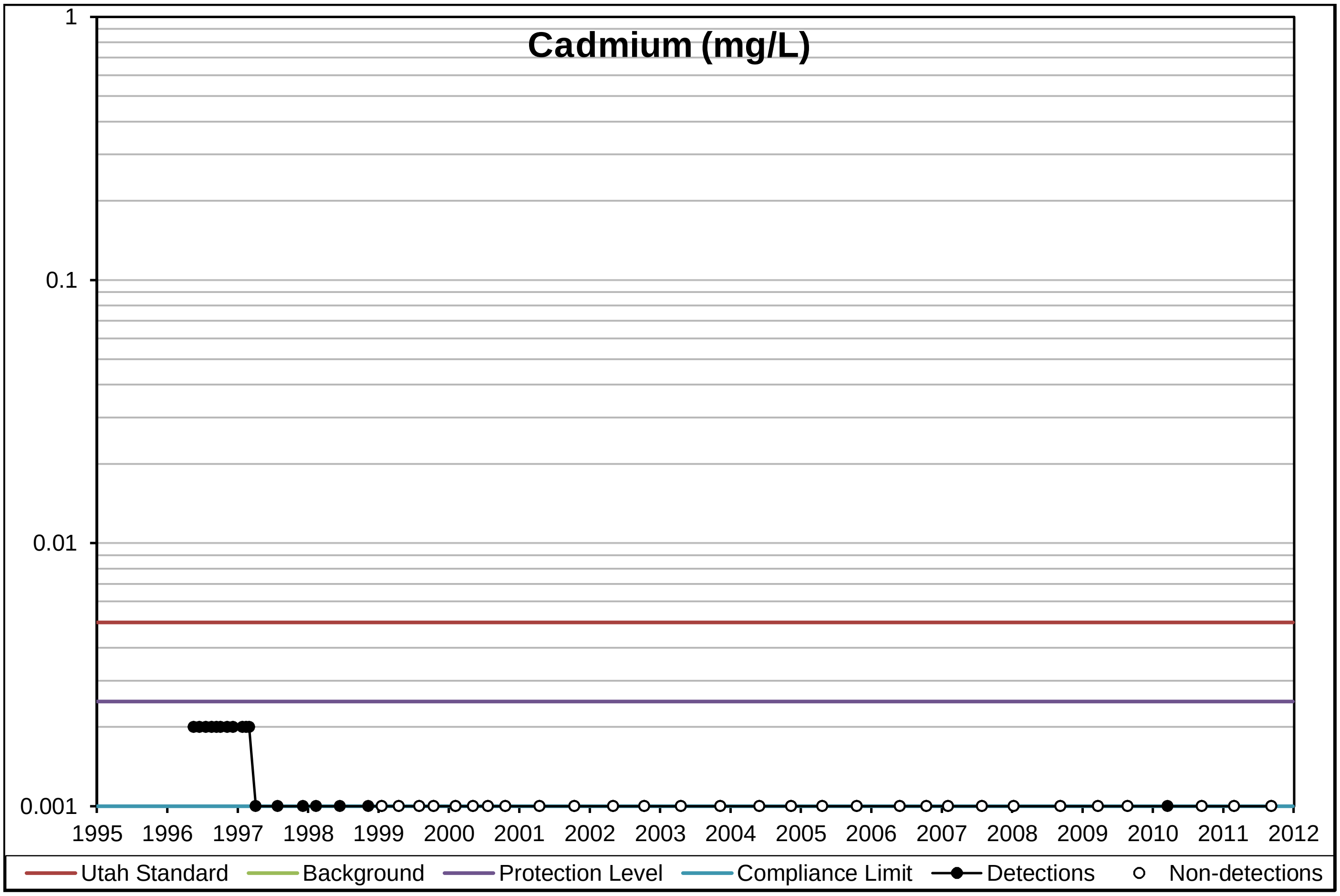
Concentration Versus Year

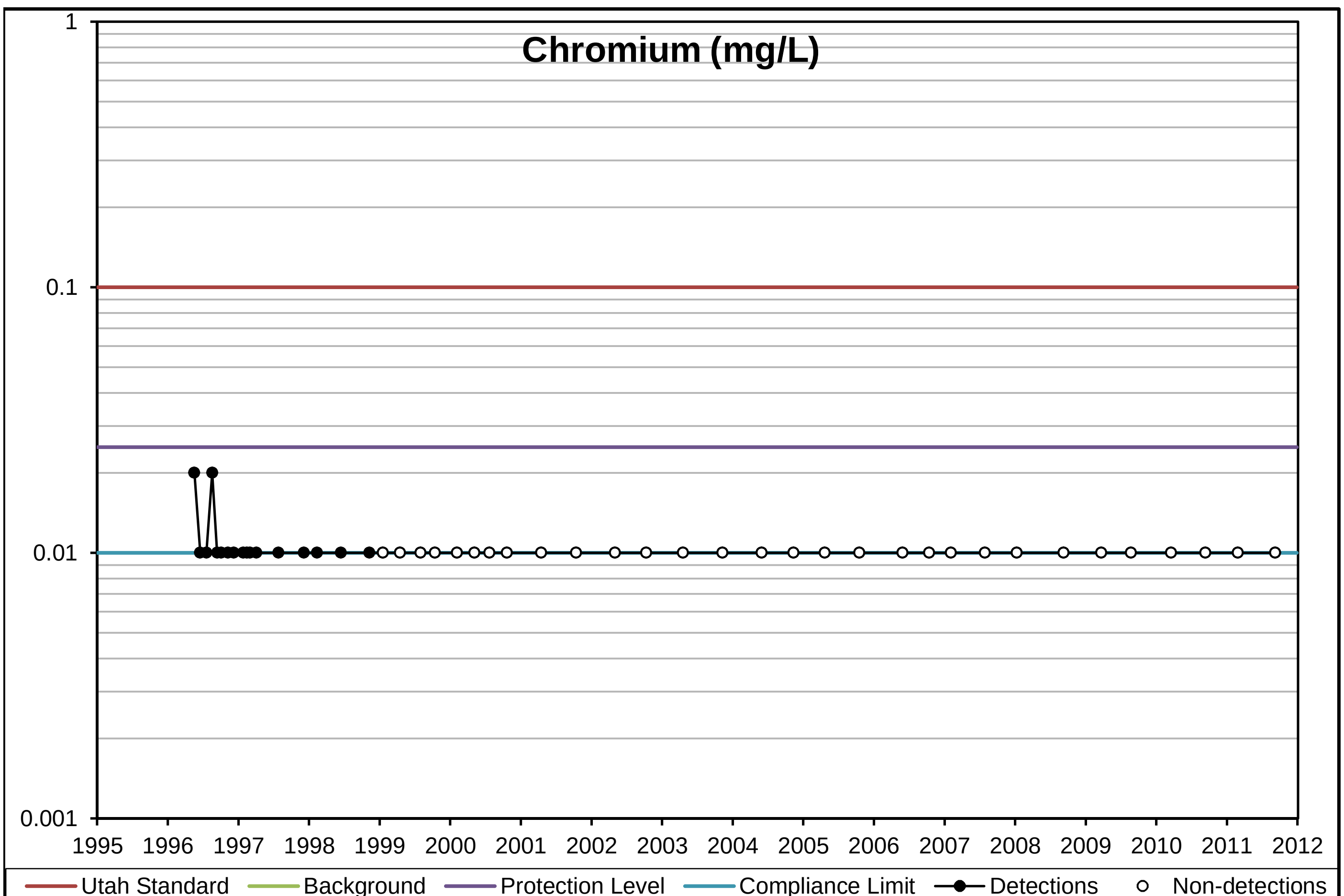




Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

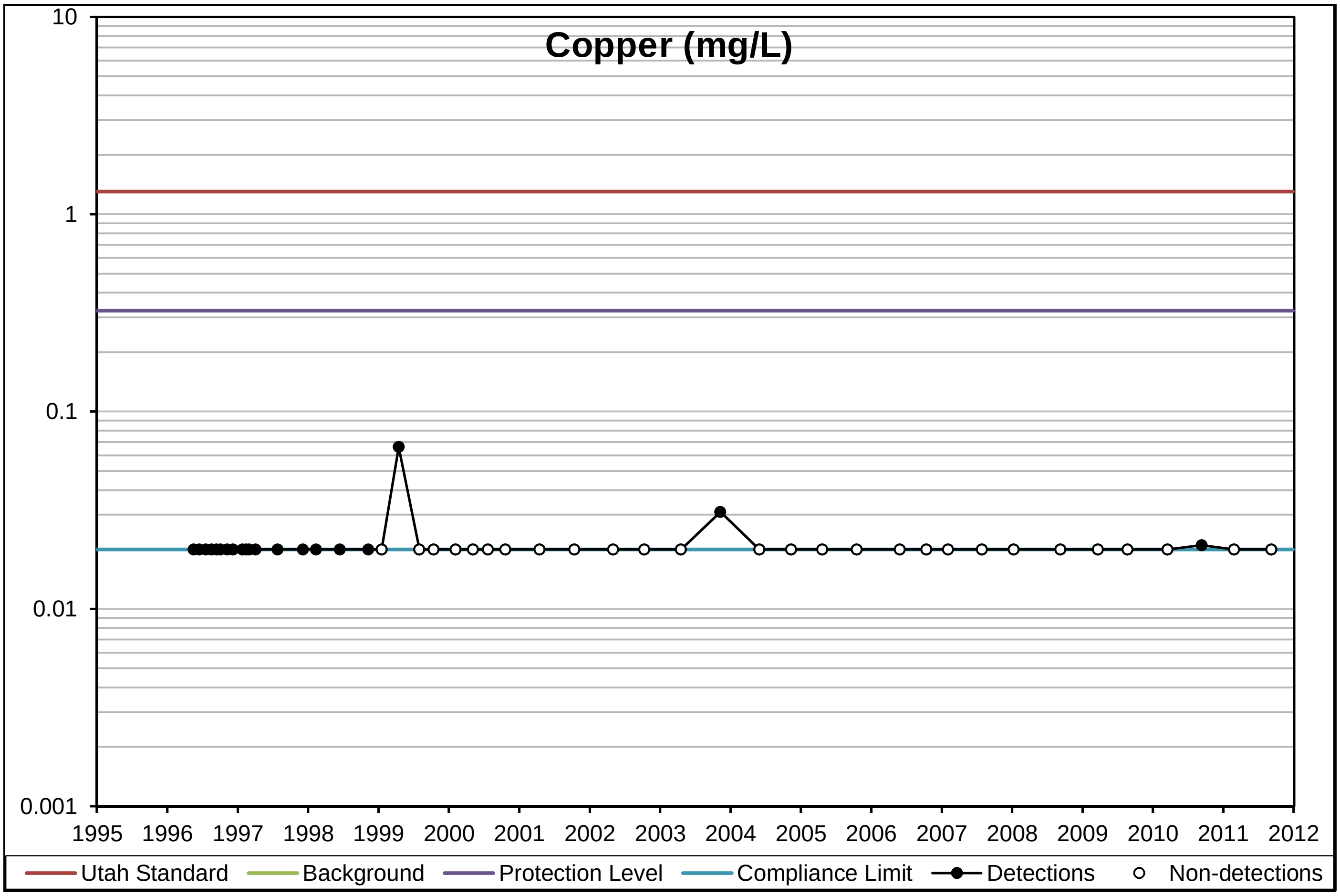


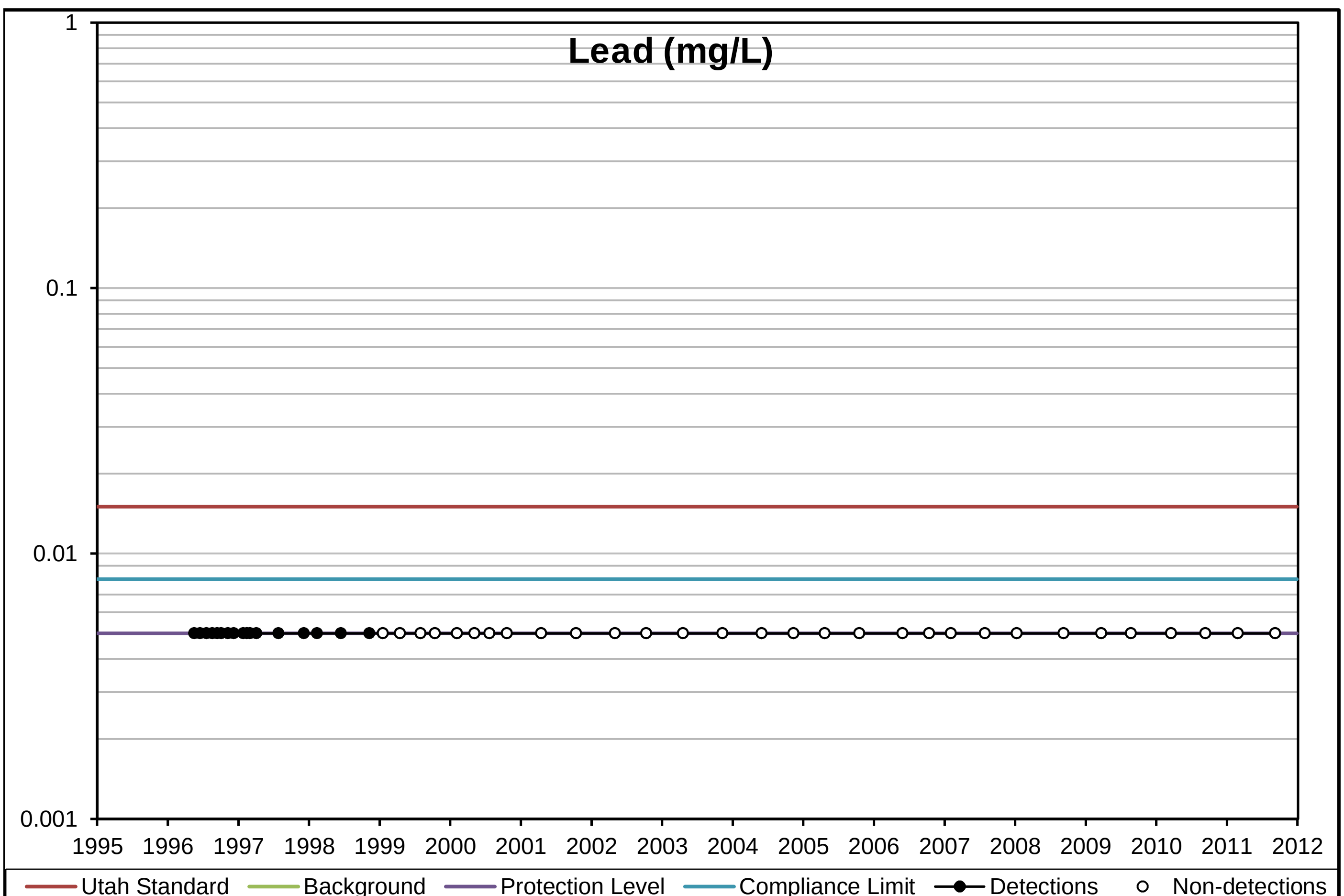


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NEM1387

Concentration Versus Year



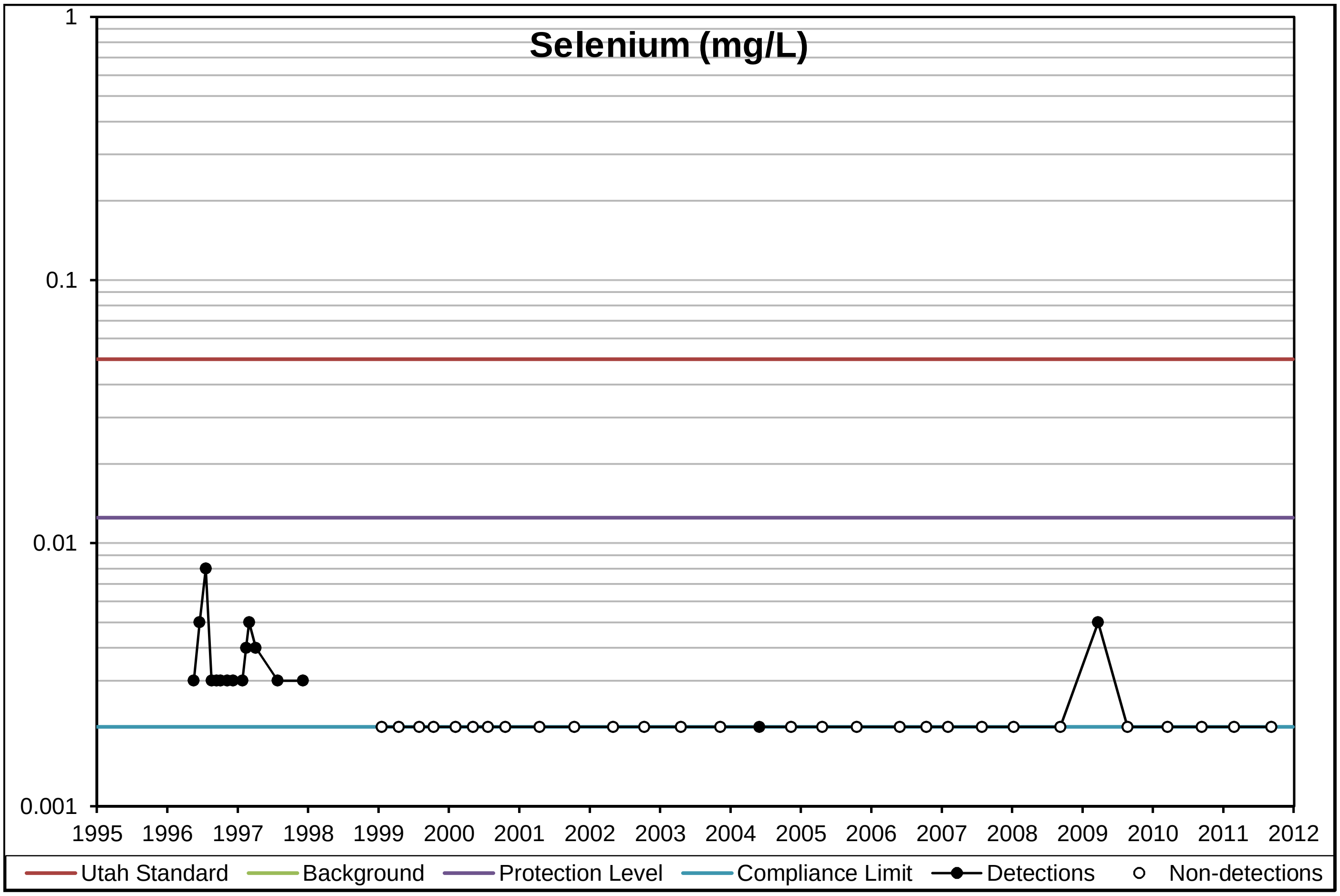


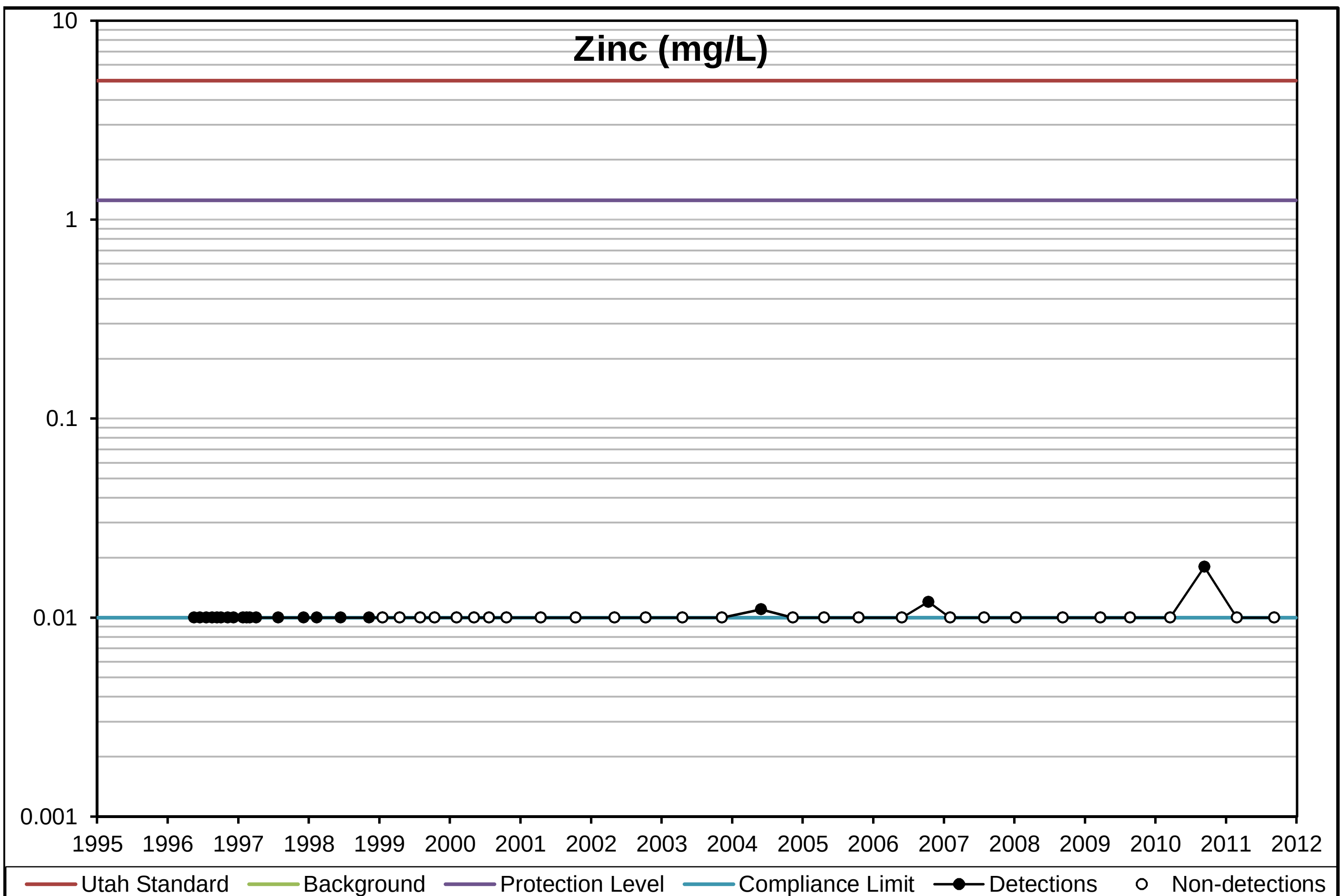
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEM1387

Concentration Versus Year



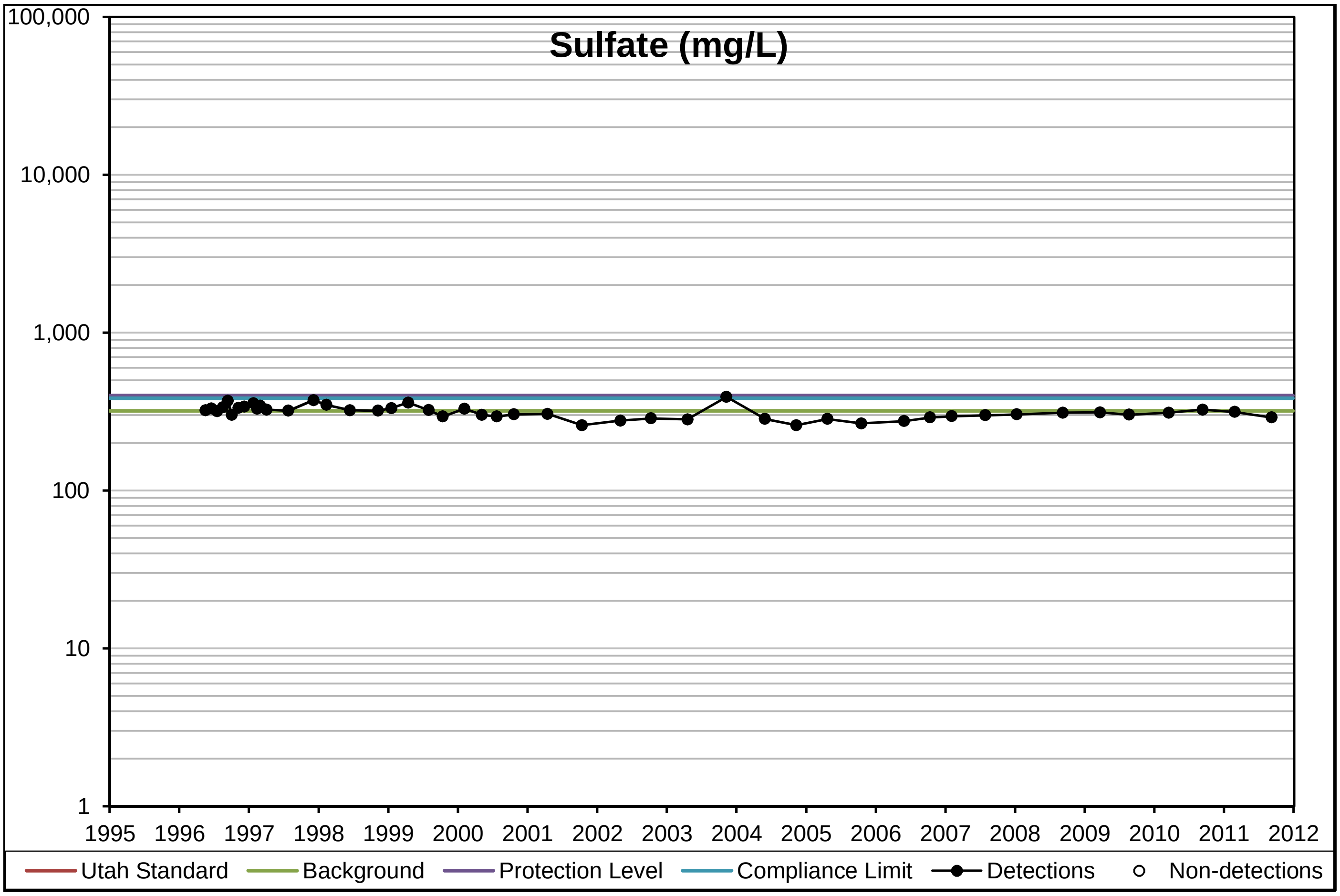


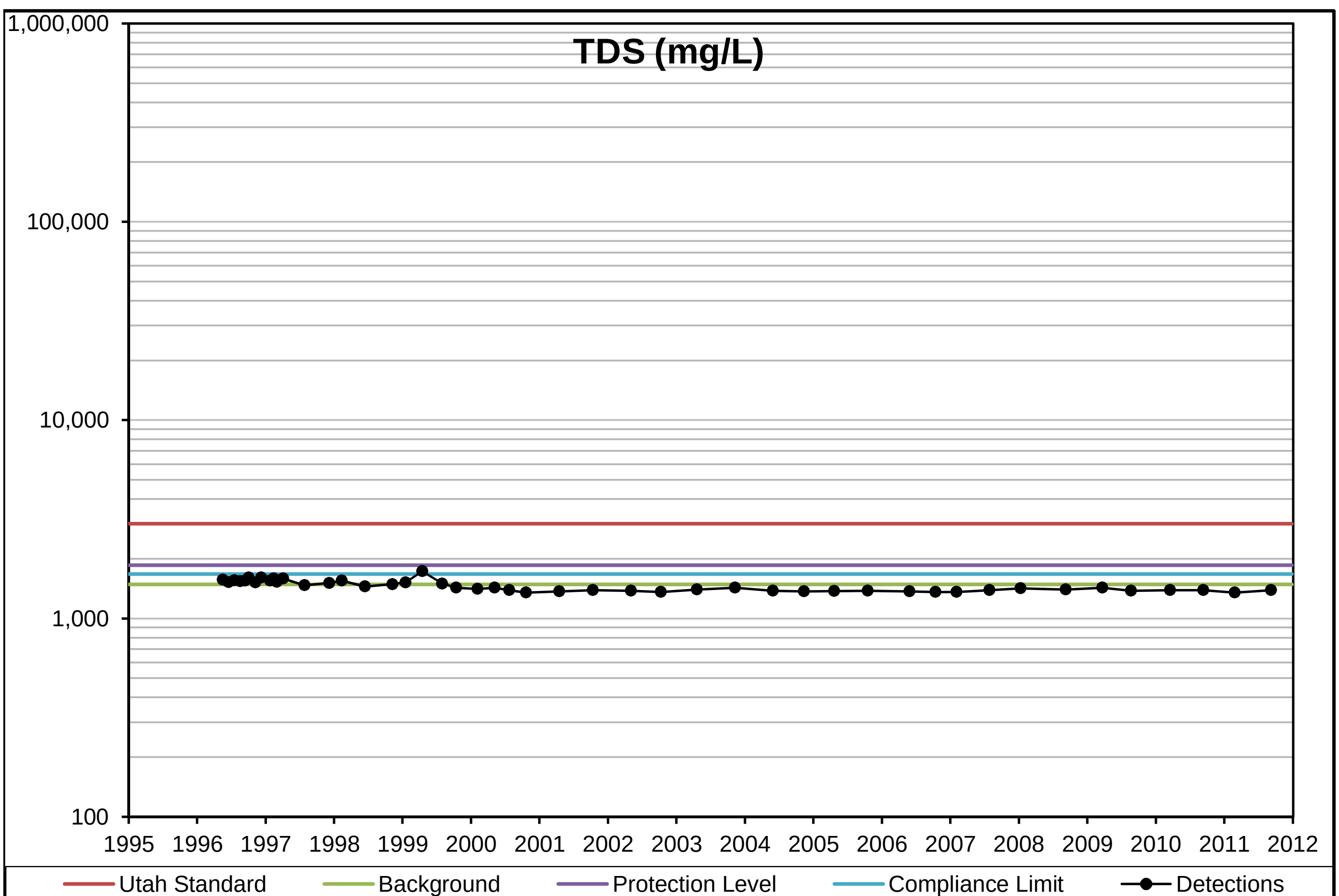
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEM1387

Concentration Versus Year



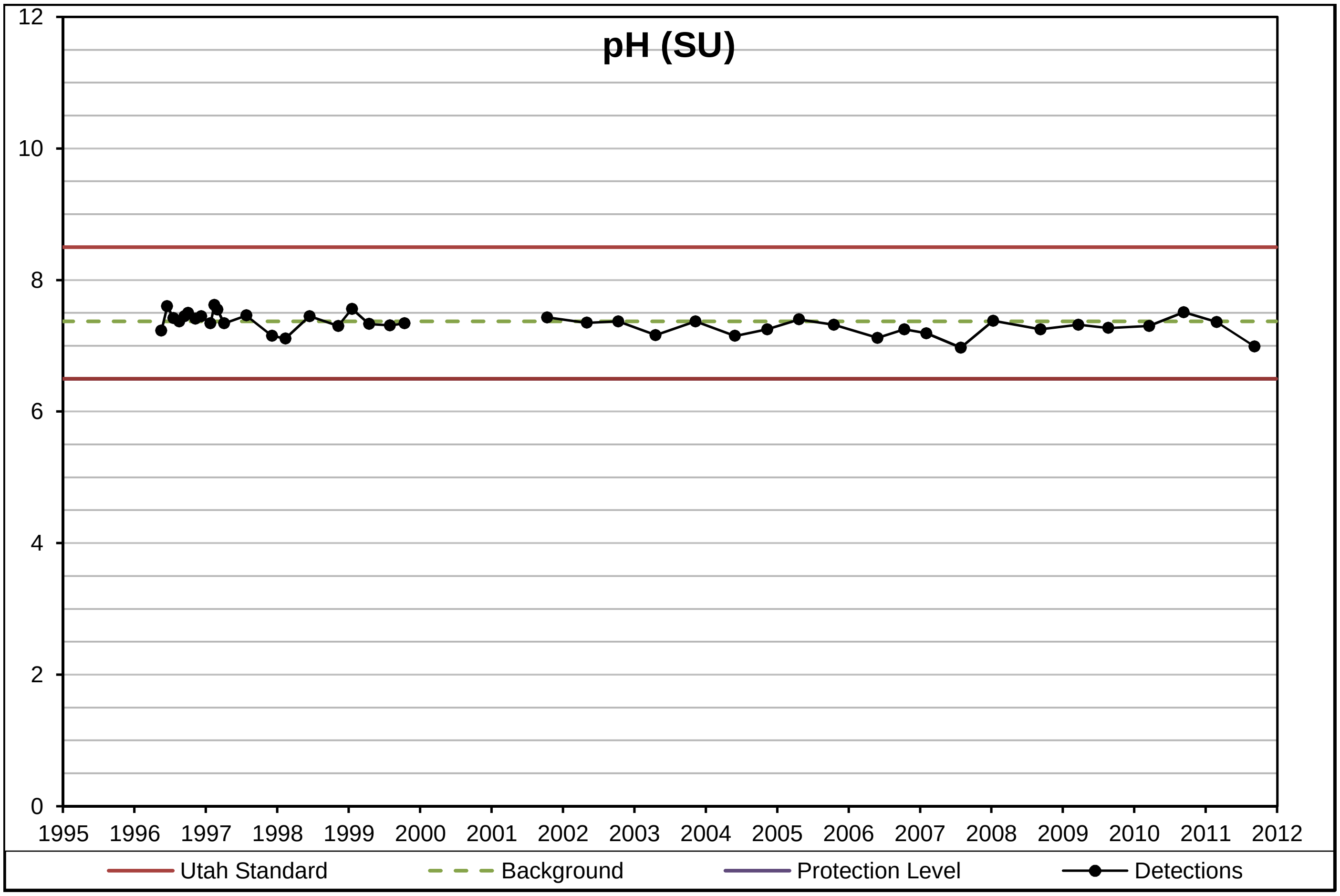


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NEM1387

Concentration Versus Year

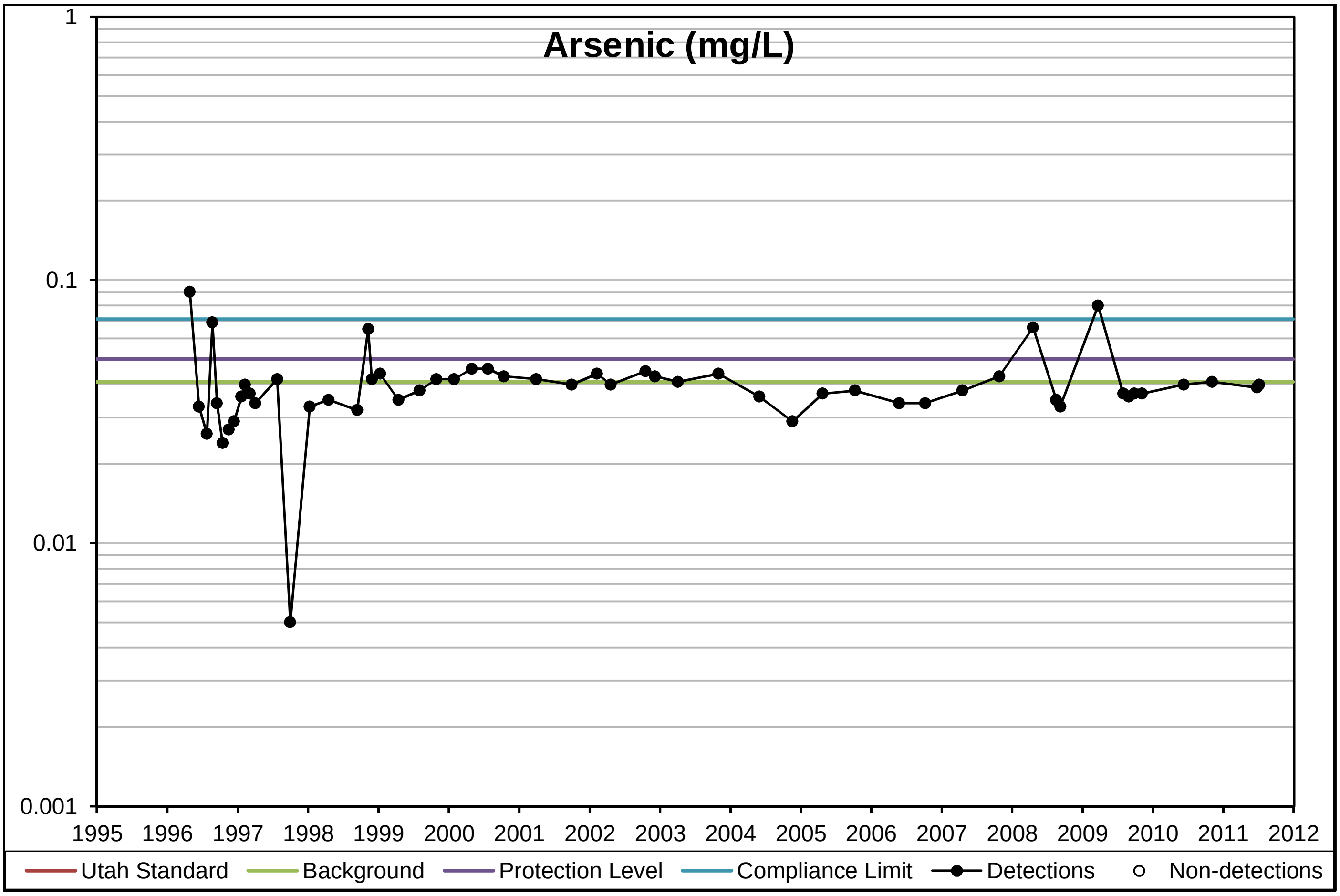


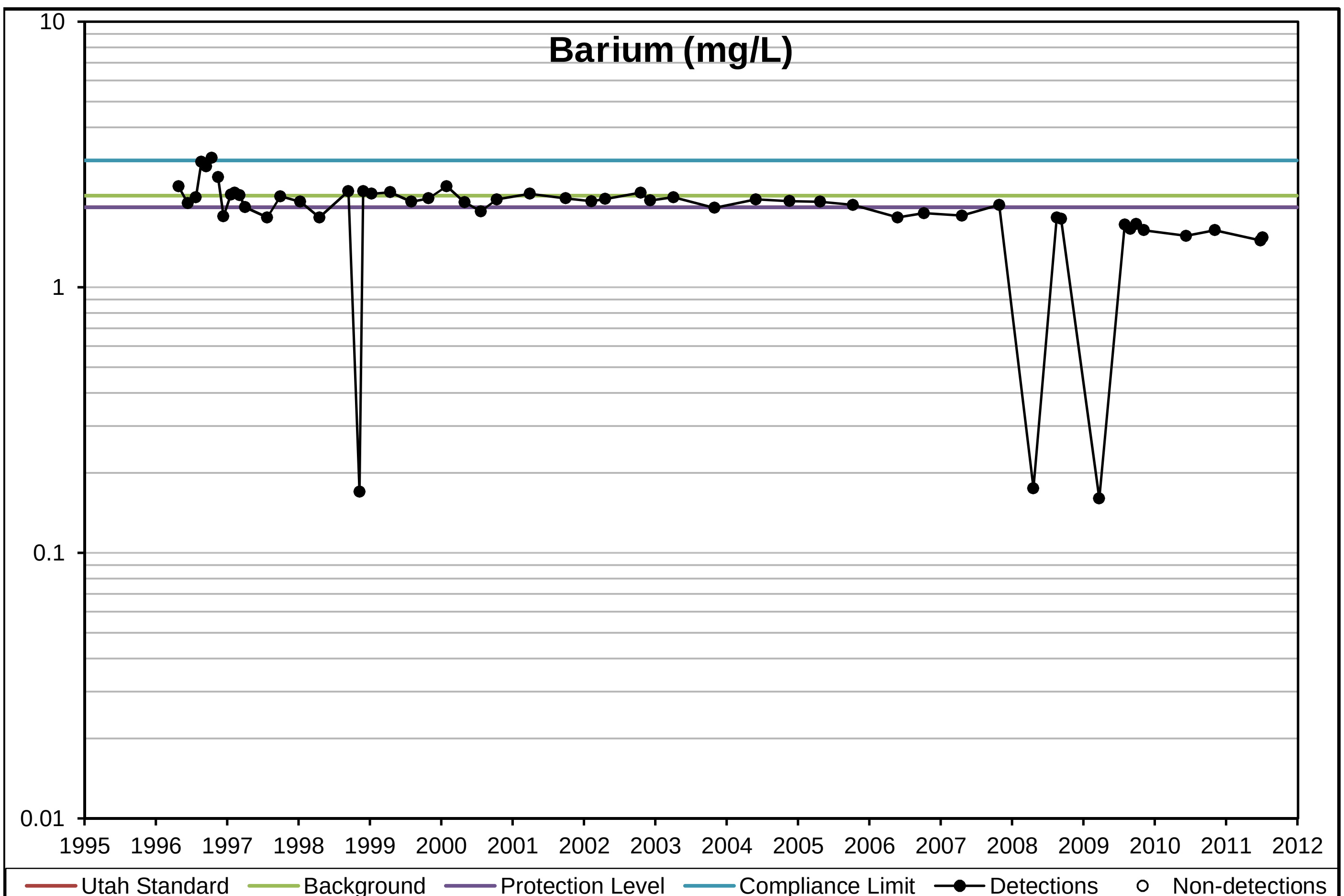
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year



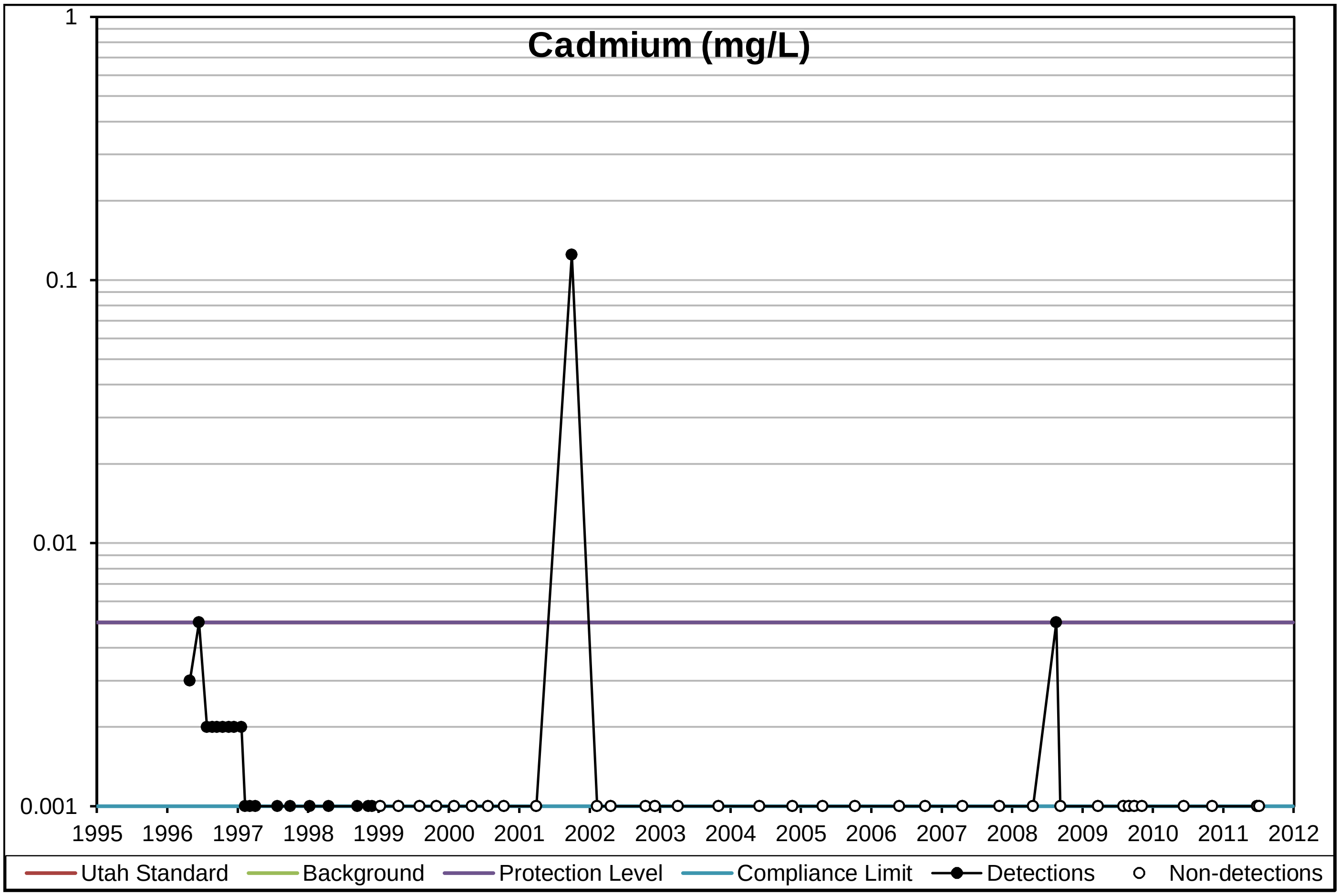


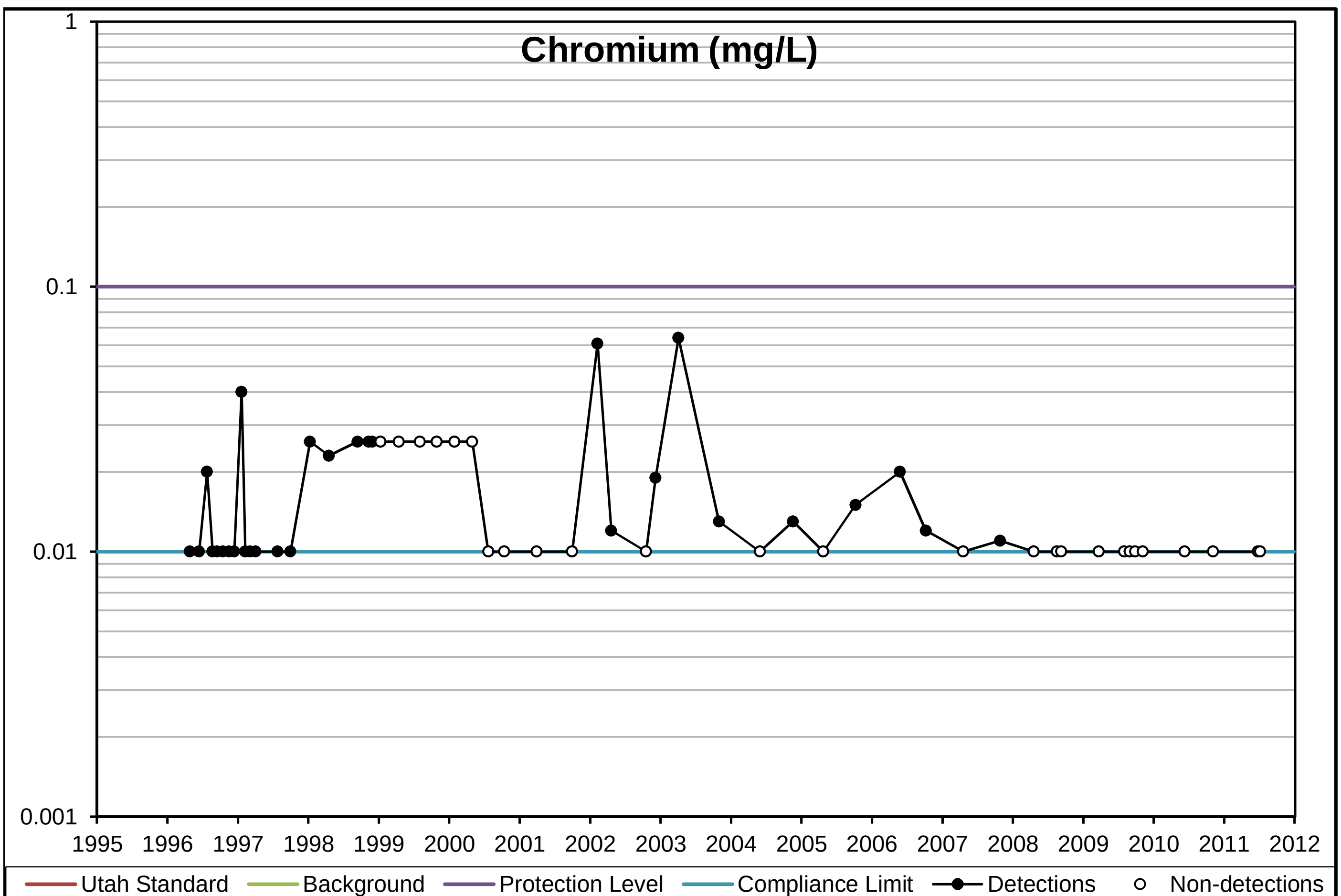
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year

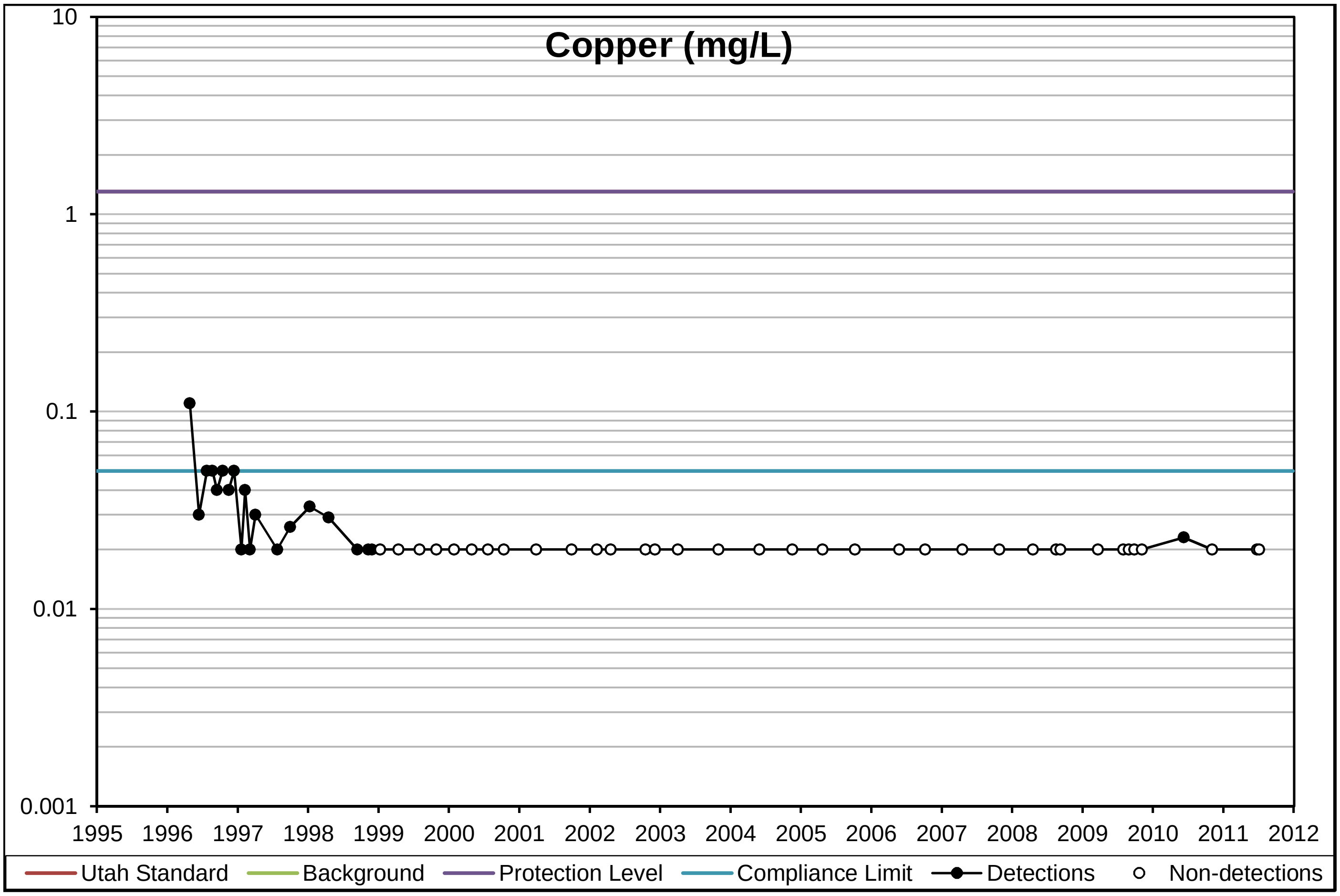


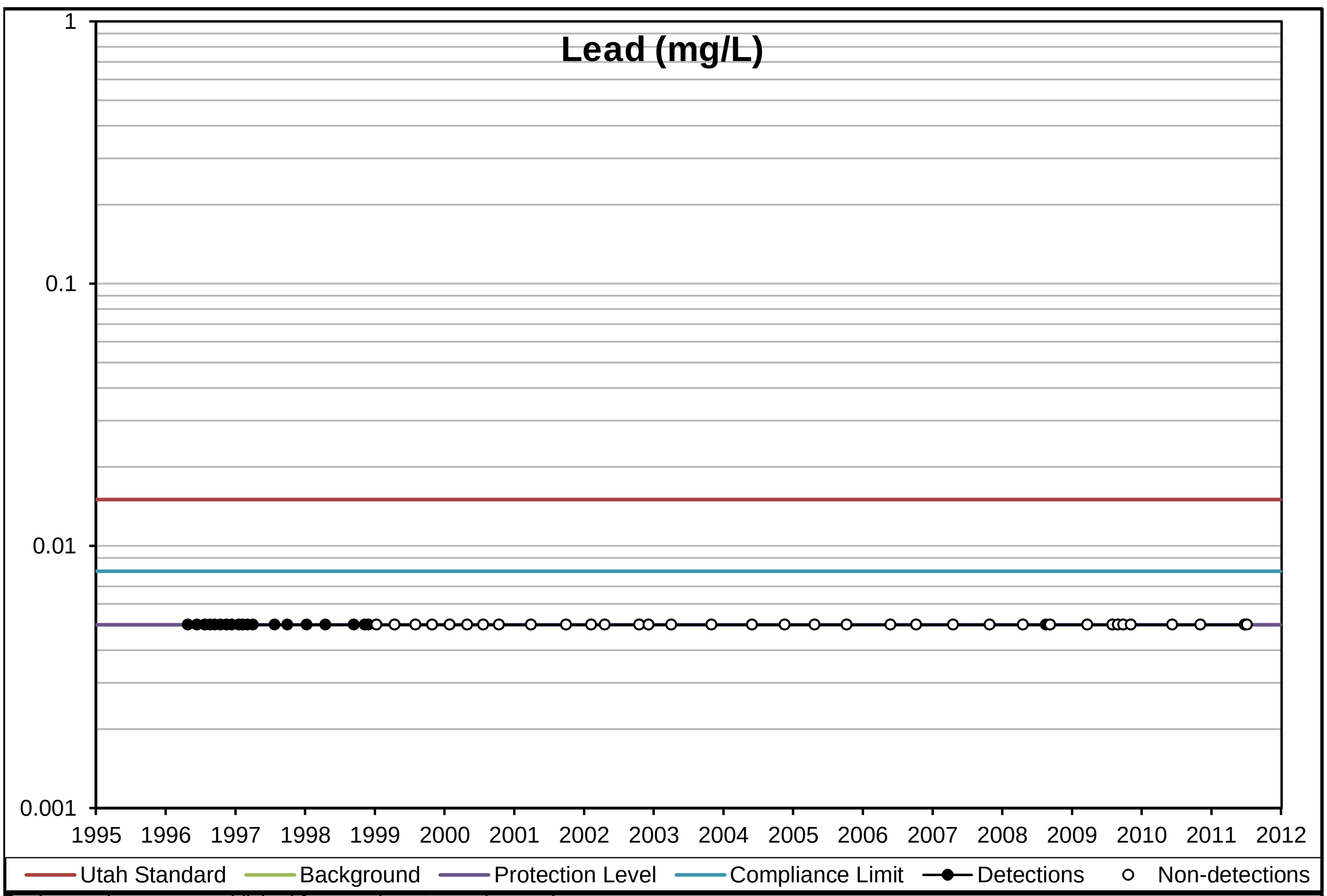


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year



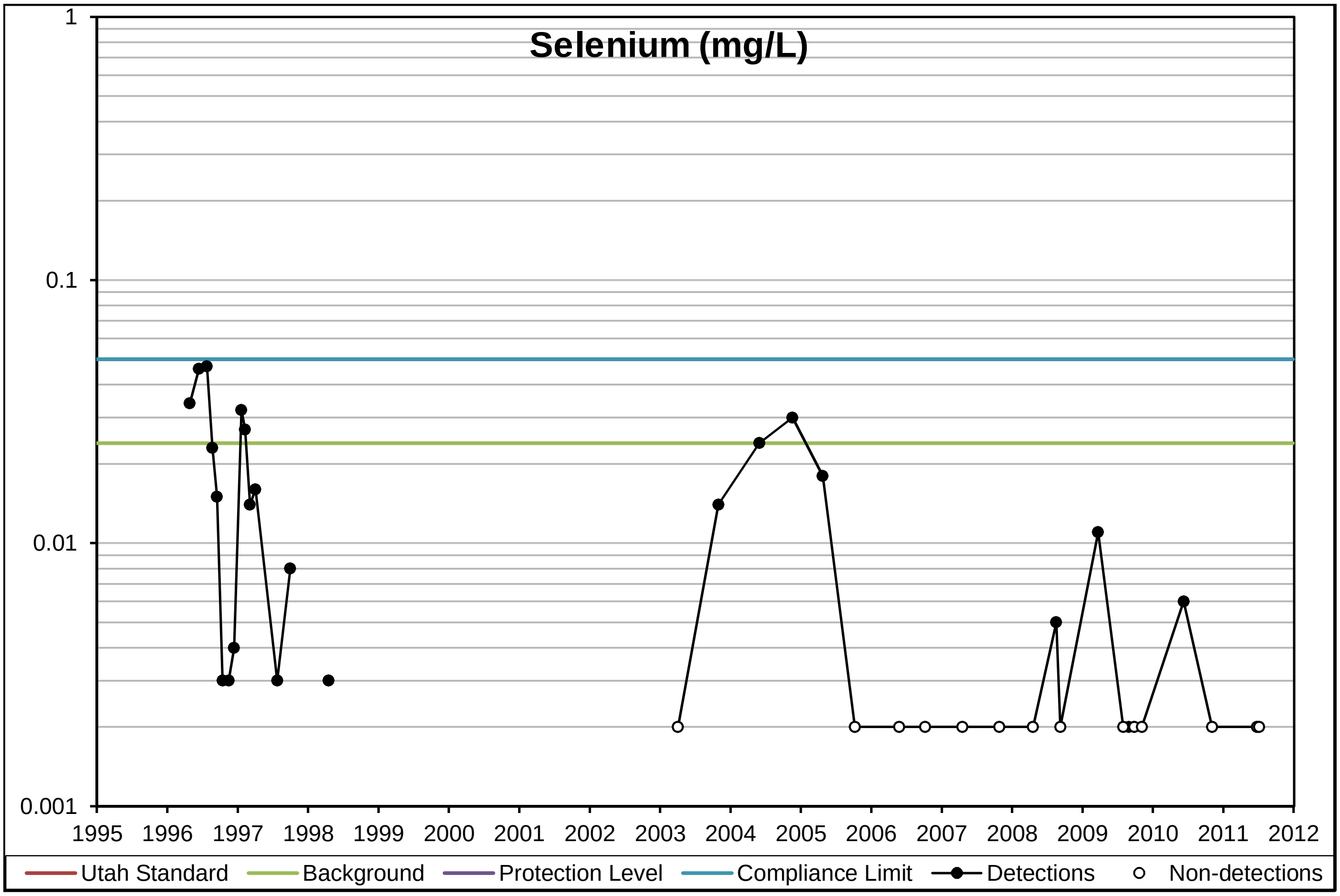


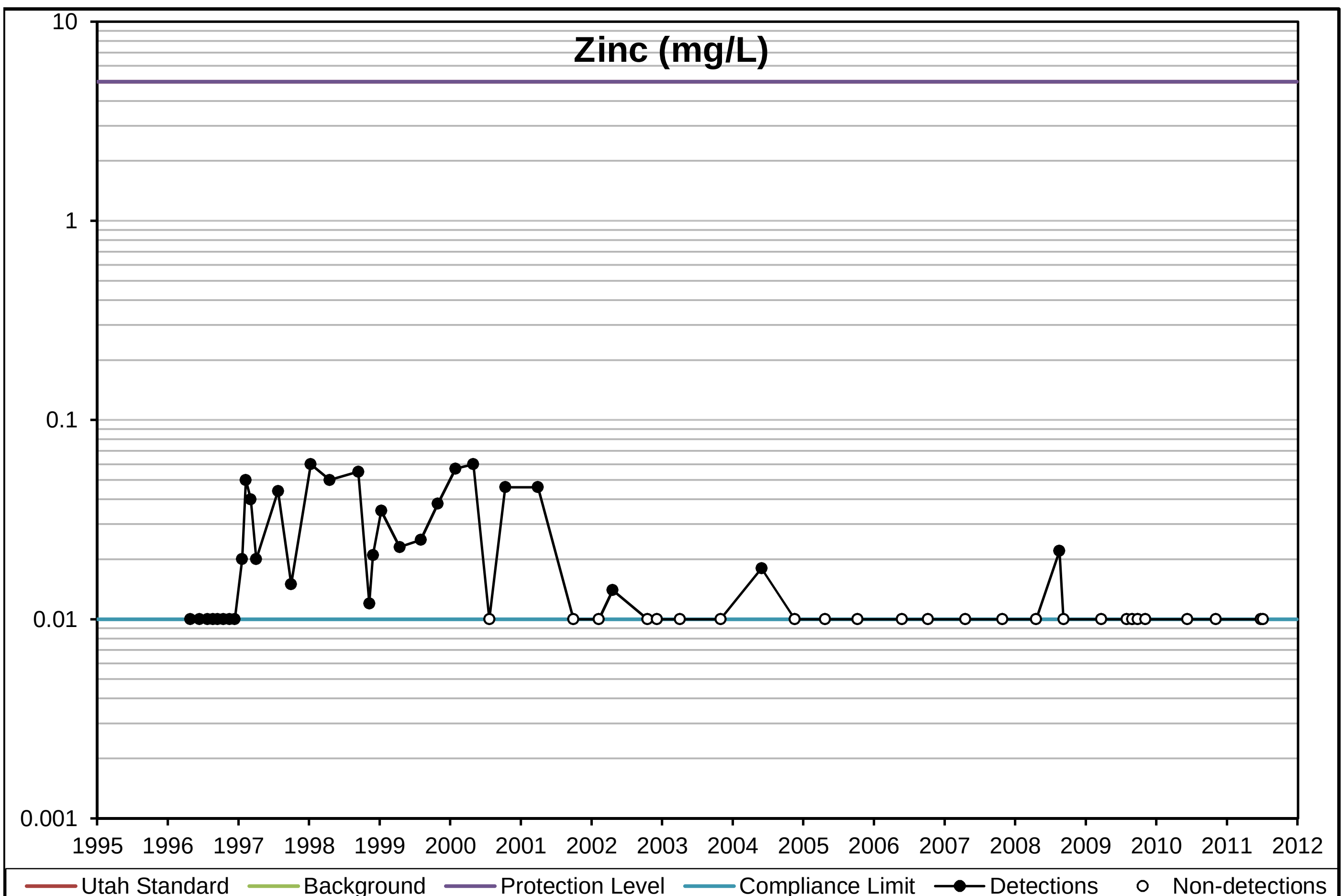
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year



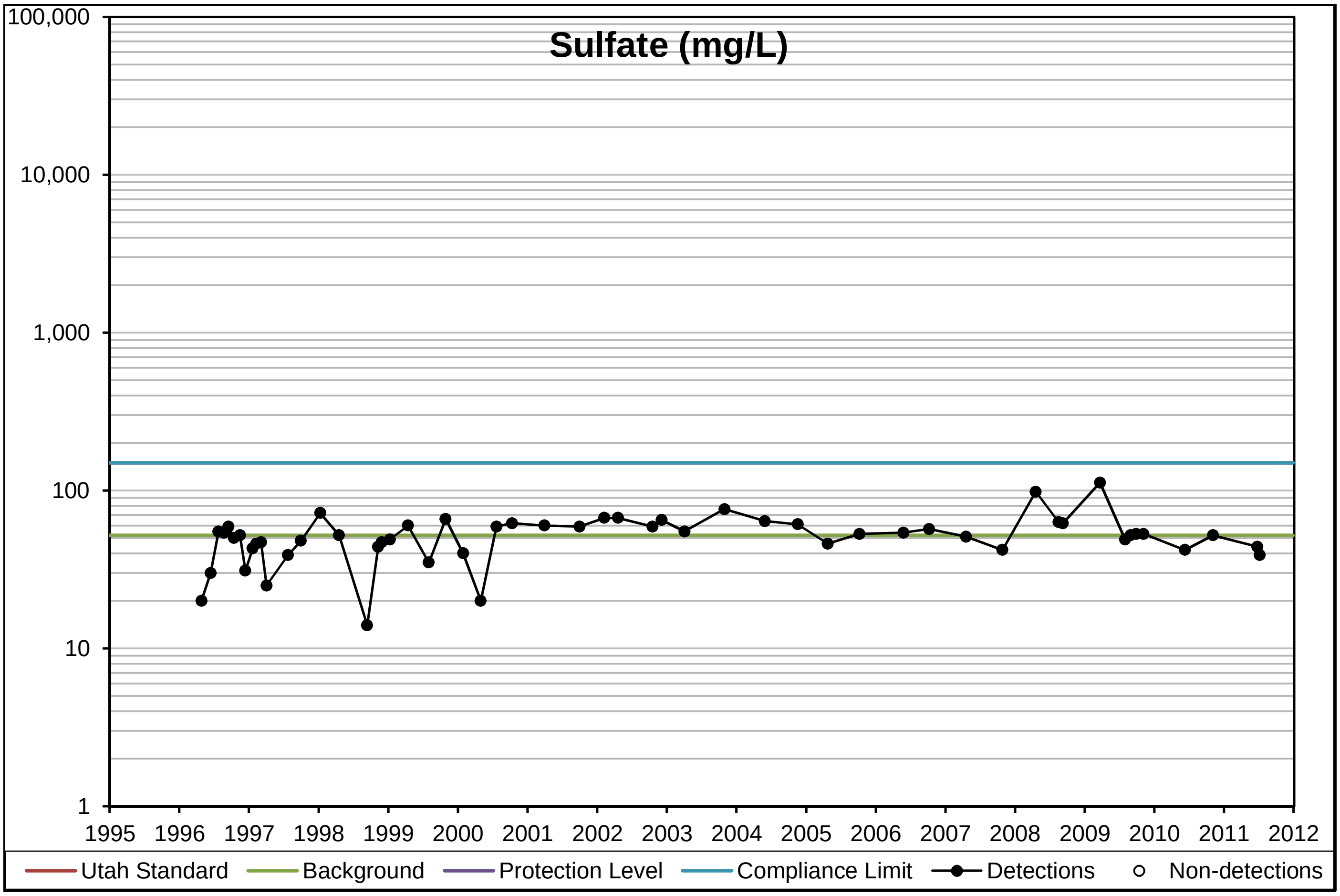


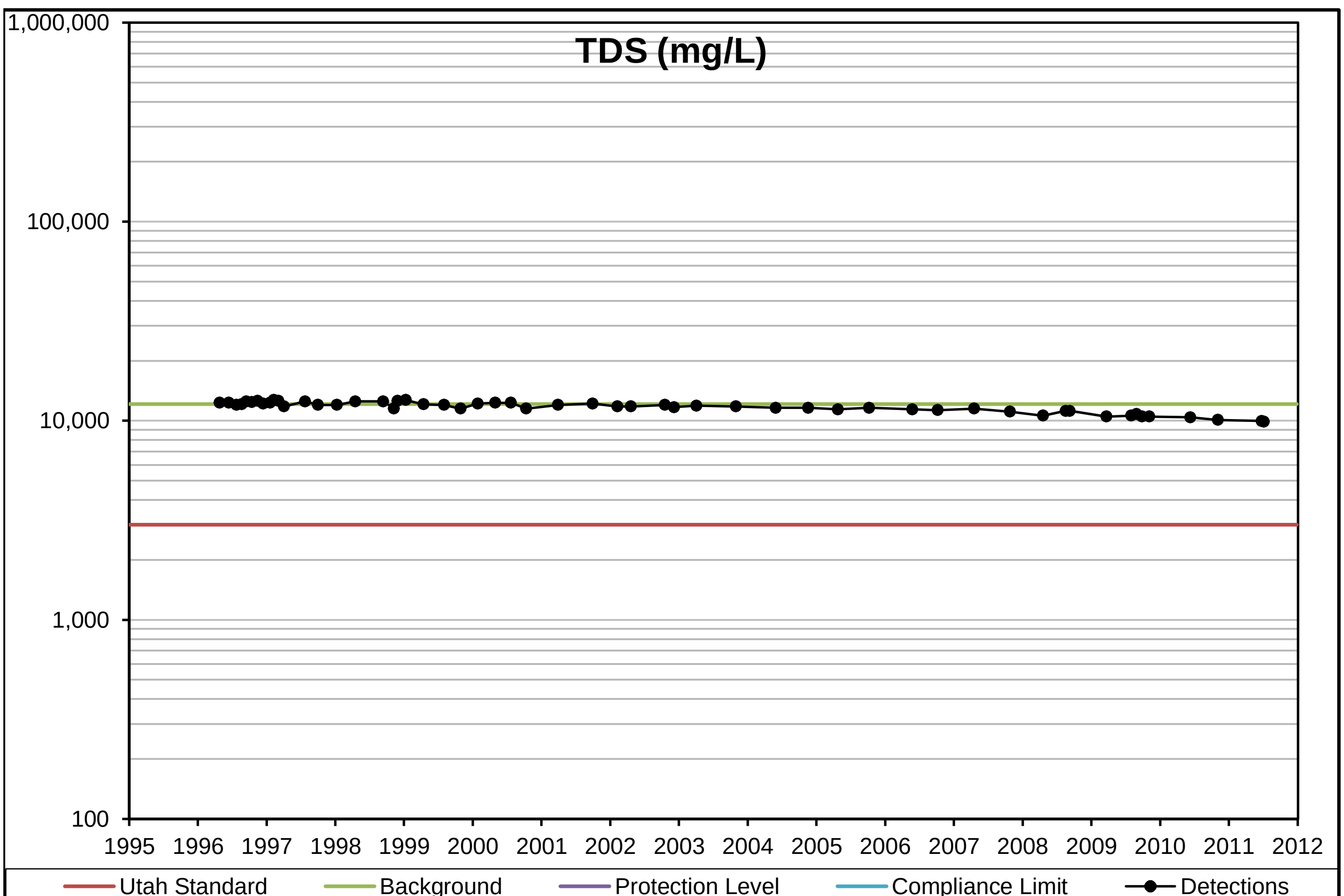
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year



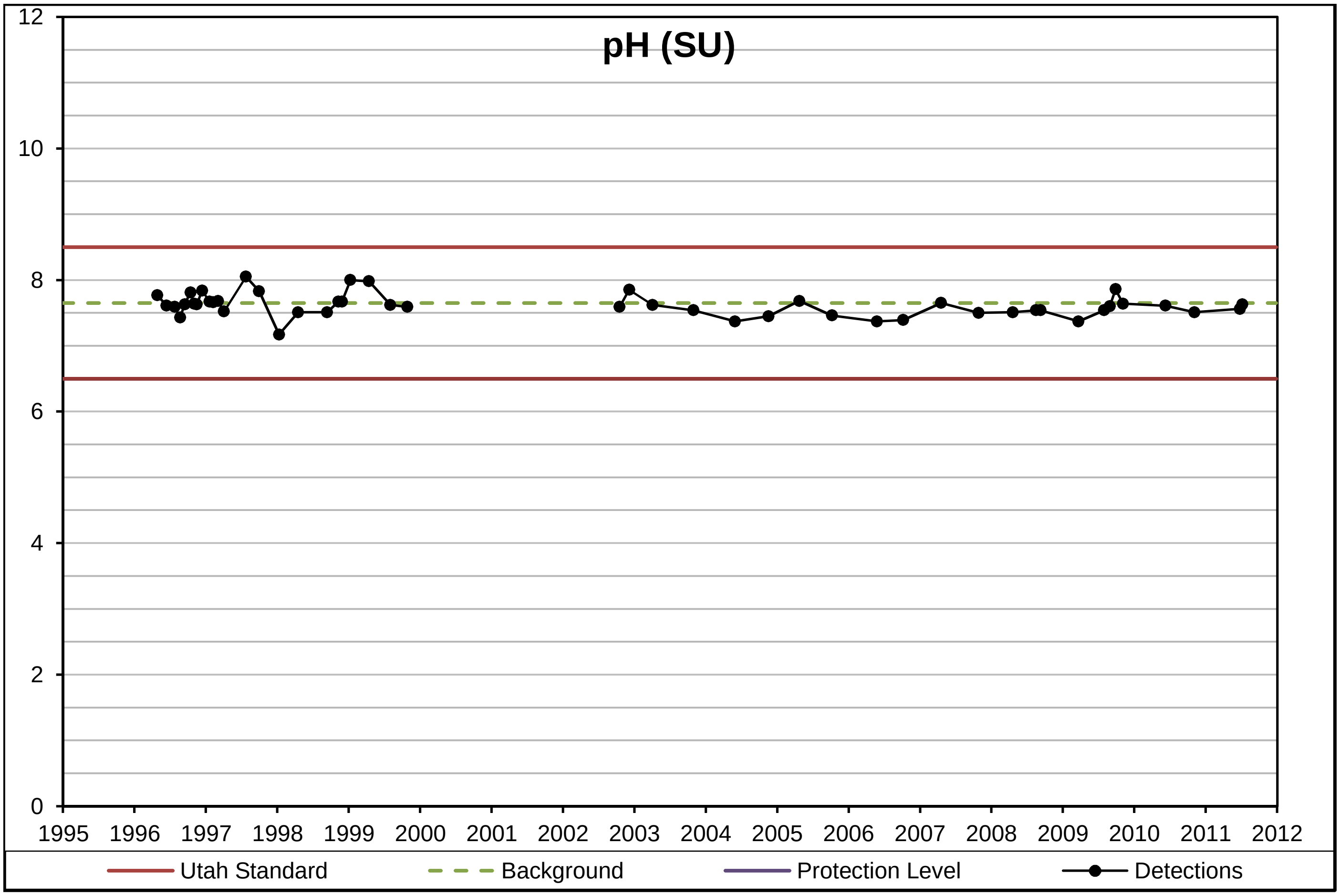


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393A

Concentration Versus Year



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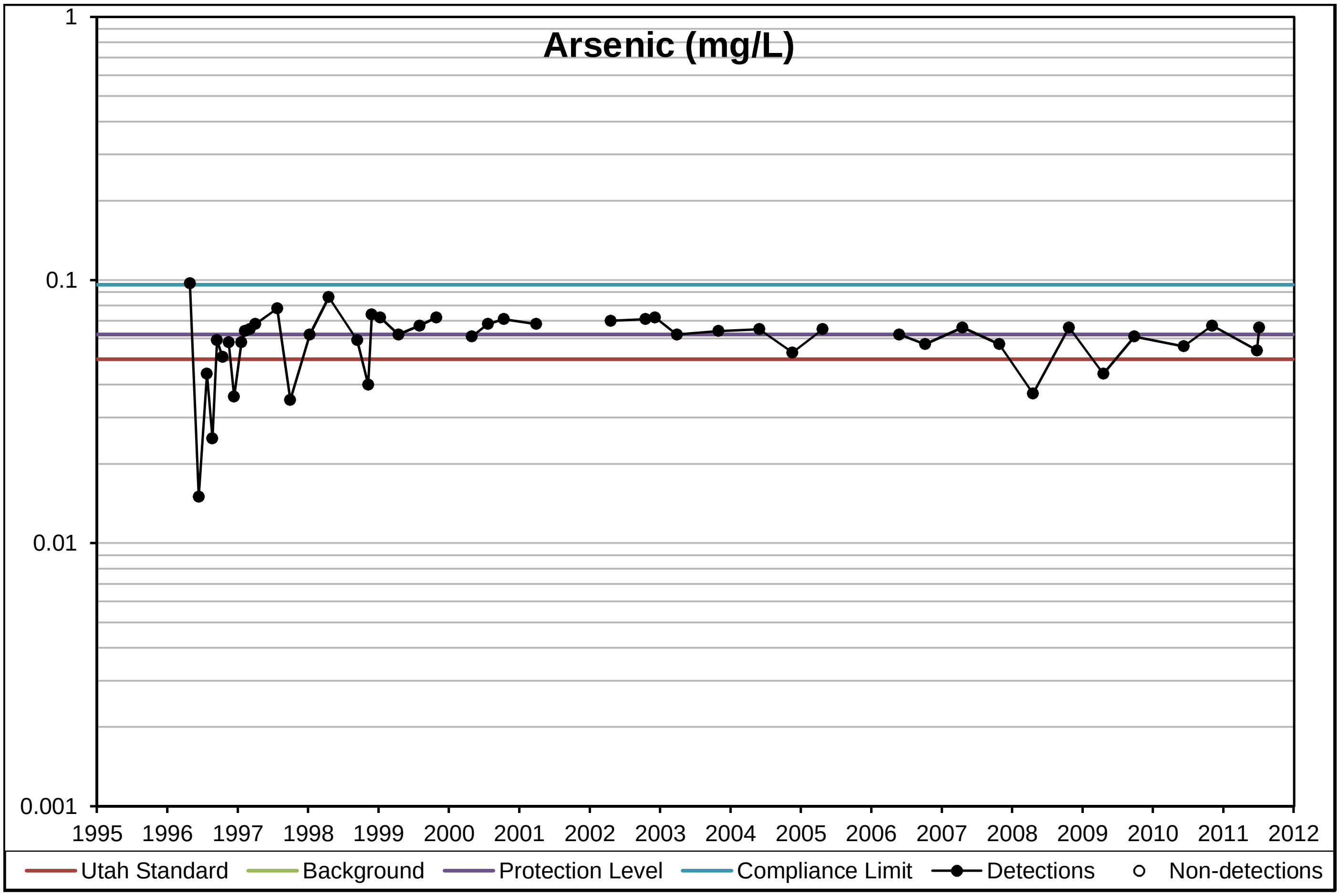
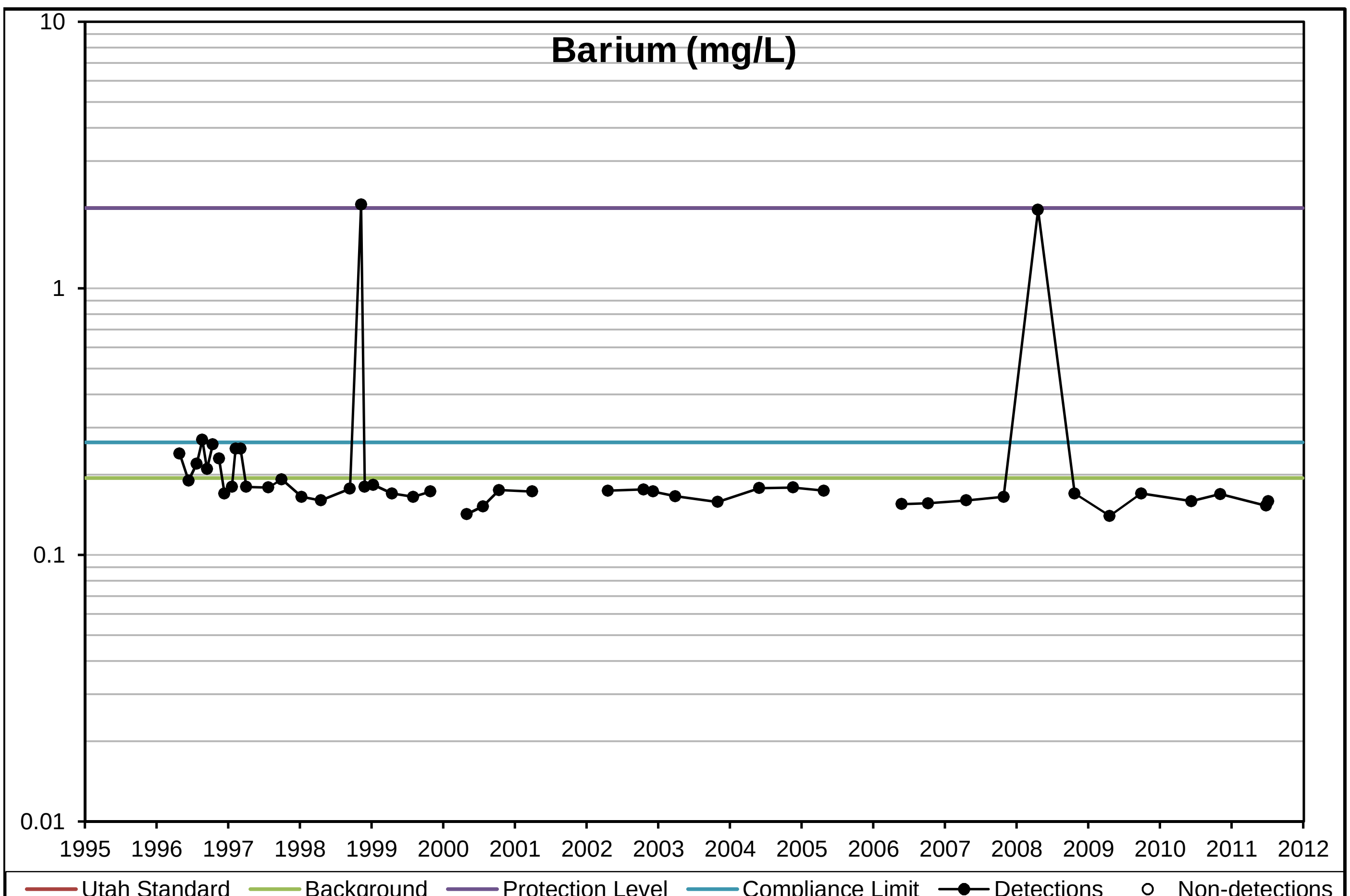
Constituent range includes minimum and maximum concentrations for all wells considered

NET1393B

Concentration Versus Year



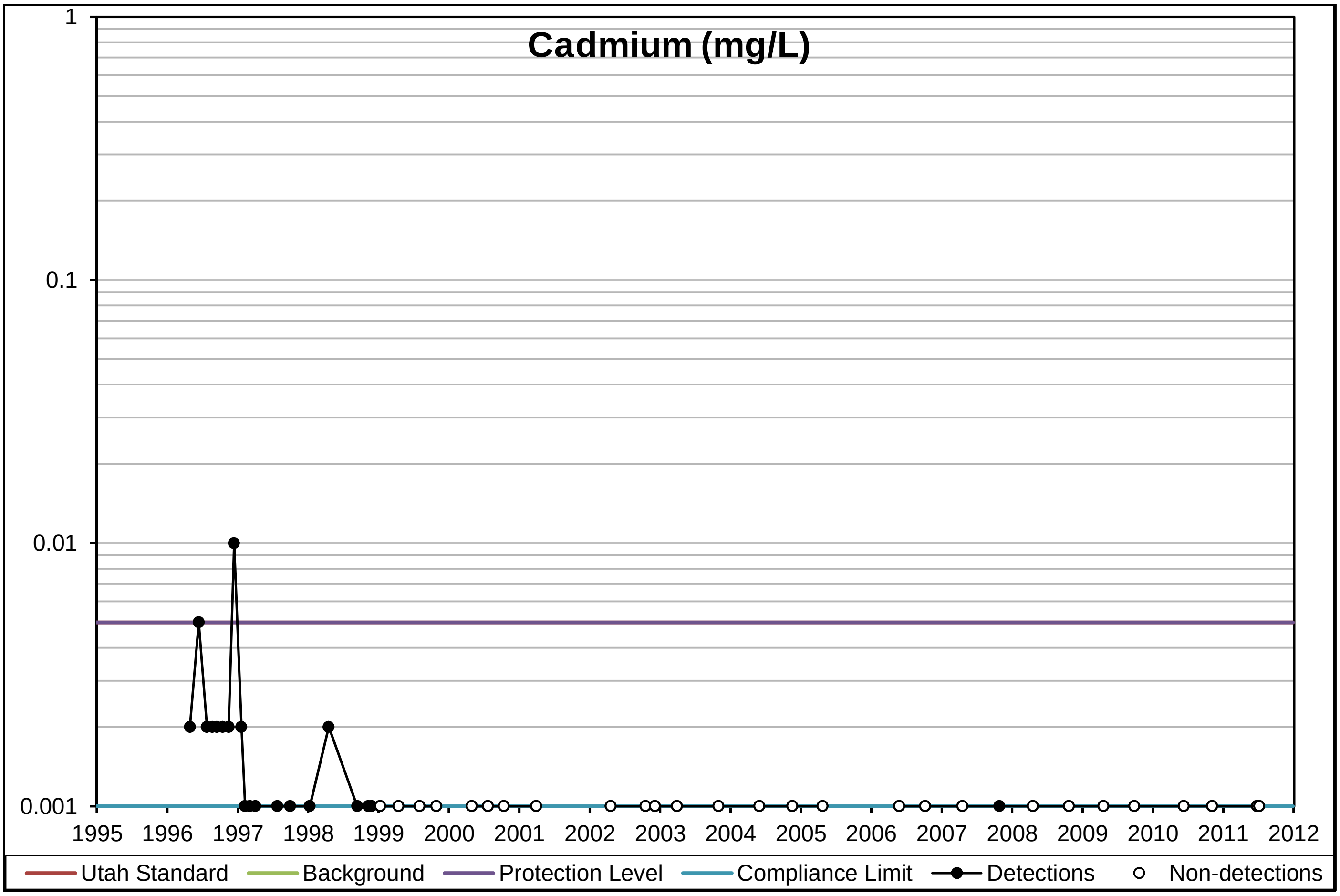


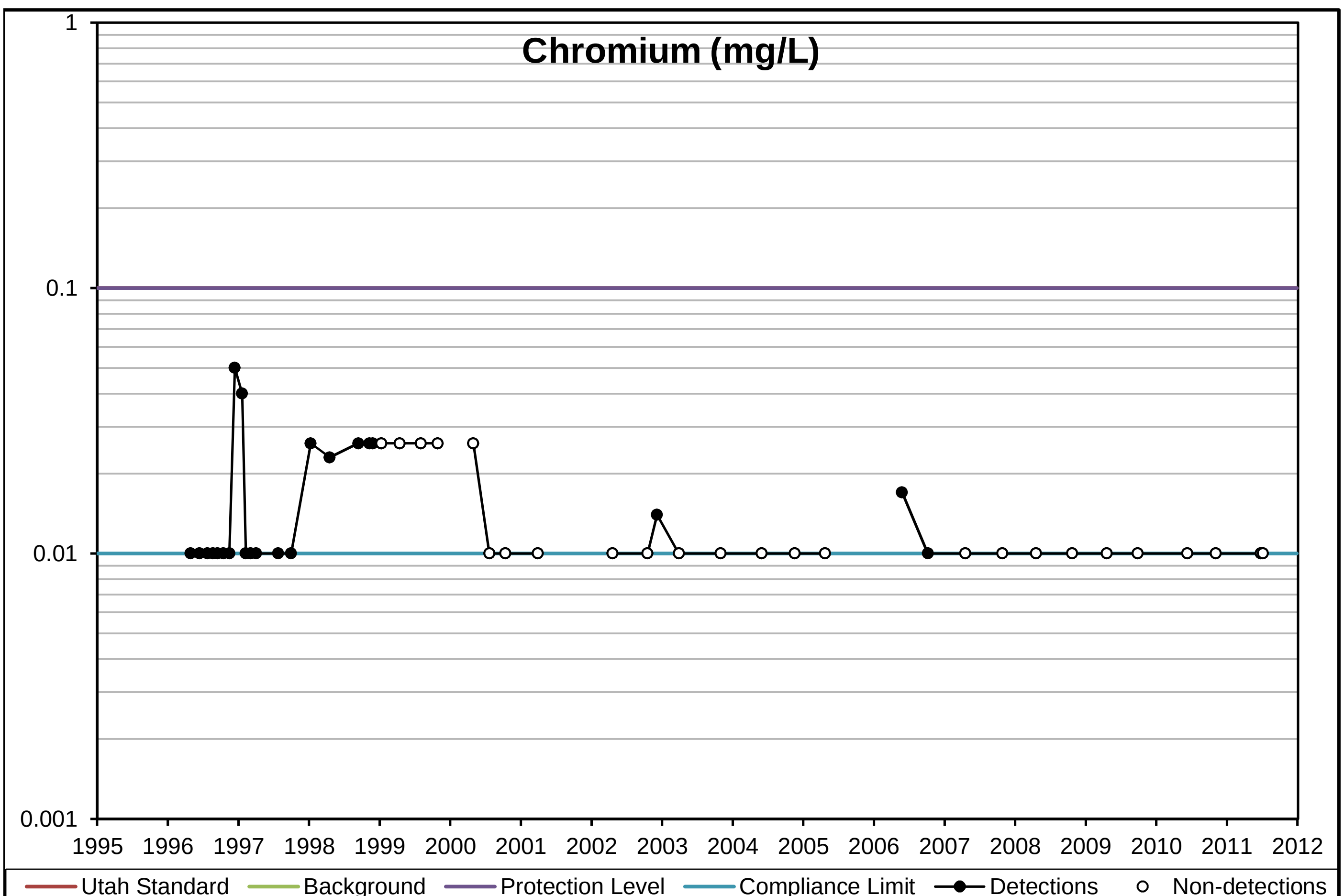
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393B

Concentration Versus Year



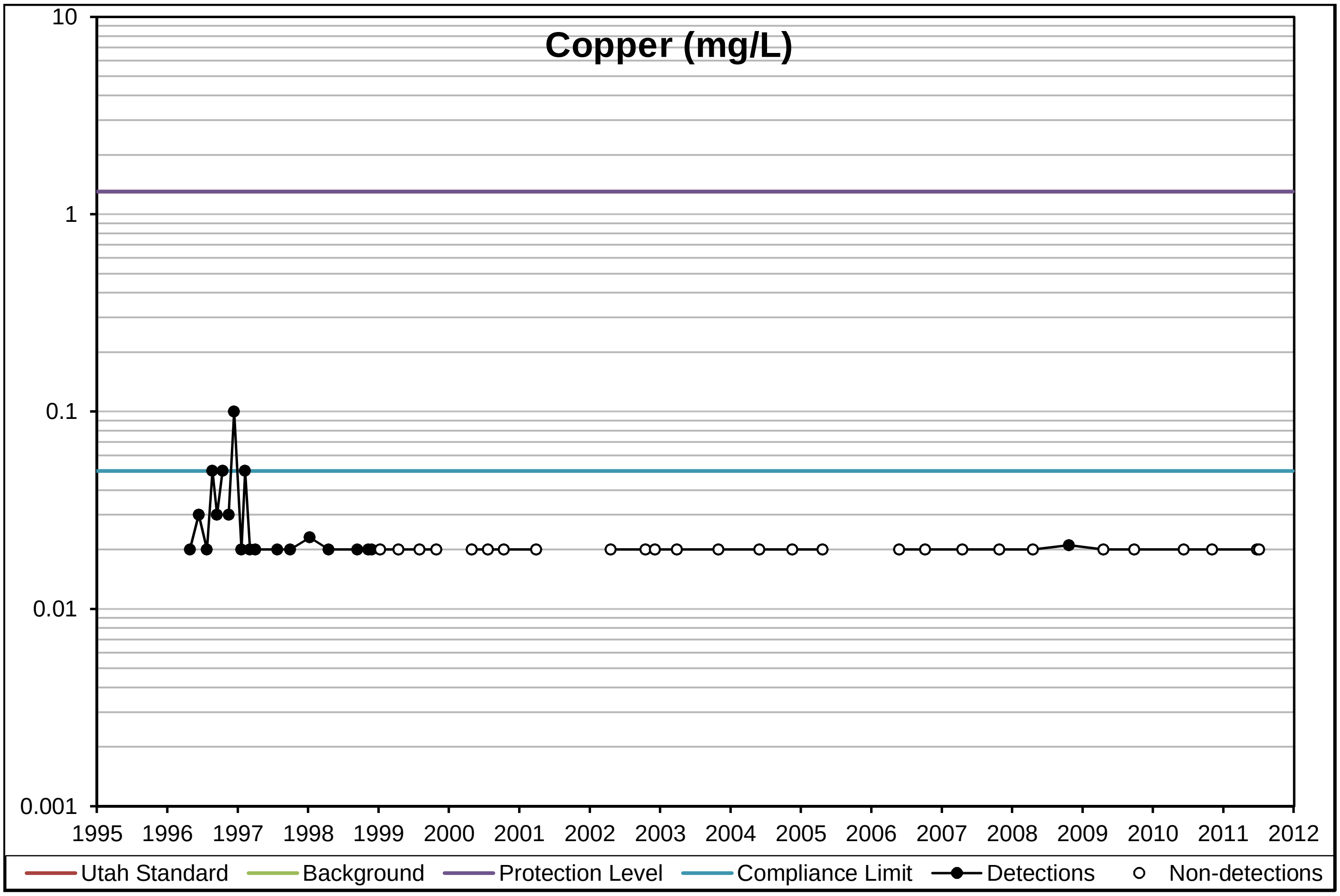


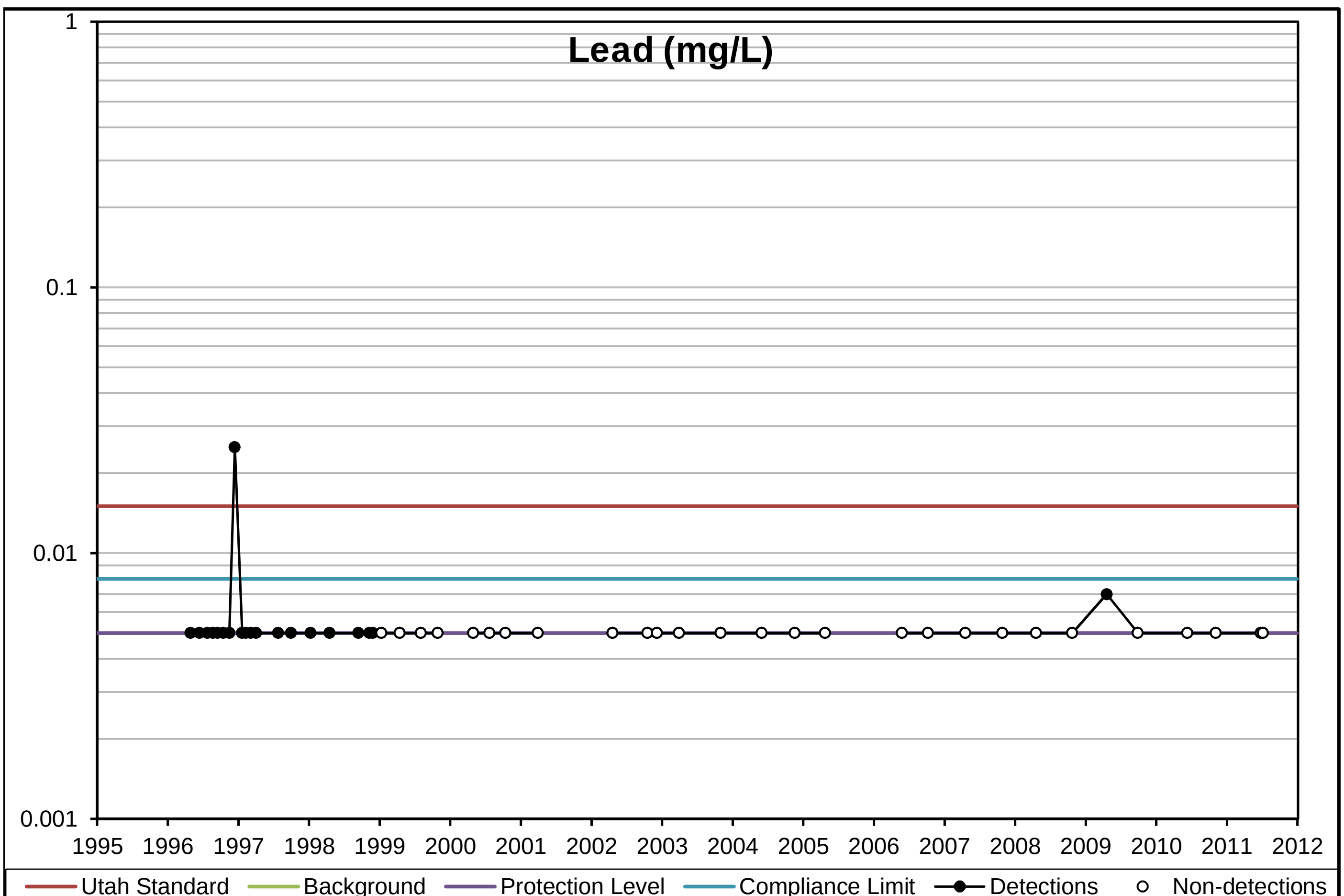
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393B

Concentration Versus Year



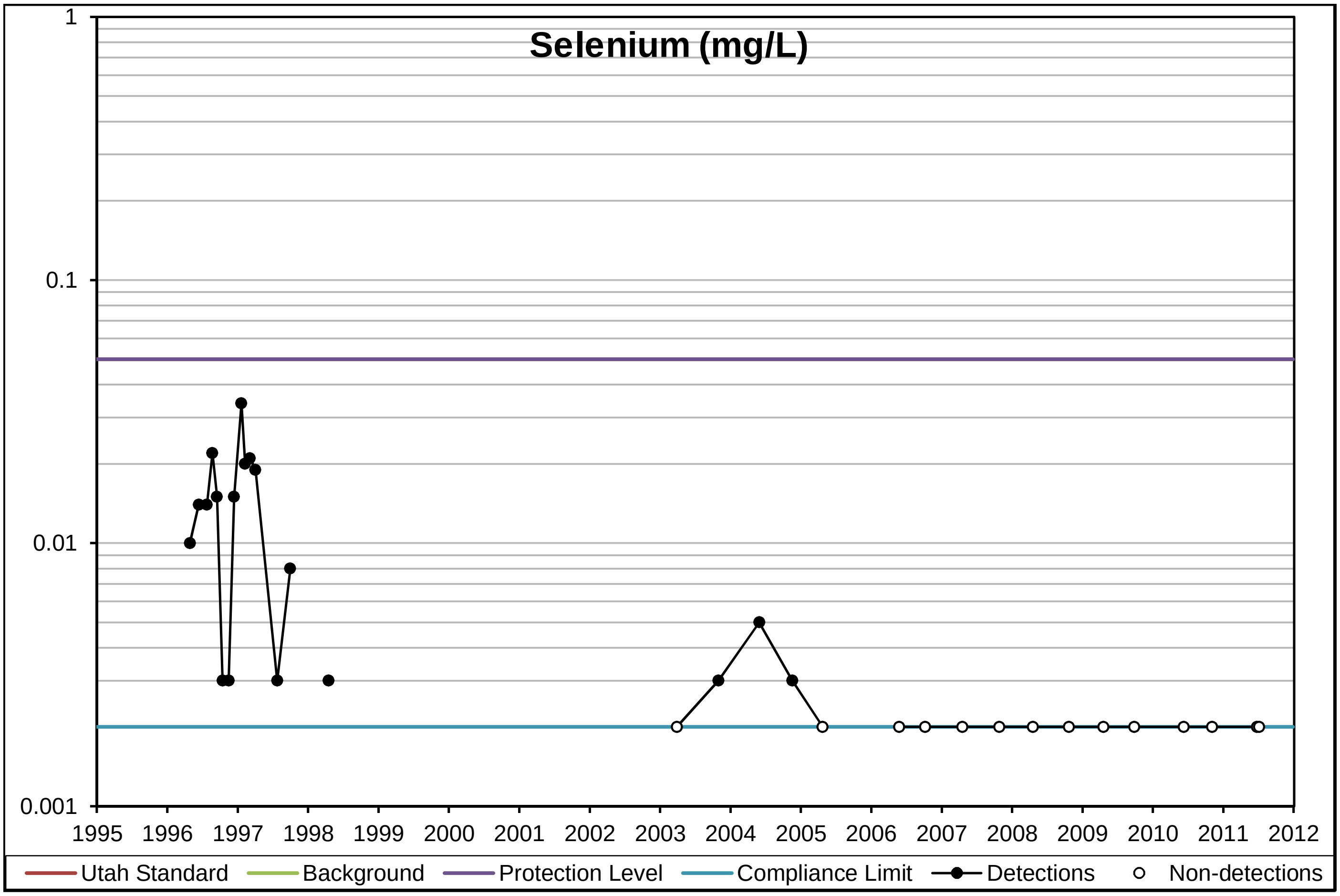


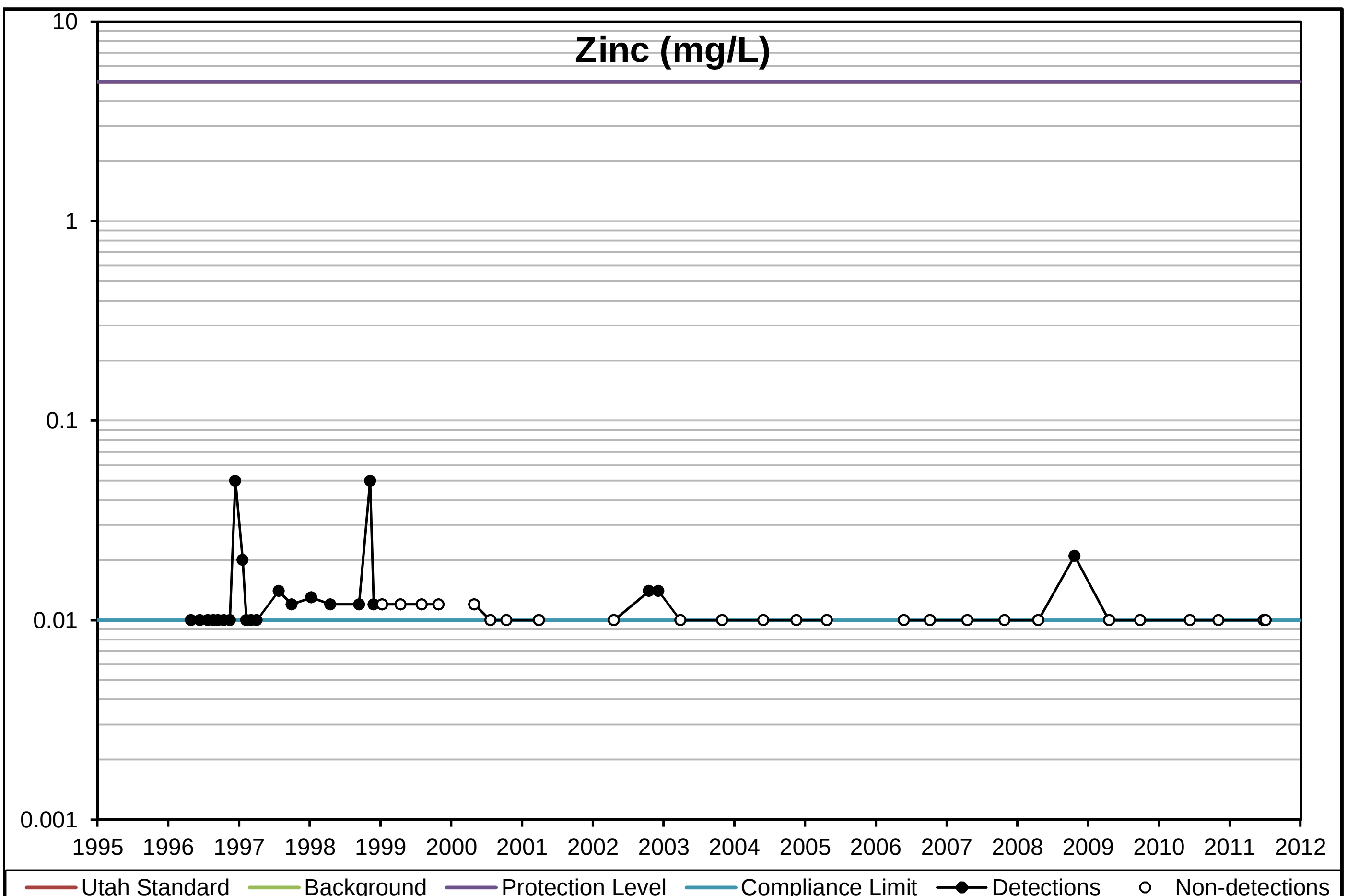
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393B

Concentration Versus Year



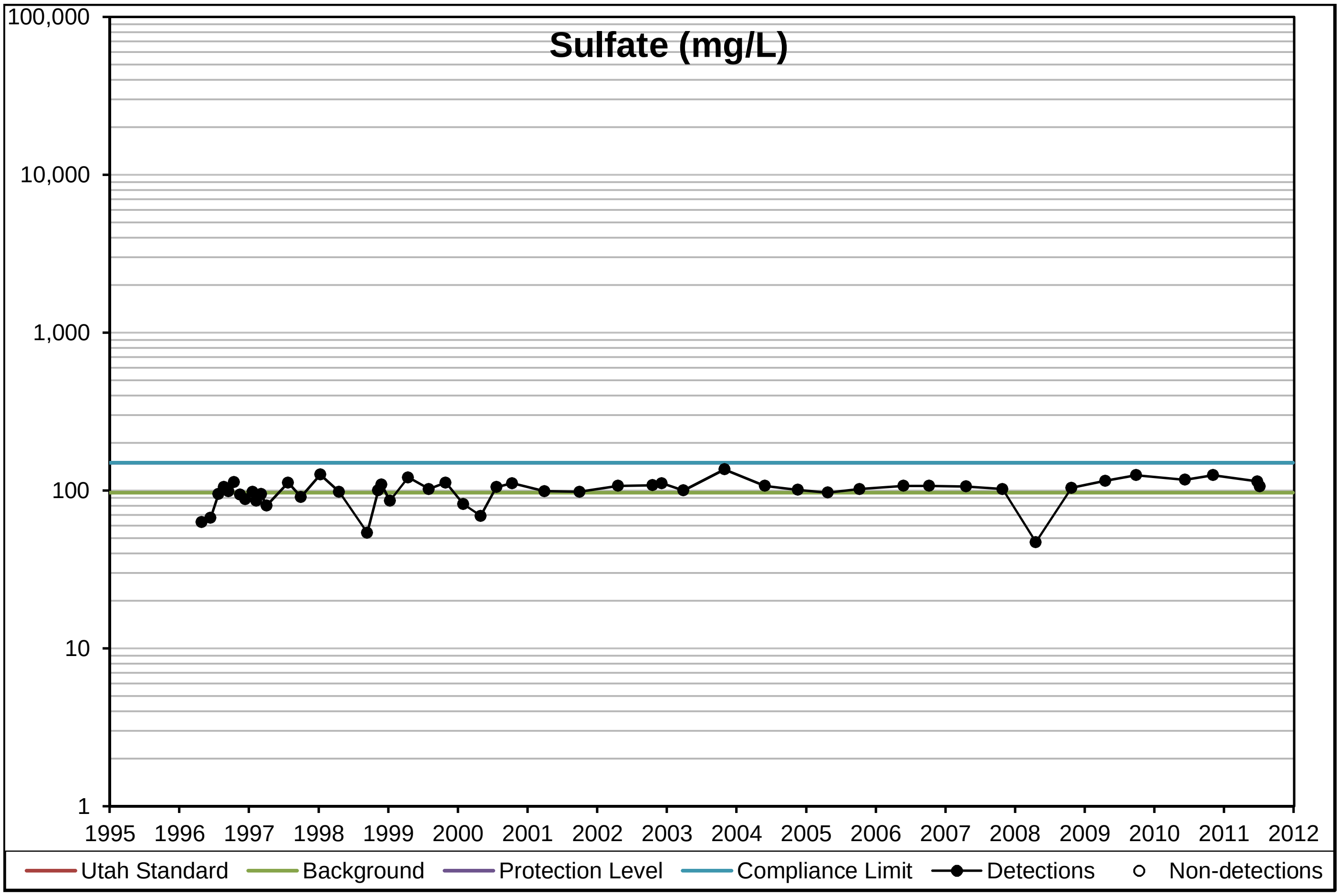


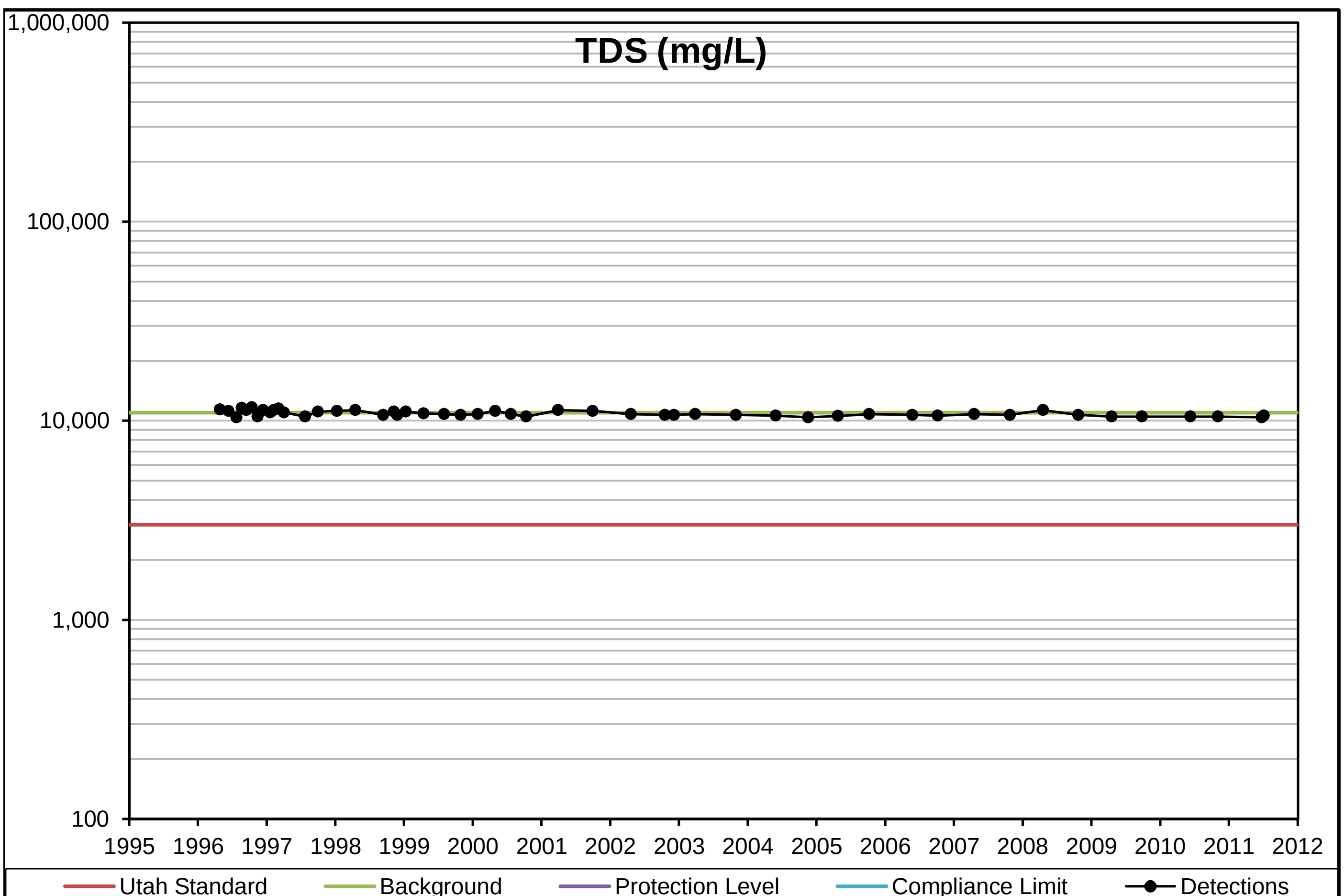
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1393B

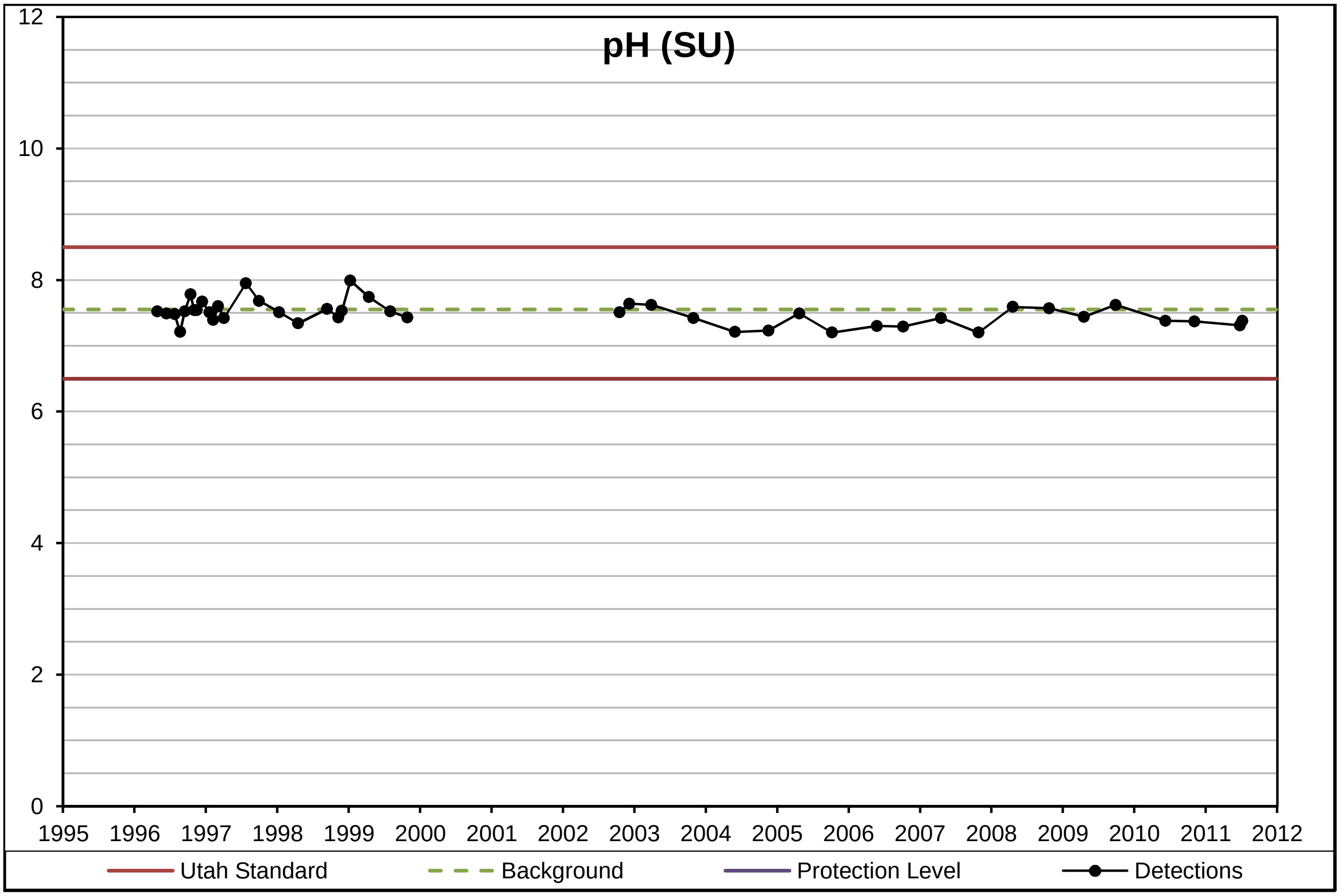
Concentration Versus Year





Background was not established for constituents not detected

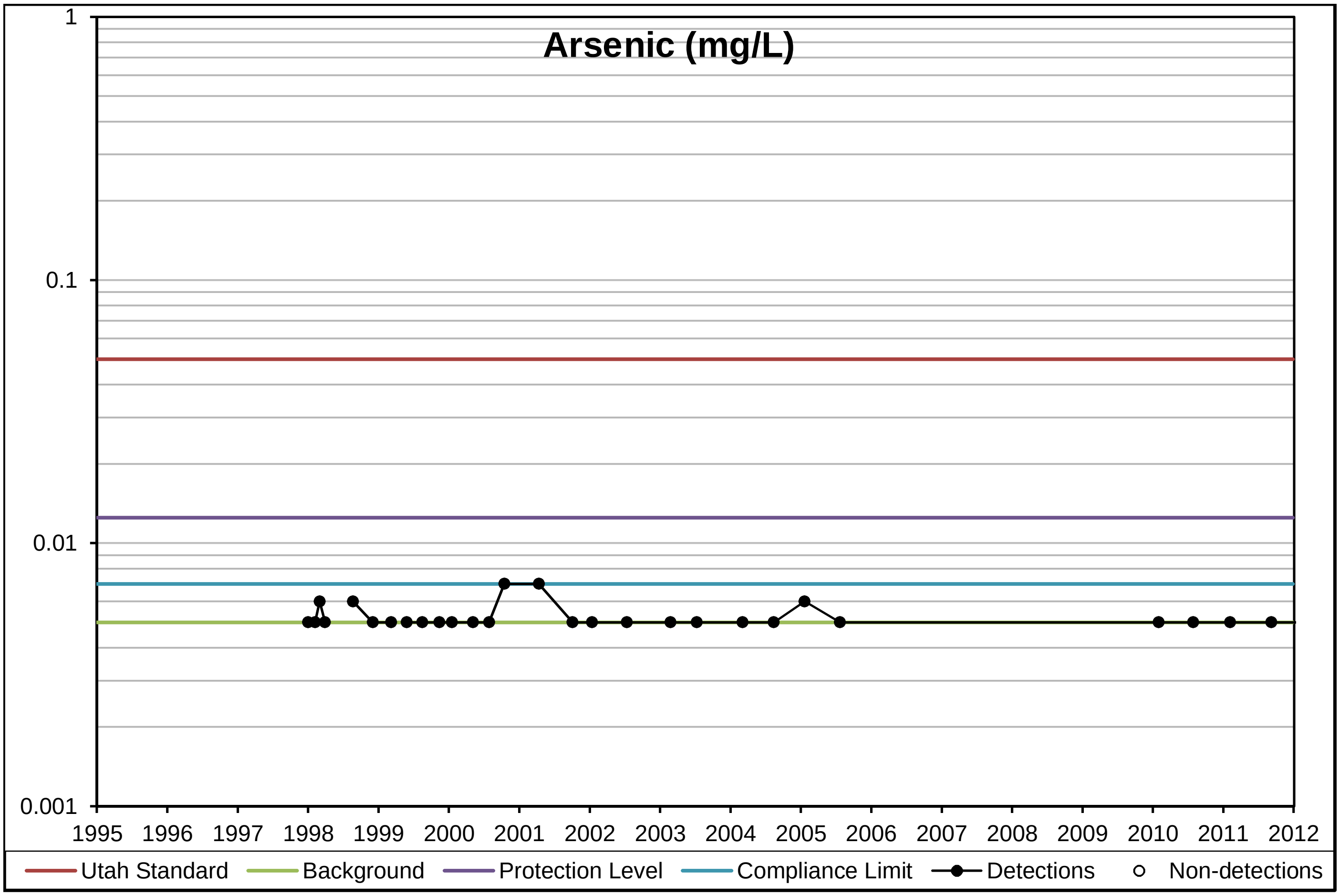
Constituent range includes minimum and maximum concentrations for all wells considered

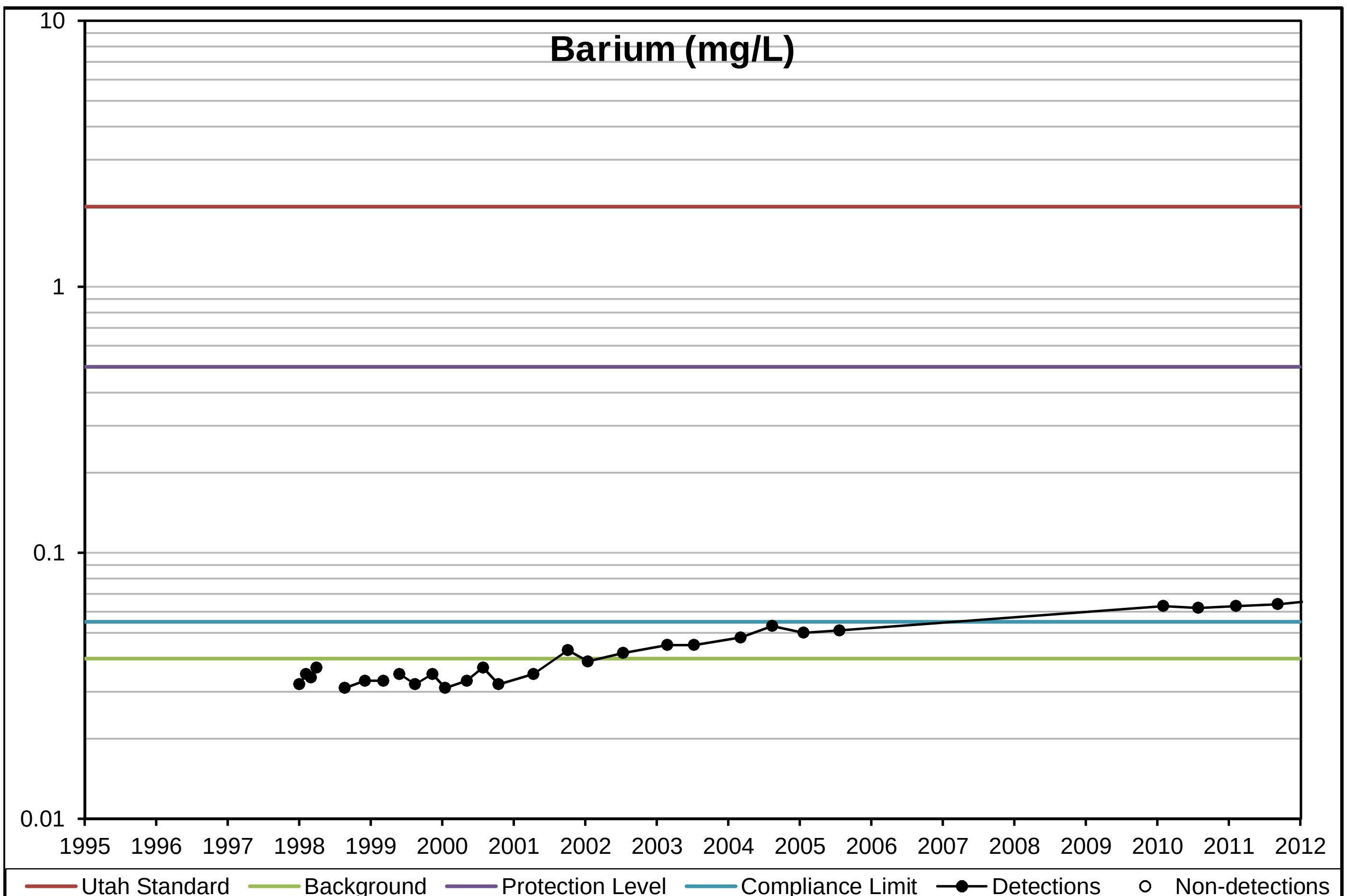


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

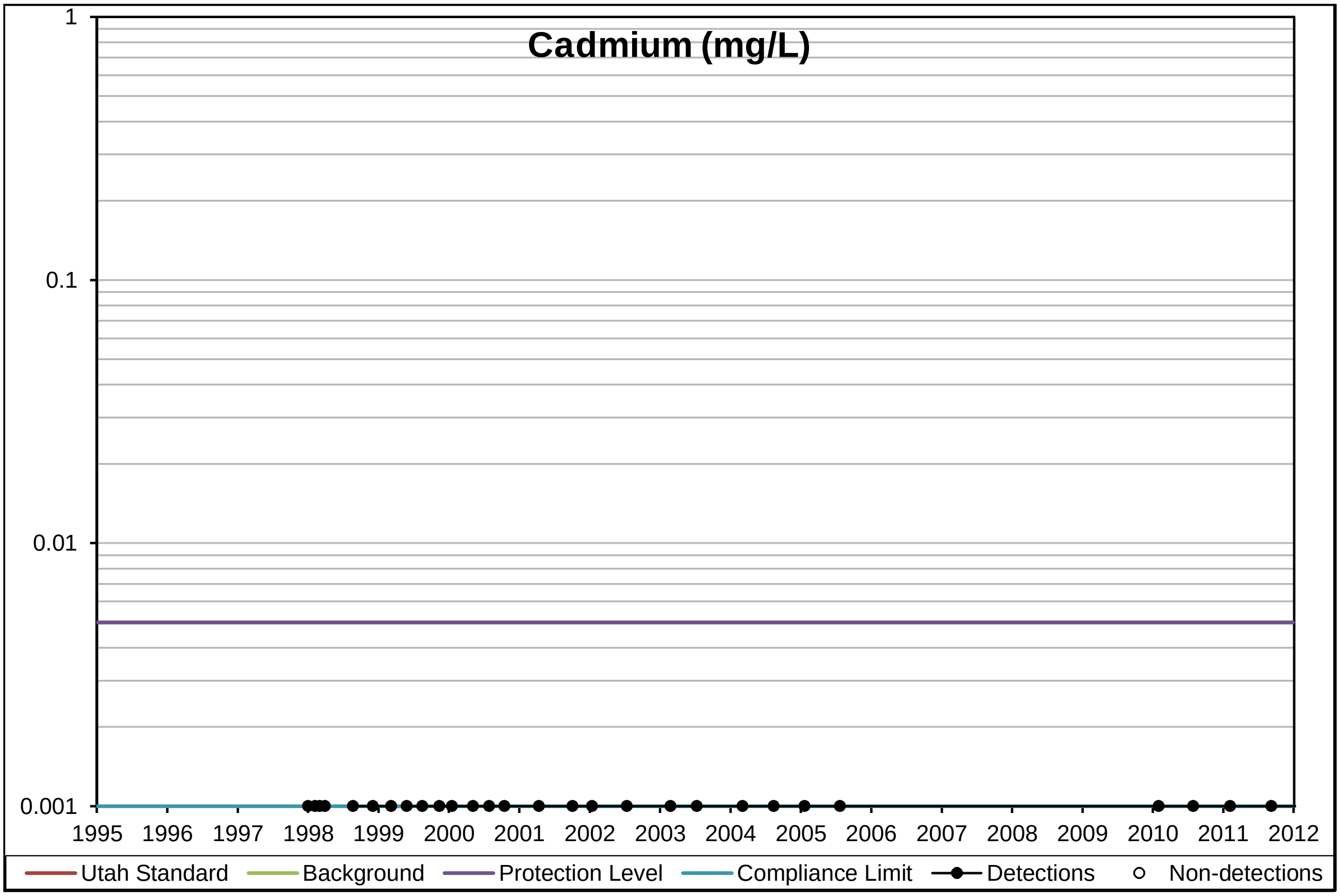
NET1490

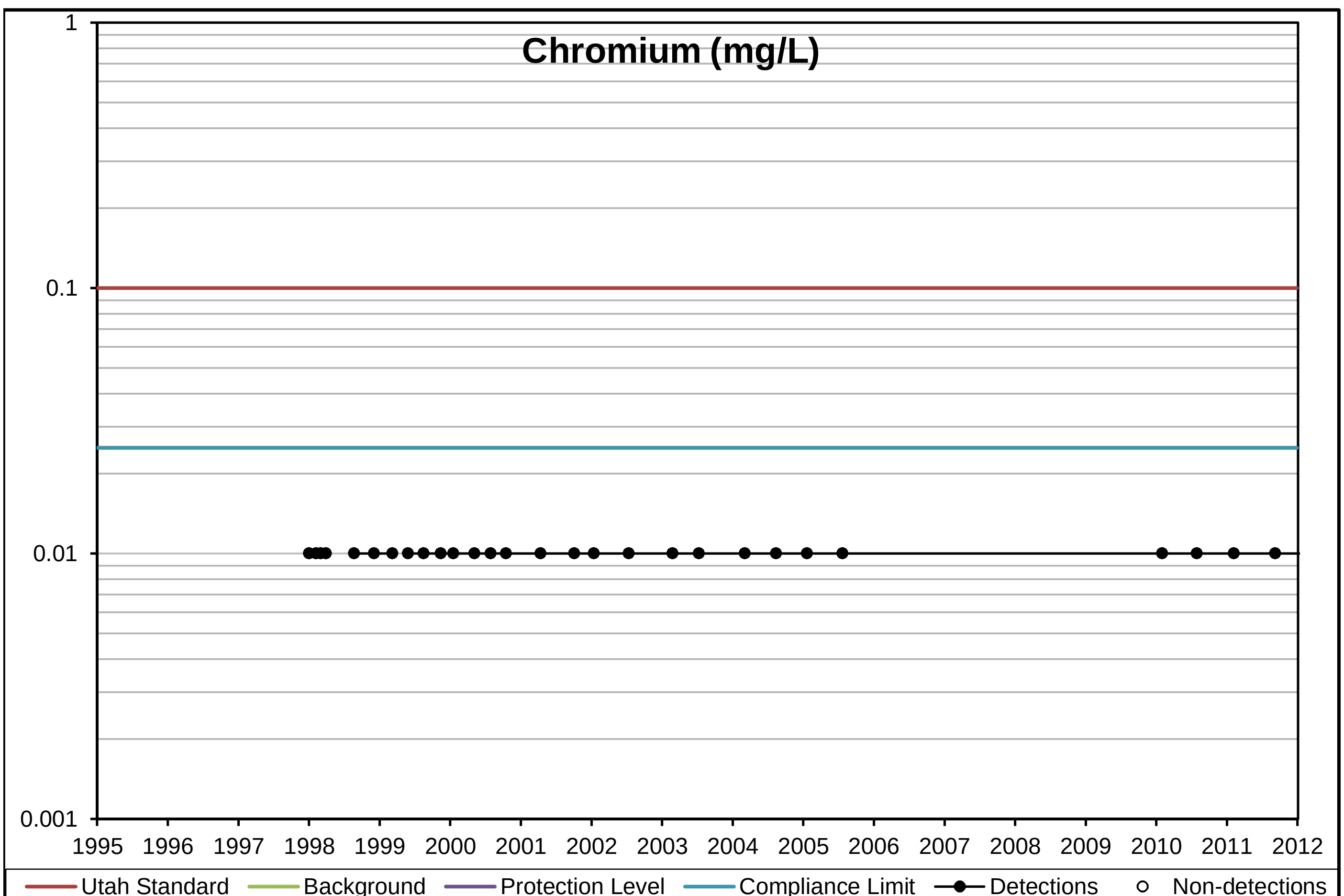
Concentration Versus Year





Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

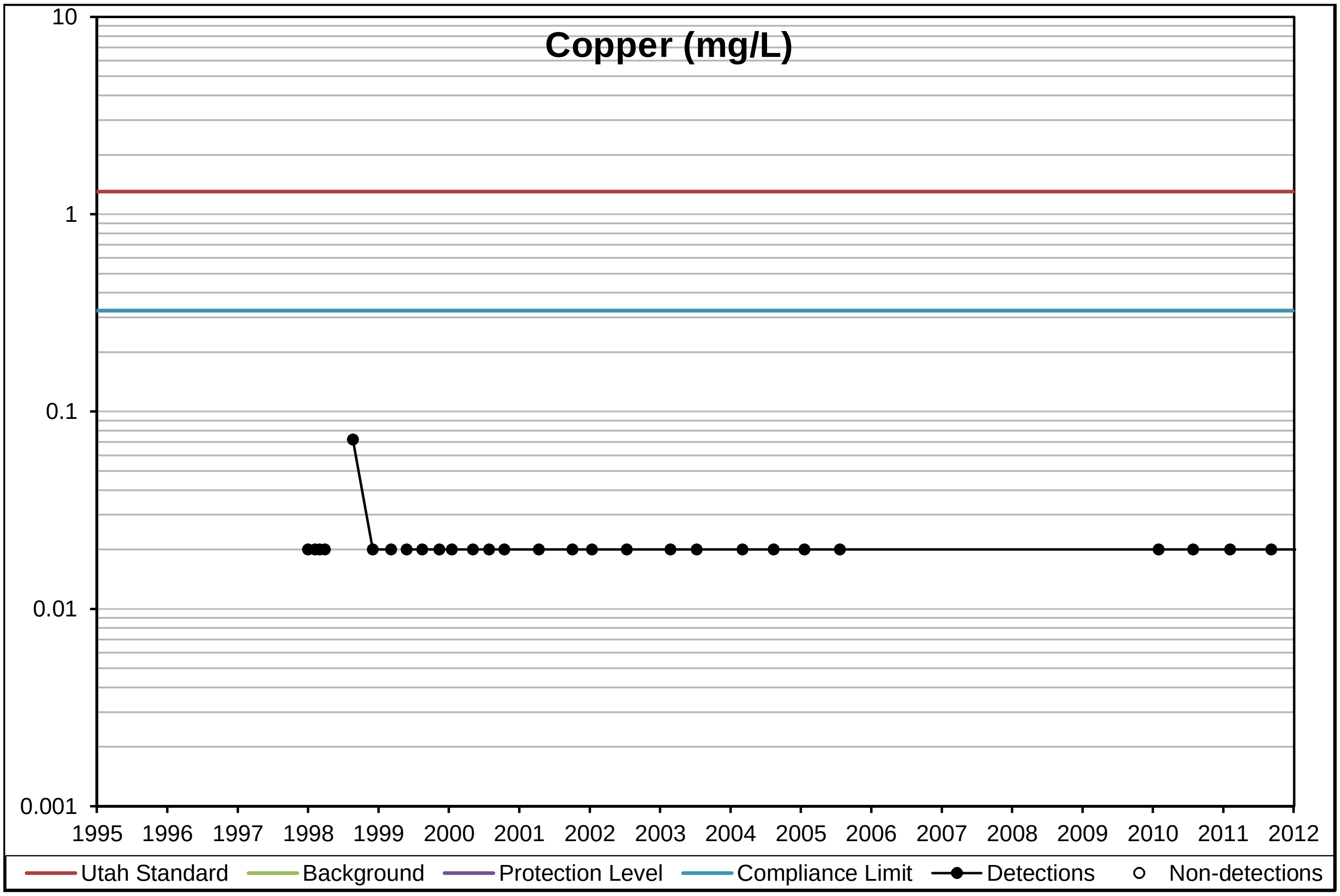


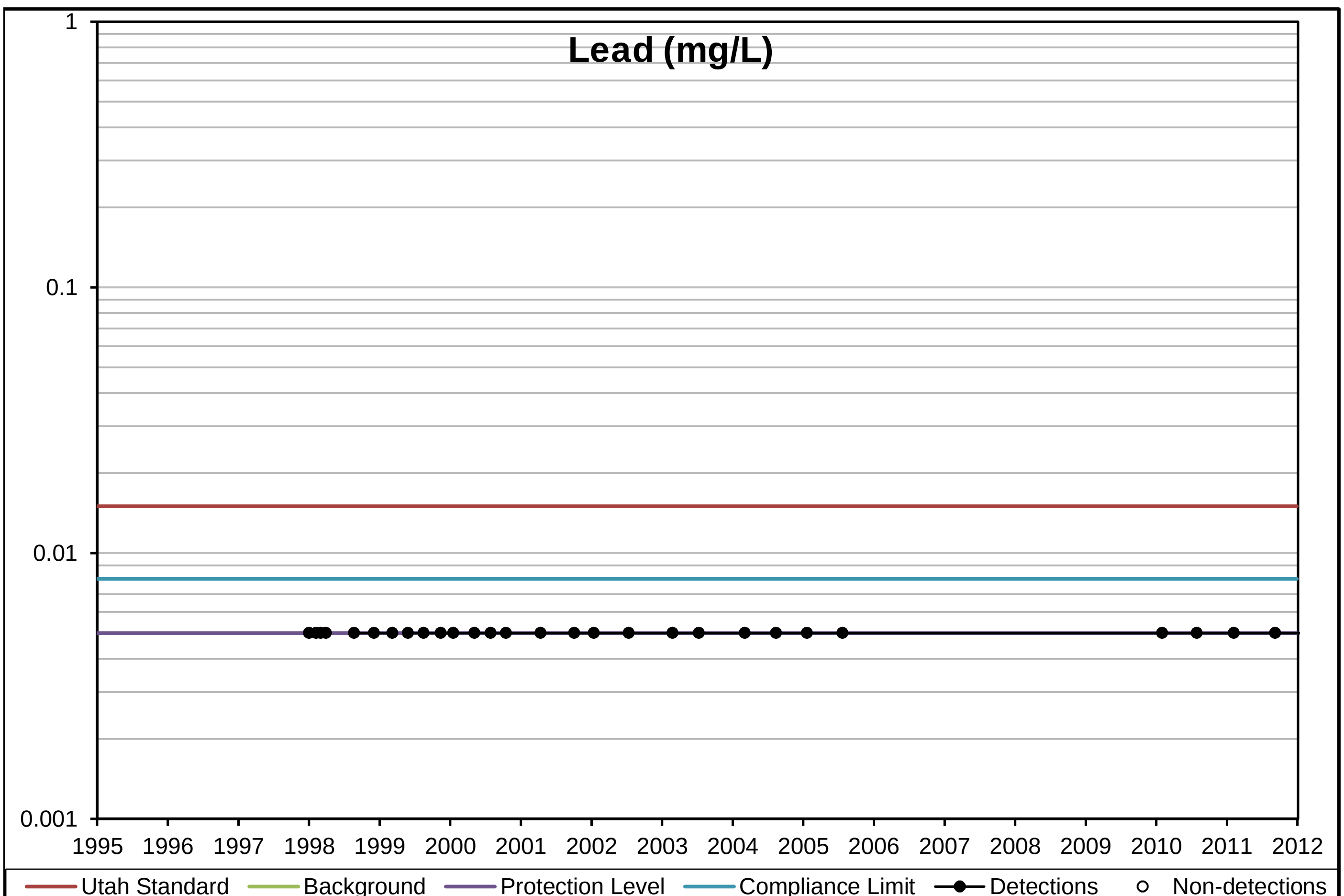


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1490

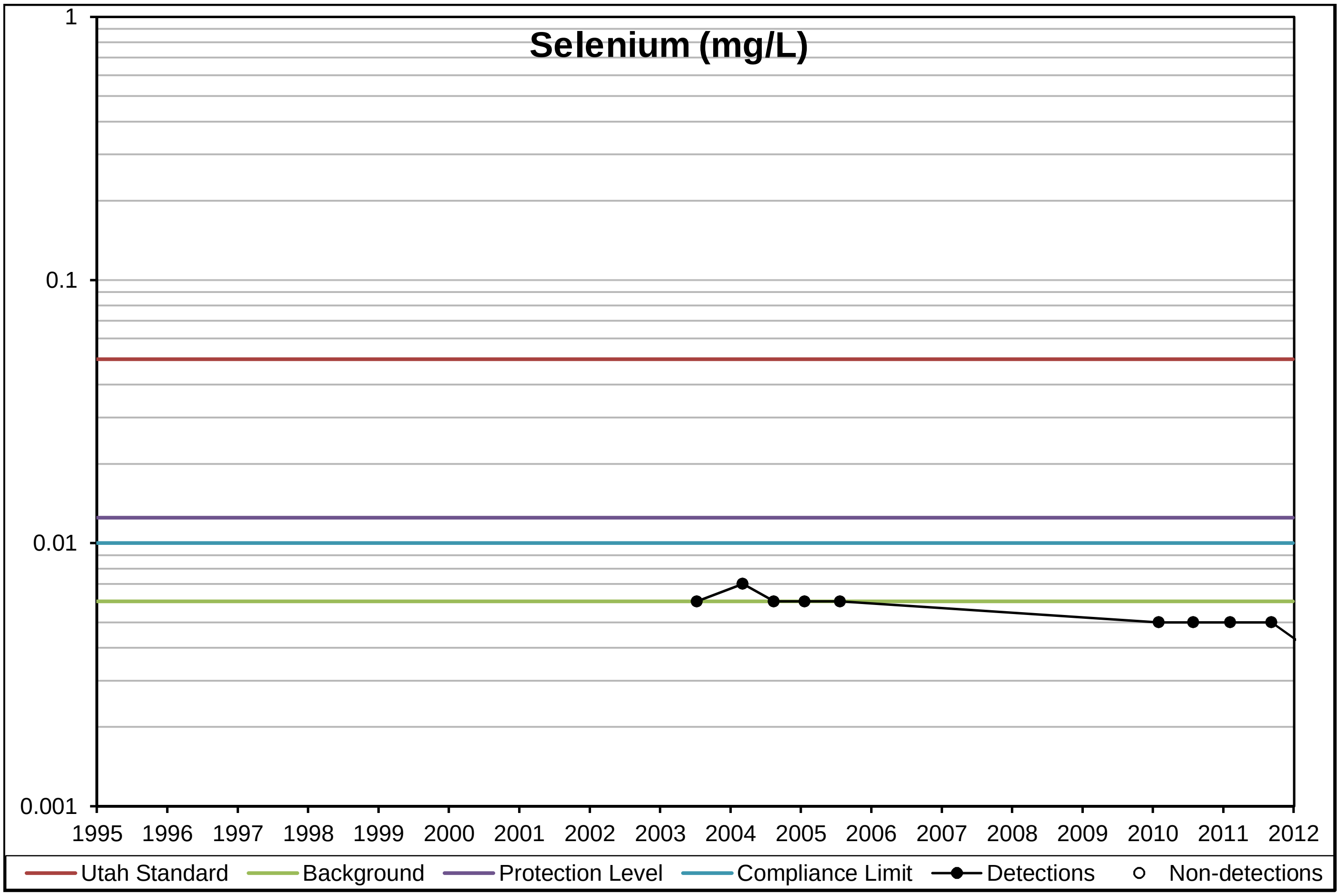
Concentration Versus Year

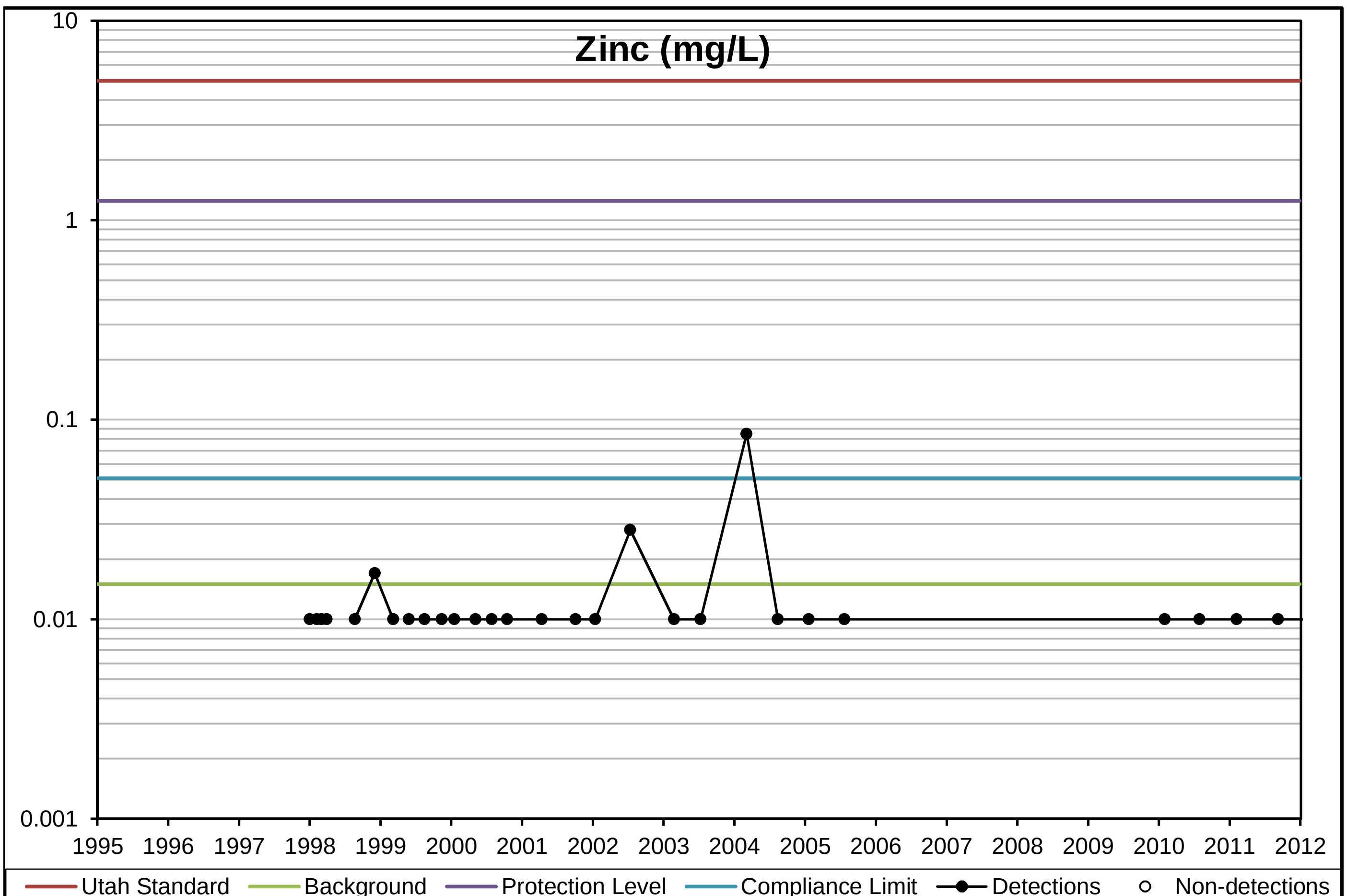




Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

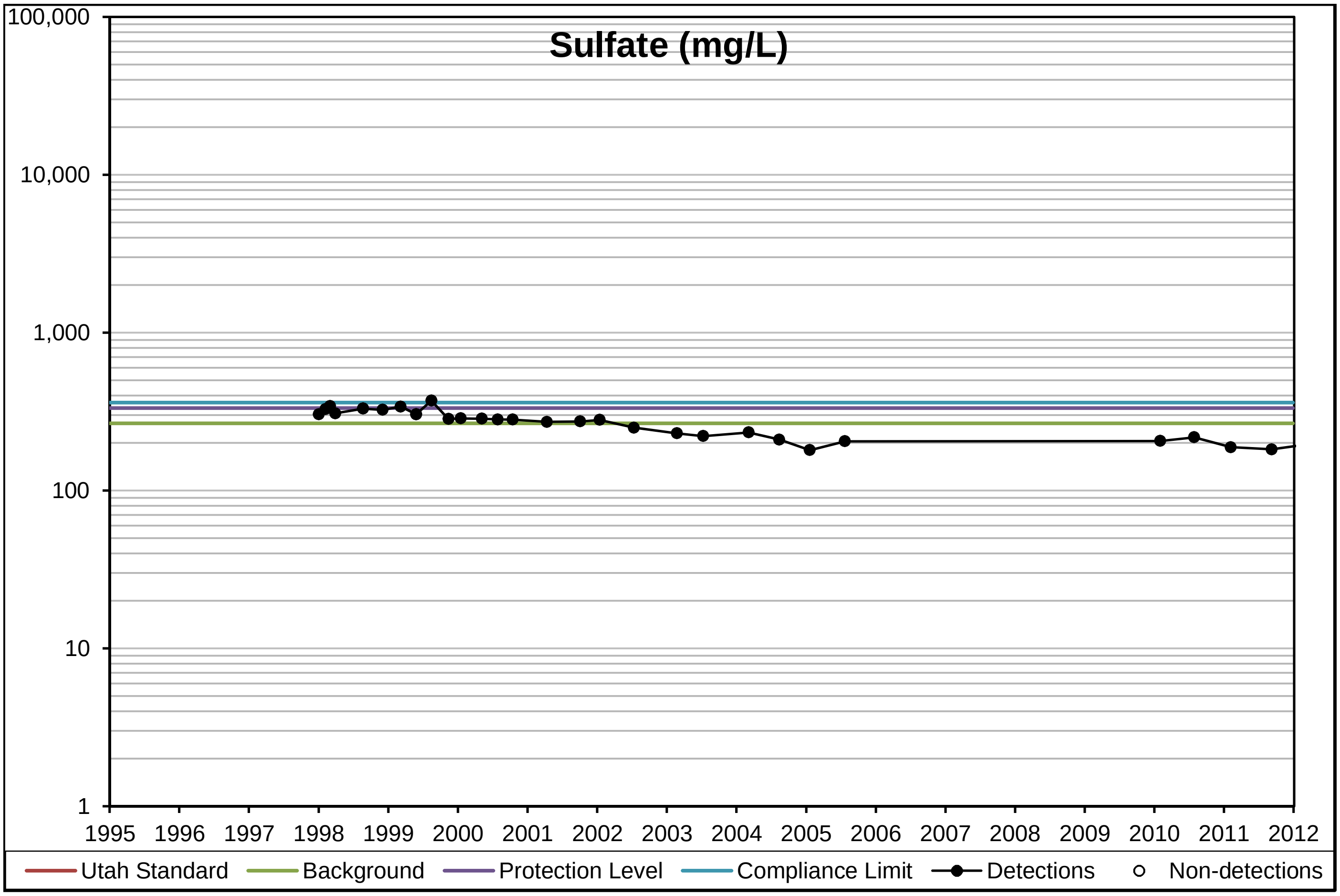


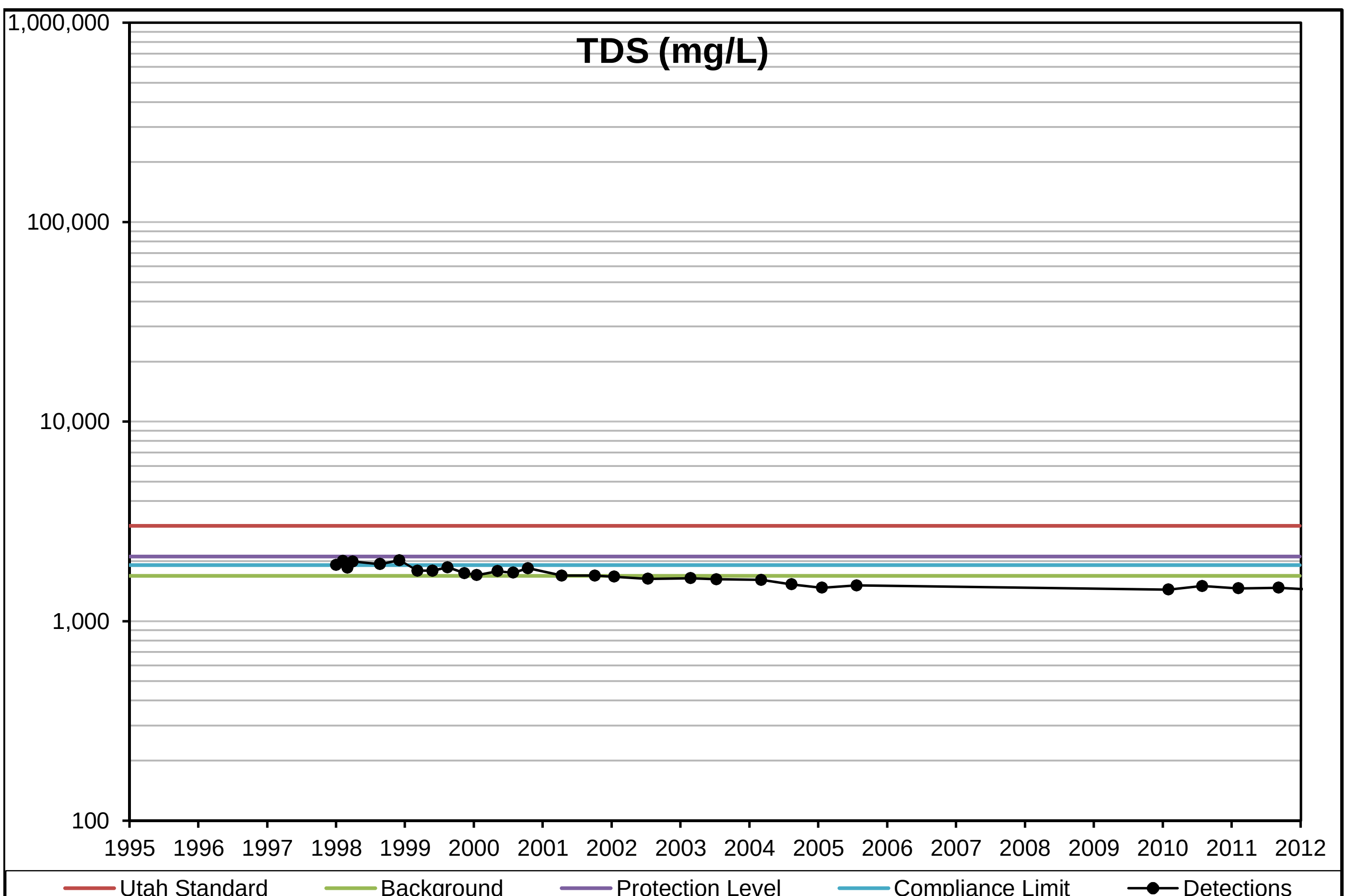


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1490

Concentration Versus Year



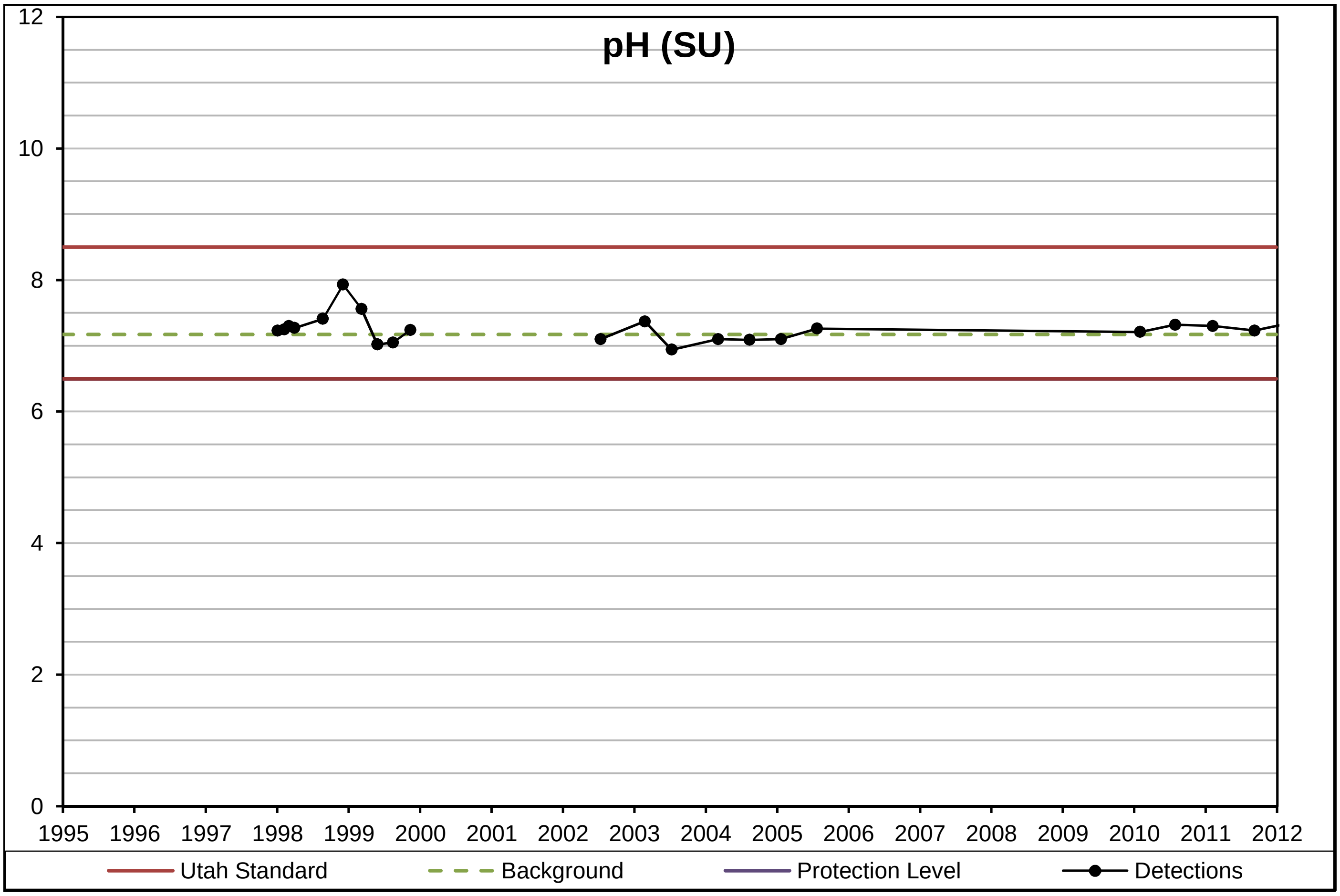


Background was not established for constituents not detected

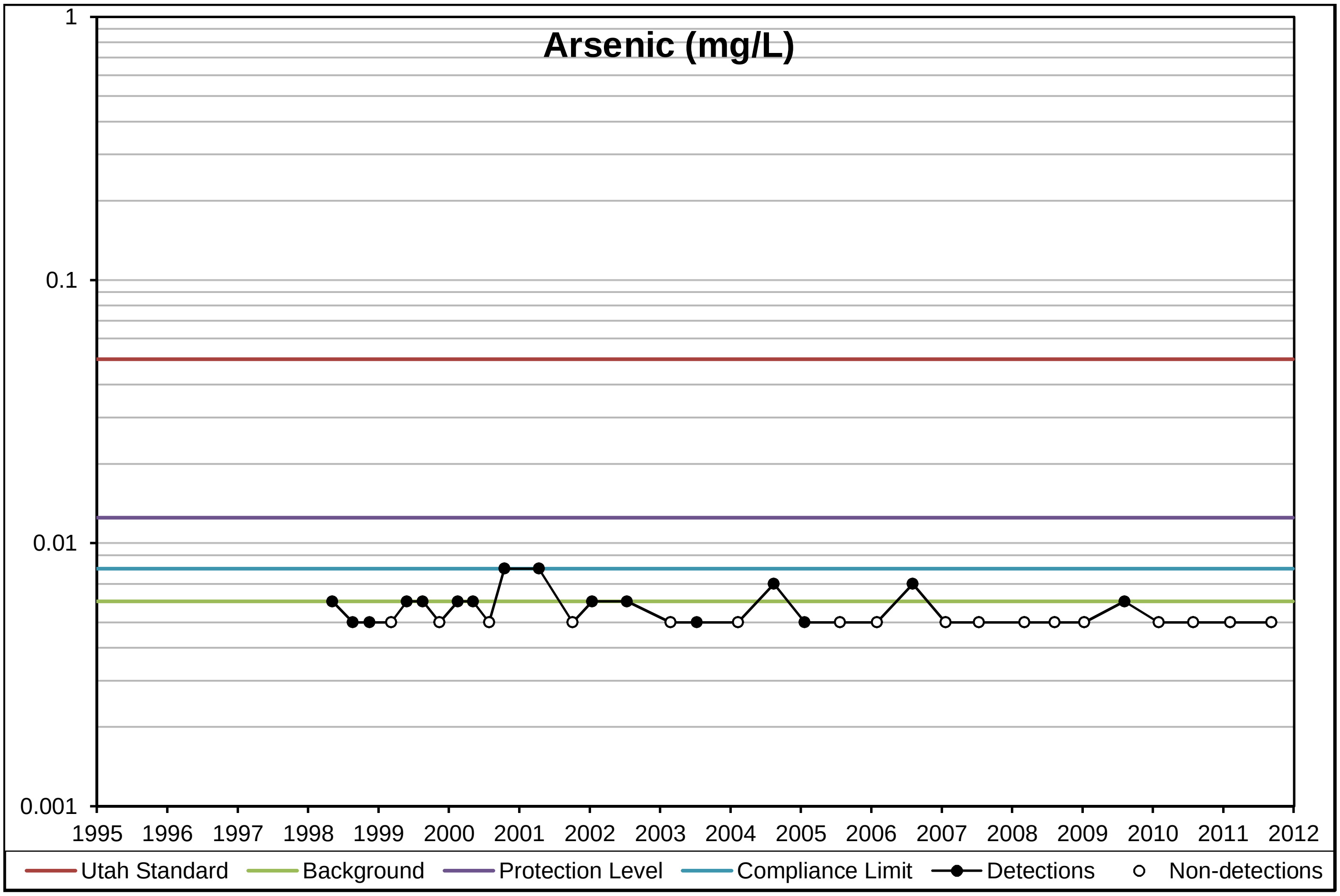
Constituent range includes minimum and maximum concentrations for all wells considered

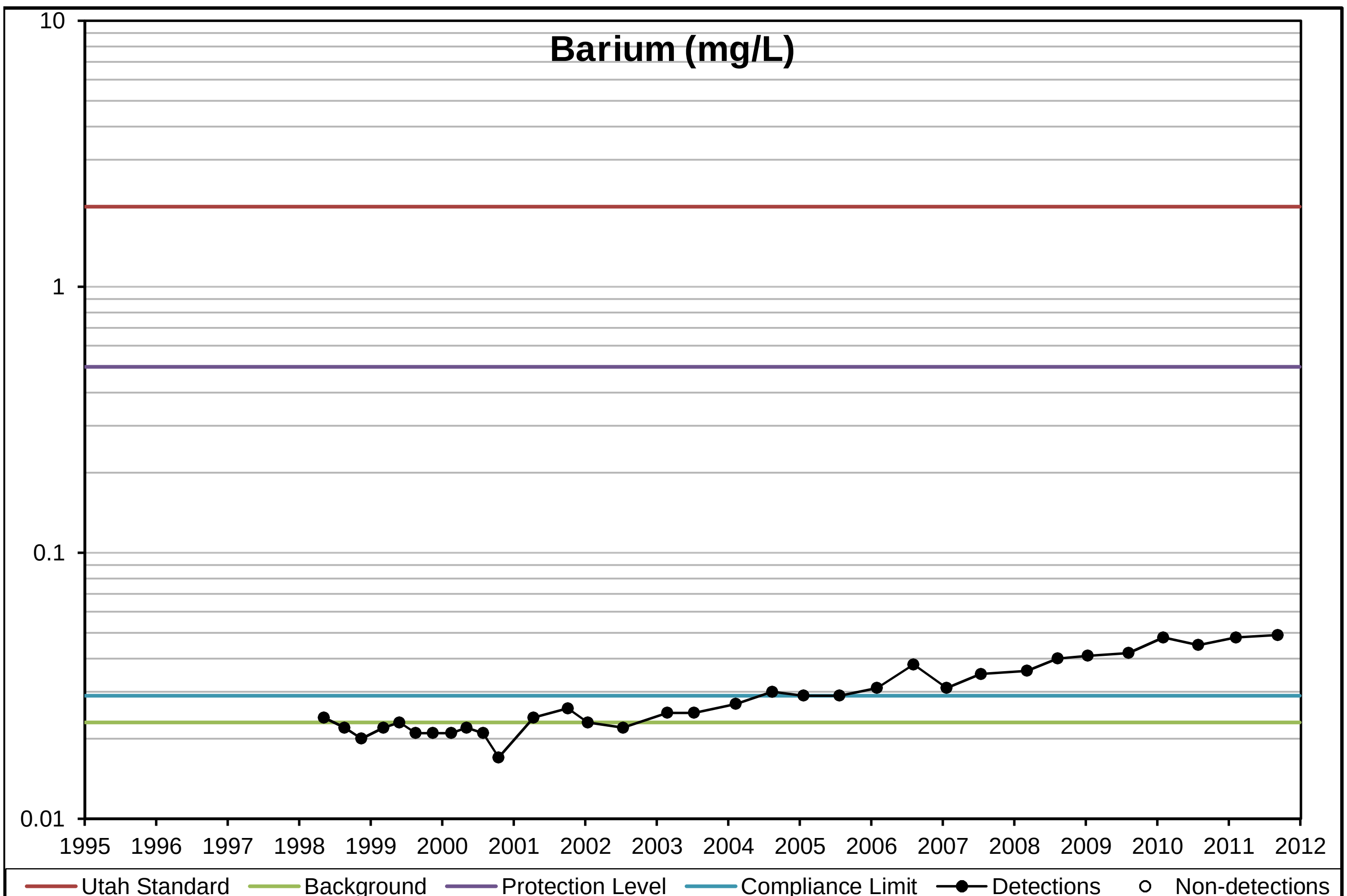
NET1490

Concentration Versus Year



Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

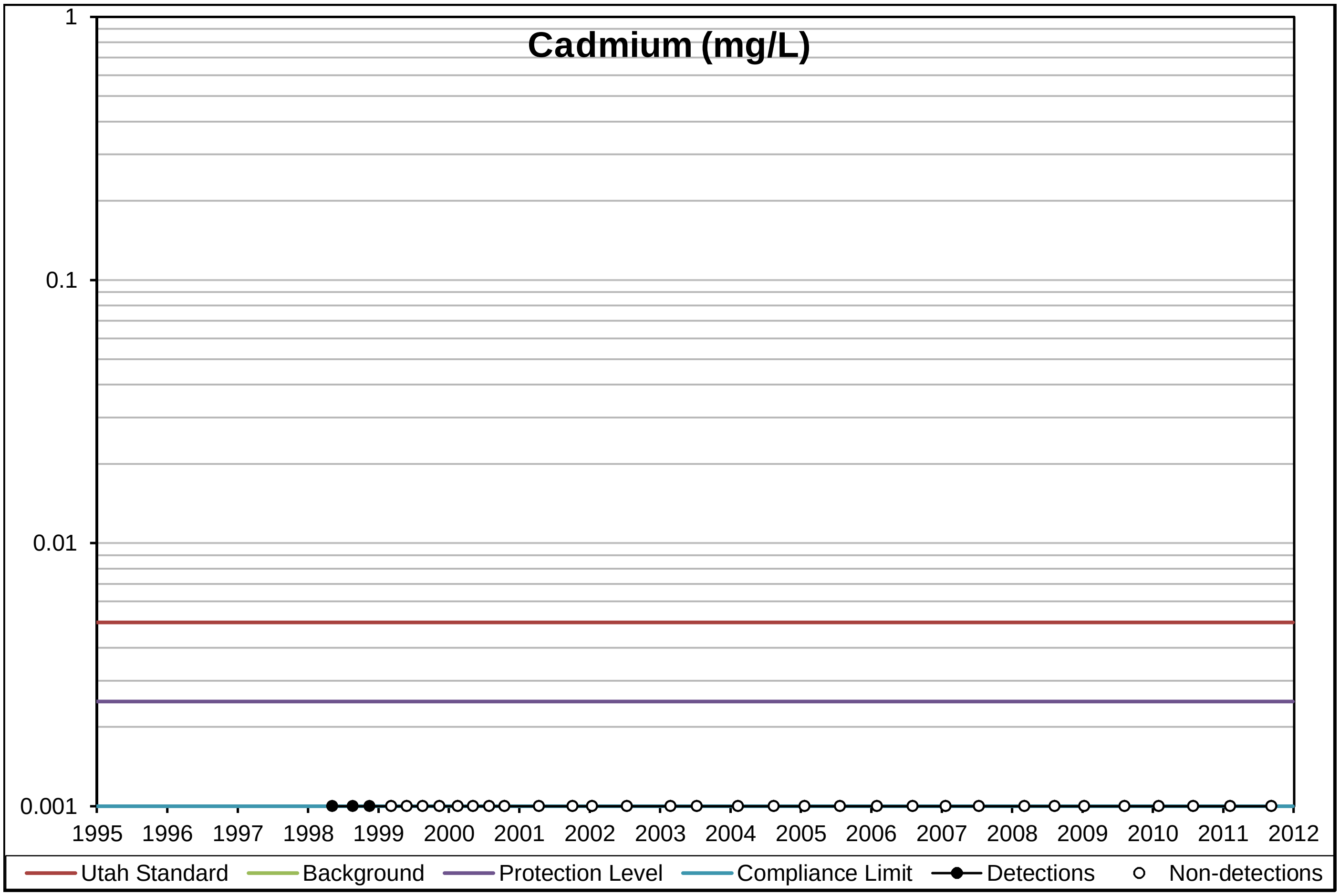


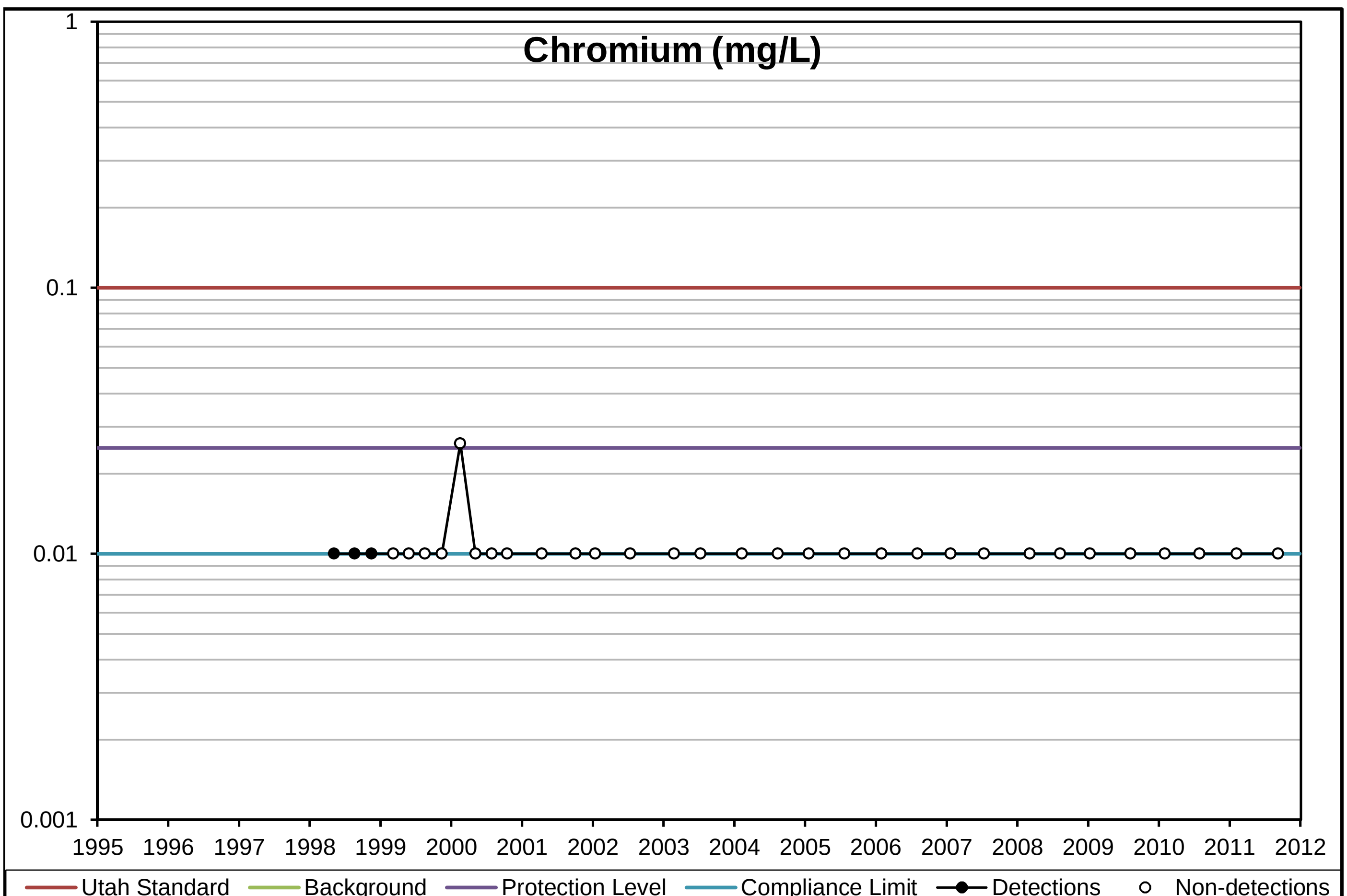


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1491

Concentration Versus Year



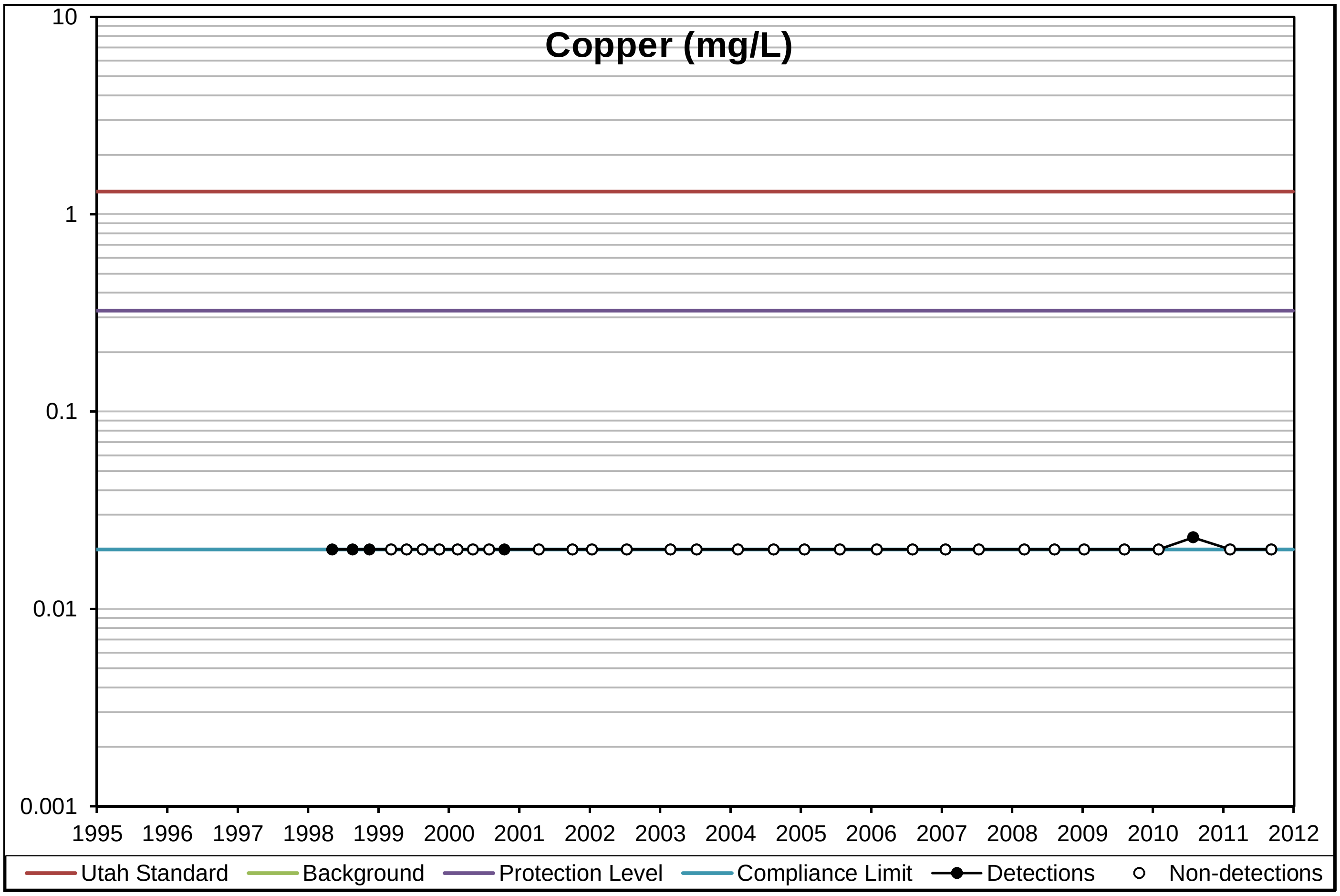


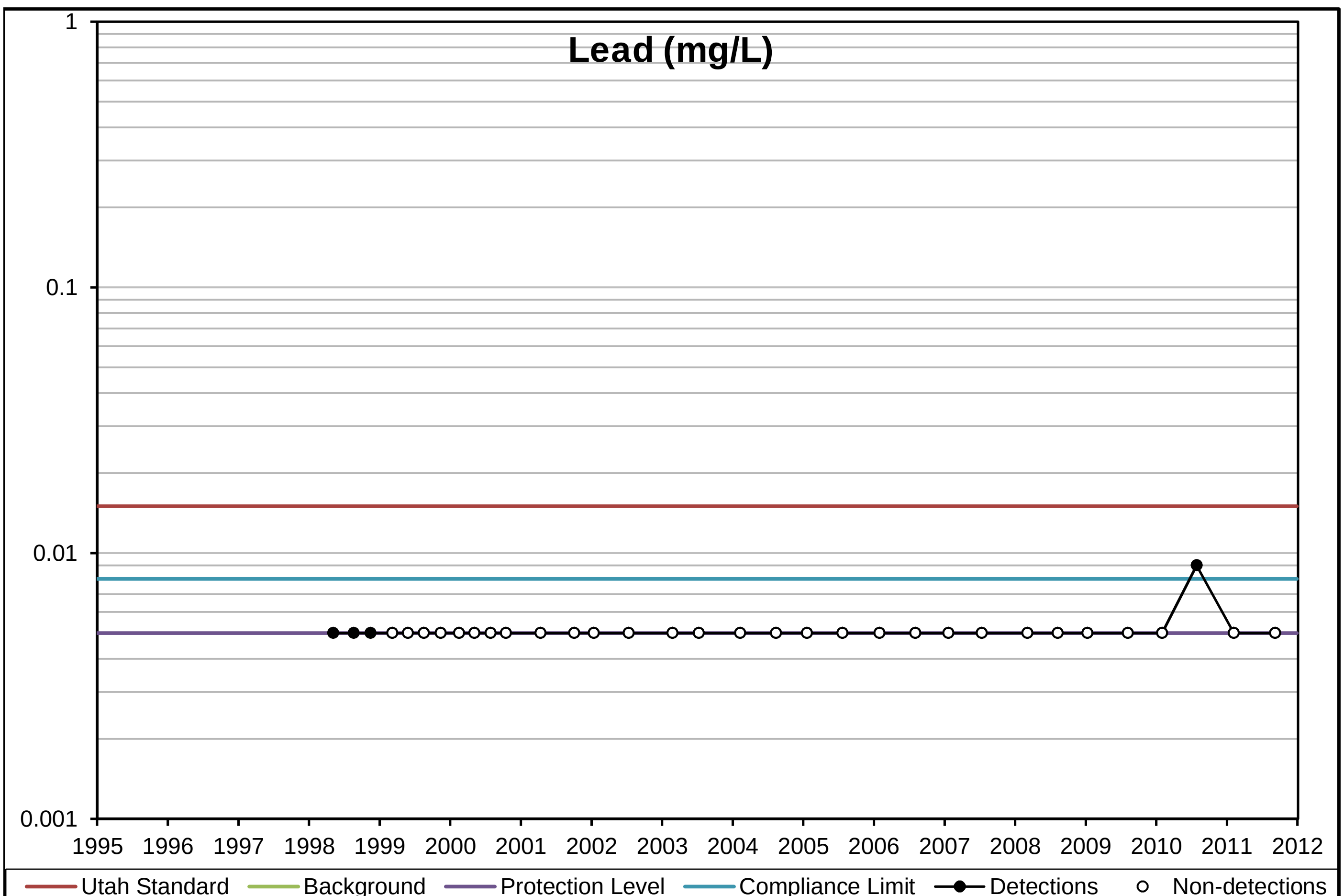
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1491

Concentration Versus Year

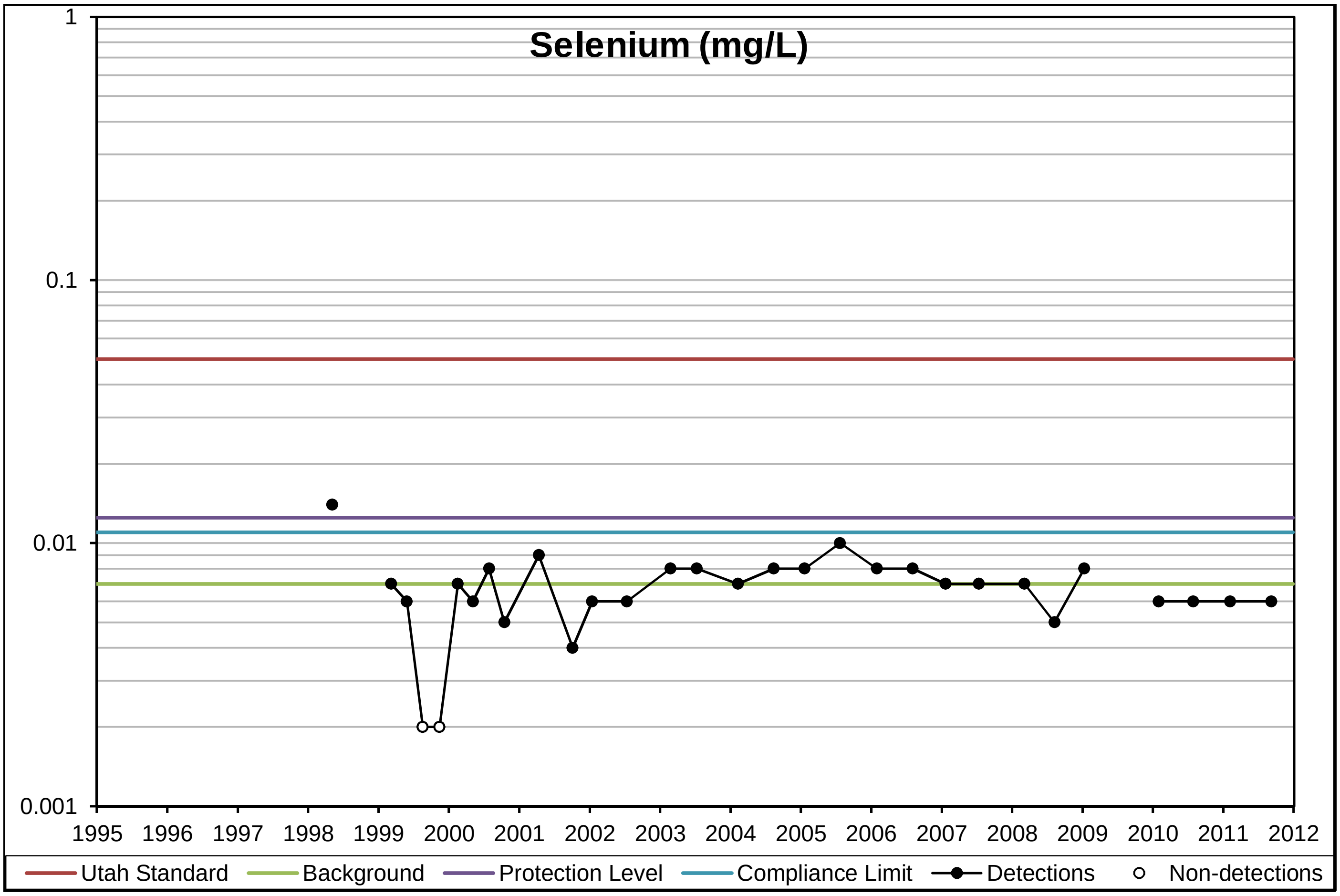


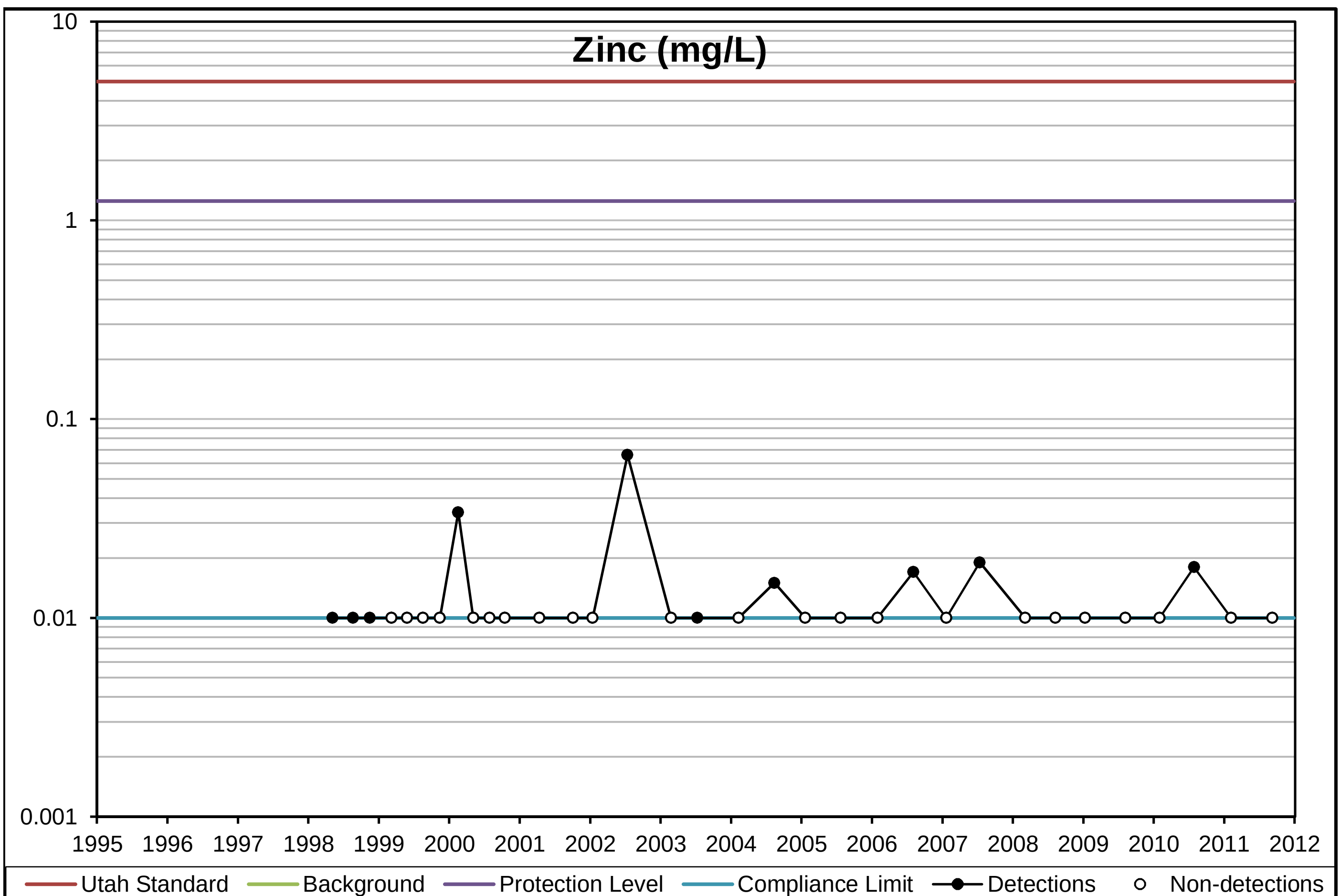


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1491

Concentration Versus Year



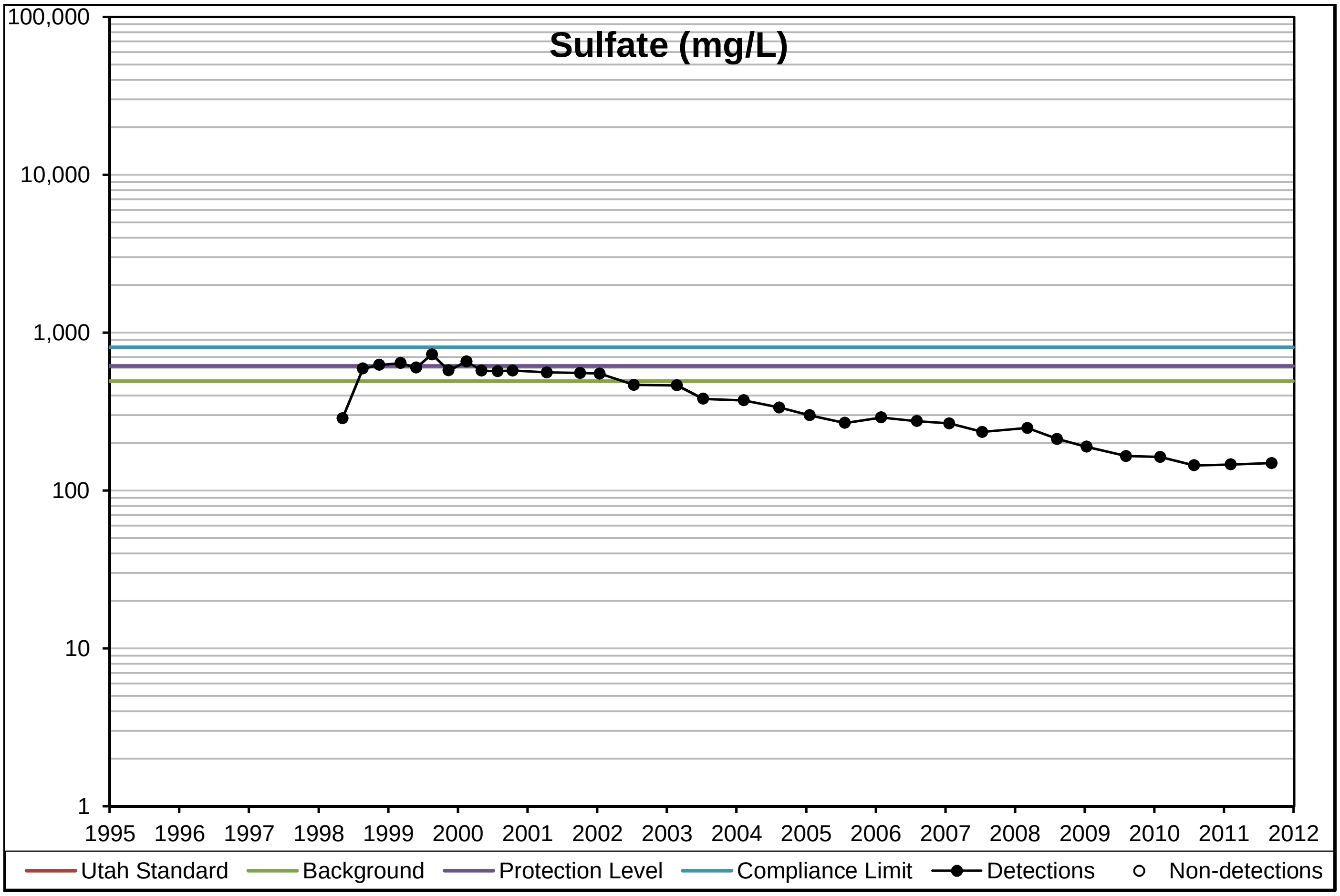


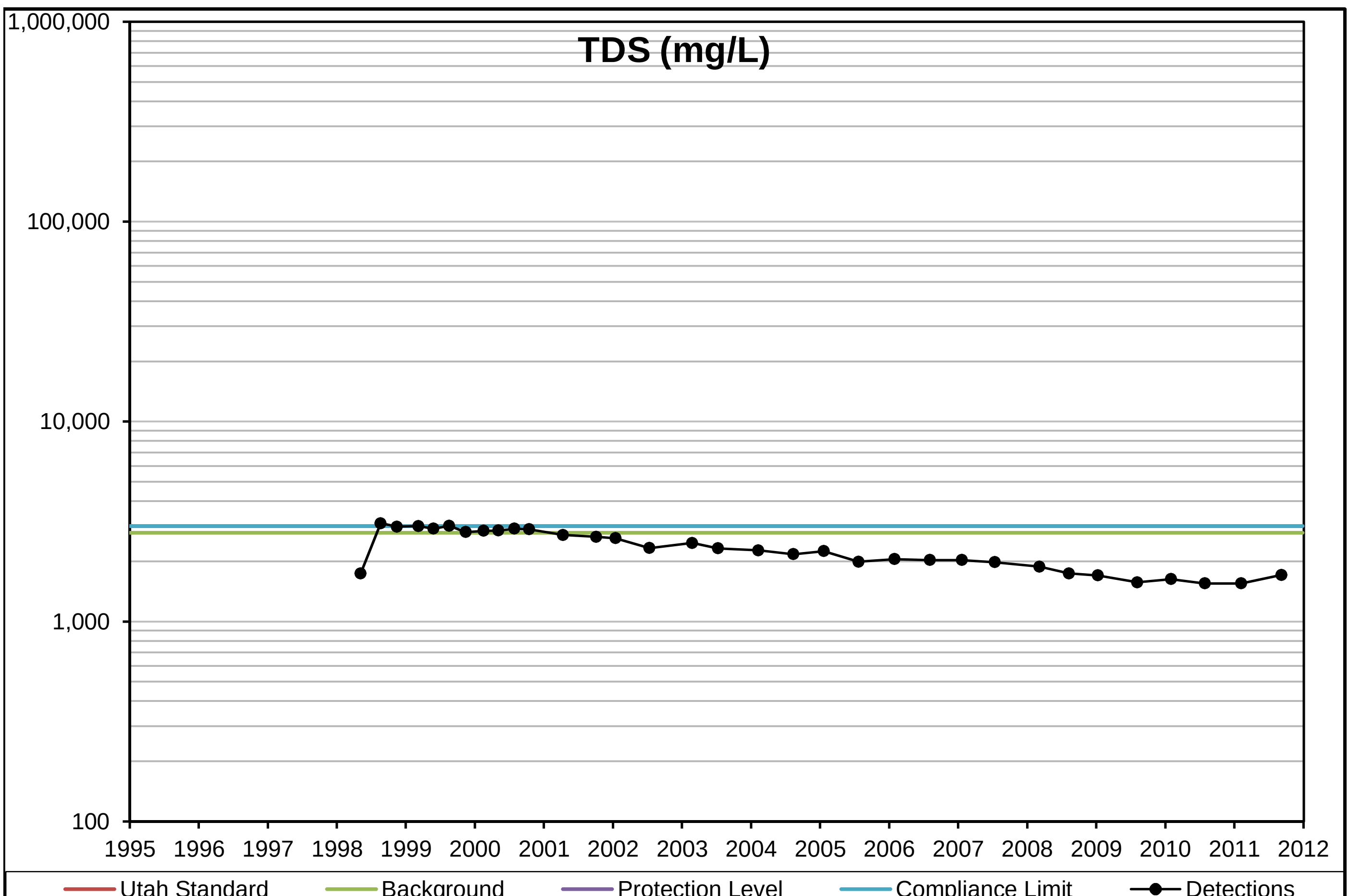
Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1491

Concentration Versus Year



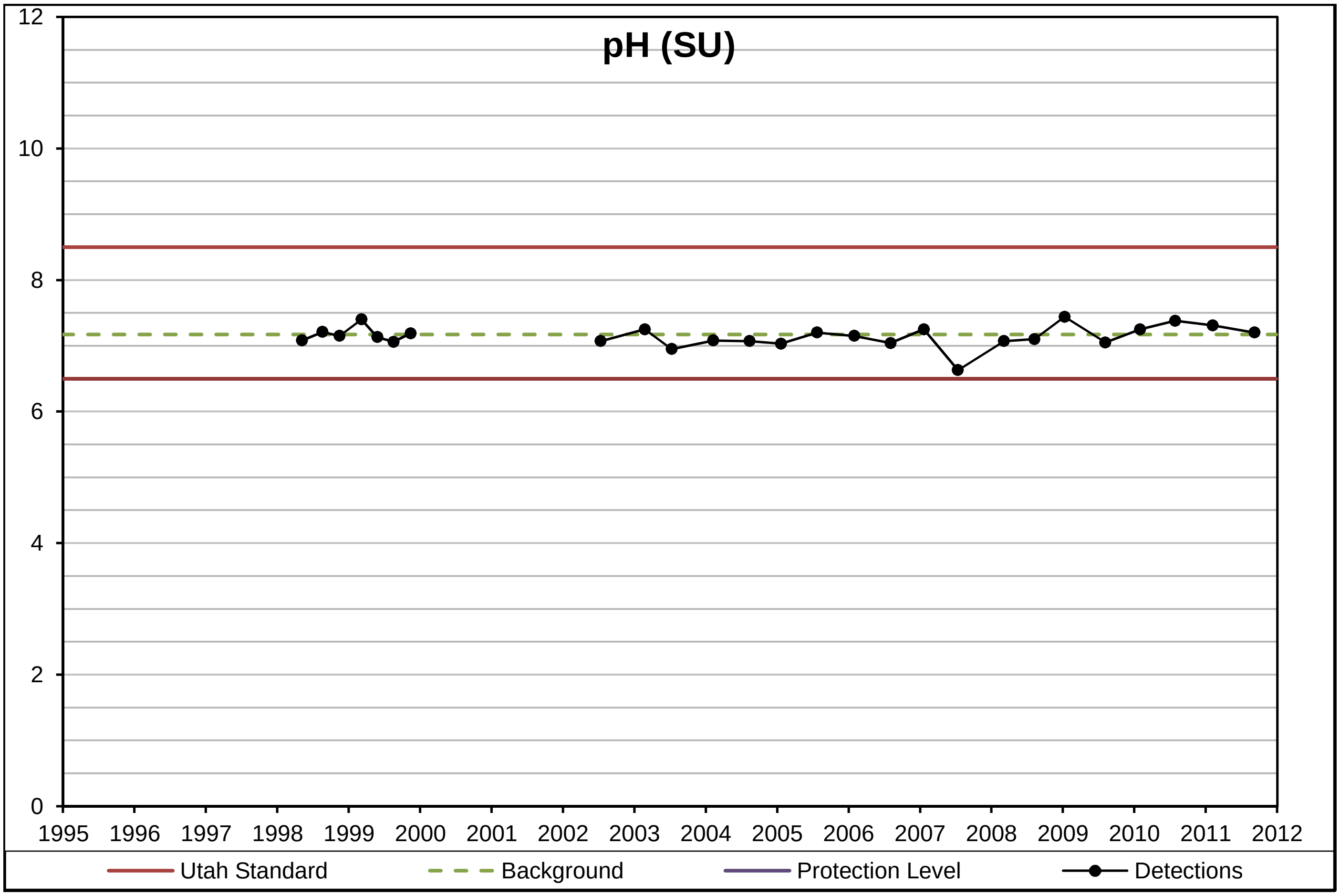


Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

NET1491

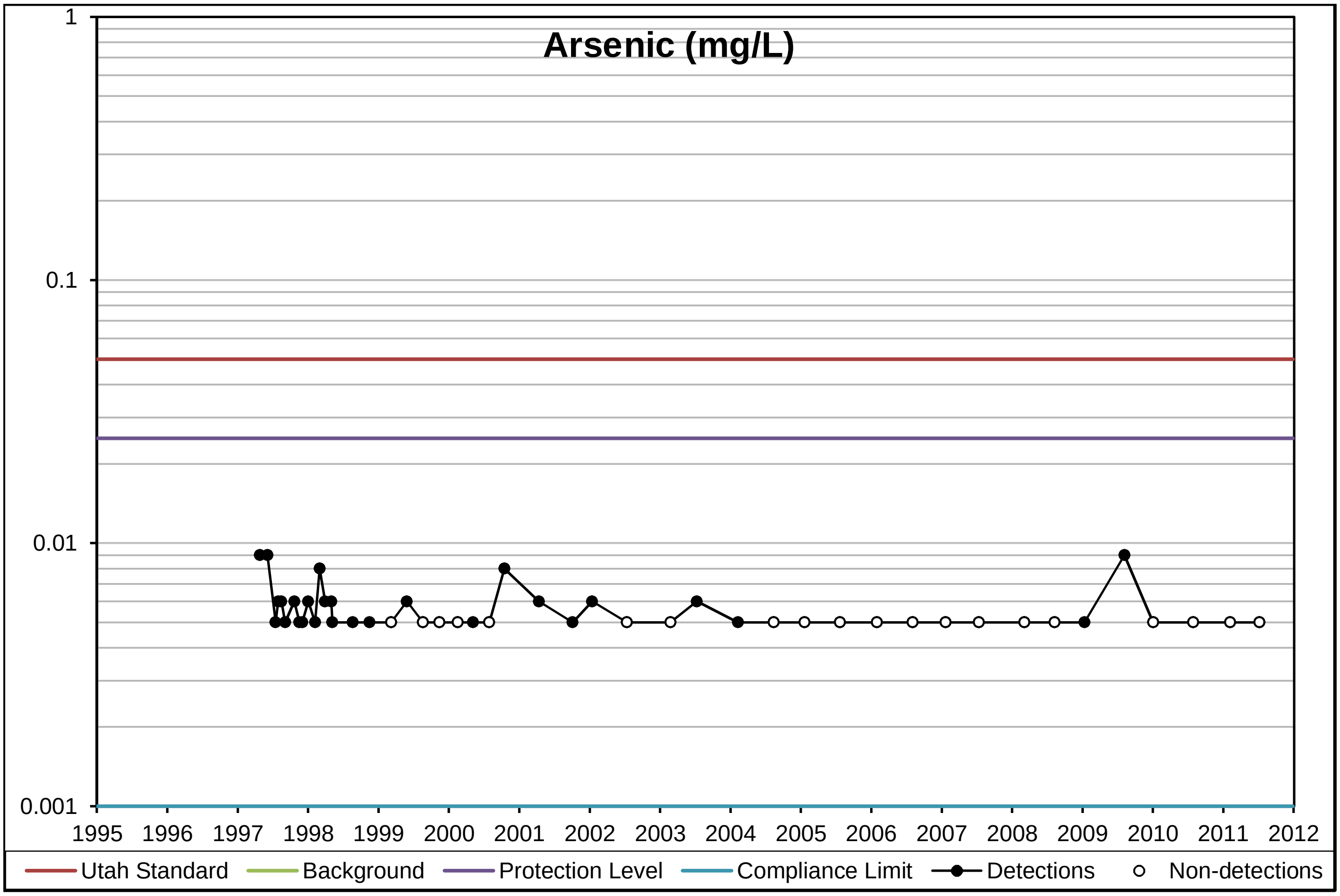
Concentration Versus Year

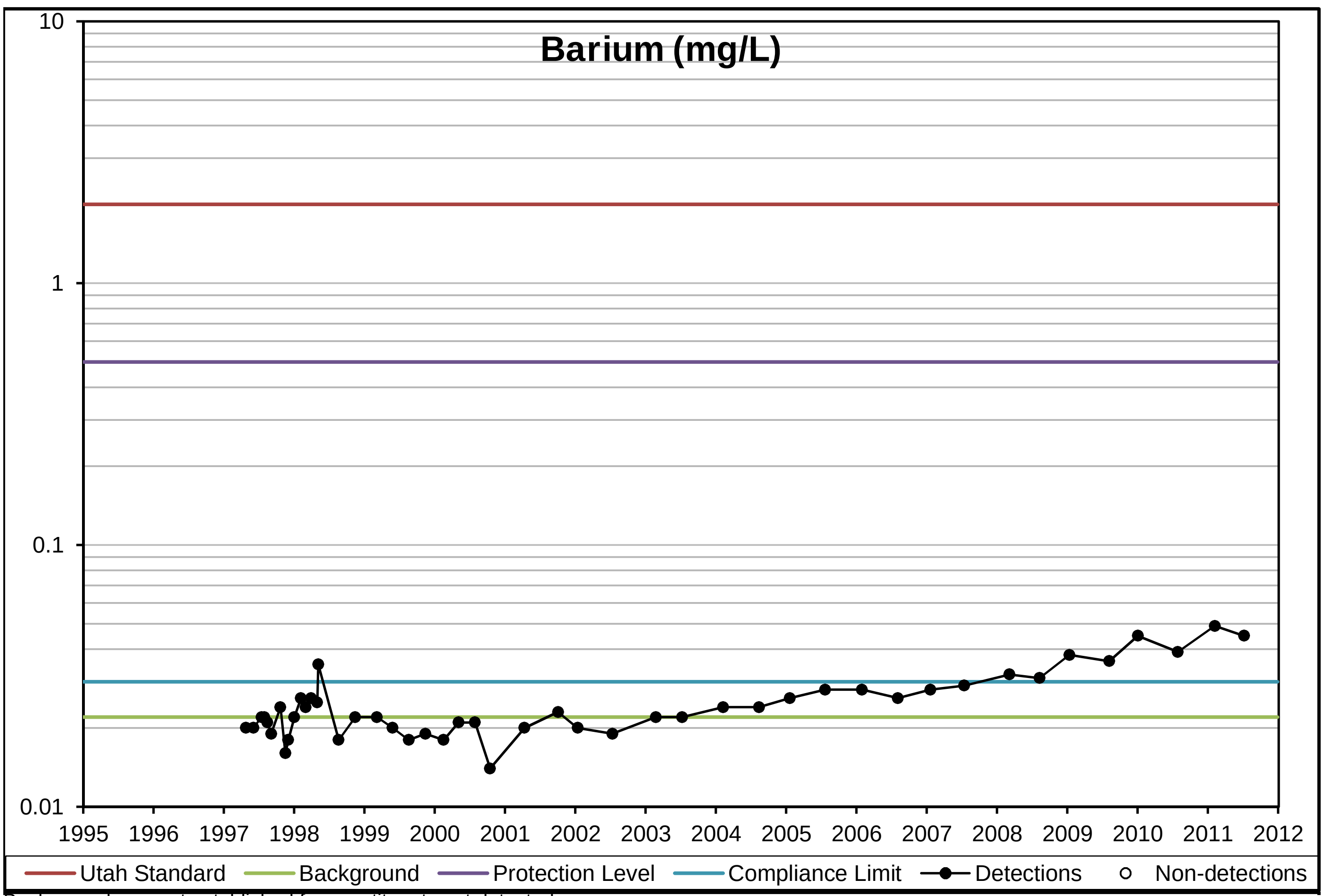


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1492

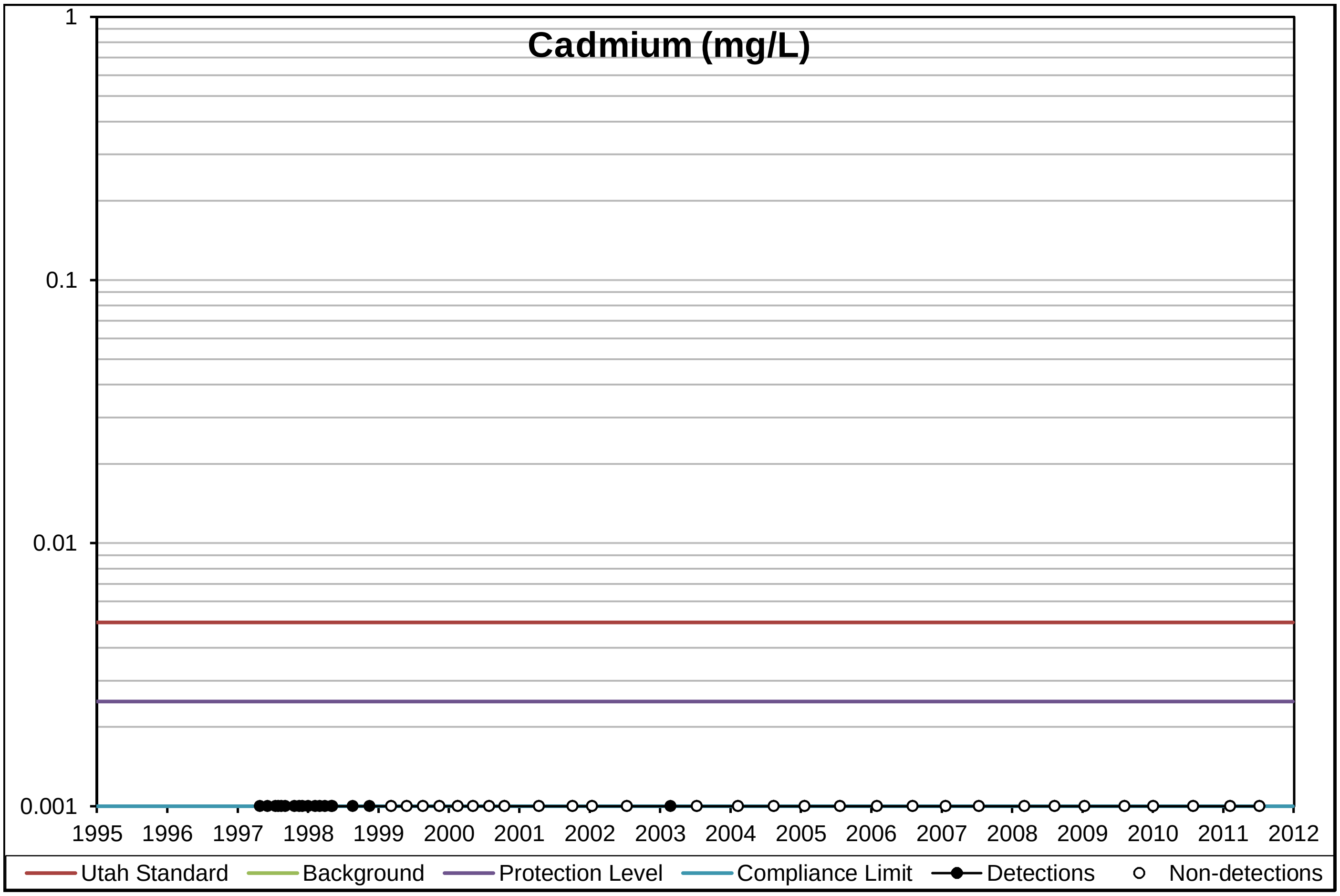
Concentration Versus Year

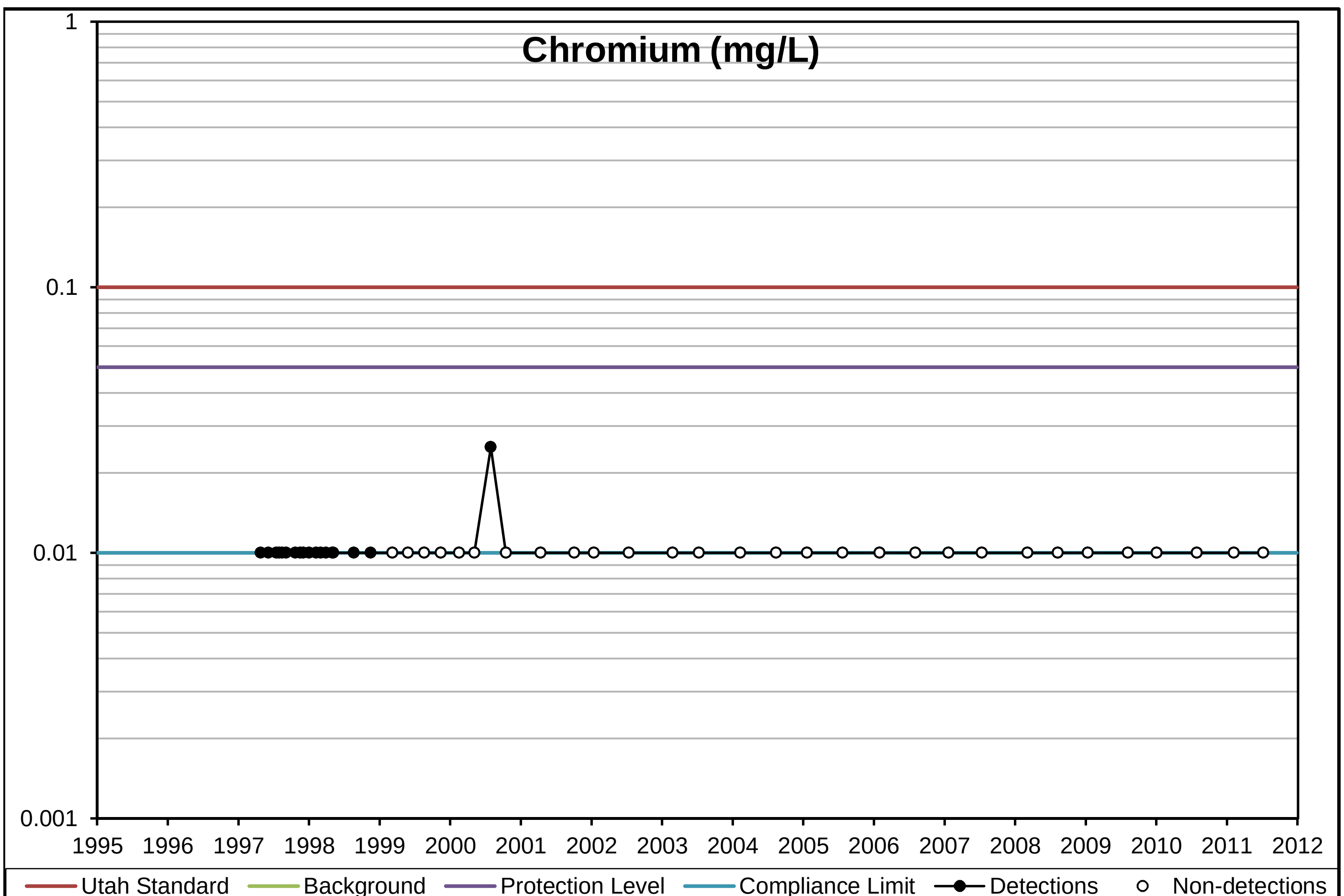




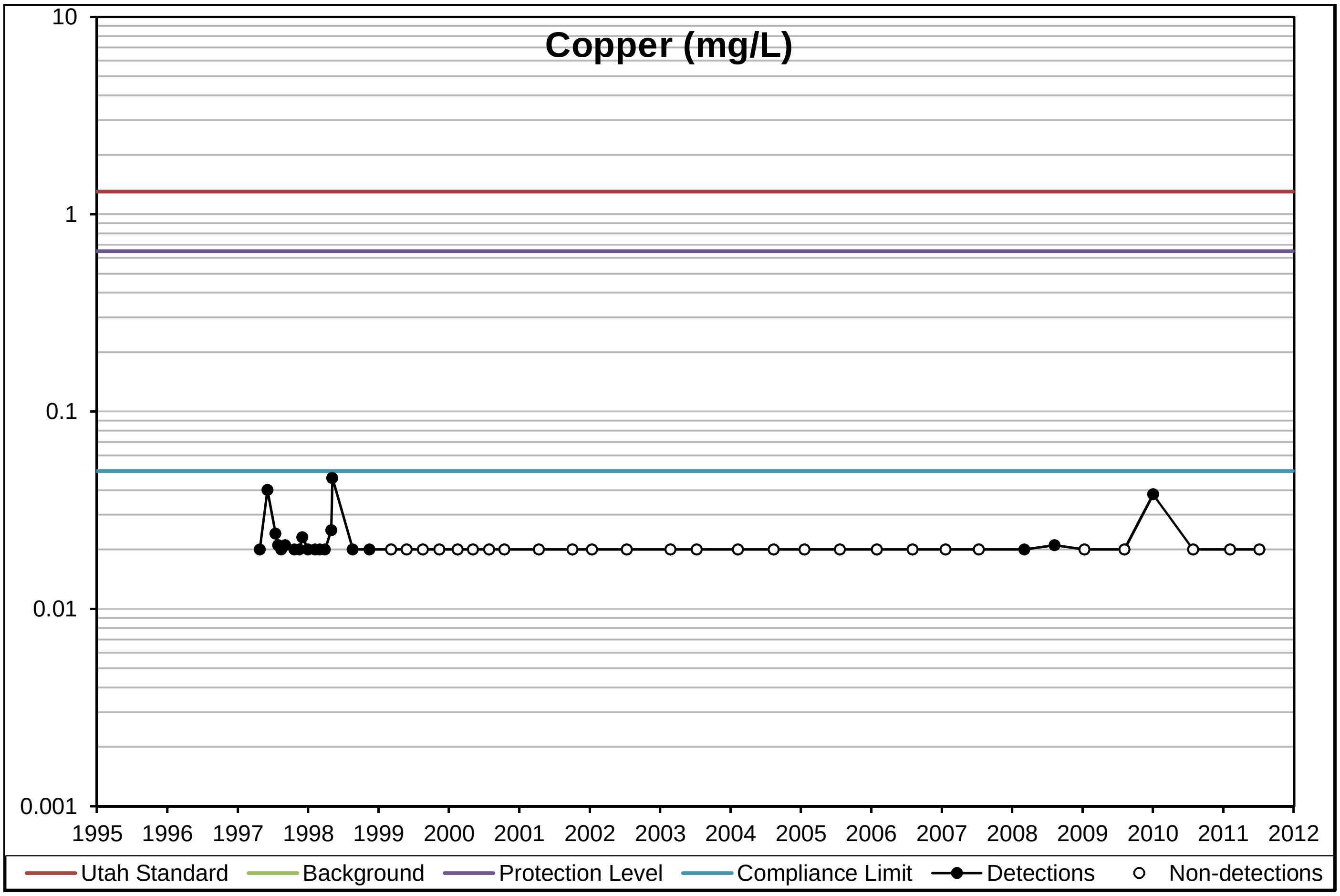
Background was not established for constituents not detected

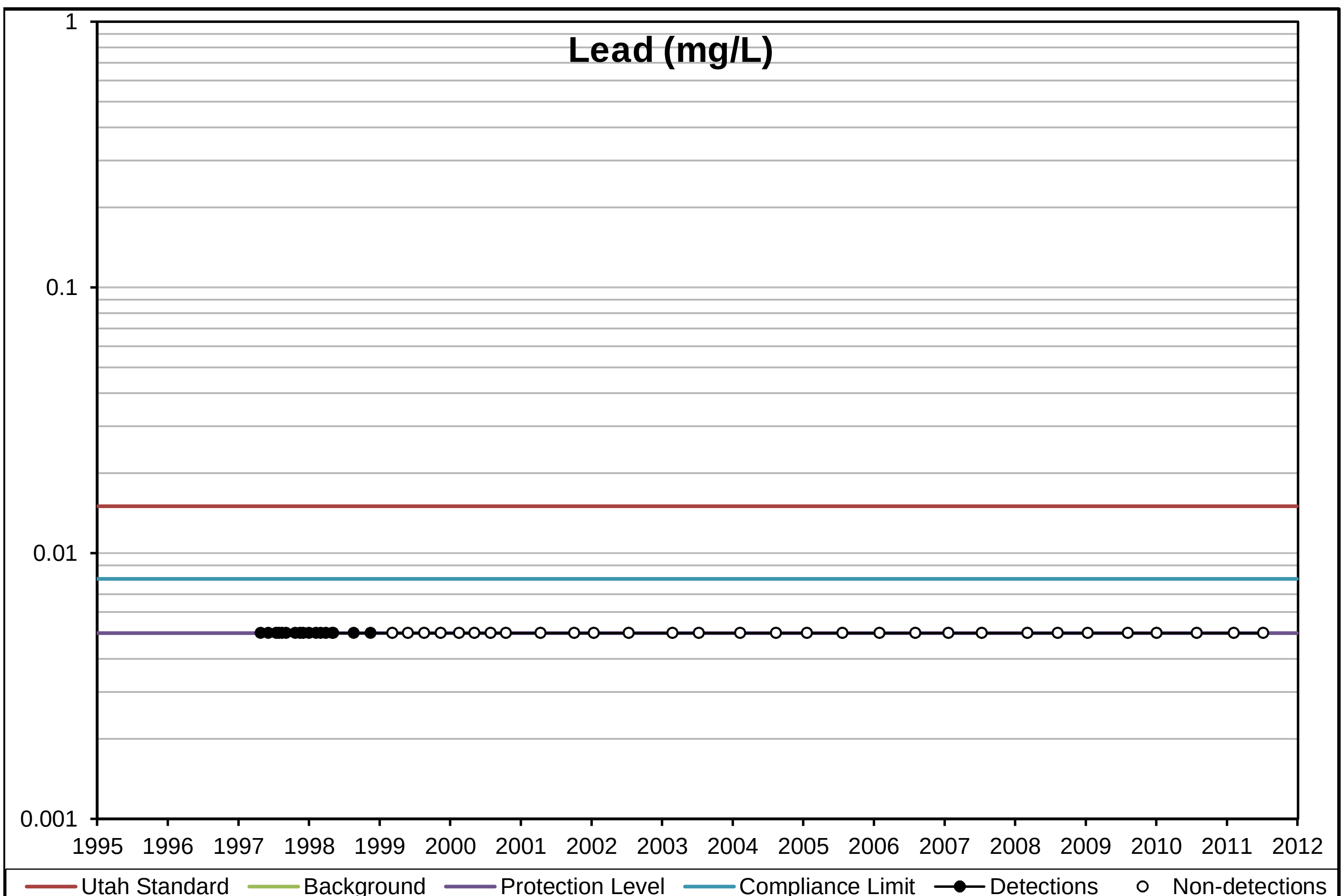
Constituent range includes minimum and maximum concentrations for all wells considered





Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

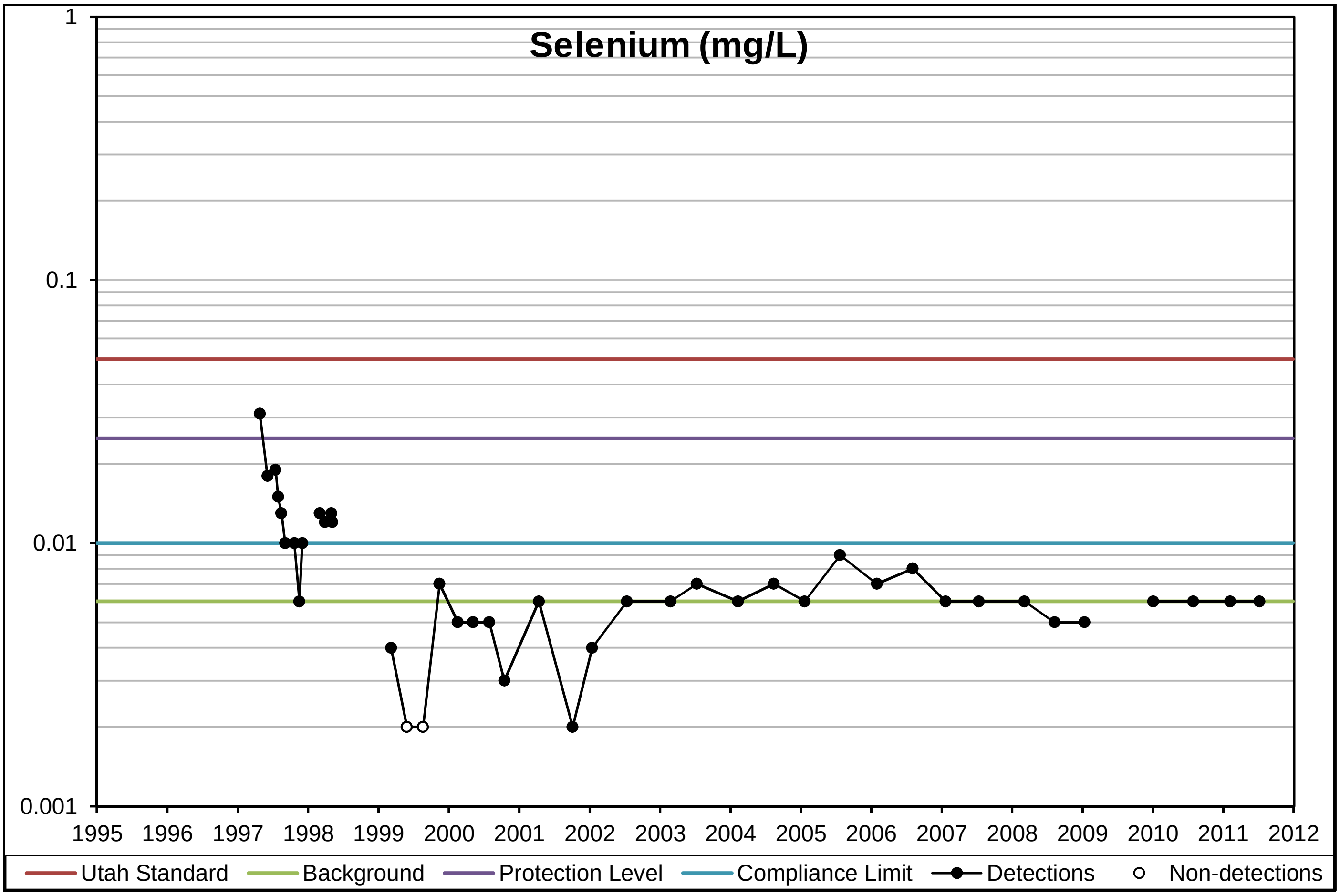


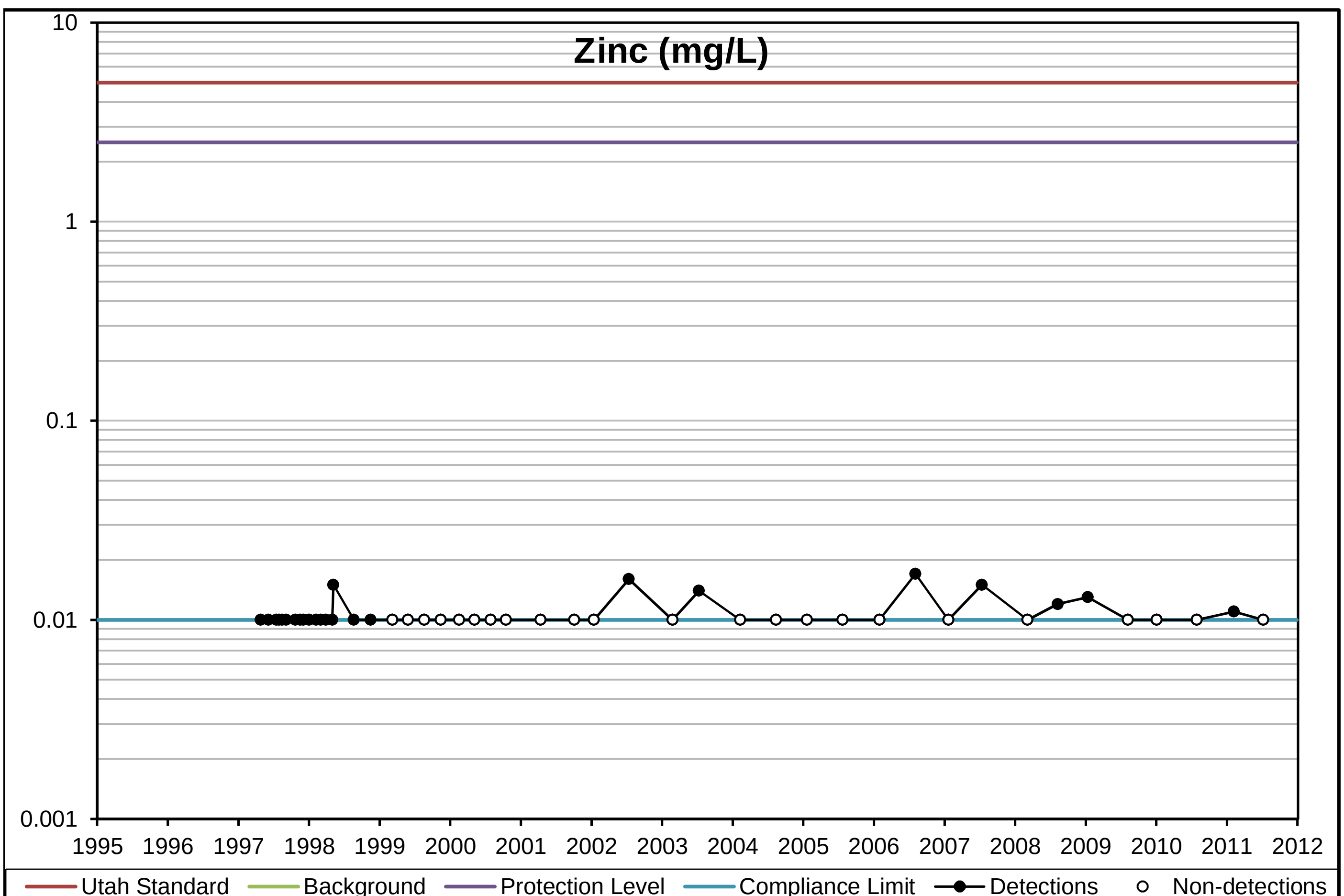


Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1492

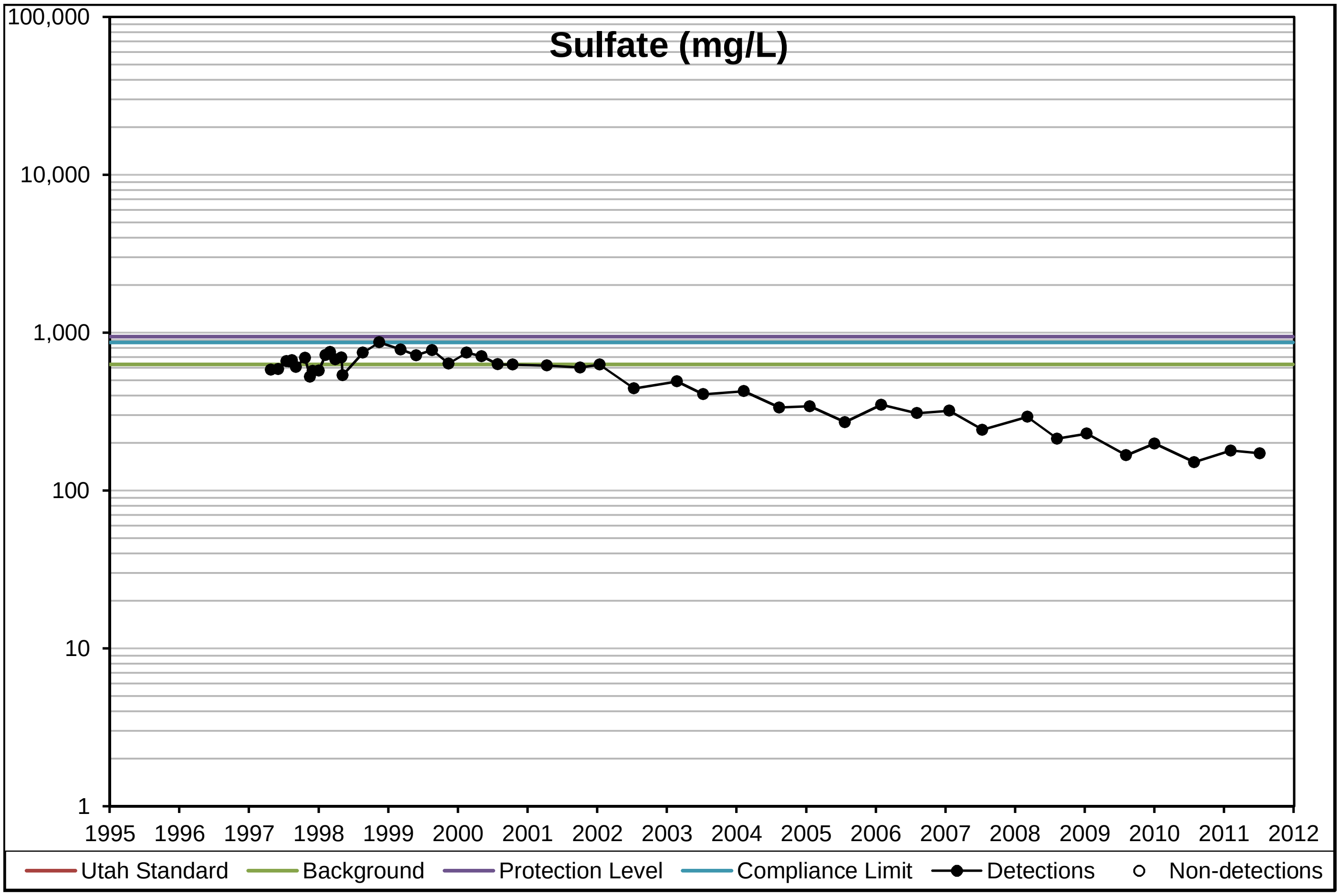
Concentration Versus Year

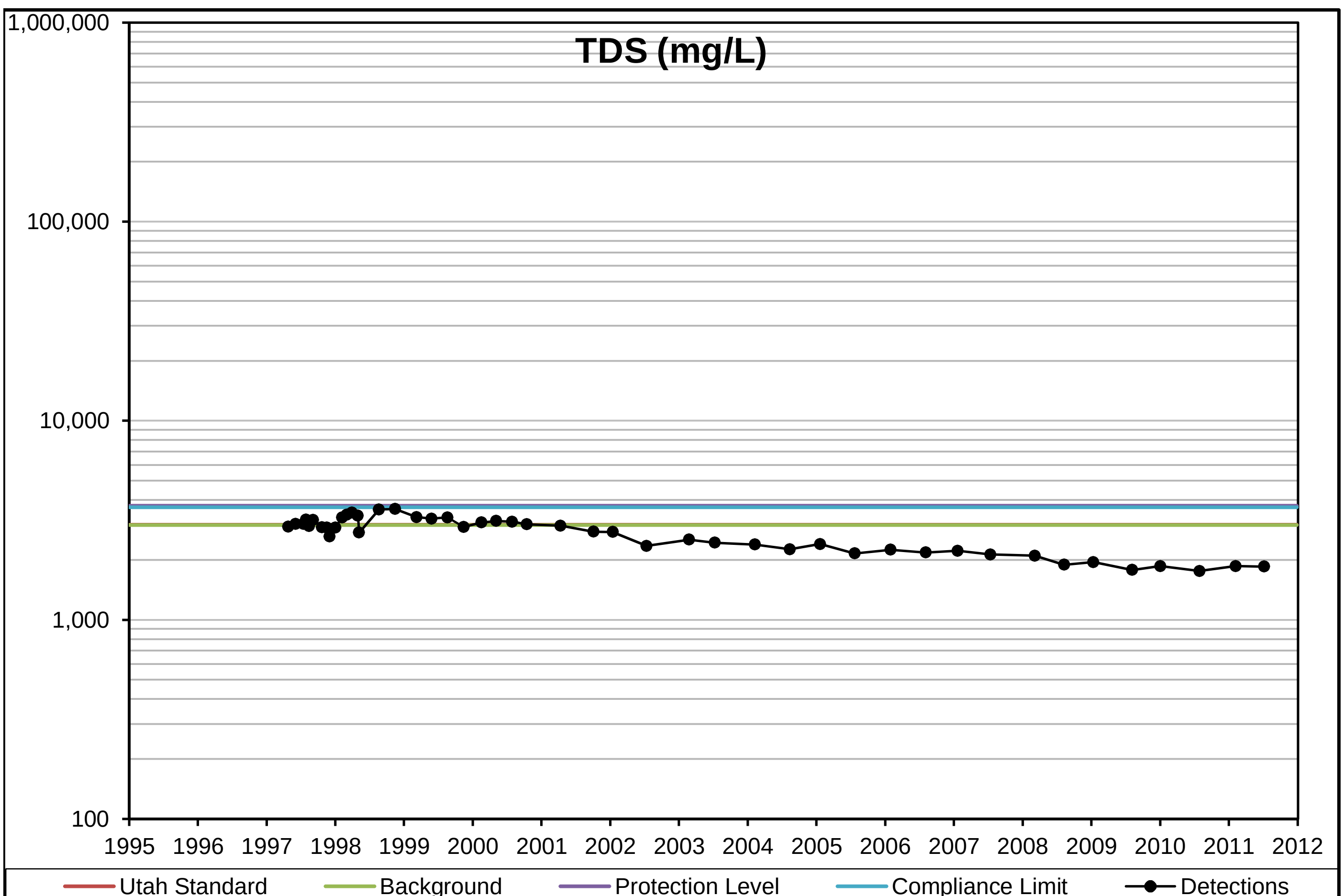




Background was not established for constituents not detected

Constituent range includes minimum and maximum concentrations for all wells considered

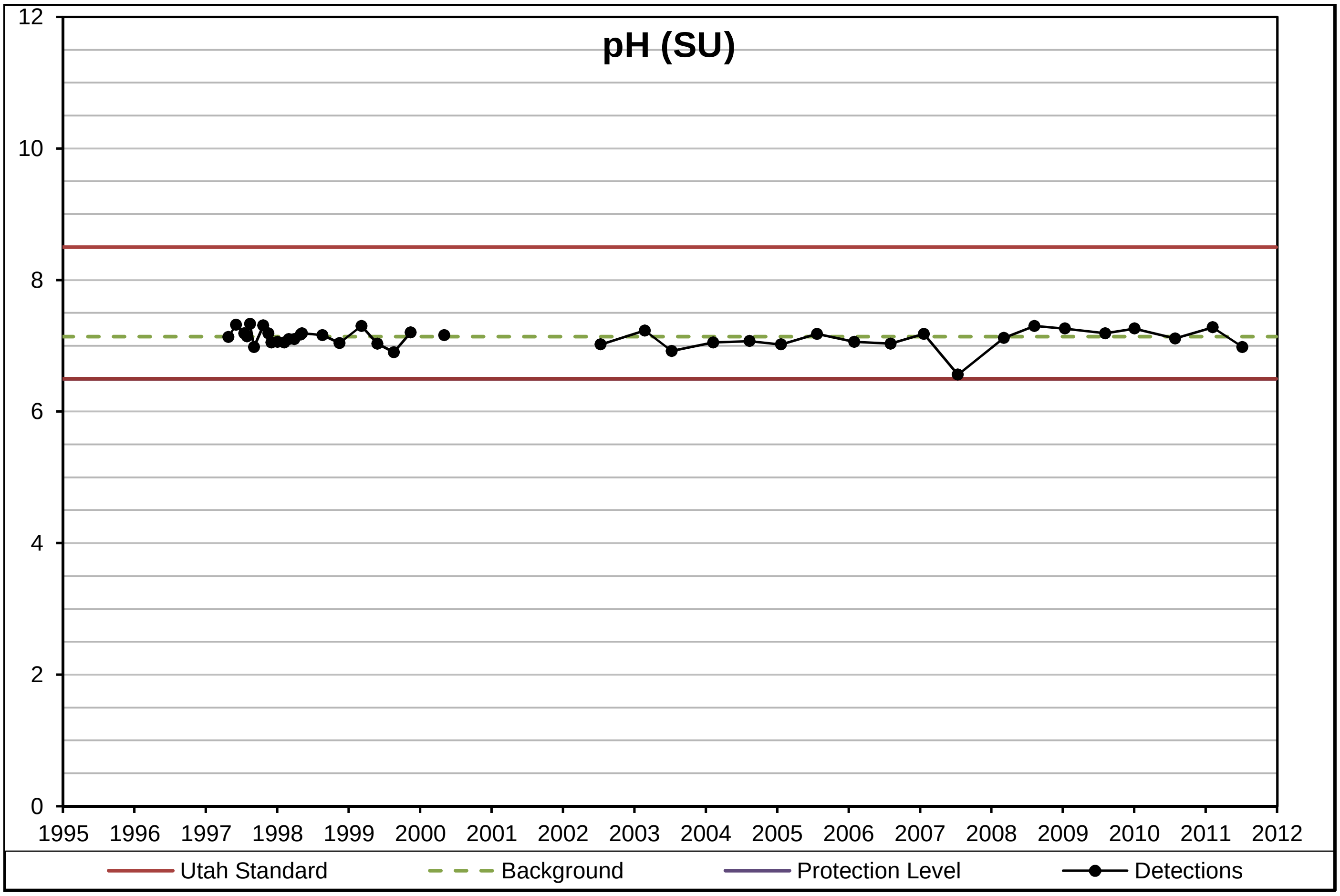




Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

NET1492

Concentration Versus Year



Background was not established for constituents not detected
Constituent range includes minimum and maximum concentrations for all wells considered

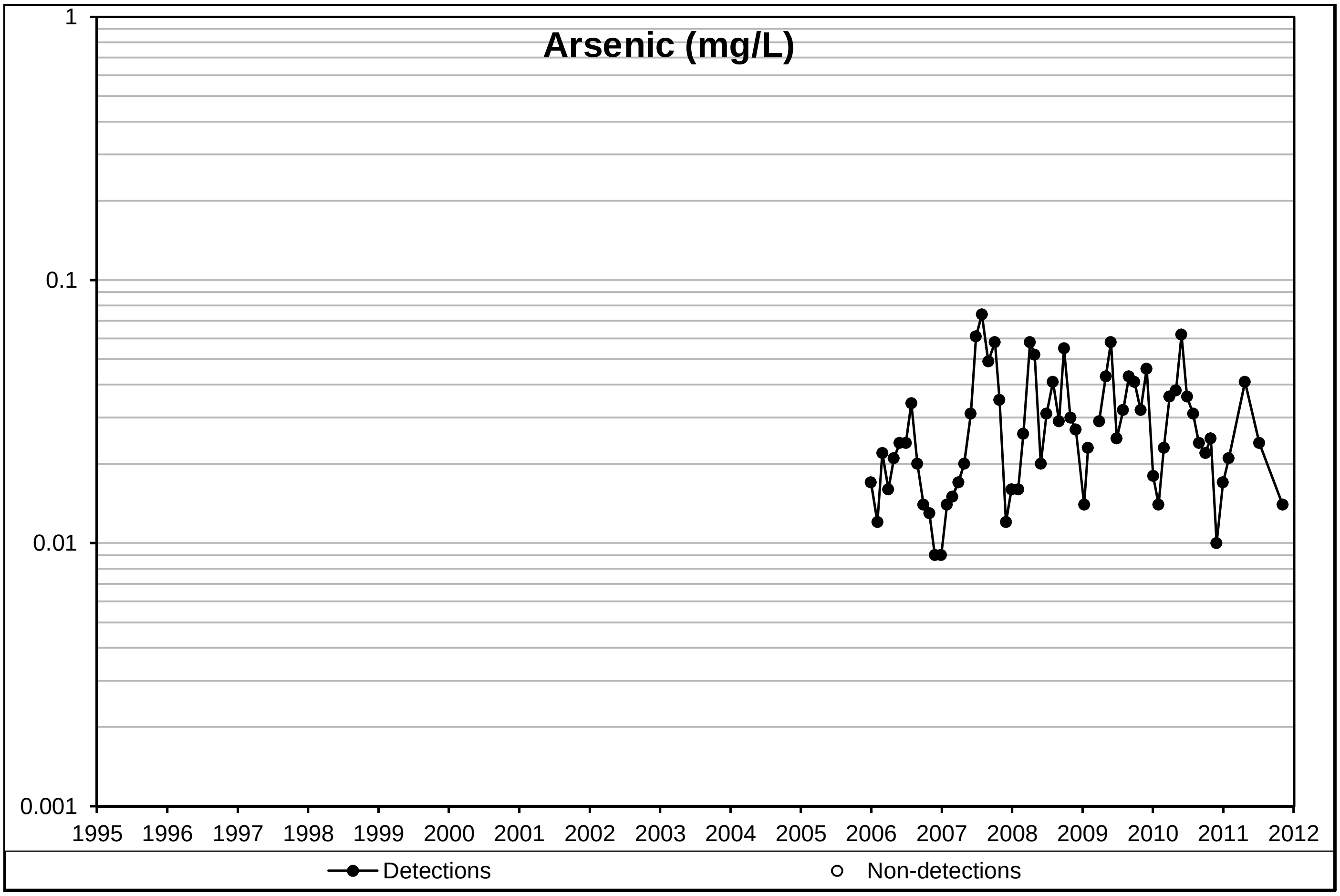
Sampled Process Water Locations

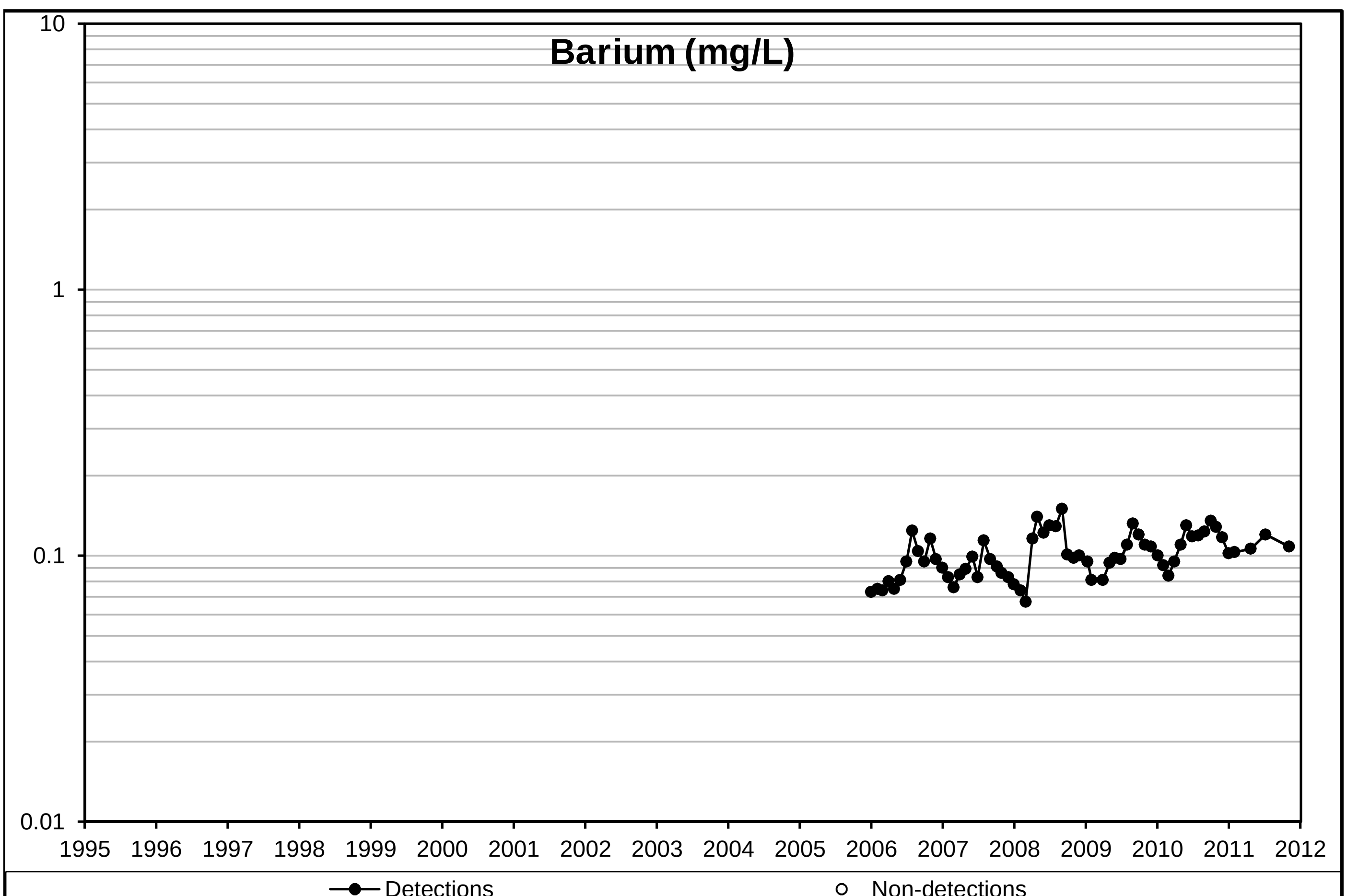
CLC452	Clarification Canal
TLT887	Tailings Well
TLL4100	Lysimeter
TLL4101	Lysimeter
TLL4102	Lysimeter
TLL4103	Lysimeter
TLS1426	Seep
TLL4128	Lysimeter
TLL4129	Lysimeter
TLL4133	Lysimeter
TLL4134	Lysimeter
TLL4135	Lysimeter
TLP1436	Toe Ditch
TLP1469	Toe Ditch
TLT2452	Tailings Well
TLT2575A	Tailings Well
TLT2575B	Tailings Well
NET2596	Tailings Well

Note: background concentrations and standards are not established for the above locations

CLC452

Concentration Versus Year



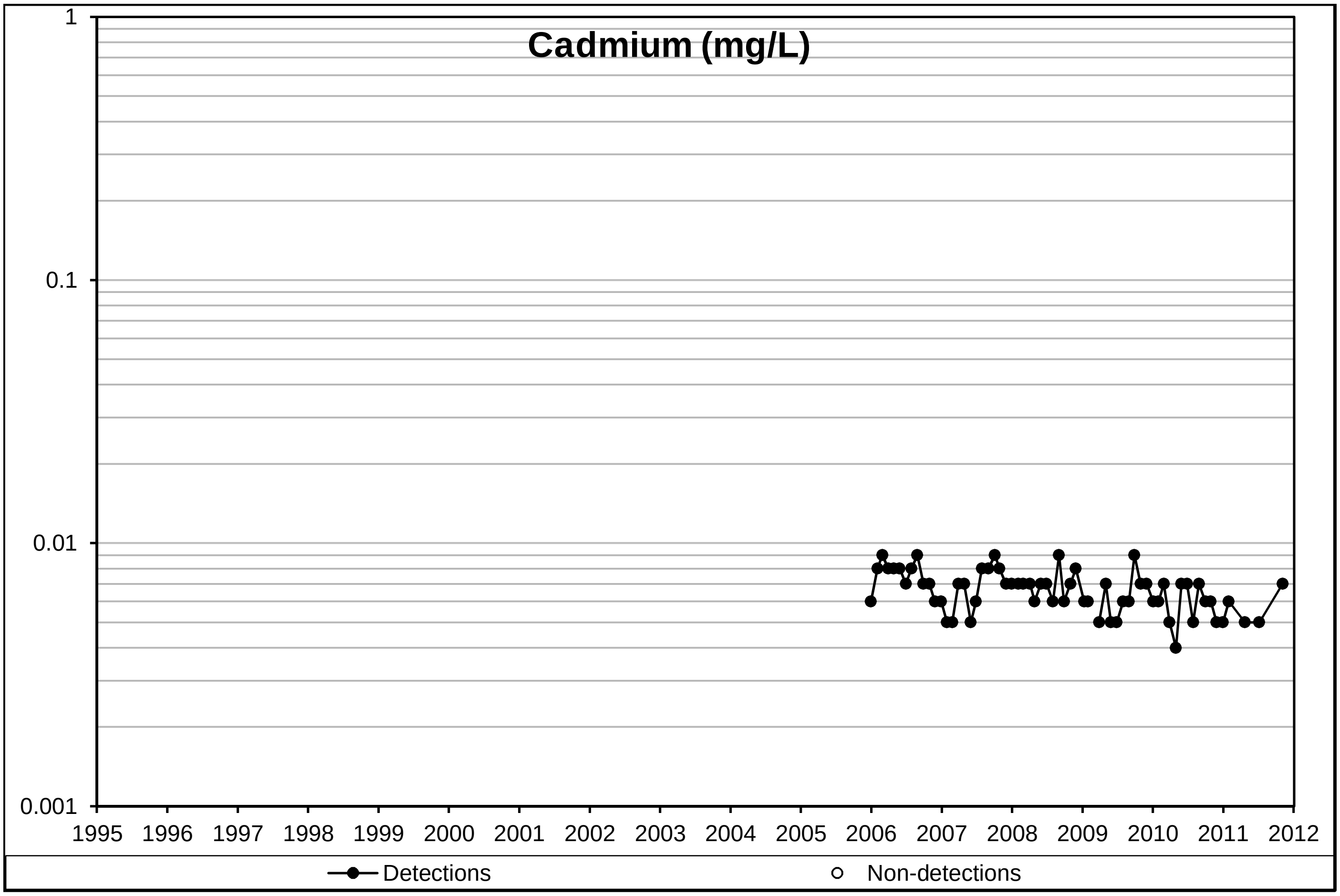


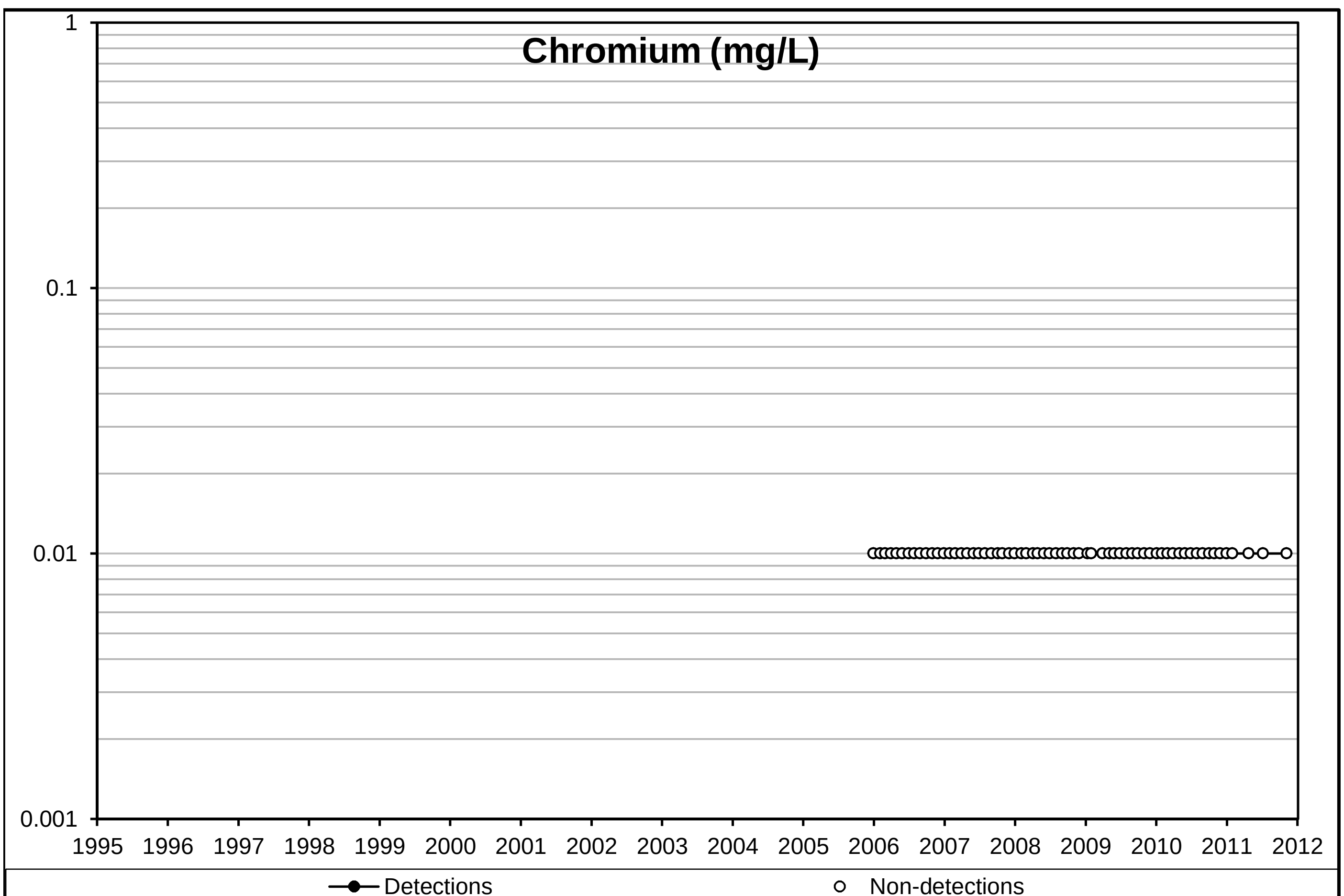
Background and standards are not shown as location is surface water

Constituent range includes minimum and maximum concentrations for all wells considered

CLC452

Concentration Versus Year



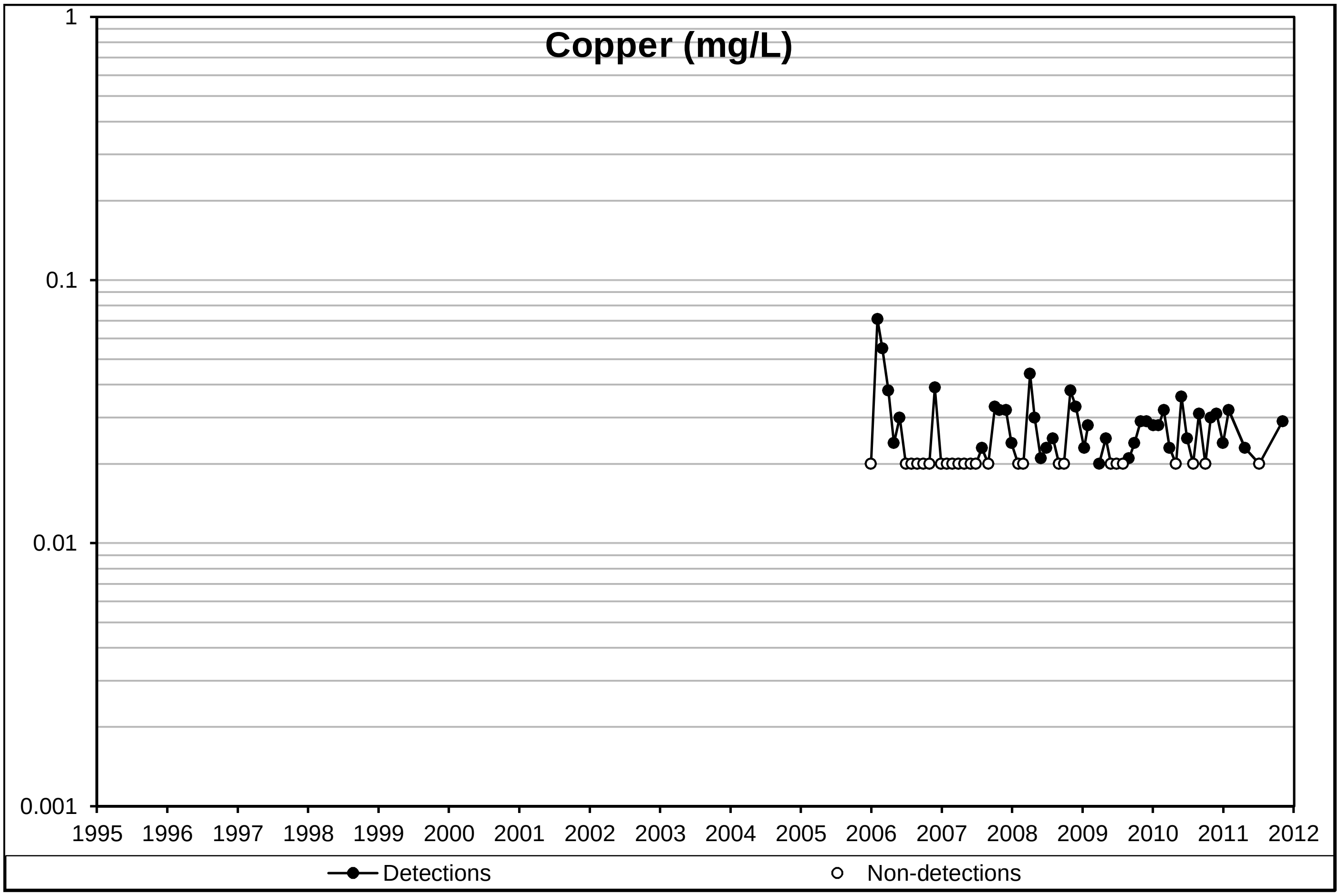


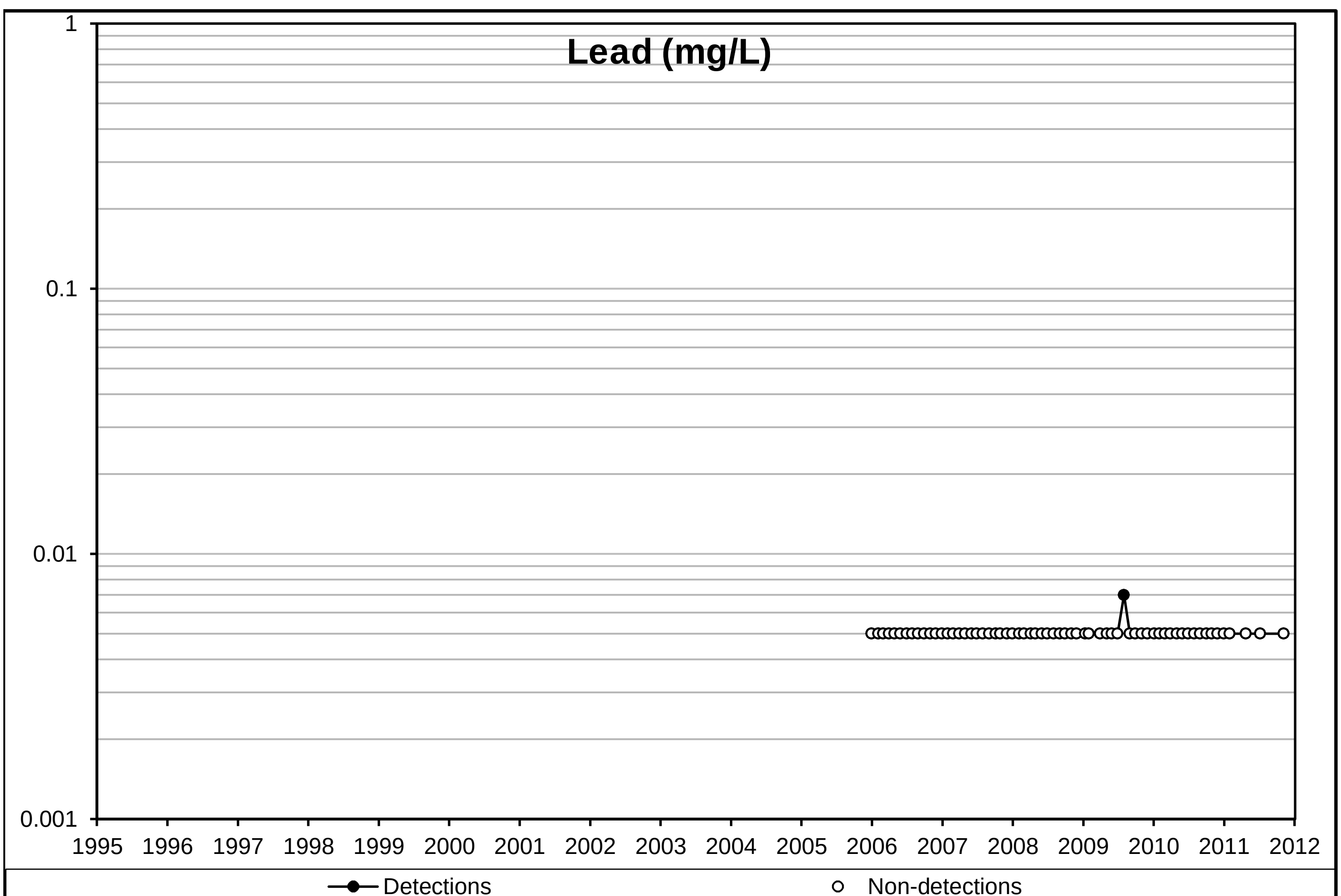
Background and standards are not shown as location is surface water

Constituent range includes minimum and maximum concentrations for all wells considered

CLC452

Concentration Versus Year



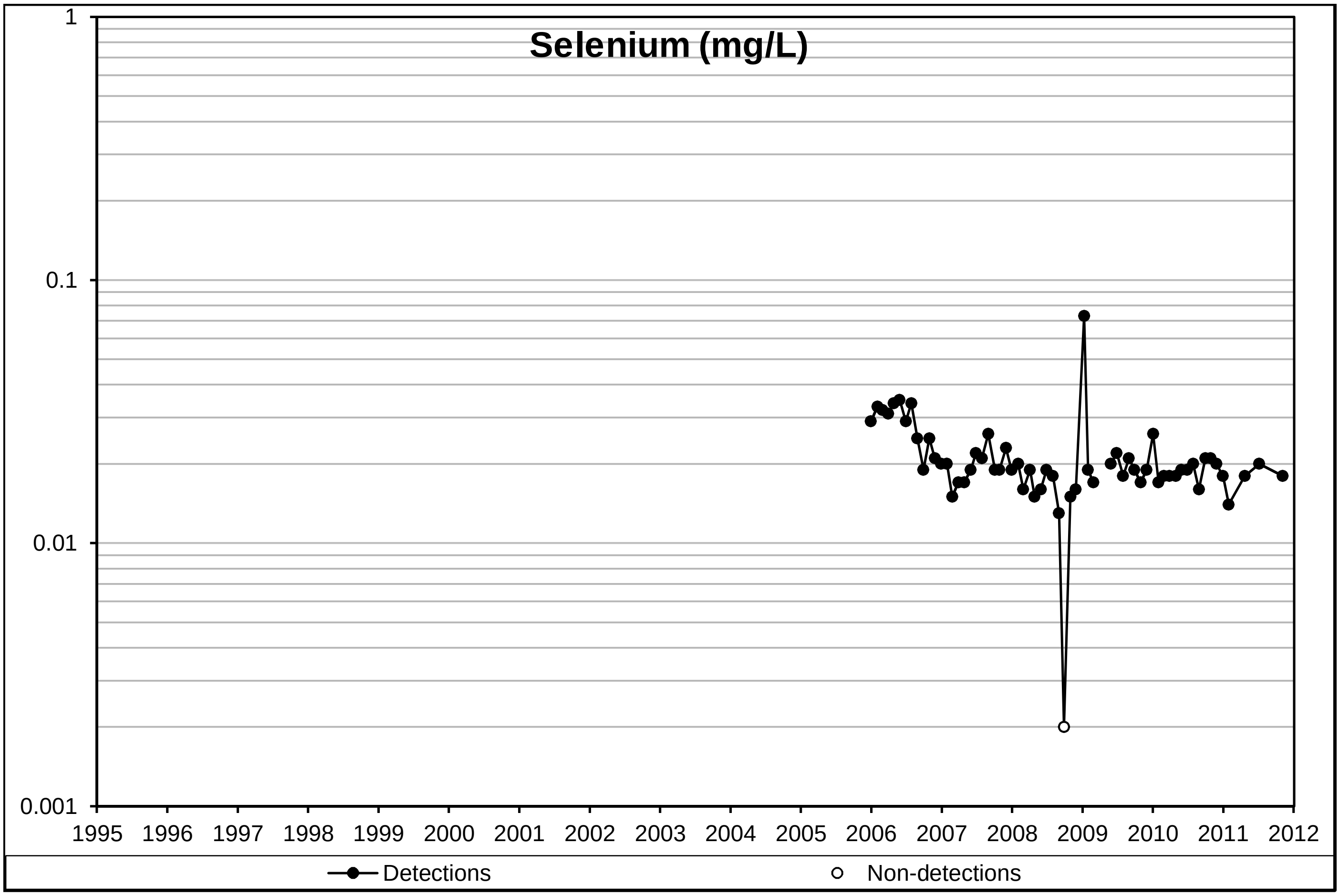


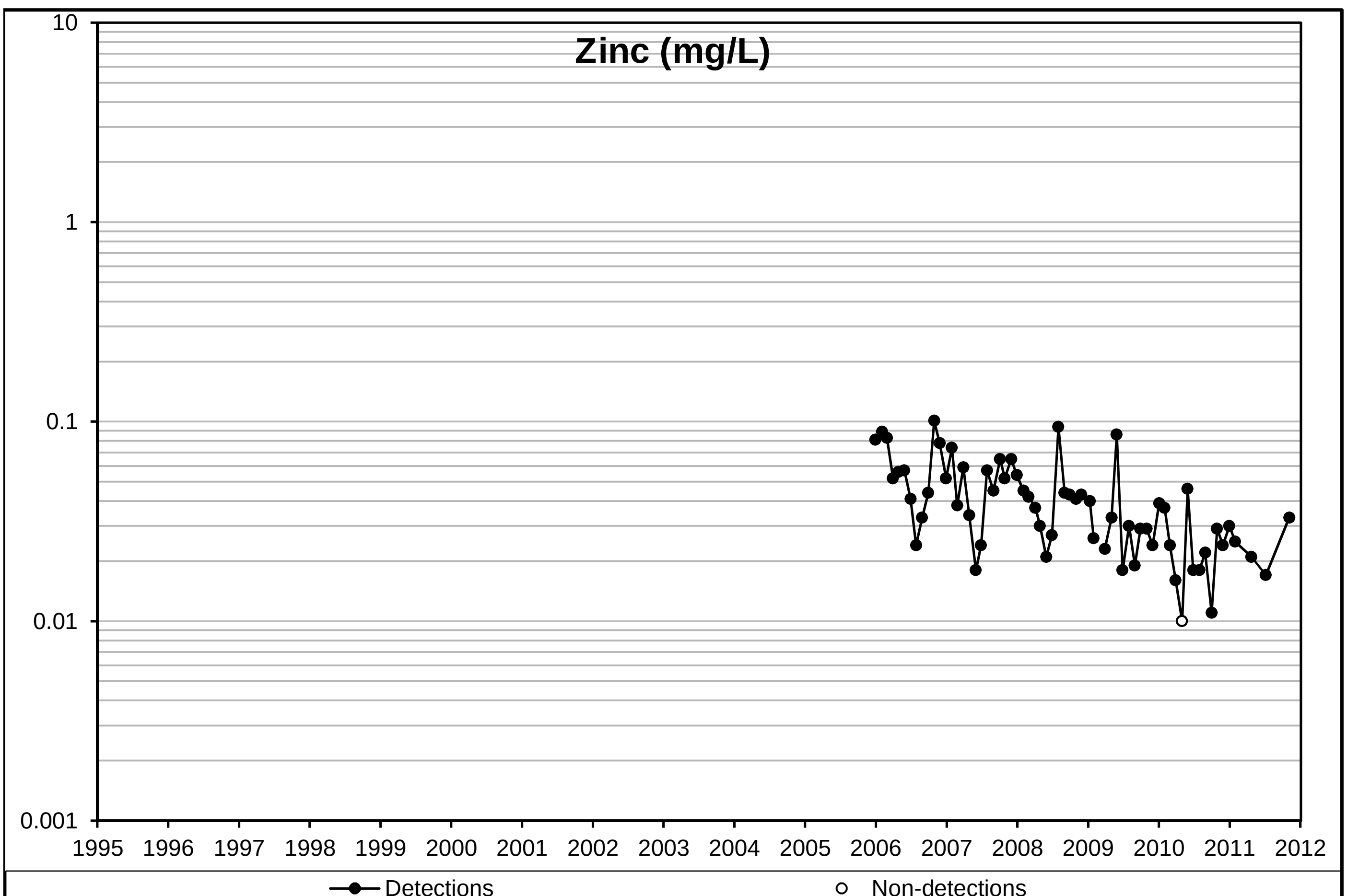
Background and standards are not shown as location is surface water

Constituent range includes minimum and maximum concentrations for all wells considered

CLC452

Concentration Versus Year



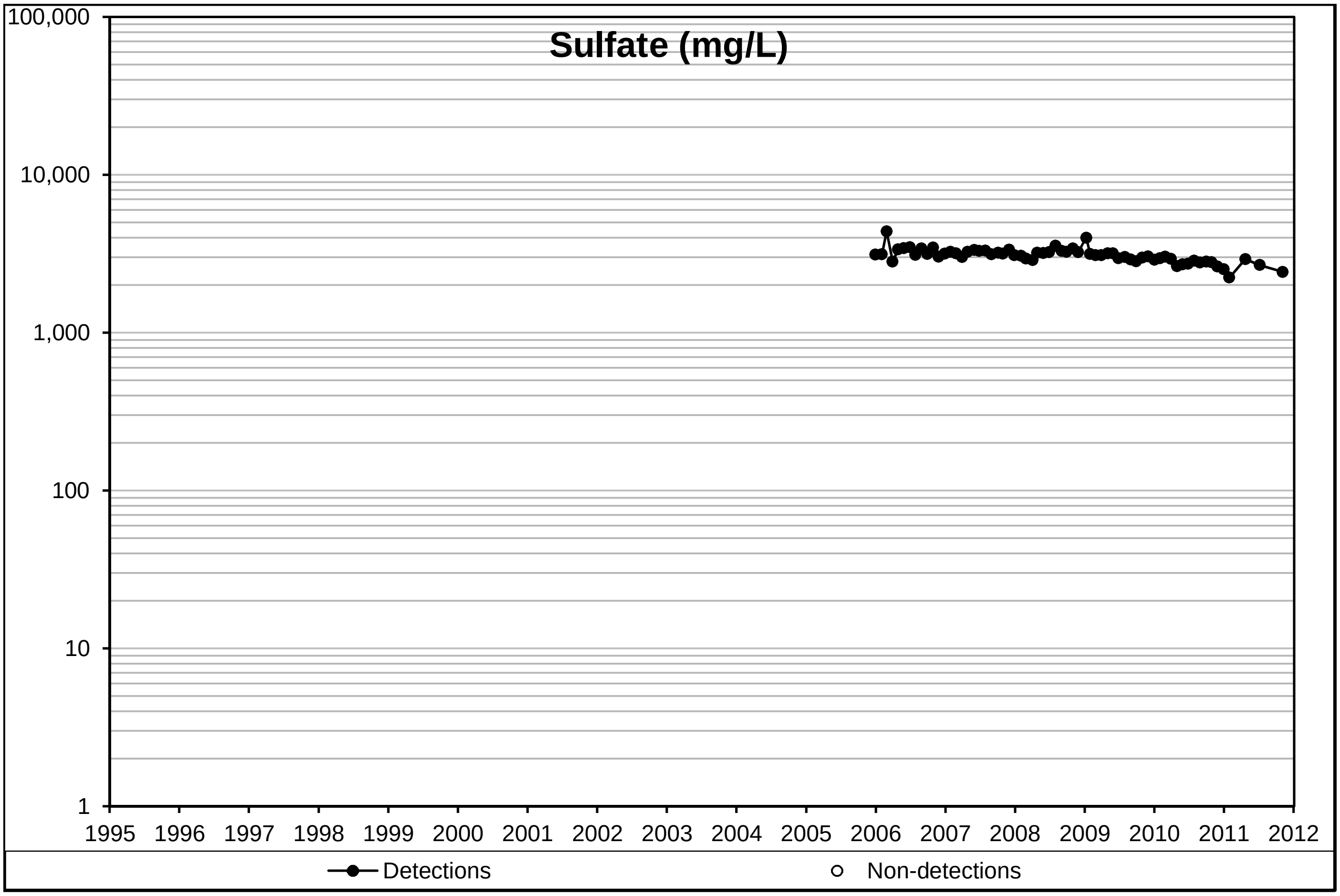


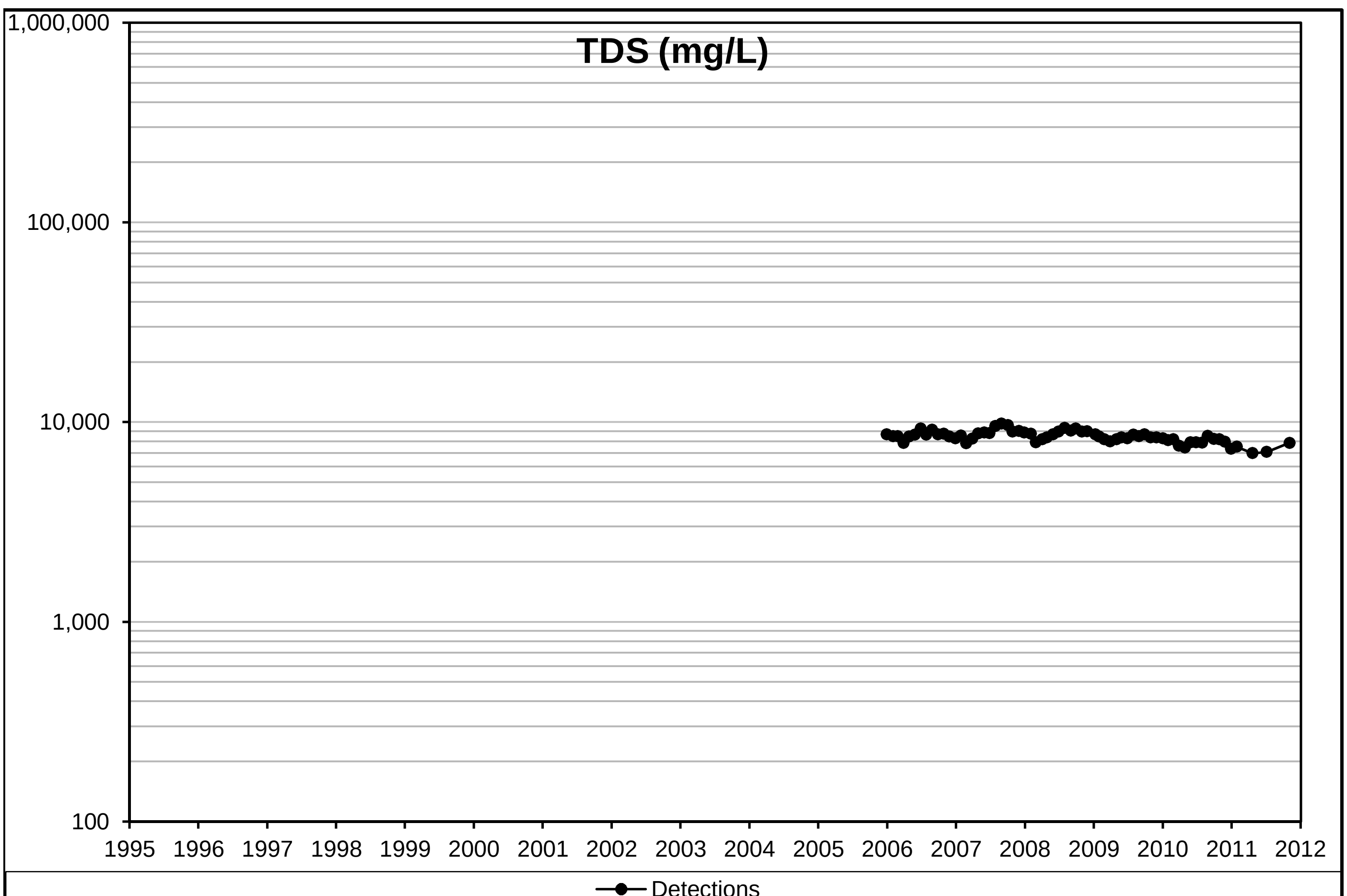
Background and standards are not shown as location is surface water

Constituent range includes minimum and maximum concentrations for all wells considered

CLC452

Concentration Versus Year

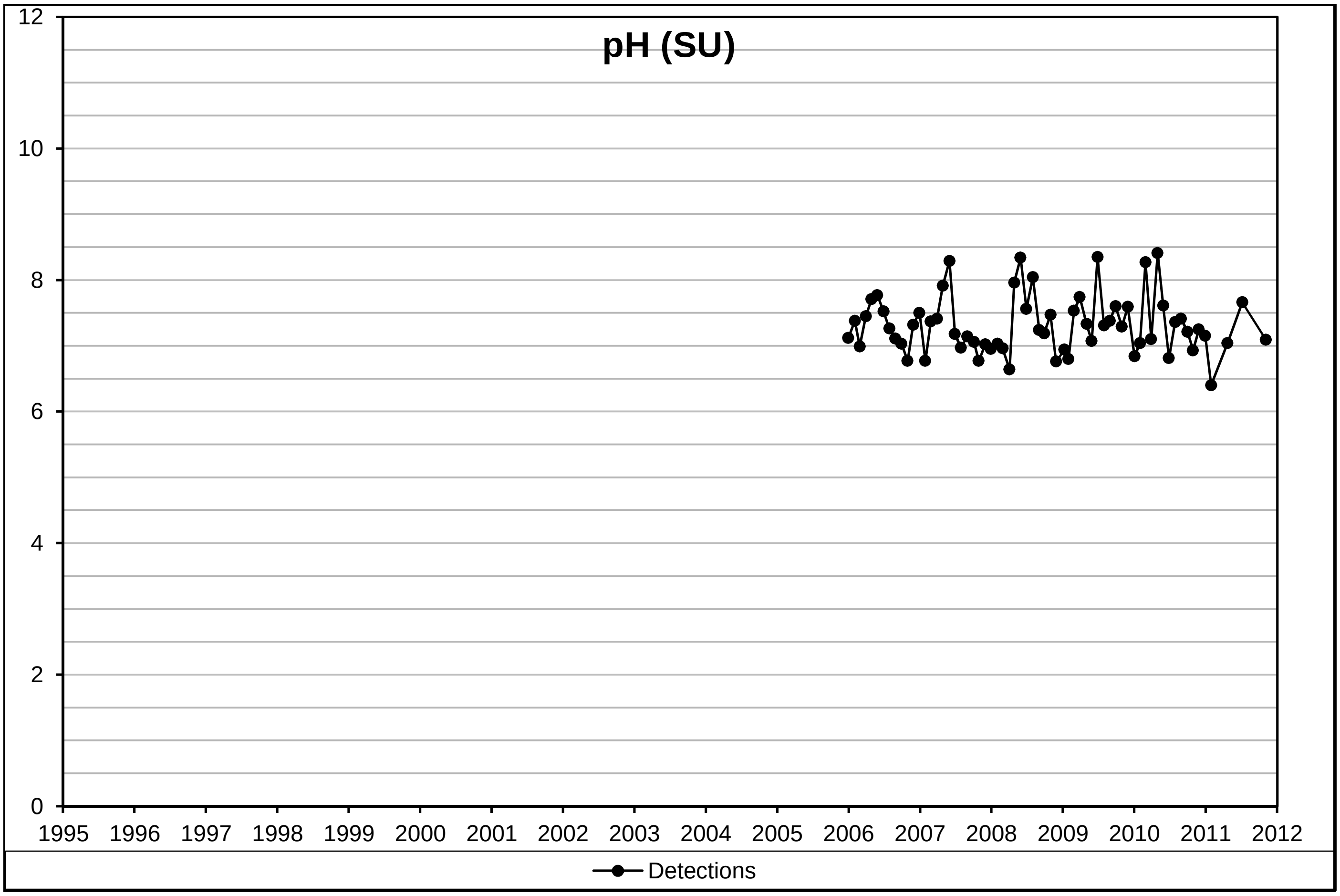




Background and standards are not shown as location is surface water

Constituent range includes minimum and maximum concentrations for all wells considered

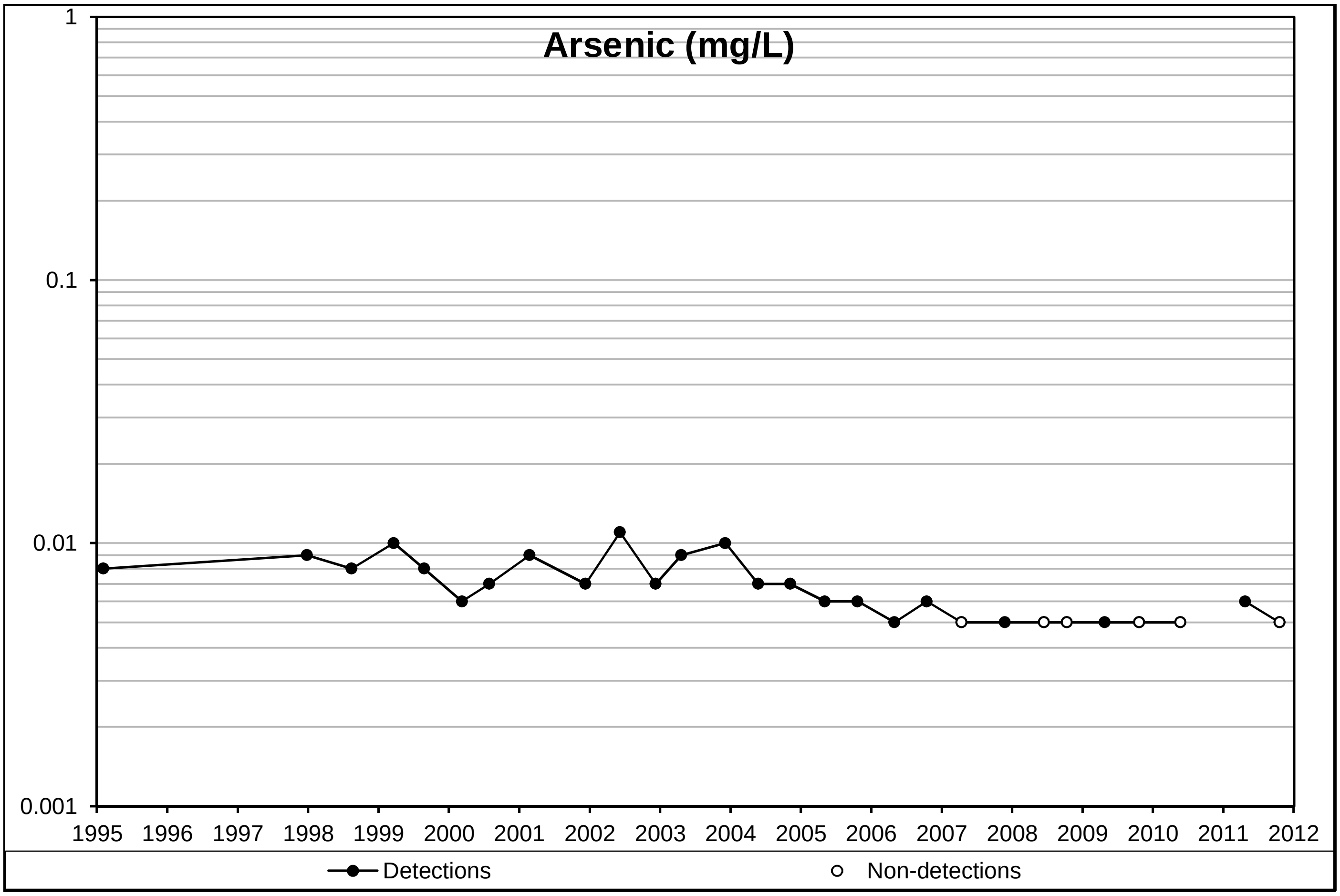
CLC452
Concentration Versus Year

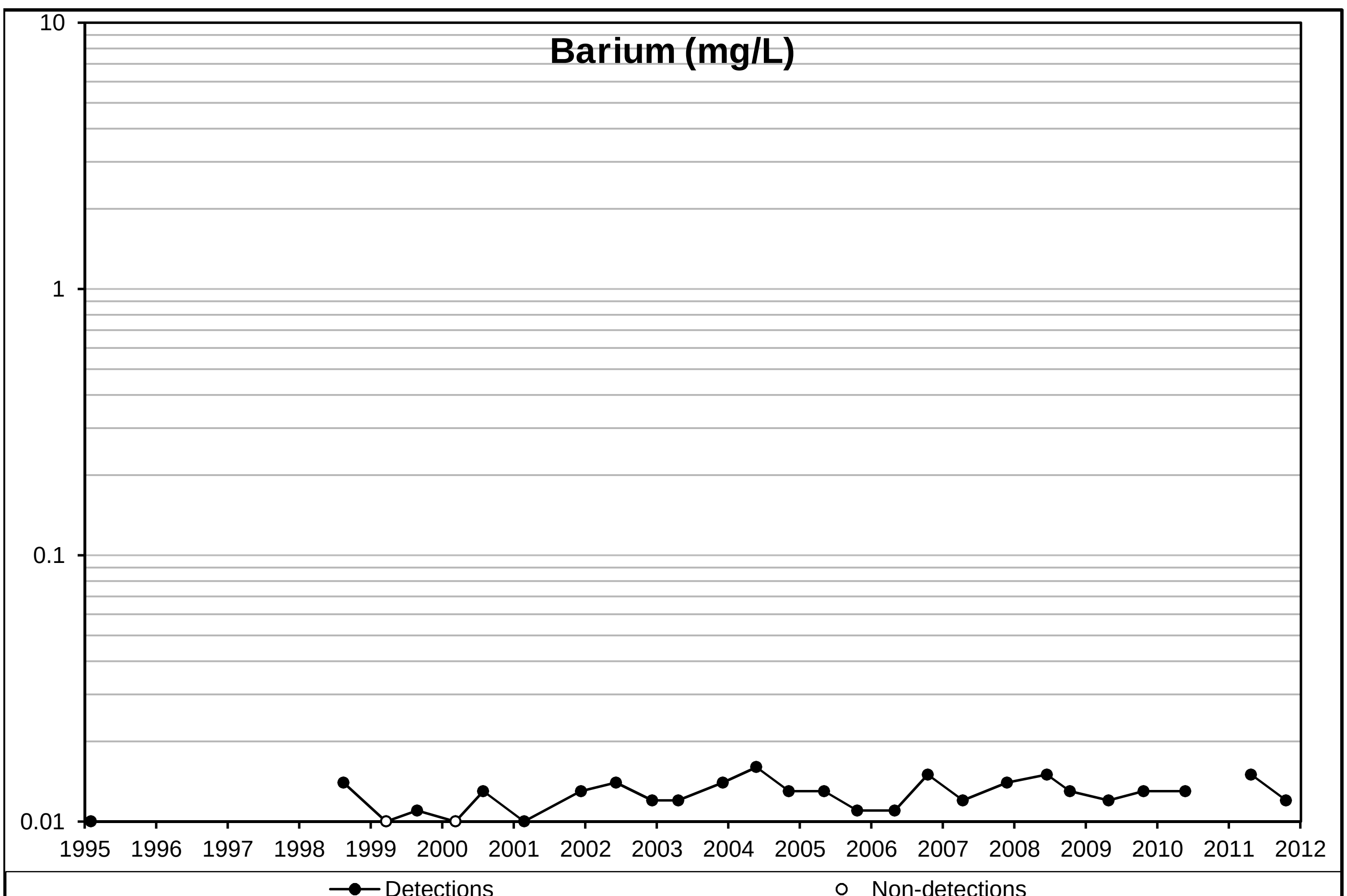


Background and standards are not shown as location is surface water
Constituent range includes minimum and maximum concentrations for all wells considered

TLT887

Concentration Versus Year

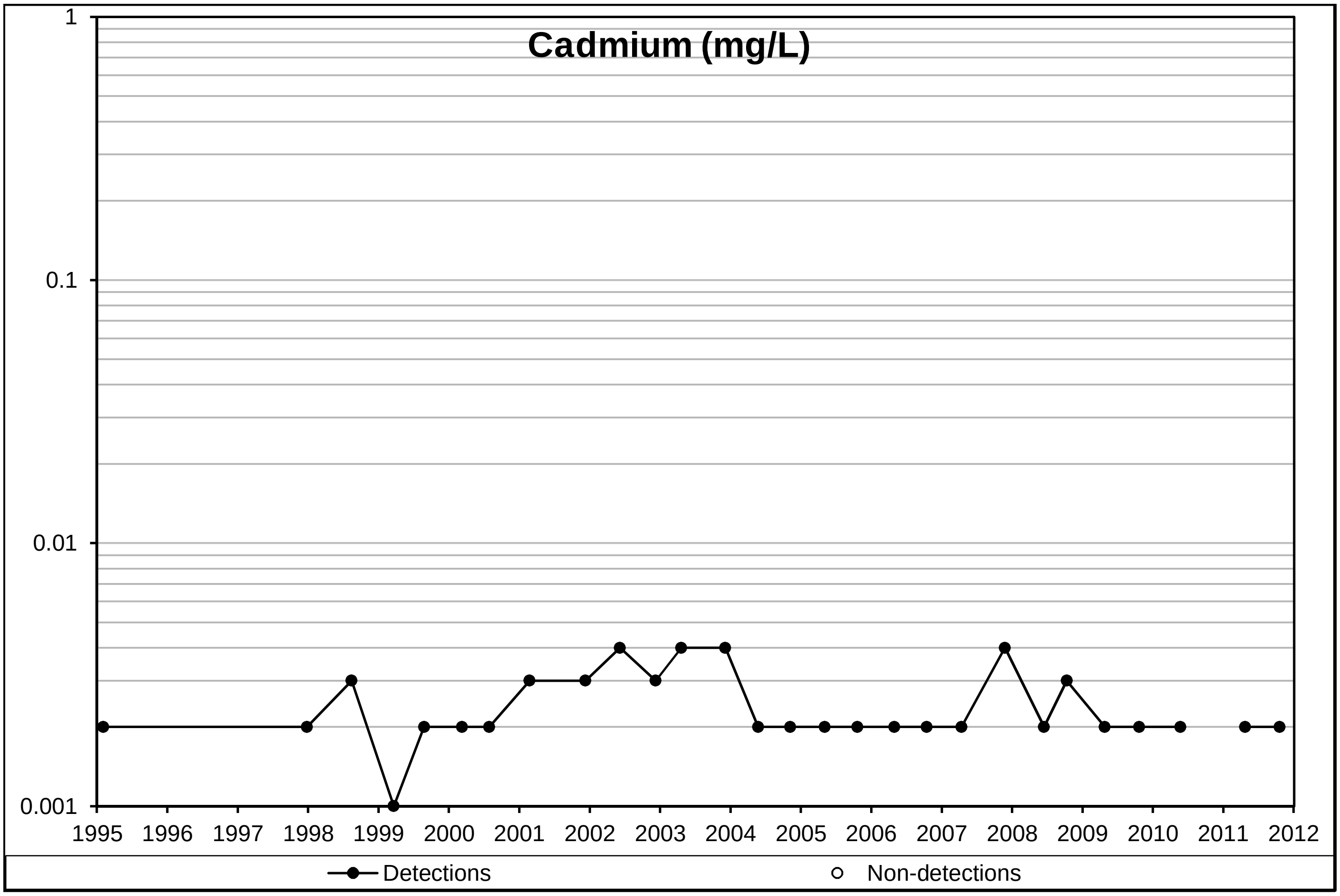


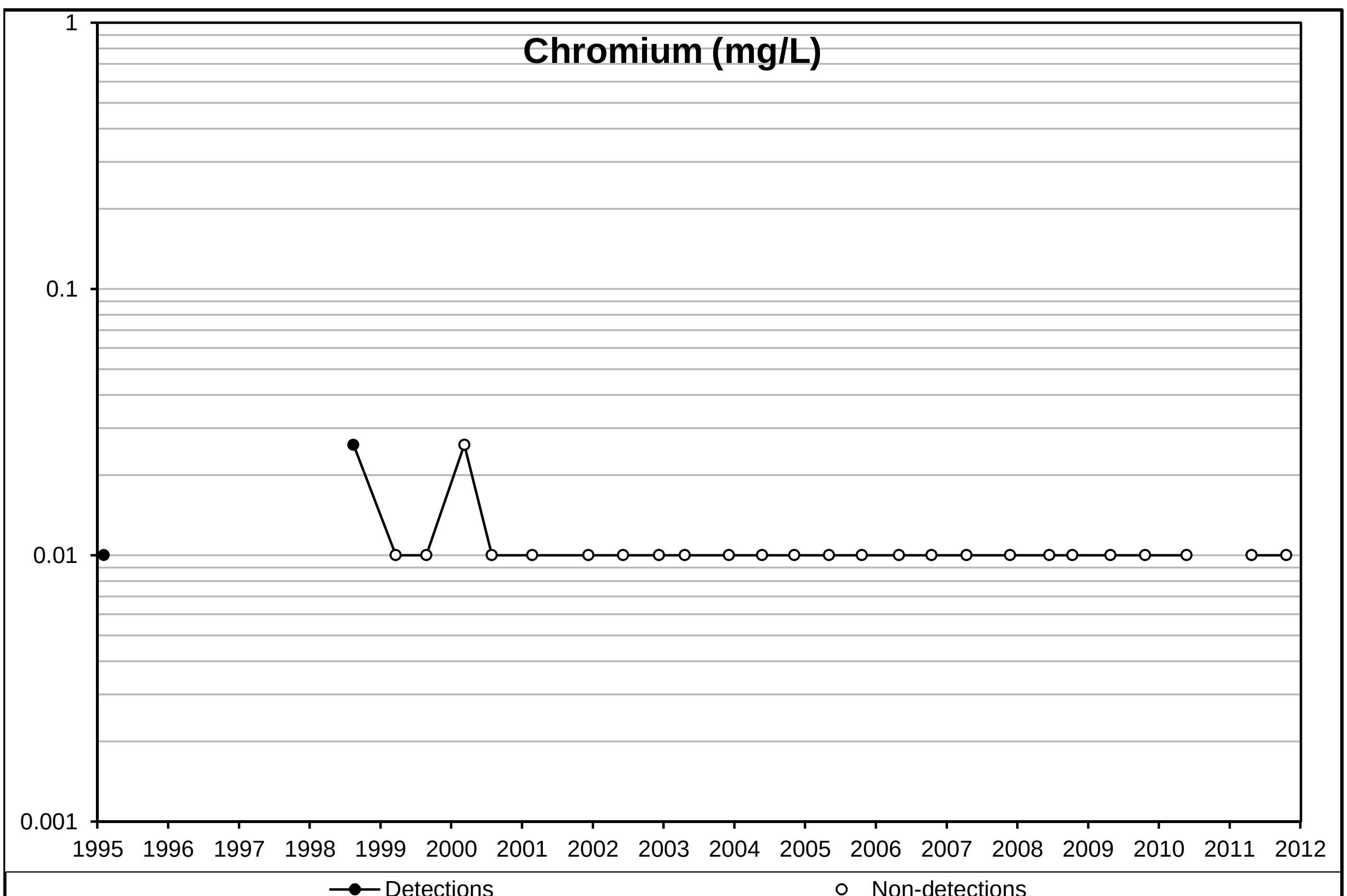


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLT887

Concentration Versus Year



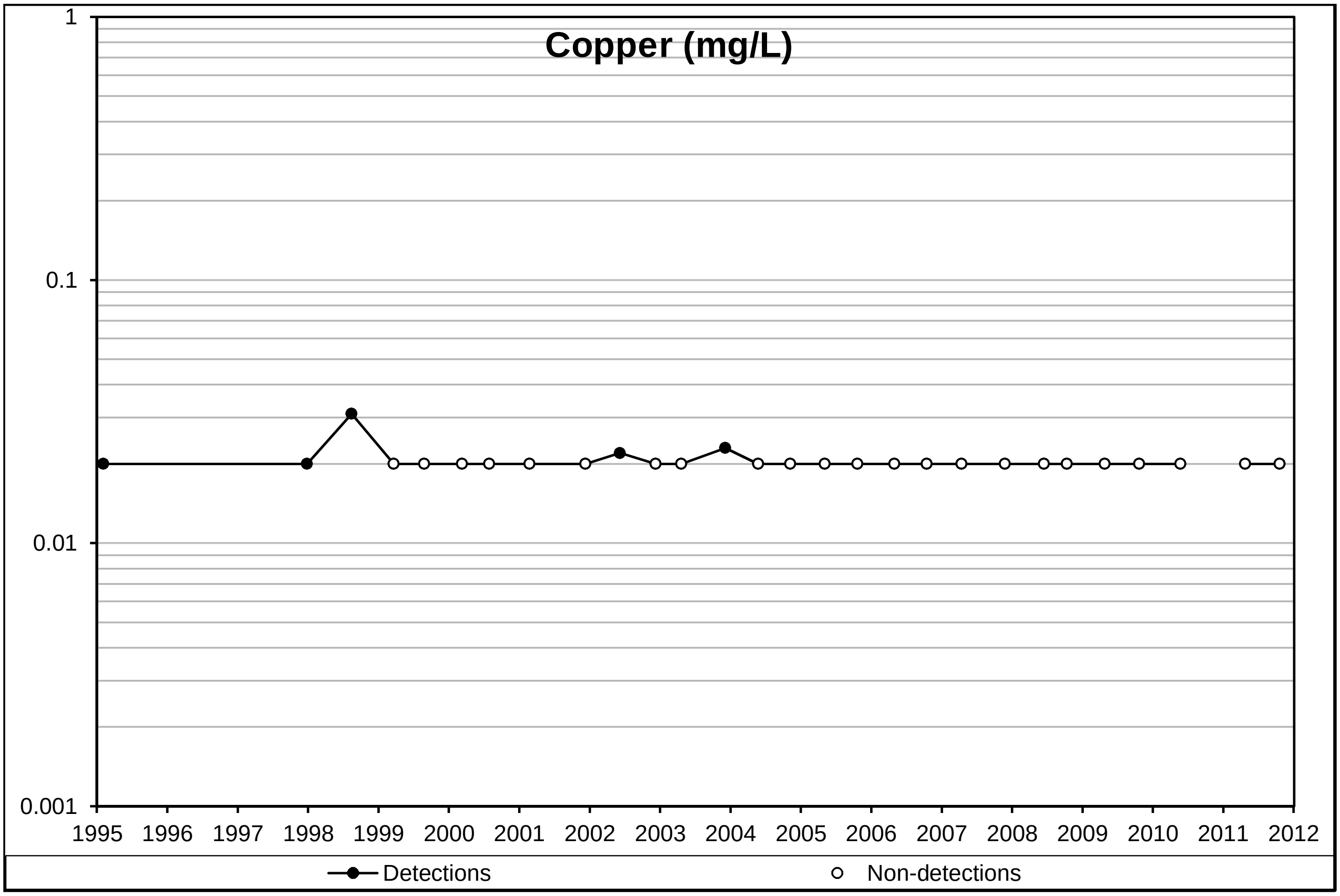


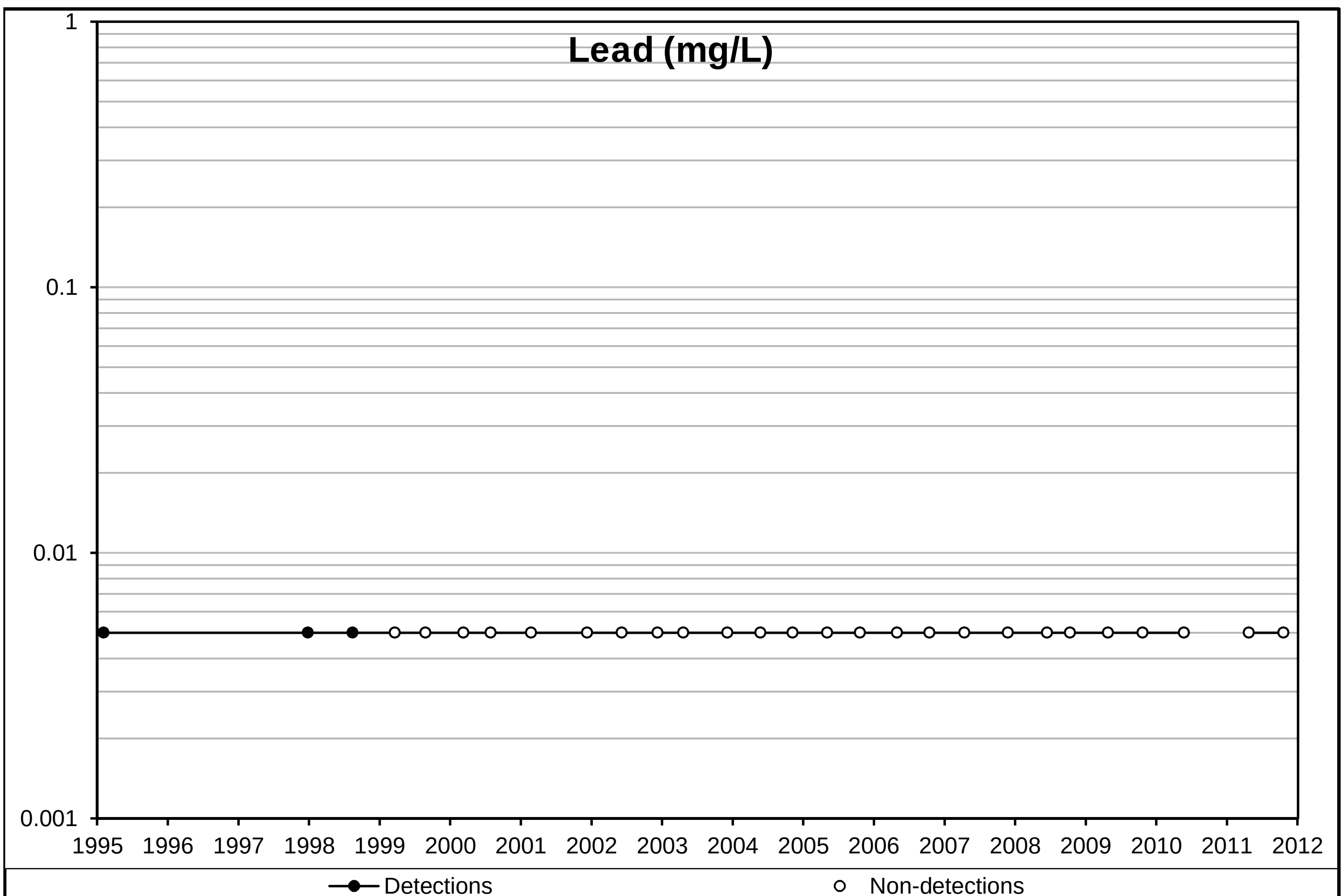
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLT887

Concentration Versus Year



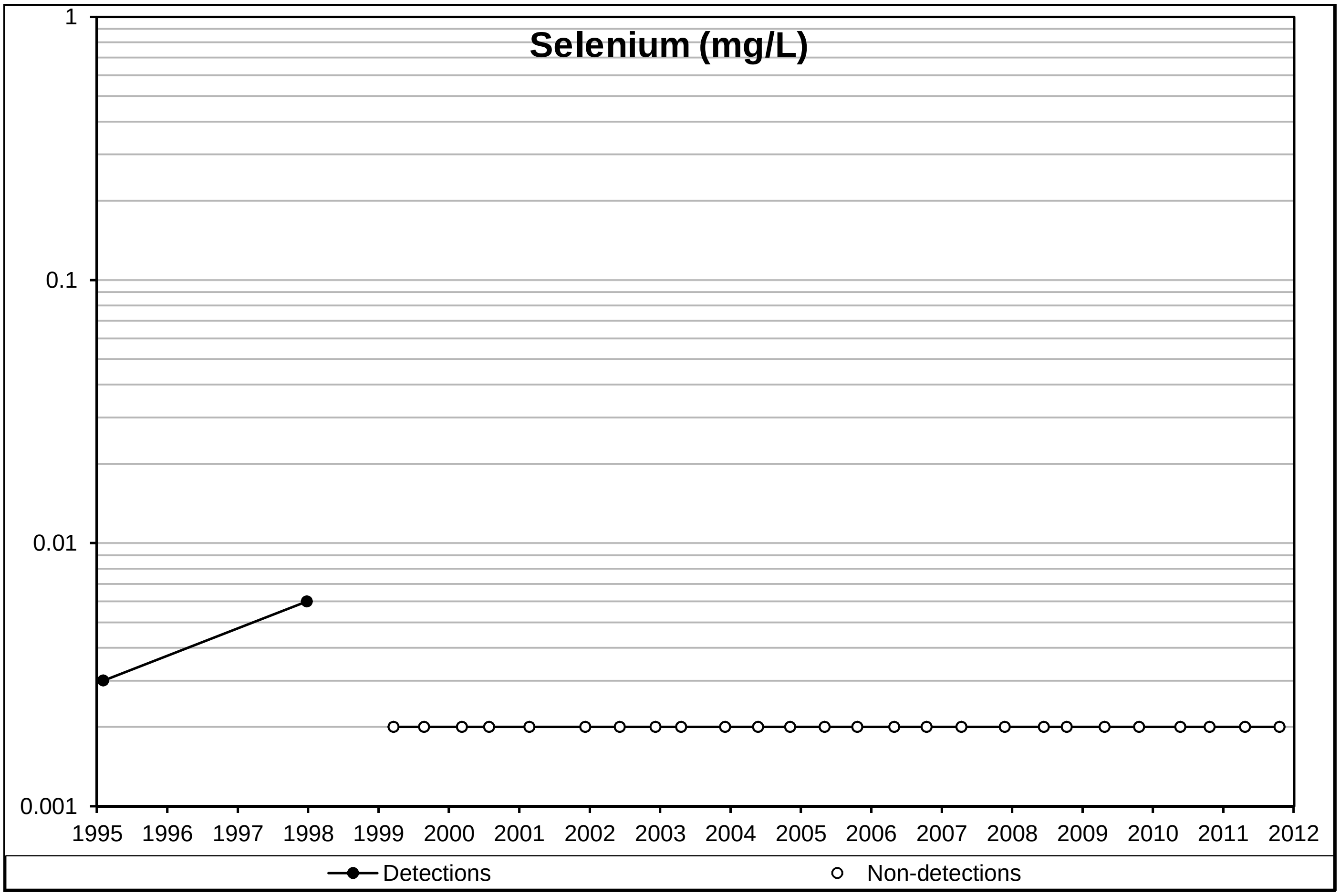


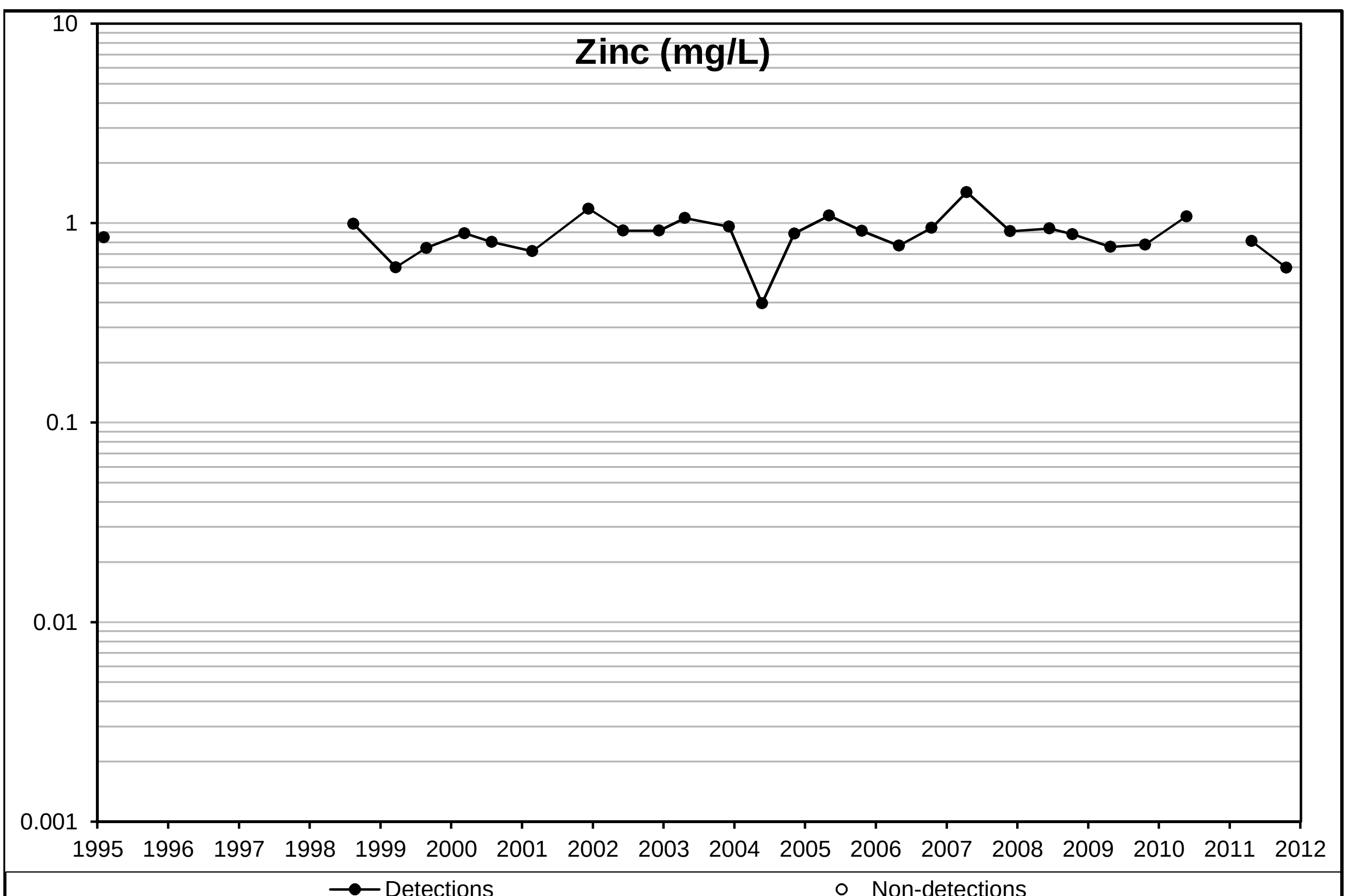
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLT887

Concentration Versus Year

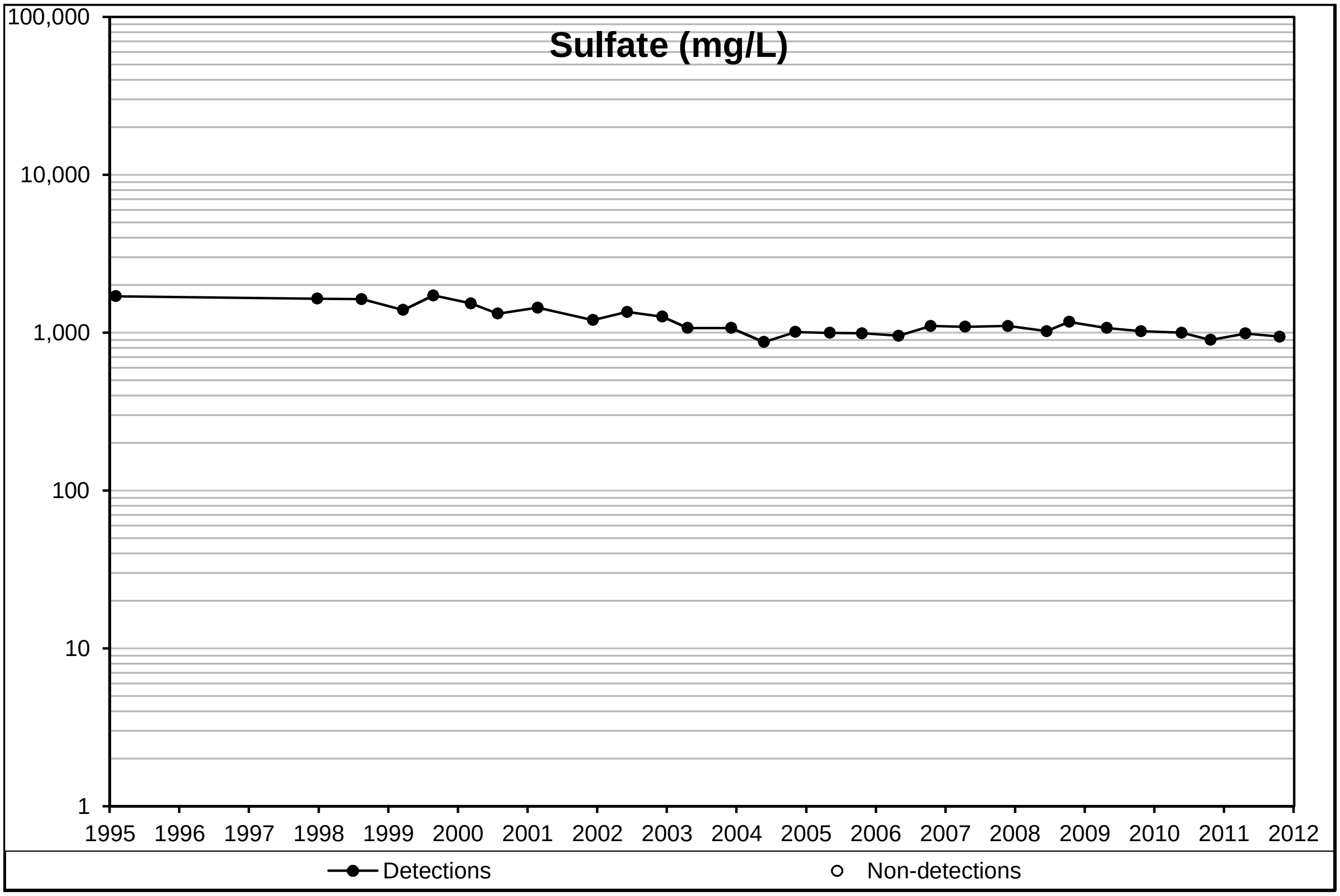


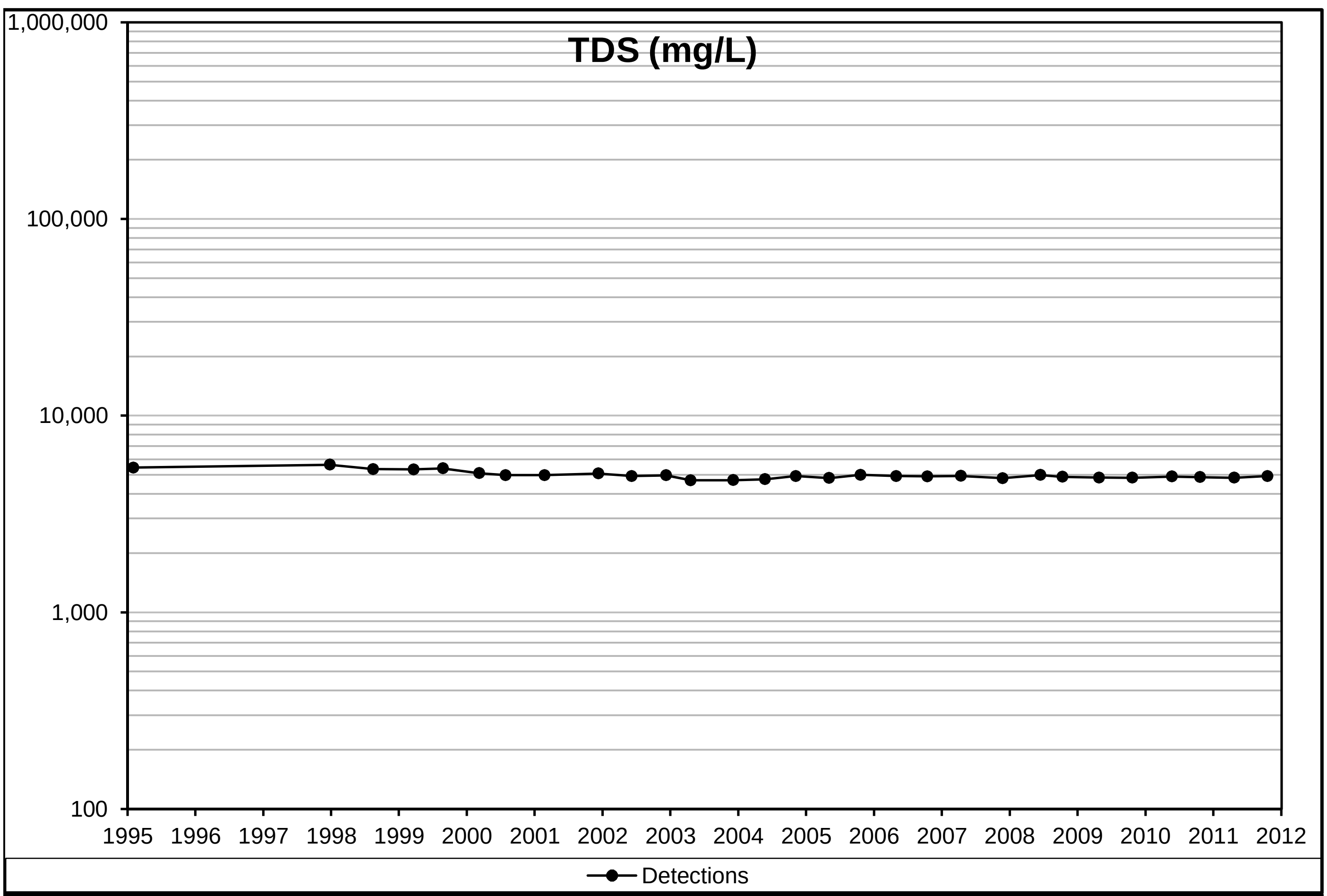


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

Concentration Versus Year

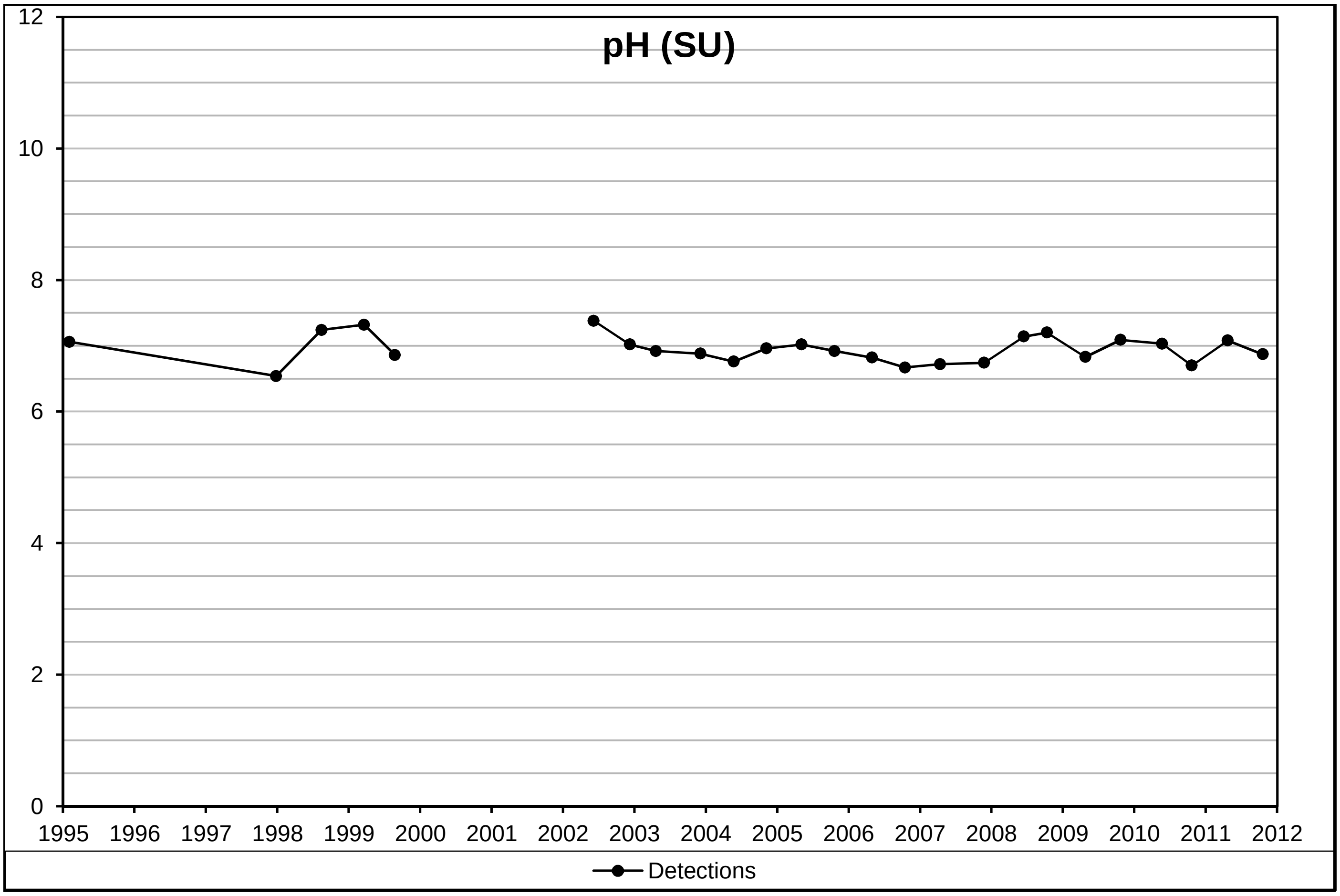




Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLT887

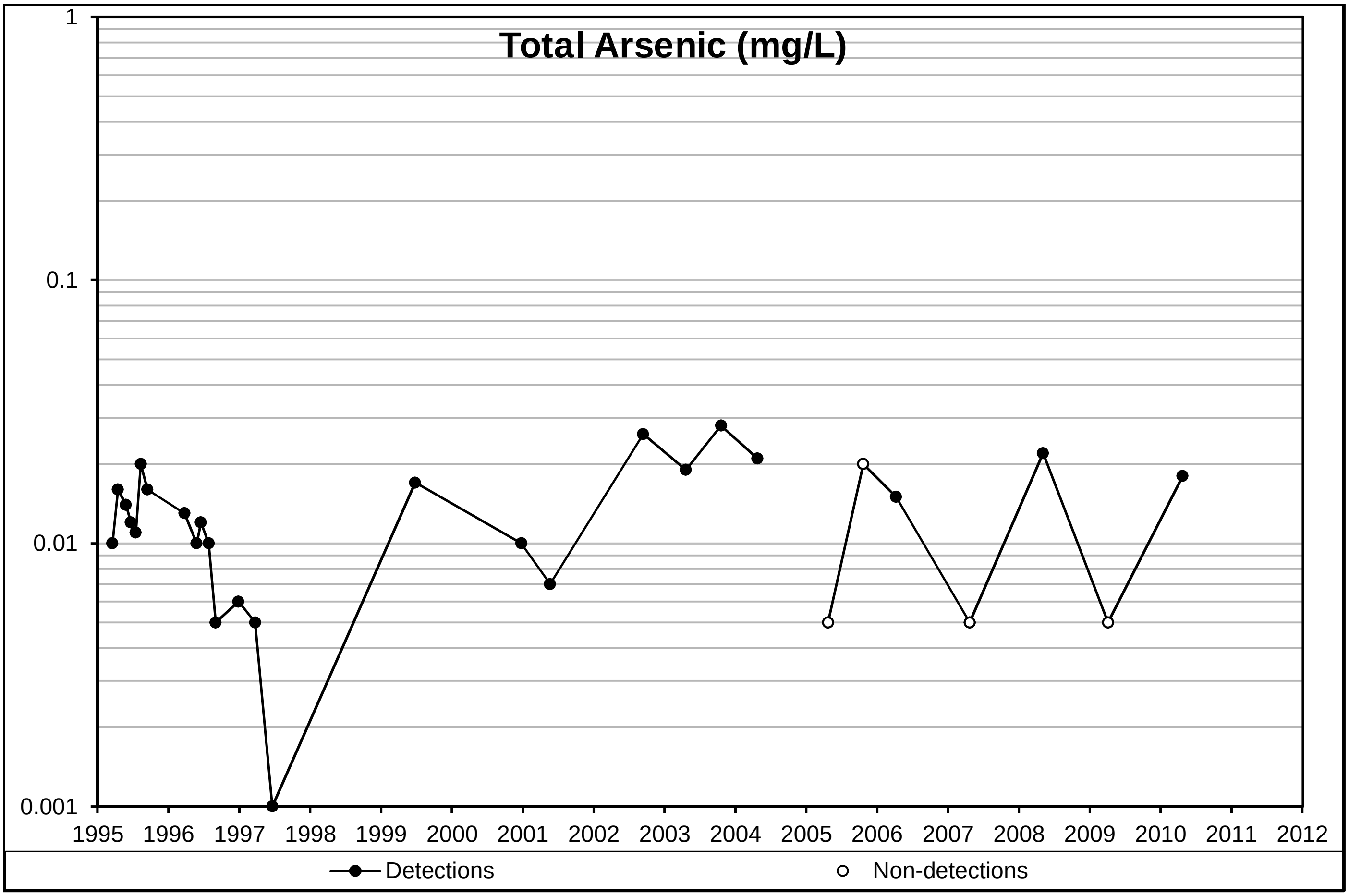
Concentration Versus Year

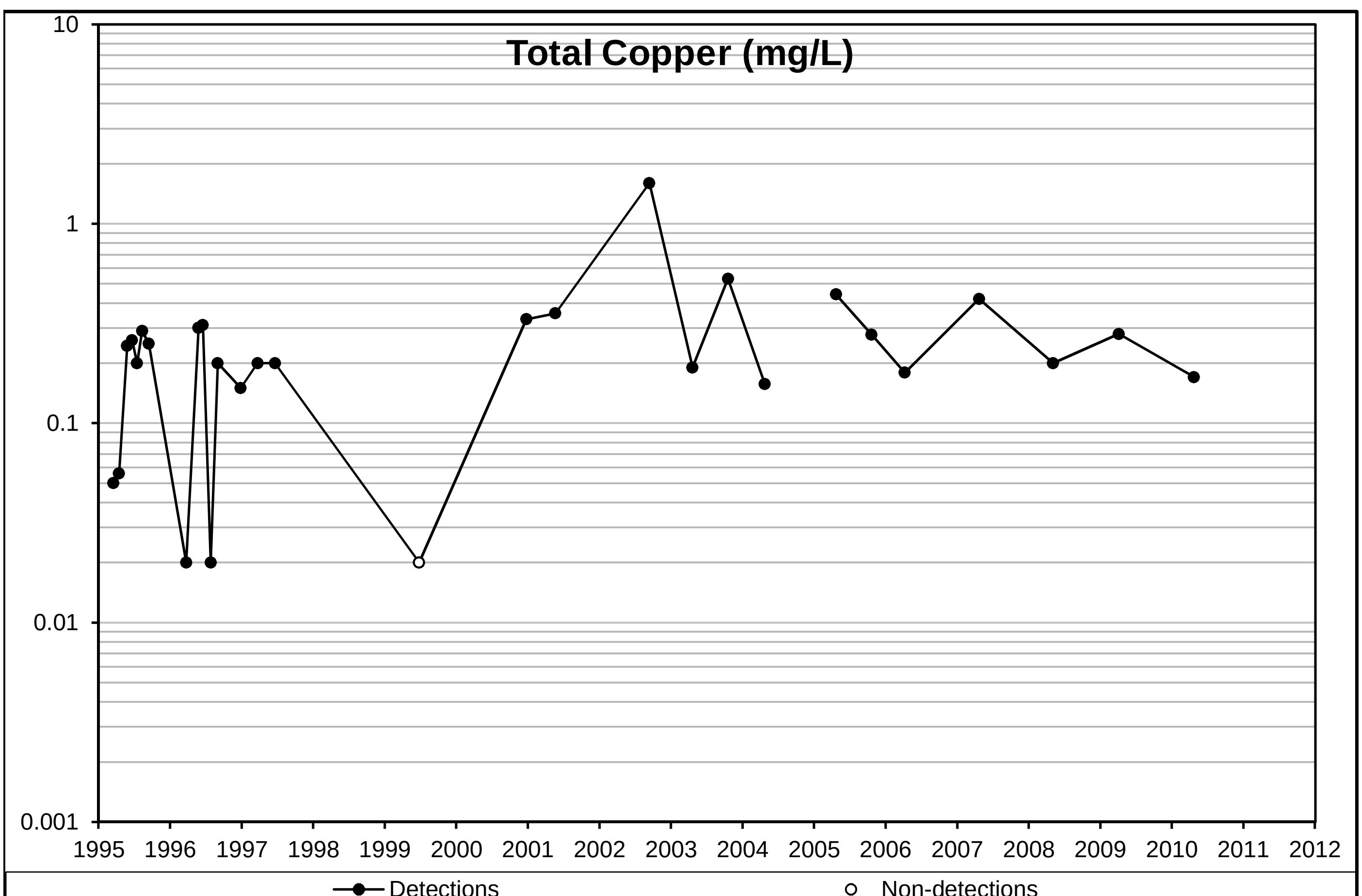


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLL4100

Concentration Versus Year



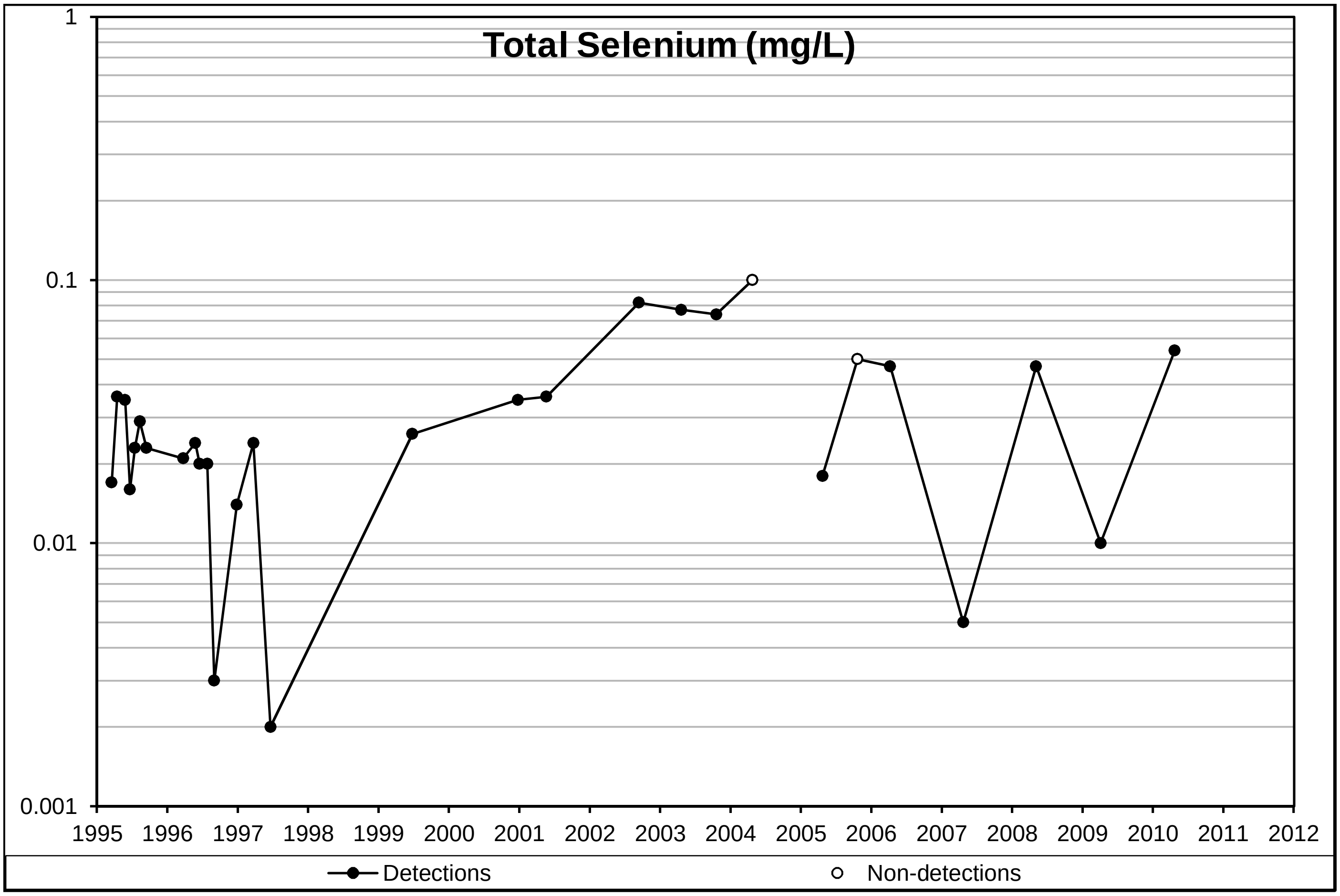


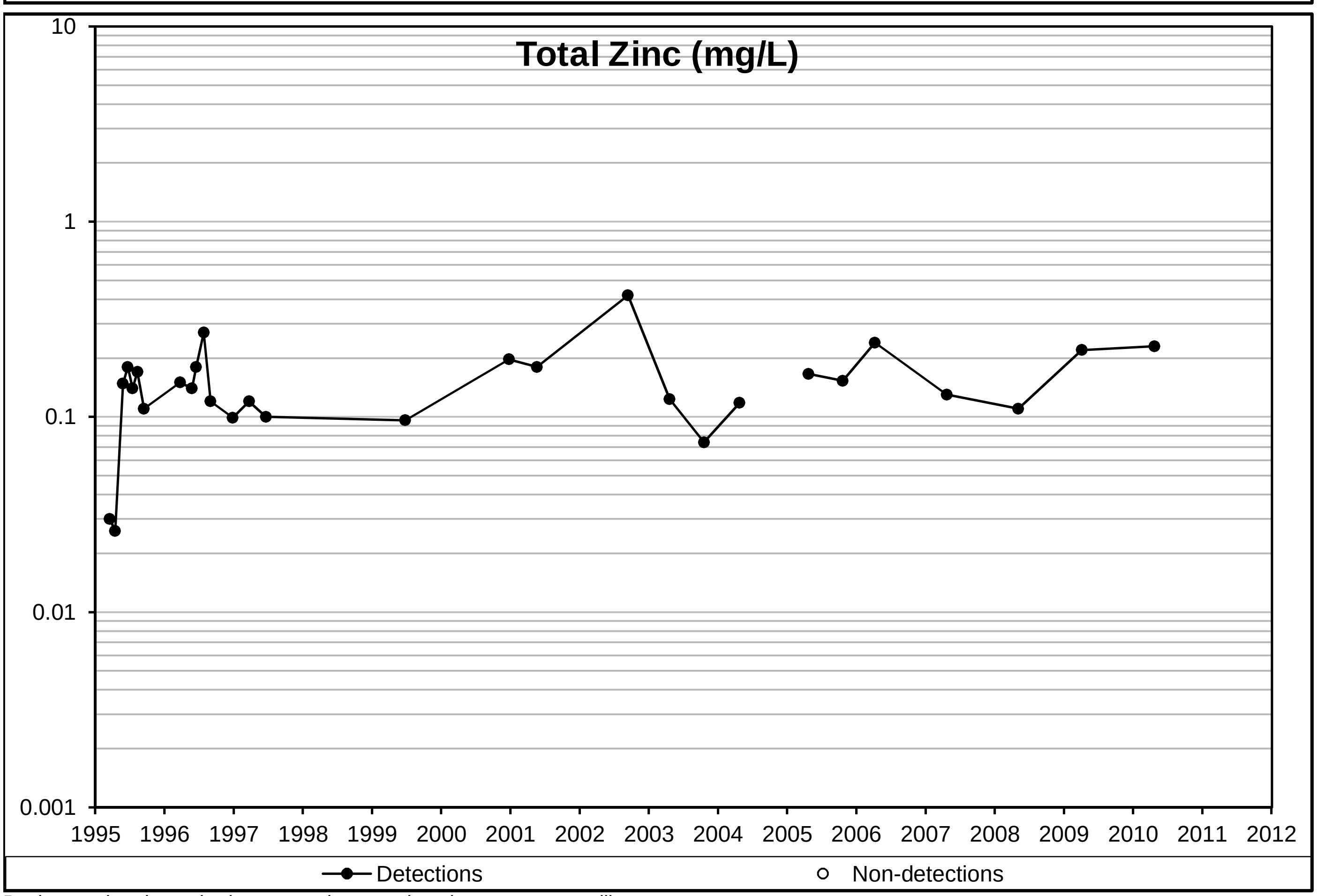
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4100

Concentration Versus Year

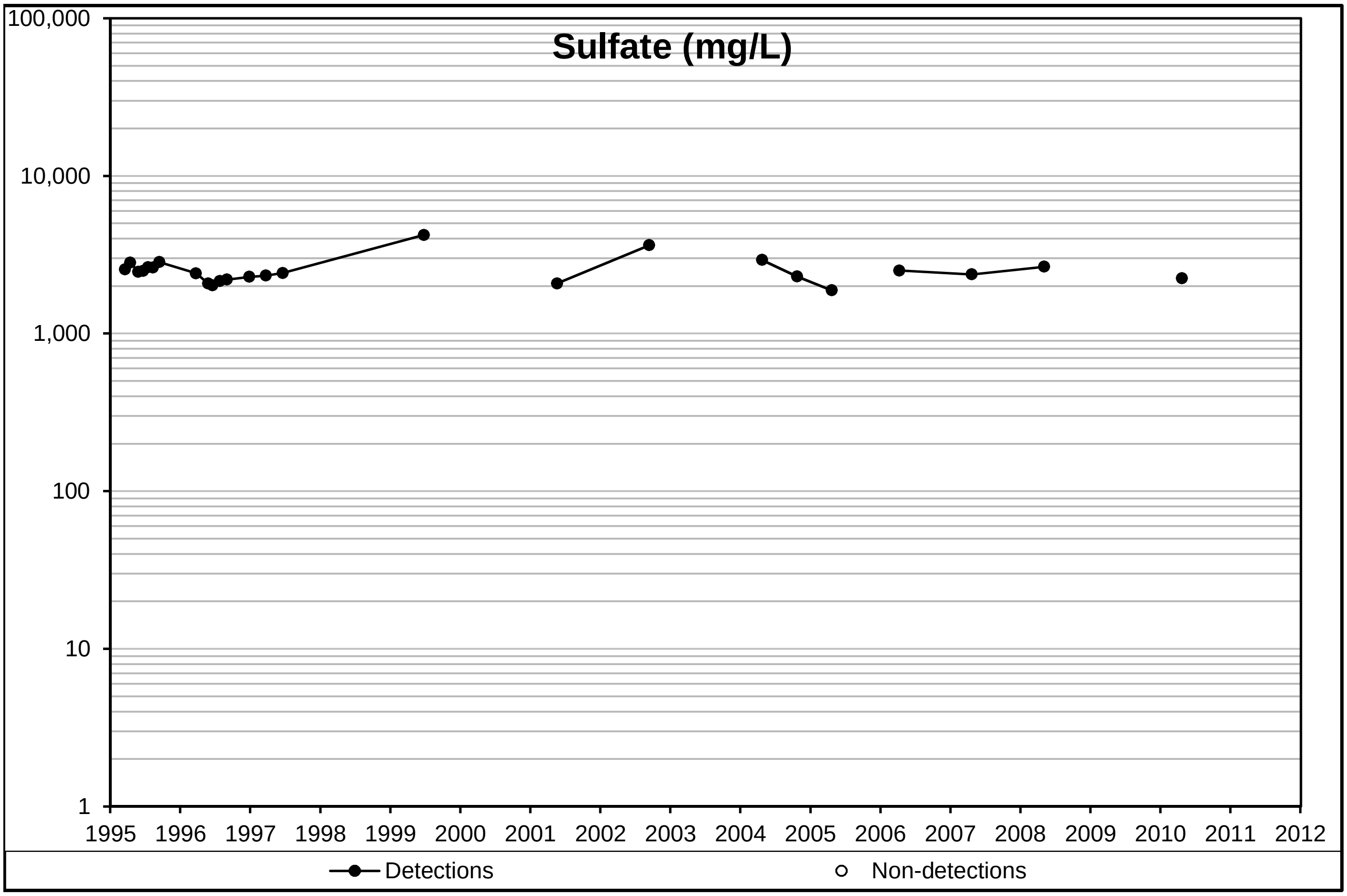


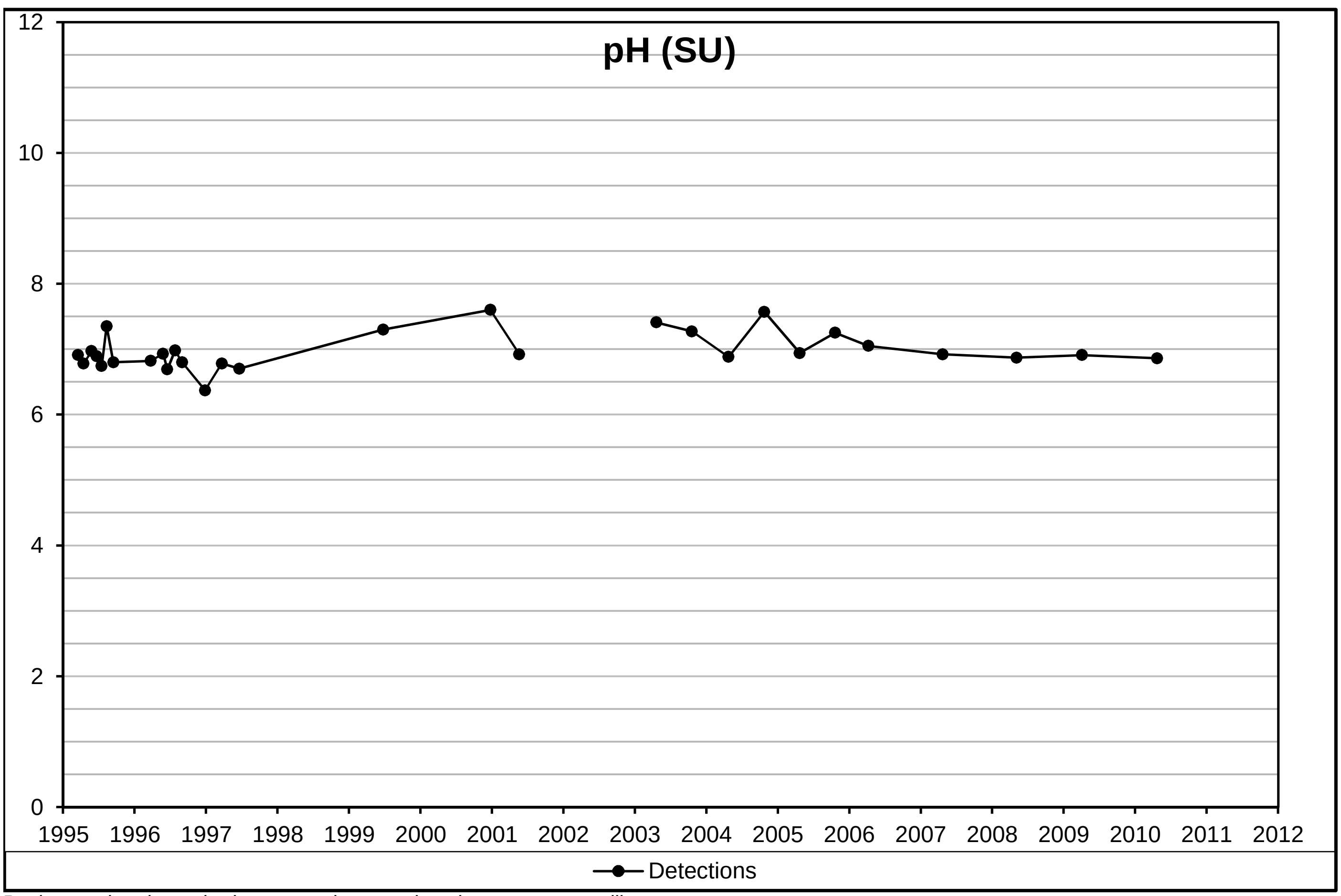


Background and standards are not shown as location represents tailing water.
Constituent range includes minimum and maximum concentrations for all wells considered

TLL4100

Concentration Versus Year

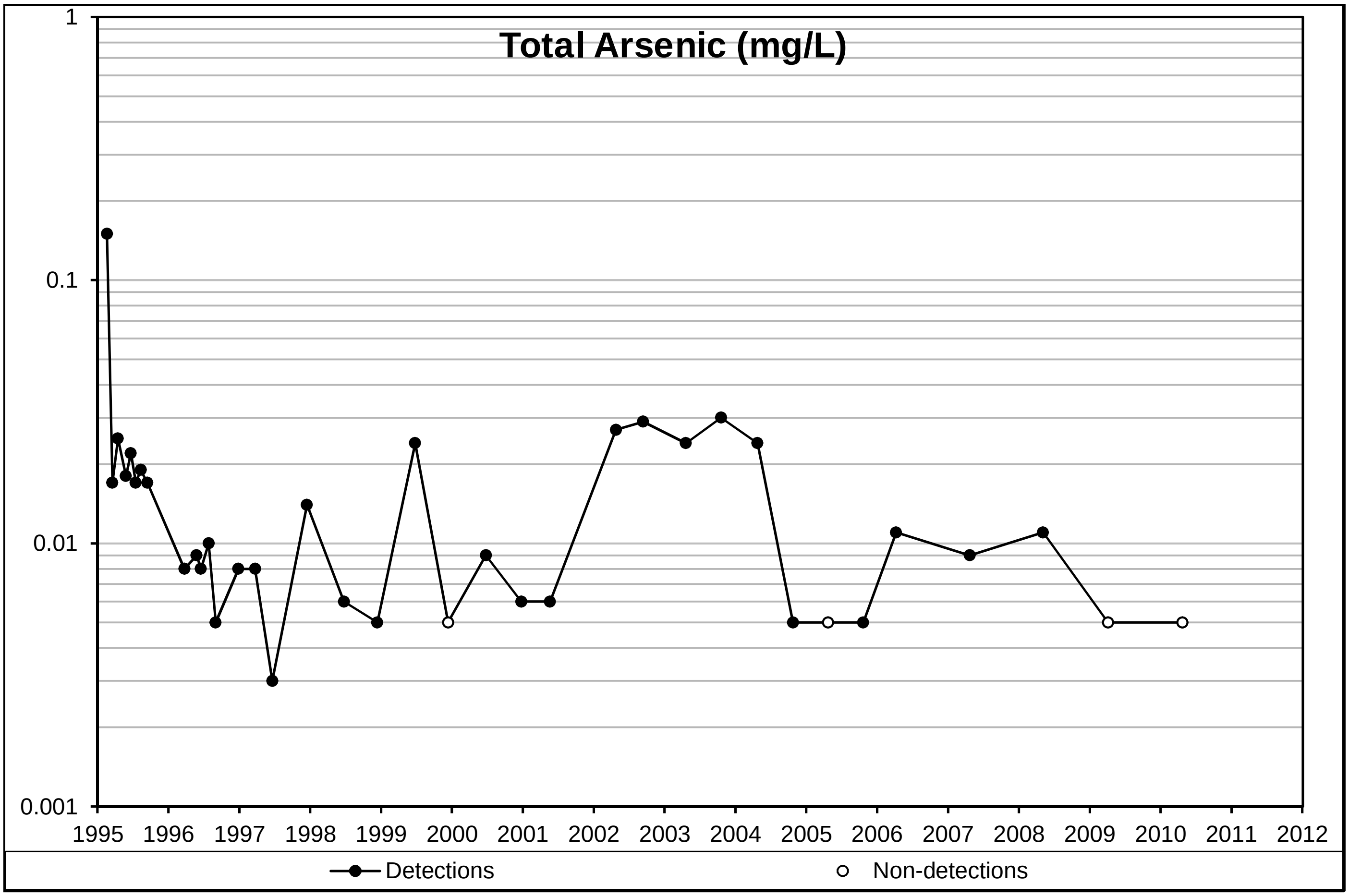


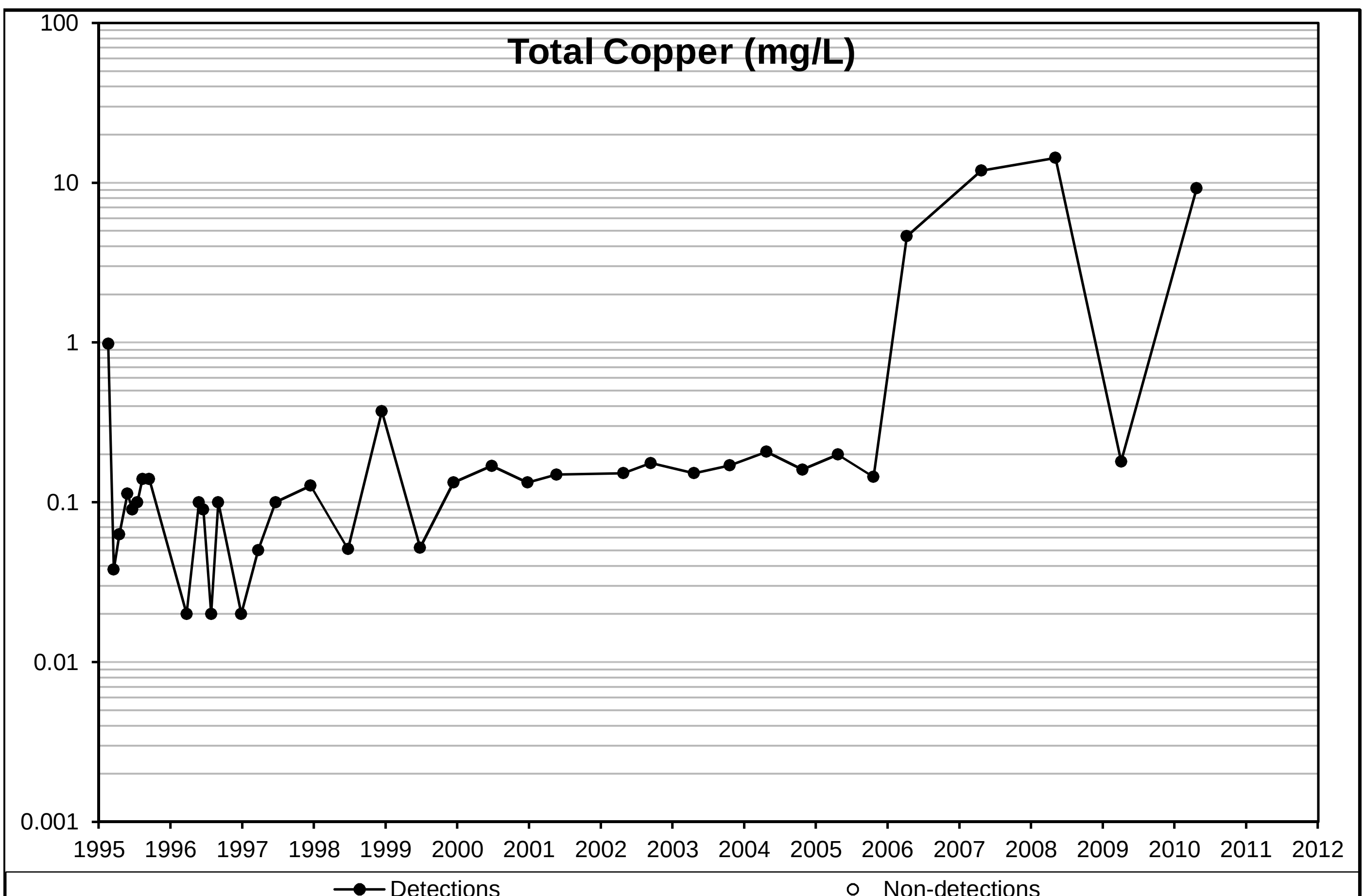


Background and standards are not shown as location represents tailing water.
Constituent range includes minimum and maximum concentrations for all wells considered

TLL4101

Concentration Versus Year

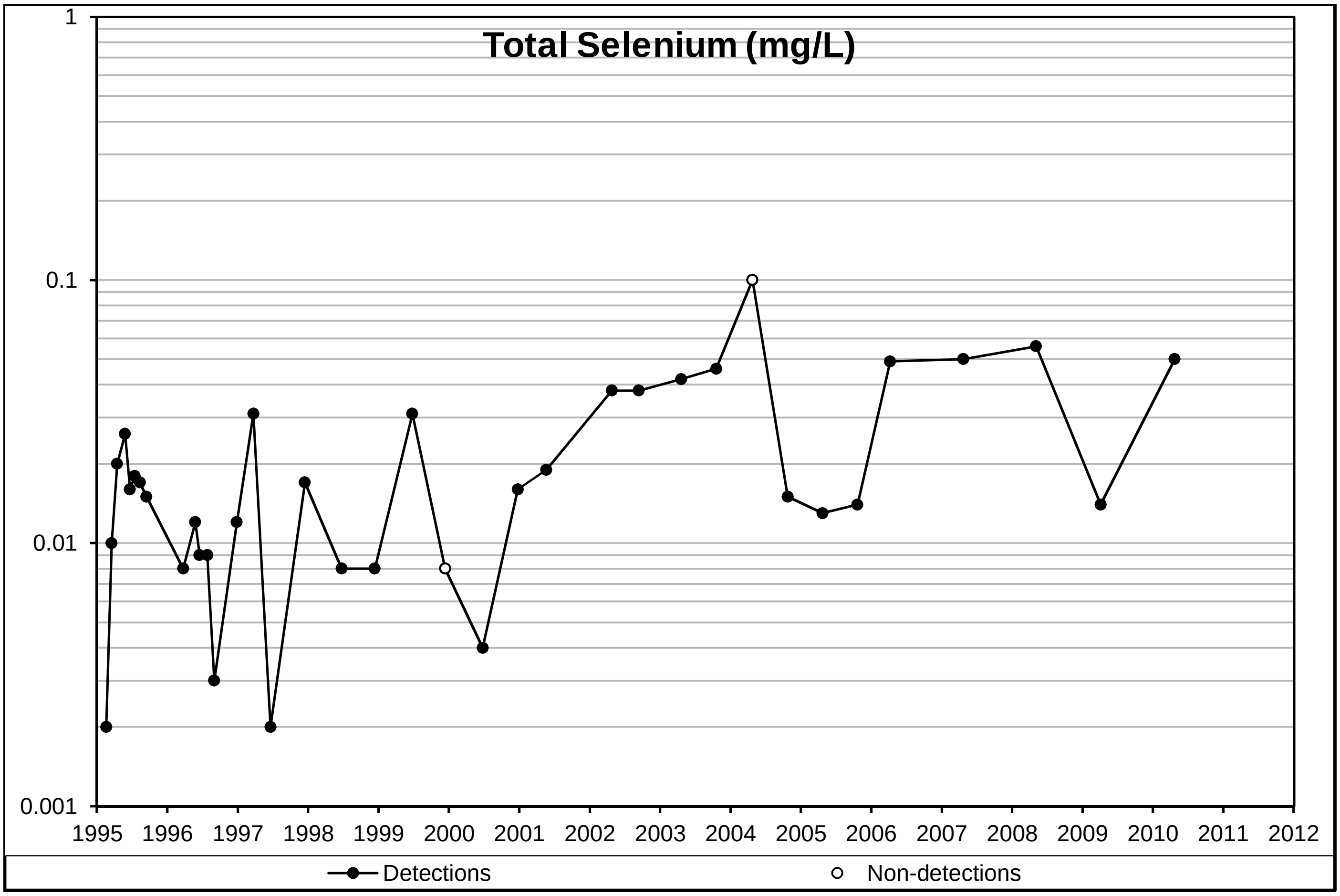


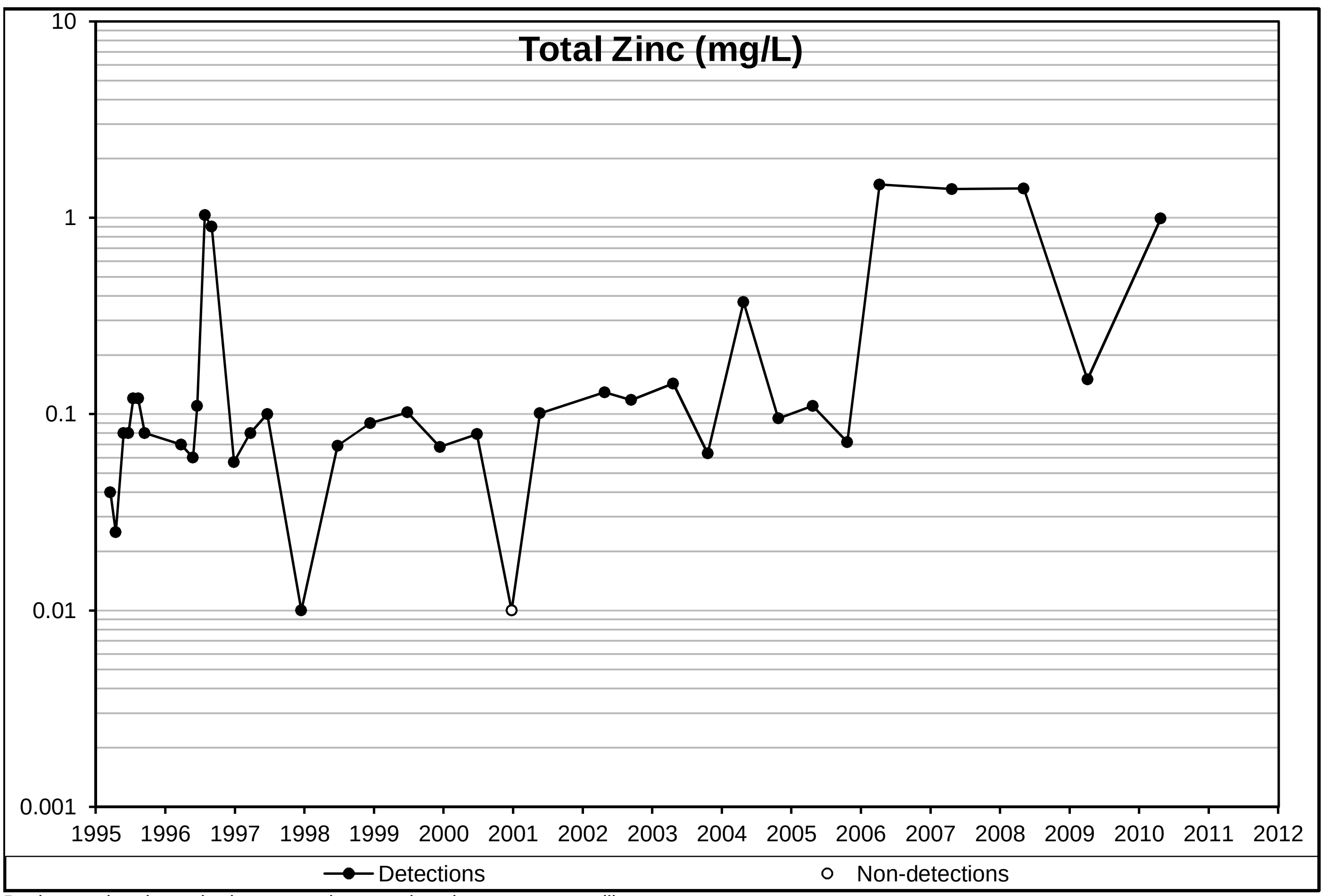


Background and standards are not shown as location represents tailing water.
Constituent range includes minimum and maximum concentrations for all wells considered

TLL4101

Concentration Versus Year



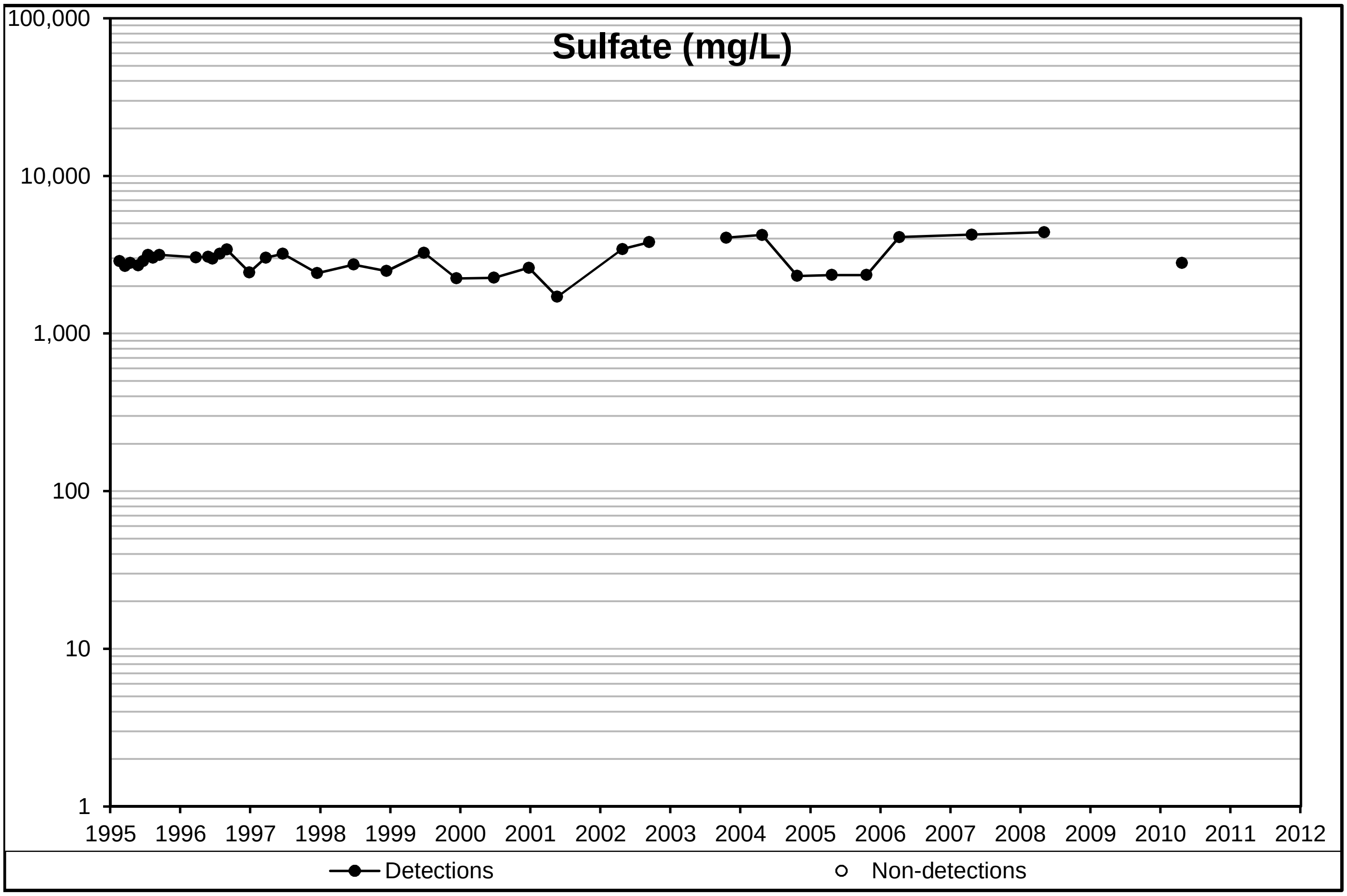


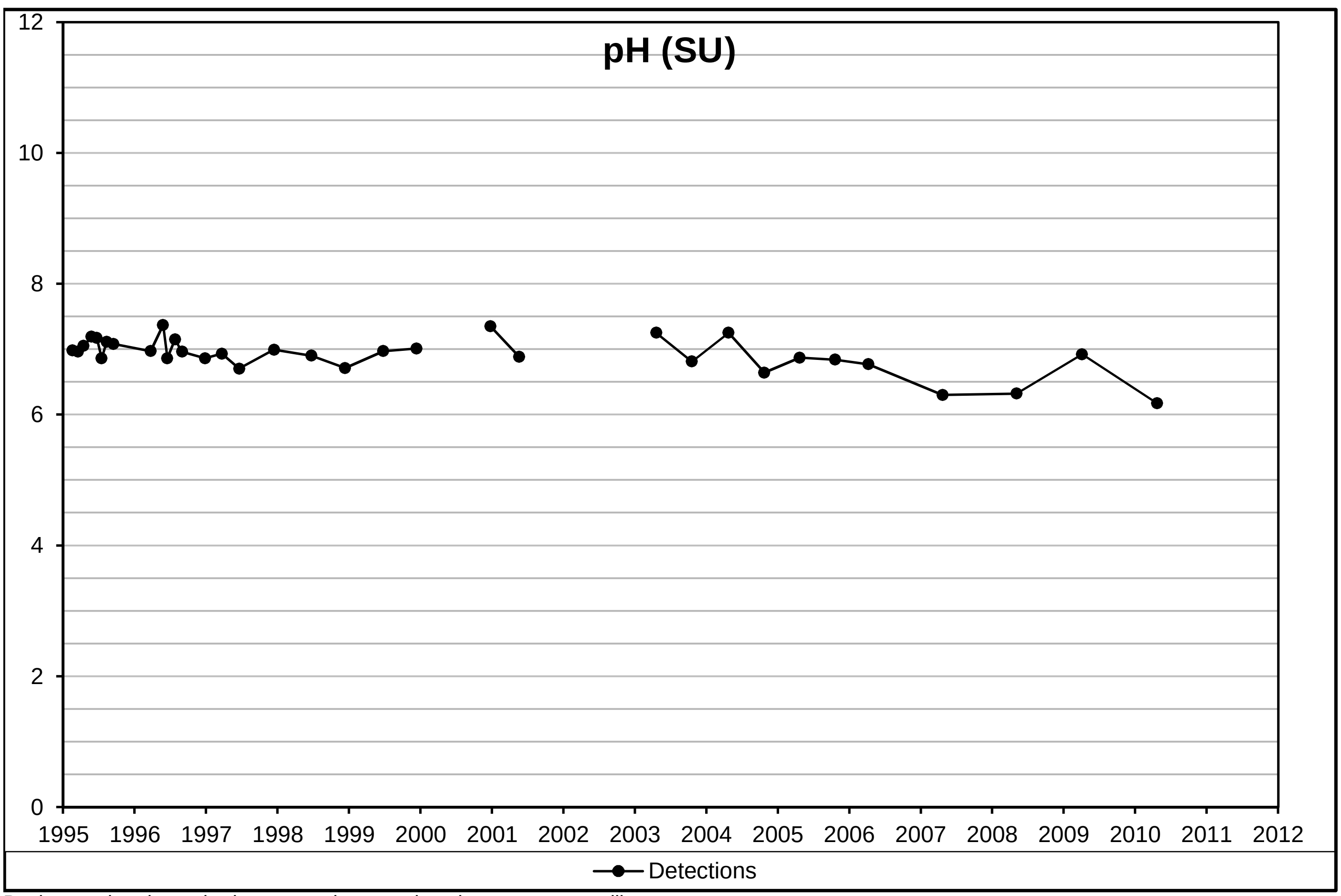
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4101

Concentration Versus Year



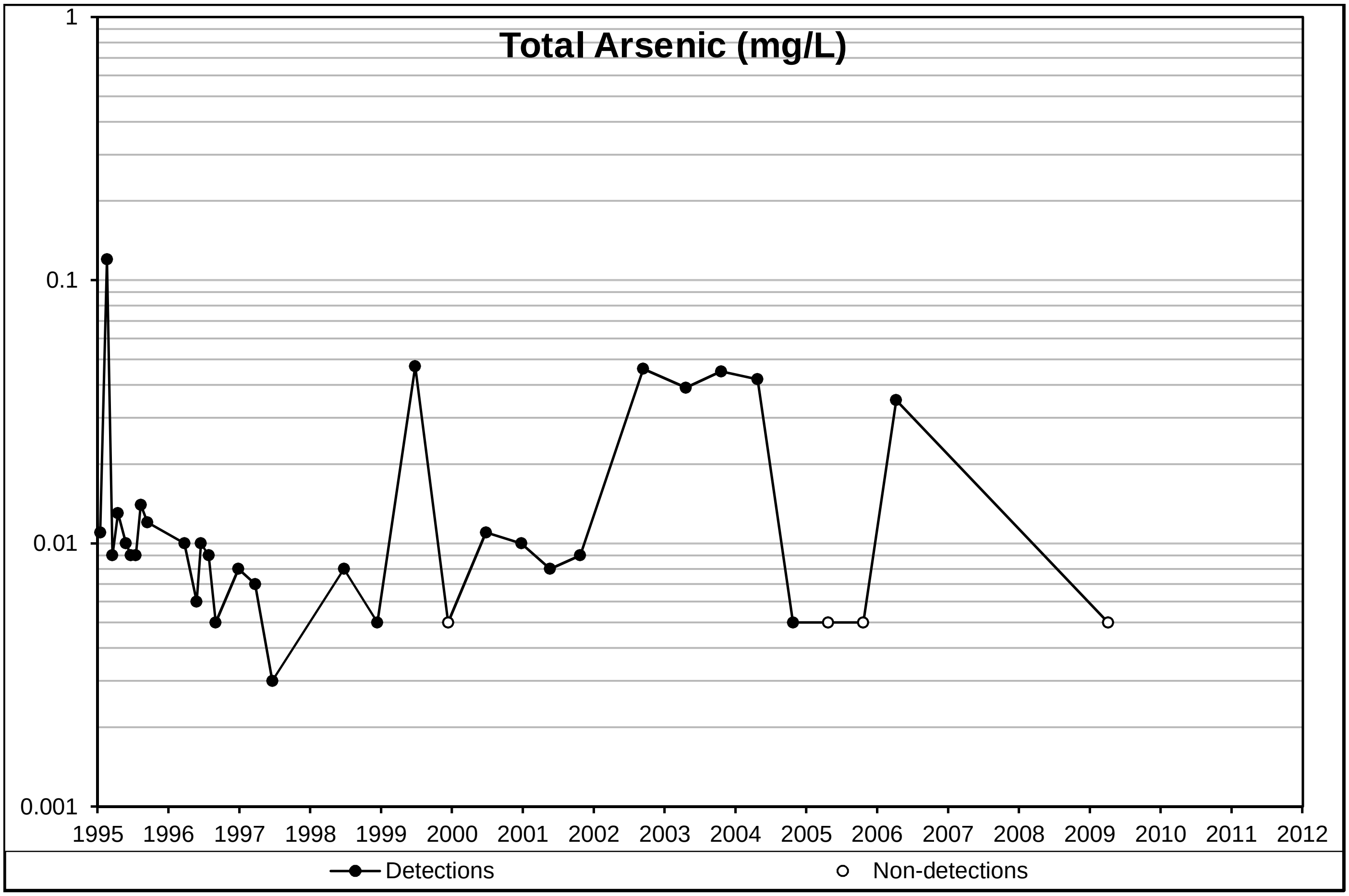


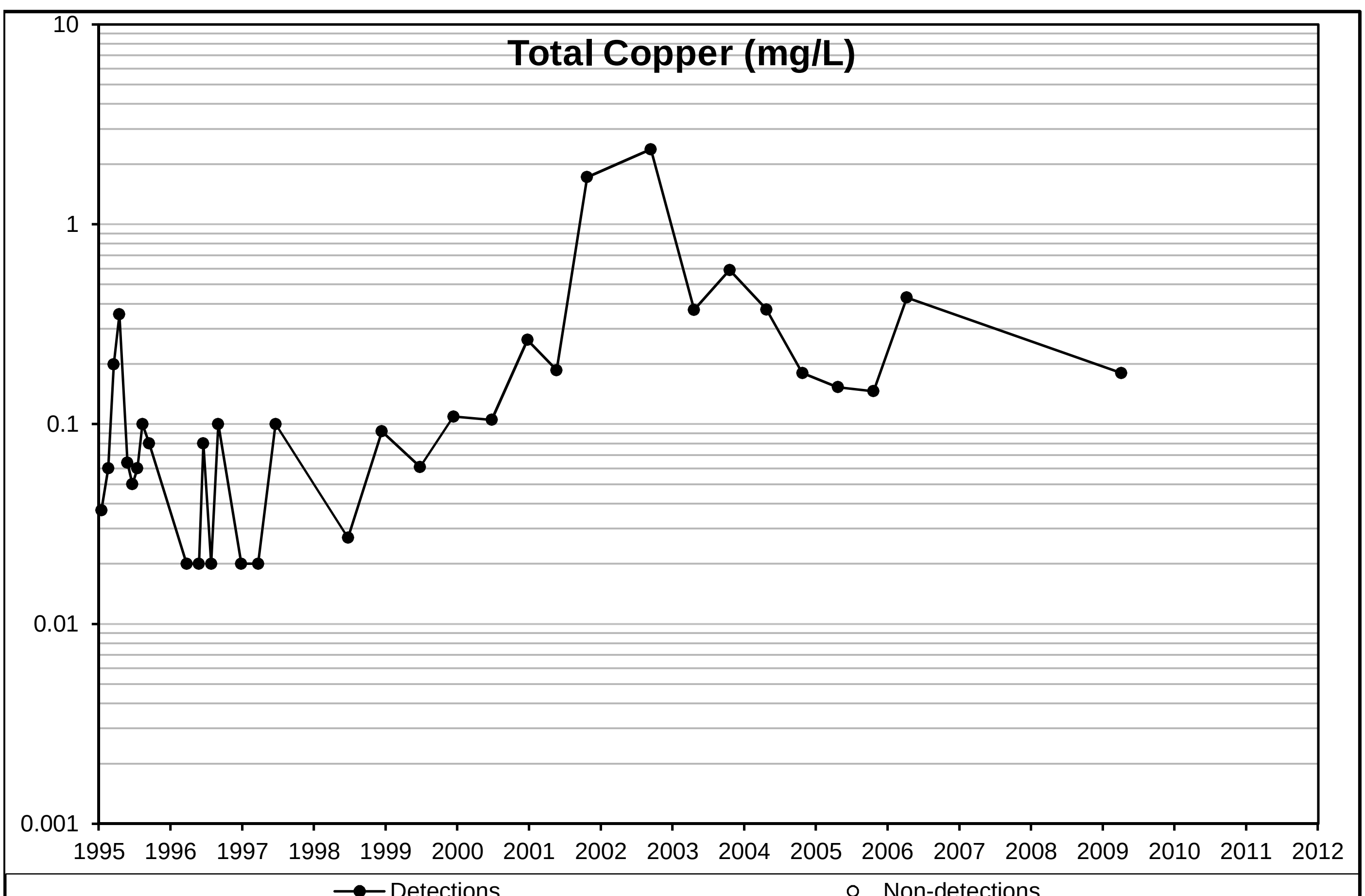
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4102

Concentration Versus Year

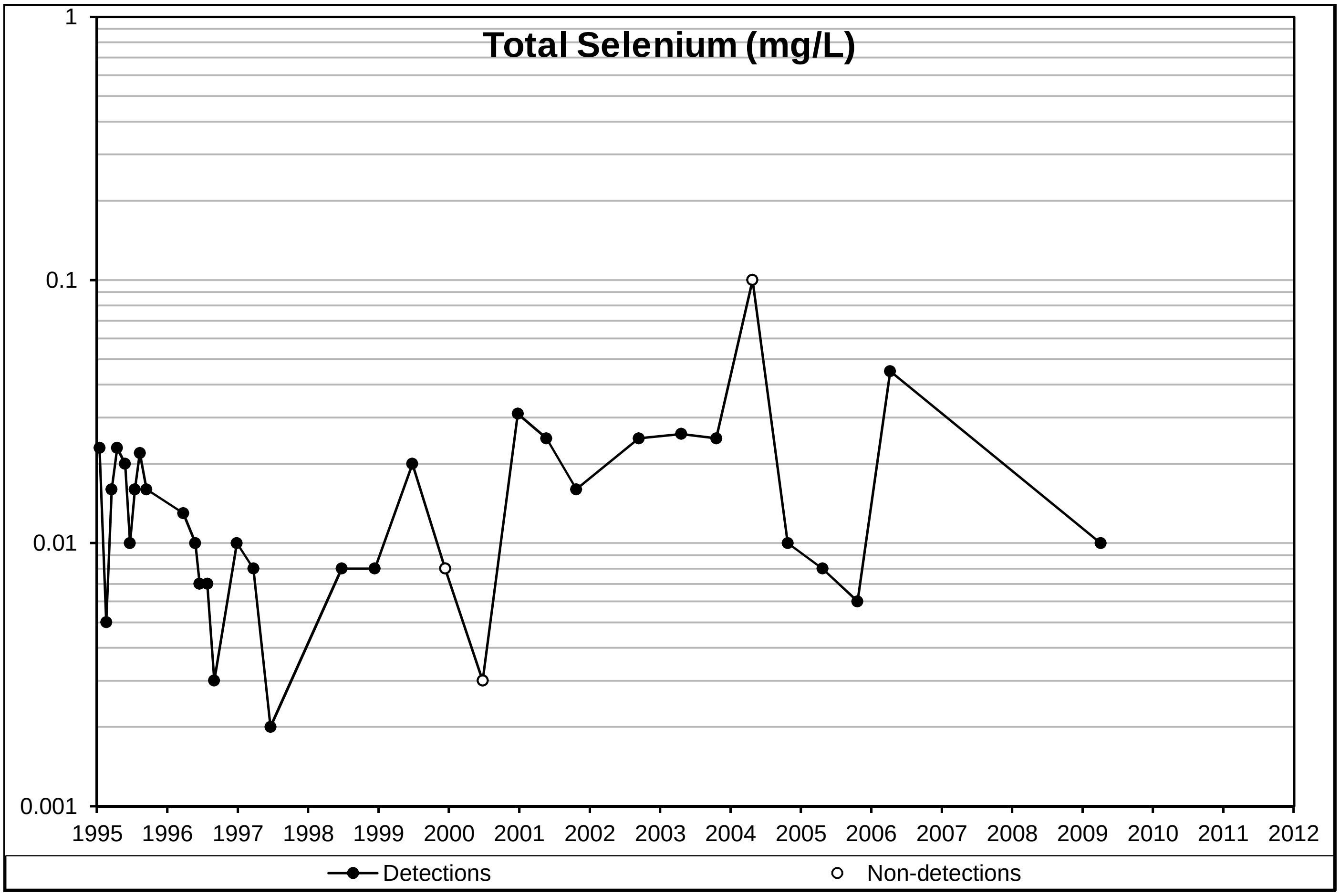


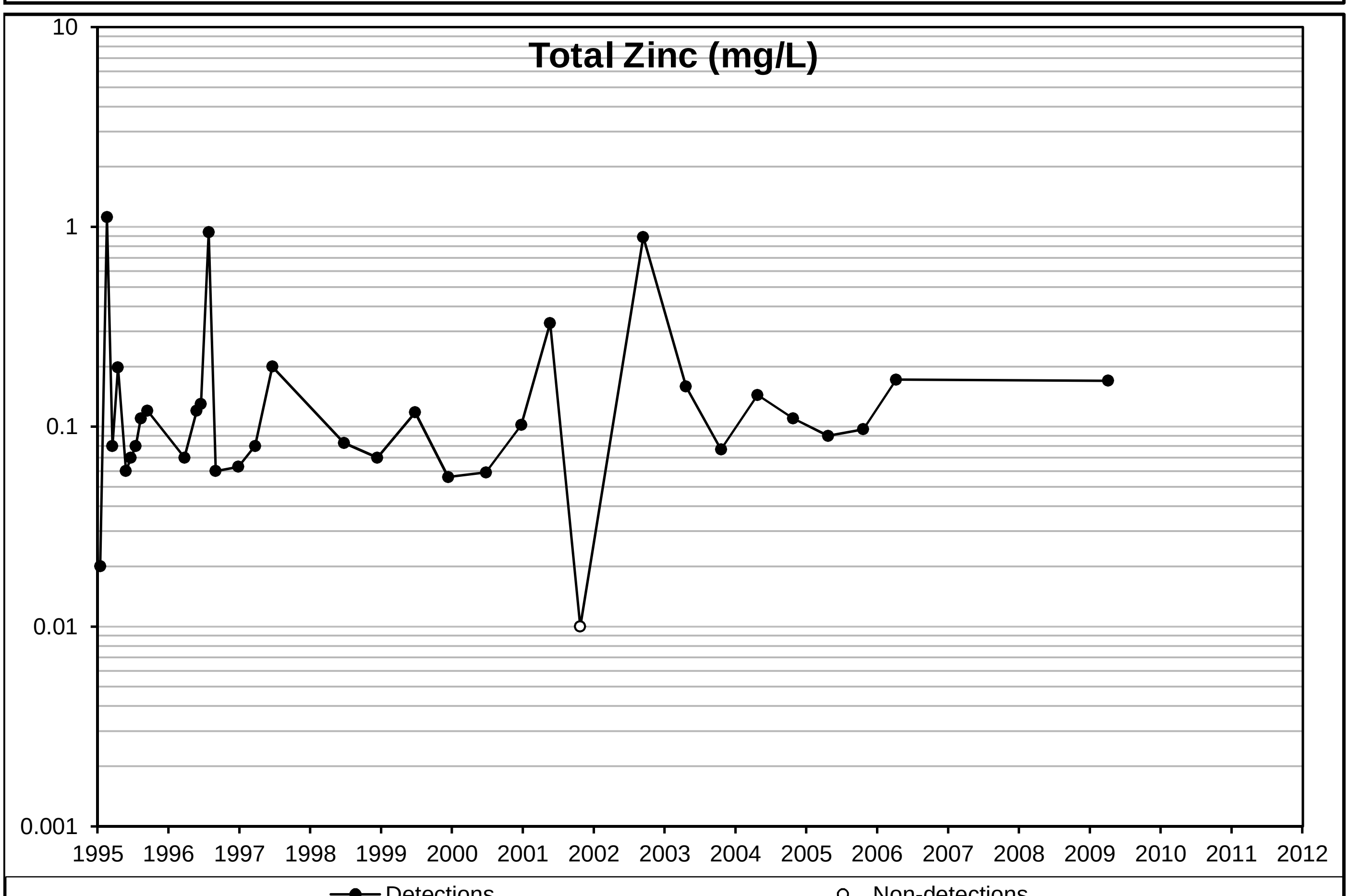


Background and standards are not shown as location represents tailing water.
Constituent range includes minimum and maximum concentrations for all wells considered

TLL4102

Concentration Versus Year



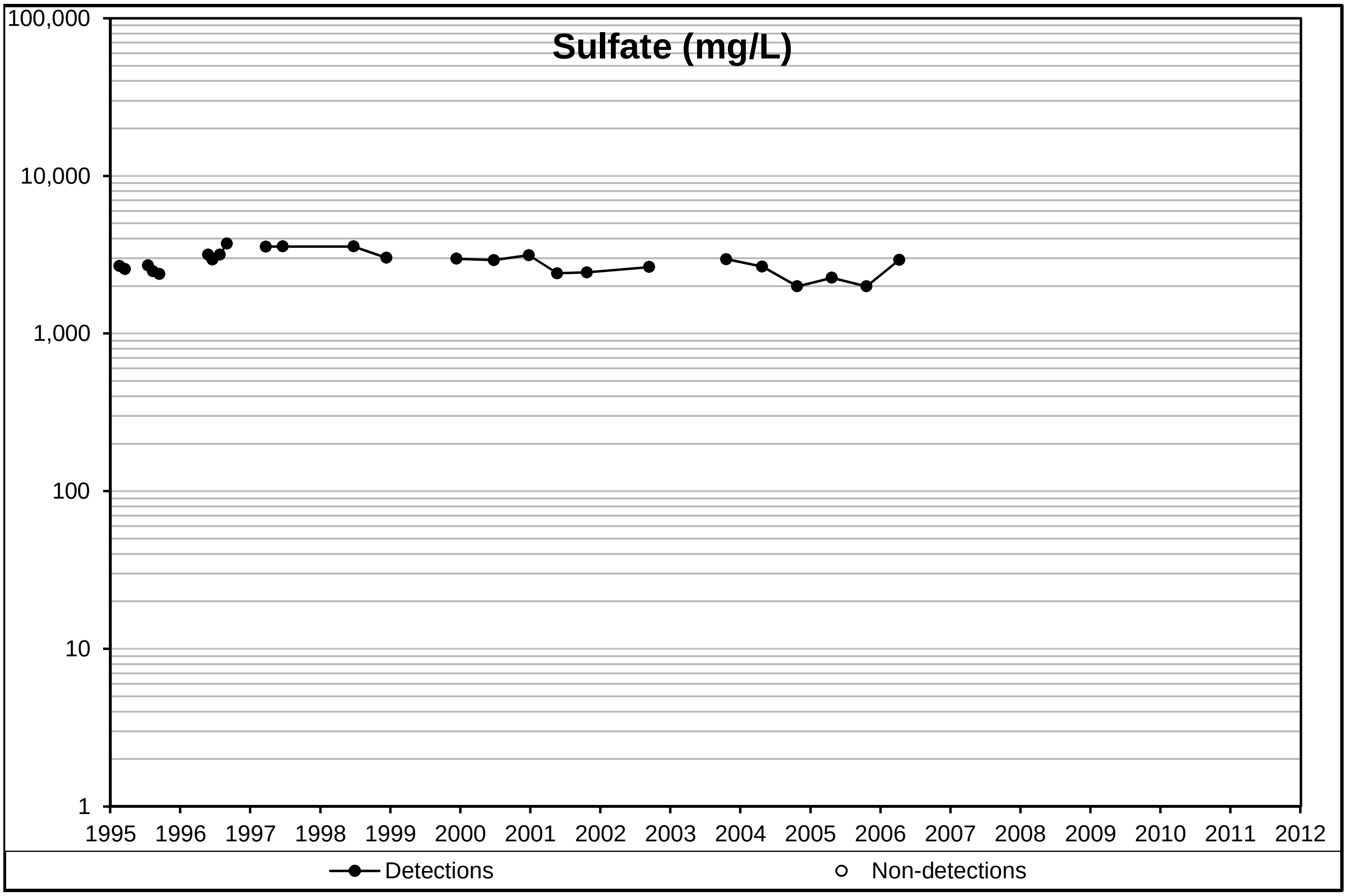


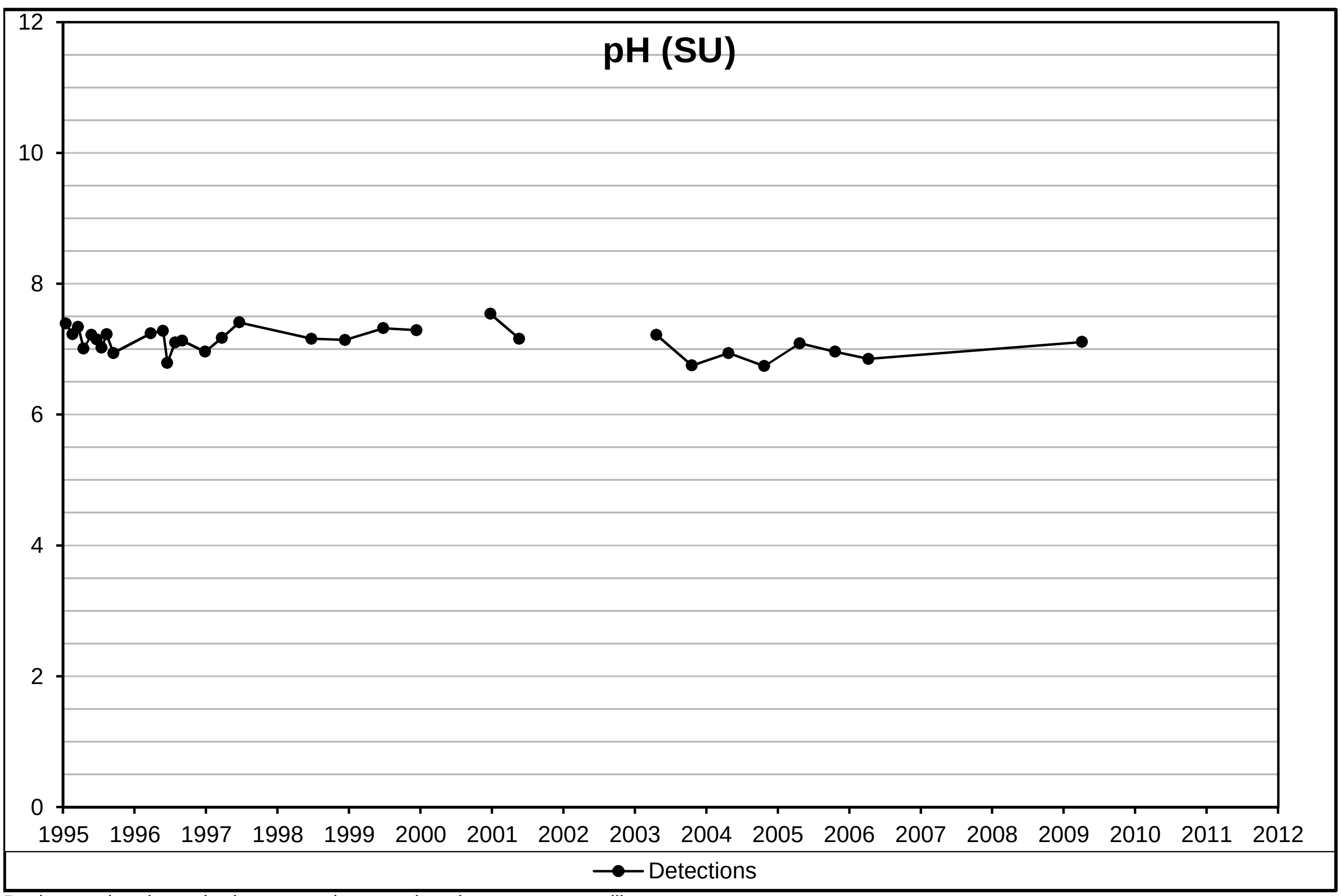
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4102

Concentration Versus Year



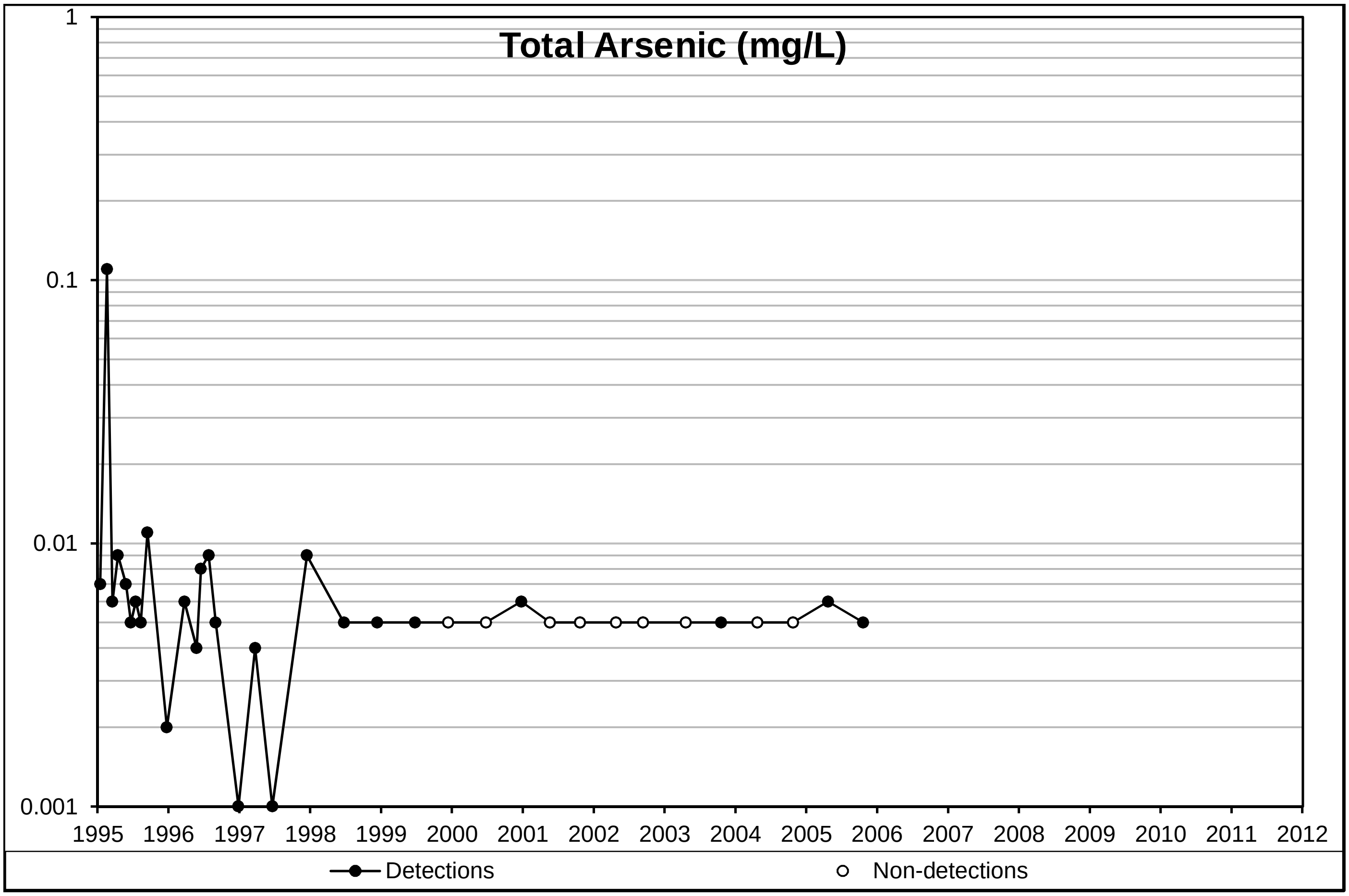


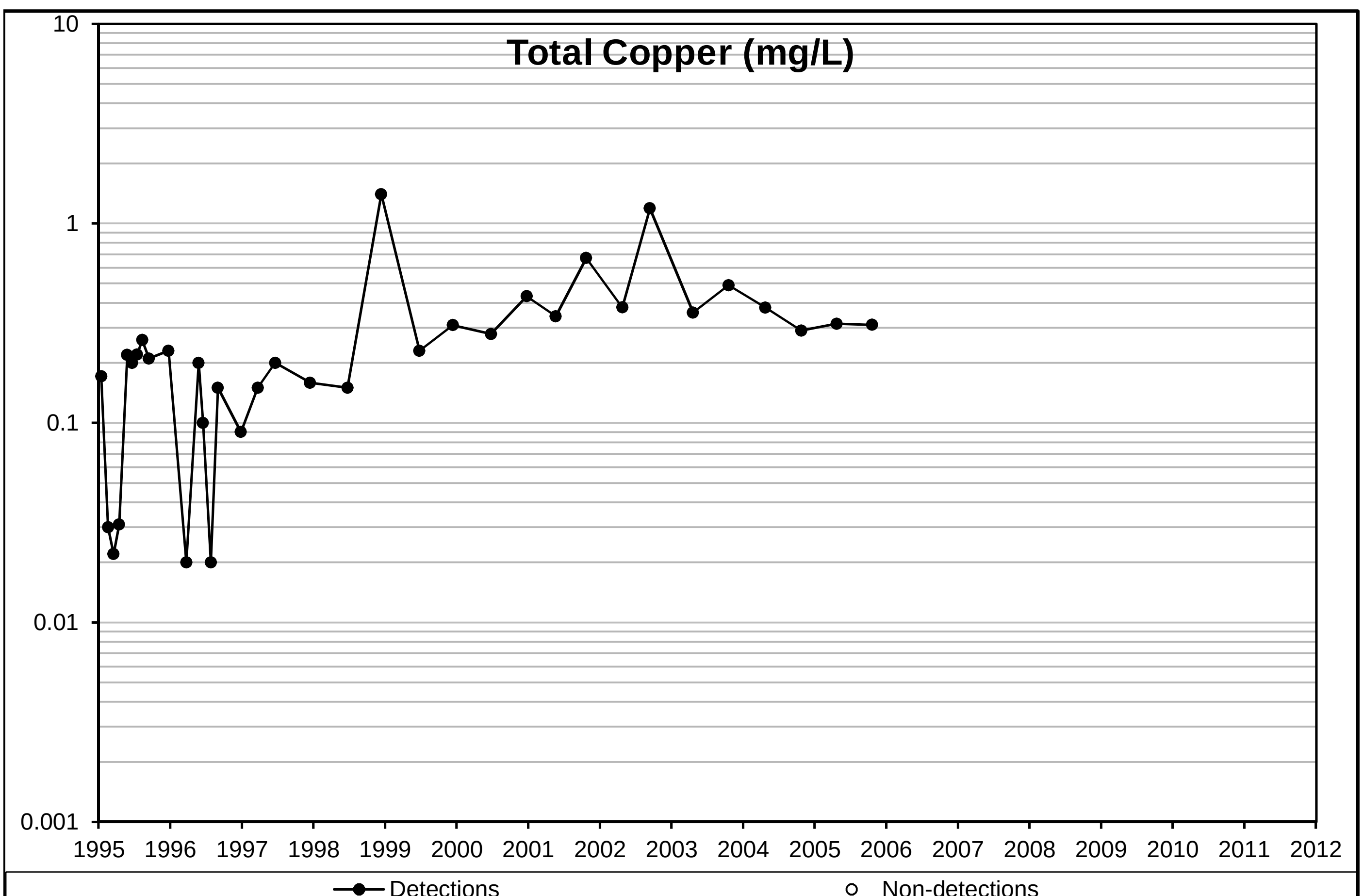
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4103

Concentration Versus Year



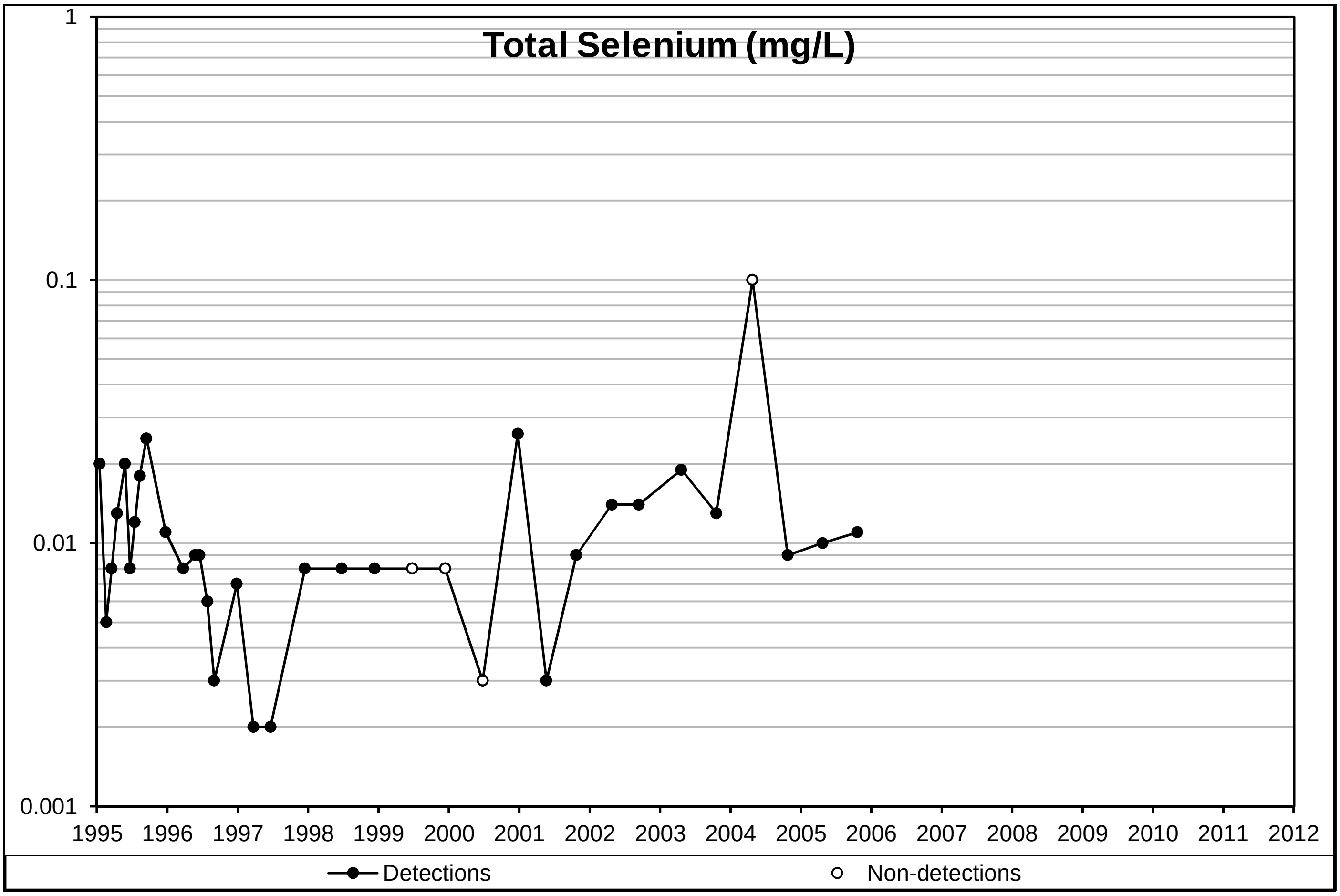


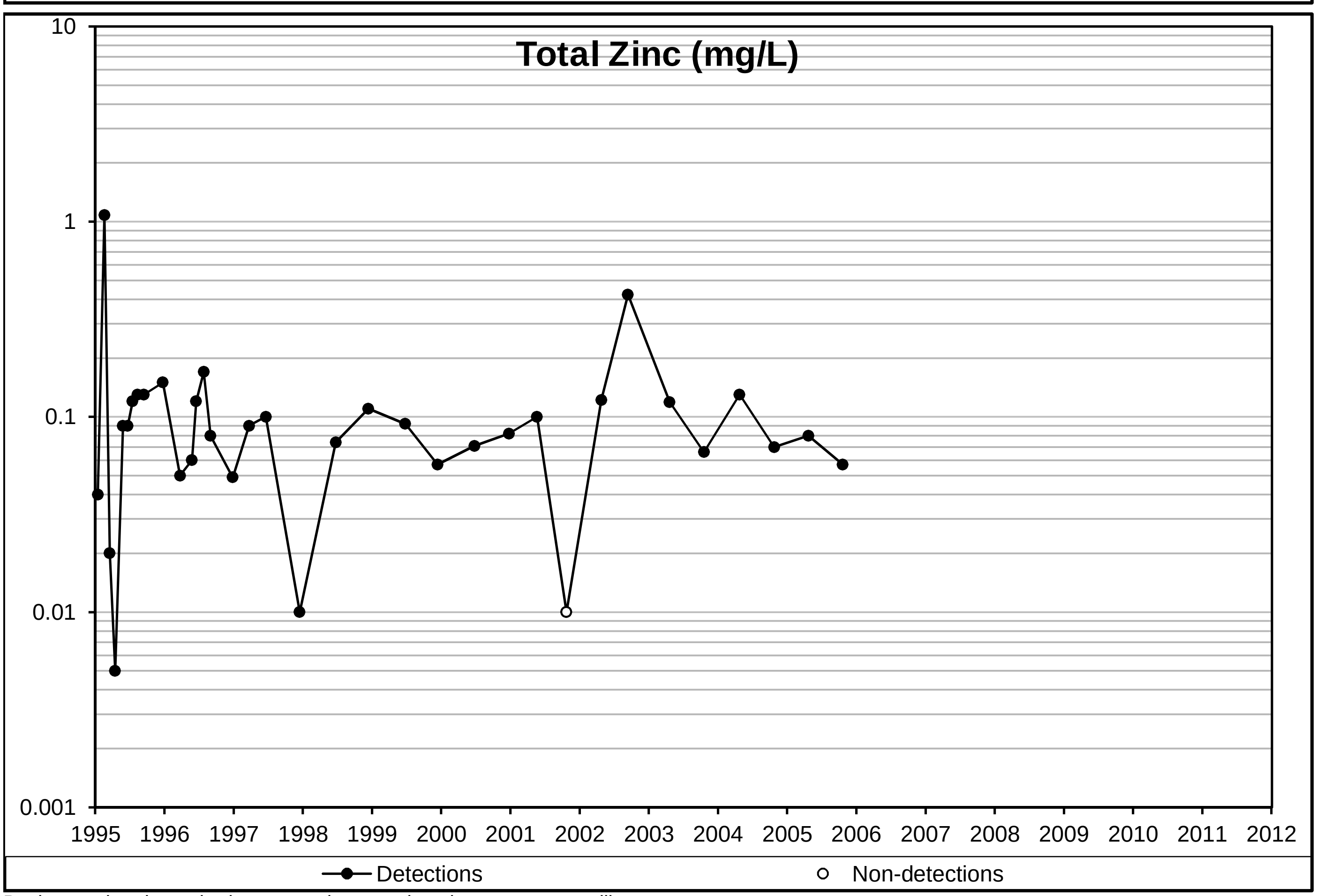
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4103

Concentration Versus Year



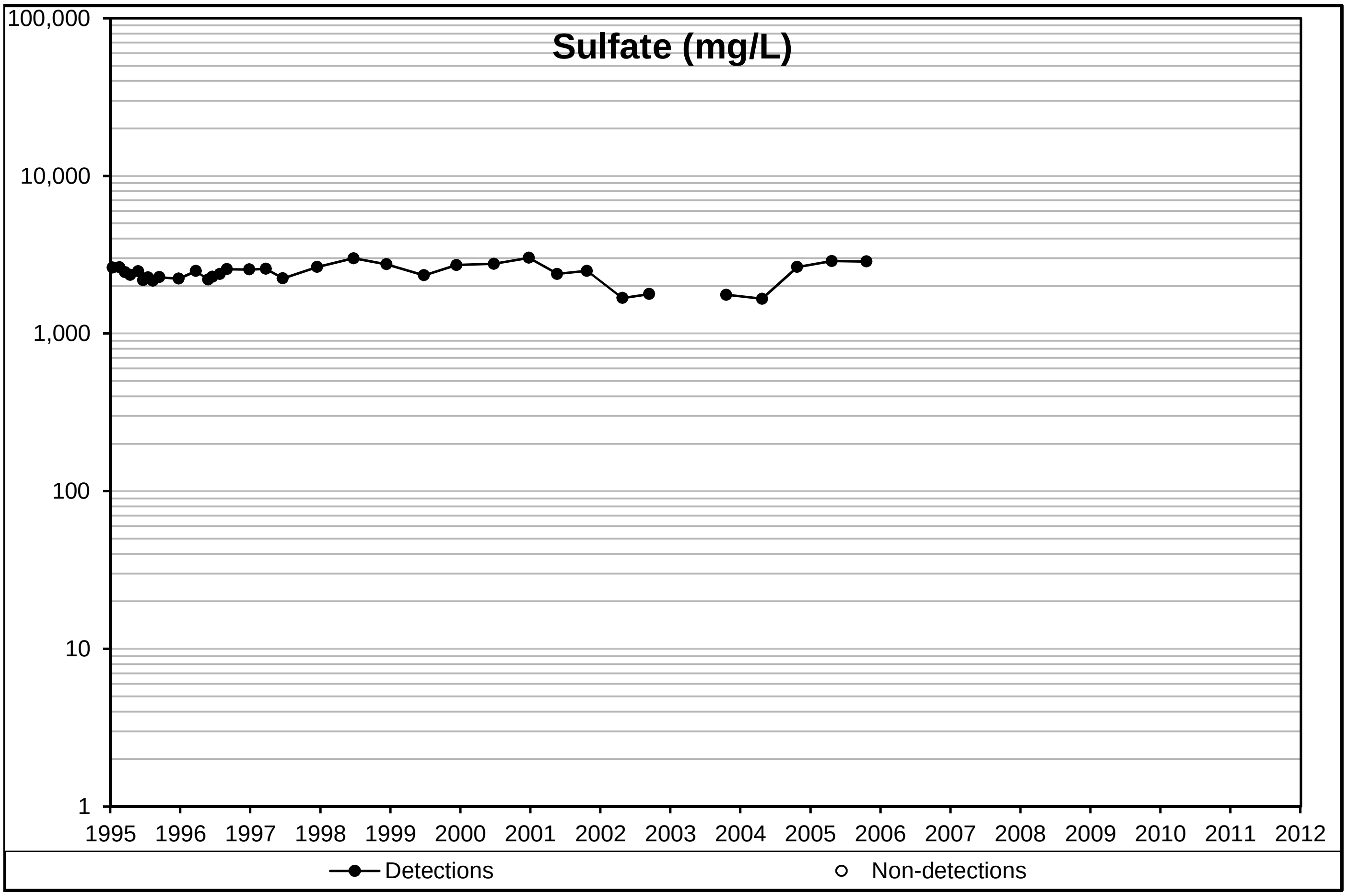


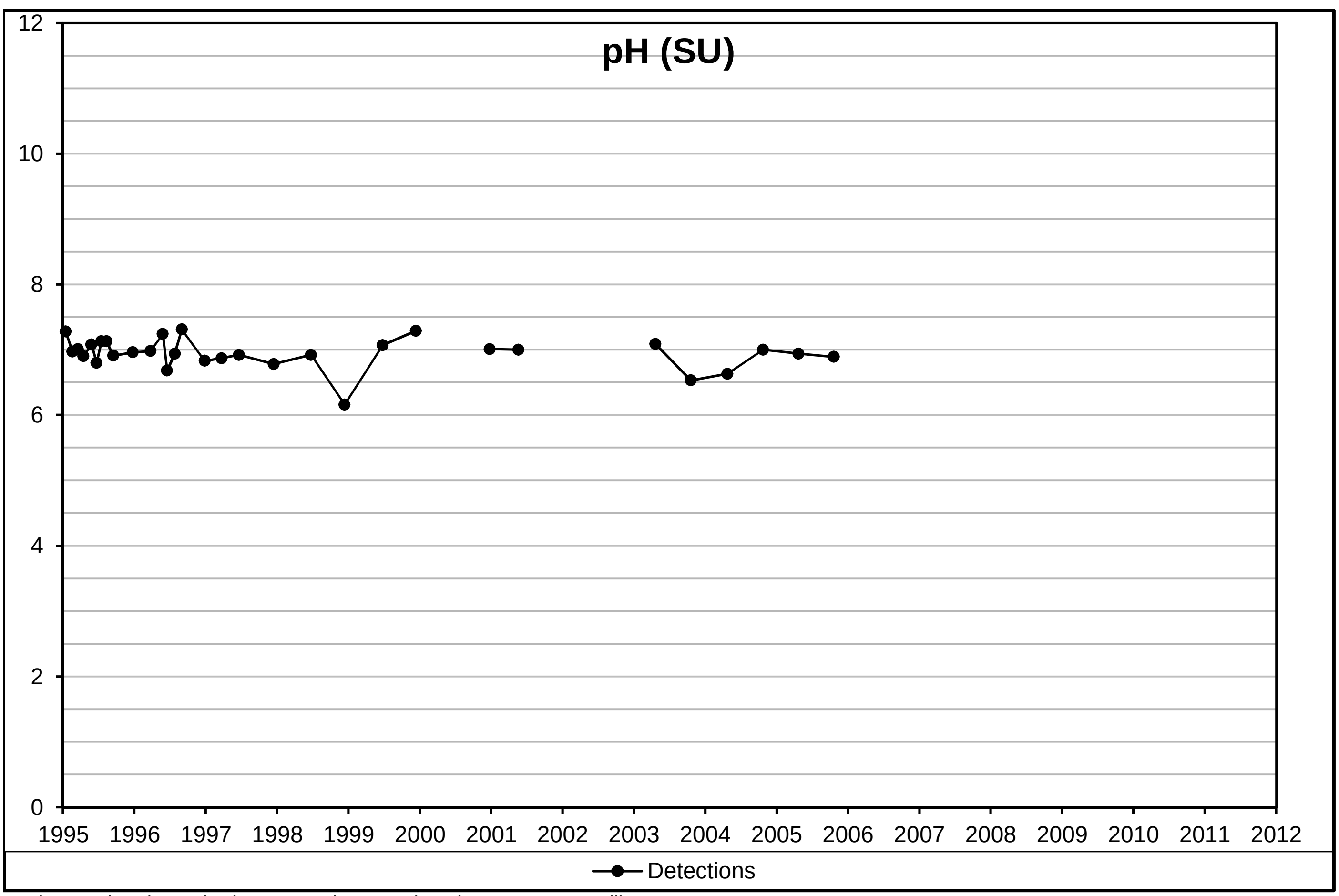
Background and standards are not shown as location represents tailing water.

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4103

Concentration Versus Year

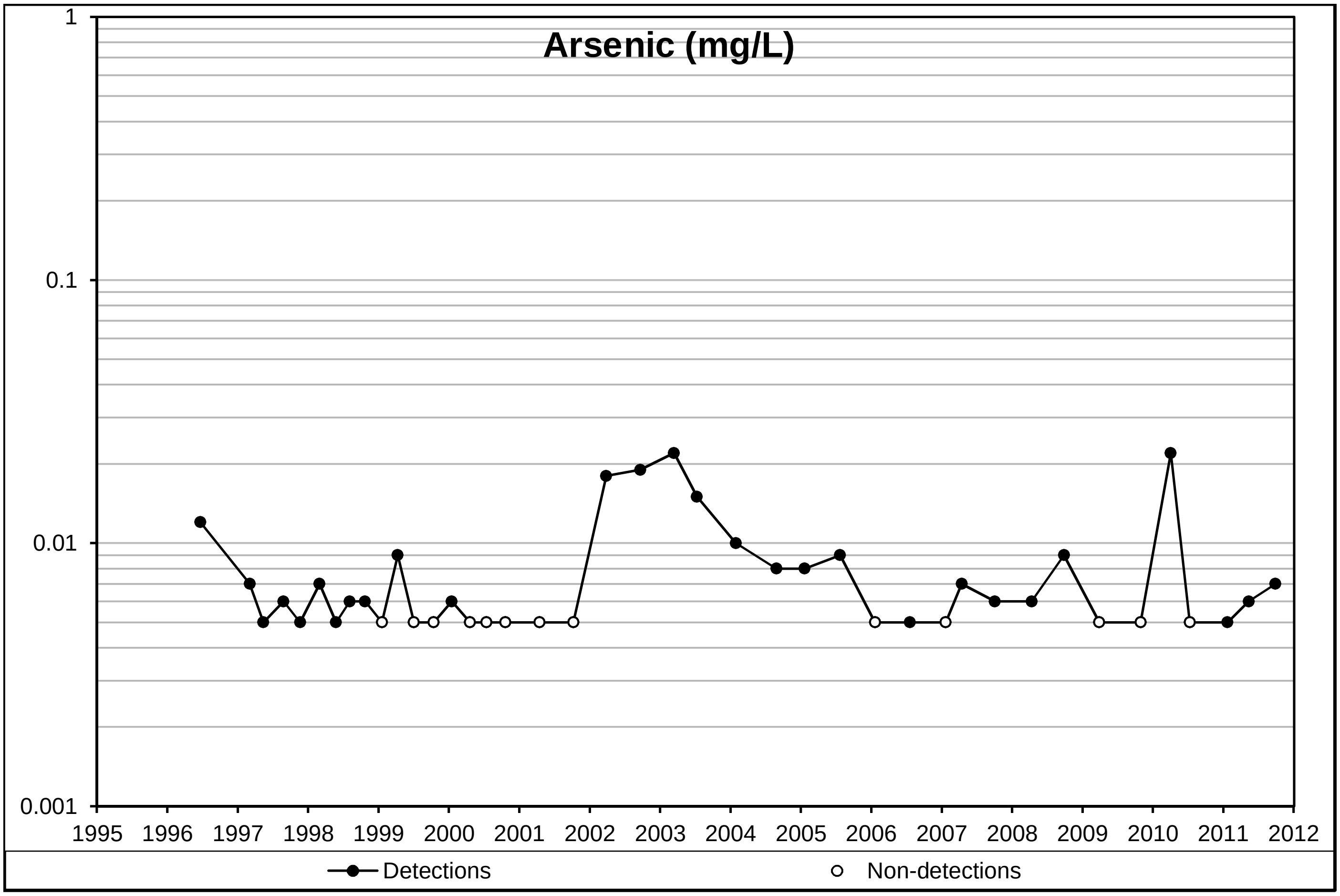


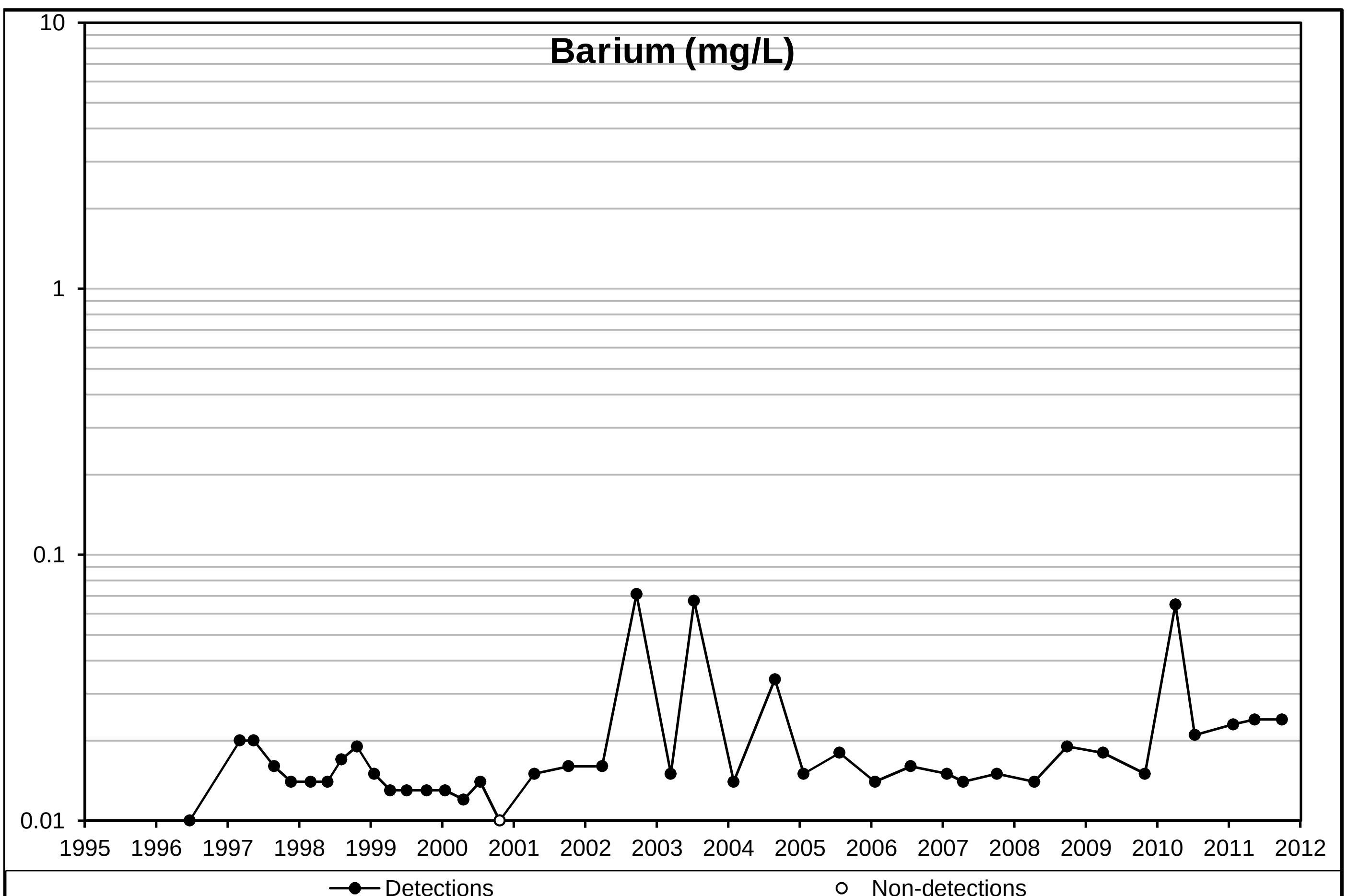


Background and standards are not shown as location represents tailing water.
Constituent range includes minimum and maximum concentrations for all wells considered

TLS1426

Concentration Versus Year

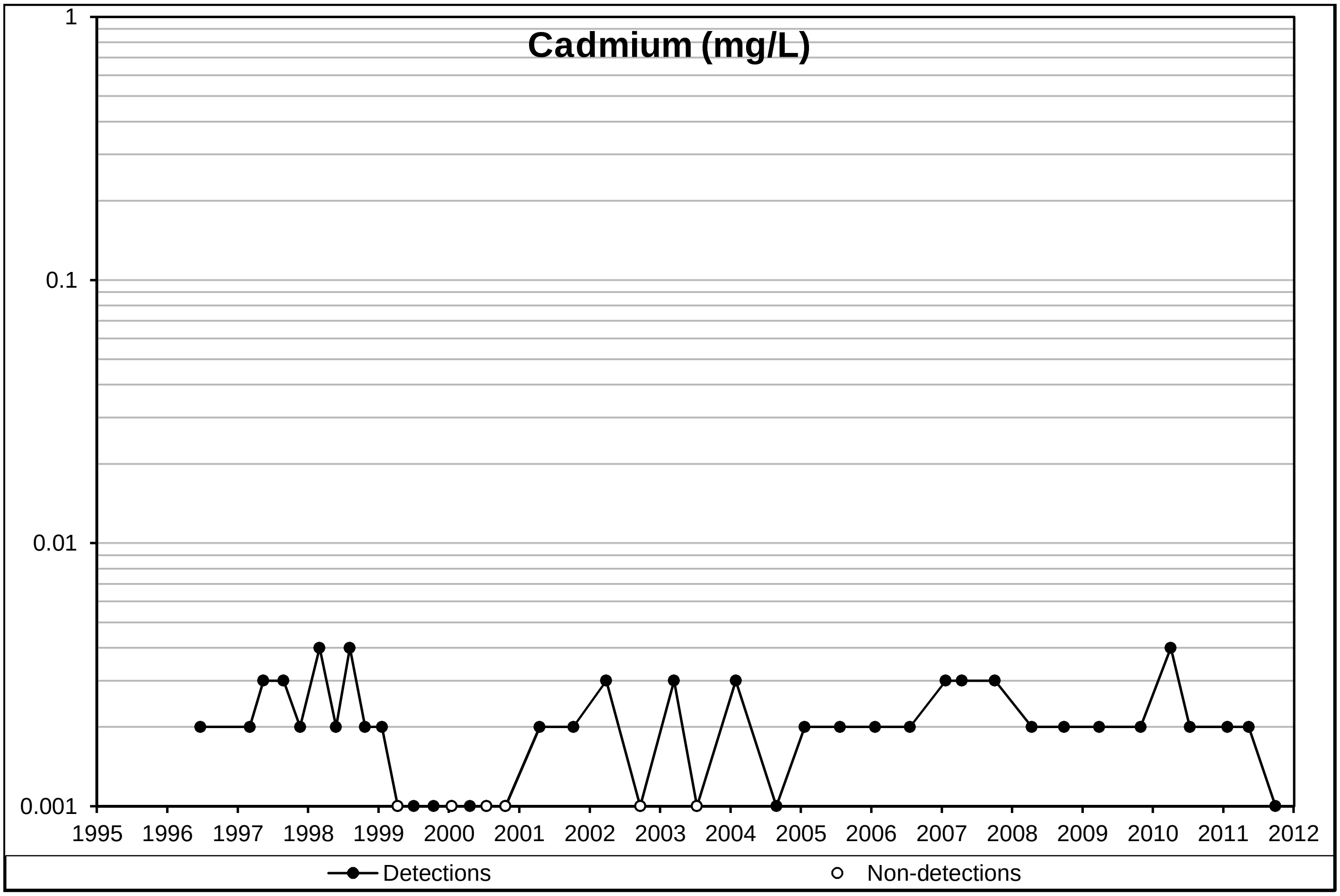


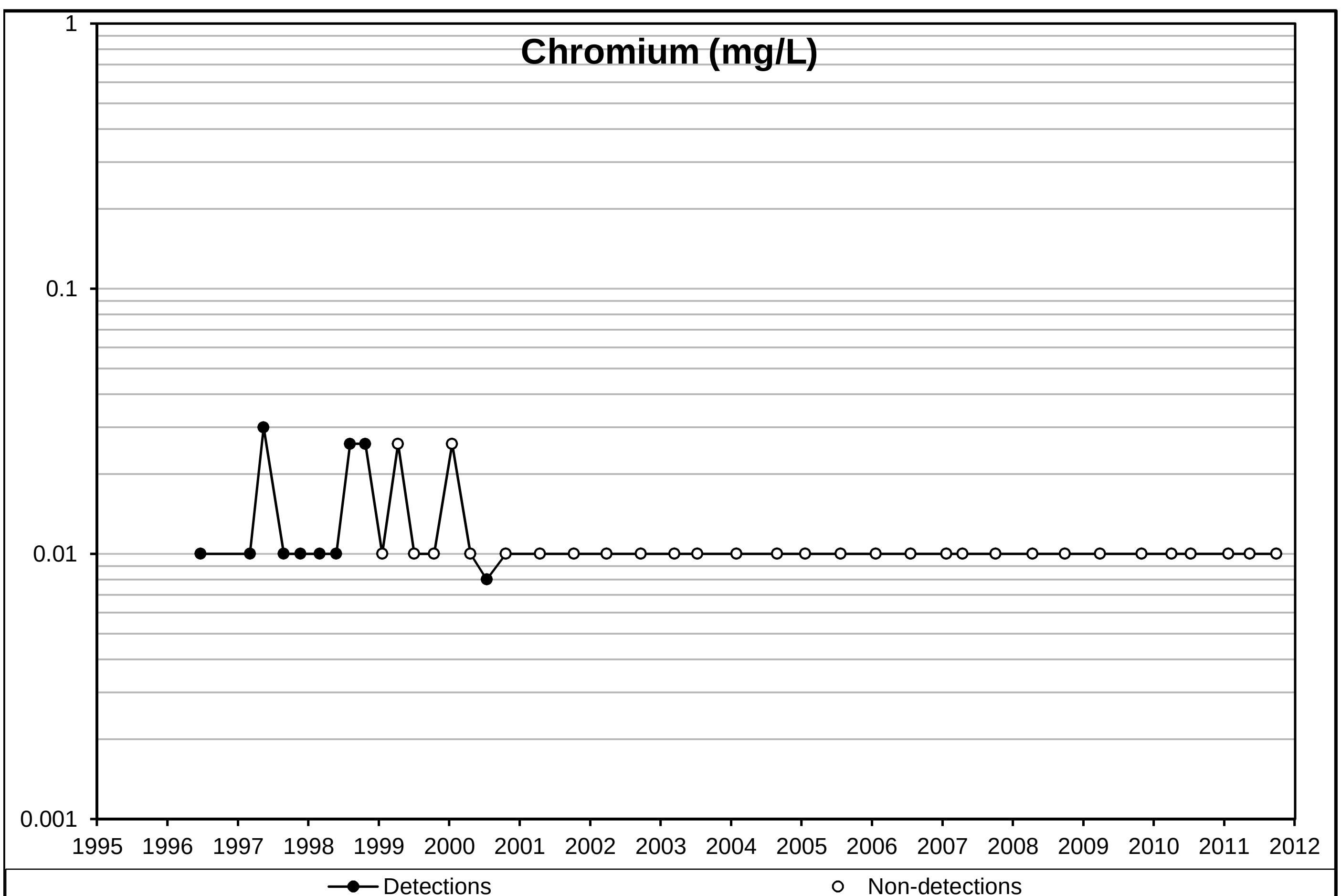


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

Concentration Versus Year

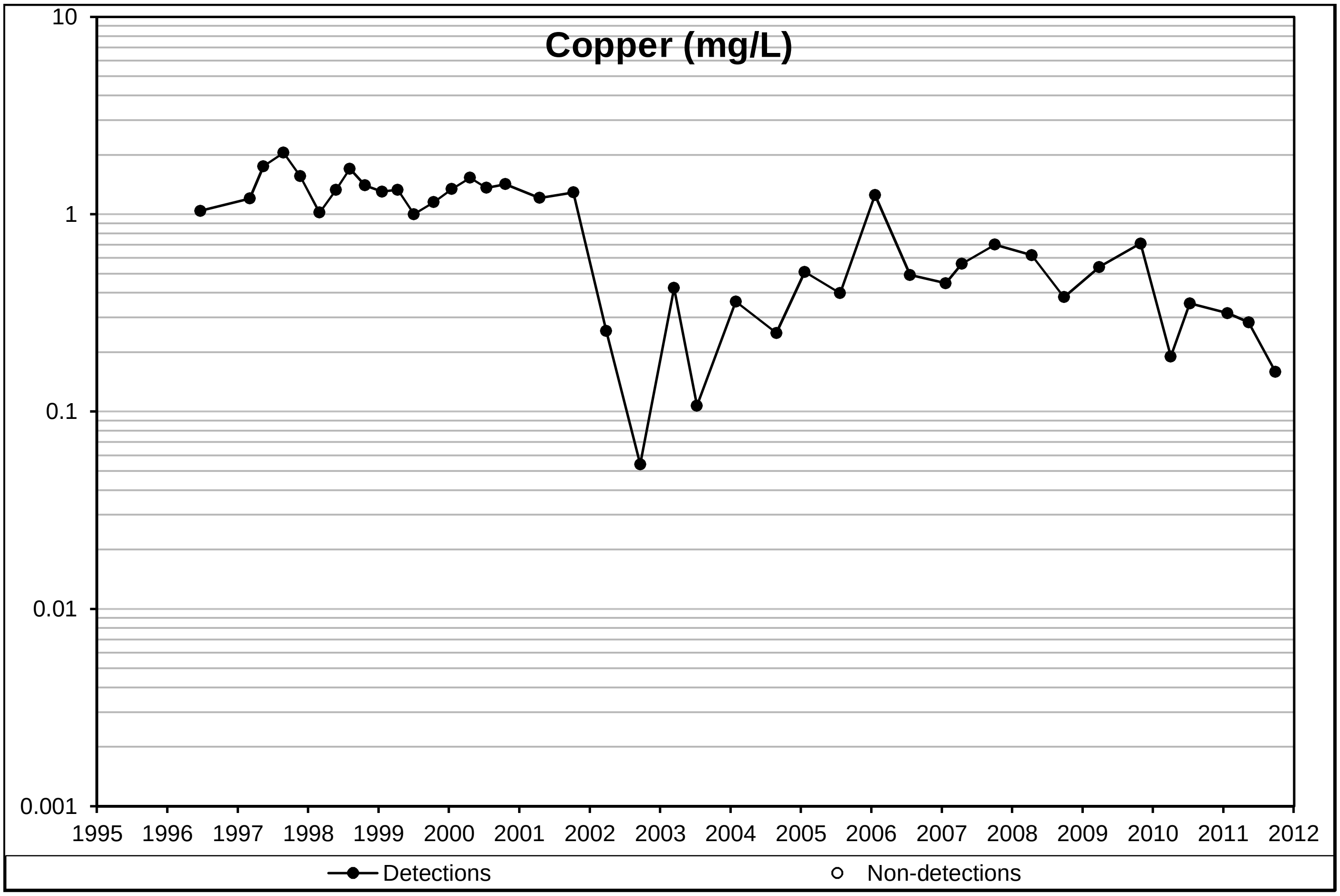


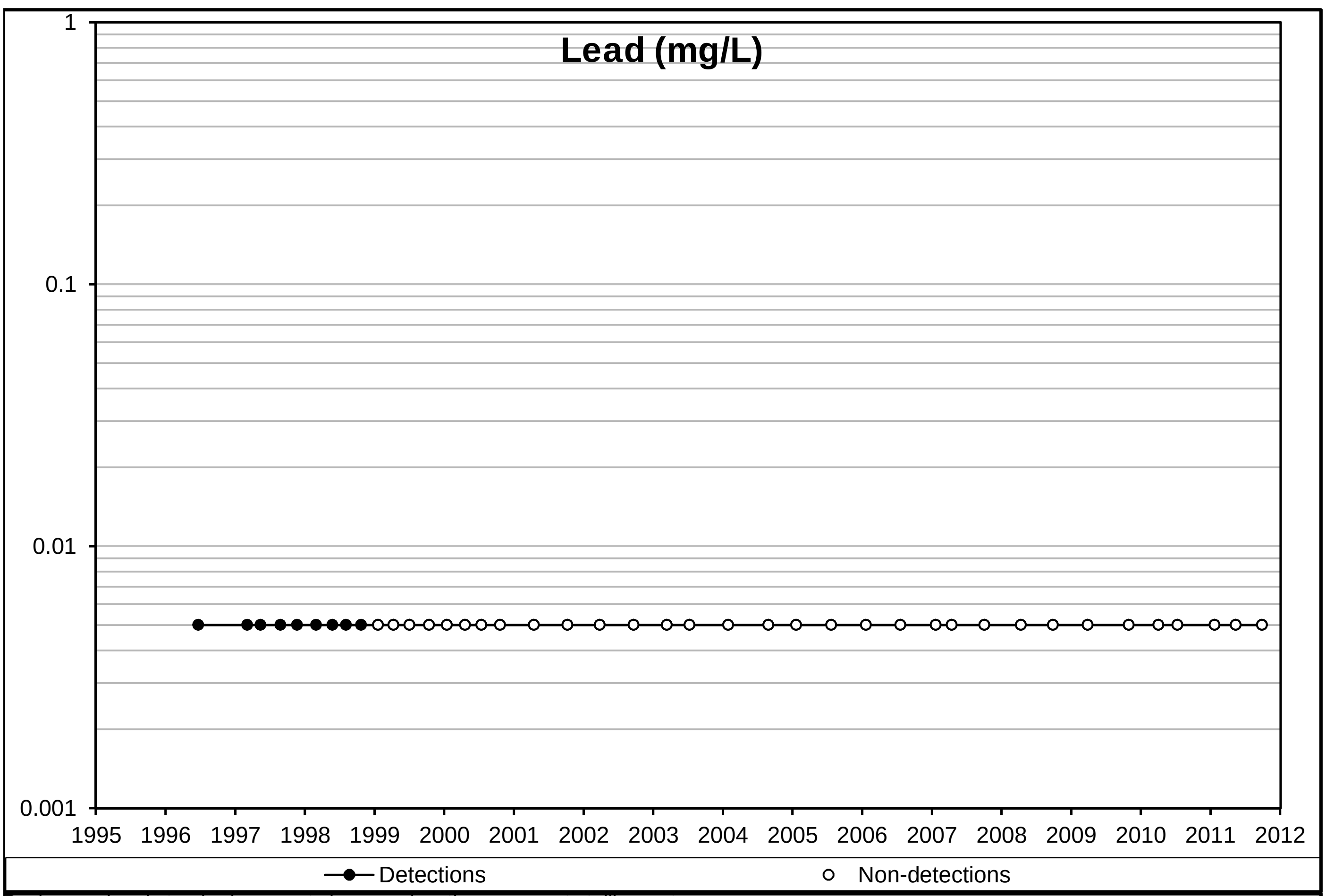


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLS1426

Concentration Versus Year

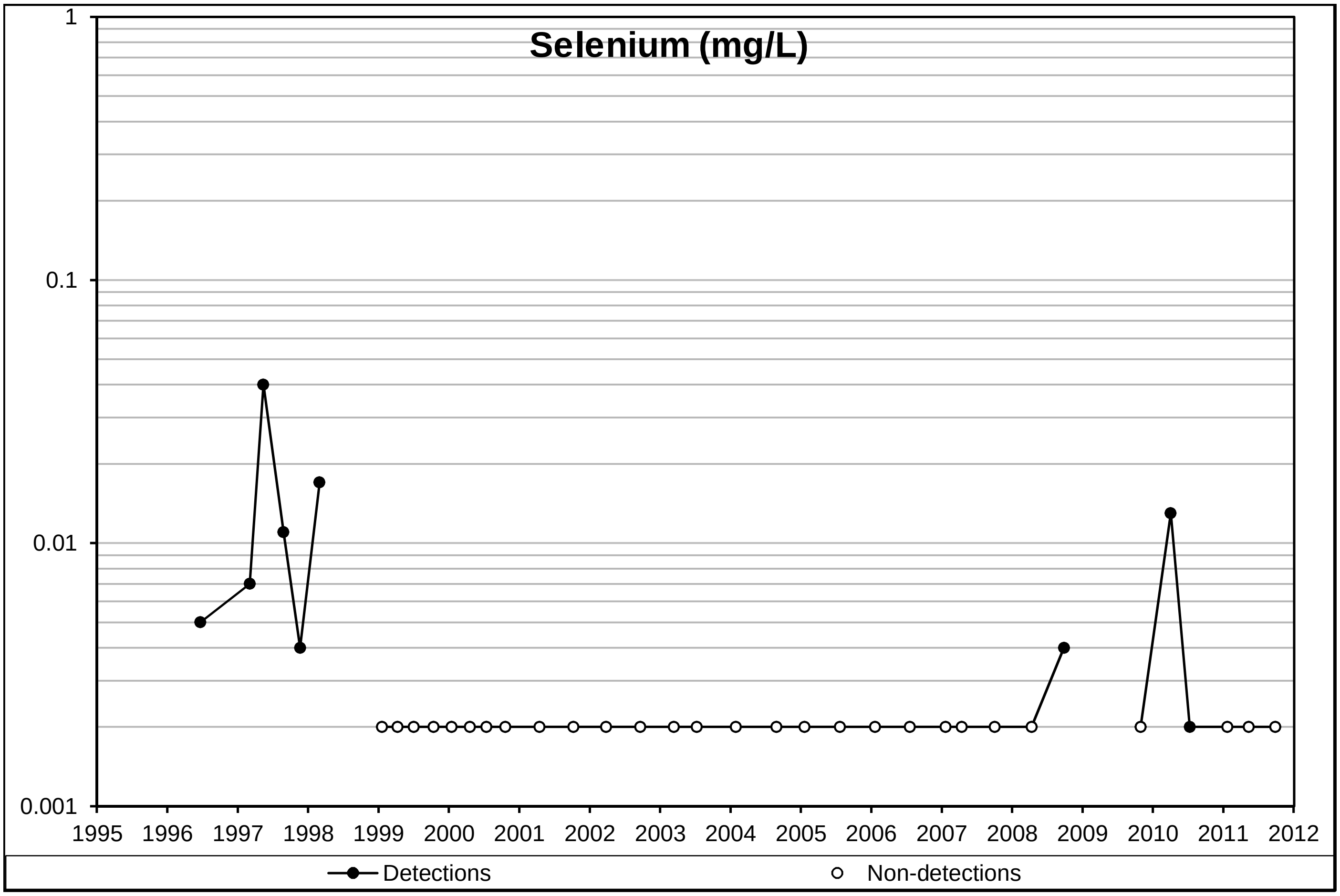


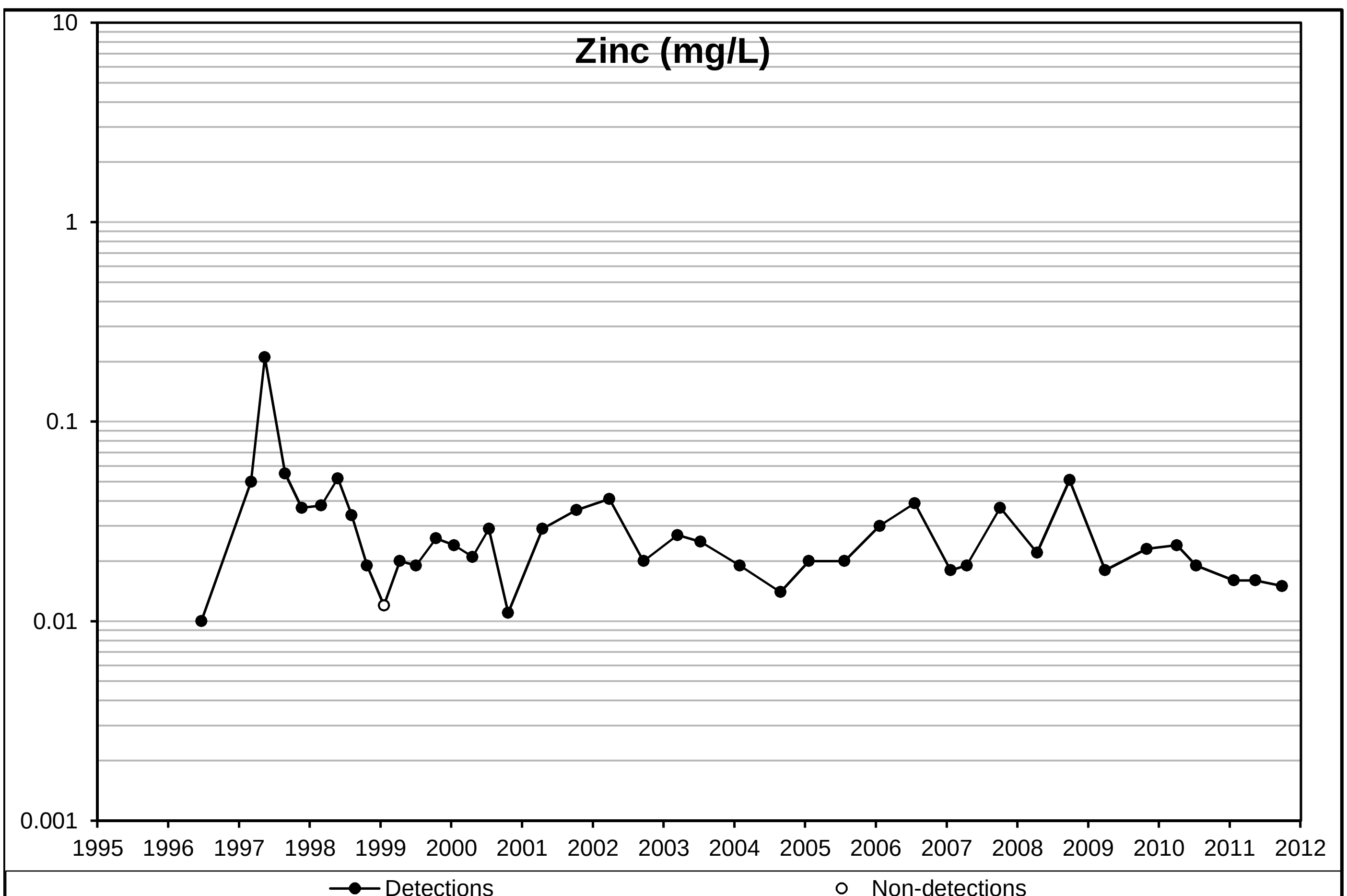


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

Concentration Versus Year

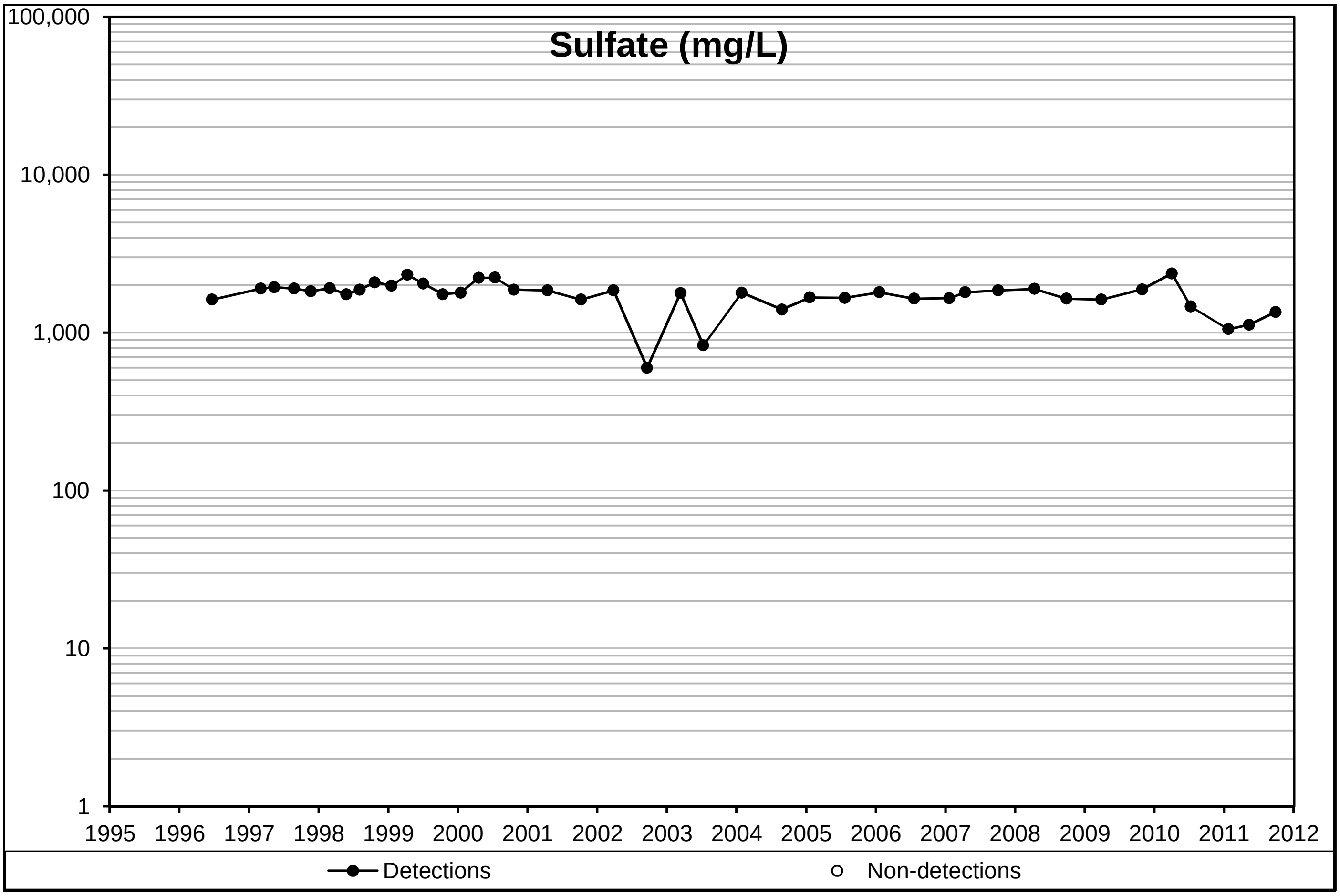


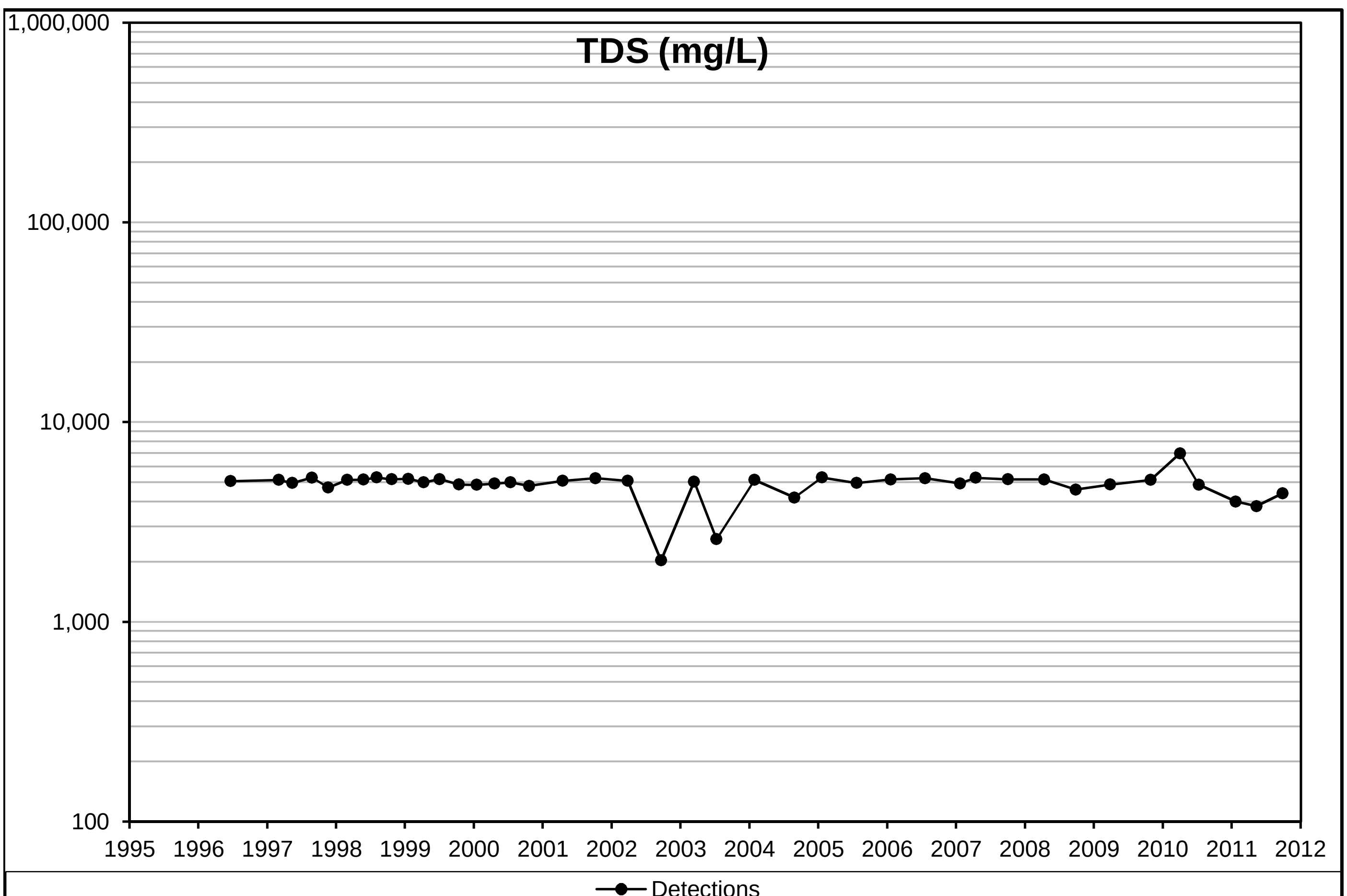


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLS1426

Concentration Versus Year



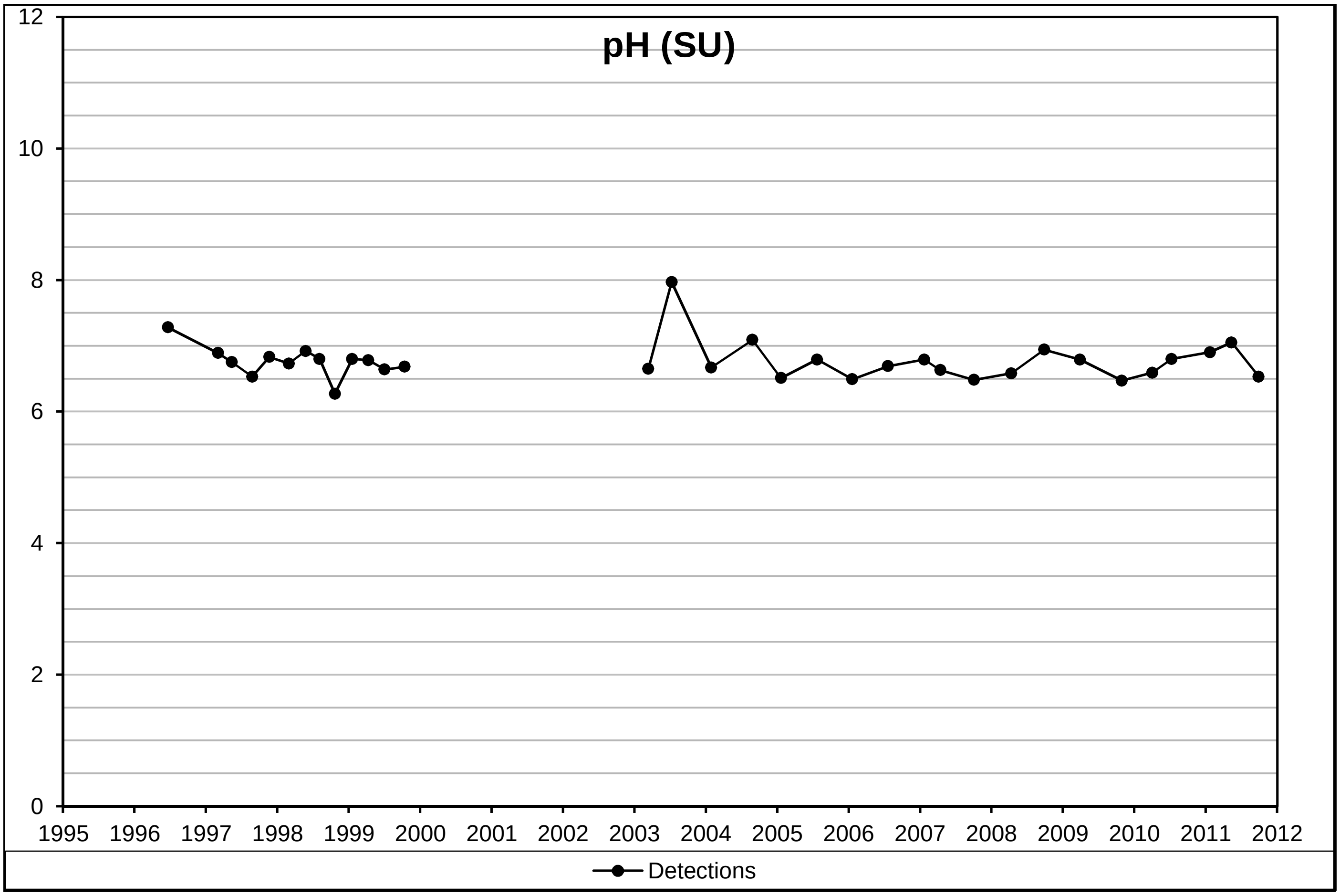


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLS1426

Concentration Versus Year

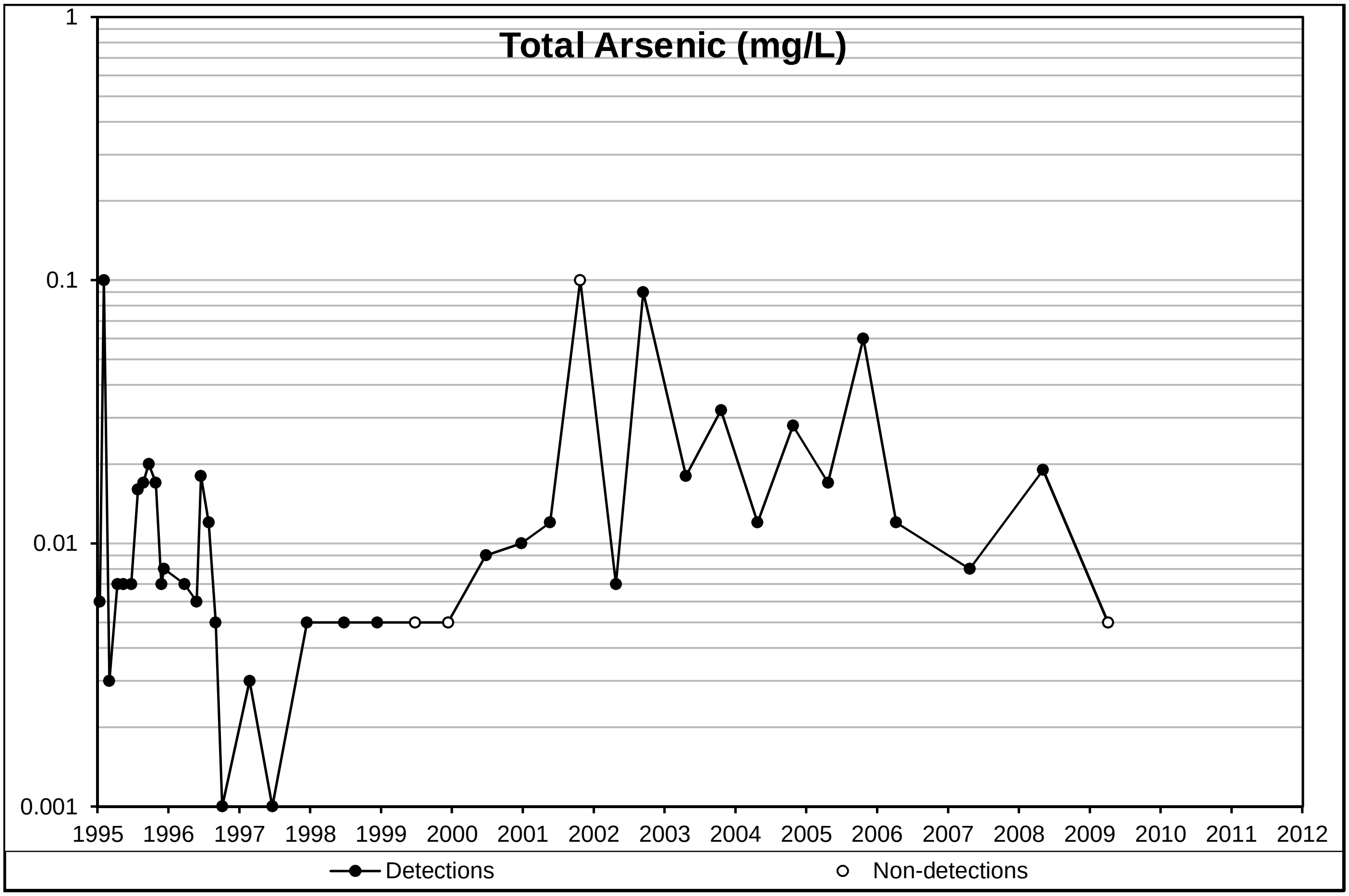


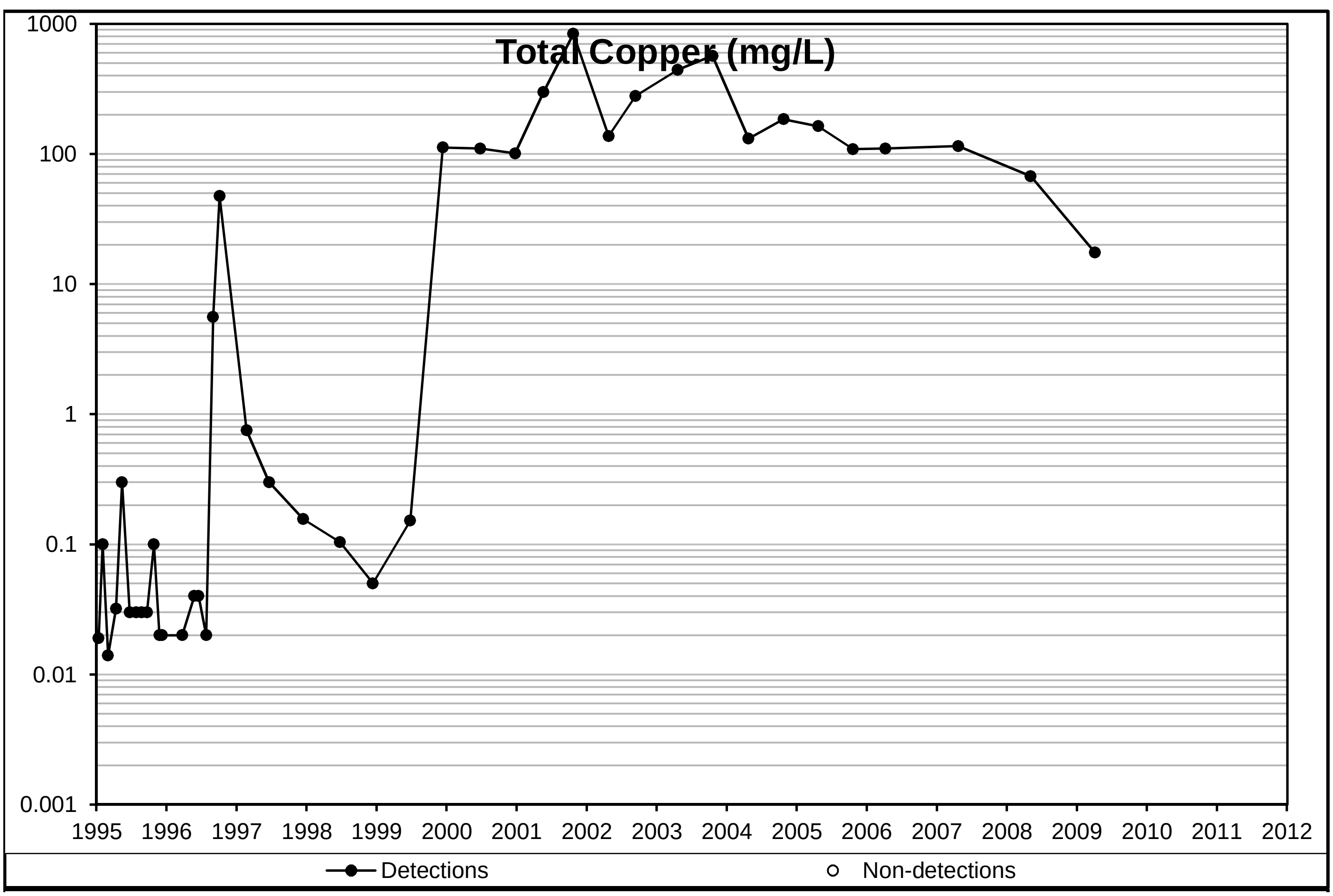
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLL4128

Concentration Versus Year

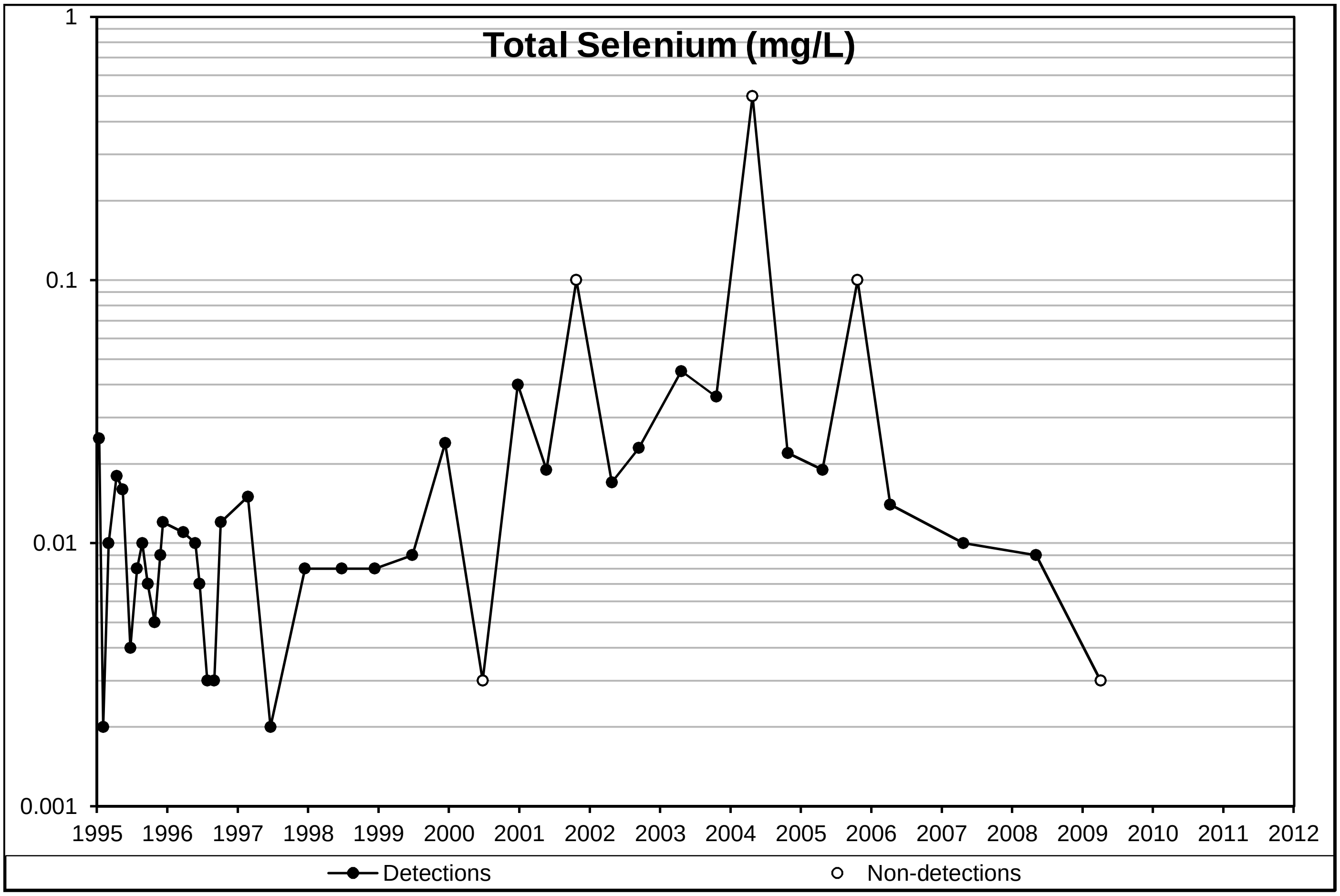


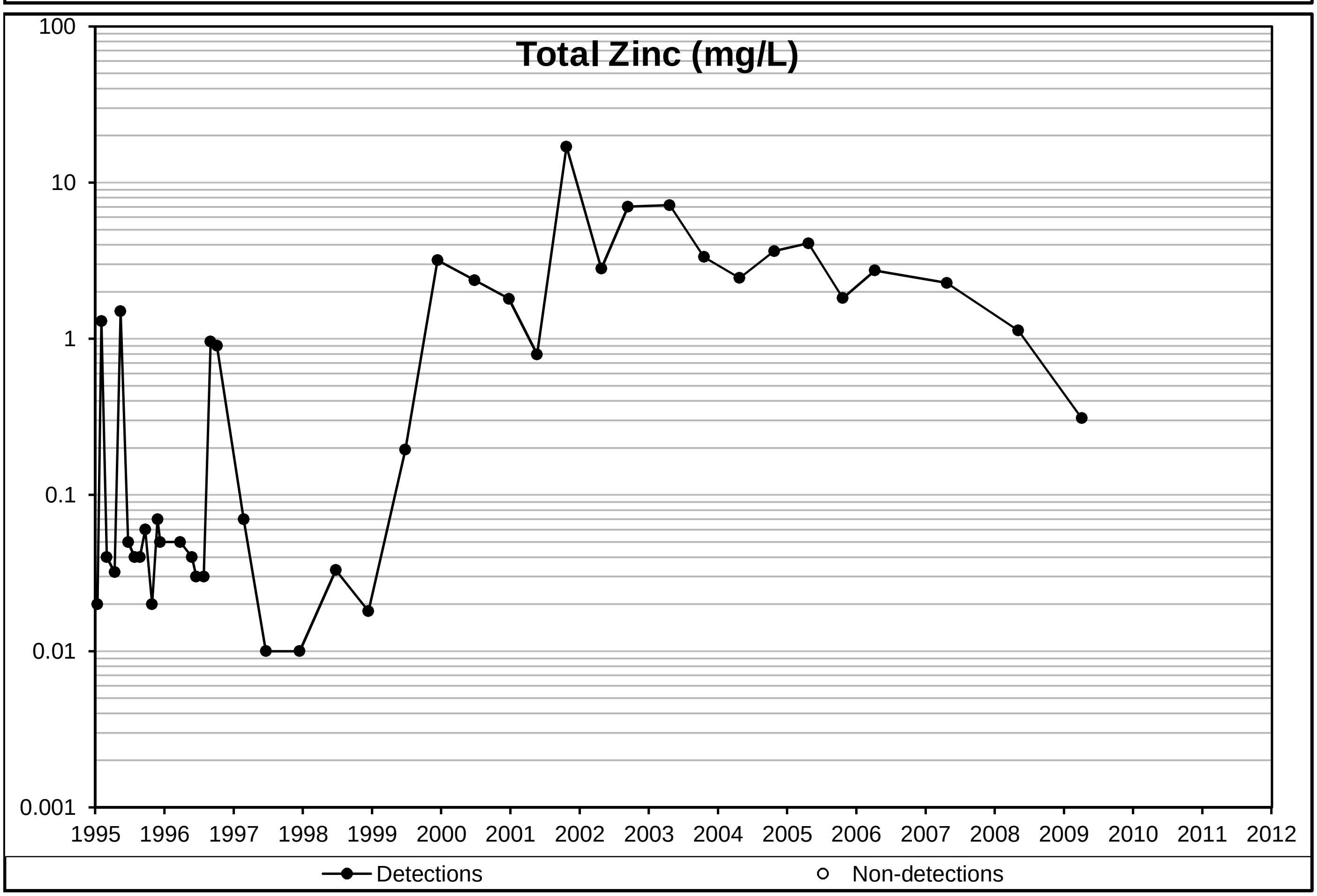


Background and standards are not shown as location represents tailing water.

TLL4128

Concentration Versus Year

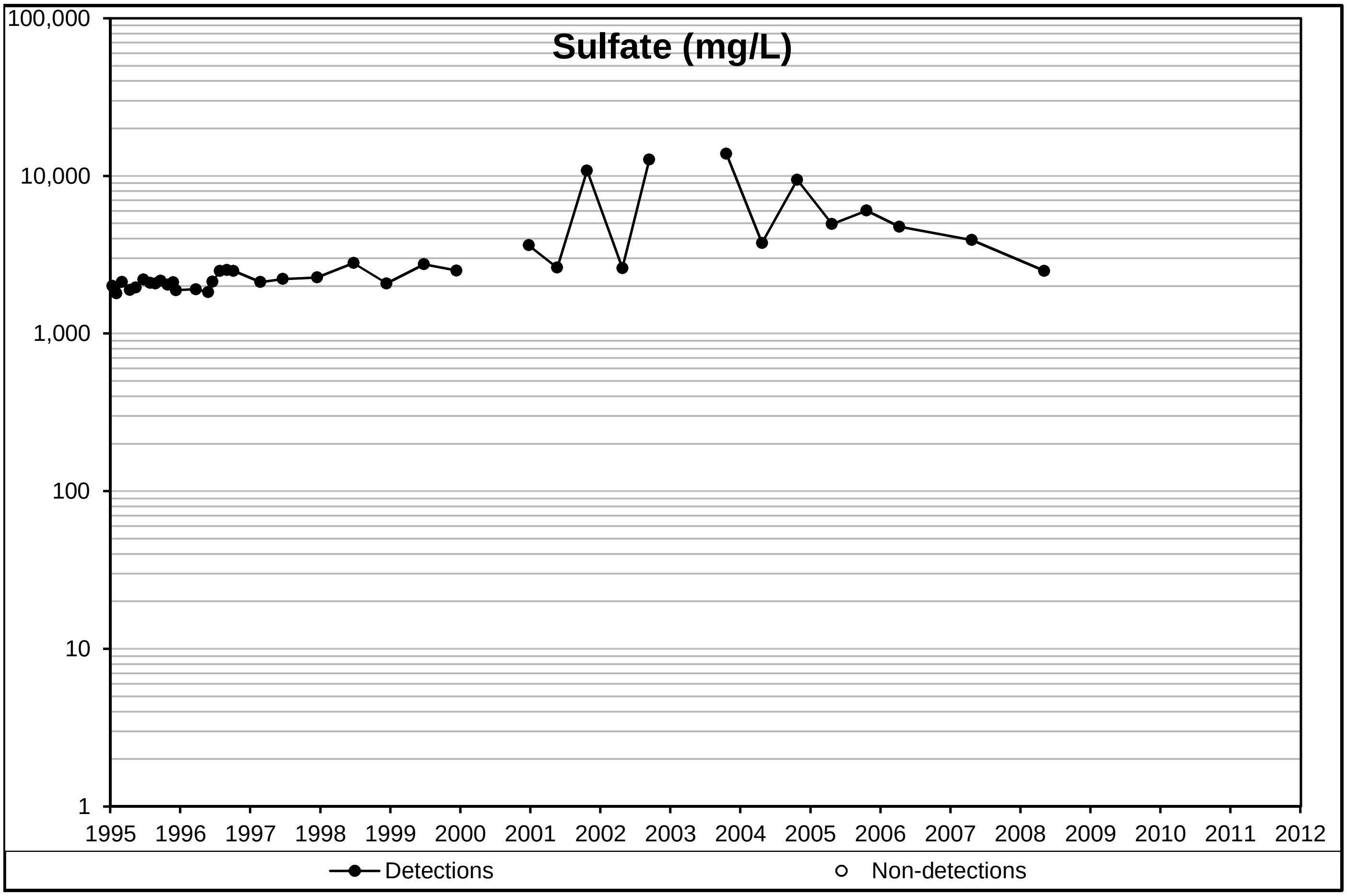


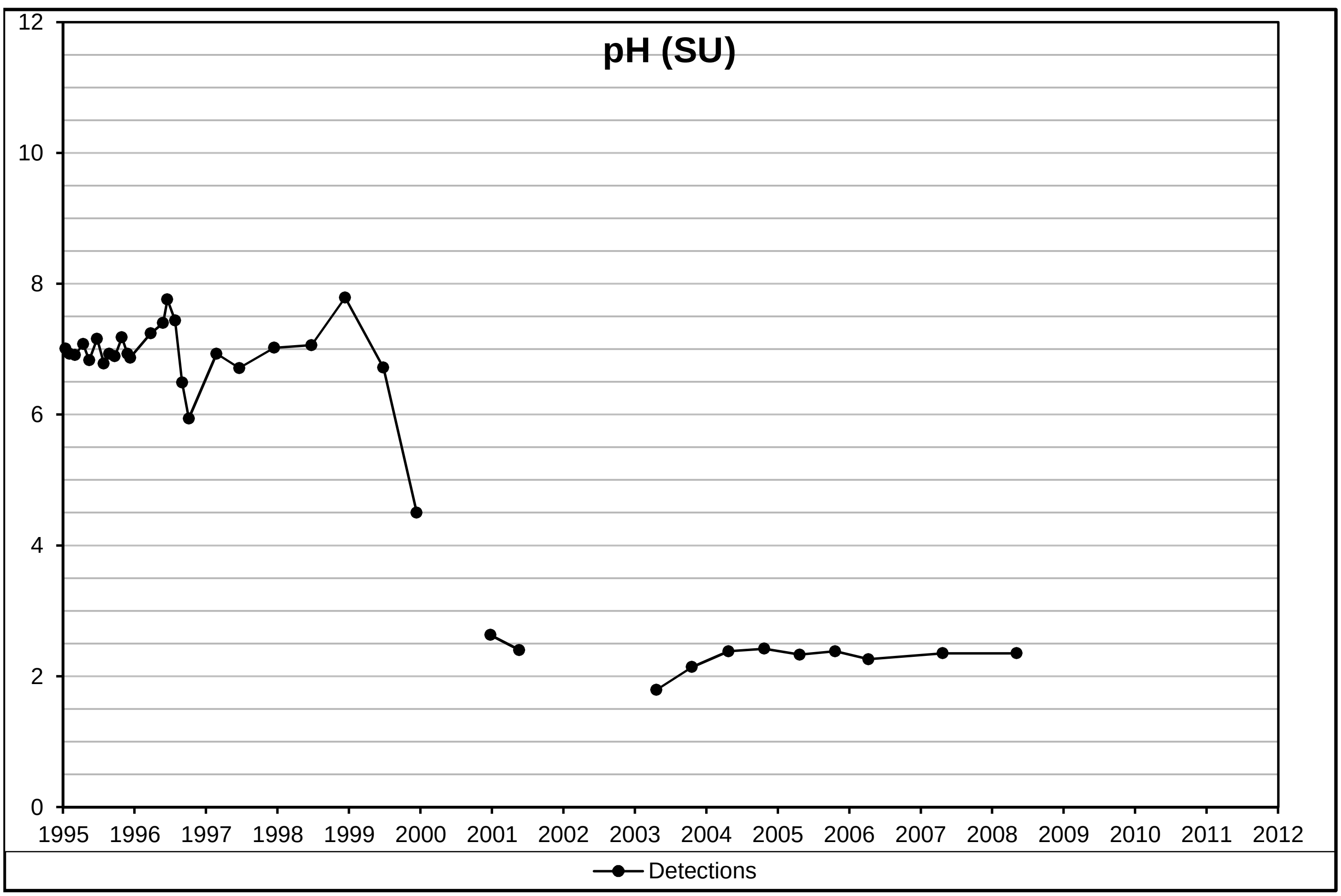


Background and standards are not shown as location represents tailing water.

TLL4128

Concentration Versus Year

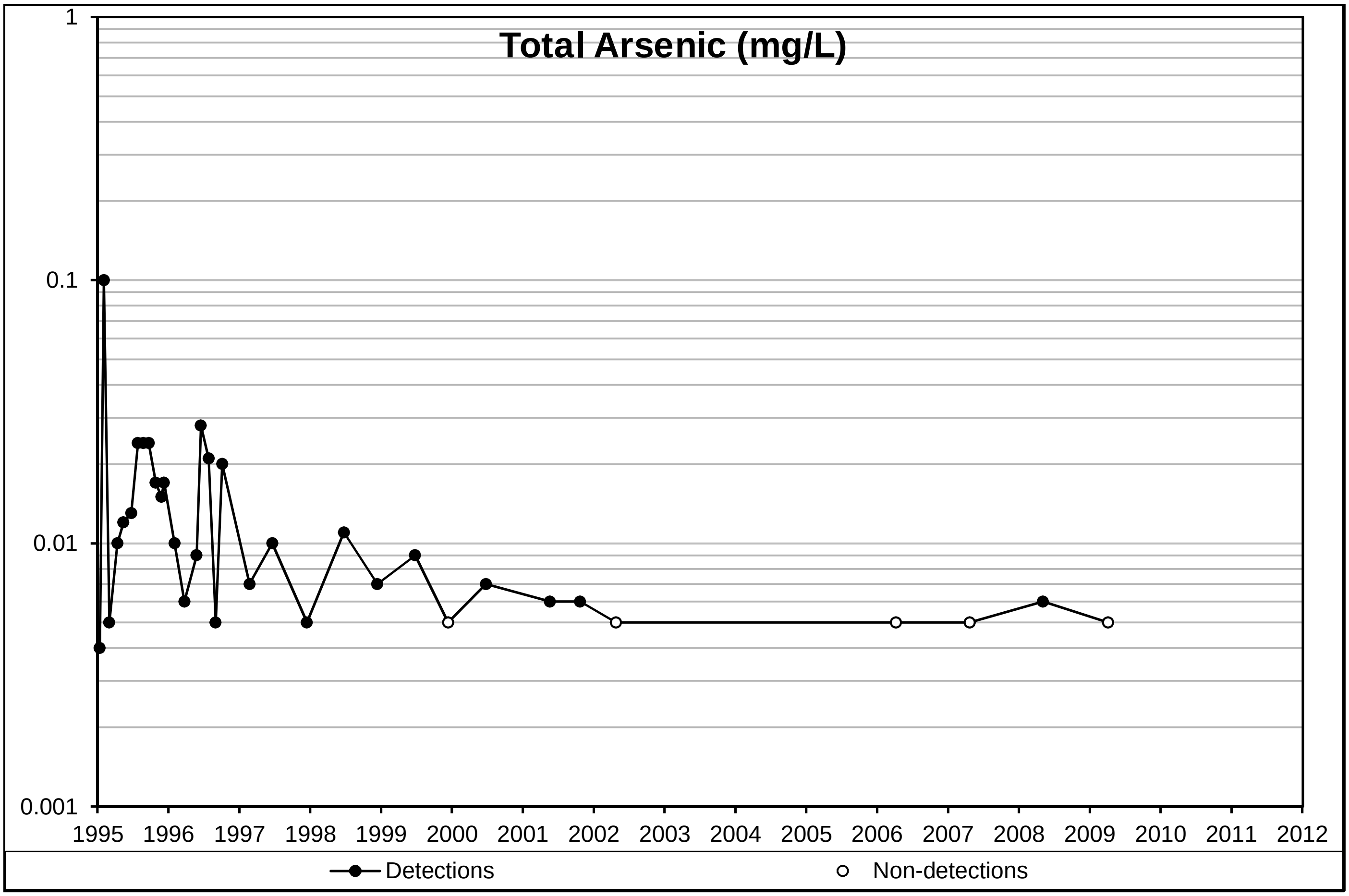


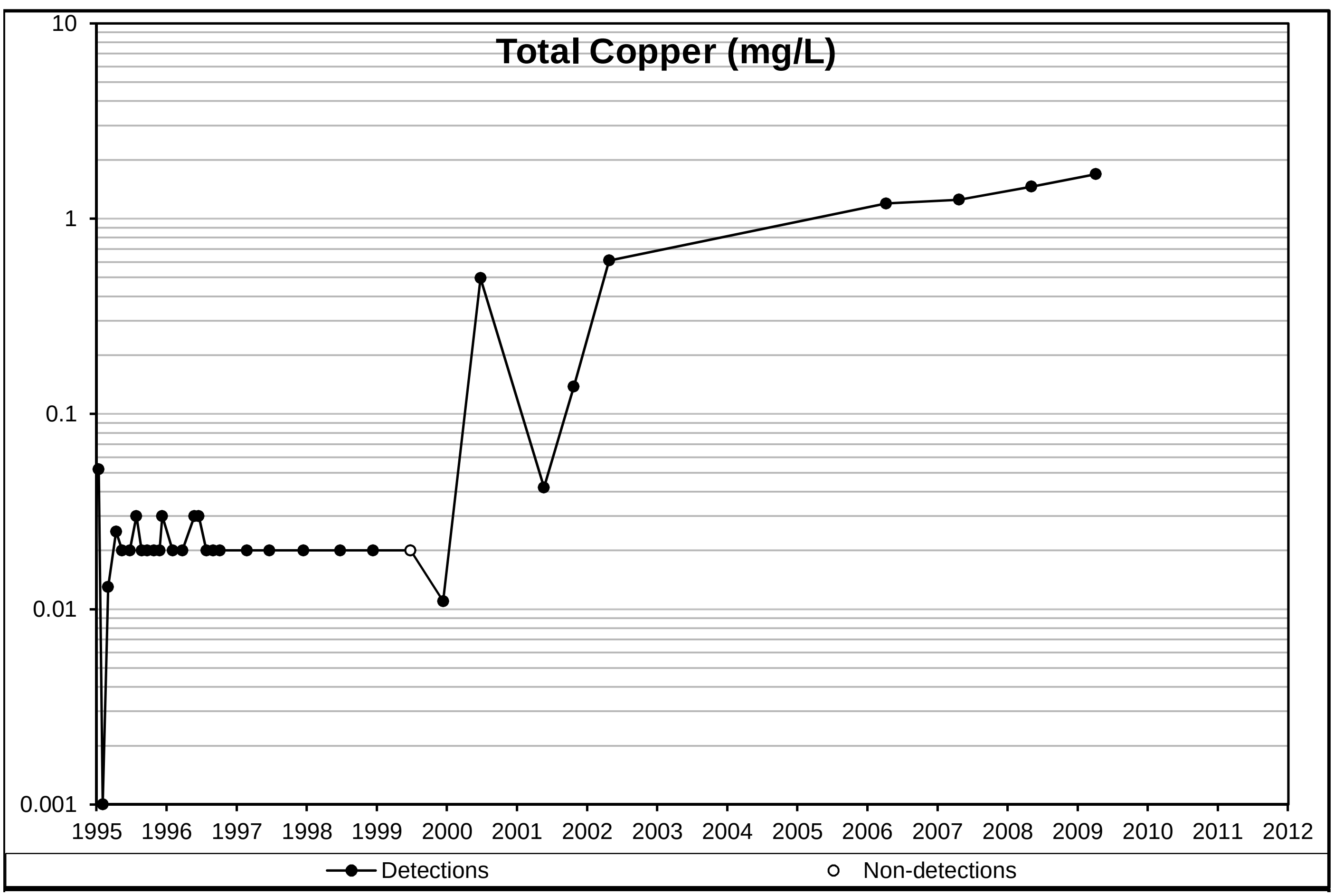


Background and standards are not shown as location represents tailing water.

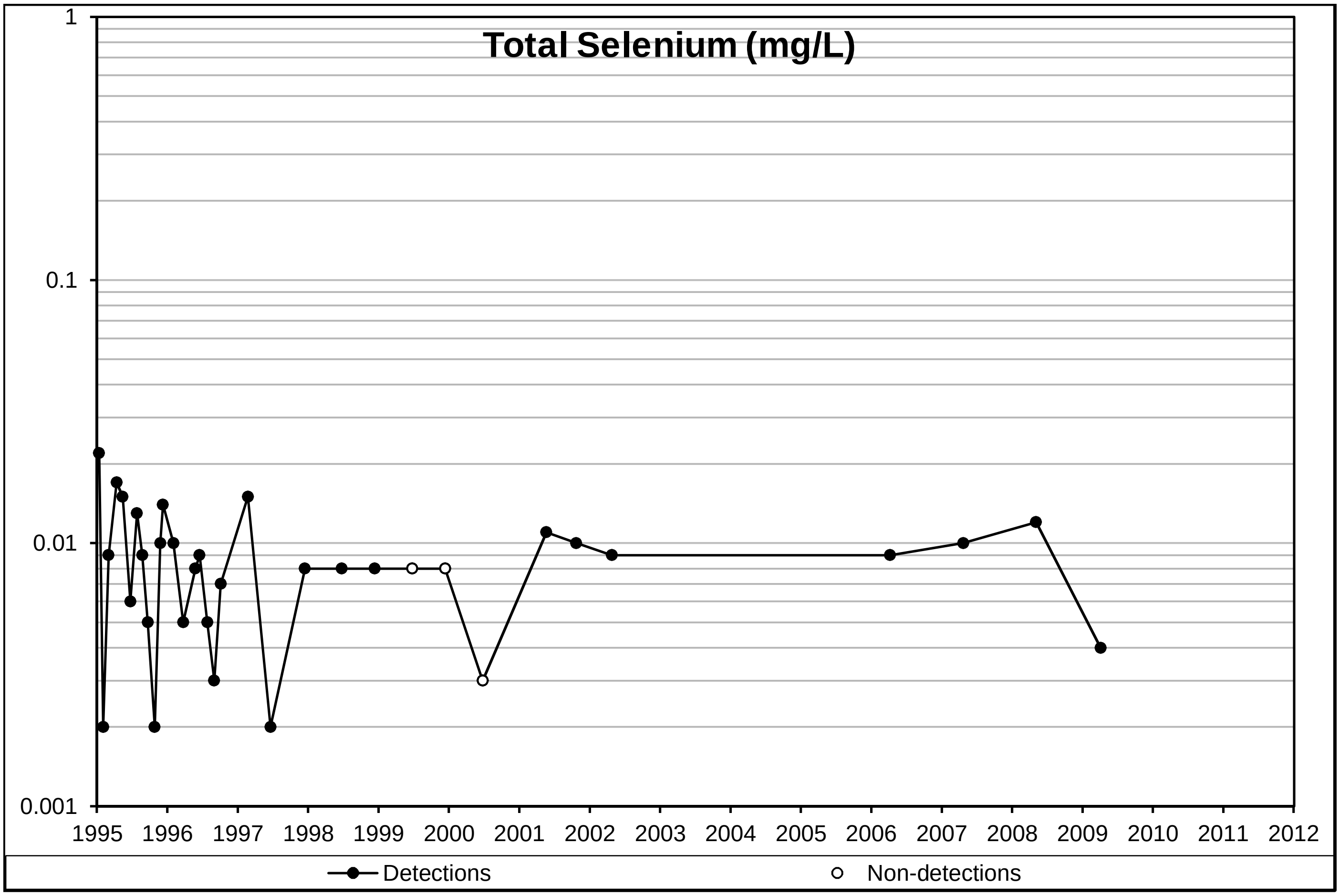
TLL4129

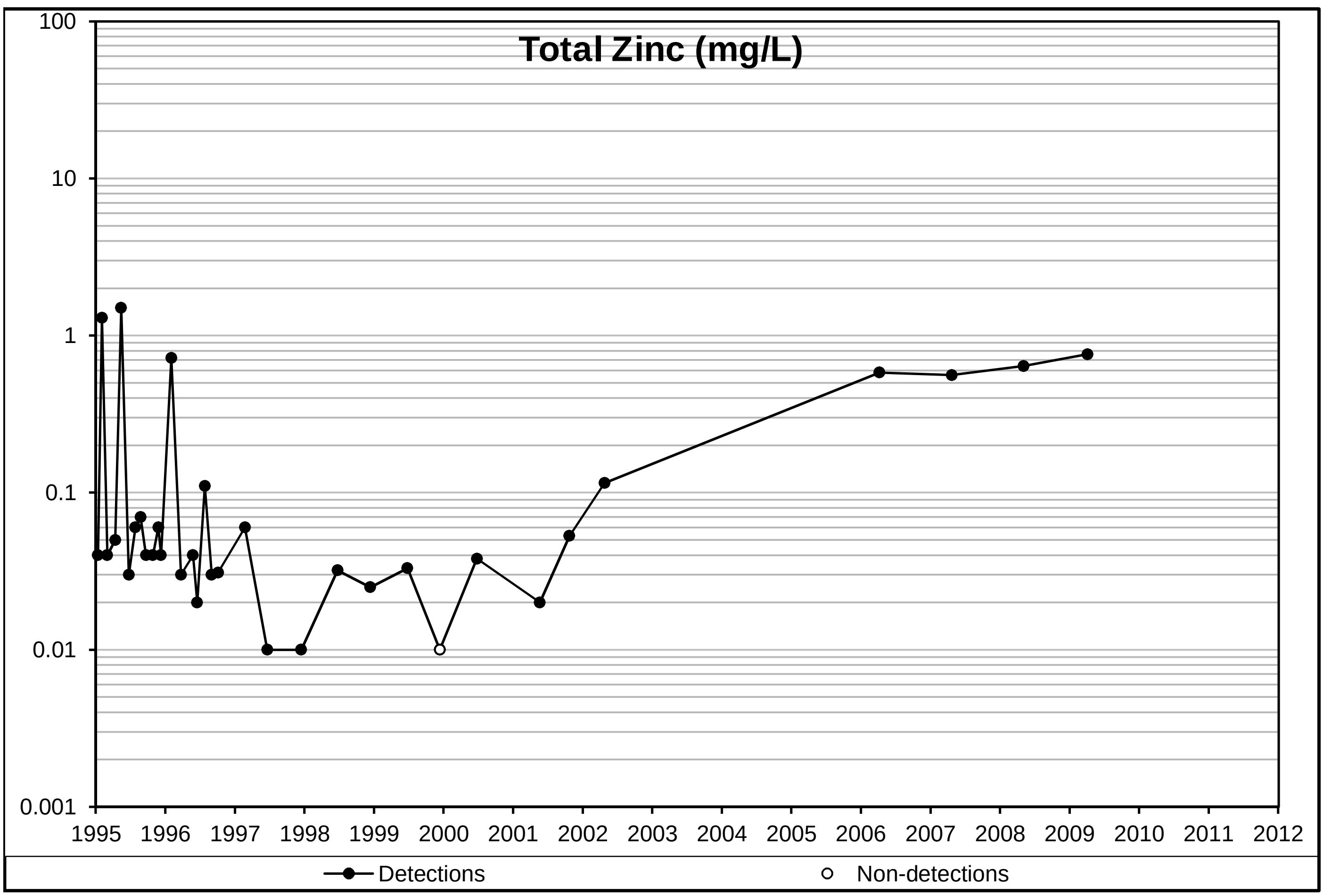
Concentration Versus Year





Background and standards are not shown as location represents tailing water.

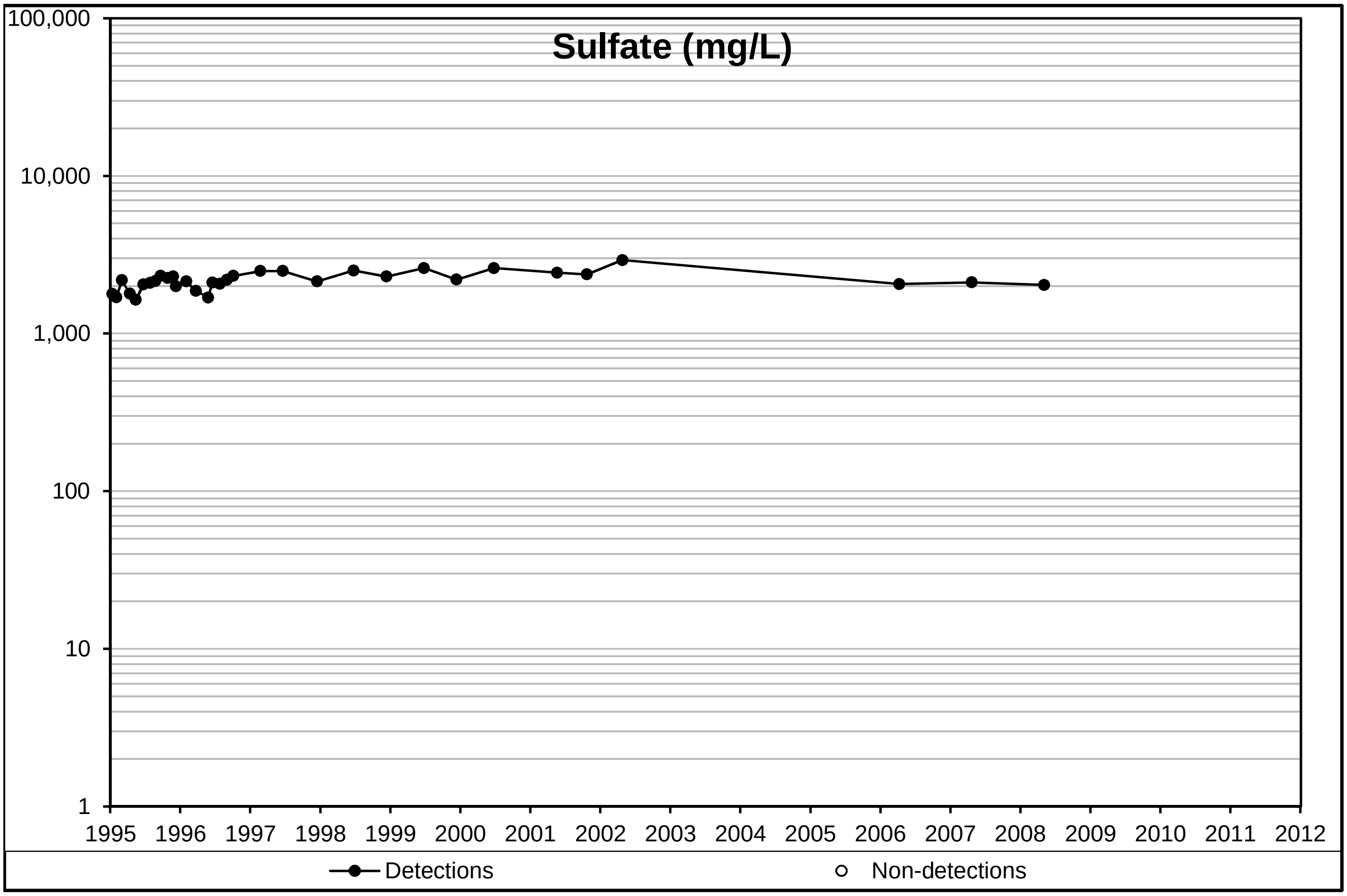


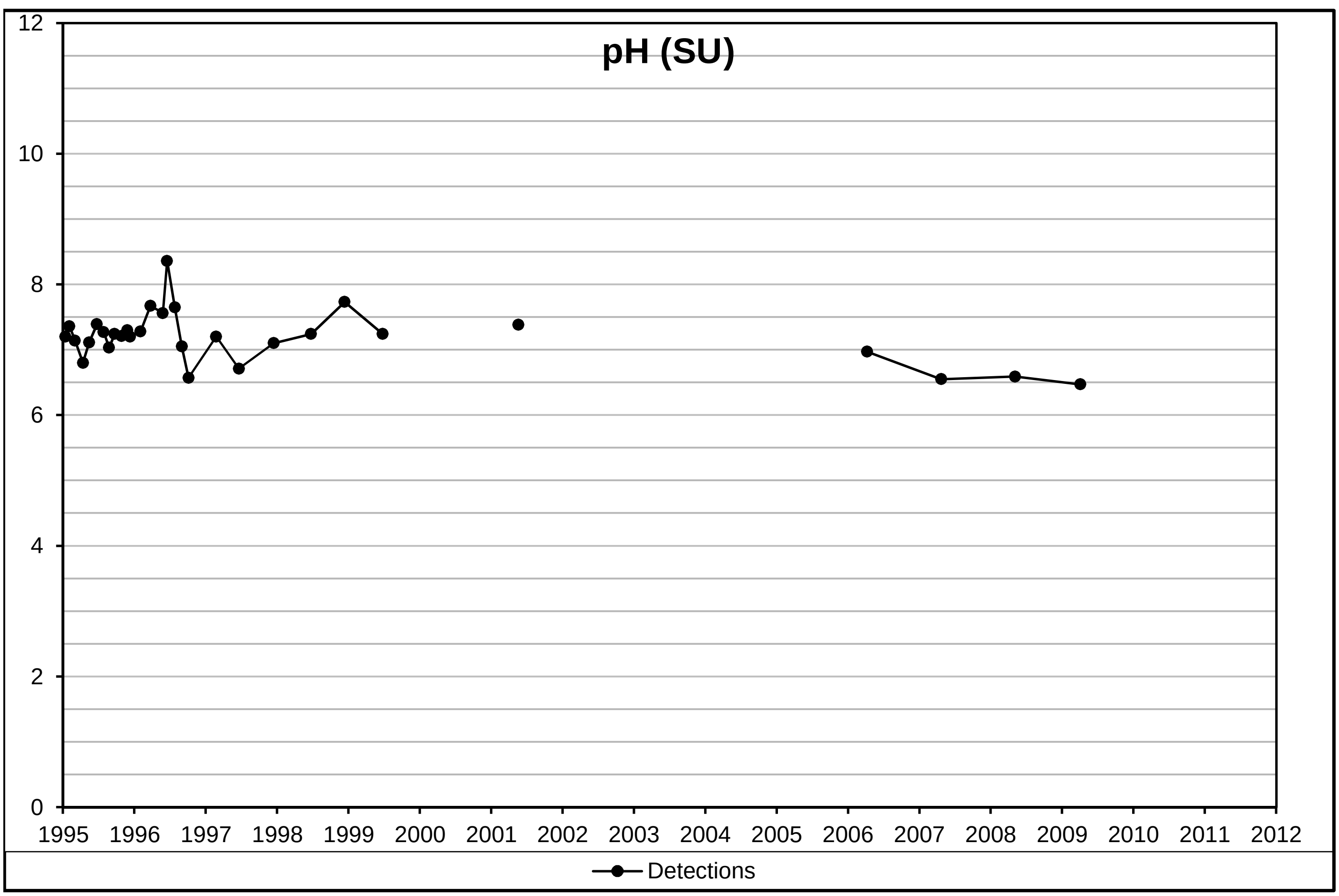


Background and standards are not shown as location represents tailing water.

TLL4129

Concentration Versus Year

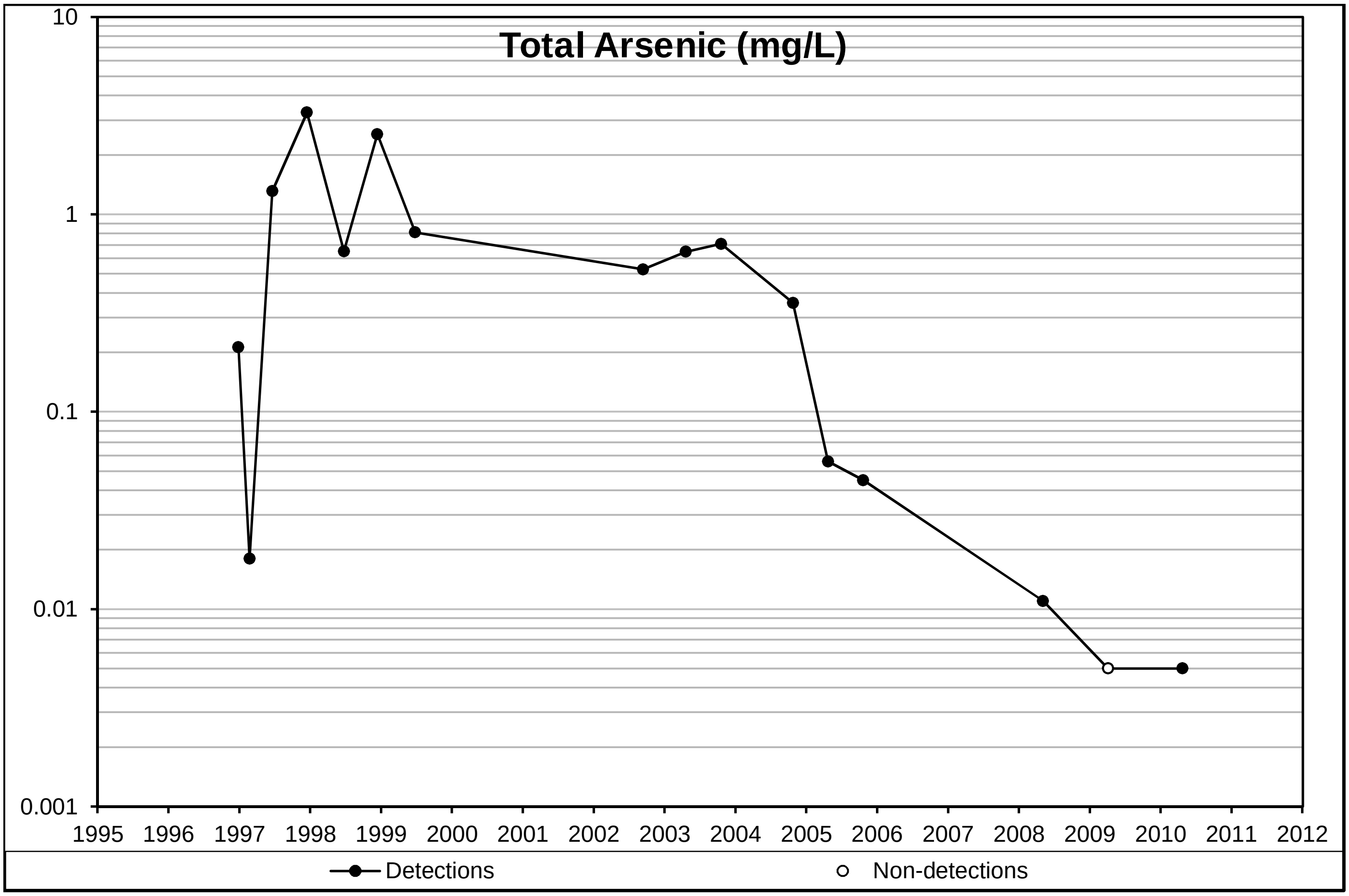


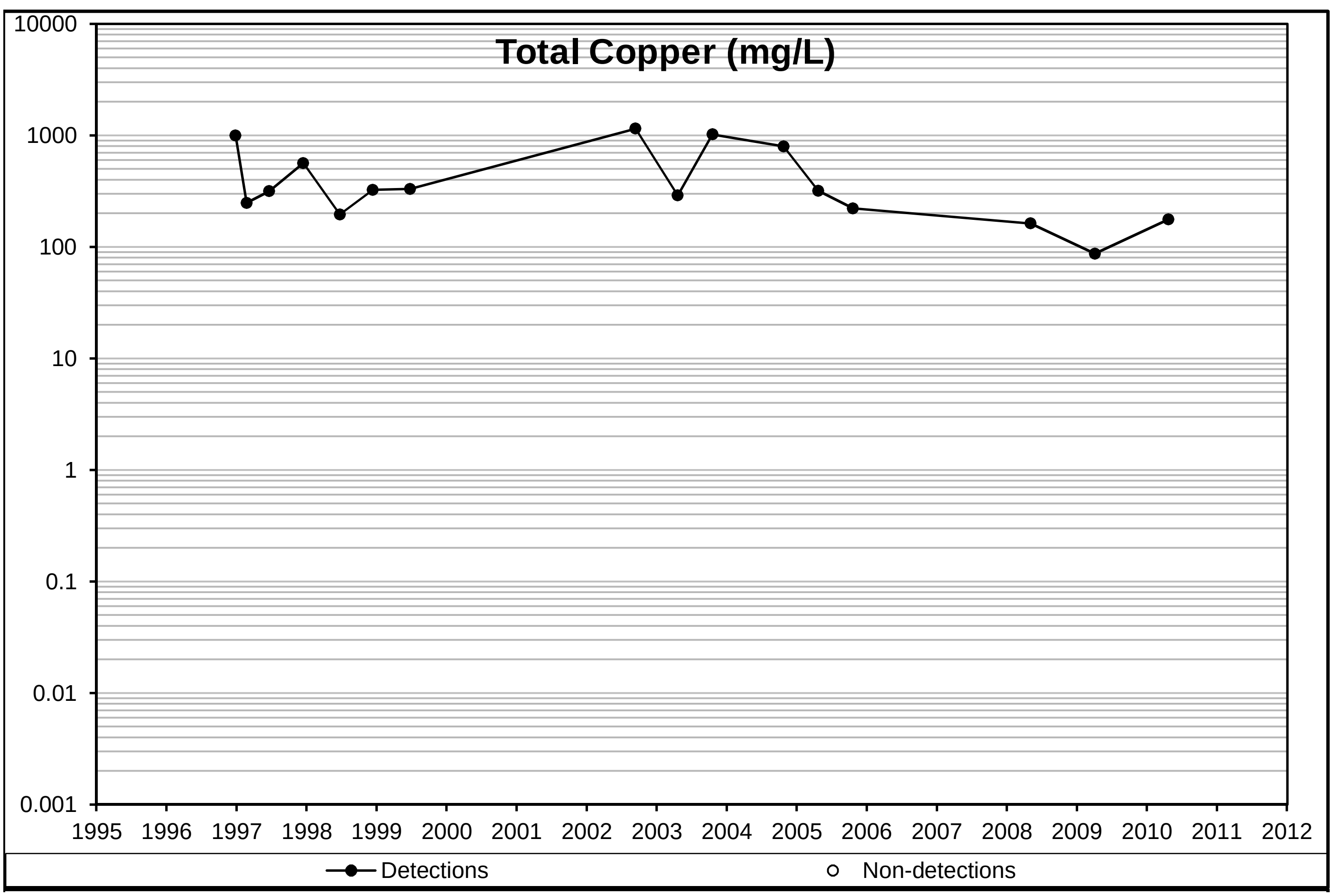


Background and standards are not shown as location represents tailing water.

TLL4133

Concentration Versus Year

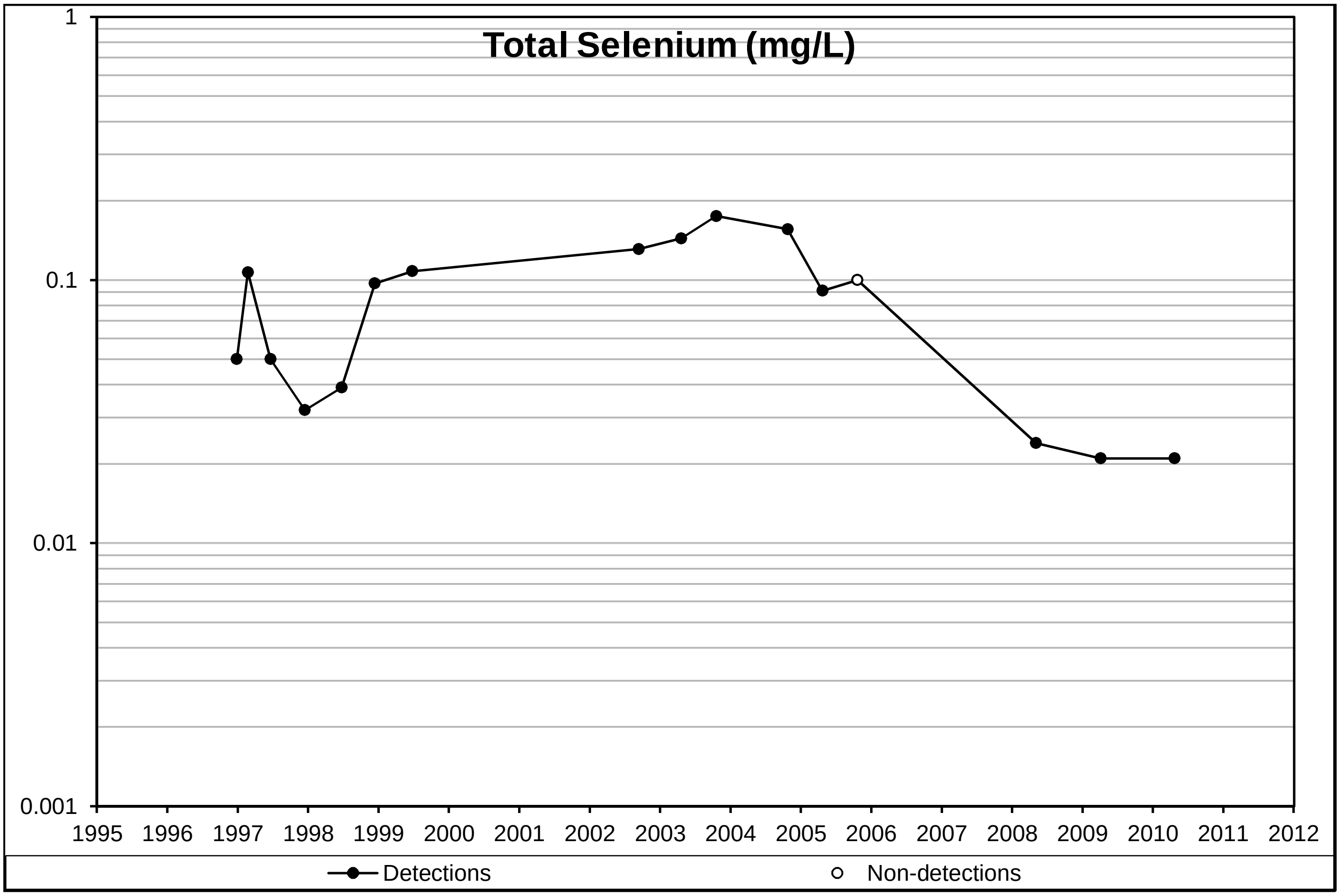


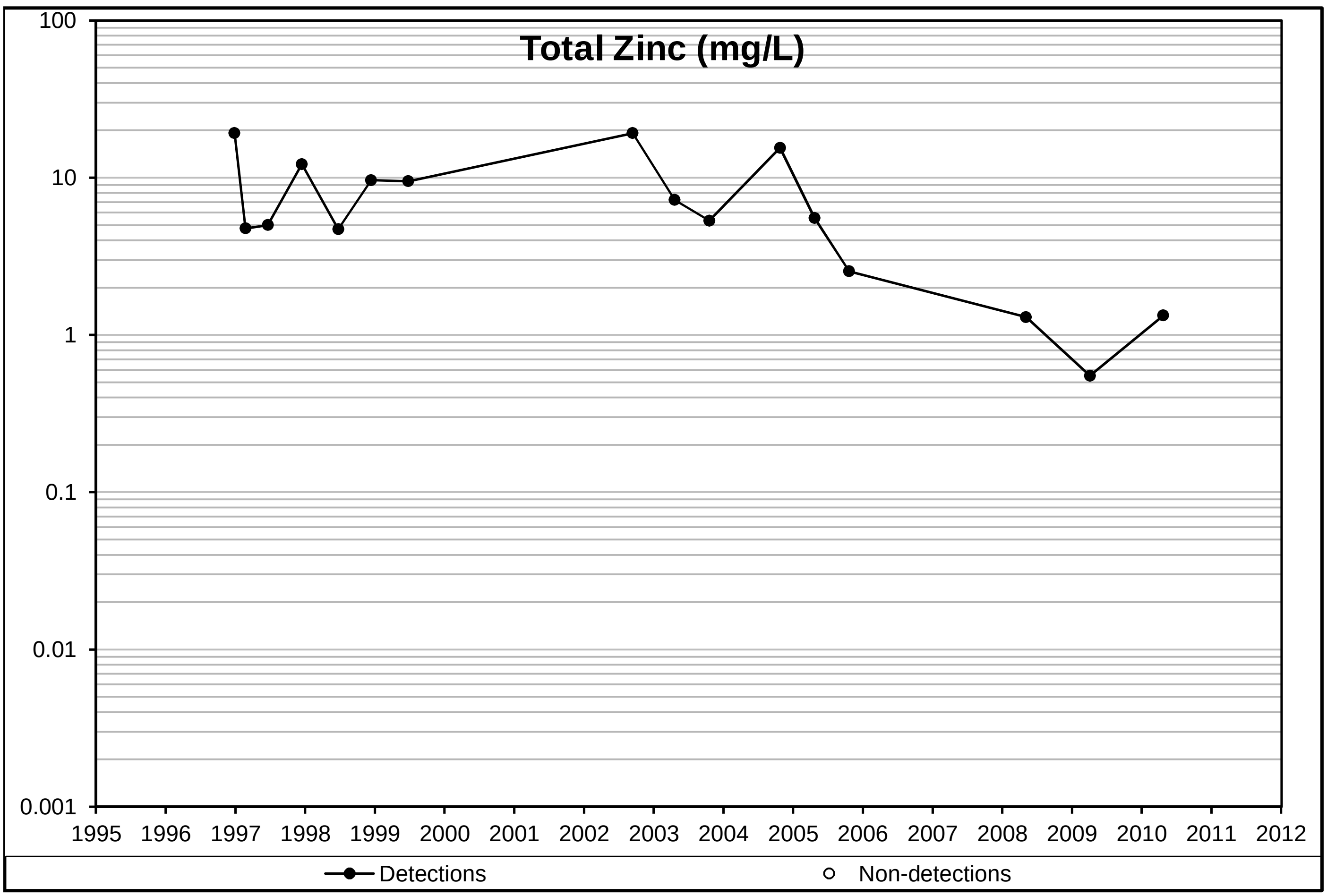


Background and standards are not shown as location represents tailing water.

TLL4133

Concentration Versus Year

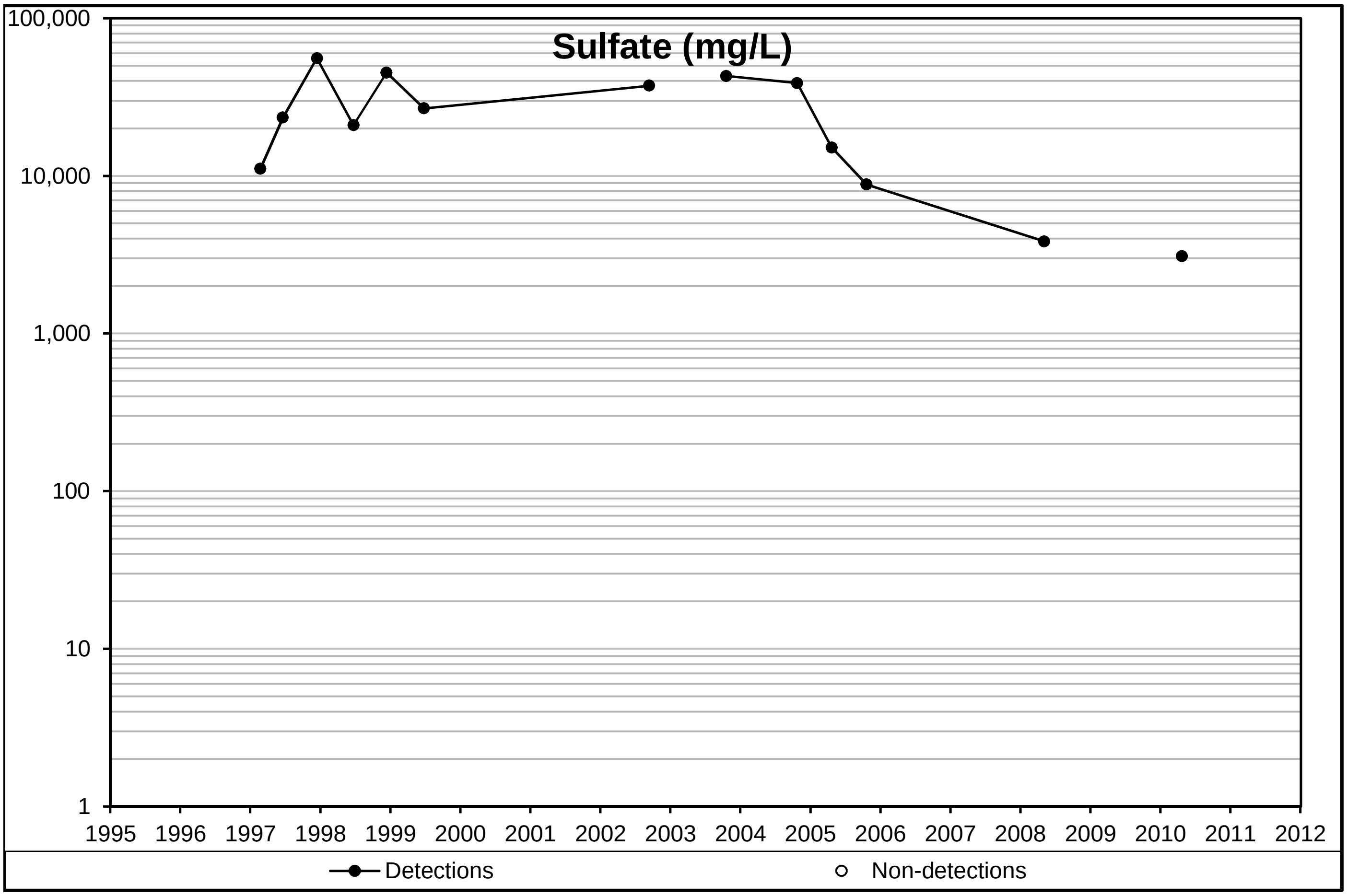


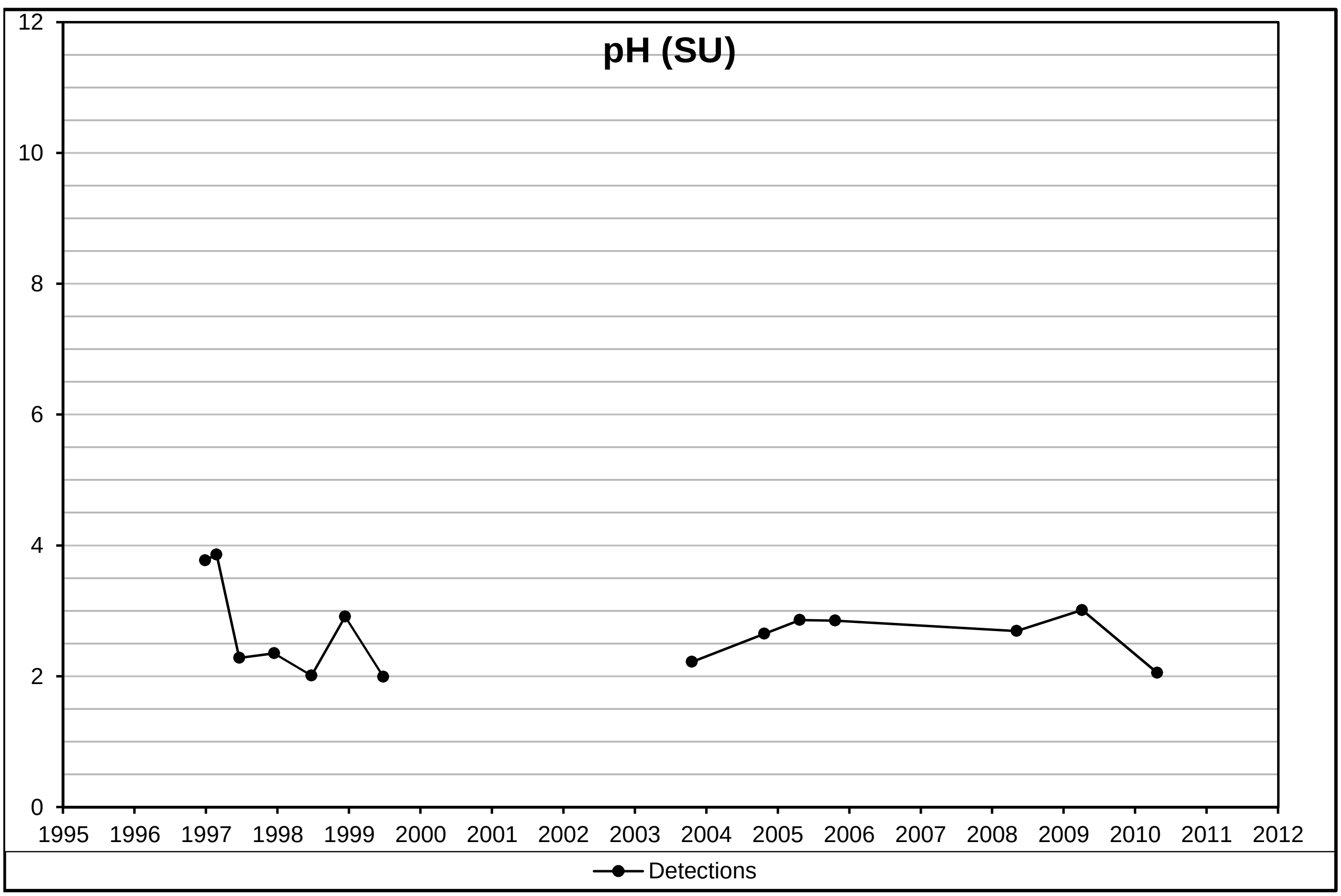


Background and standards are not shown as location represents tailing water.

TLL4133

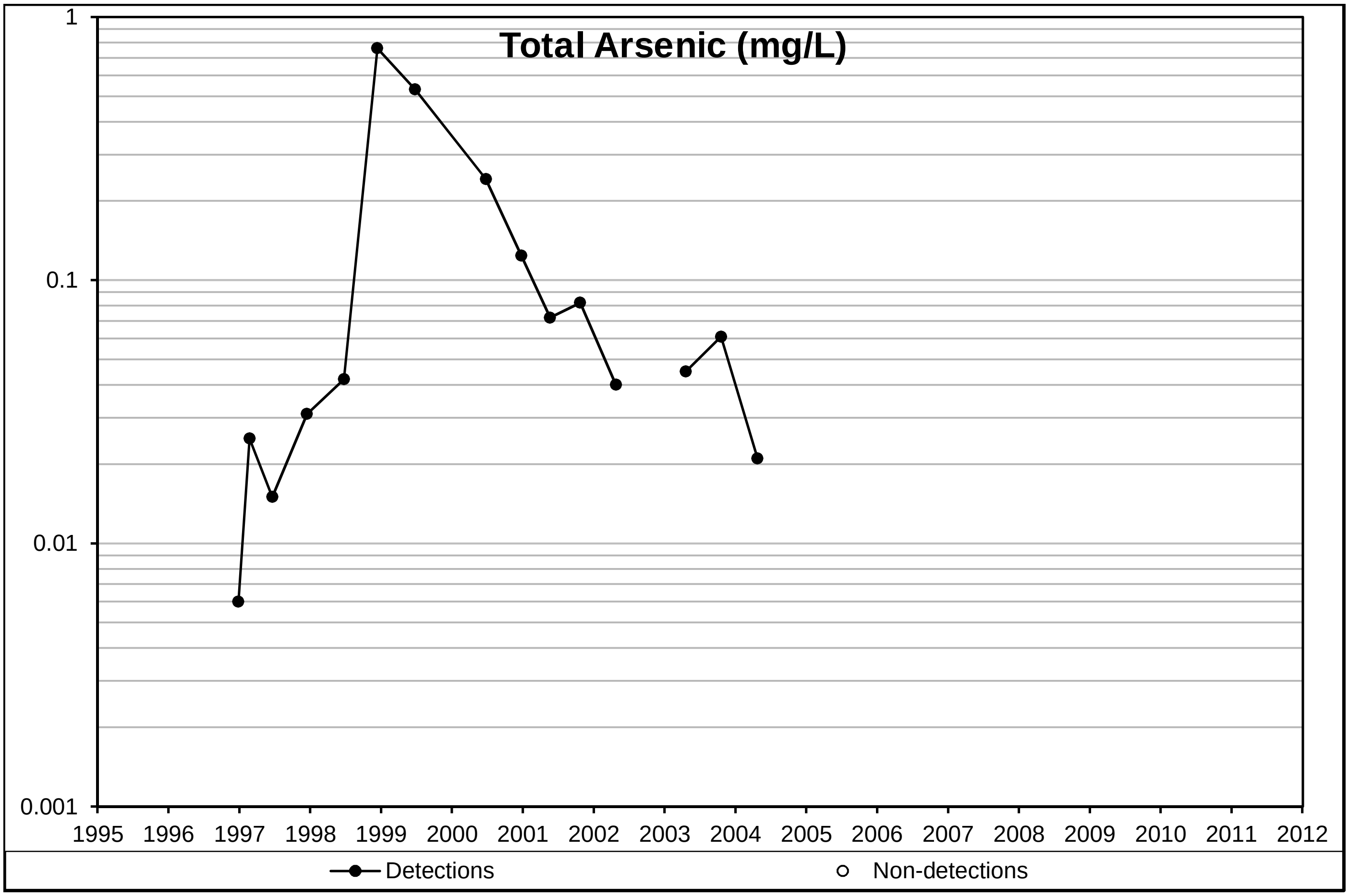
Concentration Versus Year

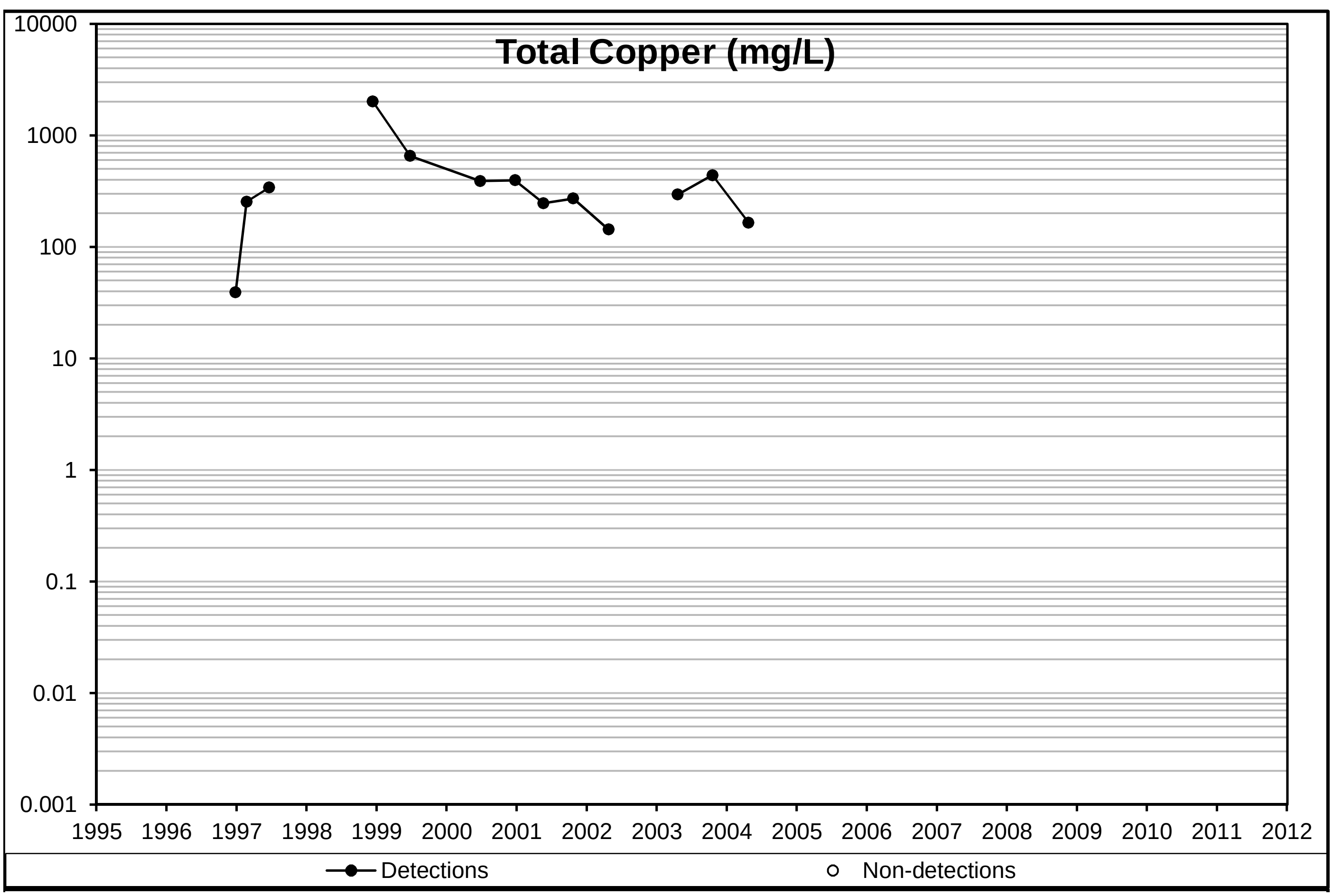




Background and standards are not shown as location represents tailing water.

Concentration Versus Year

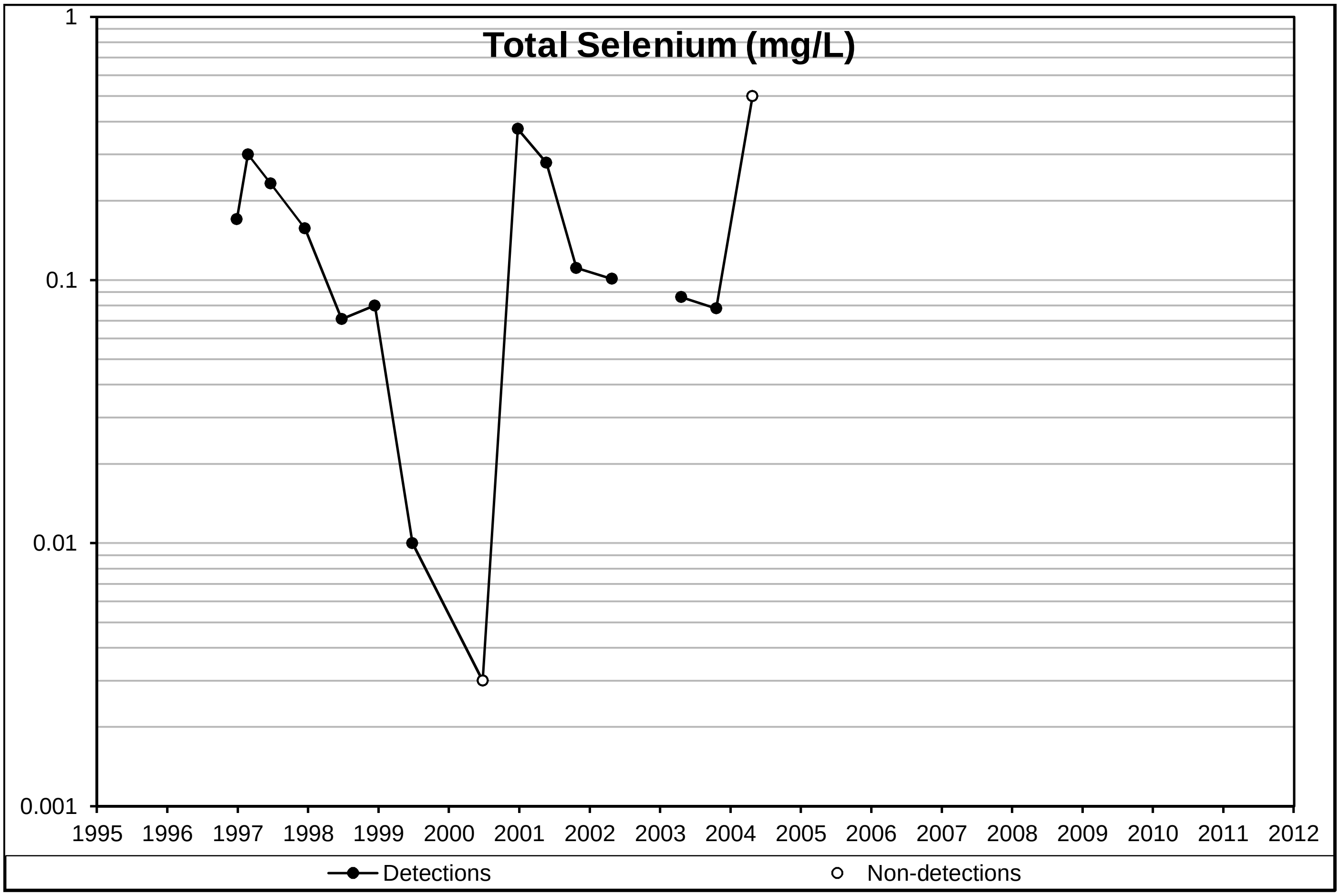


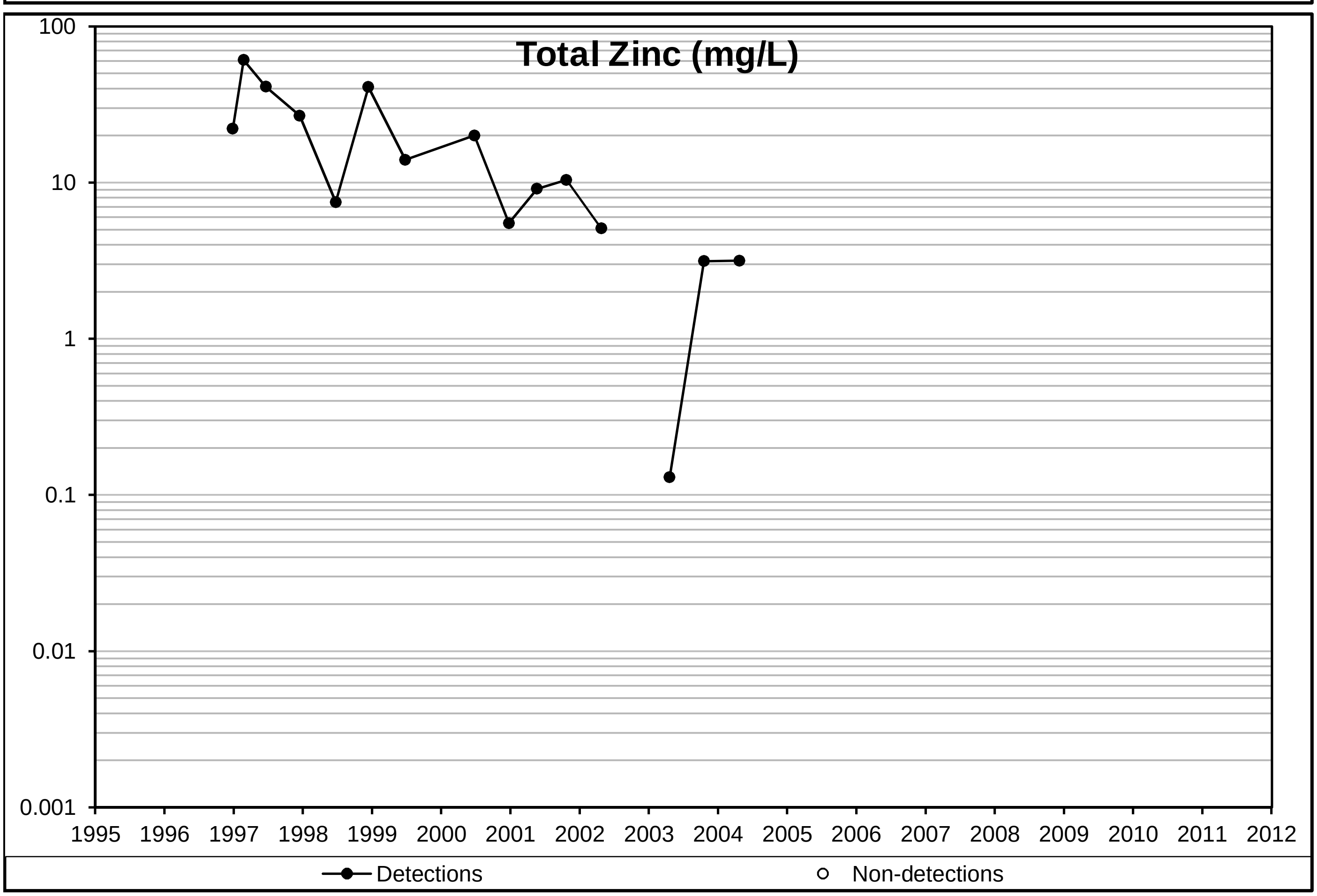


Background and standards are not shown as location represents tailing water.

TLL4134

Concentration Versus Year

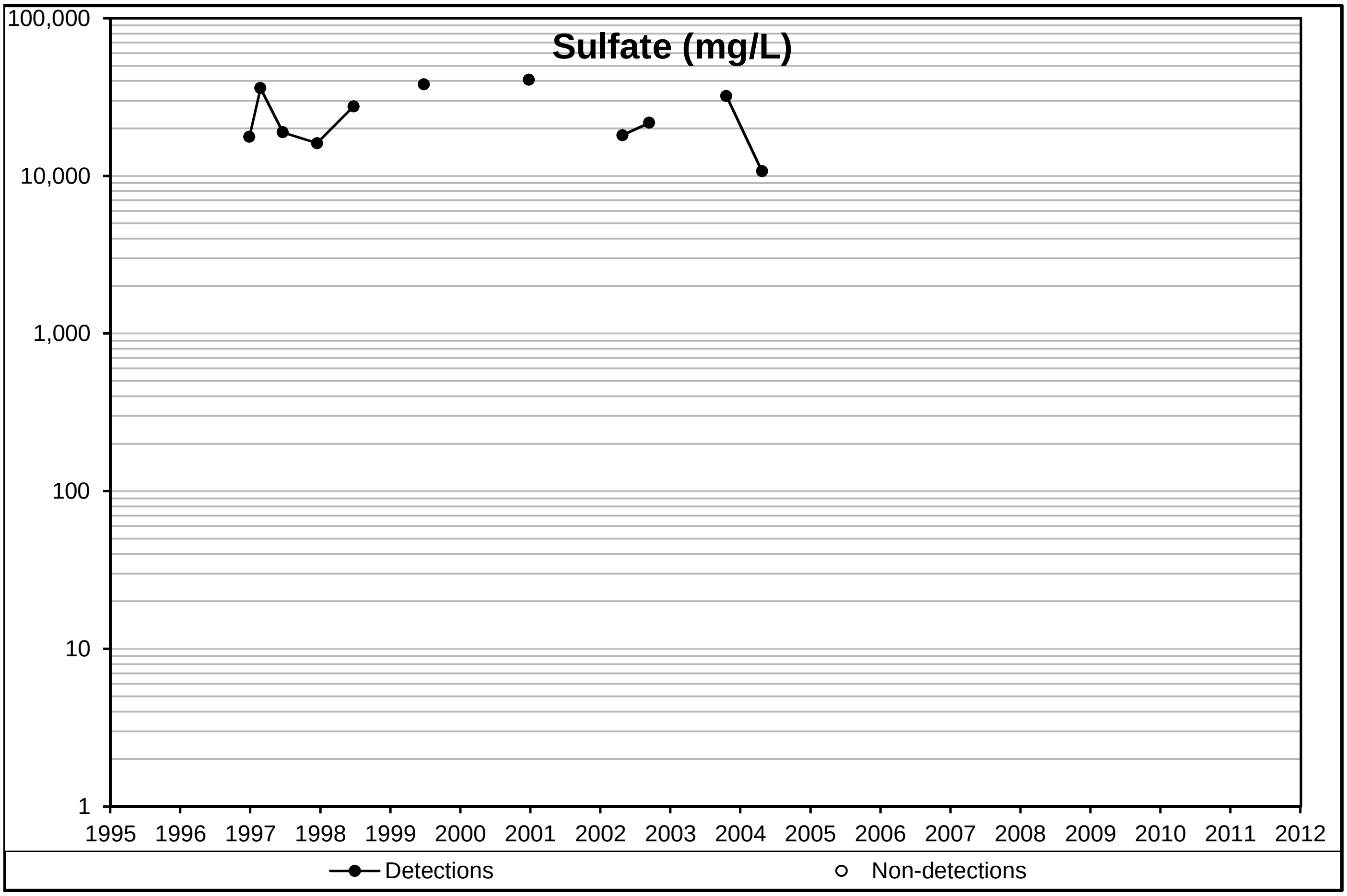


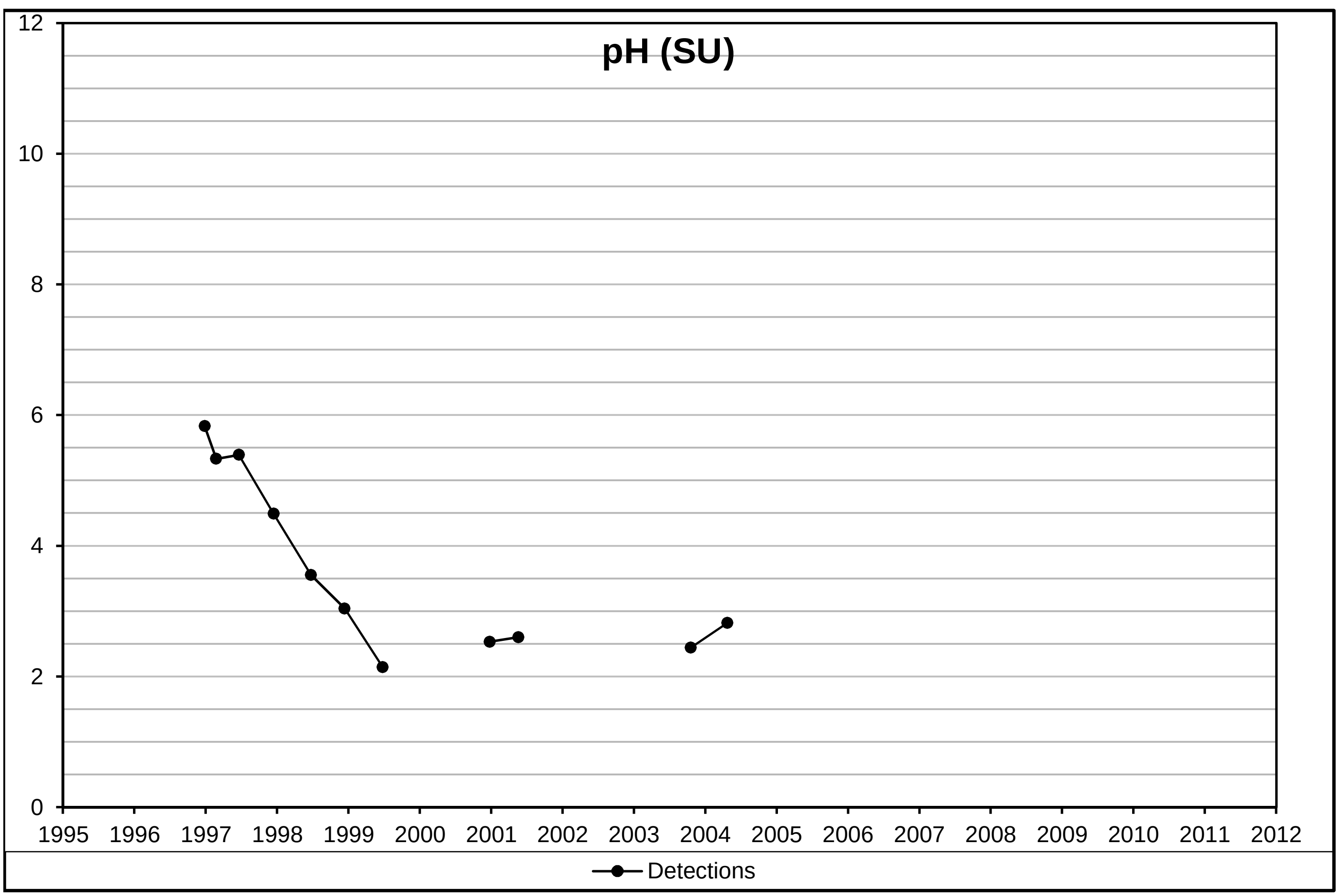


Background and standards are not shown as location represents tailing water.

TLL4134

Concentration Versus Year

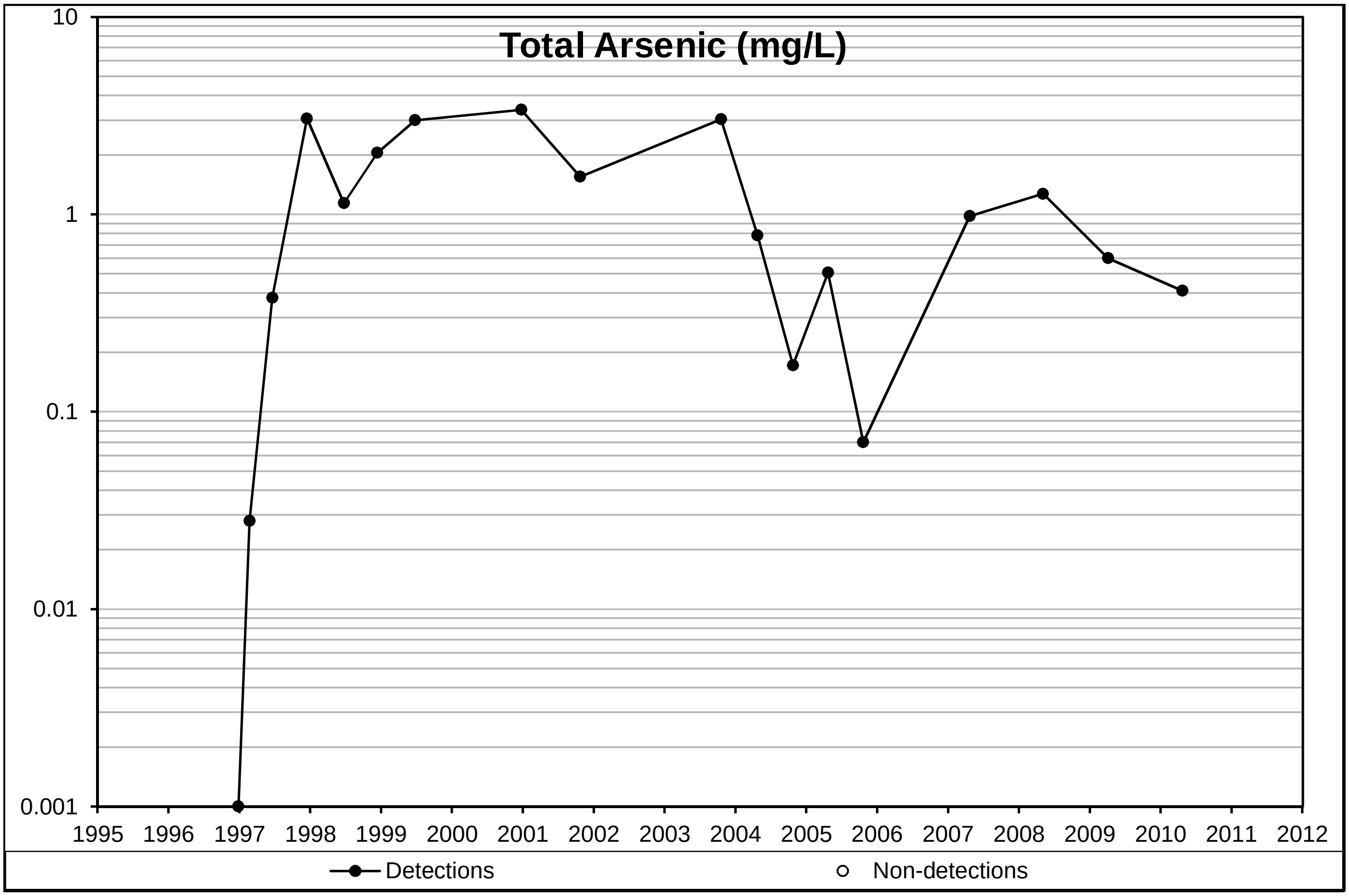


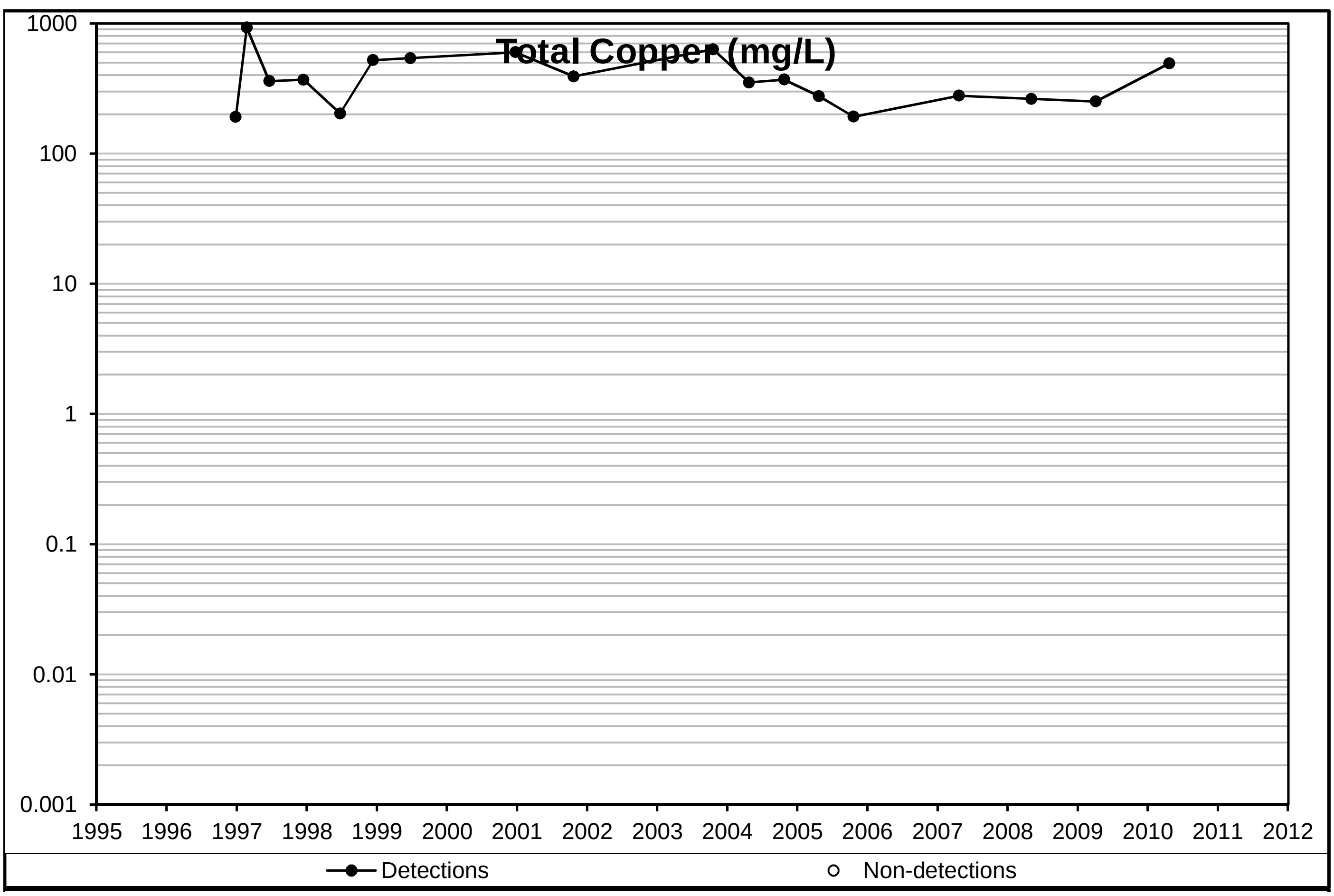


Background and standards are not shown as location represents tailing water.

TLL4135

Concentration Versus Year

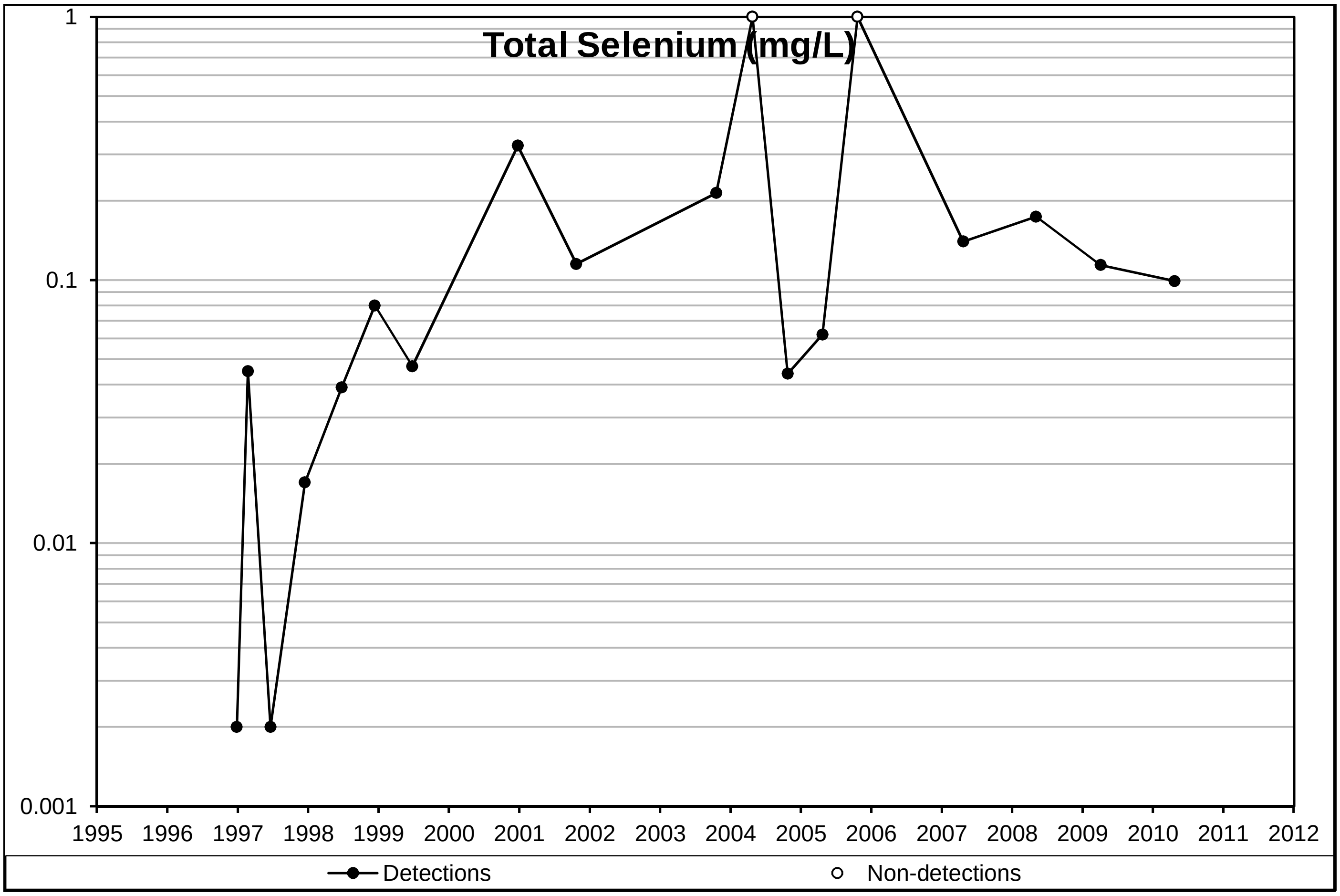


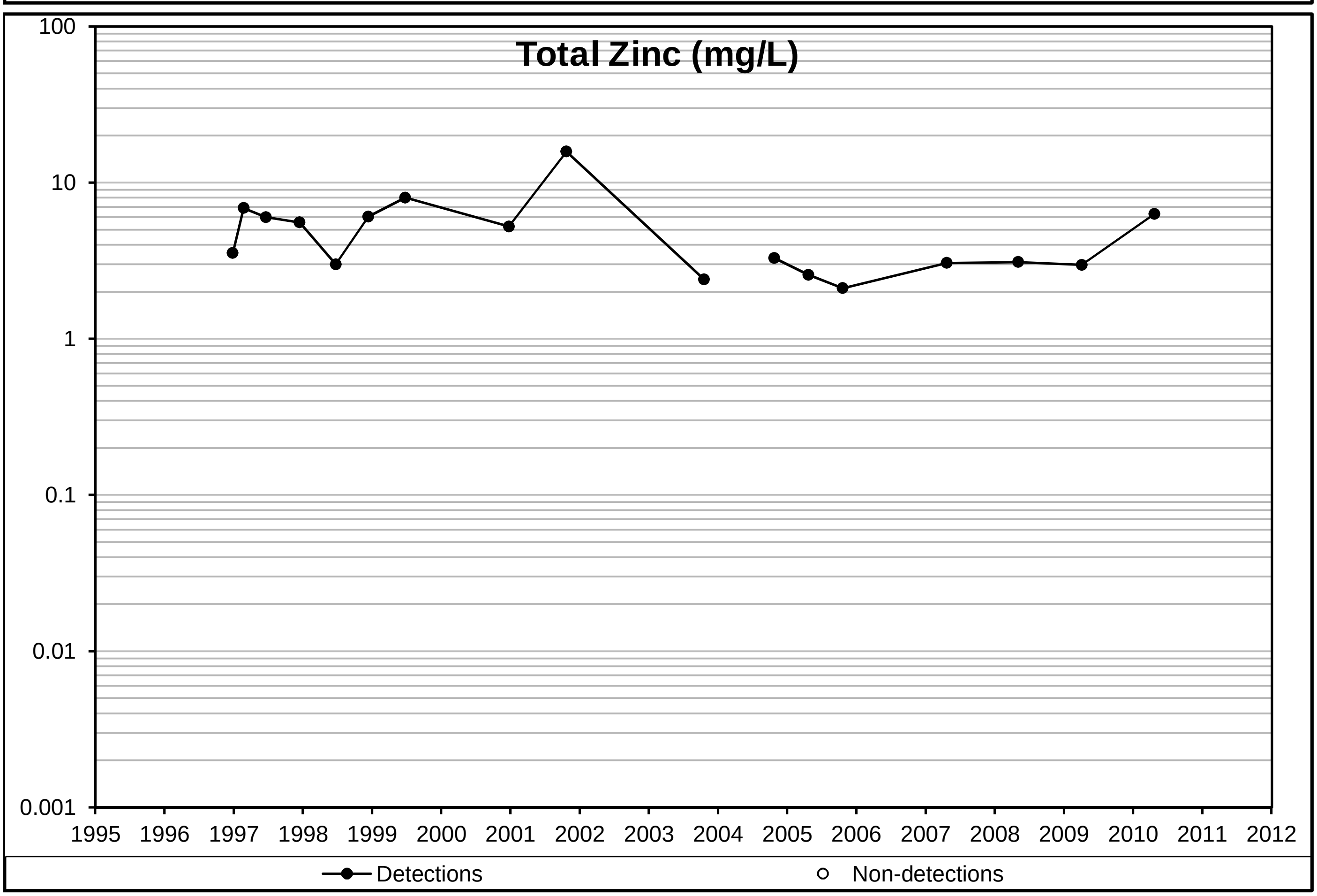


Background and standards are not shown as location represents tailing water.

TLL4135

Concentration Versus Year

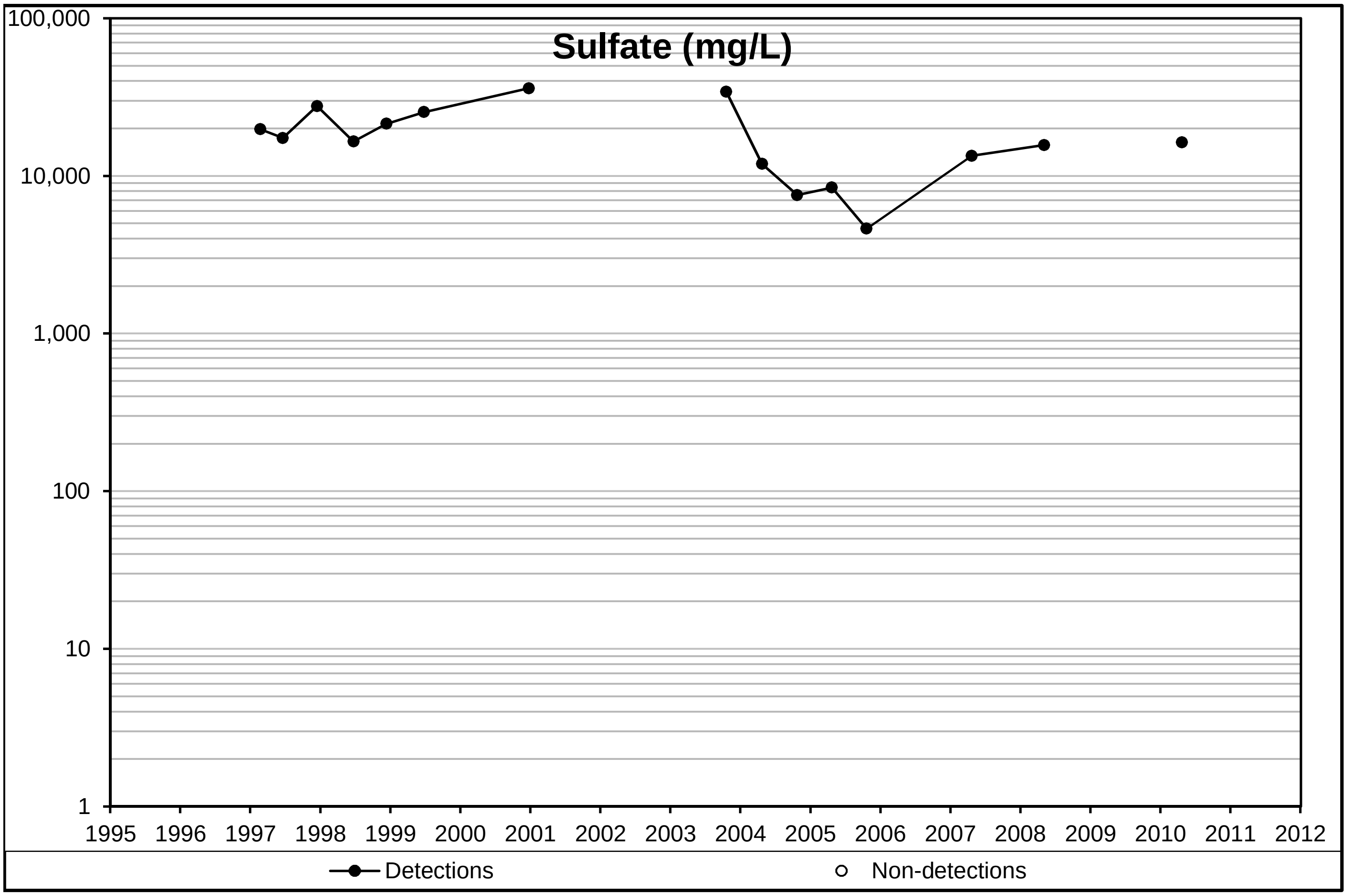


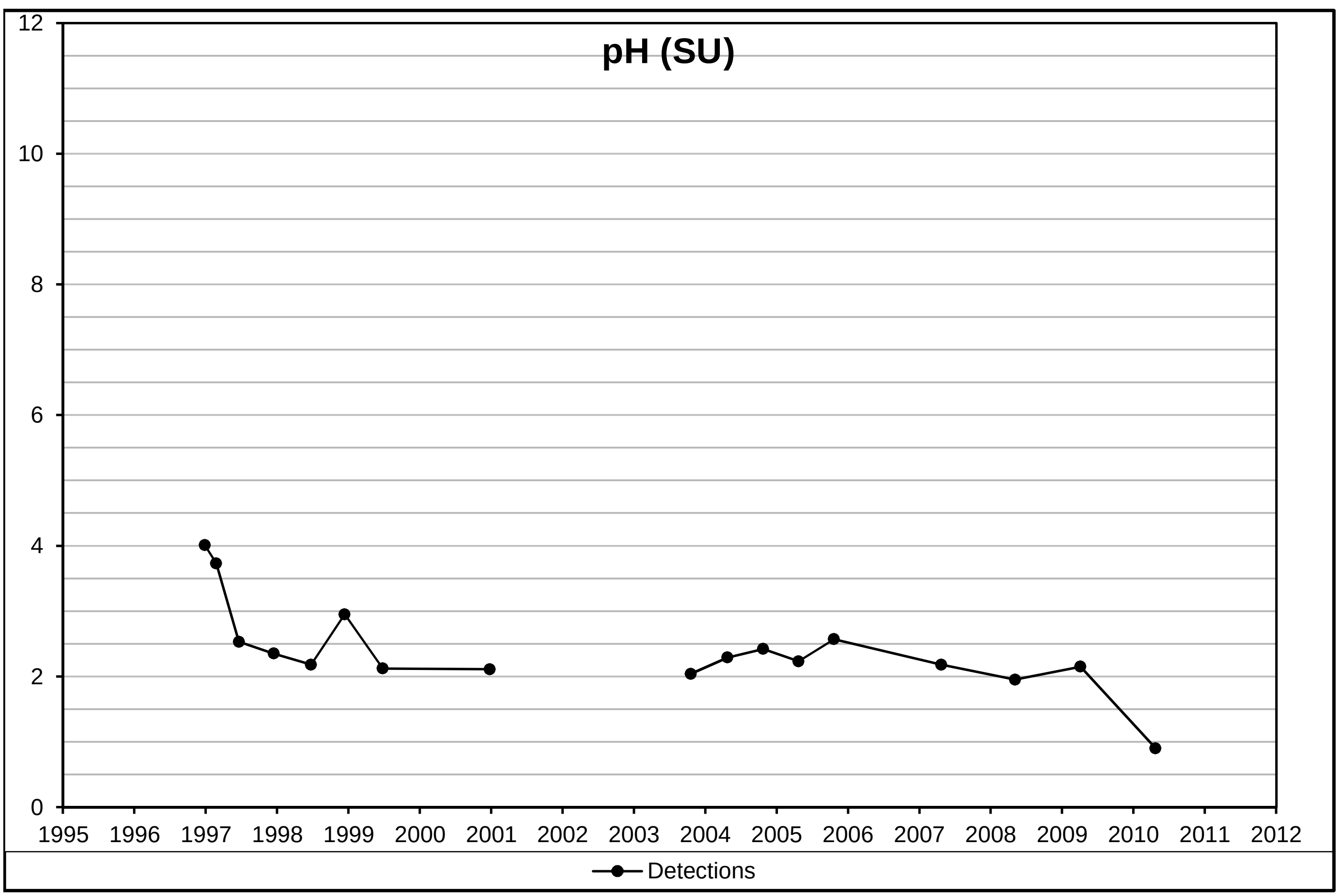


Background and standards are not shown as location represents tailing water.

TLL4135

Concentration Versus Year

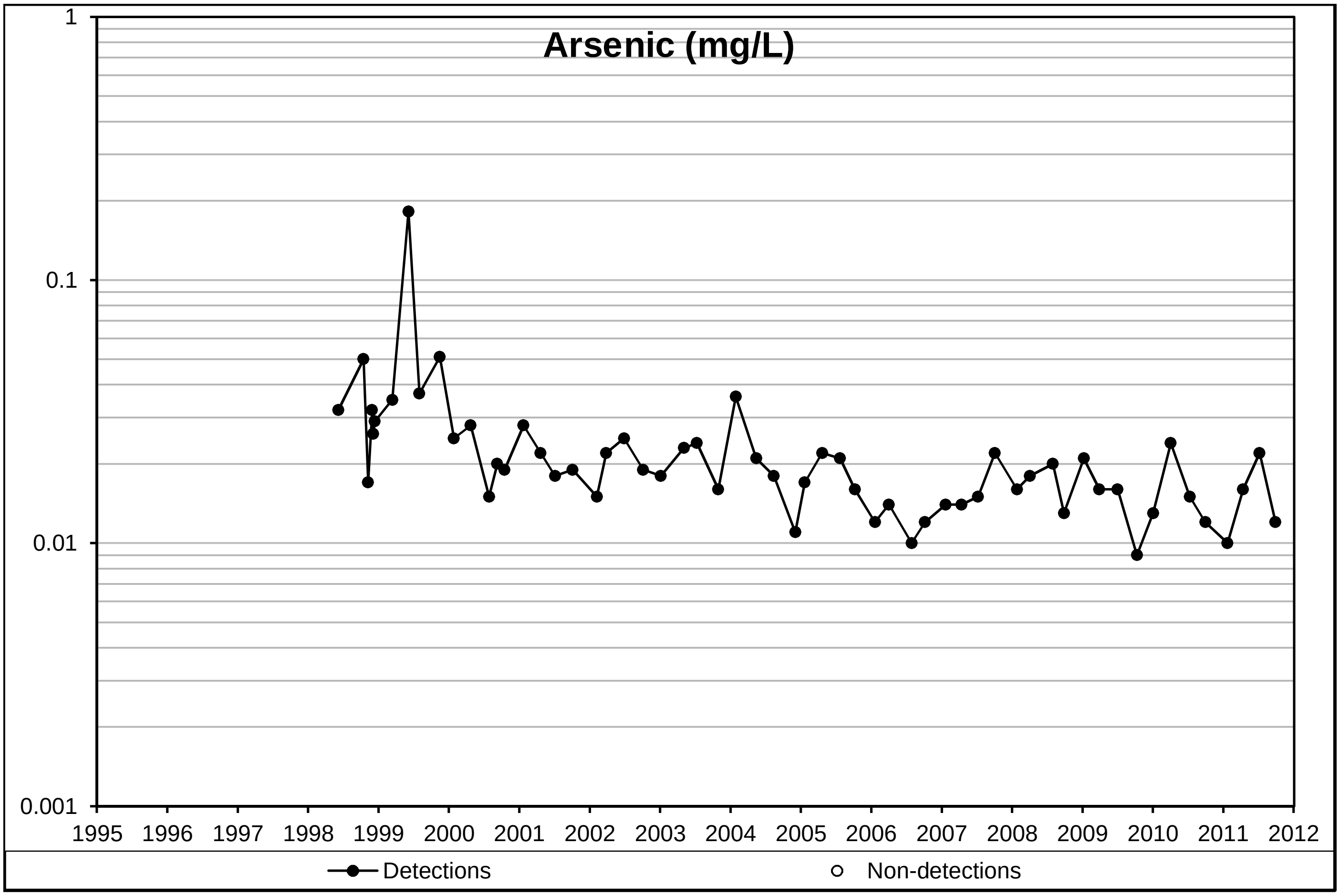


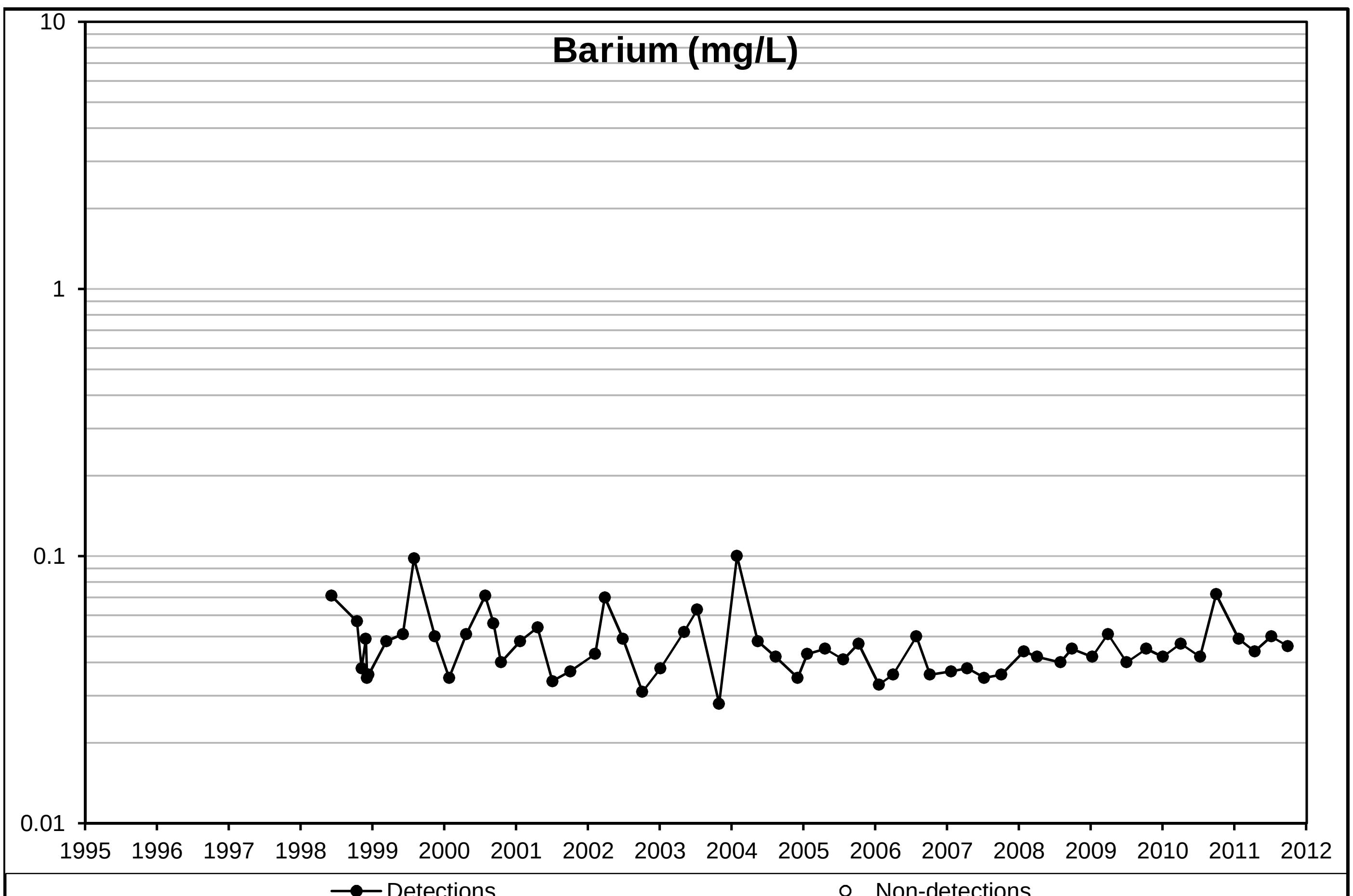


Background and standards are not shown as location represents tailing water.

TLP1436

Concentration Versus Year



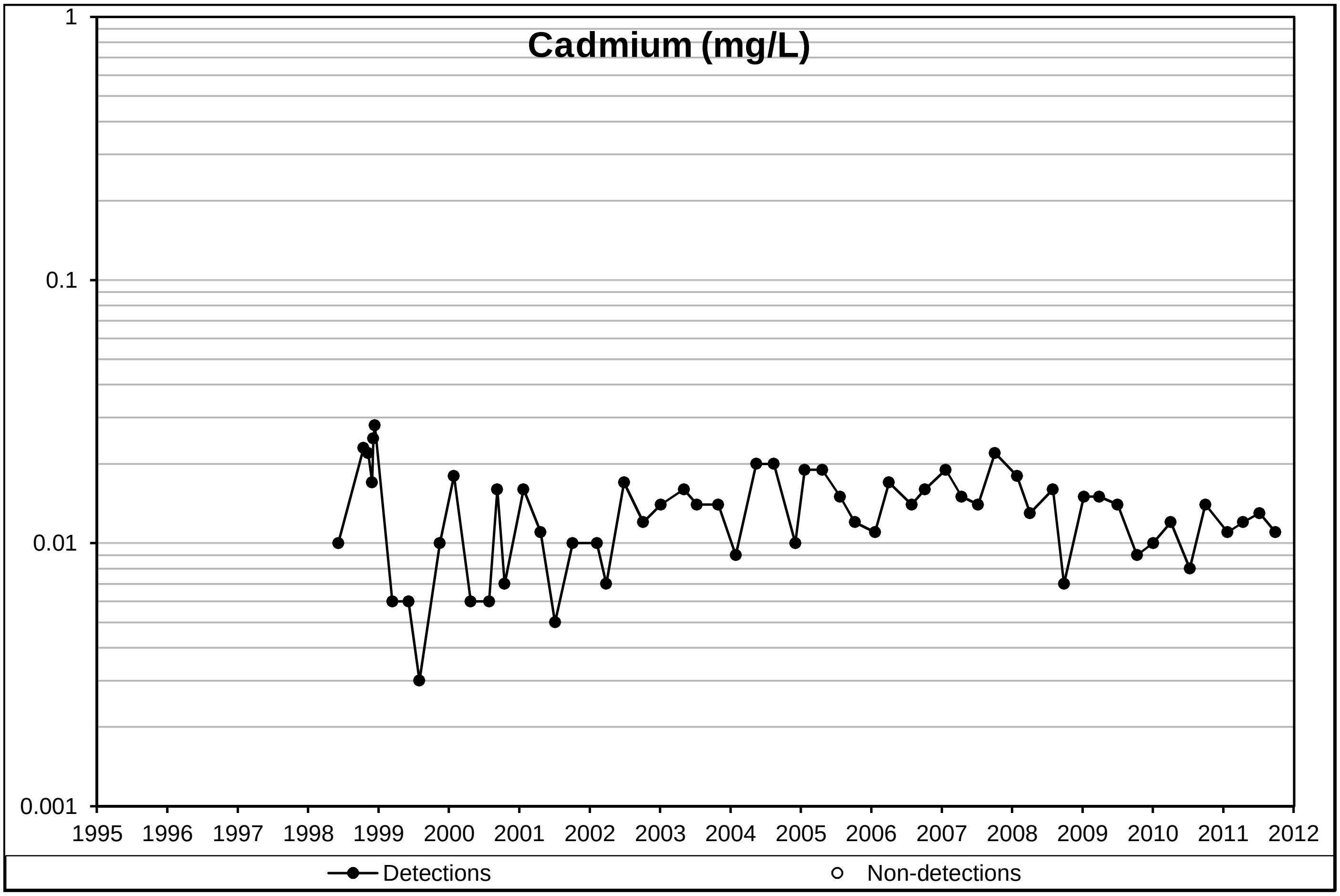


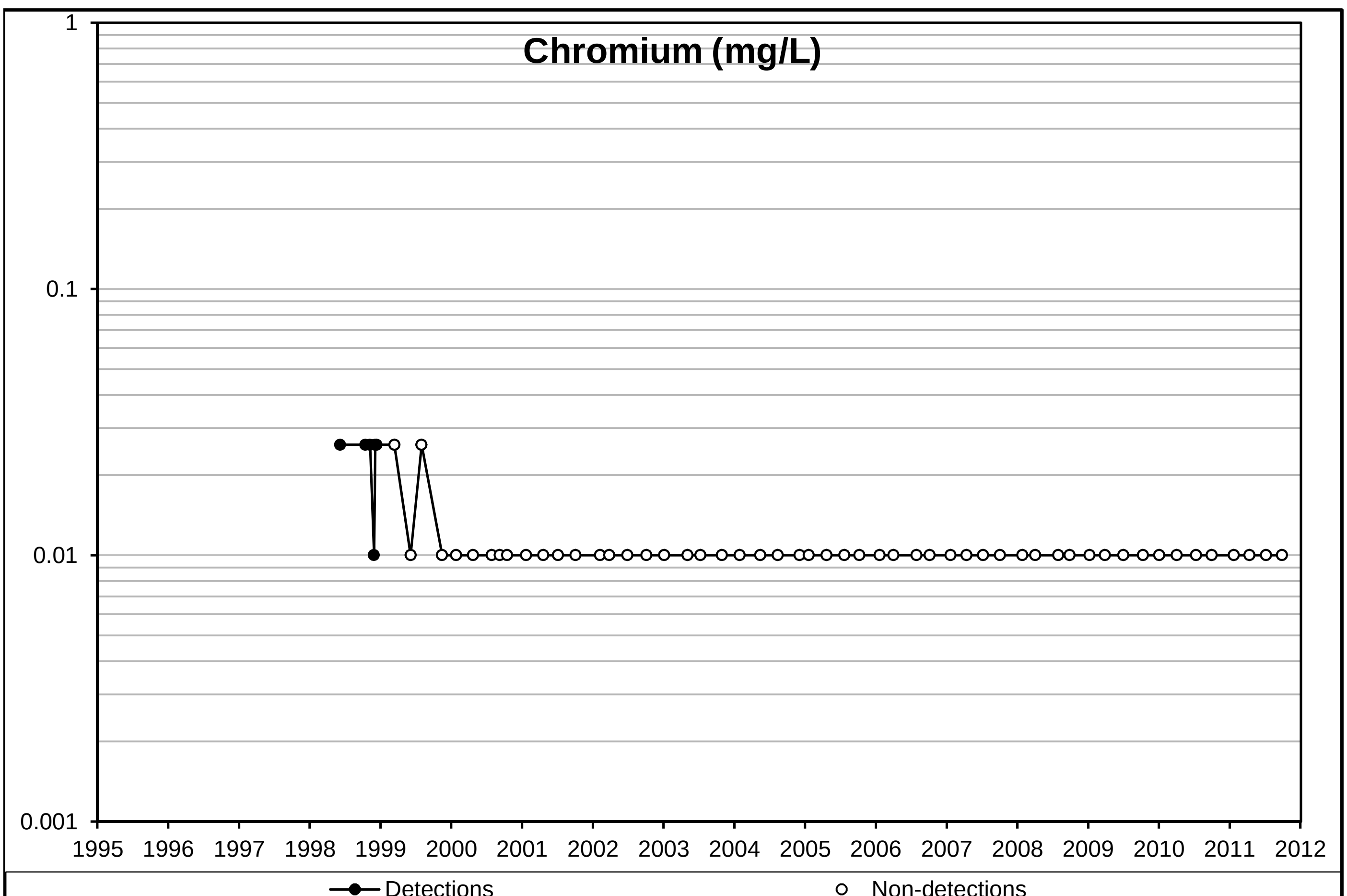
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1436

Concentration Versus Year



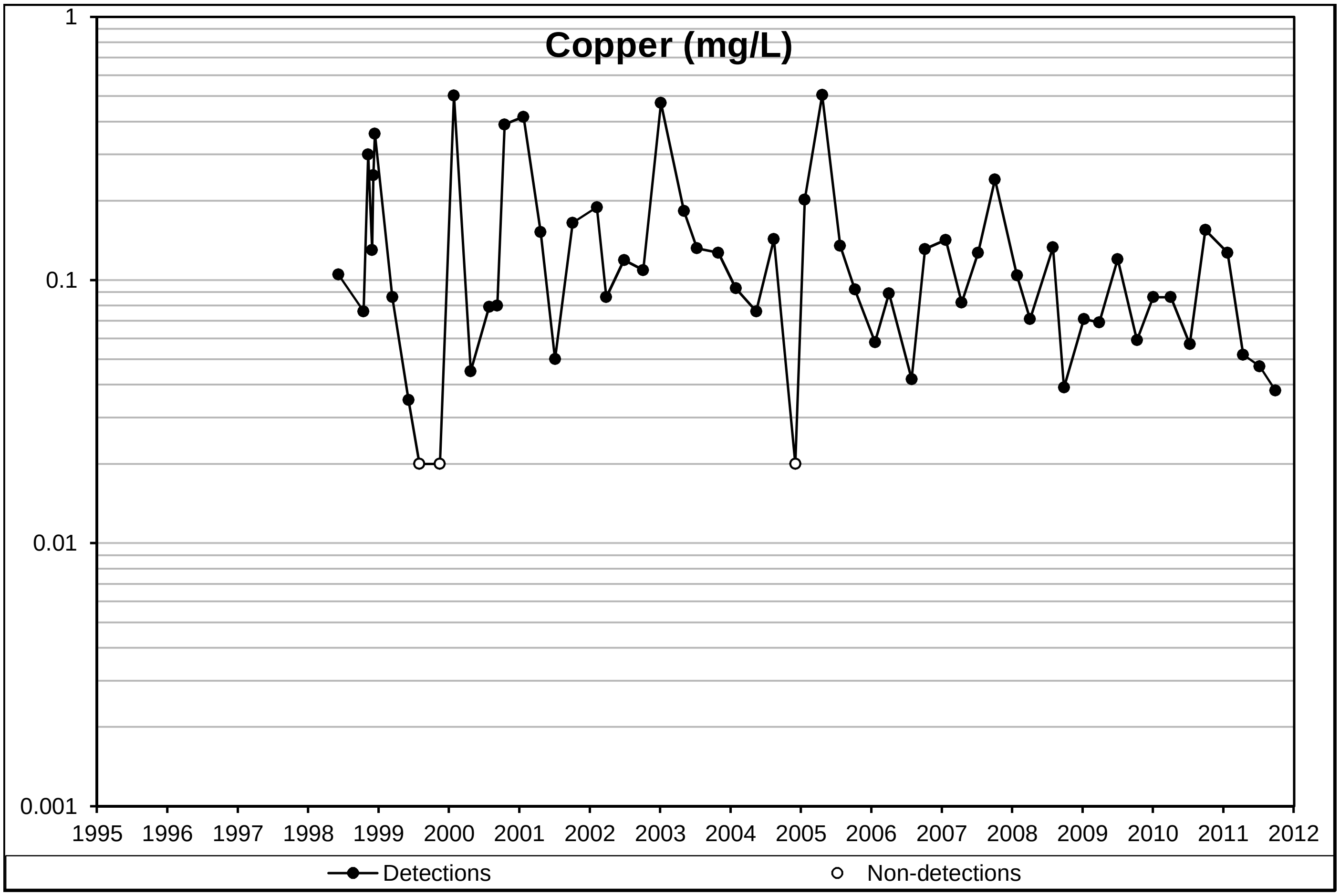


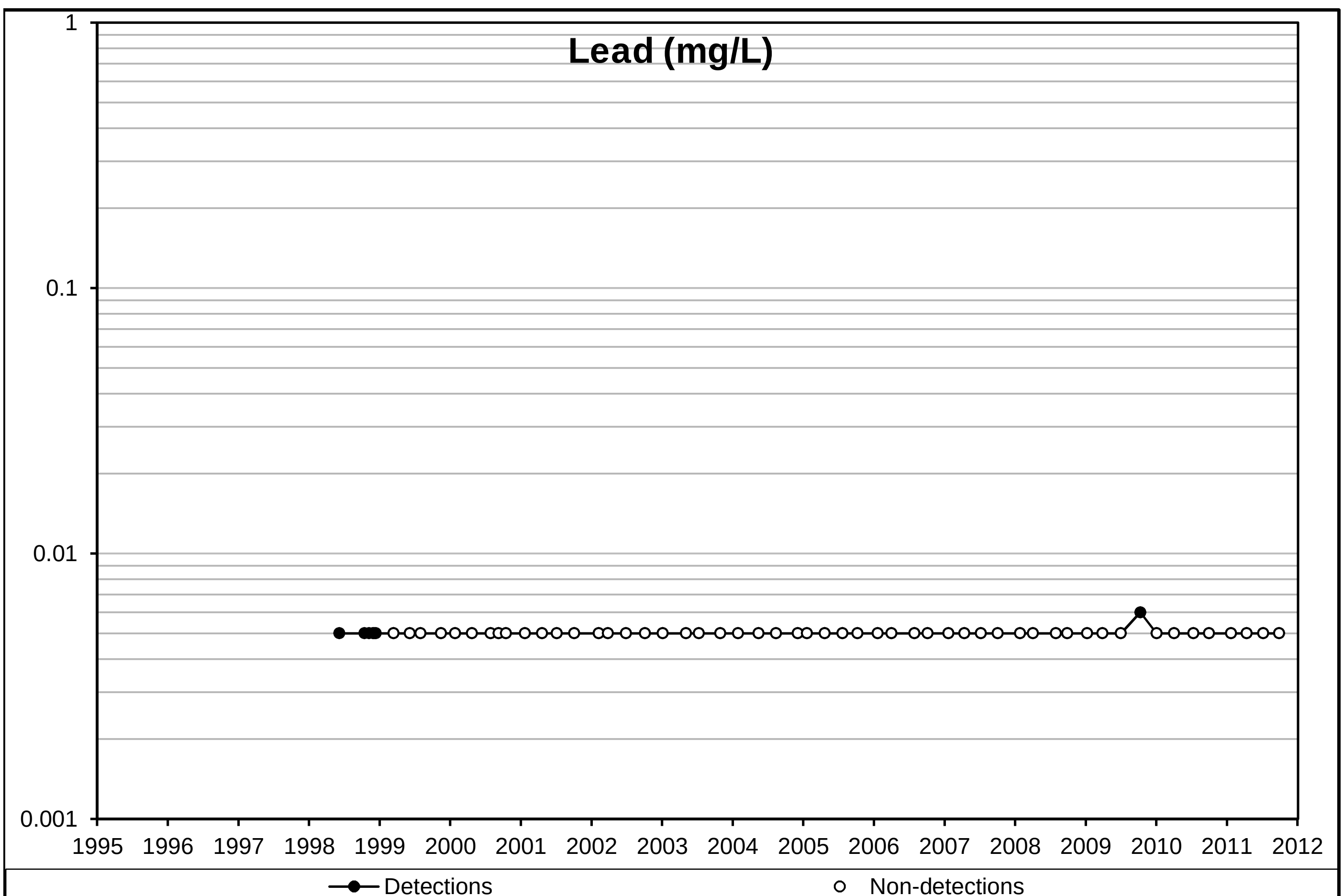
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1436

Concentration Versus Year



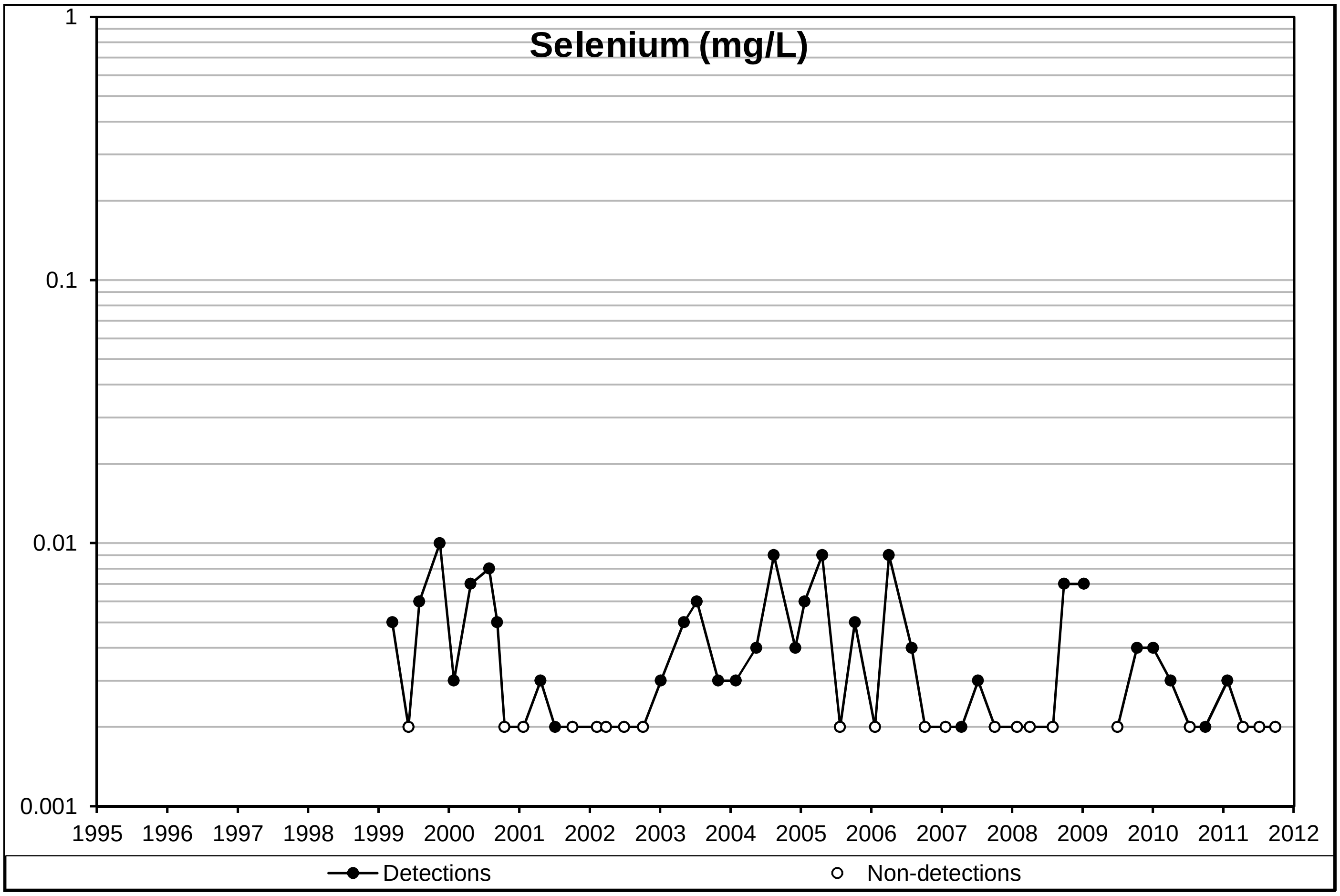


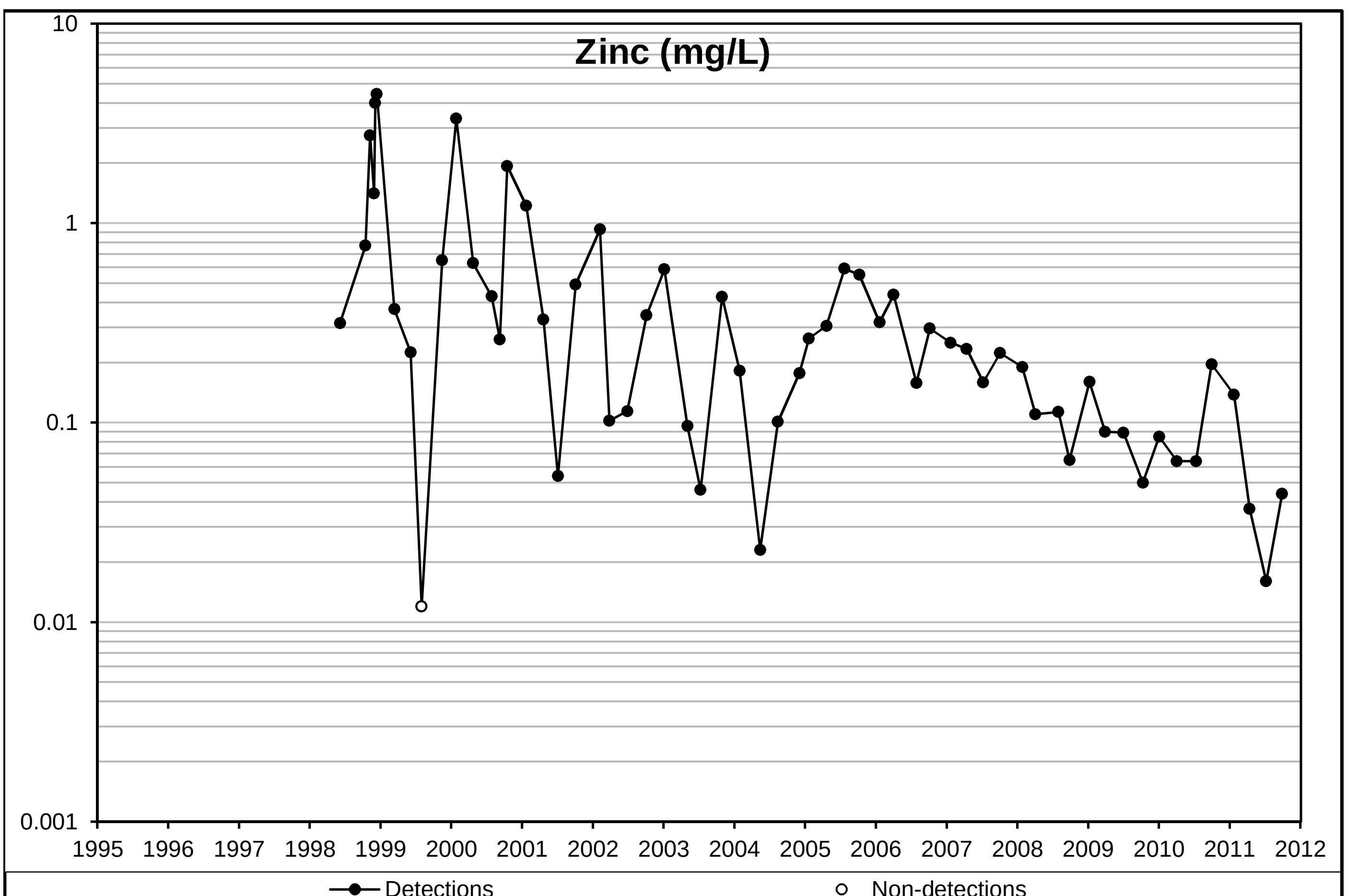
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1436

Concentration Versus Year



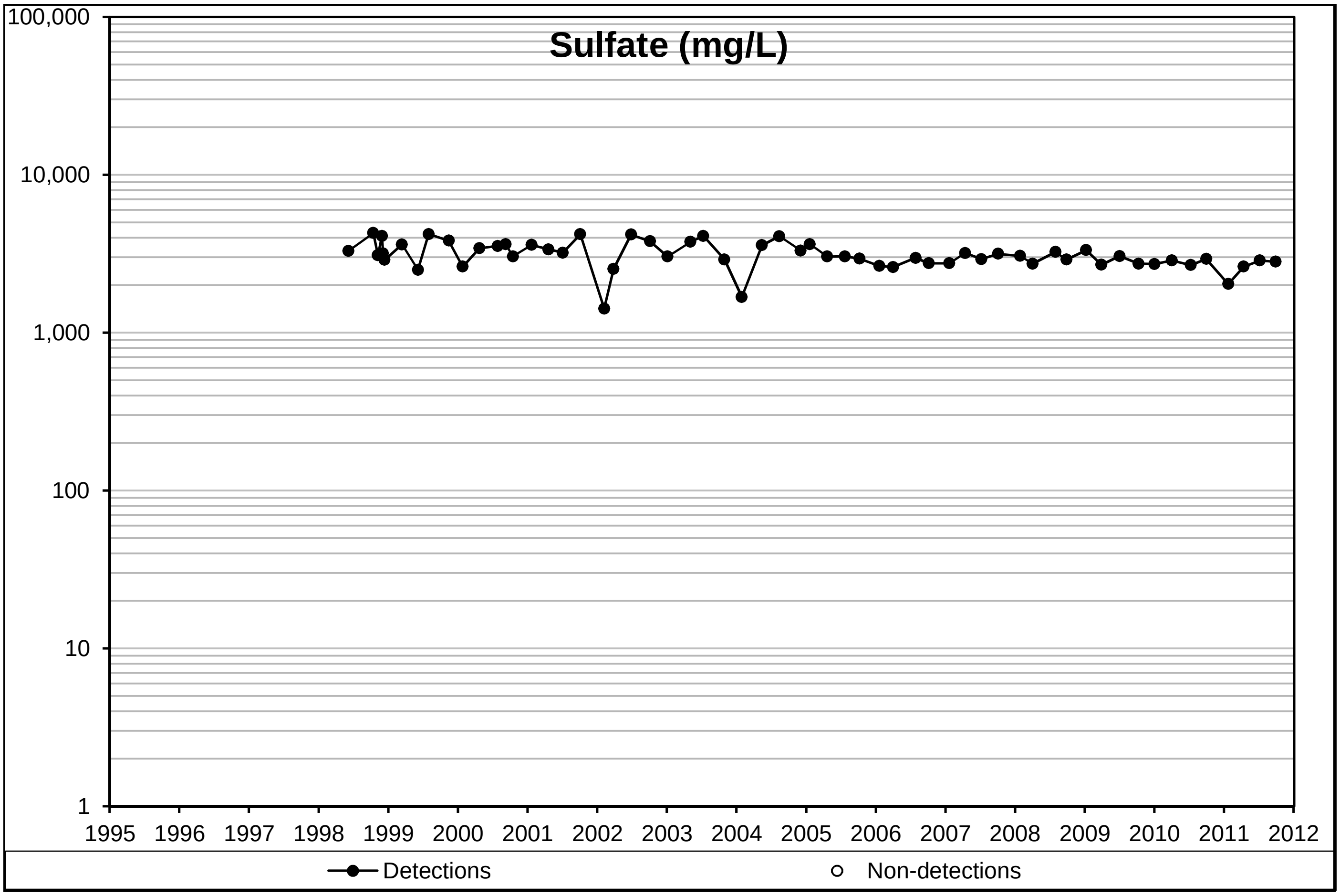


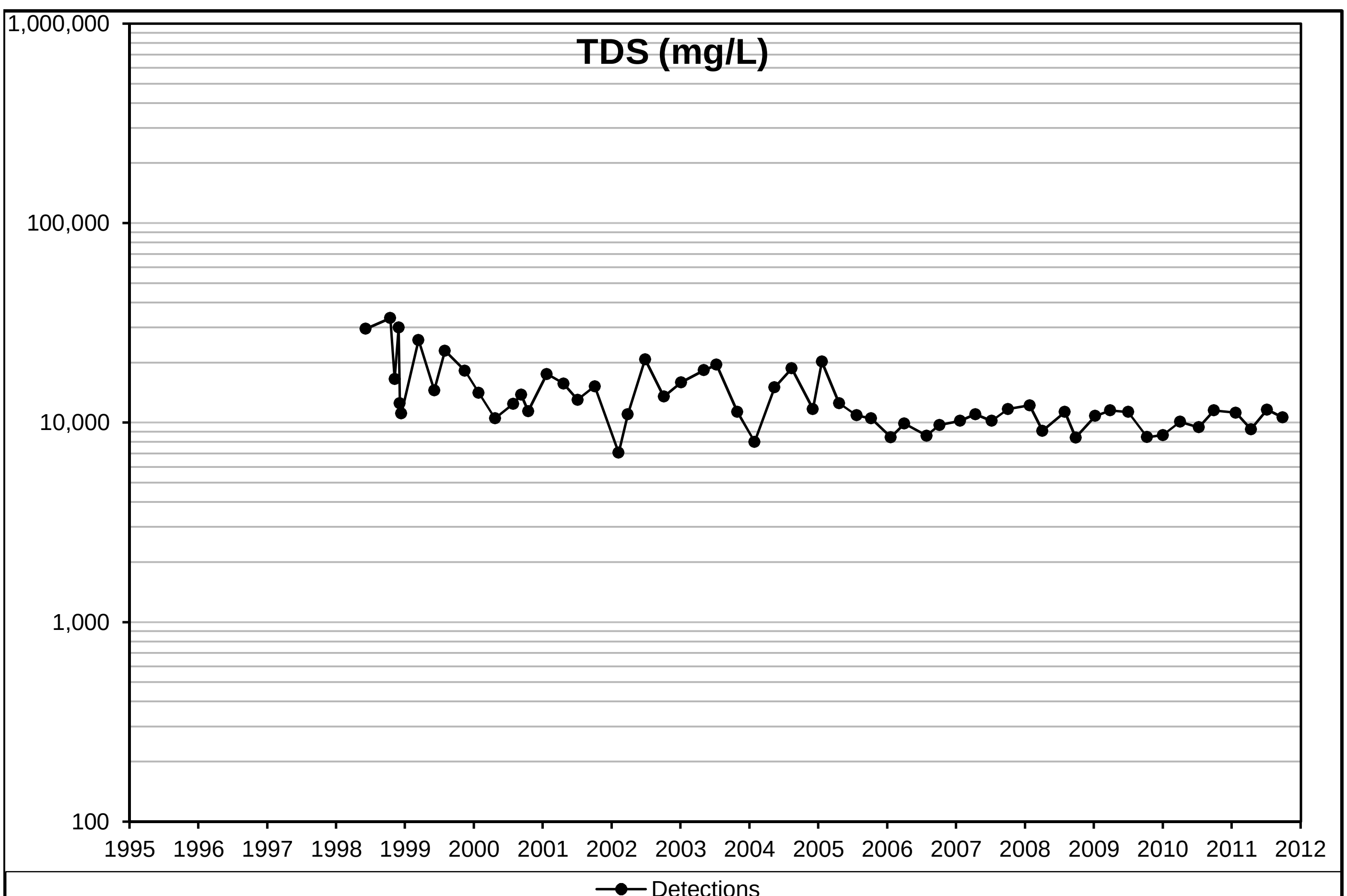
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1436

Concentration Versus Year



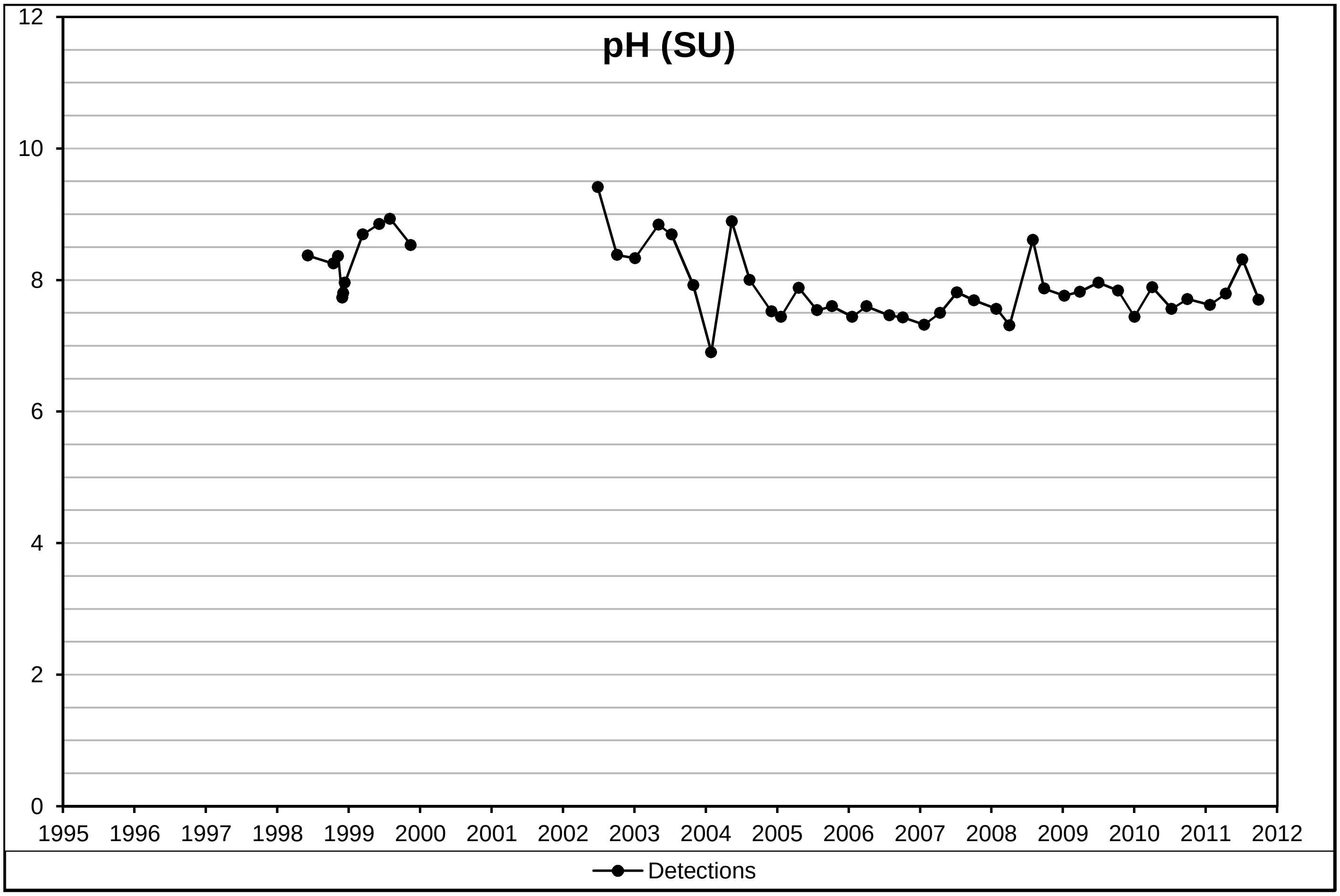


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1436

Concentration Versus Year

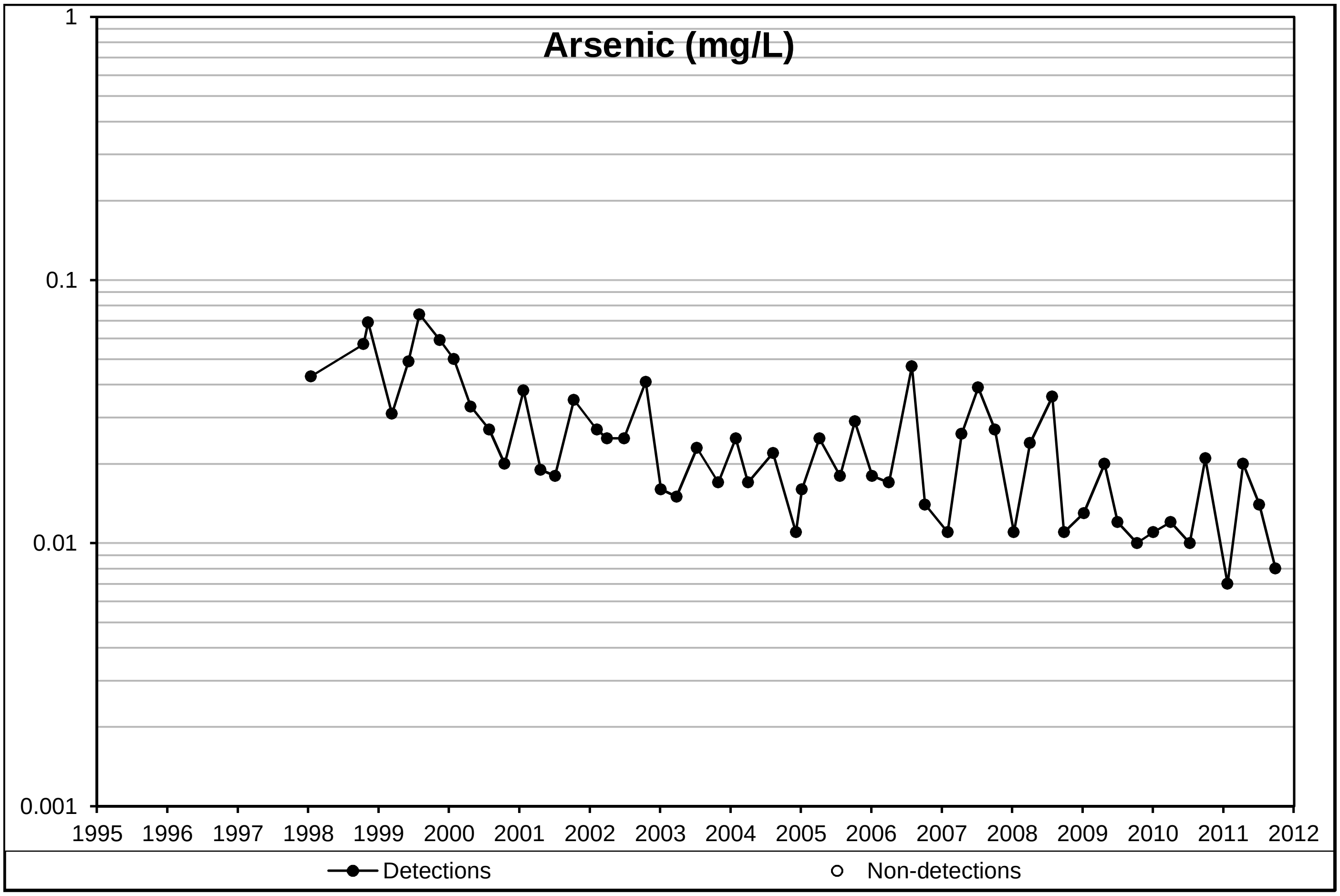


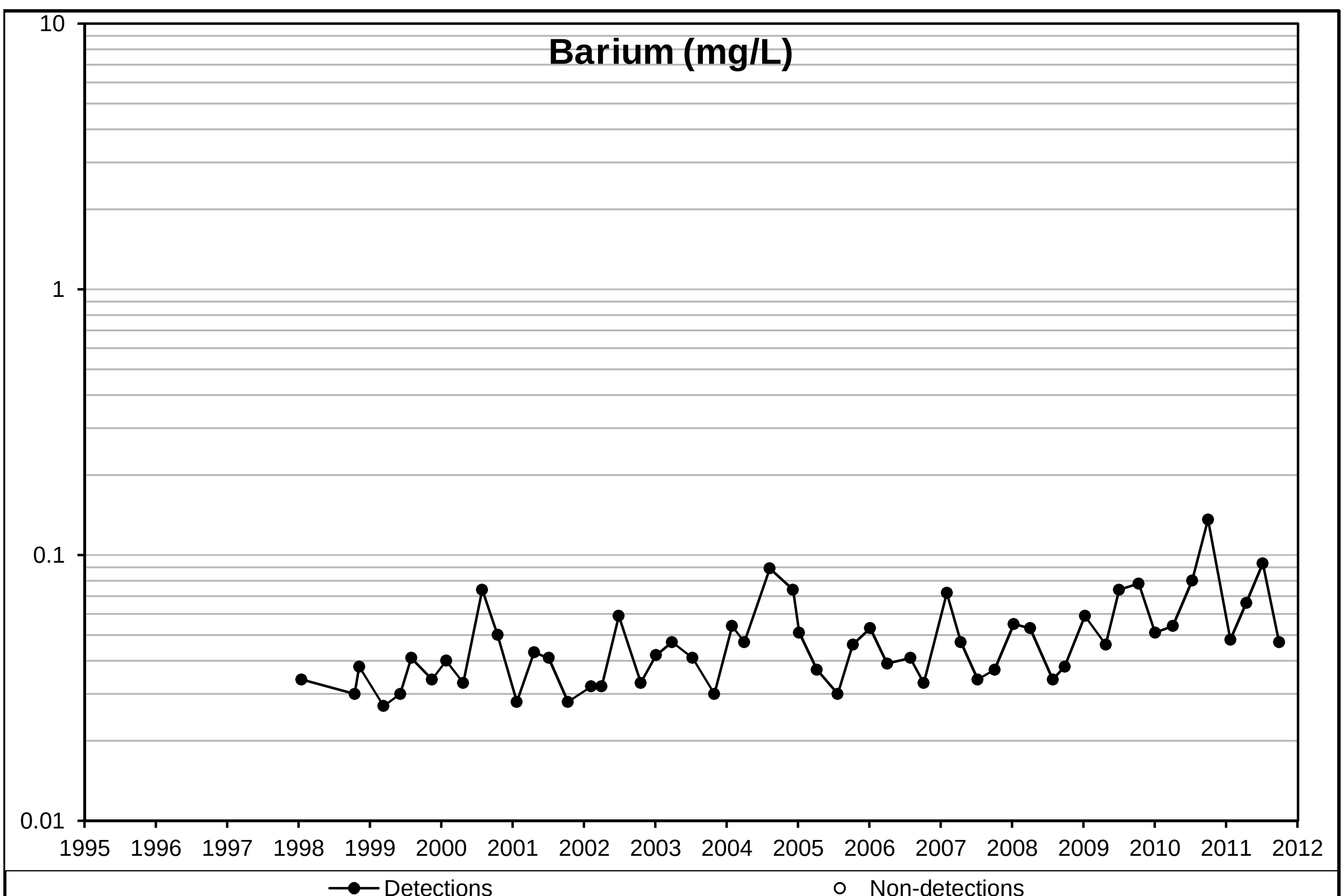
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

Concentration Versus Year



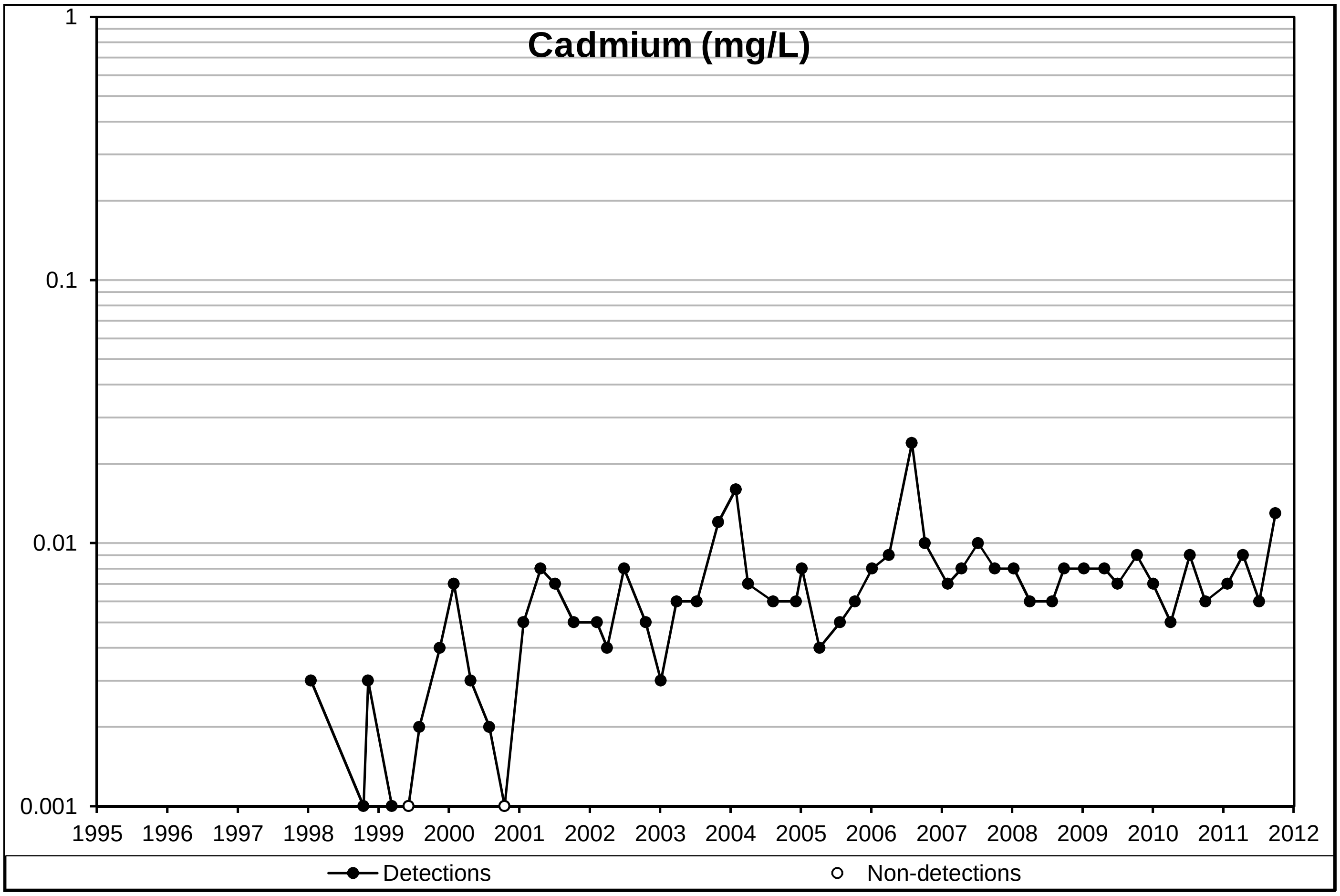


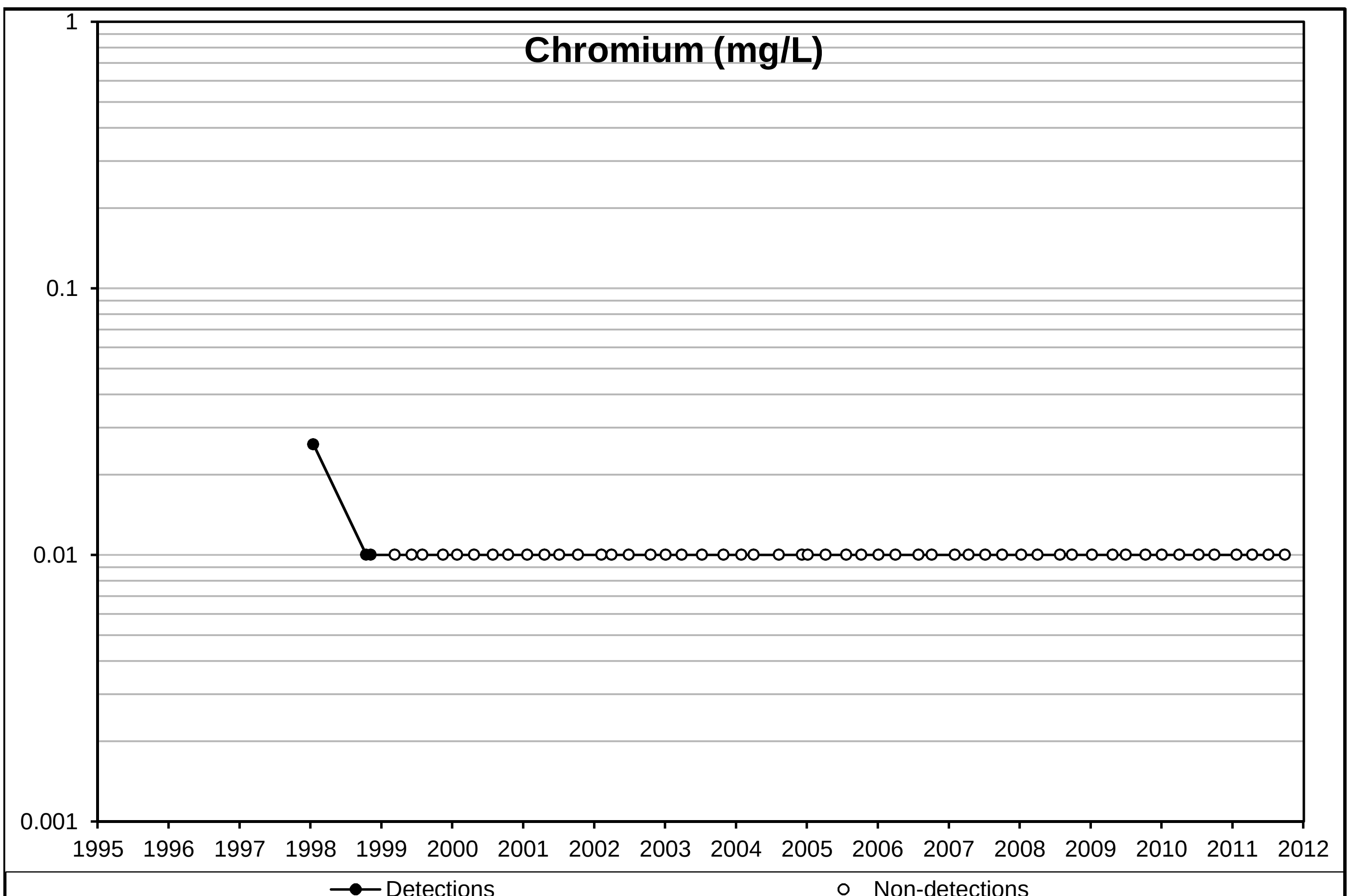
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

Concentration Versus Year



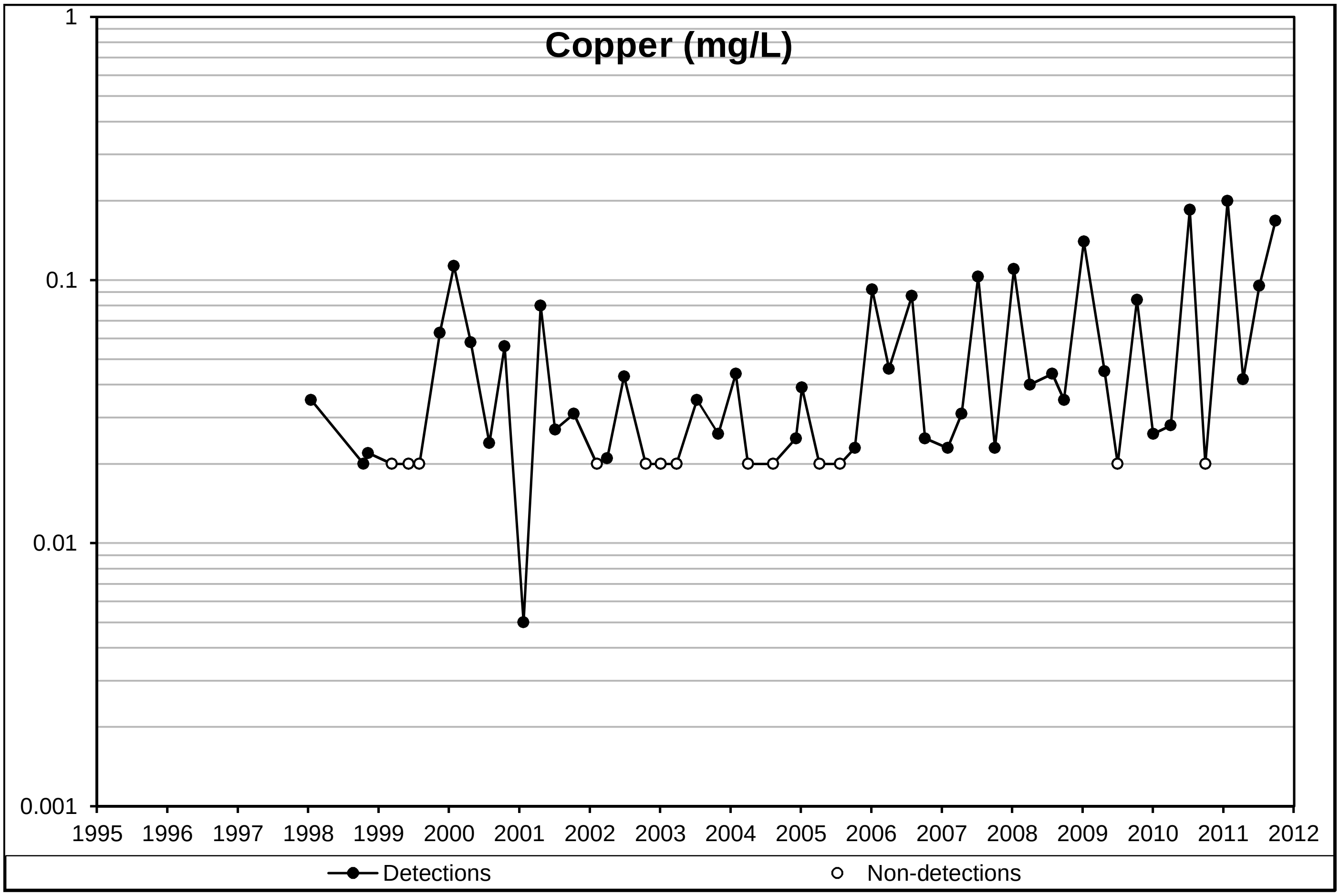


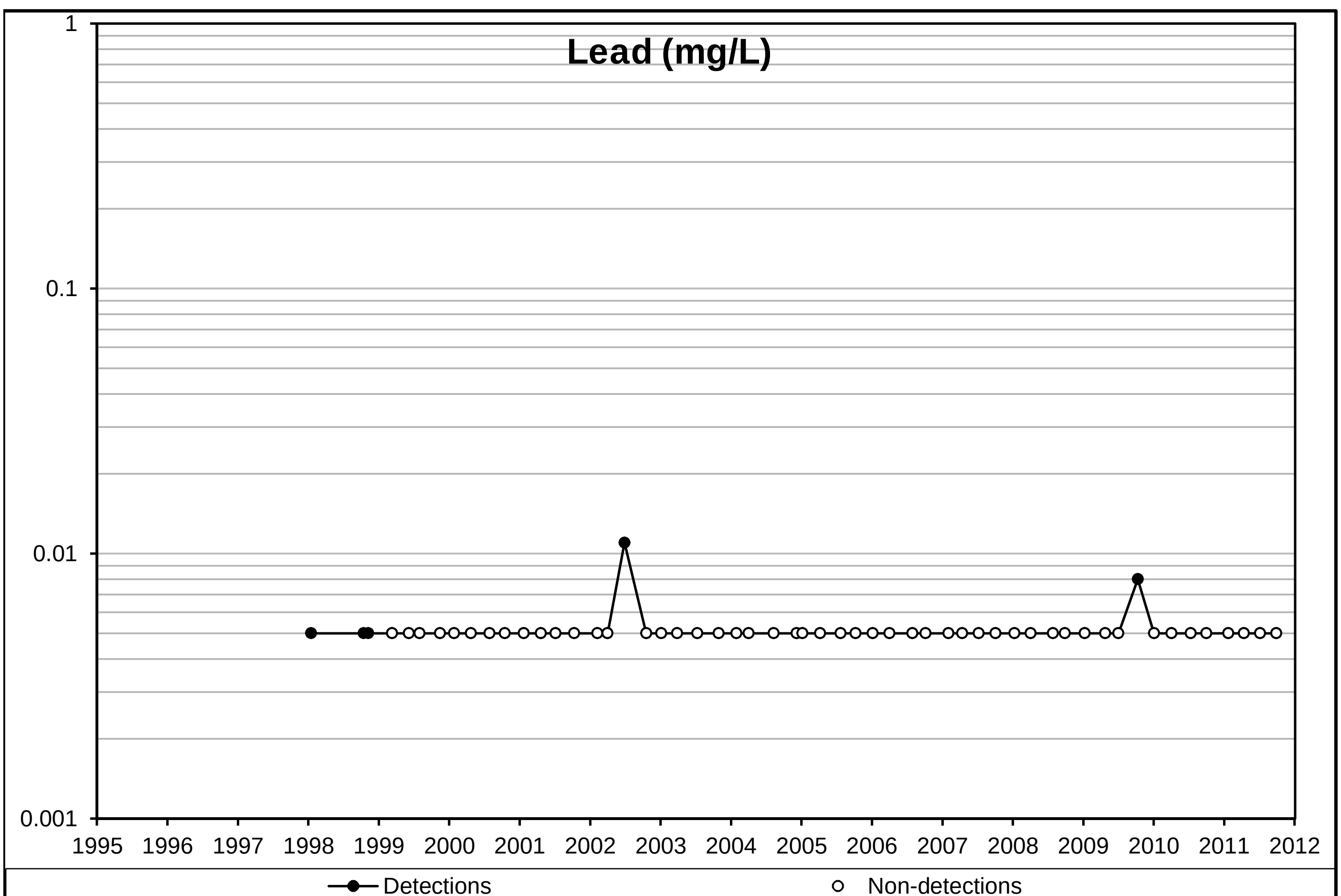
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

Concentration Versus Year



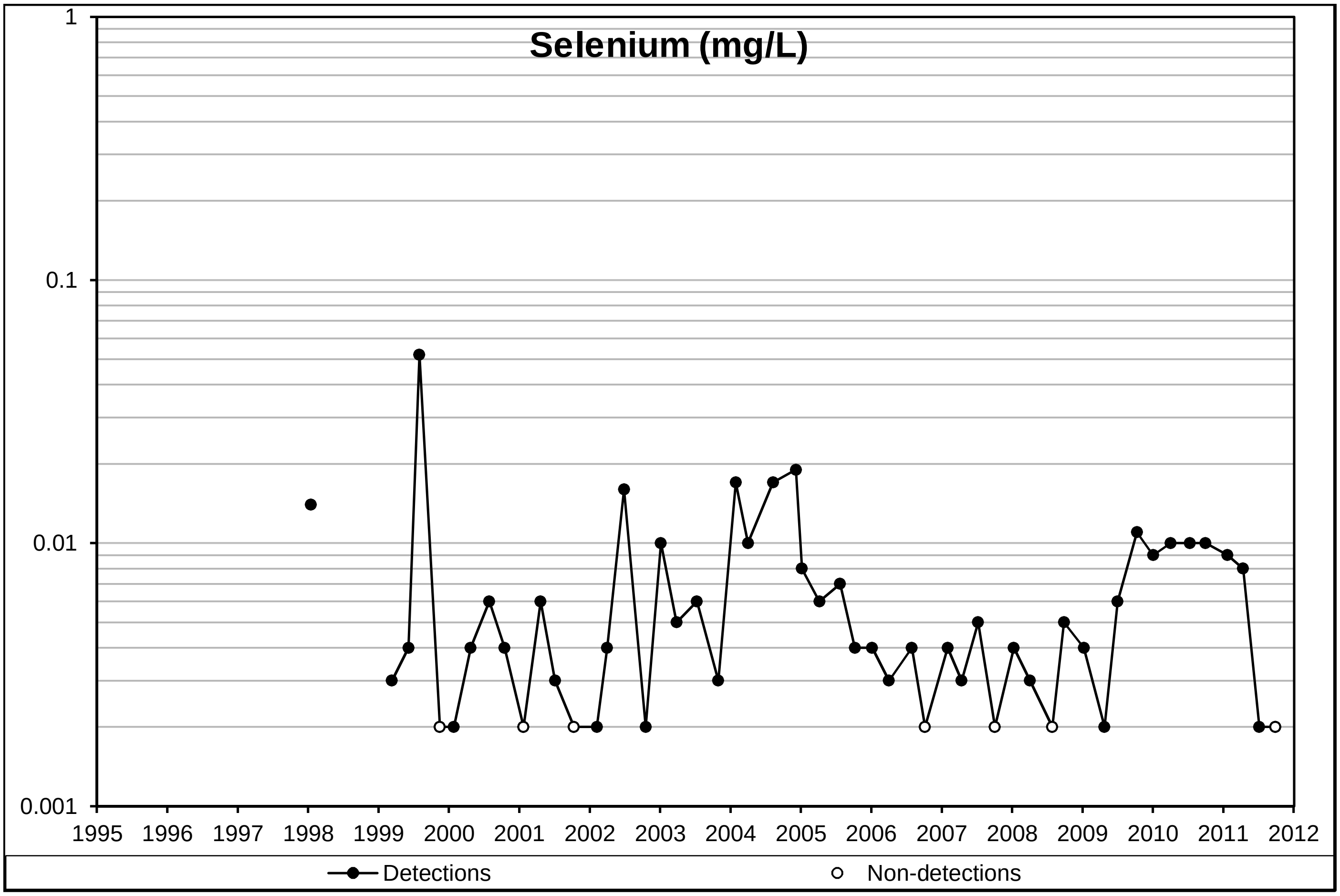


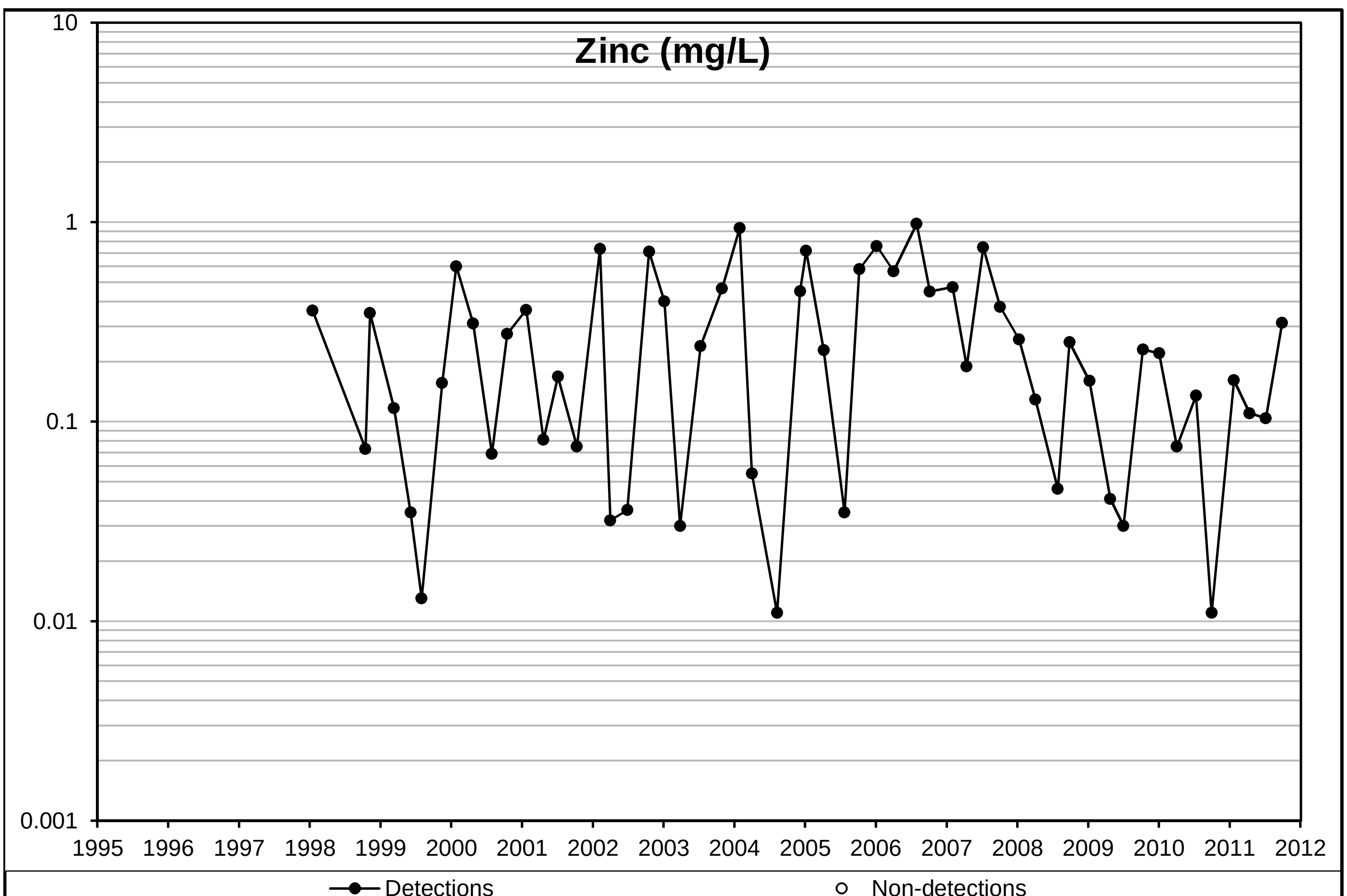
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

Concentration Versus Year



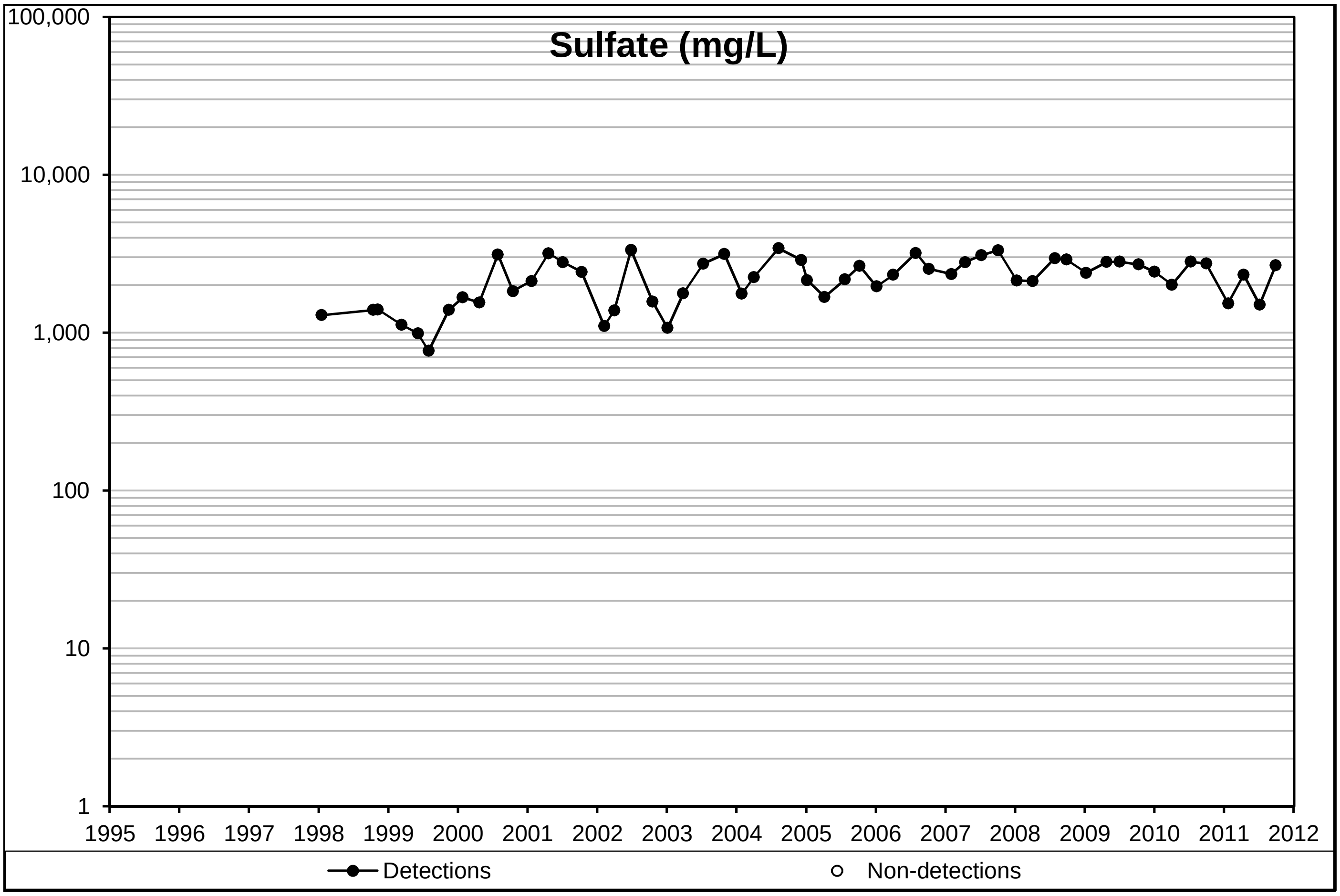


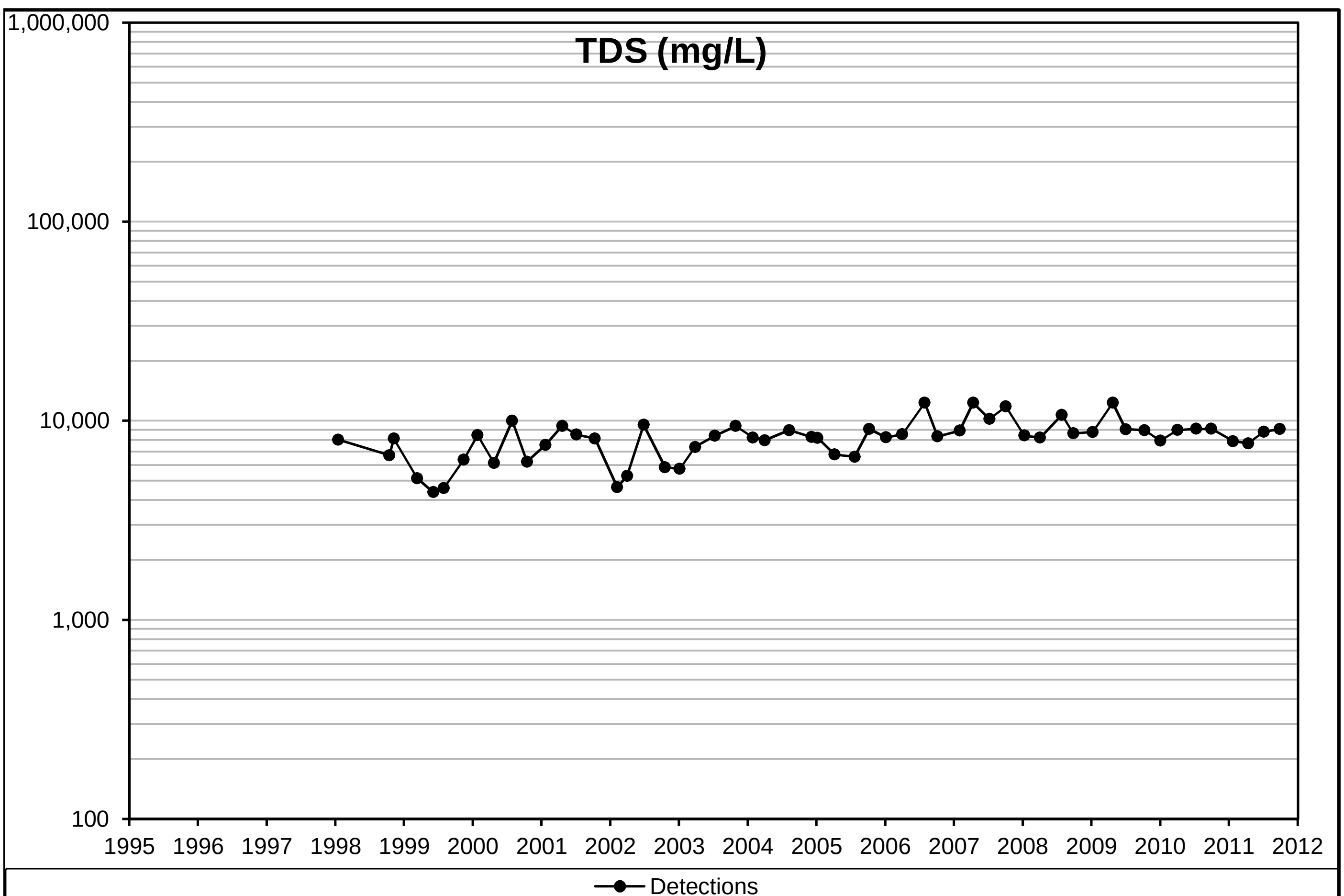
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

Concentration Versus Year



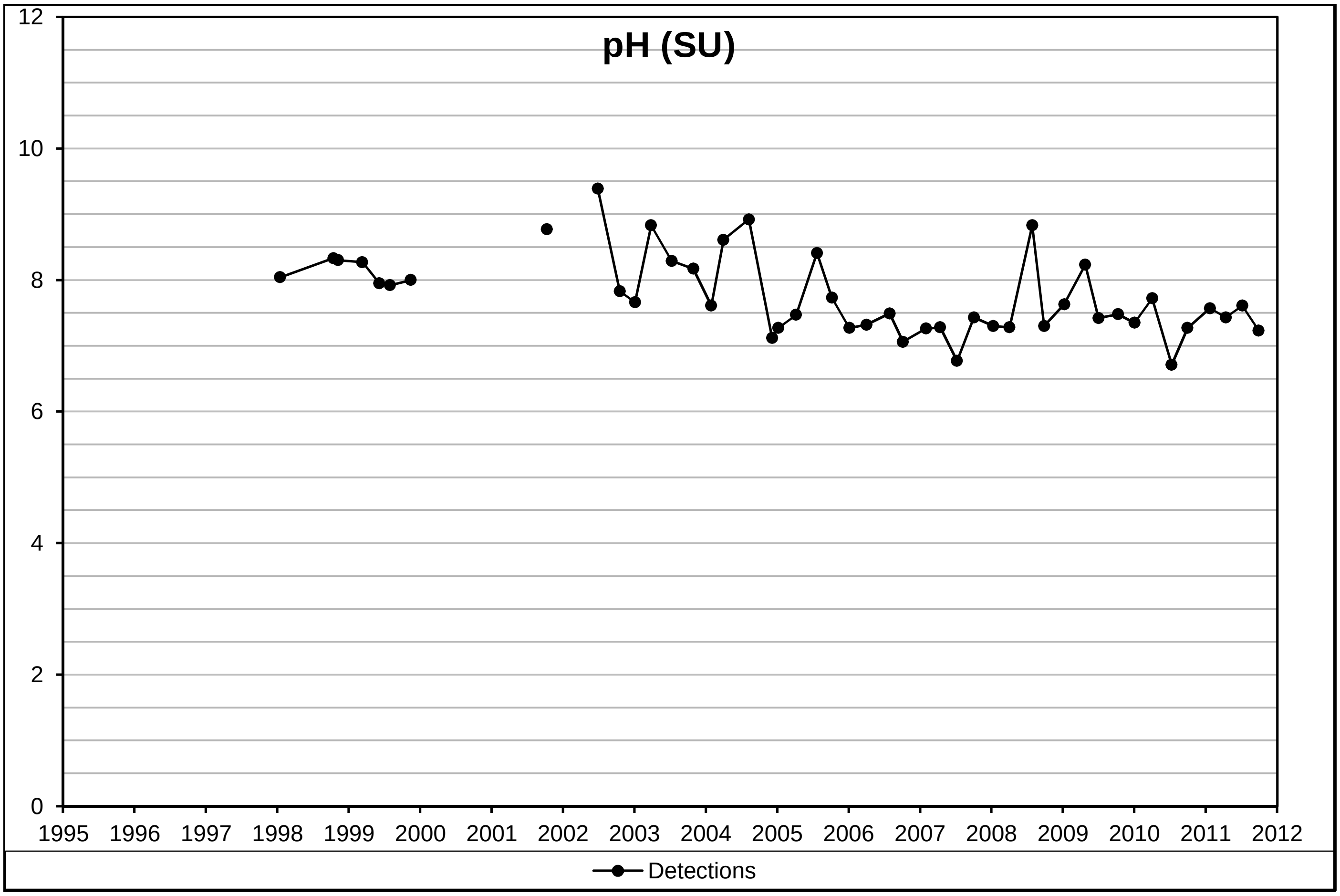


Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLP1469

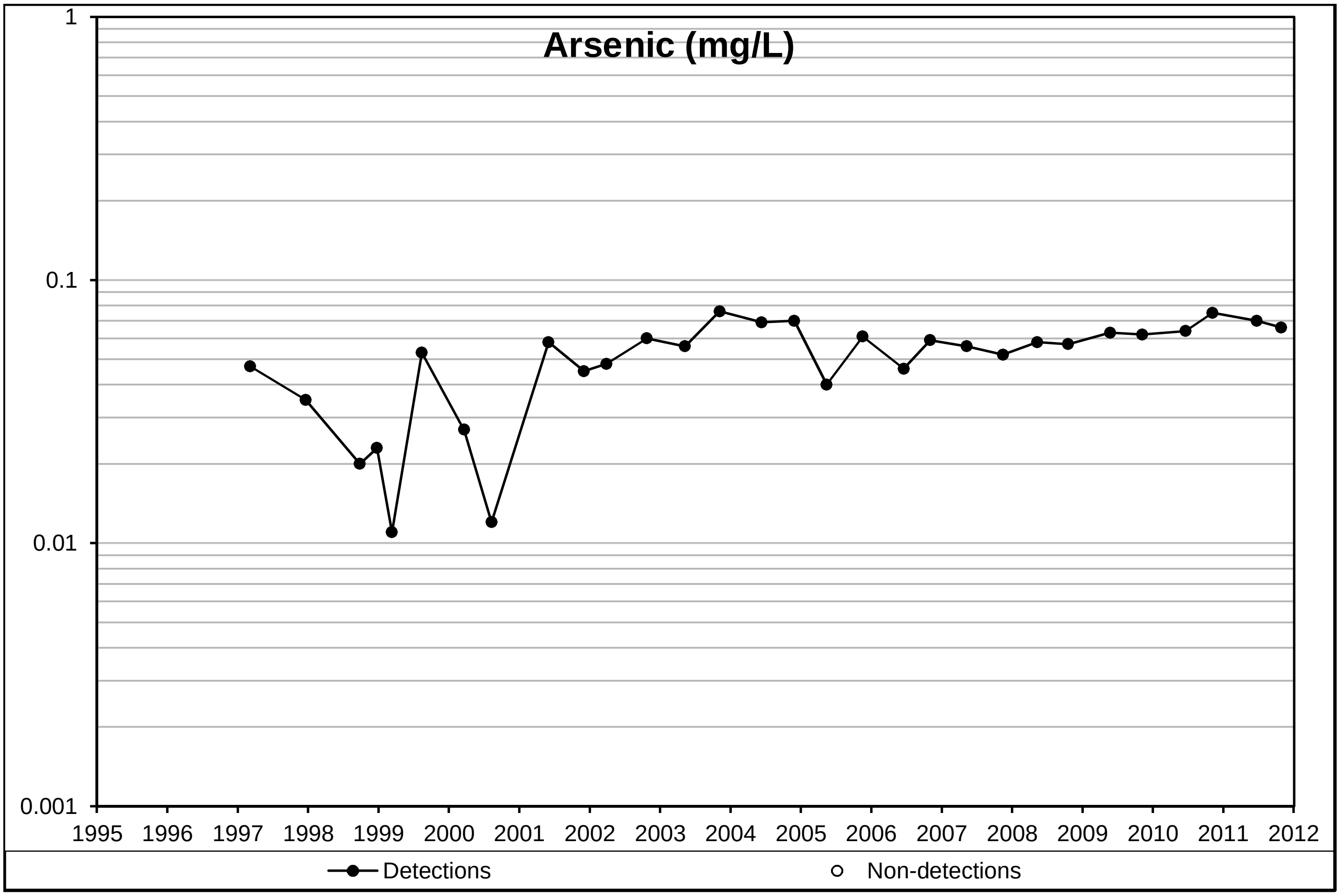
Concentration Versus Year

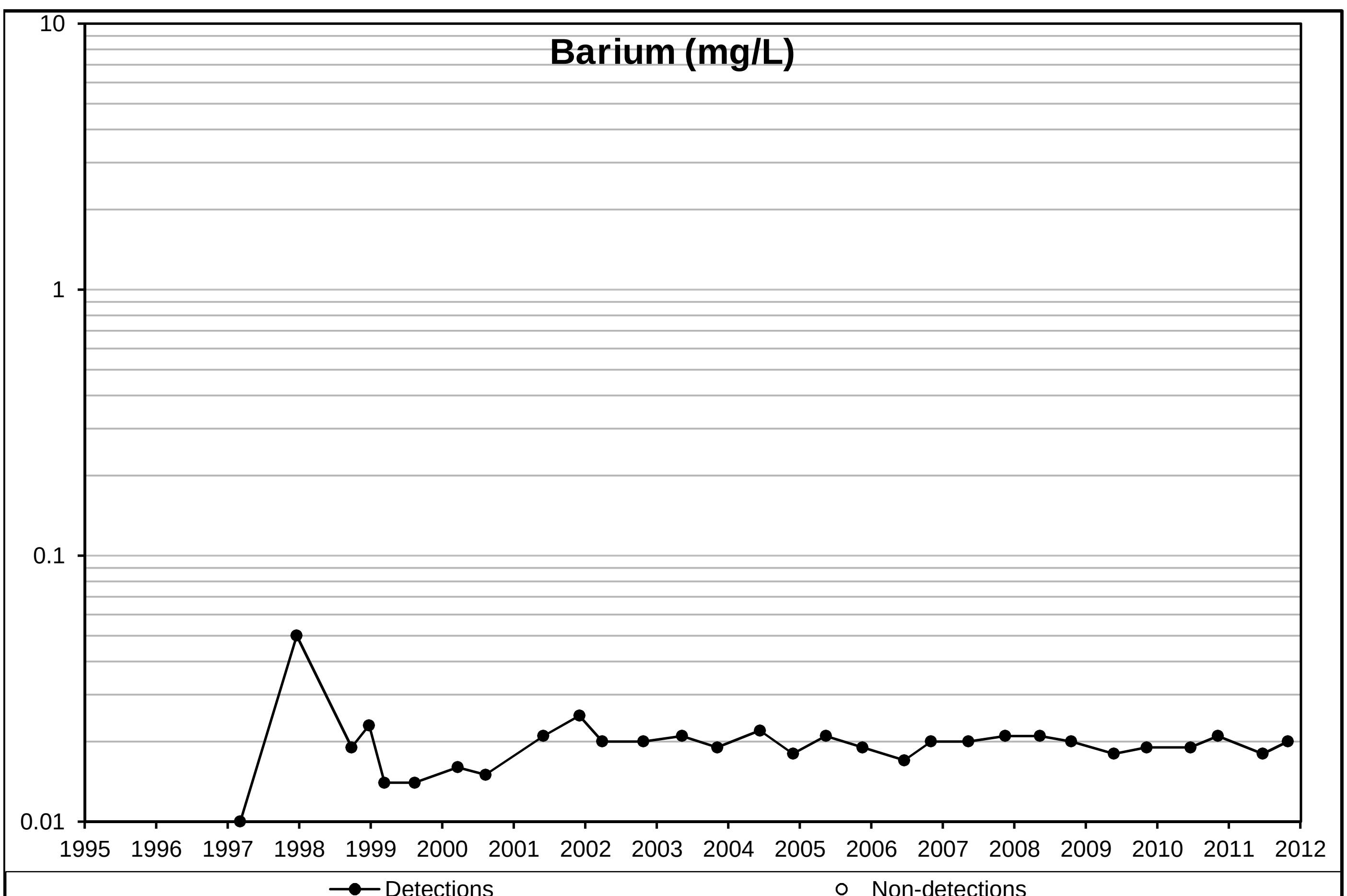


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLT2452

Concentration Versus Year



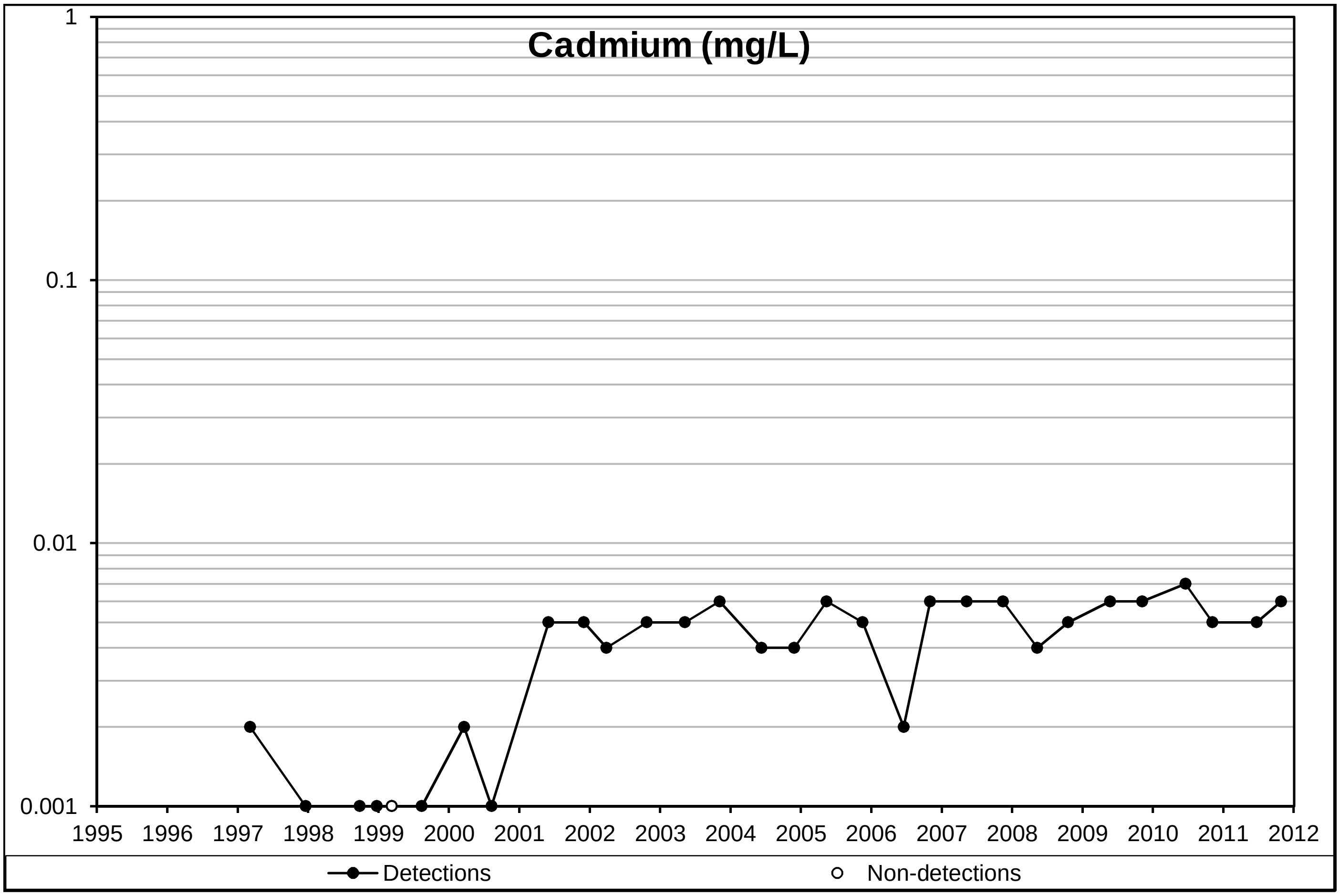


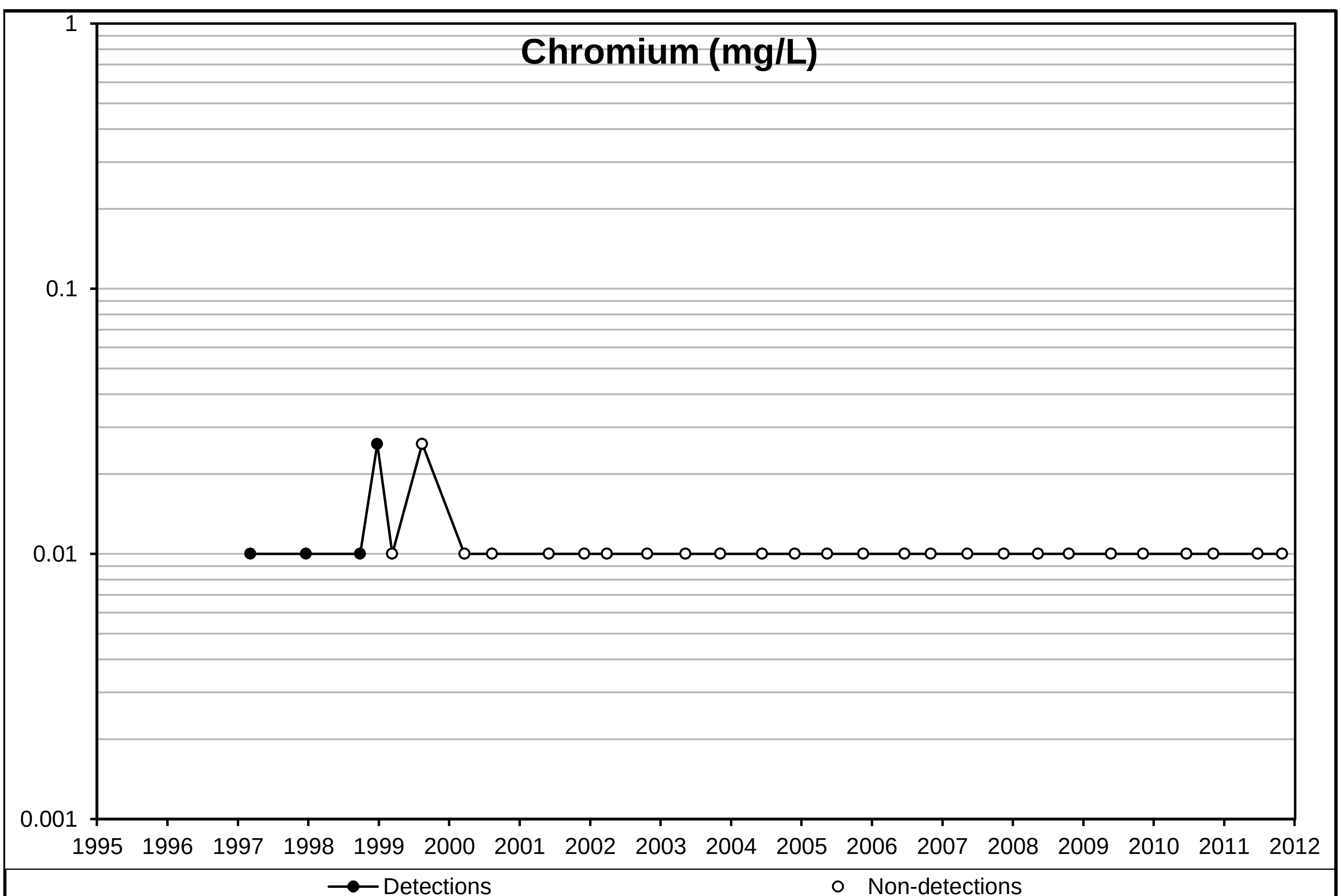
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLT2452

Concentration Versus Year



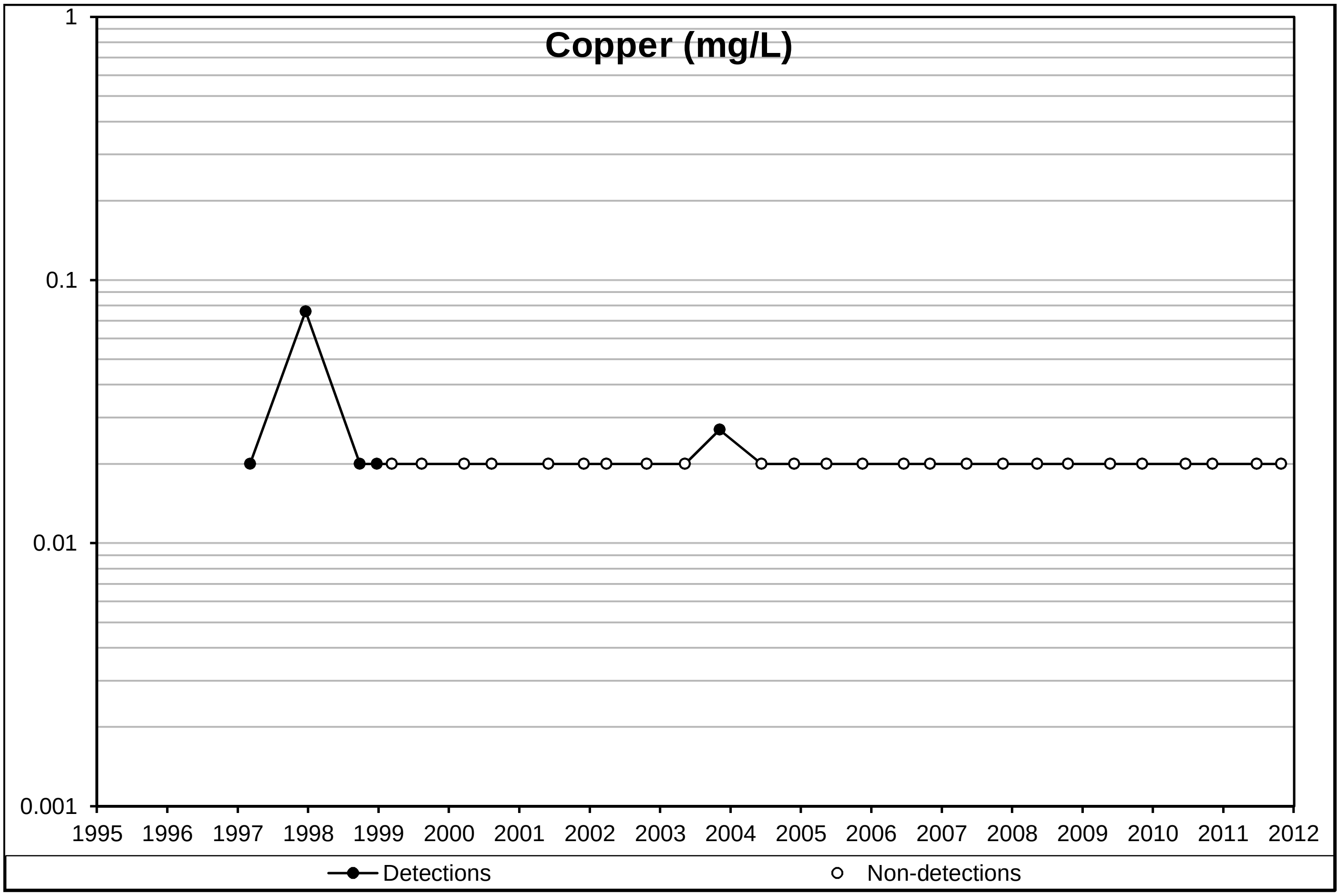


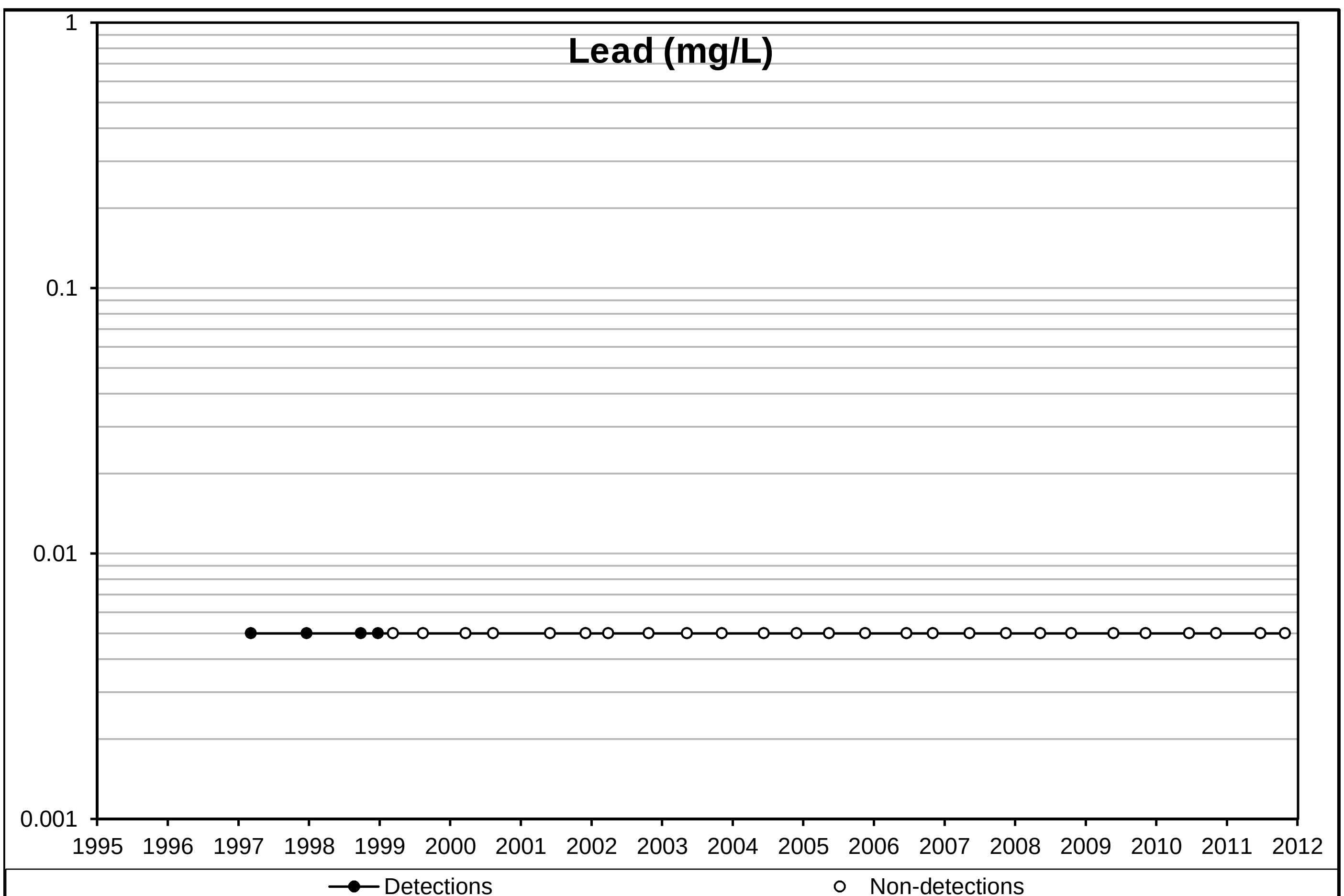
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLT2452

Concentration Versus Year



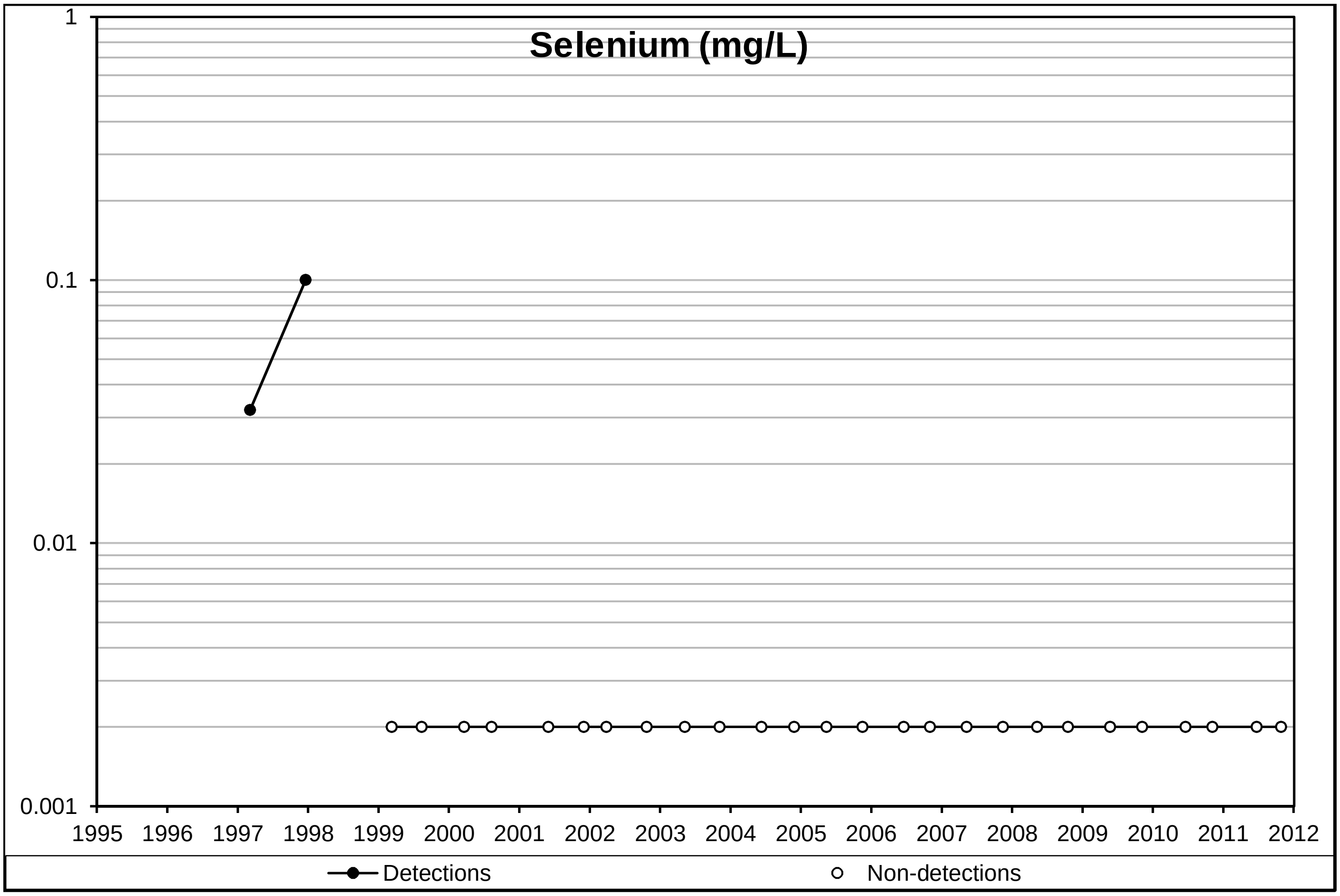


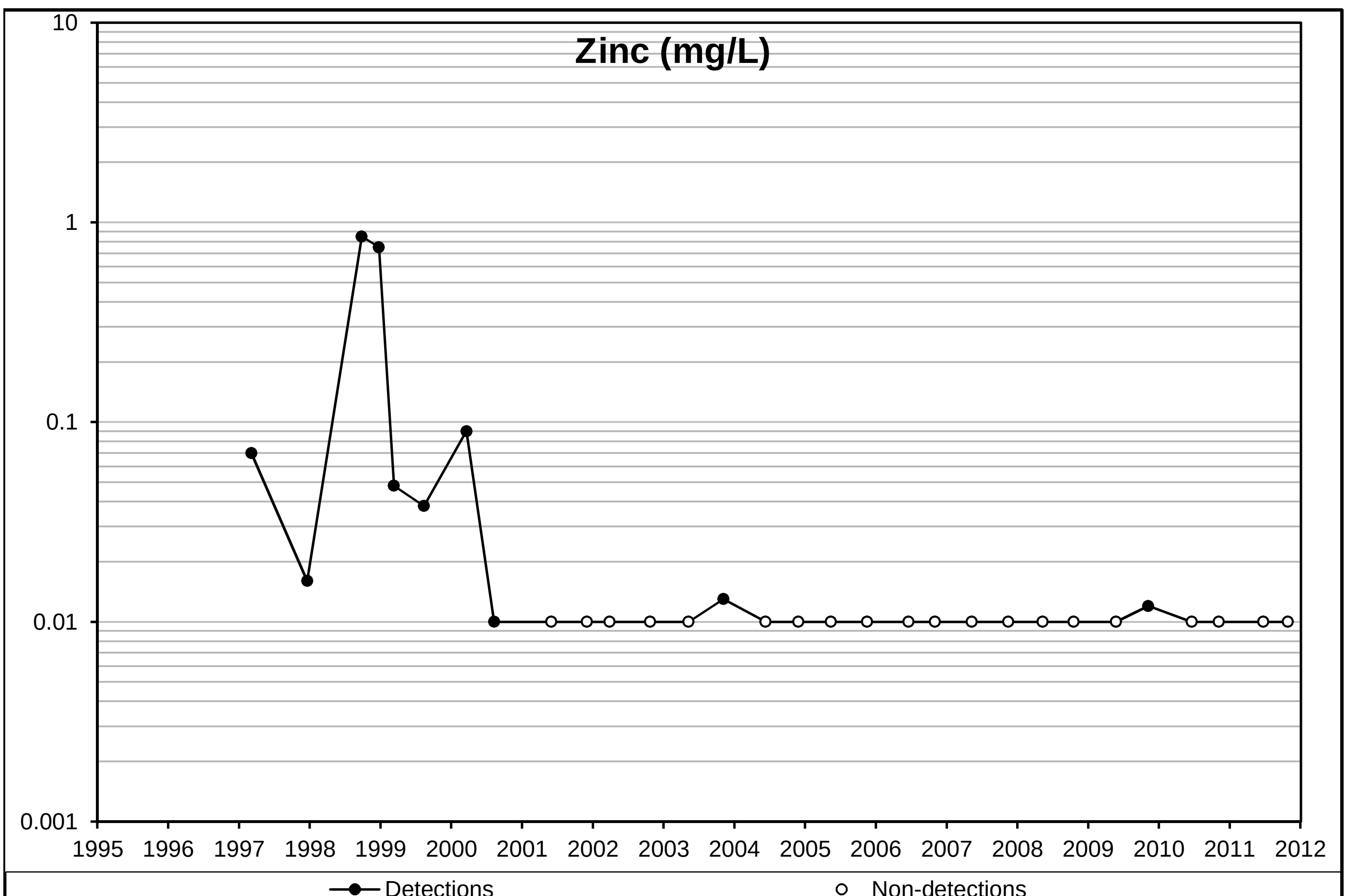
Background and standards are not shown as location represents tailing water

Constituent range includes minimum and maximum concentrations for all wells considered

TLT2452

Concentration Versus Year

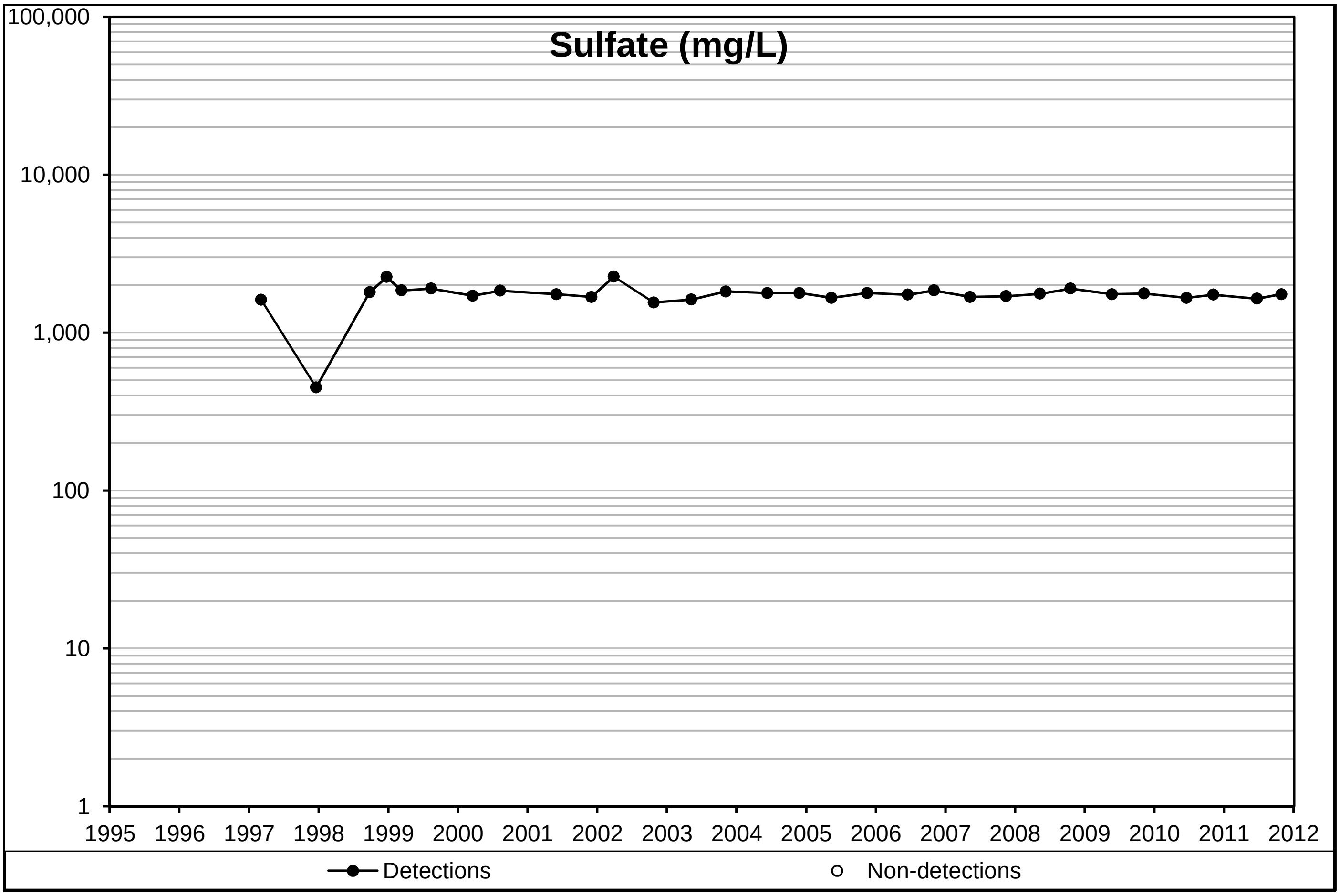


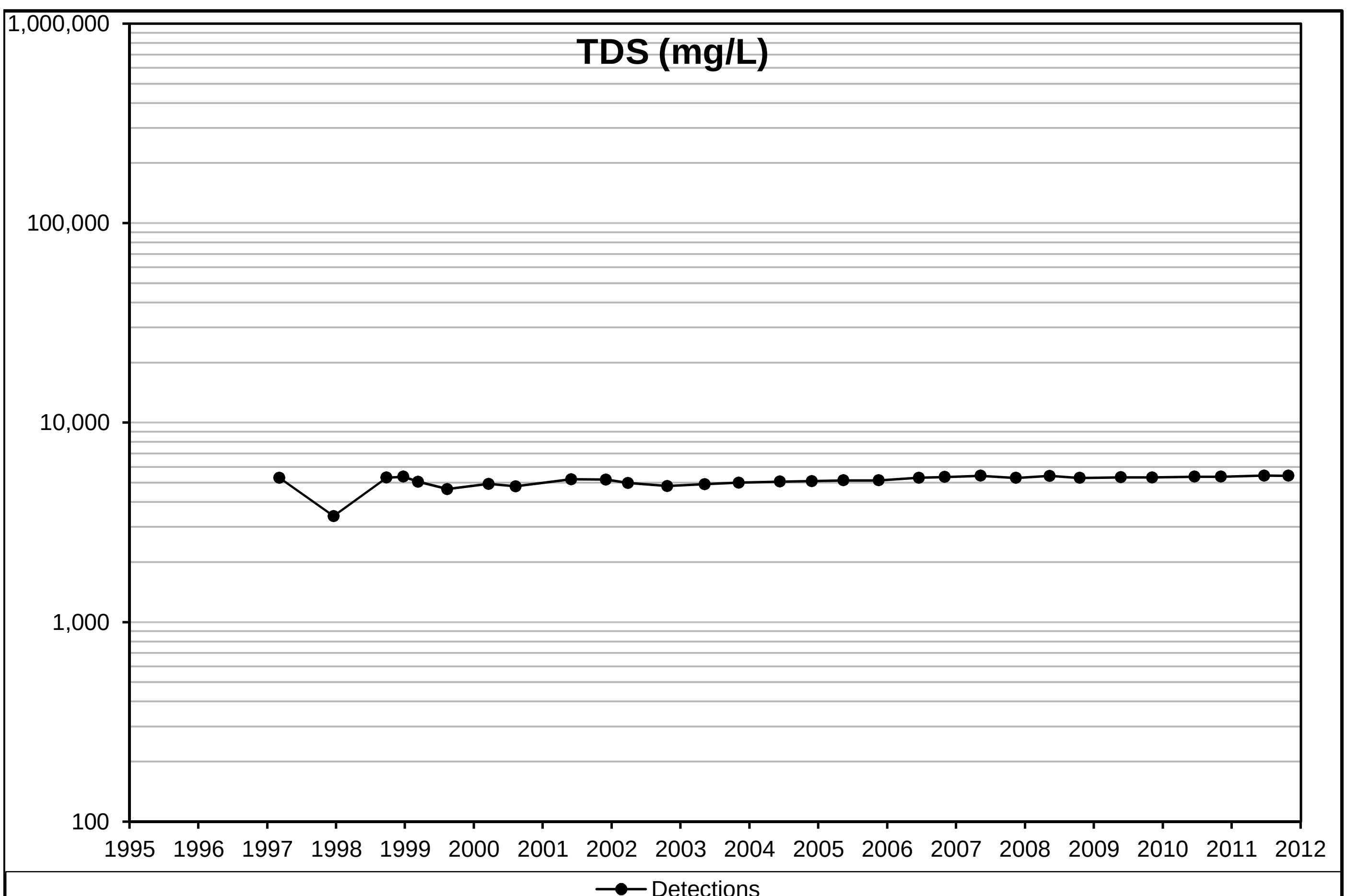


Background and standards are not shown as location represents tailing water
Constituent range includes minimum and maximum concentrations for all wells considered

TLT2452

Concentration Versus Year





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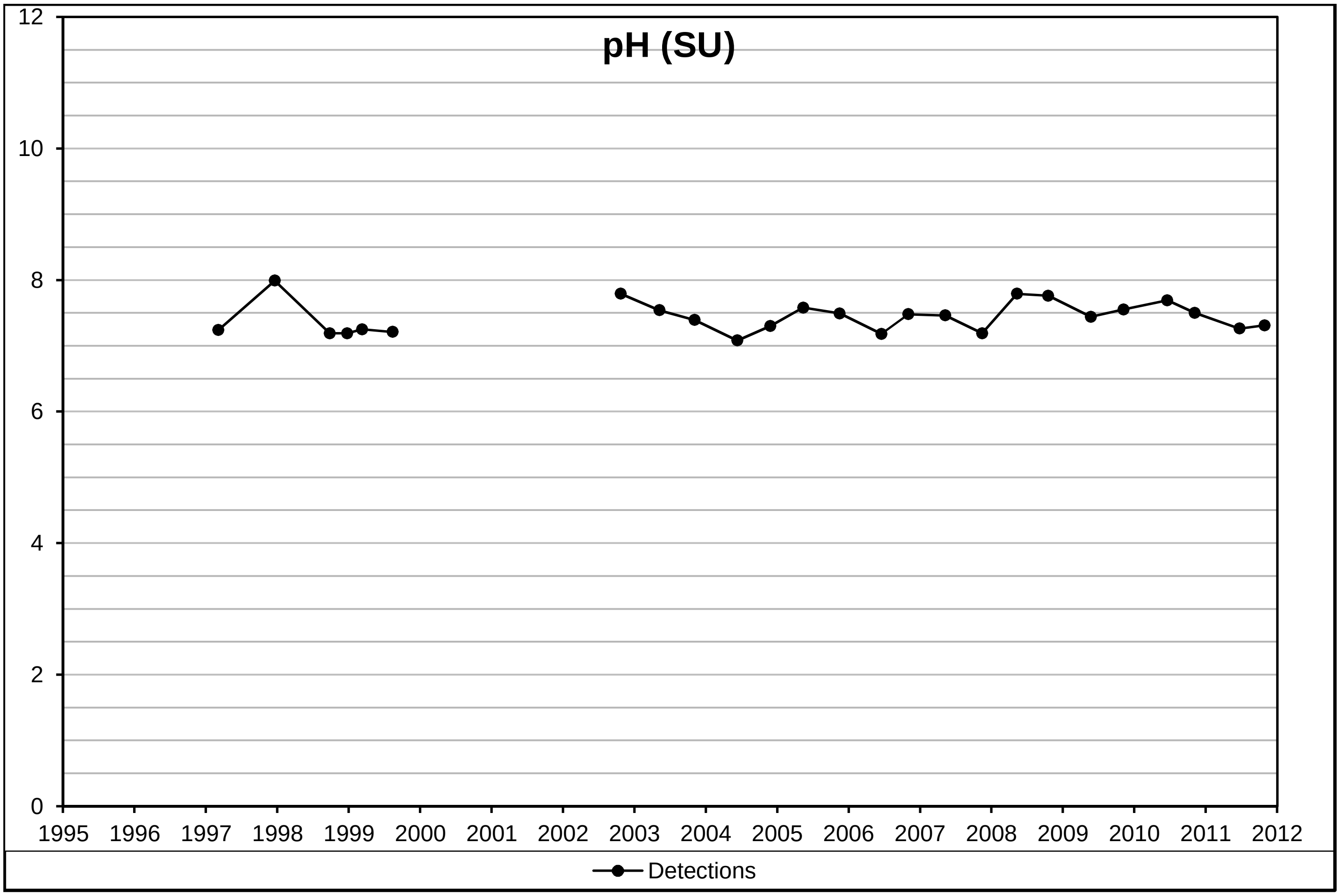

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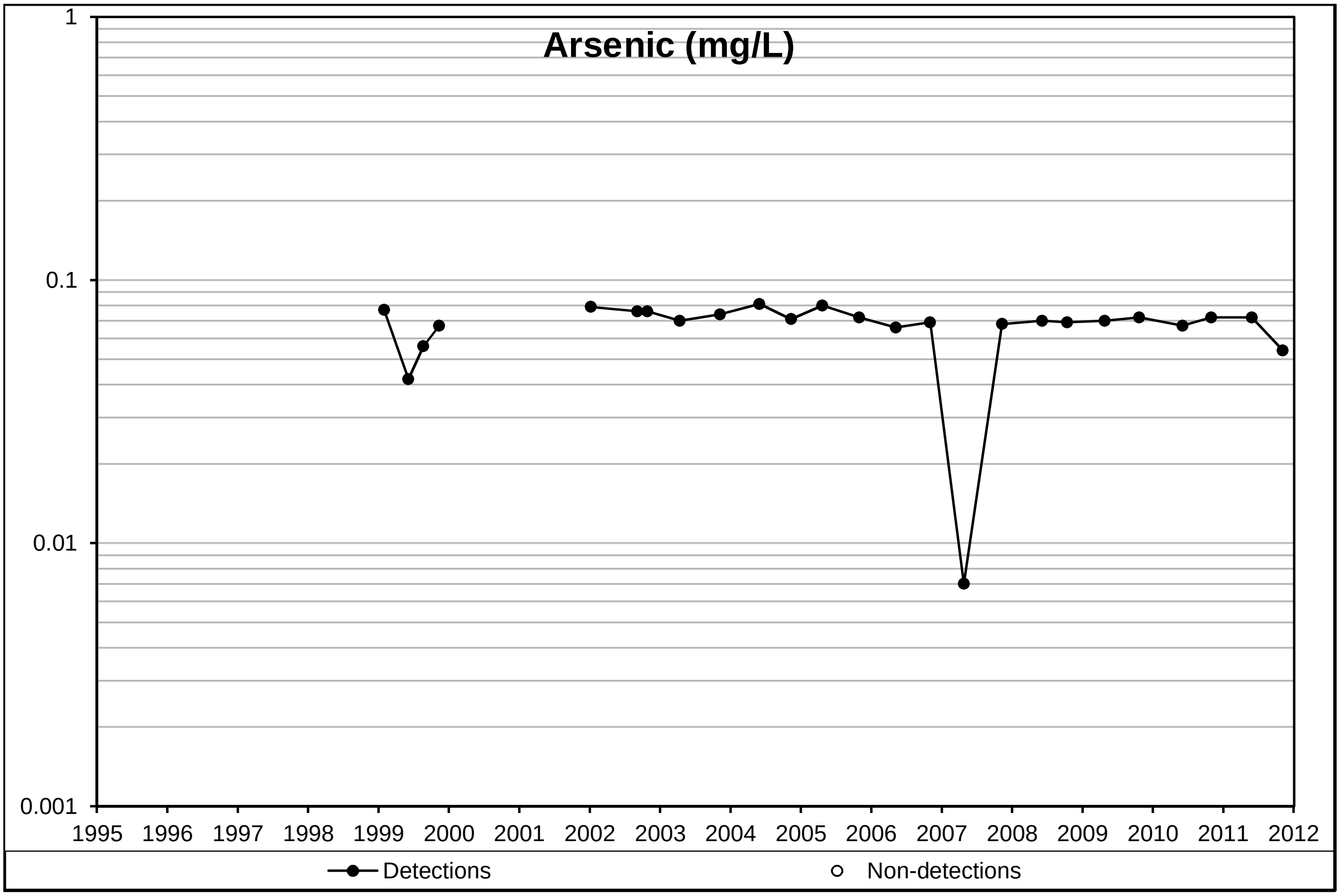
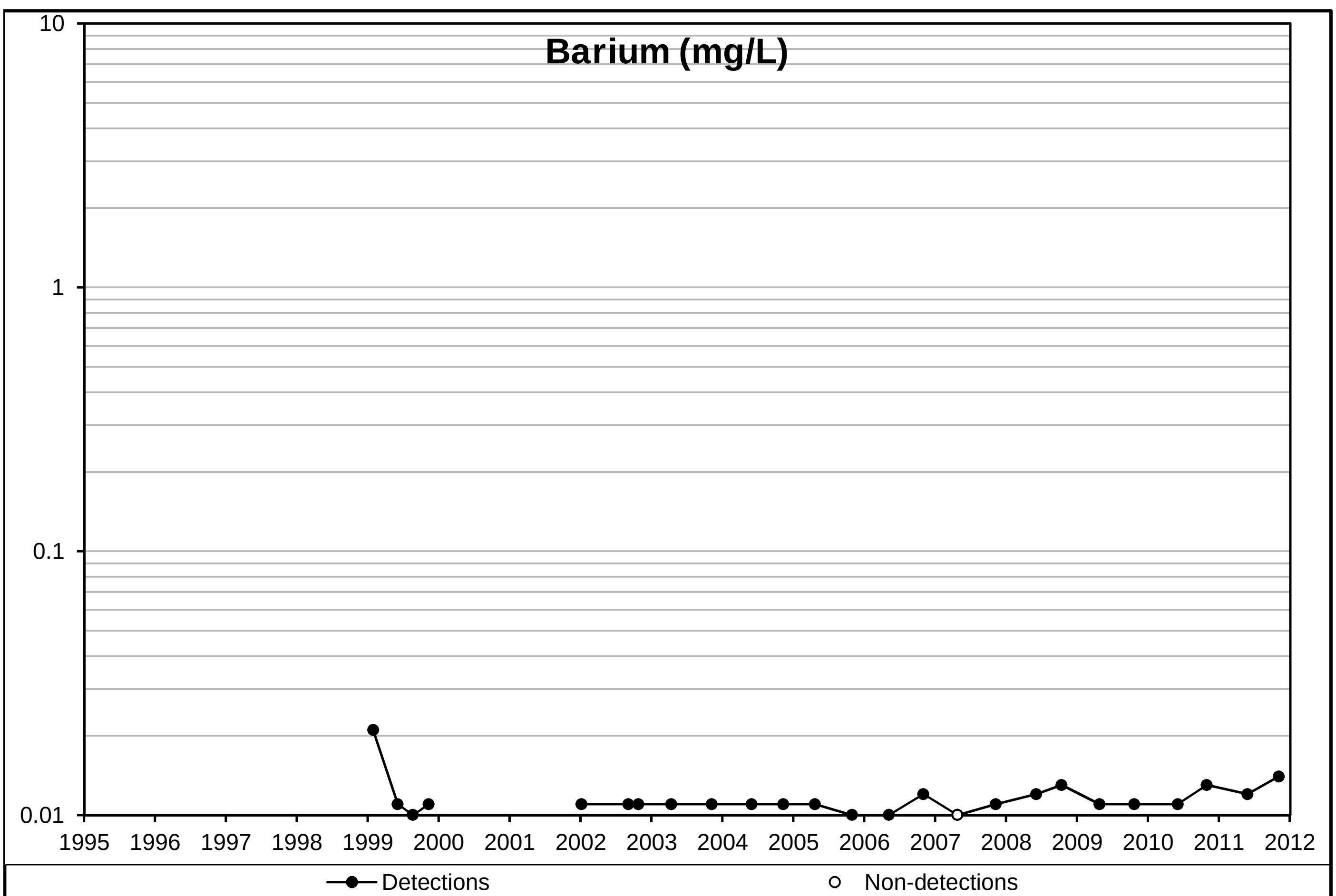
TLT2575A

Concentration Versus Year





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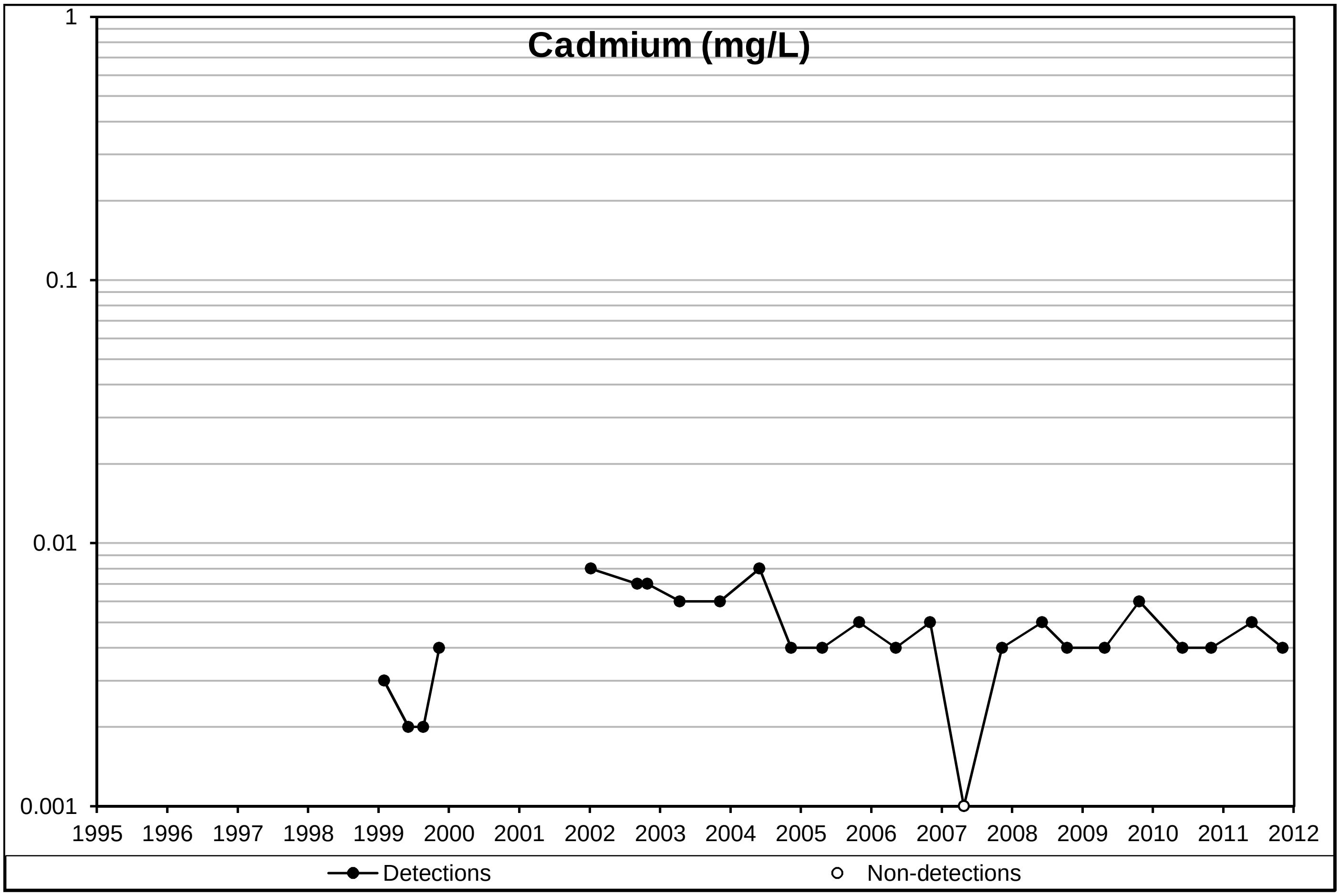

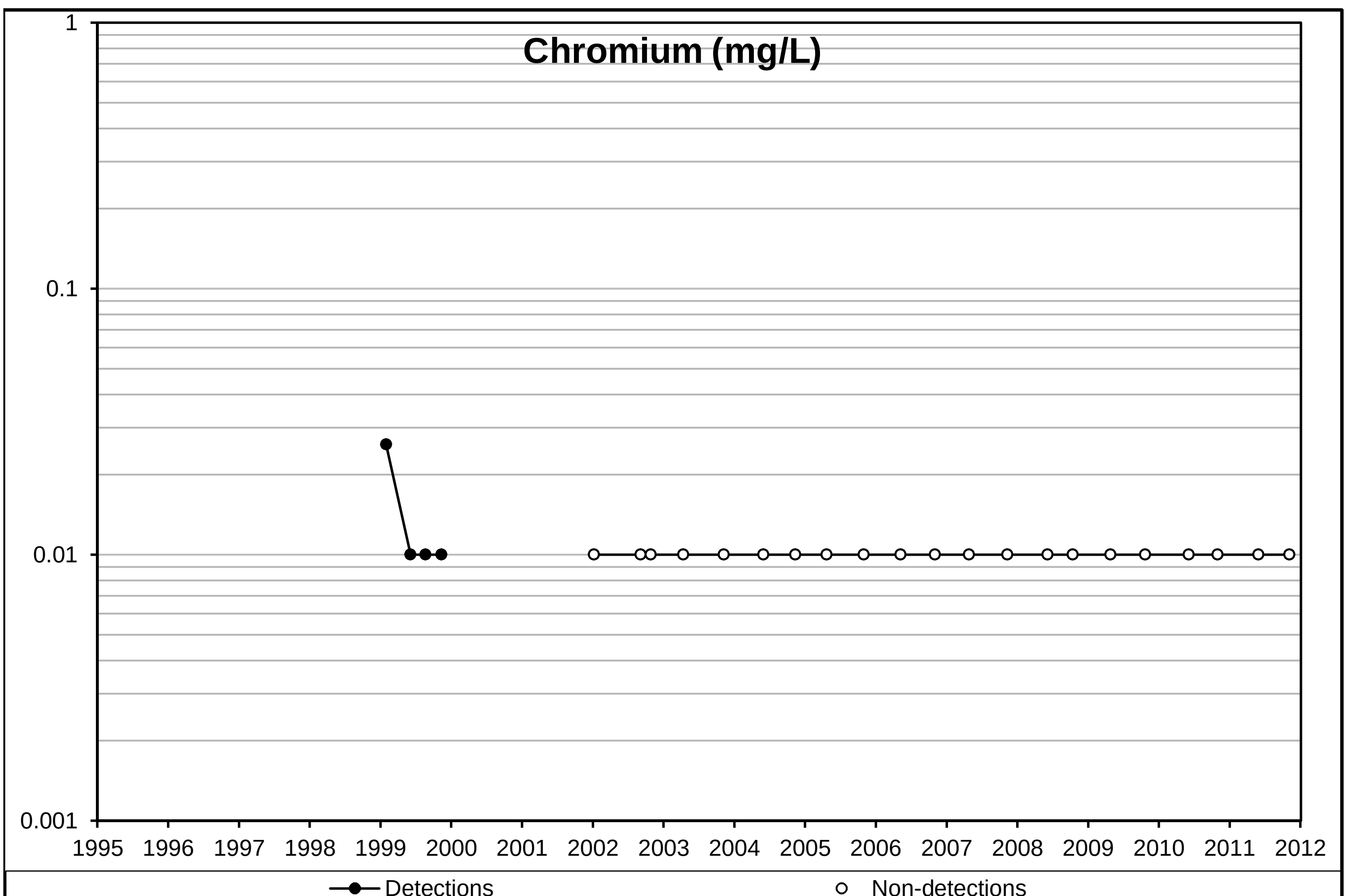

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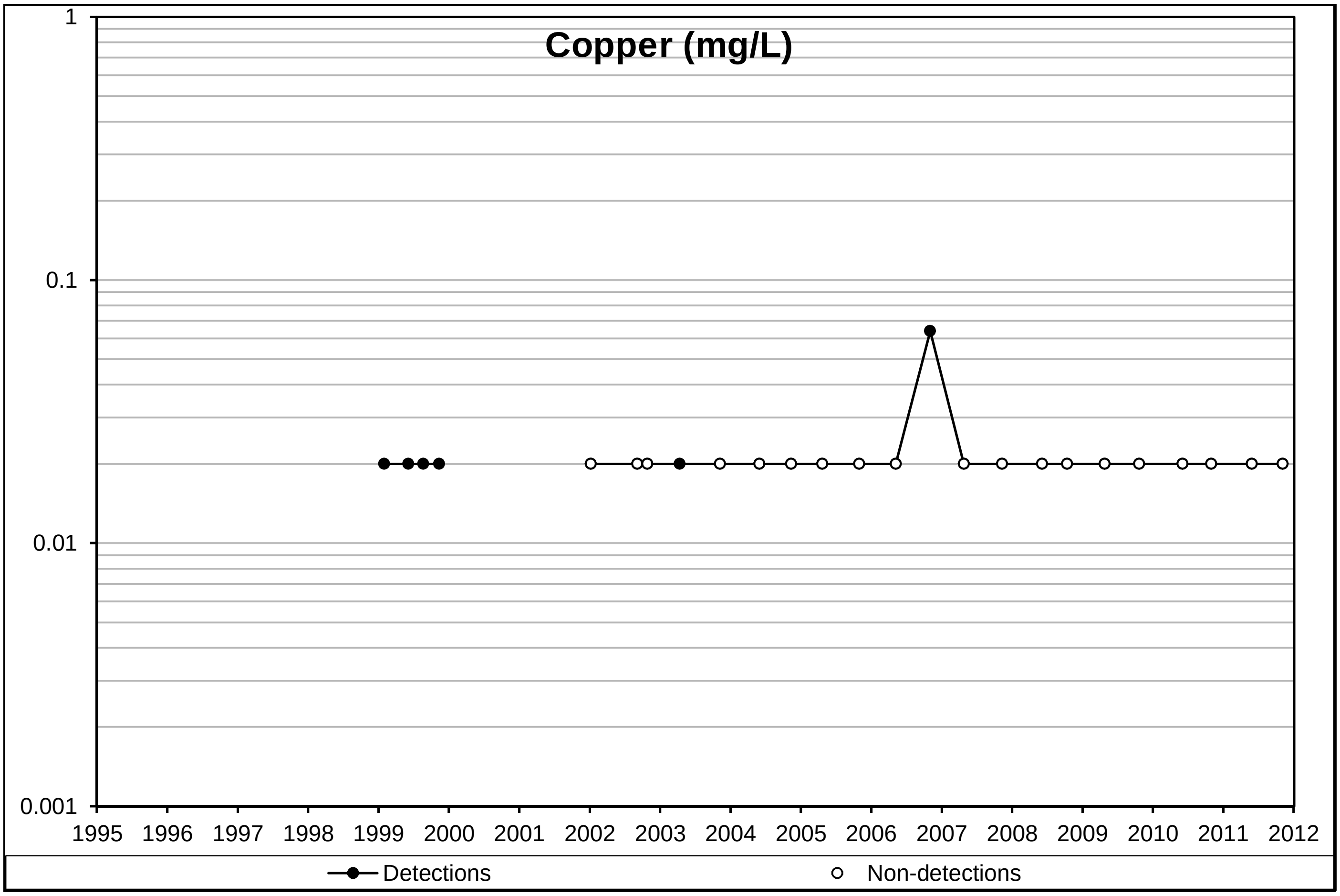
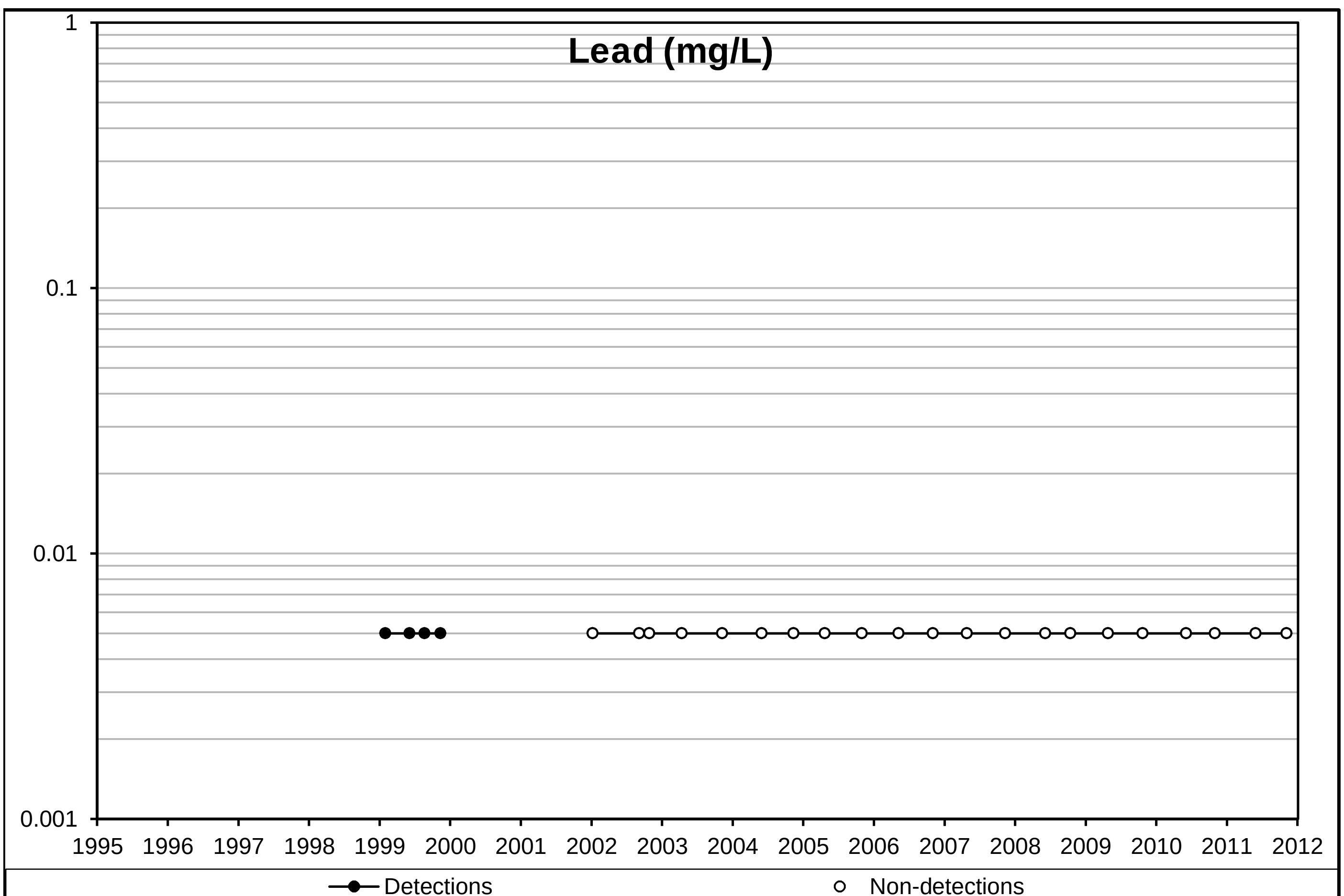
Concentration Versus Year





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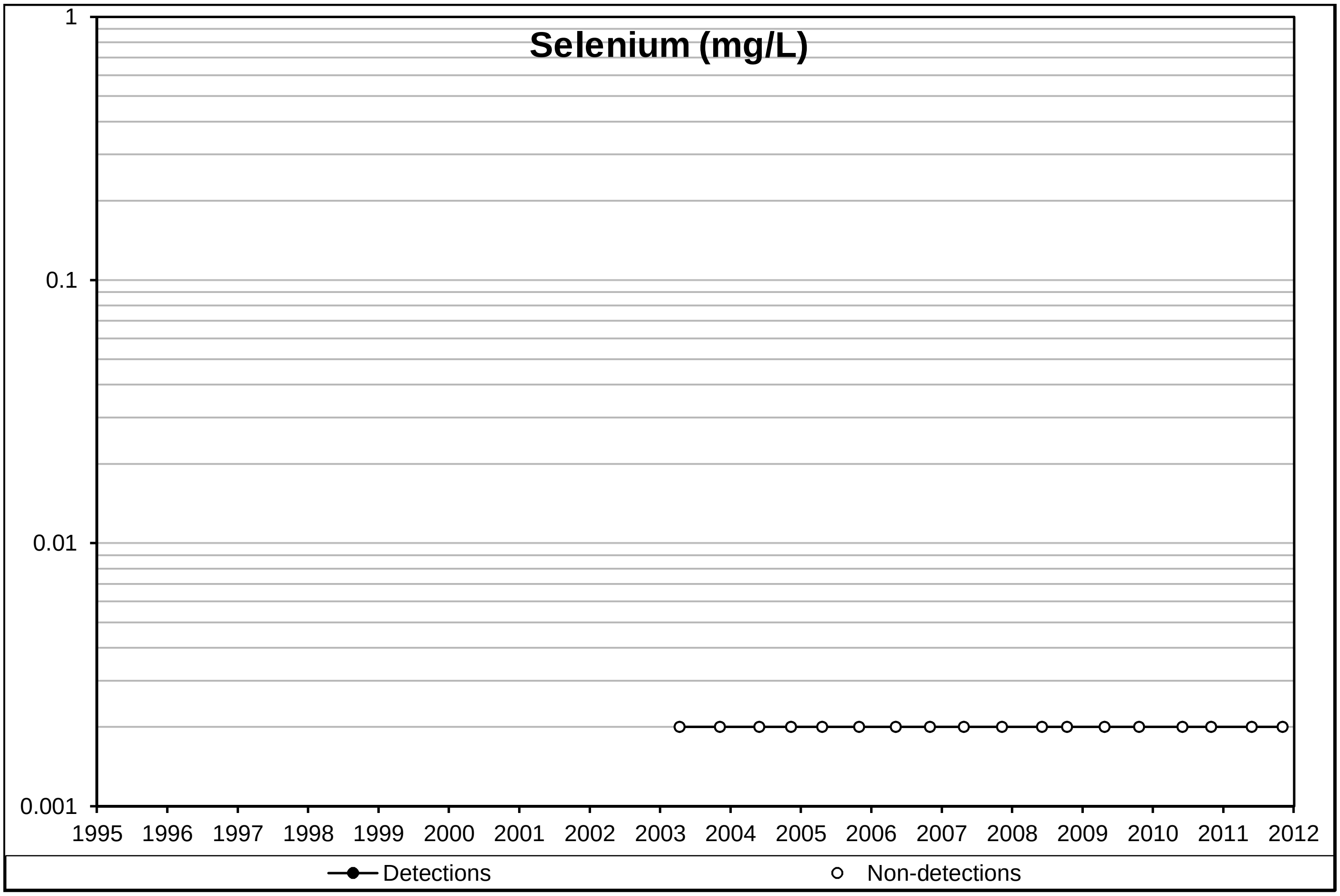
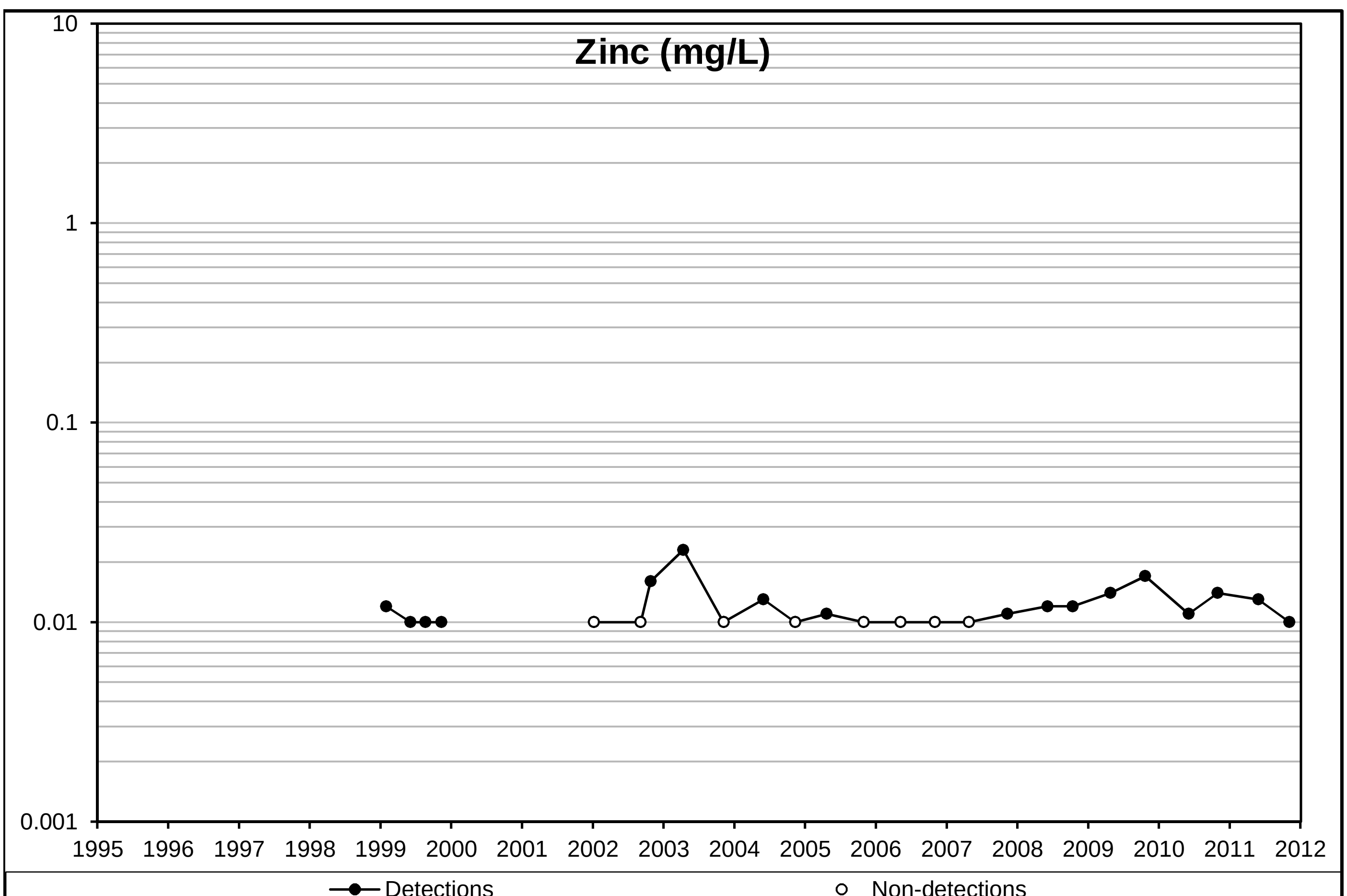
Concentration Versus Year





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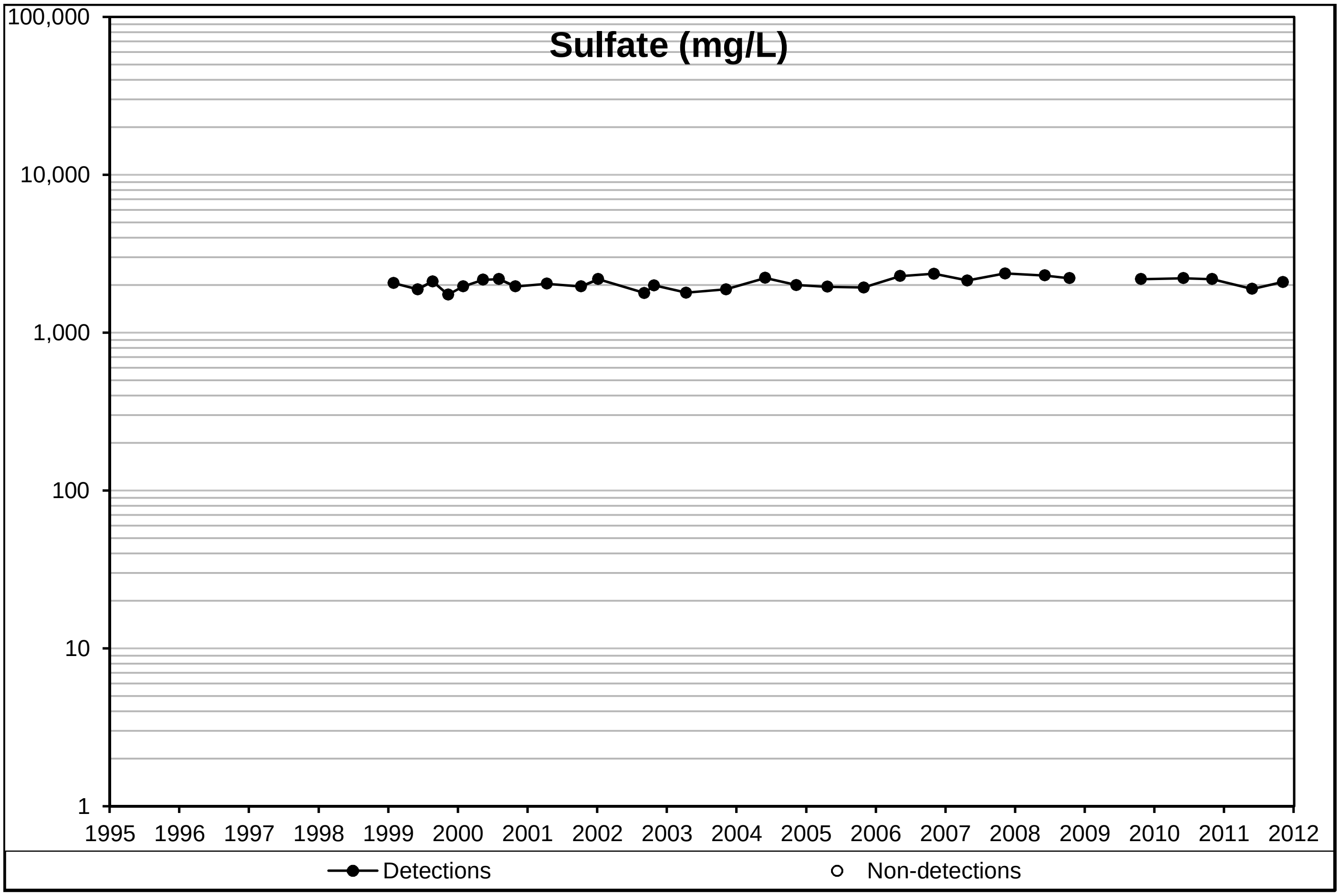

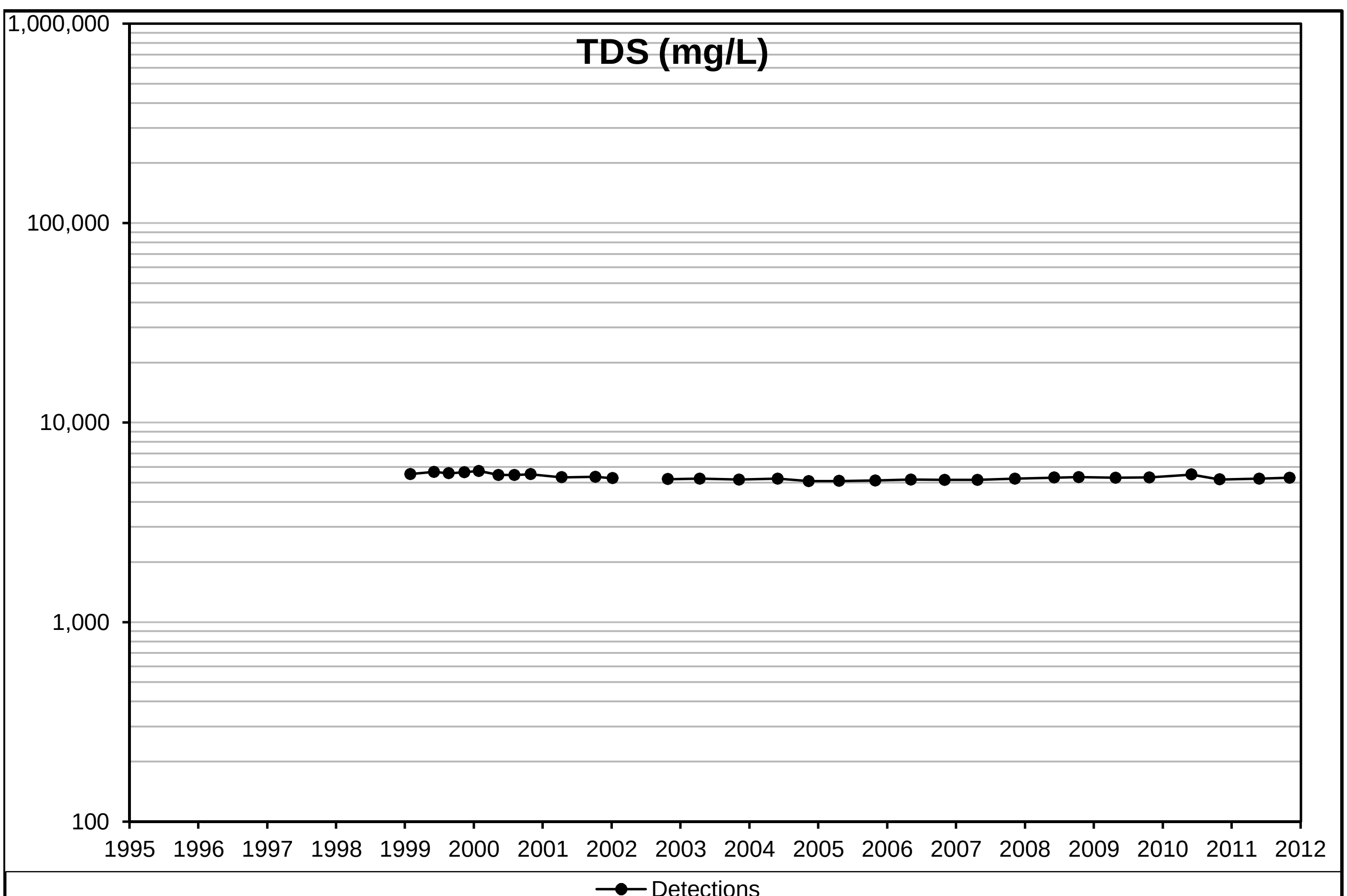

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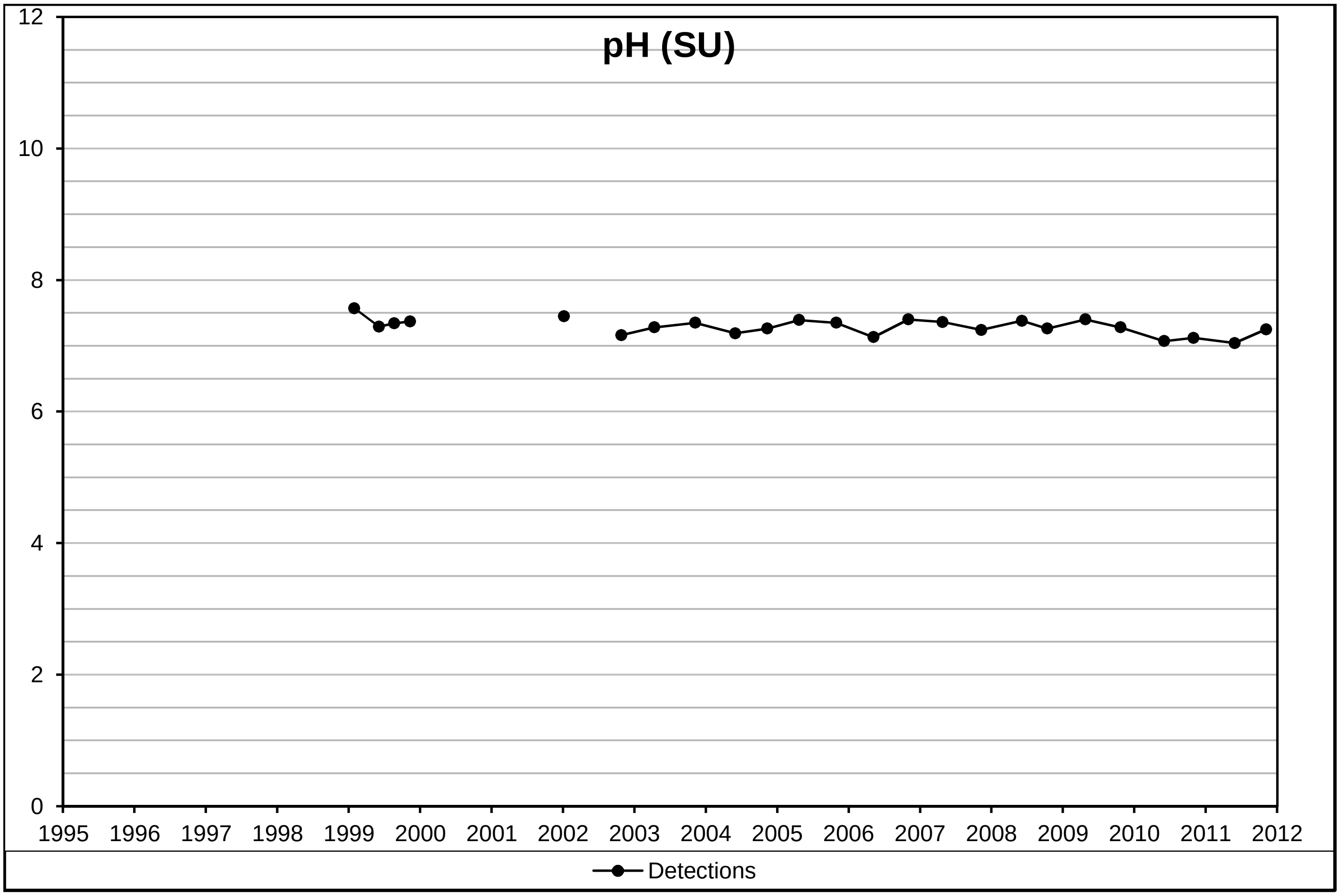

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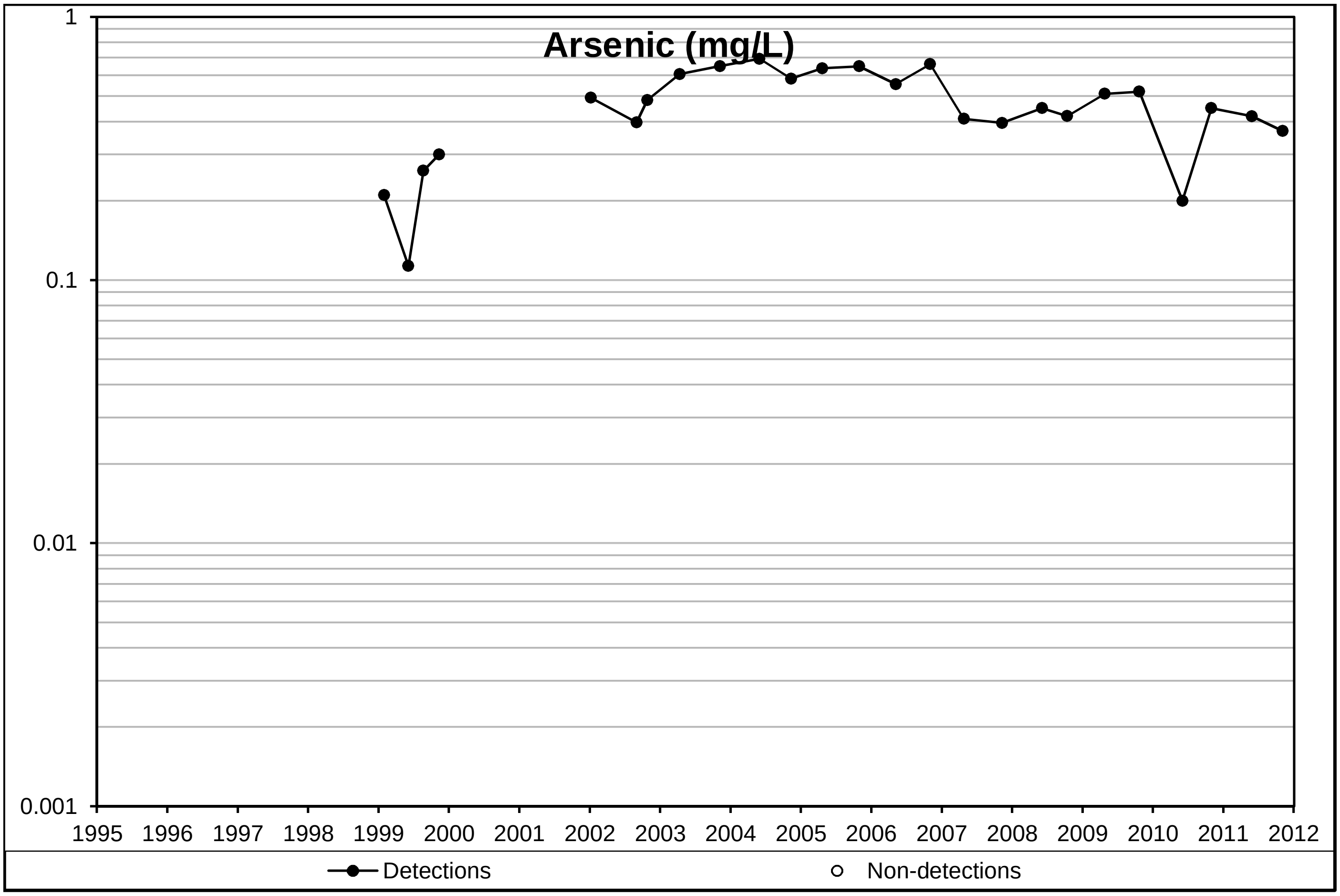

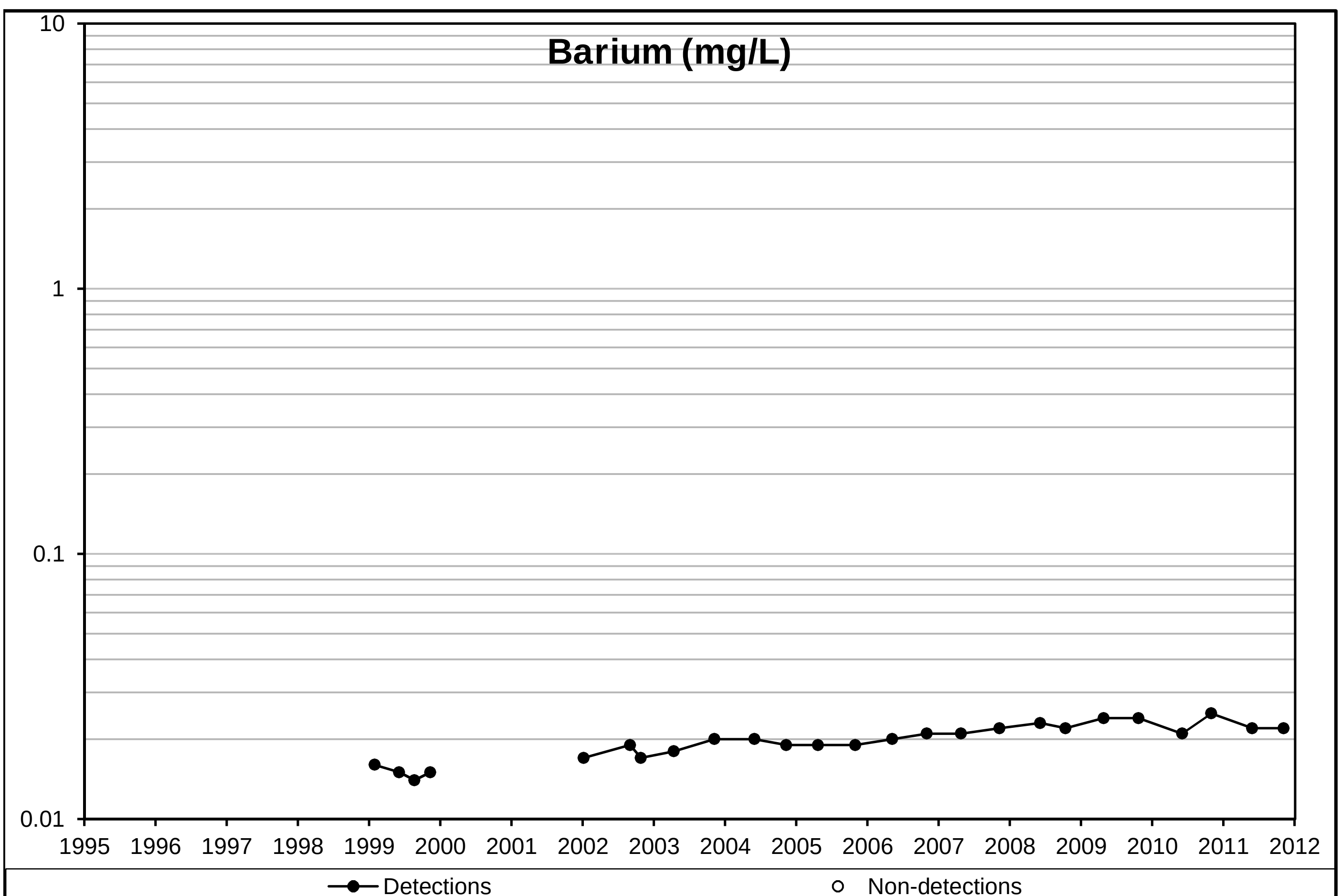

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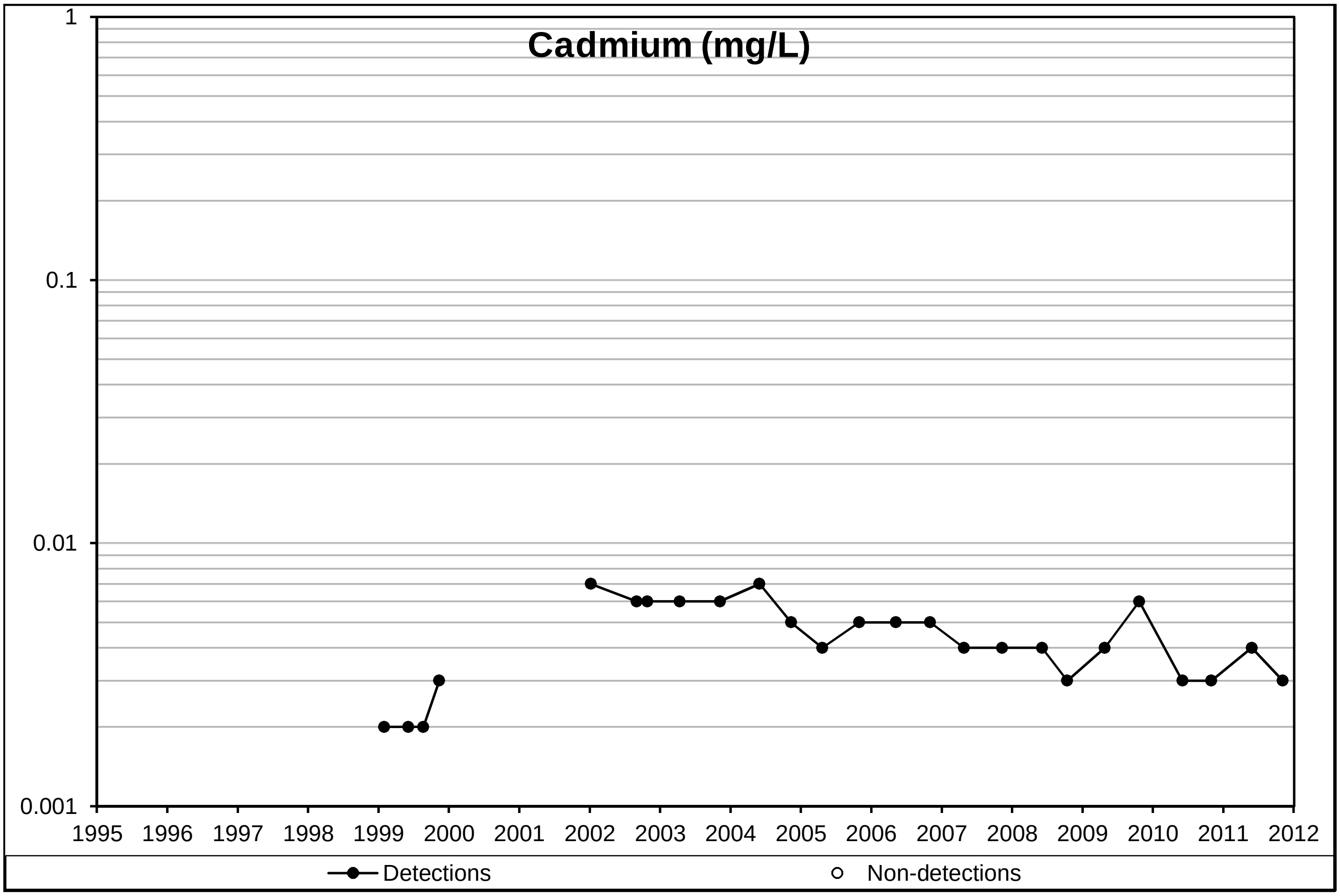

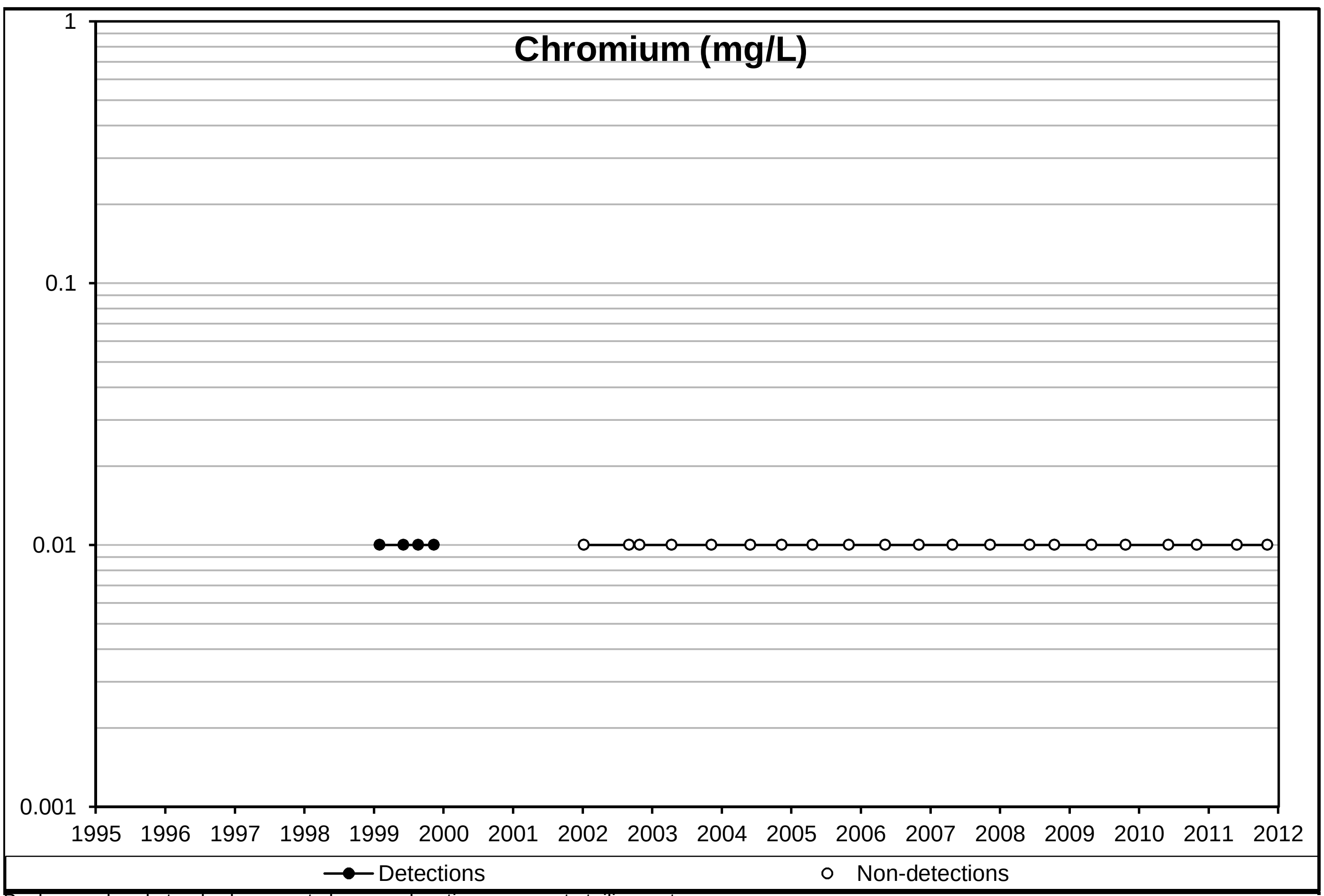

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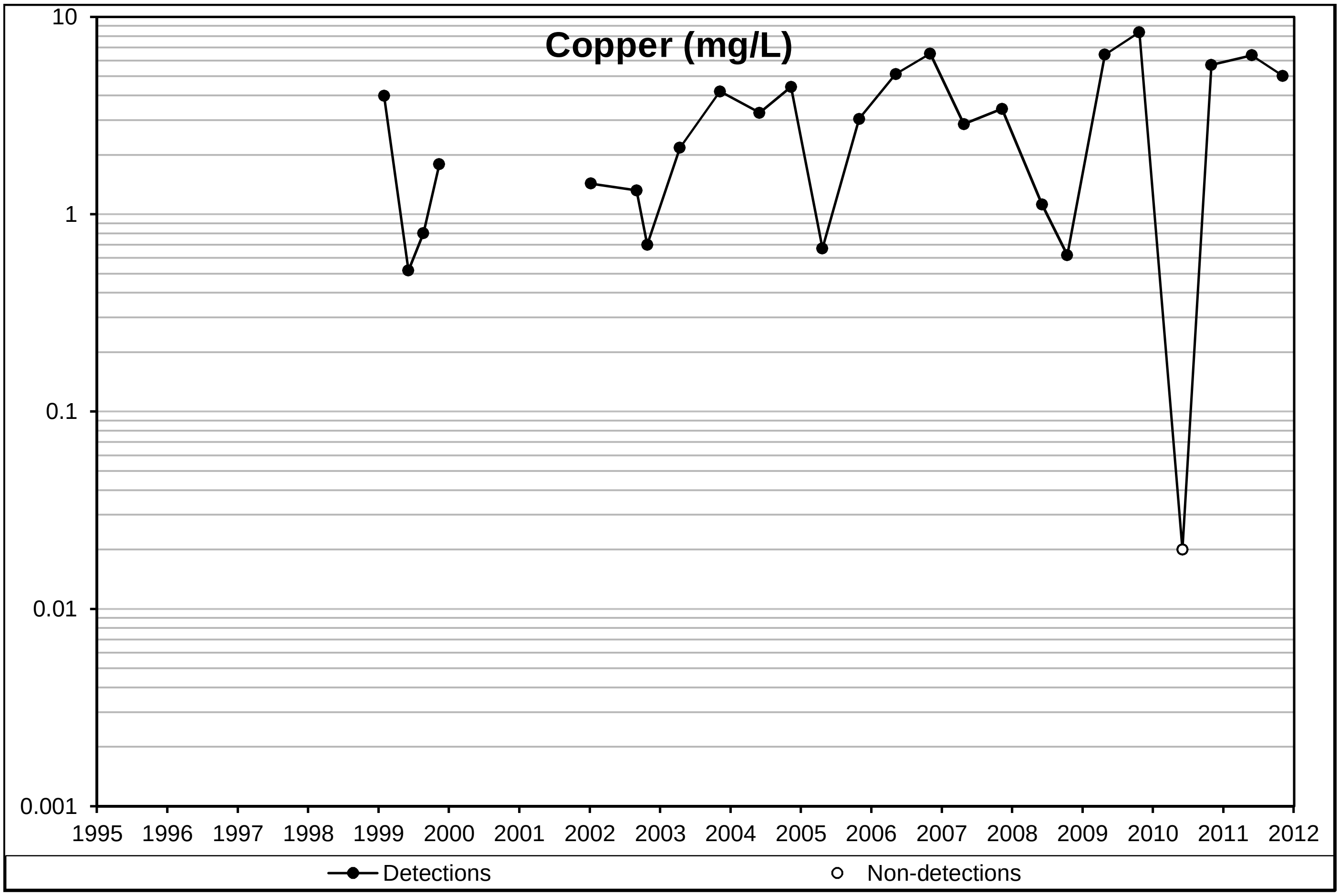

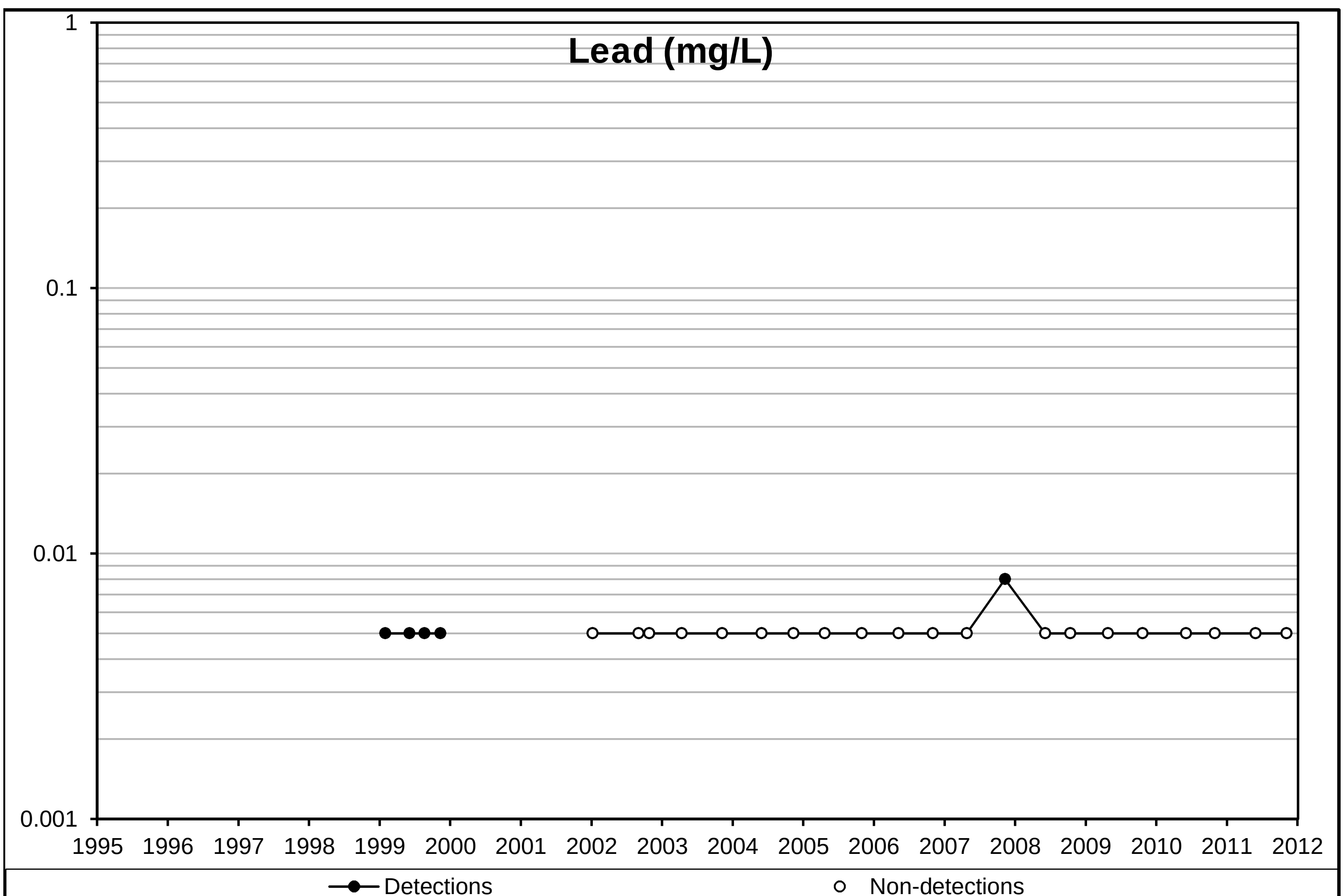

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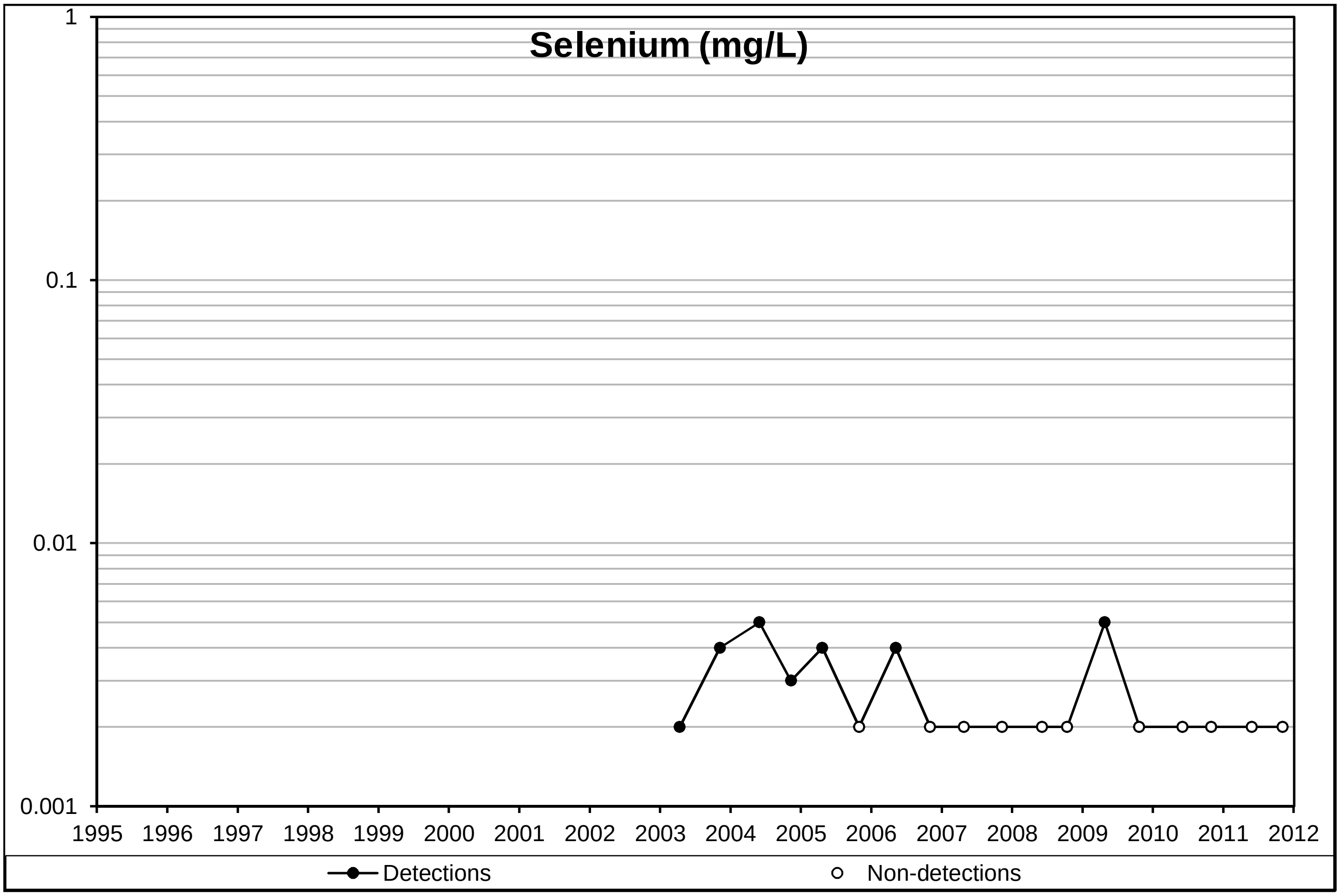

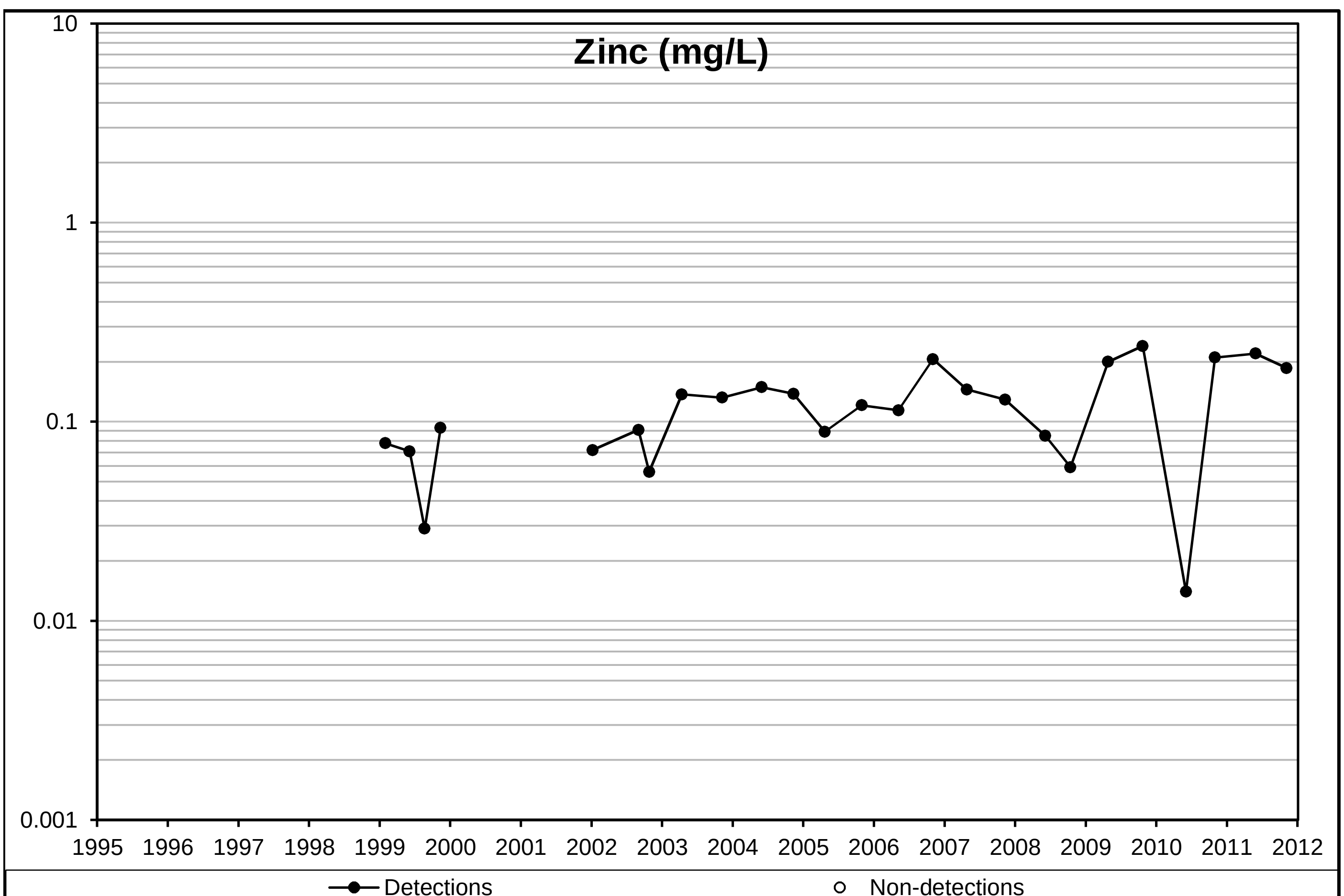

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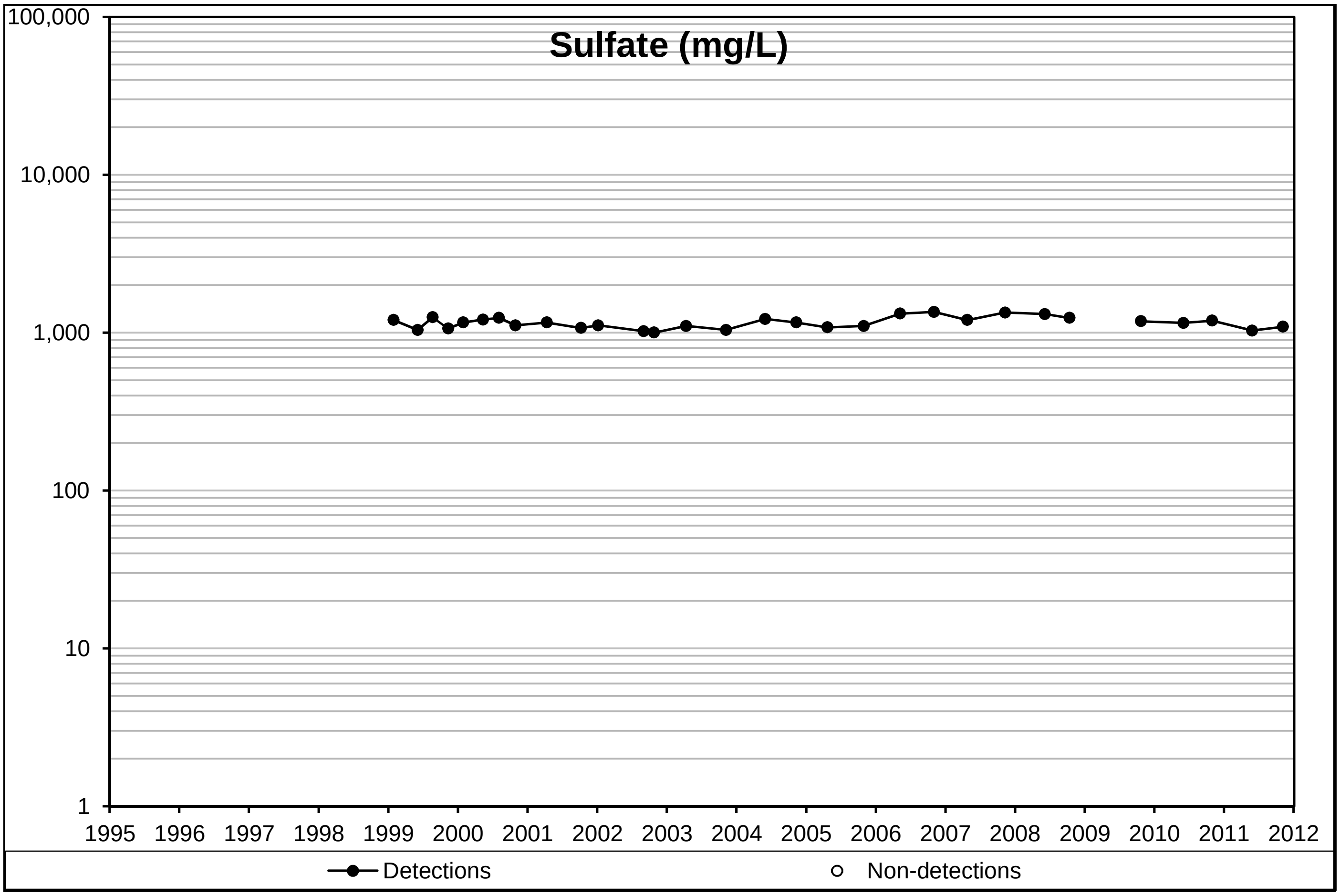

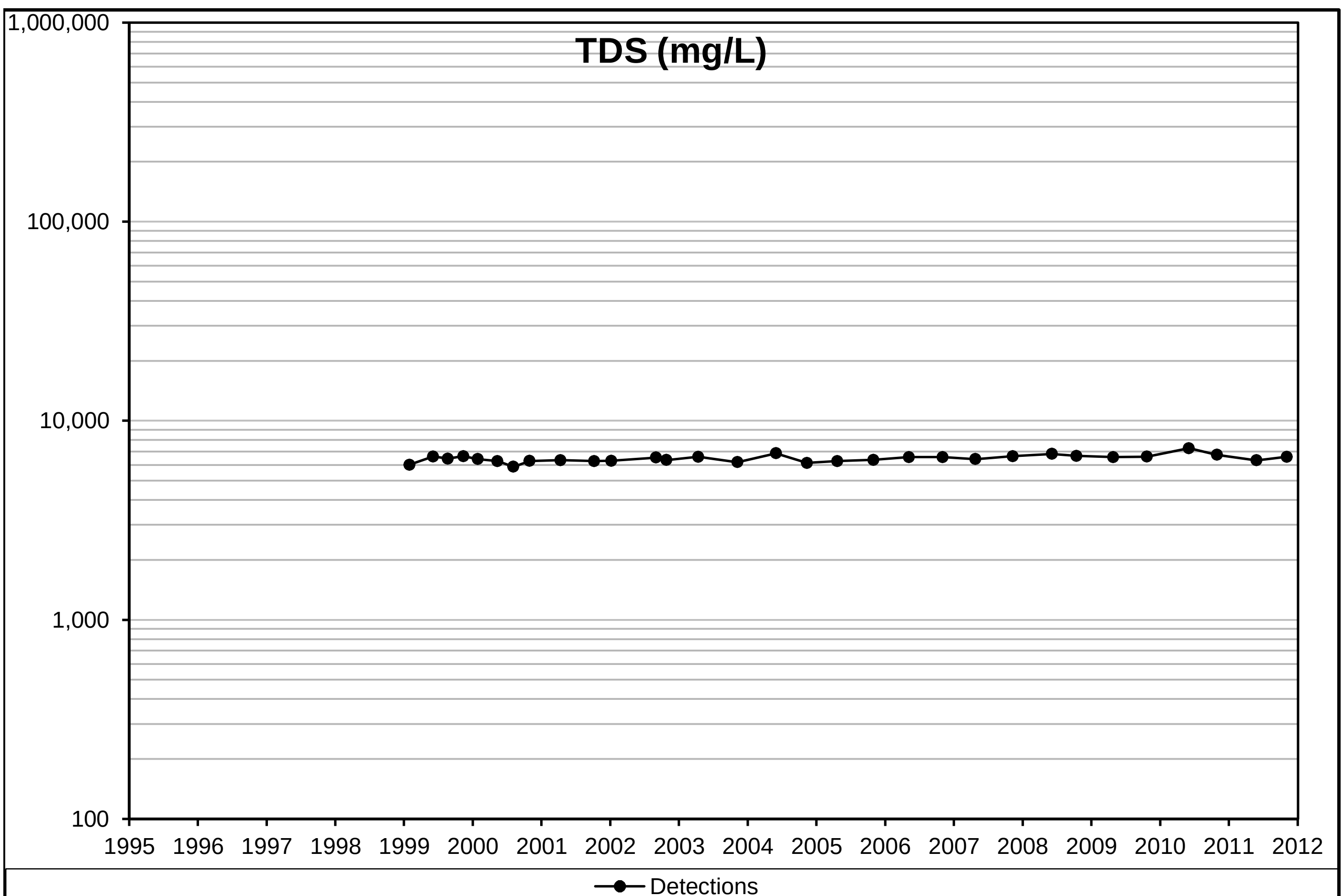

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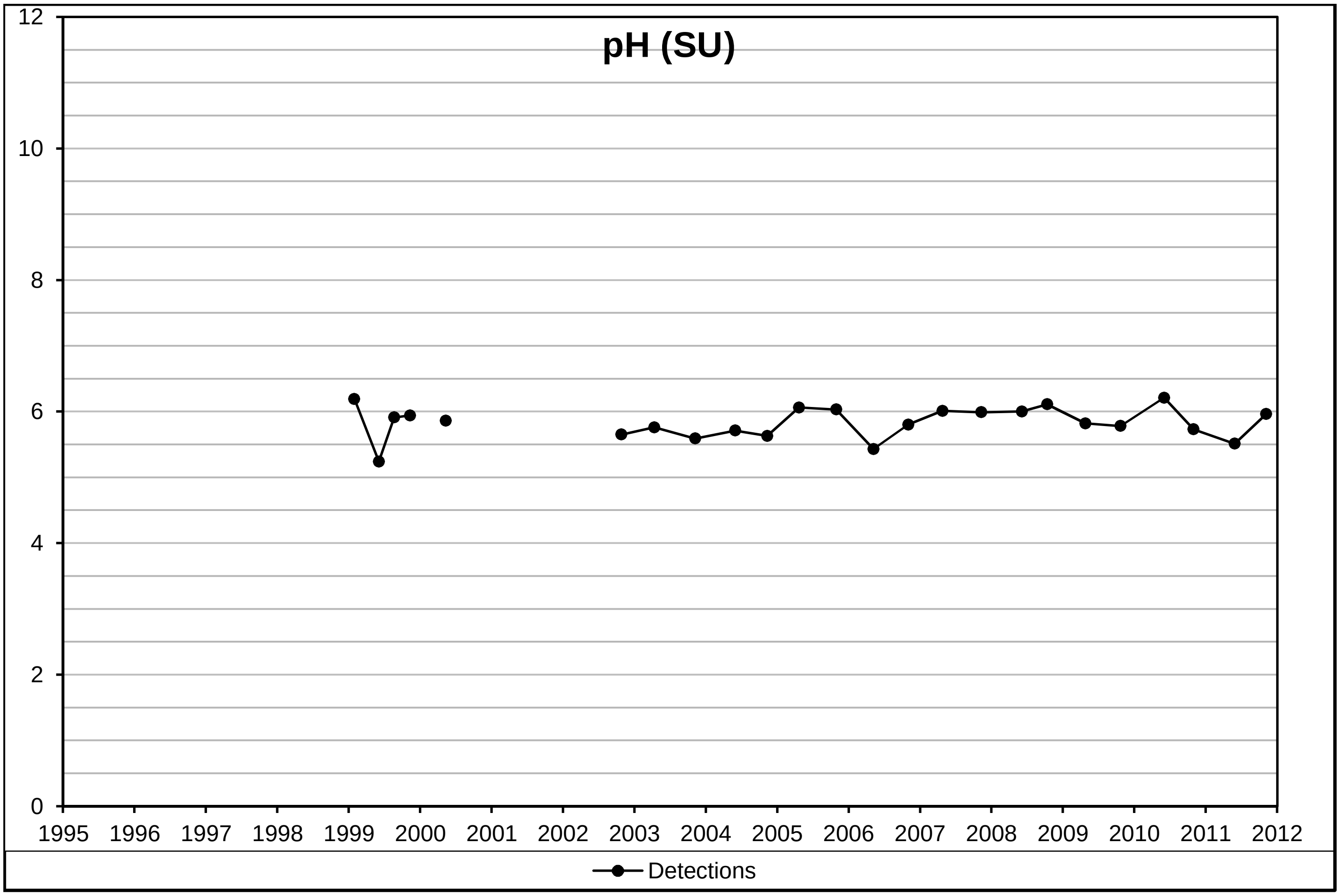

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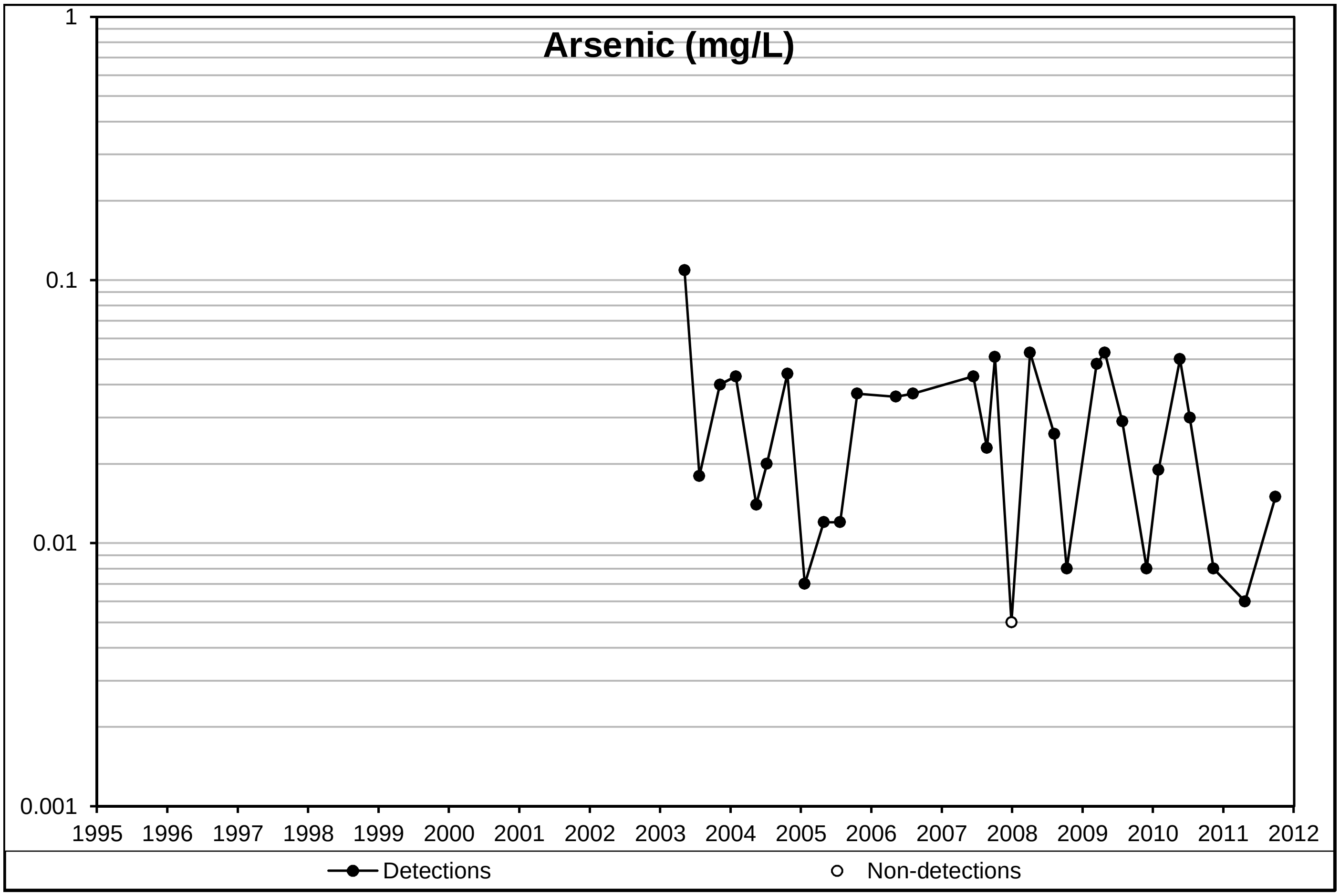
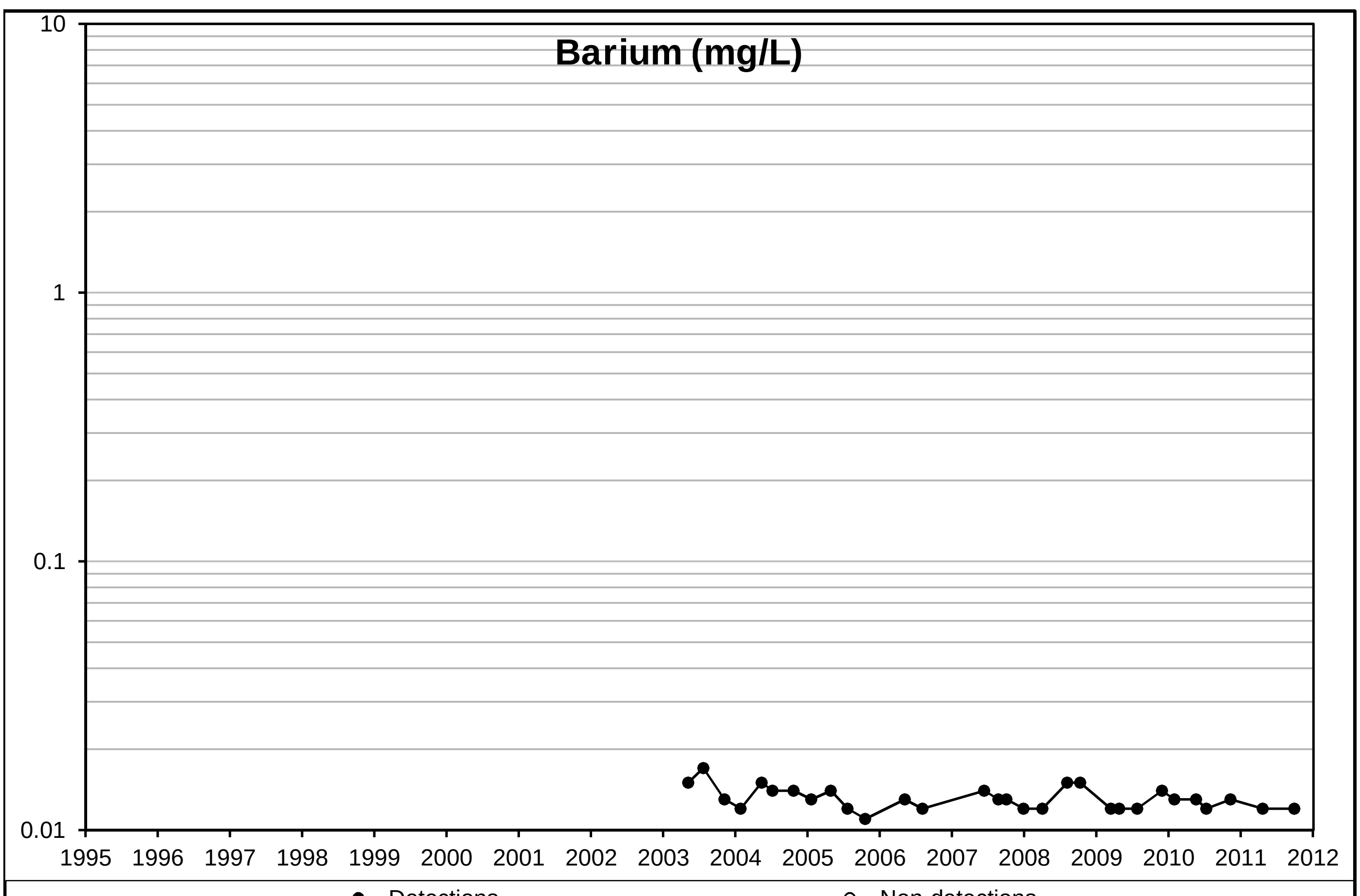
NET2596

Concentration Versus Year





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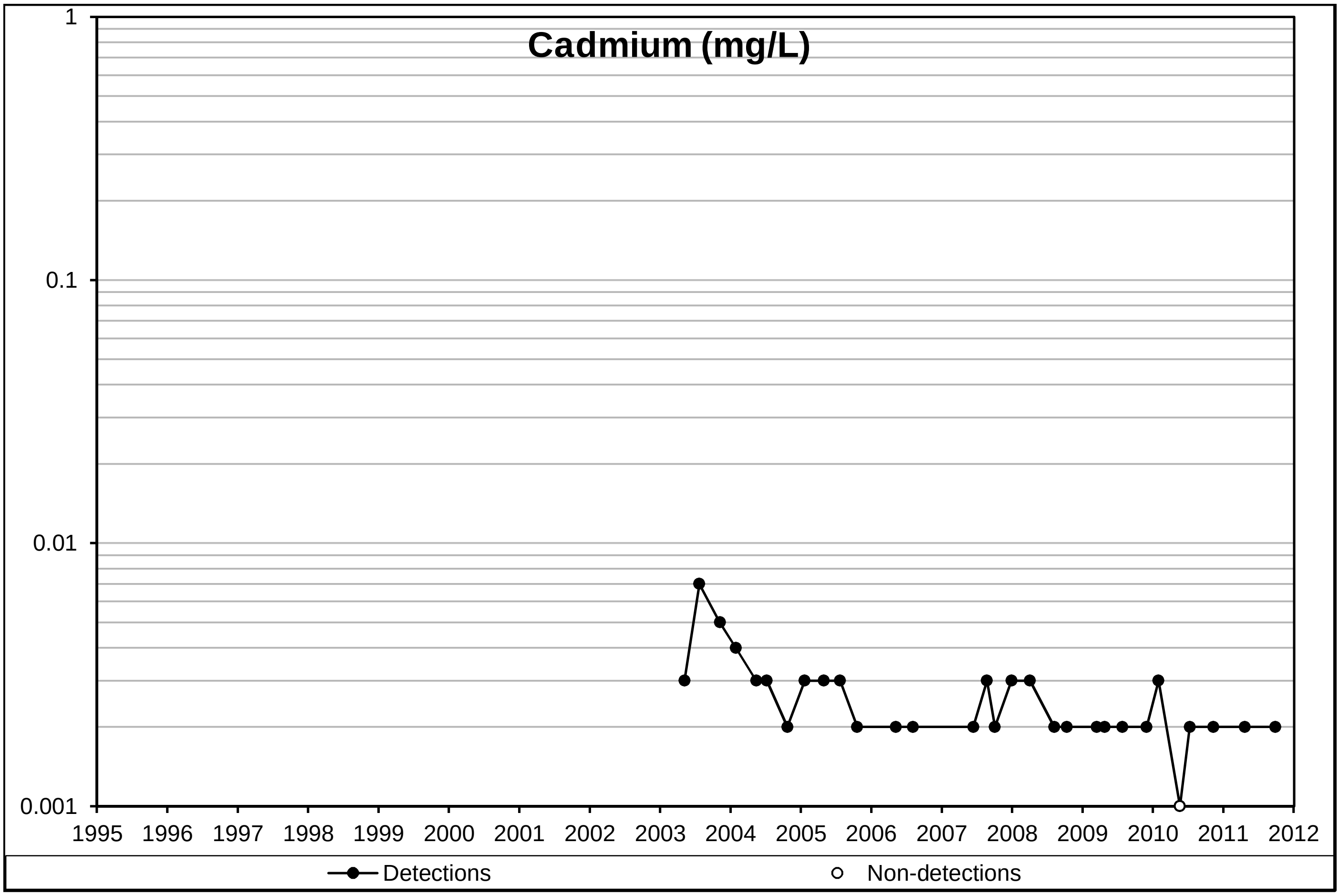

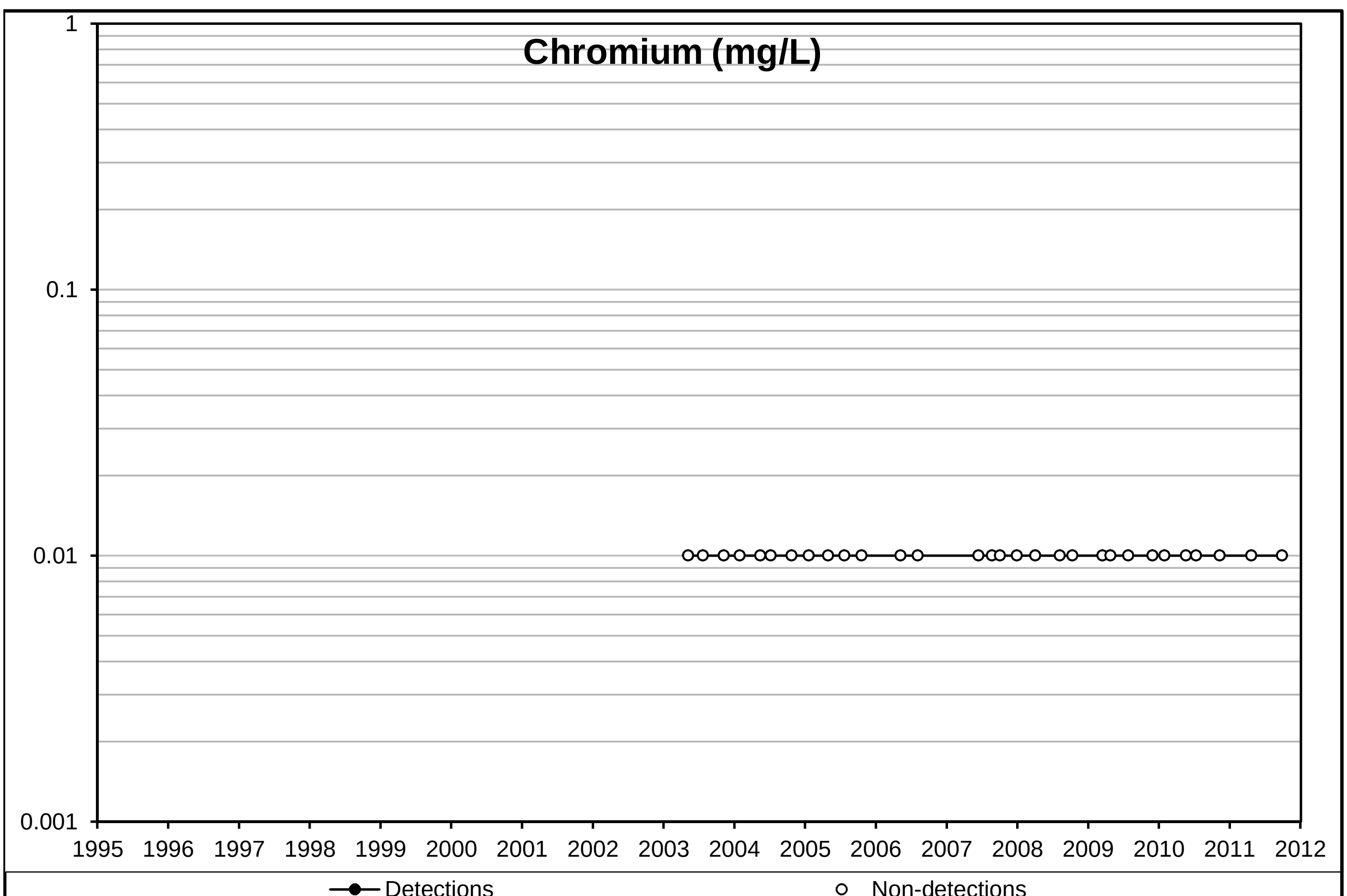

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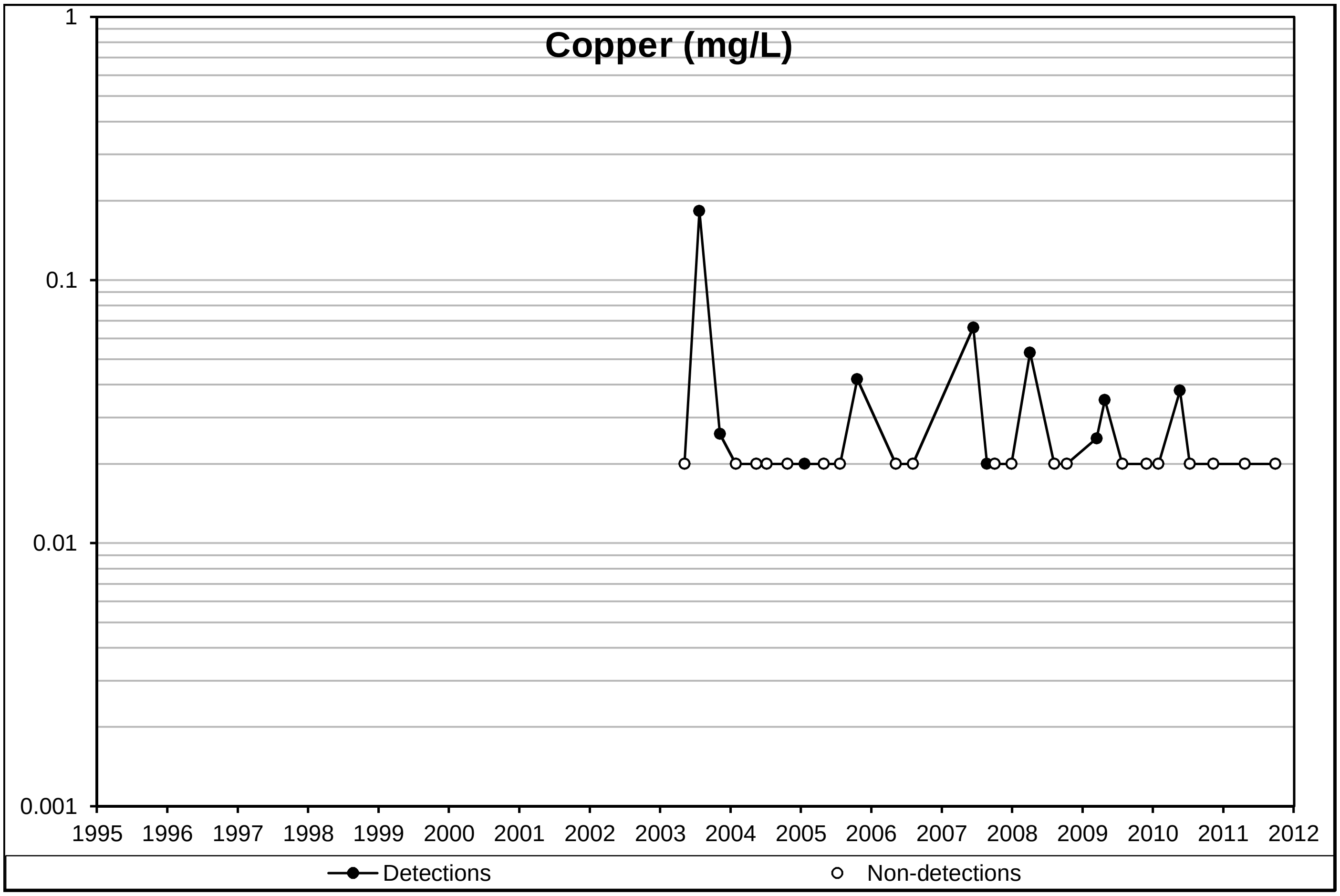

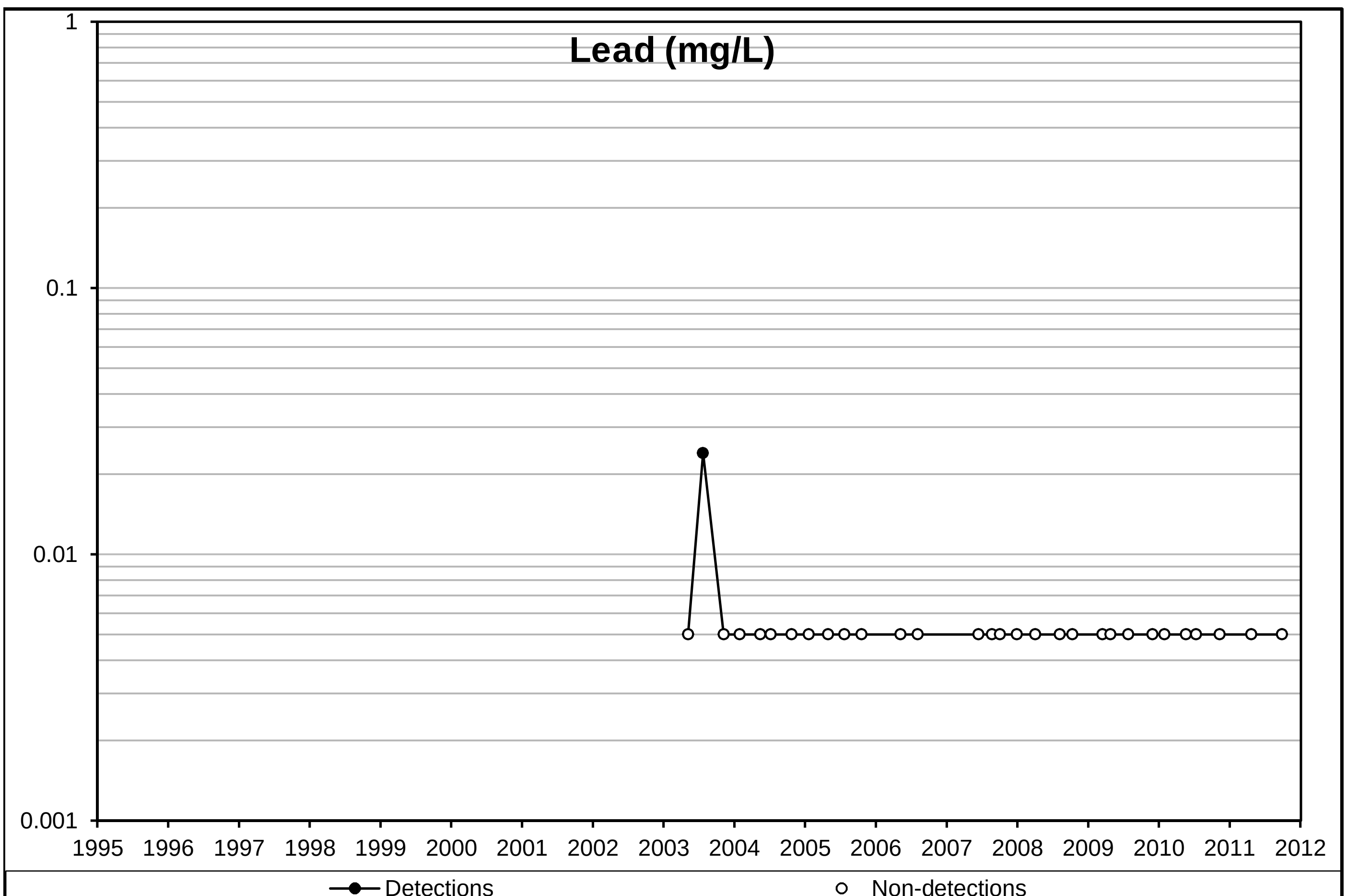

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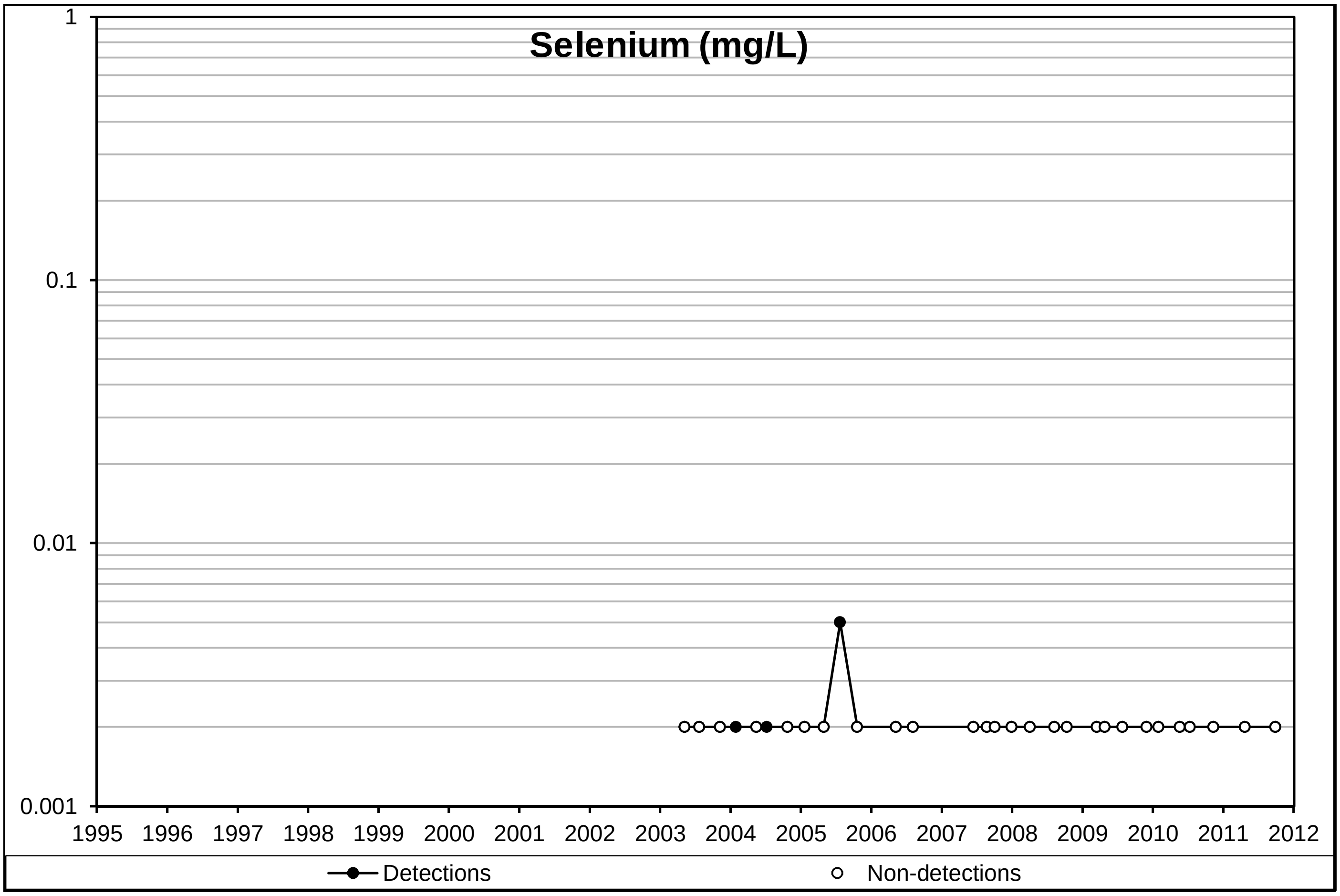

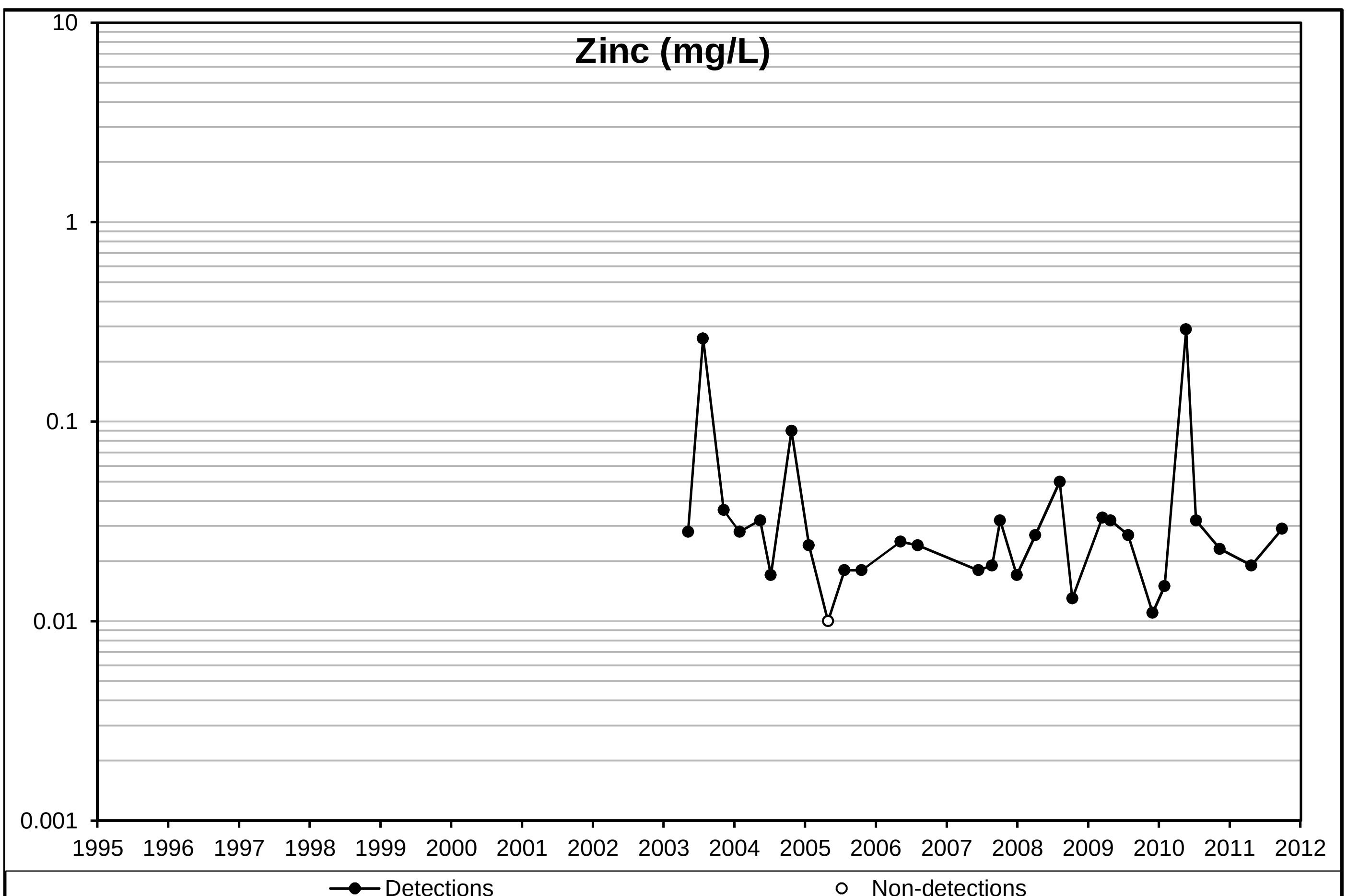

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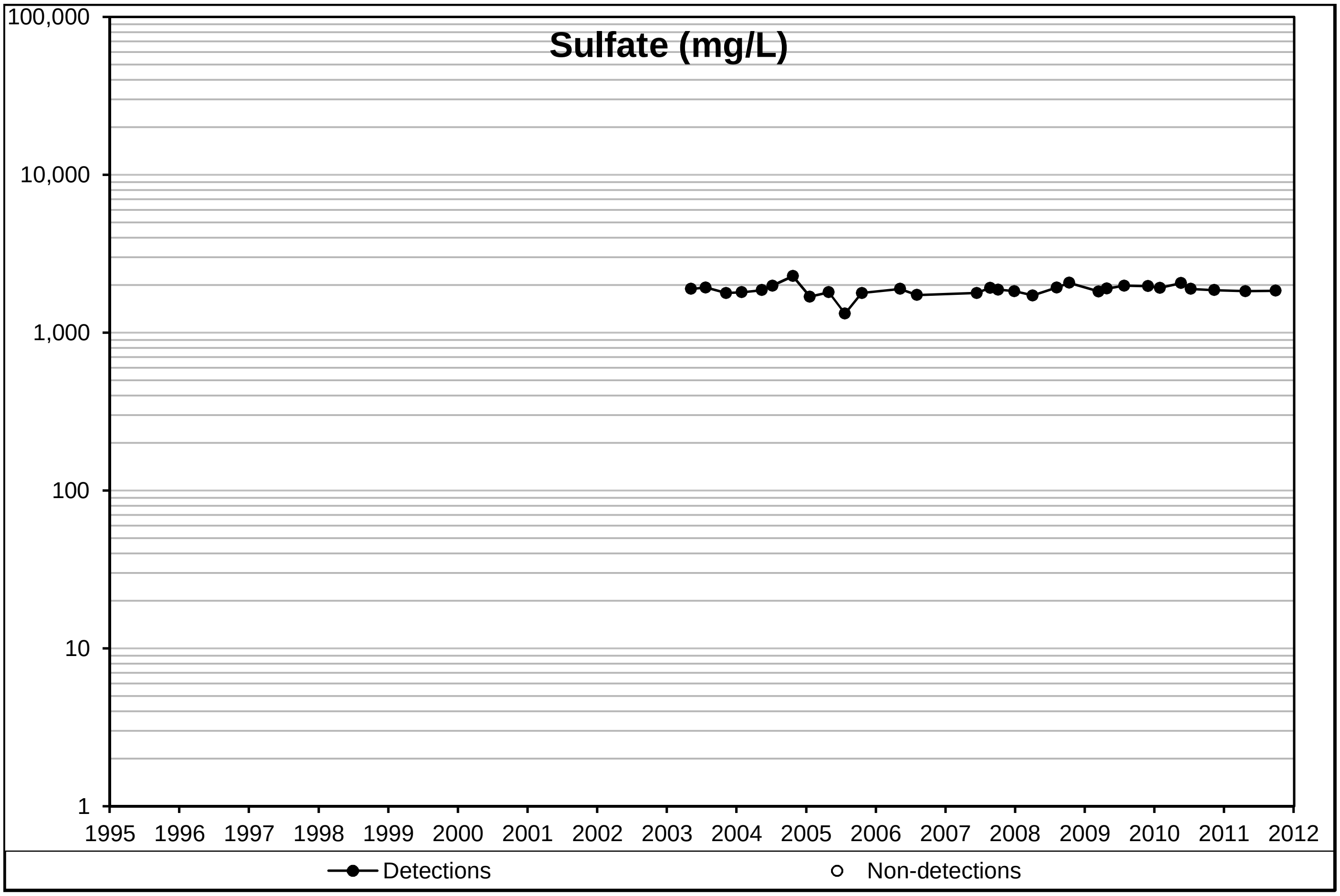

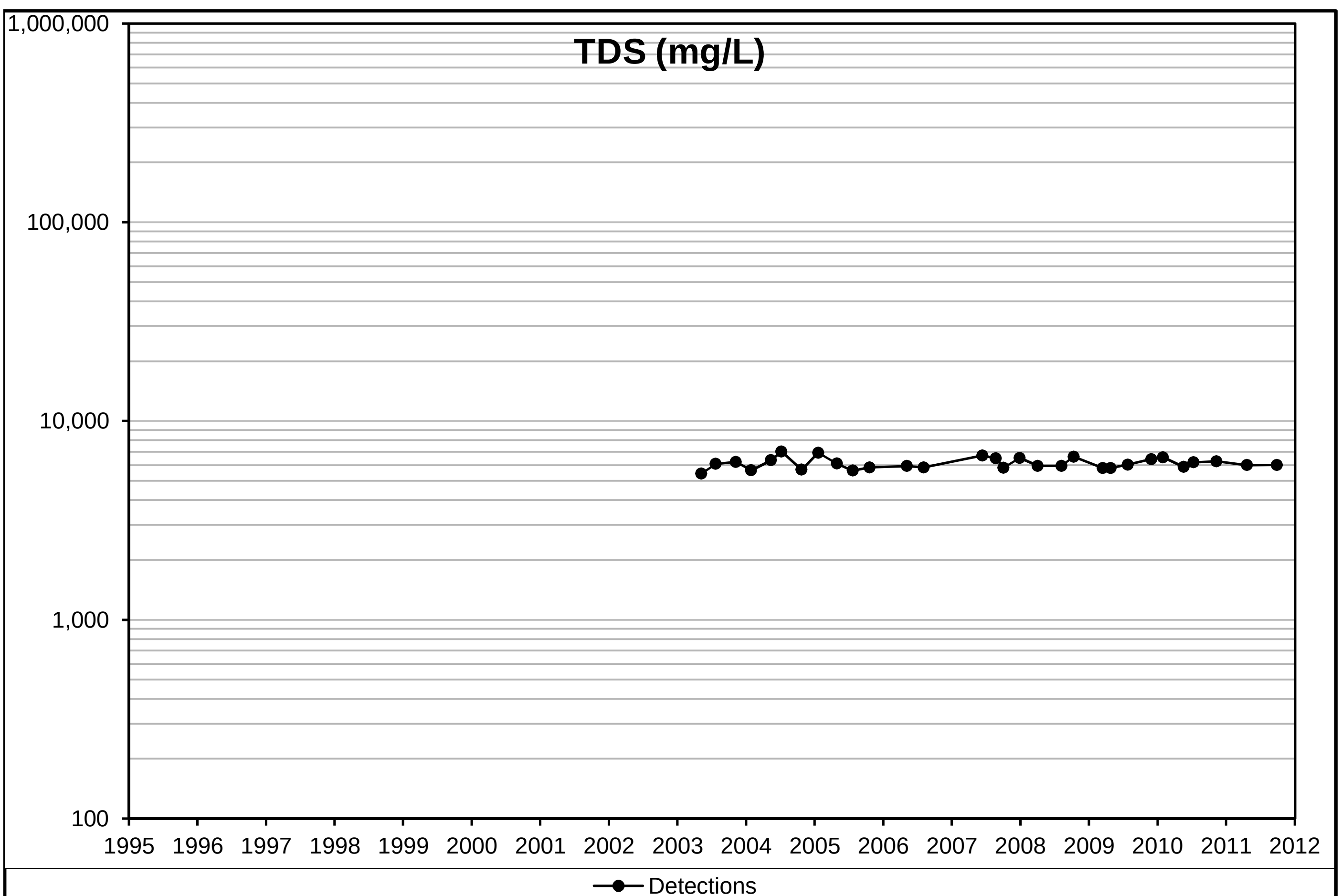

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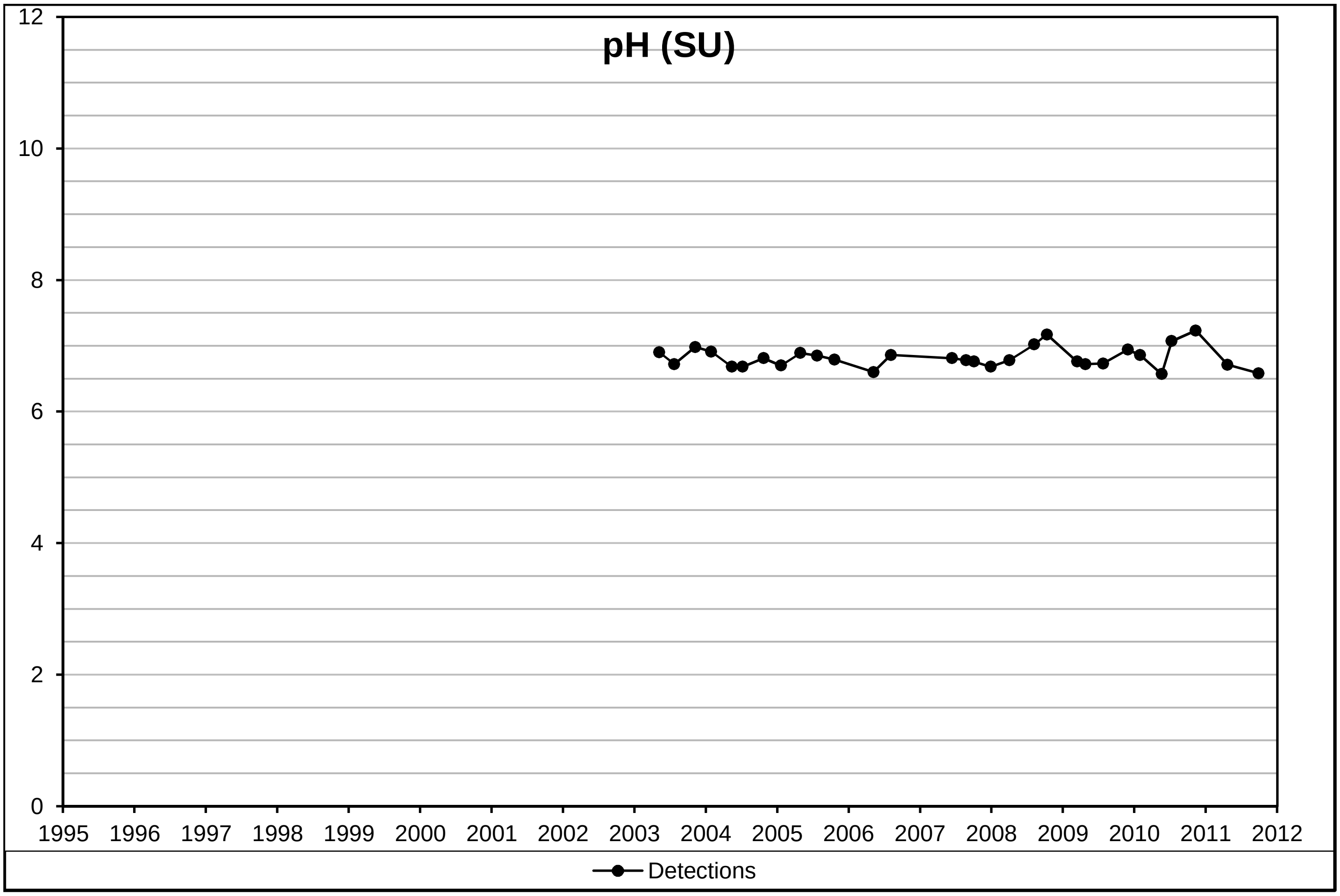

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Part C

Attachment 2

Groundwater Discharge Control Plan

ATTACHMENT 2
GROUNDWATER DISCHARGE CONTROL PLAN

INTRODUCTION

This plan provides a description of the various discharge control methods in place at the existing North and South Impoundments, as well as the planned controls for the proposed Tailings Expansion Project Area. This plan relies on and references technical information presented in the Draft Supplemental Hydrogeology Report (Attachment 1 of Part C). This plan discusses the following methods and controls:

- Natural controls including underlying native low-permeability materials, an upward hydraulic gradient, and influences from tailings deposition.
- Engineering controls including horizontal PVC drains, blanket and finger drains, dewatering pumps, ditches, and decanting pumps.
- Monitoring network for changes in hydraulic head and water quality.

NATURAL CONTROLS FOR DISCHARGE MITIGATION

This section discusses natural conditions that reduce tailings water seepage.

Native Low Permeability Underlying Materials

The native geologic materials underlying the existing and proposed tailings impoundments serve as an effective natural liner to reduce discharge from the tailings to the underlying Shallow and Principal Aquifers. These geologic materials consist of a clay-dominant lacustrine sequence with silty clay and occasional sand layers of the Upper and Lower Lake Bonneville cycles and the Cutler Dam series. Additional details regarding the geology and water bearing nature of the underlying units are included in Sections 3 and 4, respectively, of the Supplemental Hydrogeology Report.

The clays within the Bonneville Clay mitigate vertical flow within the sequence, serving as a liner and confining layer. The Bonneville Clay is laterally extensive and continuous beneath the tailing impoundments having only few sand layers bound by clay. The uppermost continuous clay varies in thickness from 3 to greater than 15 feet beneath the impoundments (see Figure 3-2 and Section 3 of the Supplemental Hydrogeology Report), where the sand layers encountered below the continuous clay are typically thin, poorly connected, and bounded by clay sequences. Therefore, the existing natural Bonneville Clay, in conjunction with the underlying Cutler Dam lacustrine deposits, provides an effective liner beneath the existing impoundments and the proposed Northeast Expansion area.

Upward Hydraulic Gradient

As demonstrated by groundwater elevations in site monitoring wells (see Section 5 of the Supplemental Hydrogeology Report), there is a strong upward vertical hydraulic gradient between the Principal and Shallow Aquifers. This upward gradient prevents tailings seepage from migrating to the Principal Aquifer. Both aquifers exist under confined (artesian) conditions beneath the tailings impoundments.

Influences from Tailings Deposition

The nature of the tailings impoundment construction and deposition naturally promotes preferential horizontal flow to the tailings embankments, where water is collected by drains and pumps, rather than vertically through the center where tailings are less permeable. Lower permeability tailings (i.e., slimes) are deposited in the center of the impoundment, where sands and better drained tailings are deposited along the embankments to encourage dewatering.

Additionally, the tailings permeability decreases with depth due to confining stresses. This further reduces vertical seepage and preferentially increases horizontal flow to the impoundment perimeters where the impoundment is better drained and dewatered. In addition, the loading stresses of the impoundment reduce the vertical permeability of the underlying native clays by up to two orders of magnitude (100 times) due to compression from the weight of the existing tailings impoundment.

ENGINEERING CONTROLS FOR DISCHARGE MITIGATION

The engineering controls are primarily designed to dewater the tailings for stability purposes; however, they also serve to minimize discharge to the Shallow Aquifer through dewatering, seepage collection, and surface water diversion. The engineering controls in place are shown on Figure 1 described as follows:

- Dewatering Southeastern Embankment of the South Impoundment: Horizontal drains are installed partway into the impoundment from the western terminus of the clarification canal to approximately 1,500 feet north of the southeastern corner of the South Impoundment. Also, forty-six dewatering wells are installed in the South Impoundment embankment in this area. Both the wells and horizontal drains dewater the southeastern corner of the South Impoundment and drain the tailings water into the clarification canal. This dewatering system will continue to operate during the proposed TEP.
- Dewatering Perimeter Embankment of North Impoundment and Proposed Northeast Expansion: The width of the perimeter embankment of the North Impoundment is approximately 1,100 feet, the interior half of which is underlain by a blanket drain that extends approximately 200 feet into the impoundment. The downstream half was constructed later with finger drains connecting the blanket drain to the toe ditch where they discharge. The finger drains and the blanket drain are three-layered drains with a permeable material in between an upper and lower fine filter layer to prevent tailings slime and underlying clays from filling pores of the permeable drain. The embankment drainage system for the proposed Northeast Expansion will be constructed using finger drains.
- Collection Toe Ditch: The toe ditch at the base of North Impoundment embankment receives water from multiple sources including ongoing discharge from the embankment finger drains, surface water runoff from embankment slopes during storm events, and minimal shallow groundwater infiltration. Water is then pumped from a collection point at Pump Station No. 9 located in the northeast corner of the North Impoundment to the clarification canal. A portion of the collected water is used in the sprinkler system for dust suppression on the North Impoundment. A toe ditch will be constructed around the proposed Northeast Expansion, similar to that of the North Impoundment.
- Decant Pond: The decant pond on the North Impoundment receives water from process tailings slurry, embankment construction, and from surface water runoff during storm events. Water is decanted and pumped to the upstream (northern) portion of the clarification canal. Some water in the decant pond also infiltrates into the North

Impoundment tailings until it is then collected and discharged via the finger drains into the toe ditch. The decant pond will be operated similarly during the proposed TEP.

- Clarification Canal: The clarification canal located along the southeast corner of the South Impoundment receives water from multiple sources including decanted water from the North Impoundment decant pond, water from the North Impoundment toe ditch, ongoing discharge from the embankment horizontal drains and dewatering wells, as well as surface water runoff from embankment slopes during storm events. Sediments settle out of the water as it drains to the collection point at Pump Station 1 where it is then pumped to the Magna Reservoir to re-enter the process system. The clarification canal will be operated similarly during the proposed TEP.
- The C-7 Ditch: The C-7 ditch does not receive process water but rather redirects surface water features (i.e., Kersey Creek) and storm water around the tailings impoundments. It serves to minimize the contact of natural waters with the tailings. The C-7 ditch will be rerouted around the proposed Northeast Expansion. Portions of the old C-7 ditch that underlie the proposed Northeast Expansion area will be backfilled. During the construction of the new rerouted portion of the C-7 ditch, clay material will be compacted above ground as berms along the ditch edges.

The above control measures reduce the amount of water available to potentially seep to the underlying aquifers. In addition, dewatering measures lower the hydraulic head exerted on the clay layer overlying the Shallow Aquifer, therefore reducing seepage from the tailings.

MONITORING METHODS

The site monitoring network under the groundwater discharge permit includes the sampling and gauging of 29 compliance groundwater monitoring wells, five wells screened in the tailings, one observed flowing seep, nine lysimeters, the clarification canal, and the toe ditch. These locations are shown on Figure 1-1 of the Supplemental Hydrogeology Report. Of the 29 compliance groundwater monitoring wells, 16 wells are screened within the Shallow Aquifer (often denoted by an appended "A" to the site identification) and 13 wells are screened within the Principal Aquifer (often denoted by an appended "B" or "C" to the site identification). Details regarding the changes to the permit monitoring program to address the increased footprint of the proposed Northeast Expansion are included in the Compliance and Operational Monitoring Plan Addendum (Attachment 3 of Part C).

Hydraulic Head

Depth to water measured in the tailings wells, Shallow Aquifer wells, and Principal Aquifer wells is used to assess water flow direction, horizontal gradients, and vertical gradients within the units over time. As mentioned in the above section and in Section 5 of the Supplemental Hydrogeology Report, the hydraulic head data demonstrates a strong upward vertical hydraulic gradient from the Principal Aquifer to the Shallow Aquifer. Long-term gradual increases may be indicative of a continual recharge source (i.e., surface water or tailings water), whereas a stable groundwater elevation likely suggests that there are no significant sources of continual recharge.

Water Quality Constituents

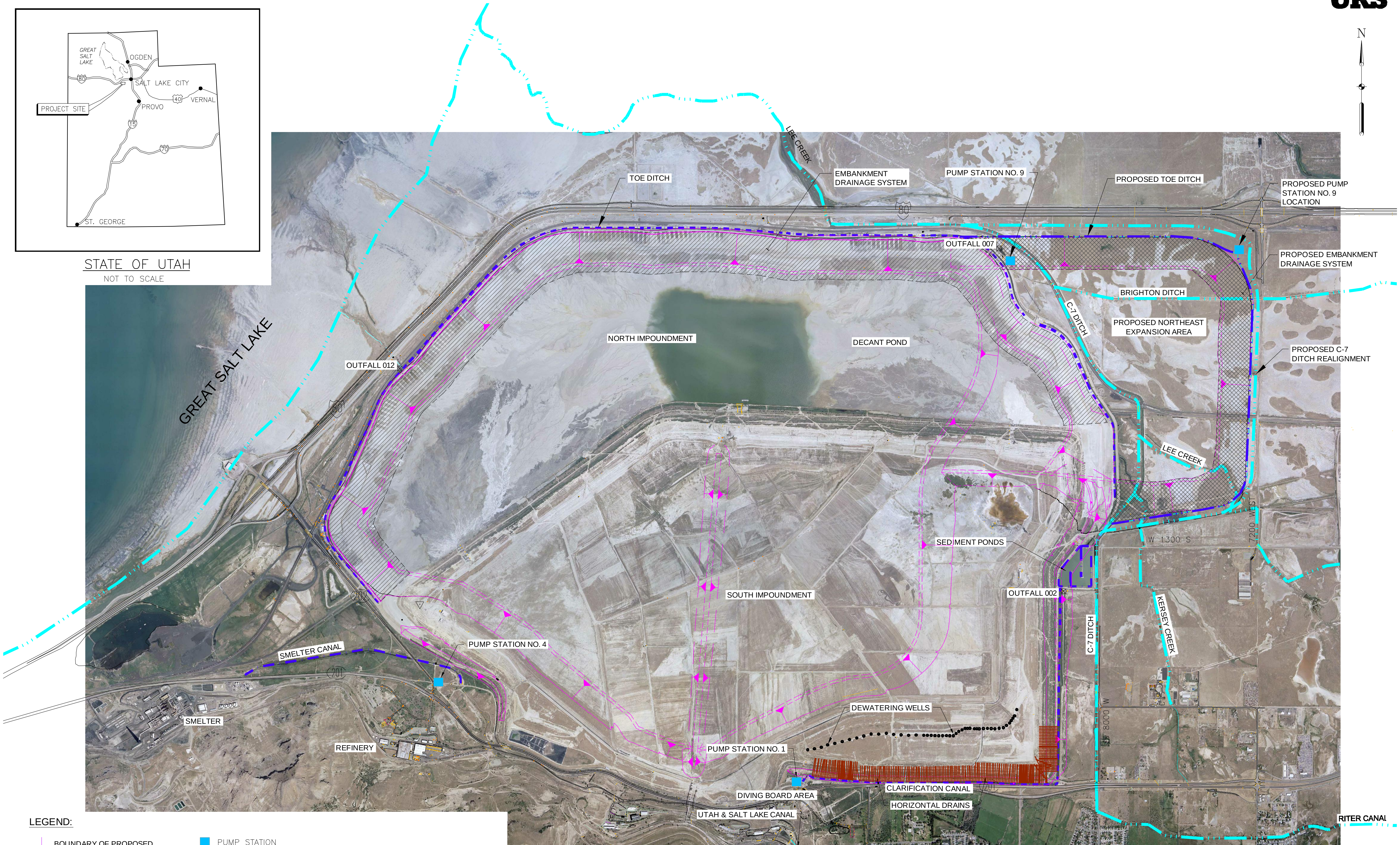
Select constituents are monitored at sampled locations in an effort to assess potential impacts from tailings seepage to the underlying aquifers. Of the sampled analytes, eleven parameters are compared to the location-specific Protection Level and Compliance Limit including pH, eight metals (i.e., arsenic, barium, cadmium, chromium, copper, lead, selenium, and zinc), sulfate, and total dissolved solids (TDS). Additional details regarding the presentation and interpretation of water quality is included in Section 7 of the Supplemental Hydrogeology Report.

Tailings water quality is compared to Shallow and Principal Aquifer water quality. Long term gradual increases and decreases may be indicative of a long term recharge source (i.e., tailings water) for constituents of greater and lower concentrations in tailings water, respectively. Stable trends suggest that seepage of tailings water is not causing changes to groundwater quality.

SUMMARY OF DISCHARGE CONTROL

There are multiple methods of controlling discharge from the tailings to the underlying aquifers, including natural controls and engineering controls. Seepage is limited by the natural liner provided by the underlying native low-permeability materials (namely the Bonneville Clay and Cutler Dam series) comprising the upper 35 feet beneath the impoundments. Furthermore, the tailings deposition decreases permeability with depth and reduces vertical seepage rates, influencing groundwater to preferential flow horizontally to the more permeable embankments where water is collected via drains and recycled as process water.

Engineering controls - such as blanket and finger drains, pumping wells, and collection ditches – serve to reduce the hydraulic head applied to the natural clay liner as well as the amount of water available for vertical seepage. Dewatering processes encourage horizontal water flow within the tailings and reduce the gradient differential between the hydraulic pressures in the tailings and the Shallow Aquifer.



LEGEND:

- BOUNDARY OF PROPOSED TAILINGS EXPANSION PROJECT
- PUMP STATION
- SURFACE WATER DRAINAGES
- PROCESS WATER DRAINAGES

0 1500 3000 6000
SCALE IN FEET

DRAWING PATH: W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\ENGINEERED FEATURES.dwg

URS

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT MODIFICATION	LOCATION OF ENGINEERING CONTROLS FOR GROUNDWATER DISCHARGE MITIGATION	FIGURE 1 (ATTACH. 2)
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Part C

Attachment 3

Compliance Monitoring Plan Addendum

ADDENDUM

COMPLIANCE AND OPERATIONAL MONITORING PLAN

GROUND WATER DISCHARGE PERMIT PERMIT NO. UGW350011 (May 2012)

1.0 INTRODUCTION

This addendum presents planned changes to the Compliance and Operational Monitoring Plan at the tailings impoundment (Appendix B of UGW350011) to address the construction and operation of Phase I of the proposed Tailings Expansion Project (TEP). The TEP includes the proposed expansion of the tailings impoundment to the northeast (Northeast Expansion) and the raising of the North Impoundment. This addendum addresses proposed changes only. These changes will be incorporated into the Compliance and Operational Monitoring Plan following final design of the proposed TEP. This addendum addresses monitoring changes (Section 2), background monitoring (Section 3), routine monitoring (Section 4), and surveying of new monitoring points (Section 5). All monitoring changes will be in accordance with procedures in the State-approved Groundwater Characterization and Monitoring Plan (GCMP).

2.0 MONITORING CHANGES

Proposed monitoring changes include: (1) monitoring well abandonment and replacement, (2) discontinuance of lysimeter monitoring, and (3) toe ditch sampling modification. The locations of proposed changes are shown on Figure 1 and listed on Table 1. The following discusses the proposed changes.

2.1 Monitoring Well Abandonment and Replacement

Two compliance monitoring well nests consisting of a total of four individual wells (NET1381A, NET1381B, NE1385A, and NET1385B) will require plugging and abandonment prior to construction of the proposed Northeast Expansion. These wells are located on the northeast perimeter of the North Impoundment (Figure 1) and are within the footprint of the proposed Northeast Expansion. In addition to these four compliance wells, there are six to seven other Kennecott-owned monitoring well nests within the general area of the proposed Northeast Expansion not currently part of the current permit compliance monitoring program that may require plugging and abandonment depending on the final footprint of the Northeast Expansion. The need to plug and abandon these wells will be further assessed during the design of the proposed Northeast Expansion. The plugging and abandonment of all wells will be coordinated through the GCMP program. Plugging and abandonment will be conducted in accordance with Utah regulations (R655-4-14).

In addition to Kennecott-owned wells that may require plugging and abandonment, there are potentially six or fewer historical monitoring wells associated with the closed Salt Lake County Landfill located near the south boundary of the proposed Northeast Expansion that may be affected by future construction. Kennecott will work with Salt Lake County on identifying the location and construction of these historical wells, so that the effects of the proposed Northeast Expansion on these wells can be properly evaluated.

To replace the two permit well nests that will be plugged and abandoned, four well nests, consisting of a total of eight individual wells, will be installed around the perimeter of the proposed Northeast Expansion. These well nests are temporarily identified as TEP-1, TEP-2, TEP-3, and TEP-4 on Figure 1 and Table 1, but will be re-named in accordance with the GCMP well numbering scheme when they are installed. The replacement wells are located so that the currently approved well spacing of at least one well (or nest) per mile of embankment is maintained. Because the length of the embankment perimeter will increase following the construction of the proposed Northeast Expansion, the two well nests to be abandoned are replaced by four. It is possible that Kennecott-owned well nests that currently exist near the perimeter of the proposed Northeast Expansion may not be affected by the construction and could be used as compliance monitoring wells for UGW350011. The use of these wells to replace permit well nests that will be abandoned will be evaluated before installing new monitoring wells.

Each replacement well nest will consist of one well screened in the Shallow Aquifer and one well screened in the upper portion of the Principal Aquifer. An "A" and "B" suffix will be included in the final well identification number for the Shallow Aquifer and Principal Aquifer wells, respectively, consistent with other wells in the permit monitoring program.

The Shallow Aquifer well screen will be placed in the thickest sand layer or sequence encountered below the uppermost clay layer in the Bonneville Clay, which exists from approximately ground surface to a depth ranging from 3 to 15 feet or more, and above a depth of approximately 35 feet below ground surface (bgs). The depth to groundwater is expected to be approximately 2 feet below ground surface at these locations.

The Principal Aquifer well in each well nest will be installed in the first significant sand layer (approximately 2 feet thick or more) in the depth interval from 35 to 70 feet bgs. The Principal Aquifer well may be under flowing artesian conditions.

The wells will be installed in conformance with with EPA RCRA Groundwater Monitoring Technical Enforcement Guidance Document, 1986, OSWER-9950.1, Section 3.5, in accordance with UGW350011. Documentation of the well completion will be provided to Utah Department of Water Quality (UDWQ) within 60 days of well installation.

2.2 Discontinuance of Lysimeter Monitoring

Sampling of water accumulation in the eight lysimeters located on the South Impoundment (Figure 1) every five years will be discontinued. Sample production from the lysimeters is unreliable due to their completion depth in unsaturated or partially saturated tailings material, and the sample objective of assessing acidification potential in the surficial tailings is achieved more reliably through annual surface sampling of the tailings material (see Appendix A of UGW350011, Assessment of Acidification Potential, Kennecott Tailings Impoundment, January 2011).

The lysimeters will be left in place and available for other monitoring purposes, as needed. Two lysimeters, TLL4128 and TLL4129 (Figure 1), will require abandonment prior to raising the North Impoundment. The lysimeters are completed in the tailing material from depths ranging from 2 to 20 feet bgs, and do not require special well abandonment procedures. Replacement lysimeters will be installed in the South Impoundment tailing material as close to the original locations as possible.

2.3 Toe Ditch Sample Location Modification

One toe ditch sampling location, TLP1436, will be covered by the proposed Northeast Expansion embankment. This location will be relocated as close to the original location as possible.

3.0 BACKGROUND MONITORING

Groundwater Protection Levels are established for UGW350011 using existing background water quality on a well-by-well basis. The four replacement monitoring well nests will be Class III groundwater, consistent with the wells they are replacing. Protection levels for the replacement monitoring wells will be established following the collection of eight consecutive quarterly samples over a period of two years to establish baseline conditions that account for seasonality.

The collection of groundwater samples for background monitoring will be in accordance with the Compliance and Operational Monitoring Plan (Appendix B of UGW350011).

Background monitoring of the toe ditch sample location is not required.

4.0 ROUTINE MONITORING

Following the establishment of baseline conditions (Section 3), the four new monitoring well nests will be sampled semiannually, consistent with the sample schedule for the wells they are replacing. The new toe ditch sampling location will be sampled quarterly, consistent with the location it is replacing.

The collection of groundwater samples for routine monitoring will be in accordance with the Compliance and Operational Monitoring Plan (Appendix B of UGW350011).

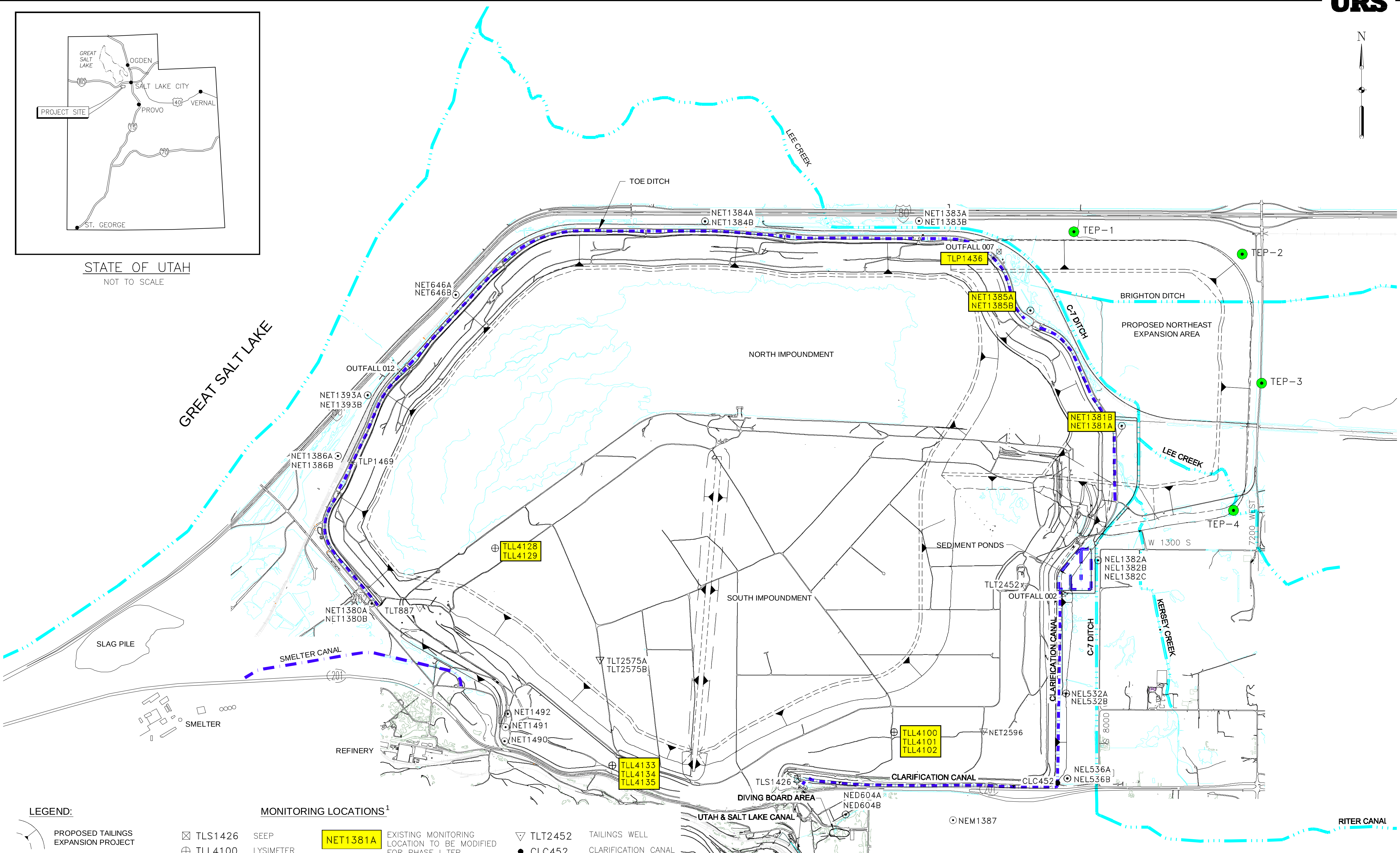
5.0 SURVEYING

Following new well installation and relocation of the toe ditch sampling point, the monitoring points will be surveyed by a Utah licensed surveyor. The survey will be tied into the 2012 re-survey of the UGW350011 monitoring locations. For each well location, the survey will include ground surface elevation, casing top elevation (i.e., groundwater elevation measurement point) and northing-easting in state planar coordinates. The survey will be performed in accordance with Standard Operating Procedures developed for the 2012 re-survey of the UGW350011 monitoring locations.

Table 1
MONITORING LOCATION MODIFICATIONS FOR THE PROPOSED TEP

Monitoring ID[1]	Modification	Northing	Easting	Ground Elevation (ft amsl)	Elevation Mark (ft amsl)	Well Depth (ft)	Screen Top (ft)	Screen Bottom (ft)
Compliance Monitoring Well Modifications								
NET1381A	abandon/replace	7443041.228	1479773.31	4219.361	4221.454	36	25	35
NET1381B	abandon/replace	7443040.648	1479779.41	4219.259	4221.438	55	44	54
NET1385A	abandon/replace	7446894.687	1476726.33	4214.988	4217.494	25	14.5	24.5
NET1385B	abandon/replace	7446898.159	1476718.97	4214.99	4217.181	71	60	70
TEP-1A	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				30	20	30
TEP-1B	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				70	60	70
TEP-2A	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				30	20	30
TEP-2B	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				70	60	70
TEP-3A	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				30	20	30
TEP-3B	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				70	60	70
TEP-4A	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				30	20	30
TEP-4B	New well on proposed NE Expansion perimeter	To be deternined (see Figure 1)				70	60	70
Tailings Wells Modification								
None								
Lysimeters Modification[2]								
TLL4128	abandon/replace	7438944.922	1458826.79	4389.21	4390.933	2	NA	NA
TLL4129	abandon/replace	7438948.285	1458831.55	4389.248	4390.838	5	NA	NA
Toe Ditch Sampling Modification								
TLP1436	abandon/replace	7431247.082	1468939.16	4241.533	NA	NA	NA	NA
Seep Sampling Modification								
None								

Notes:
[1] Only the monitoring locations that potentially are affected by Phase I of the proposed Tailings Expansion Project are listed on this Table.
[2] Lysimeter monitoring will be discontinued. Lysimeters affected by construction will be replaced and lysimeters unaffected by construction will be left in place.
NA = Not applicable



LEGEND:

- PROPOSED TAILINGS EXPANSION PROJECT
- SURFACE WATER DRAINAGES
- PROCESS WATER DRAINAGES

MONITORING LOCATIONS[1]

TLS1426	SEEP	NET1381A	EXISTING MONITORING LOCATION TO BE MODIFIED FOR PHASE I TEP
TLL4100	LYSIMETER	TEP-4	APPROXIMATE LOCATION OF EXISTING OR NEW WELL TO REPLACE ABANDONED WELLS
NEL532A	MONITORING WELL	TLT2452	TAILINGS WELL
TLP1469	TOE DITCH	CLC452	CLARIFICATION CANAL
		OUTFALL 012	OUTFALL
			ROADS

TEP = TAILINGS EXPANSION PROJECT

0 1500 3000 6000

SCALE IN FEET

[1] LOCATIONS WERE RE-SURVEYED IN JANUARY AND MARCH 2012.

DRAWING PATH: W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\COMP MONITORING POINTS.dwg

URS

PROJECT NO. 22242186	KENNECOTT TAILINGS GROUNDWATER DISCHARGE PERMIT MODIFICATION	LOCATION OF EXISTING AND PROPOSED COMPLIANCE MONITORING POINTS DURING TEP OPERATION	FIGURE 1 (ATTACH. 3)
	URS		

Part C

Attachment 4

Closure and Post-Closure Plan

CLOSURE AND POST-CLOSURE PLAN

(RESERVED)

Kennecott is currently updating the Mining and Reclamation Plan as part of the Division of Oil, Gas and Mining (DOGM) permit M-035-0015. This revision will provide the basis for the Closure and Post-Closure Plan for the tailings impoundment that is required for this groundwater discharge permit.

Part C

Attachment 5

Contingency and Corrective Action Plan

CONTINGENCY AND CORRECTIVE ACTION PLAN

The Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6) require applicants to submit a Corrective Action Plan or other response measures to be taken to remedy any violation of ground water quality standards resulting from discharges. Permit UGW350011 has a compliance condition that allows the Executive Secretary to call for a Contamination Investigation and Corrective Action Plan to be submitted and made a part of this permit should future data indicate that clean-up of existing contamination at the Tailings Impoundment site is in fact needed.

Revised Statement of Basis and Permit

GROUND WATER QUALITY DISCHARGE PERMIT UGW350011
STATEMENT OF BASIS

Kennecott Utah Copper **LLC**
Tailings Impoundment
Magna, Utah

~~January 2011~~**September 2012**

Facility Description and Background

The Tailings Impoundment complex is located in**, or in portions of,** Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23 and 24 of Township 1 South, Range 3 West**;** ~~and~~ Sections **4,** 5, 6, 7, 8, 9, 17, 18, 19, and 20 of Township 1 South, Range 2 West**;**~~.~~ **Sections 31, 32 and 33 of Township 1 North, Range 2 West; and Sections 35 and 36 of Township 1 North, Range 3 West.** The Tailings Impoundment has operated since 1906 for the storage of tailings from concentrators processing ore from the Bingham Canyon mine, and has undergone numerous changes and expansions to accommodate the volume of materials. The original 1**,**350-acre impoundment was located in the western portion of the Magna impoundment area. Around 1914, the original impoundment was enlarged to the east by approximately 1,466 acres. By the early 1990's, the footprint of the South Impoundment had reached approximately 5**,**700 acres with a height of over 220 feet, storing 1.5 billion tons of tailings. The South ~~i~~**I**mpoundment ~~has completed its operational life and no longer~~**currently does not** receive~~s~~ tailings materials. In 1995, Kennecott **Utah Copper LLC (Kennecott)** added approximately 3,~~3~~**5**00 acres adjacent to and north of the existing impoundment to enable operations of the Bingham Canyon Mine to continue for approximately another 20 years. This expansion also allowed for the seismic upgrade of the impoundment. Beginning in 1999, tailings deposition began transitioning from the South Impoundment to the North Impoundment. The current discharge into the North Impoundment is approximately 170,000 tons per day of tailings from the Copperton Concentrator. **Kennecott is proposing to expand the tailings impoundment area by approximately 1,300 acres adjacent to and east of the North Impoundment (the Northeast Expansion), raise the North Impoundment above its current design height, and raise portions of the South Impoundment.**

Site Hydrogeology

Three aquifer systems exist in the vicinity of the Tailings Impoundment: the Bedrock Aquifer system associated with the Oquirrh Mountains, the confined Principal Aquifer, and the ~~unconfined~~ Shallow Aquifer. The bedrock aquifer is comprised of highly fractured Paleozoic carbonate rocks. Recharge to this system is principally from precipitation on the mountains to the south. The flowpath through this aquifer moves from the fractured bedrock into the Principal and Shallow Aquifers or is discharged as spring water along bedrock contacts at the base of the mountains. Water quality of the bedrock aquifer is generally Class II ground water (TDS less than 2,000 mg/l). There are occasional arsenic and selenium values that exceed ground water quality standards in the bedrock aquifer. The high selenium values are attributable to localized impacts from past Refinery operations.

The Principal Aquifer is a confined system which includes a gravel zone and lacustrine deposits. The gravel zone was most likely derived from the local mountains during an extensive low lake cycle. Many high-yield water supply wells near the Oquirrh Mountains are completed in the gravel zone of the Principal Aquifer. The lacustrine zone consists of clay, silt and interbedded fine sand. Ground water flow direction for the Principal Aquifer is north toward the Great Salt Lake. ~~Except directly beneath the existing Tailings Impoundment, m~~**M**easured water levels in the ~~p~~**P**rincipal ~~a~~**A**quifer **wells located around the perimeter of the tailings impoundment** are above ~~ground~~ **the water** levels ~~at locations north of Highway 201~~**in adjacent nested Shallow Aquifer wells,** indicating an upward hydraulic gradient throughout the vicinity of both impoundments. **The majority of Principal Aquifer wells located along the perimeter of the North and South Impoundments are under flowing artesian conditions.**~~A ground water mound, with downward vertical gradients, exists directly beneath the impoundments.~~ Ground water quality in the Principal Aquifer is generally better than the Shallow Aquifer, with TDS values ranging from 700 to 40,000 mg/l. The higher TDS values correlate with proximity to the Great Salt Lake. Concentrations of arsenic, selenium, and cadmium in excess of Utah Ground Water Quality Standards have been observed in the Principal Aquifer.

The Shallow Aquifer system consists of interbedded lacustrine Bonneville Clay, silt, and fine sand. The exact depth of this system varies but is approximately the upper 35 to 50 feet of saturated sediments. The potentiometric surface for the Shallow Aquifer system depicts lateral flow in a northerly direction toward the Great Salt Lake. An upward hydraulic gradient from the underlying Principal Aquifer exists for the majority of well~~s~~ **nests** completed in **both** the Shallow **and Principal** Aquifer~~s system~~. **The majority of Shallow Aquifer wells located along the northern perimeter of the North Impoundment are under flowing artesian conditions.** ~~A ground water mound exists directly beneath~~ ~~t~~The **hydraulic head in the** Tailings Impoundment **is higher than the hydraulic head in the Shallow Aquifer, resulting in** ~~with~~ downward vertical gradients ~~indicating~~ **with** a potential for discharge of tailings water into the shallow system. Ground water quality in ~~this system varies markedly from the contact with the bedrock system on the south showing relatively high quality waters~~ **the shallow lacustrine unit is relatively poor** with TDS values ~~around 1,000 mg/l to TDS values~~ exceeding 200,000 mg/l in the vicinity of the Great Salt Lake. **Background** ~~C~~concentrations of arsenic, selenium, and cadmium in excess of Utah Ground Water Quality Standards have been observed in the Shallow Aquifer.

Facility Operations

<u>South Impoundment</u> - Tailings deposition into the South Impoundment ceased in October 2002. Draindown water from the South Impoundment is collected in the clarification

canal and **horizontal PVC drain pipes**~~toe drains~~ that have been constructed around the perimeter of the impoundment. When necessary, the water in the clarification canal can be discharged through UPDES permitted discharge points. Some seepage from the impoundment enters the ~~s~~**S**hallow ~~a~~**A**quifer system. Kennecott estimates ~~this amount at 620~~**the maximum potential discharge rate to be 700** gallons per minute, however, this will gradually decrease over time due to the establishment of a vegetative evapotranspiration cover. **The South Impoundment is underlain by the Bonneville Clay, a thick, laterally extensive, low-permeability lacustrine deposit.**

A sedimentation pond **is located** ~~has been constructed~~ east of the ~~southeast~~ **northeast** corner of the South Impoundment to **settle out suspended sediments in the water prior to entering the Clarification Canal.**~~allow for further clarification of the draindown water to reduce total suspended solids on an as needed basis prior to return of water to the process circuit.~~ The Sedimentation Pond is also underlain by the low permeability Bonneville Clay.

<u>Diving Board</u> - The Diving Board area is located immediately south of State Road 201 and west of 9180 West. This area is a small earthen impoundment **originally** designed to retain tailings discharges resulting from ~~scheduled~~ **emergency** shutdowns~~ and temporary upsets~~. ~~Drainage from this area is collected via a ditch and channeled to the clarification canal. Accumulated tailings are periodically excavated and transferred from the Diving Board area to the Tailings Impoundment. Past releases of process water to this area have resulted in d~~ **Due to the relocation of the tailings pipeline, the Diving Board is no longer used for this purpose. It is currently designated as the capture area for the Magna Reservoir in the unlikely event of a catastrophic failure. D**issolved arsenic levels ~~of~~ in the shallow groundwater ~~that~~ **have** exceed**ed** the Utah ground water quality standard**, likely due to historical operations in this area**. The upward hydraulic gradient has protected the intermediate aquifer from arsenic degradation.

<u>North Impoundment</u> **-** The North Impoundment is underlain by the Bonneville Clay, a thick laterally extensive low-permeability lacustrine deposit. This contiguous stratum represents the top layer of a several hundred foot thick sequence of fine-grained lacustrine sediments.

Tailings are deposited into the North Impoundment in slurry ~~form via~~**from** a single point discharge system that deposits tailings into the interior as well as through two main discharge facilities (cyclones). Cyclones direct overflow (fine-grained material) to the interior and the underflow (coarse material) to the embankment. **An underdrain consisting of a**~~Both~~ blanket **drain** and finger drains composed of crushed slag were constructed in the base of the embankment to promote horizontal seepage of ~~process~~ water under the embankment and into the perimeter toe drain collection ditch. ~~This water is recycled back to the Copperton Concentrator.~~ Water is also removed ~~through~~ **from** a decant pond **and recycled back to the Copperton Concentrator**. When necessary, the water can be discharged through a UPDES permitted discharge point. **The estimated maximum potential discharge rate from the North Impoundment to the Shallow Aquifer is 560 gallons per minute.**

~~Construction of the North Impoundment embankment is proceeding in advance of tailings deposition. There are insufficient tailings available on an annual basis to construct the full width of the north embankment, therefore it is being constructed in two phases. Phase 1 includes the Zone A embankment that is being constructed over a composite slag drainage blanket. In 2005, construction of Phase 2 was initiated to construct Zones B&C over a system of slag finger drains tied into the drainage blanket to facilitate dewatering of the tailings. Phase 1 is anticipated to be completed by 2016 when Phase 2 construction essentially covers and expands beyond the Zone A embankment. Closure of the North Impoundment will be conducted similar to the South Impoundment~~

<u>Proposed Expansion</u> - Kennecott has proposed to expand its tailings storage facilities to prolong the life of the Bingham Canyon Mine approximately 30 years. The project will be completed in two phases and will increase the available tailings storage by an additional 1.2 billion tons for a total of 2.2 billion tons. It includes the construction of a tailings impoundment to the northeast (Northeast Impoundment) to a height of approximately 4,462 feet above mean sea level (amsl) and increasing the height of the existing North and South Impoundments to approximately 4,500 feet amsl. The Northeast Impoundment will add an approximate 1,300 acres that will extend the overall Tailings Impoundment facility to include Section 4 of Township 1 South, Range 2 West. The total area of the proposed Tailings Impoundment facility, after the expansion, will be approximately 10,500 acres.

Phase I will consist of constructing the Northeast Impoundment, relocating infrastructure, and raising the North Impoundment. The Northeast Impoundment will be adjacent to the northeast corner of the existing impoundments. The northeast area is underlain by Bonneville Clay, a thick, laterally extensive, low-permeability lacustrine deposit that also underlies the existing North and South Impoundments. In addition to this low-permeability layer, a drainage blanket will be constructed underneath the northeast embankment. A 25,000 linear foot toe ditch around the proposed expansion will also be added. The estimated maximum potential discharge rate from the Northeast Impoundment to the Shallow Aquifer is 240 gallons per minute.

Other Phase I ancillary work includes: upgrading and expanding the tailings delivery system; adding a new tailings and underflow delivery system; installing a dust control system; re-routing existing electrical and fiber optic utilities; realigning four miles of the Union Pacific Railroad; and constructing an overpass bridge along 7200 West. Initial tailings deposition in the Northeast Impoundment is scheduled for 2015.

Phase II will consist of continuing to raise the North Impoundment and raising portions of the South Impoundment. The Northeast Impoundment will continue to be raised until transition of deposition to the North and South Impoundments is complete. Engineered structures will be constructed along the east, west, and south slopes of the South Impoundment. The tailings delivery system for the North and

South Impoundments will be upgraded and expanded to accommodate deposition on the South Impoundment. Two additional pumps will be added to provide extra pump head for the existing North Impoundment.

Bevill-Excluded Wastes - Congress granted an exclusion from the requirements of the hazardous waste program for certain mining wastes. This exclusion, known as the Bevill Amendment, identifies solid wastes from the extraction, beneficiation, and processing of ores and minerals and excludes them from the requirements of the EPA Hazardous Waste Program. The basis of this exclusion was that these wastes are characterized by high volume, low hazard, and that management as hazardous waste may be inappropriate. On June 23, 1990 EPA issued a final rule that listed 20 mineral processing wastes that are excluded. ~~Three of the ten~~**Several** inflows to the Tailings Impoundment are included under this Bevill exclusion and therefore are not subject to the requirements of the Hazardous Waste Program **(see below)**.

Waste Stream Inflows - Waste stream inflows authorized under this permit for placement in the Tailings Impoundment are:

1. Copper tailings from the Copperton Concentrator;
2. Slag tailings from the slag concentrator at the Smelter;
3. Power plant ash slurry;
4. Smelter process waters;
~~4.~~**5.** Wastewater effluent slurry from the Hydrometallurgical Plant at the Smelter;
~~5.~~**6.** Mine leach water and meteoric contact water that have been treated in the tailings pipeline;
~~6.~~**7.** Wastewater effluent from the Reverse Osmosis treatment of sulfate-contaminated waters;
~~7.~~**8.** Neutralization of acid-mine contaminated waters;
~~8.~~**9.** Barneys Canyon mine pit dewatering and heap leach pad draindown waters;
~~9.~~**10.** Construction, maintenance and lunchroom trash **(Salt Lake Valley Health Department Permit: 35-0011805 covering footprint of Tailings Impoundment)**;
11. Treated effluent from the sewage treatment plant; ~~and~~
~~10.~~**12. MAP (molybdenum autoclave plant) effluent and autoclave waste (second quarter 2013); and**
~~11.~~**13.** Other inflows that are approved by the Executive Secretary for this permit.

The first three waste streams listed above **and the autoclave waste** are included under the regulatory exclusion from RCRA as Bevill waste. Over 99~~%~~ **percent** of the volume of materials placed in the **Tailings** ~~i~~Impoundment are copper tailings. ~~Items 7 and 8 are newer disposal inflows into the Tailings Impoundment.~~ Following settlement of a natural resources damage claim, the State of Utah has approved a plan to clean up contaminated ground water in the Southwest Jordan Valley area of Salt Lake County. Over the next 40 years, extraction and treatment of ground water from contaminated zones will remove contaminants and provide municipal-quality drinking water to the public. By removing contaminated water from the underlying aquifer, the project will also improve ground water quality and prevent further migration of the contamination in the valley. In the absence of a better disposal option for contaminants removed from the treated water, the treatment concentrates will be introduced into the tailings pipeline for disposal in the Tailings Impoundment. The concentrate streams represent less than 4 percent of the total volume of material placed in the Tailings Impoundment.

These sources enter the Tailings Impoundment at the following discharge points:

1) West Cyclone Station
2) East Cyclone station
3) North Impoundment Single Point Discharge **(East and West)**
4) North Impoundment Peripheral Discharge

Corrective Actions

The Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6) require applicants to submit a Corrective Action Plan or other response measures to be taken to remedy any violation of ground water quality standards resulting from discharges. The permit has a compliance condition that allows the Executive Secretary to call for a Contamination Investigation and Corrective Action Plan to be submitted and made a part of this permit should future data indicate that clean-up of existing contamination at the Tailings Impoundment site is in fact needed.

Background Ground Water Quality

Assessing background ground water quality is a complicated task for the area around the Tailings Impoundment because several complicating factors impede measurement or estimation of true background. There are two previously existing facilities that may have impacted ground water quality. The abandoned Morton Salt operation and the Chevron Phosphate operation are within the footprint of the North Impoundment. These operations have likely complicated the ability to observe any impacts from tailings. In addition, given the nearly century-long history of operations, impacts from the Tailings Impoundment have probably already occurred.

In light of the aforementioned complicating factors, Ground Water Protection Levels for this permit are established using existing ground water quality on a well-by-well basis. This approach ensures that the existing ground water quality will be protected by not allowing significant degradation from existing protection levels. There are several compliance monitoring wells that are relatively close to the bedrock contact and that reflect Class II ground water quality. These wells are assigned protection levels consistent with Class II ground water. The majority of the compliance monitoring wells are placed in Class III ground water. These wells are assigned protection levels consistent with Class III ground water. Additionally, the method given in R317-6-4.6.A.3, which allows for a no net increase standard for Class III waters when the background concentration already exceeds the ground water quality standard, is used where indicated. Compliance wells completed in Class IV ground water are assigned protection levels equal to the greater of the Utah Ground Water Quality Standards, which are typically adopted from federal drinking water MCLs, or the background value plus two standard deviations, with the exception that TDS limits are not imposed for Class IV Saline ground water. Due to influences of the Great Salt Lake, TDS values in the Class IV wells range from 18,000 to over 100,000 mg/l. The basis for assigning protection levels (except TDS) to Class IV waters that are in close proximity to the Great Salt Lake is to protect wetland systems that exist in proximity to the lake and serve as habitat for shore birds and other aquatic species.

In ~~several~~ **most of the** Class III wells, the background value for arsenic exceeds the Ground Water Quality Standard of 0.05 mg/l. In these cases a protection level equal to the background value has been set as the protection level in accordance with R317-6-4.6 (no net increase). However, because sample results from these wells routinely exceed the background value due to normal variation around the mean, probable out of compliance is defined as when concentrations exceed the background value plus two standard deviations (referred to as the compliance limit in Table 1).

Kennecott has conducted Toxic Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) analyses of tailings material to describe the toxicity of the tailings even though this material is not subject to RCRA requirements. Both TCLP and SPLP analysis did not reveal any toxicity concerns. Analytical results of these tests were below the detection limit except for barium. Barium values from the TCLP analysis ranged from 0.2 to 0.4 mg/l. The TCLP maximum limit for barium is 100 mg/l. The interstitial waters in the tailings have been characterized and do not appear problematic. To assure that the waste streams going into the Tailings Impoundment do not contain materials that differ markedly from those waste streams that have been characterized, the permit requires only materials of Bingham Pit origin and related processing wastes be disposed of in the Tailings Impoundment. There is a provision that allows Kennecott to request a variance from this standard for incidental situations that would not impact overall water quality of the impoundment.

Kennecott utilizes a discharge minimization approach with ground water monitoring to assess if any impacts occur. Discharge minimization is achieved by utilizing a natural clay liner beneath the impoundment to impede downward flow of tailings waters. The clay liner consists of the upper portion of the Bonneville Clay, which ~~is generally 9~~**has been mapped at an average of 8** feet thick and is continuous throughout the **10,500 acre area of the South Impoundment, North Impoundment, and proposed Northeast Impoundment**~~northern expansion area~~. Measured vertical hydraulic conductivities for this segment of the Bonneville Clay range from 3 x 10^{-7} cm/sec to 4 x 10^{-8} cm/sec. The liner technology meets the requirements of R317-6-6.4.A3 and C3. Best Available Technology is defined in R317-6-1.3 as "... the application of design, equipment, work practice, operation standard or combination thereof at a facility to effect the maximum reduction of a pollutant achievable by available processes and methods taking into account energy, public health, environmental and economic impacts and other costs."

~~Given the liner alternatives that exist and the logistical as well as economic challenges of~~

~~installation of a liner system in the north expansion portion, an area of approximately 3,300 acres, the best alternative is utilization of the Bonneville Clay as the liner to minimize seepage out of the impoundment.~~

The compliance monitoring well network is comprised of 2**9**~~8~~ wells in 1**4**~~5~~ locations. Most locations contain nested or paired wells: one screen interval in the upper shallow ~~unconfined~~ aquifer and one screen interval completed in the lower confined aquifer. The perimeter of the South and North Impoundment is approximately 14 miles long. The 1**4**~~5~~ locations comprise a well frequency of about one well location per mile of embankment. **Additional compliance monitoring wells will be located around the perimeter of the proposed Northeast Impoundment at a frequency consistent with the existing facility.**

Potential Impacts to Water Quality

With the height of Tailings Impoundment reaching over 2**9**0~~0~~ feet, it is likely that downward hydraulic gradients will develop and allow some movement of tailings interstitial waters through the Bonneville Clay and into the underlying aquifer systems. The average concentrations of contaminants in the interstitial waters of the tailings, when compared to the concentrations in the shallow and principal aquifers, are summarized in Table S-1 of this Statement of Basis.

While the numbers in Table S-1 are average values and some individual values may differ significantly, it is anticipated that the overall water quality of the Shallow and Principal Aquifers will not be degraded by water from the impoundment. Interstitial waters and toe drain (recycled) waters from the impoundment will continue to be sampled semi-annually throughout the term of this permit to provide a check on quality of these waters.

One of the most important technical issues associated with the Tailings Impoundment is the long term potential for acidification of the tailings materials. The chemical reactions associated with oxidation of sulfides results in production of acid, which if not neutralized could, over time, acidify the tailings materials. Should this happen, leaching of metals and other constituents that are not mobile in neutral pH conditions may occur. Kennecott conducts static and kinetic testing of tailings materials to predict the potential for the tailings to acidify over time. Results to date indicate that the potential for the fine fraction tailings (overflow) to go acidic are low. The coarse fraction (underflow) can acidify under conditions mentioned above. To assure that signs of acidification are not showing up through the life of the impoundment, Kennecott is required to monitor the interstitial water within the tailings and to perform analysis of the copper tails inflow to the impoundment on a semi-annual basis. Surface sites on the impoundment exterior are also sampled and analyzed for acidification potential. ~~Over time, these data may provide useful information on whether acidification of tailings is a potential risk.~~

The North Impoundment covers a phosphogypsum tailings pile (gypstack) in the northwestern corner of the expanded impoundment. This tailings pile was part of a phosphate fertilizer production facility that was not affiliated with Kennecott ~~Utah Copper~~. Downward hydraulic gradients could move gypstack pore fluids into the Shallow Aquifer and toward the toe drain. Hydraulic conductivity modeling has estimated a very slow rate of travel in the mine tailings and aquifer. Two monitoring well pairs were installed to detect effects, if any, from burial of the phosphogypsum tailings. These wells have 14 years of background monitoring to establish background levels of radionuclides. Monitoring frequency has been changed to once every five years, until such time that detections of radionuclides and uranium may exceed Utah Ground Water Quality Standards.

Basis for Permit Issuance

As a basis for issuance**, modification,** and renewal of the ground water discharge permit as required under UAC R317-6-6.4 and to assure adequate ground water quality protection, the facility has been designed to employ discharge control technology and ground water monitoring to prevent any impairment of present and future beneficial uses of the ground water.

Ground water monitoring is the primary compliance monitoring method for the Tailings Impoundment. General monitoring of the ~~KUC~~ **Kennecott** well network is performed to develop a data base and identify trends. Compliance monitoring is performed at selected wells located outside the impoundment footprint. Most sites are situated to characterize the influence of the tailings disposal on ground water. Compliance monitoring wells are listed in Table 1 of the Permit. The compliance monitoring parameters are listed in Permit Part I, Section F.

Basis for Specific Permit Conditions

1. Corrective Action - Please see the discussion on Page **54** of this Statement of Basis for an explanation of the rational for this condition.

2. Assessment of Acidification Potential - Ongoing analysis and testing is being required to assess the potential for the tailings material to acidify using Net Acid Generation (NAG) testing. Kennecott is required to provide an annual report that compiles the results of each year's sampling and analysis.

3. Operational Monitoring Plan - A water quality summary and analysis is required to assess long term changes to water quality over the life of this structure. The water quality of interstitial waters within the tailings, waters that are decanted from the top of the impoundment and other outflows such as seeps, and characterization of inflows will provide information that will assist in predicting potential impacts from the impoundment as well as track changes over time. This condition requires Kennecott to provide an annual report that compiles the results of each years sampling and analysis.

4. Permit Renewal Application Items - This condition requires three items to be included in the application for permit renewal to be submitted 180 days prior to

permit expiration in the year 201~~1~~**6**. Maps of the potentiometric surface for both the shallow and principal aquifer systems will be required in order to observe temporal changes to these aquifer systems near the impoundment, and monitoring results for radionuclides and uranium in wells NET1386A&B and NET1393A&B.

5. Closure Plan - ~~Final c~~**C**losure of the South Impoundment is complete**; however, portions of the South Impoundment will be raised during Phase II of the proposed expansion**. Any proposed changes to the current closure plan based on ongoing characterization of tailings mineralogy, impoundment surface oxidation, internal pore water chemistry, or other data, shall be submitted to the Executive Secretary for review and approval.

Table S-1
Water ~~Quality~~ Chemistry Summary ~~of Tailings Impact to Ground Water~~

Constituent	Mean Concentrations in Shallow Aquifer[1]	Mean Concentrations in Principal Aquifer[1]	Mean Concentrations in Tailings Pore Waters [~~3~~1, 2]	Mean Concentrations in Clarification Canal [1, 3]
pH	7.~~5~~49	7.~~6~~73	~~7.3~~6.86	7.~~8~~31
TDS	~~22373~~15,417	~~6573~~8,847	~~5591~~5,604	~~9030~~8,448
Sulfate [2]	~~1900~~987	~~360~~373	~~1700~~1,603	~~3569~~3,087
Arsenic	~~0.043~~0.068	~~0.071~~0.156	~~0.038~~0.123	~~0.052~~0.029
Barium	~~0.137~~0.248	~~0.127~~0.191	~~0.022~~0.015	~~0.103~~0.101
Cadmium	0.0015~~2~~	0.0013	0.0036	0.0066
Chromium	~~0.004~~0.015	~~0.004~~0.013	~~0.007 (51% ND)~~0.011	~~<0.010 (ND)~~0.010
Copper	~~0.118~~0.033	0.030~~2~~	~~0.023~~0.658	~~0.053~~0.026
Lead	0.005~~1~~	0.005~~1~~	~~89% ND~~0.005	<0.005 ~~(ND)~~
Selenium	0.008~~5~~	0.005~~6~~	0.0030~~2~~	~~0.026~~0.021
~~Silver~~	~~0.002~~	~~0.001~~	~~94% ND~~	~~<0.001 (ND)~~
Zinc	~~0.022~~0.014	~~0.022~~0.013	~~0.165~~0.226	~~0.017~~0.041

All concentrations in mg/l

[1] **Arithmetic mean concentrations are based on available analyses from 1995 through 2011. The mean incorporates non-detections, assuming that the reporting limit is the concentration.**

[2] **Tailings pore water is represented by 5 tailings wells.**

[3] **The clarification canal is represented by sample location CLC452.**

~~ND - Non Detects~~

~~1 - CLC 452 : approximate mean 1991-2005. Leach water added to circuit beginning in 1998~~

~~2 - Sulfate values for Shallow and Principal Aquifers were obtained from Shepherd Miller 1995~~

~~3 - Values for tailings pore waters were obtained from tailings operational wells~~

DRAFT REVISED

STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY
UTAH WATER QUALITY BOARD
P.O. BOX 144870
SALT LAKE CITY, UTAH 84114-4870

Ground Water Discharge Permit
Permit No. UGW350011

In compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended, the Act,

Kennecott Utah Copper LLC
4700 Daybreak Parkway
South Jordan, Utah 84095

hereafter referred to as the "Permittee" is granted a Ground Water Discharge Permit for the operation of the **Tailings Impoundment** in Salt Lake County, Utah.

The Tailings Impoundment is located on**, or on a portion of,** the following tract of land (Salt Lake Base and Meridian):

Township 1 South, Range 2 West - ~~Portions of~~ Sections **4,** 5, 6, 7, 8, 9, 17, 18, 19, and 20
Township 1 South, Range 3 West - ~~Portions of~~ Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23, and 24
Township 1 North, Range 2 West - ~~Portions of~~ Section**s** 31**, 32, and 33**
Township 1 North, Range 3 West - ~~Portions of~~ Section**s** 35 and 36

The permit is based on representations made by the Permittee and other information contained in the administrative record. It is the responsibility of the Permittee to read and understand all provisions of this permit.

The facility shall be constructed and operated in accordance with conditions set forth in the permit and the Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6).

This ~~**renewed**~~ **modified** Ground Water Quality Discharge Permit for the Tailings Impoundment amends and supersedes all other Ground Water Discharge Permits previously issued for these facilities.

This permit shall become effective on ~~January 12, 2011~~ ____________.

This permit and the authorization to operate shall expire at midnight, ~~January 12, 2016~~ ___________.

Signed this ~~12th day of January, 2011~~ _______________.

____

~~Leah Ann Lamb~~ **Walter L. Baker**
~~Acting Executive Secretary~~ **Director**
~~Utah Water Quality Board~~ **Division of Water Quality**

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I. SPECIFIC PERMIT CONDITIONS

A. Ground Water Classification and Protection Levels

The ground water classification for the uppermost aquifer in the area of the Tailings Impoundment ranges from Class II Drinking Water Quality to Class IV Saline ground water, with ground water near the Oquirrh Mountains recharge area generally Class II and water adjacent to the Great Salt Lake discharge area generally Class IV. Ground water at each compliance monitoring well has been classified based on historical monitoring data.

Compliance monitoring points and ground water Protection Levels for this permit are provided in Table 1. Protection levels are based on background sampling performed to date and the criteria of R317-6-4. Protection Levels are based on the greater of the protection level or the compliance limit (mean background plus twice the standard deviation). Protection levels for any new or replacement compliance monitoring wells approved by the Division and installed during the term of this permit will be set following an accelerated quarterly sampling program.

B. Best Available Technology Performance Standard

1. Best Available Technology for the Tailings Impoundment will be a Discharge Minimization approach operated in accordance with the approved engineering designs and specifications.

2. The Tailings Impoundment is comprised of two sections: an older South Impoundment and a North Impoundment. Active tailings disposal **currently** occurs ~~only~~ in the North Impoundment. Tailings disposal into the South Impoundment ceased in October 2002. **Planned expansion of the tailings impoundment includes the construction of a Northeast Impoundment, raising the height of the North Impoundment, and raising portions of the South Impoundment.** Only Mine Waste materials that originate from the Bingham Canyon Mine**,** ~~and~~ related processing waste**, and other permitted waste streams** as outlined in Part I.D may be disposed of in the Tailings Impoundment unless prior approval for disposal of other waste streams is obtained from the Executive Secretary.

   South Impoundment - The Lake Bonneville Clay (Bonneville Clay) is a low-permeability lacustrine clay layer varying from 9 to 15 feet thick that underlies ~~over 90% of~~ the existing impoundment. The Bonneville Clay serves as a natural liner for the impoundment. A radial discharge capture ditch system exists for most of the South Impoundment to route lateral seepage from the tailings back into the process water network for recycle or for discharge under UPDES Permit No. UT0000051.

North Impoundment - The ~~entire~~ North Impoundment area is underlain by the Bonneville Clay. This low-permeability lacustrine clay layer serves as a natural liner for the North Impoundment. A 36-inch finger drain system consisting of crushed slag placed between filter material has been placed in the base of the impoundment. This drain layer ~~will~~ promote**s** horizontal seepage of process water through the embankment and into the perimeter toe drain collection ditch and reduce**s**, somewhat, the potential for vertical migration of tailings waters. The collection ditch around the perimeter of the North Impoundment is utilized to capture lateral seepage from the blanket drain and route waters back into the process water makeup system.

Northeast Impoundment – The proposed Northeast Impoundment is underlain by the Bonneville Clay. This impoundment will be constructed and operated in a similar manner to the North Impoundment.

Diving Board Area - This area is contained by earthen dikes composed of low-permeability native materials and is underlain by the low-permeability lacustrine clays typical of this area. Drainage from this area is collected via a ditch and channeled to the clarification canal.

3. Closure
~~Both t~~**T**he South and North sections of the **existing** Tailings Impoundment **and the proposed Northeast Impoundment** shall undergo closure in accordance with the requirements of **an** ~~the~~ approved closure plan.

C. Permitted Facilities

The Facilities authorized under this permit include:

1. The South Impoundment near Magna, Utah;
2. The North Impoundment, located east of HWY 202 and south of I-80; ~~and~~
3. The Diving Board Area, located south of State Road 201, and west of 9180 West**; and**
4. **The proposed Northeast Impoundment, located west of 7200W and south of I-80**.

D. Permitted Inflow Waste Streams

The waste streams that are permitted for placement in the existing ~~and expansion portion of the~~ Tailings Impoundment **and proposed expansion** include:

1) Copper Tailings from the Copperton Concentrator;
2) Slag Tailings from the slag concentrator at the Smelter;

3) Power plant ash slurry;
4) Smelter process waters;
5) Wastewater effluent slurry from the Hydrometallurgical Plant at the Smelter;
6) Mine leach water and meteoric contact water that have been treated in the tailings pipeline;
7) Wastewater effluent from the Reverse Osmosis treatment of sulfate contaminated waters;
8) Neutralization of acid-mine contaminated waters;
9) Barneys Canyon pit dewatering and heap leach pad draindown waters;
10) Construction, maintenance and lunchroom trash **(Salt Lake Valley Health Department Permit: 35-0011805 covering footprint of Tailings Impoundment)**;
11) Treated effluent from the sewage treatment plant;
12) MAP (molybdenum autoclave plant) effluent and autoclave waste (second quarter 2013); and
1~~2~~**3**) Other inflows that are approved by the Executive Secretary for this permit.

Kennecott shall obtain approval from the Executive Secretary prior to disposing of mine waste from ore, concentrate, or other materials that do not originate in the Bingham Canyon Mine or other listed waste streams. The use of off site anodes, scrap copper, reagents or materials to process ore, slag, or other materials does not trigger this requirement**, nor does the placement of construction and other non-hazardous industrial waste permitted under Kennecott's landfill permit or any other materials or flows authorized under other DEQ permits, including the UPDES permit**. The request to dispose of off site materials shall include characterization of the wastes using the Synthetic Precipitation Leaching Procedure (EPA SW846 Method 1312) for mining waste streams and the Toxicity Characteristic Leaching Procedure (EPA SW846 Method 1311) for non-mining waste streams. Further analysis may be required by the Executive Secretary to adequately characterize off site materials. Materials authorized for storage in Arthur Stepback Repository are described in U.S. EPA Record of Decision for Kennecott North and South Zone Sites, dated September 26, 2002.

E. Monitoring

1. General Provisions

a) *Future Modification of the Monitoring Network* - If at any time the Executive Secretary determines the monitoring program to be inadequate, Kennecott shall submit within 30 days of receipt of written notice from the Executive Secretary a modified monitoring plan that addresses the inadequacies noted by the Executive Secretary.

b) *Compliance Monitoring Period* - Monitoring shall commence upon issuance of this permit and shall continue through the life of this permit. For compliance monitoring wells that are installed during the term of this permit, monitoring shall commence upon completion of the well installation and development.

c) *Laboratory Approval* - All water quality analyses shall be performed by a laboratory certified by the State of Utah to perform such analysis.

d) *Water Level Measurement* - In association with each well sampling event, water level measurements shall be made in each monitoring well prior to removal of any water from the well bore. These measurements will be made from a permanent single reference point clearly marked on the top of the well or surface casing. Measurements will be made to the nearest 0.01 foot.

e) *Sampling Protocol* - Water quality samples will be collected, handled, and analyzed in conformance with the currently approved version of the Kennecott Ground Water Characterization and Monitoring Plan.

f) *Constituents Sampled* - The following analysis shall be performed on all water monitoring samples collected:

i) Field Measurements: pH, specific conductance, temperature.

ii) Laboratory Analysis:

- Total Dissolved Solids (TDS);
- Major Ions: chloride, sulfate, alkalinity, sodium, potassium, magnesium, and calcium; and
- Metals (dissolved): arsenic, barium, cadmium, chromium, copper, lead, selenium, silver, and zinc.

2. Operational Monitoring

Operational Monitoring will be used to assure inflows and interstitial waters are consistent with the approved BAT performance standards for this permit.

a) Tailings Waters - Kennecott shall characterize the quality of tailings waters by monitoring interstitial waters (within the tailings), water from the top of the impoundment, and other outflows such as seeps in accordance with the Compliance and Operational Monitoring Plan incorporated as Appendix B of this permit.

b) Monitoring of Inflows - Each inflow to the Tailings Impoundment listed in Section I Part D except solid waste such as Construction, maintenance and lunch room trash, shall be characterized using at a minimum the Synthetic Precipitation Leaching Procedure (SPLP) (EPA SW846 Method 1312) and total metals analysis. The details for monitoring of inflows are described in the Compliance and Operational Monitoring Plan (Appendix B).

c) Kennecott shall perform ongoing monitoring of tailings materials inflow for acid generation potential. These characterizations shall be performed in accordance with the Assessment of Acidification Potential Plan incorporated as Appendix A of this permit.

3. Monitoring Frequency

a) *Well Monitoring Frequency* - All existing compliance monitoring wells will be sampled according to the frequency listed in Table 1 of Appendix B throughout the term of this permit. All new and replacement compliance monitoring wells will be sampled quarterly over a three year period following installation to establish baseline ground water quality. Following completion of accelerated sampling, monitoring may change to a semiannual sampling frequency.

b) *Operational Monitoring Frequency* - Operational monitoring including monitoring of inflows shall occur semi-annually throughout the term of this permit, except for tailings underflow samples noted in Standard Operating Procedure #3 of Appendix A.

c) Radionuclides: Uranium, Radium 226, Radium 228, Gross Alpha, and Gross Beta Particle from monitoring wells NET1386 A&B, and NET1393 A&B shall be sampled once every five years prior to permit renewal. Analytical results shall be submitted in the ground water discharge permit renewal application.

~~d) South Impoundment lysimeters shall be sampled once every five years prior to permit renewal. Analytical results shall be submitted in the ground water discharge permit renewal application.~~

F. Demonstration of Compliance

1. Probable Out of Compliance for Ground Water Protection Levels - If the concentration of any pollutant exceeds the higher of the protection level or

compliance limit (Table 1) in any compliance monitoring well, Kennecott shall:

a. Initiate monthly sampling for the well(s) that have exceeded the Permit Limit, unless the Executive Secretary determines that other periodic sampling is appropriate, for a period of two months or until the compliance status of the facility can be determined.

b. Notify the Executive Secretary of Probable Out of Compliance status in the corresponding semi-annual ground water report.

2. Out of Compliance Status for Ground Water Protection Levels

Out of compliance status exists when:

a. Two or more consecutive samples from a compliance monitoring well exceed one or more protection levels (Table 1); and

b. Two or more consecutive samples from the same compliance monitoring well exceed the compliance limit (Table 1) for that well: or

The concentration of any pollutant in two or more consecutive samples is statistically significantly higher than the applicable protection level. Statistical significance can be determined using methods described in Statistical Methods for Evaluating Ground Water Monitoring Data from Hazardous Waste Facilities, Vol. 53, No. 196 (Federal Register, Oct. 11, 1988)

c. Upon determining that an out of compliance situation exists, Kennecott shall:

i) Notify the Executive Secretary of the out of compliance status within 24 hours of detection followed by a written notice within 5 days of the detection.

ii) Initiate monthly sampling until the facility is brought into compliance unless the Executive Secretary determines that other periodic sampling is appropriate.

iii) Submit a Source Assessment and Compliance Schedule to the Executive Secretary within 30 days of determination of the out of compliance status that outlines the following:

- Steps of action that will assess the source, extent, and potential dispersion of the contamination.

- Evaluation of potential remedial actions to restore and maintain ground water quality and ensure the permit limits will not be exceeded at that compliance monitoring point.

- Measures to ensure best available technology will be re-established.

iv) Implement the Source Assessment and Compliance Schedule as directed by the Executive Secretary.

G. Non- Compliance for Best Available Technology

Kennecott is required to maintain the Best Available Technology in accordance with the approved design and practice for this permit. Failure to maintain BAT or maintain the approved design and practice shall be a violation of this permit. In the event a compliance action is initiated against the Permittee for violation of permit conditions relating to best available technology, Kennecott may affirmatively defend against that action by demonstrating the following:

a. Kennecott submitted notification in accordance with R317-6-6.13;

b. The failure was not intentional or caused by Kennecott's negligence, either in action or in failure to act;

c. Kennecott has taken adequate measures to meet permit conditions in a timely manner or has submitted for the Executive Secretary's approval, an adequate plan and schedule for meeting permit conditions; and

d. The provisions of UCA 19-5-107 have not been violated.

H. Reporting Requirements

1. Reporting

a. *Monitoring Wells* - Water quality sampling results for monitoring wells shall be submitted semi-annually to the Executive Secretary as follows:

Quarter Sampled In		Report Due On
1st	(Jan., Feb., March)	August 15
2nd	(April, May, June)	August 15
3rd	(July, Aug., Sept.)	February 15
4th	(Oct., Nov., Dec.)	February 15

b. *Electronic Filing Requirements* - The Permittee will submit the required ground water monitoring data in one of these electronic formats: adobe pdf, CD, or other approved transmittal mechanism.

c. *Operational Monitoring* - Operational monitoring results including interstitial waters, decant pond flows, tailings inflows, and acidification analysis shall be submitted in an annual report by March 31 of each year.

Failure to submit reports within the time frame due shall be deemed as noncompliance and may result in enforcement action.

I. Compliance Schedule

1. *Documentation of New and Replacement Well Installation*s - Within 60 days of completion of any new or replacement monitoring, Kennecott shall submit documentation on the wells demonstrating that each well is in conformance with the EPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, 1986, OSWER-9950.1 (RCRA TEGD) Section 3.5.

2. *Permit Renewal Application Items* - As a part of the application for permit renewal each five years, Kennecott will include water level data and a potentiometric surface map for both the Shallow and Principal aquifer systems within at least a one mile perimeter and underlying the impoundment. The water level data and maps will delineate temporal changes in water levels that have occurred during the term of the permit. Monitoring results for radionuclides and uranium in wells NET1386A&B and NET1393A&B **will be included in the renewal application.**

3. Within 90 days of permit issuance, Kennecott shall submit a process water pipeline inspection and preventative maintenance plan that will become Appendix C of this permit. Discussion of inspections, maintenance, replacements and spill avoidance measures should be included in the semi-annual monitoring report required by this permit. Follow-up reporting of any releases shall include an assessment of the loss of process water to soil and groundwater and an assessment of the potential impacts.

4. *Tailings Impoundment Closure Plan* - At any time during the effective period of this permit, Kennecott shall submit within 180 days of written request by

the Executive Secretary, a revised closure plan for the existing ~~and expansion portions of the~~ Tailings Impoundment **and proposed expansion**. The closure plan for the Tailings Impoundment is contained within "Reclamation and Water Management Plan, Kennecott Utah Copper Corporation, Bingham Canyon Mine" submitted in March 2003. Within three years of mine closure Kennecott must submit a final set of engineered drawings and plans that clearly define the scope of the final closure for the North**,** ~~and~~ South**, and Northeast** portions of the Tailings Impoundment. The plan will provide details on all aspects of closure that are related to or have an impact on surface water or ground water quality, including all pre- and post-mine closure water sources. For any issues that require further study prior to finalizing aspects to the closure plan, details on what each study will include, and a schedule with milestones for each segment of the study shall be included in Kennecott's revised plan.

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling Samples taken in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity.

B. Analytical Procedures Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3L, unless other test procedures have been specified in this permit.

C. Penalties for Tampering The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results Monitoring results obtained for each monitoring period specified in the permit, shall be submitted to the Executive Secretary, Utah Division of Water Quality at the following address no later than 45 days after the end of the monitoring period:

Utah Division of Water Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870
Attention: Ground Water Protection Section

E. Compliance Schedules Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee If the Permittee monitors any pollutant more frequently than required by this permit, using approved test procedures as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

G. Records Contents Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time.

I. Twenty-four Hour Notice of Noncompliance and Spill Reporting

1. The Permittee shall verbally report any noncompliance, or spills subject to the provisions of UCA 19-5-114, which may endanger public health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the Permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24 hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 536-4300, during normal business hours (Monday through Thursday 7:00 am - 6:00 pm Mountain Time).

2. A written submission shall also be provided to the Executive Secretary within five days of the time that the Permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

3. Reports shall be submitted to the addresses in Part II.D, Reporting of Monitoring Results.

J. Other Noncompliance Reporting Instances of noncompliance not required to be reported within 24 hours, shall be reported at the time that monitoring reports for Part II.D are submitted.

K. Inspection and Entry The Permittee shall allow the Executive Secretary, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application. The Permittee shall give advance notice to the Executive Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Nothing in this permit shall be construed to relieve the Permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The Permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

IV. GENERAL REQUIREMENTS

A. Planned Changes. The Permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

B. Anticipated Noncompliance. The Permittee shall give advance notice of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for a permit modification, revocation and re-issuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The Permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information. When the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed as follows:

a. For a corporation: by a responsible corporate officer;

b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described above and submitted to the Executive Secretary; and

b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to Authorization. If an authorization under Part IV.G 2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part IV.G.2 must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section 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 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."

H. Penalties for Falsification of Reports. The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential by the Permittee, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Executive Secretary. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

J. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

L. Transfers. This permit may be automatically transferred to a new Permittee if:

1. The current Permittee notifies the Executive Secretary at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new Permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

3. The Executive Secretary does not notify the existing Permittee and the proposed new Permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

M. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by Section 19-5-117 of the Act.

N. Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. If new ground water standards are adopted by the Board, the permit may be reopened and modified to extend the terms of the permit or to include

pollutants covered by new standards. The Permittee may apply for a variance under the conditions outlined in R317-6-6.4.D.

2. If alternate compliance mechanisms are required.

3. If water quality of the facility is significantly worse than represented in the permit application.

4. If results from operational monitoring indicate acidification of the Tailings Impoundment is occurring or is likely to occur in the future or chemical makeup of the waste streams has changed significantly enough to effect a change in impacts to ground water.

5. If detections of radionuclides and uranium in NET1386A&B and NET1393A&B exceed Utah Ground Water Quality Standards.

6. If the Arthur Stepback Repository oversight currently provided by the EPA under the Consent Decree for the Kennecott North End Remedial Action ends and oversight is transferred to the Utah Department of Environmental Quality.

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TABLE 1 Compliance Monitoring Well Protection Levels UGW350011

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NEL532A Class III Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NEL532B Class III Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	8.03	0.18	6.5 - 8.5		7.5	0.17	6.5 - 8.5	
Arsenic	0.05	0.199	0.033	0.200 [a]	0.265	0.243	0.024	0.243 [a]	0.292
Barium	2	0.144	0.084	1.000	0.312	1.45	0.12	1.00	1.73
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.050	0.010
Copper	1.3	nd	n/a	0.650	0.020	0.017	0.013	0.650	0.043
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	nd	n/a	2.50	0.010	0.021	0.018	2.50	0.057
Sulfate	-	715	275	1072	1264	70	13	105	95
TDS	3000	6977	412	8721	7800	7546	720	10000 [b]	8985

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NEL536A Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NEL536B Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.6	0.14	6.5 - 8.5		7.9	0.17	6.5 - 8.5	
Arsenic	0.05	0.04	0.008	0.050	0.056	0.021	0.008	0.027	0.037
Barium	2	0.159	0.017	0.500	0.192	0.070	0.017	0.500	0.105
Cadmium	0.005	nd	n/a	0.0013	0.001	nd	n/a	0.0013	0.001
Chromium	0.1	nd	n/a	0.025	0.010	nd	n/a	0.025	0.010
Copper	1.3	nd	n/a	0.325	0.020	nd	n/a	0.325	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	0.002	0.001	0.013	0.003	nd	n/a	0.013	0.002
Zinc	5	0.027	0.011	1.25	0.050	nd	n/a	1.25	0.010
Sulfate	-	322	36	402	394	50	7	63	64
TDS	3000	2151	449	2689	3000	794	33	993	860

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NED604A Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NED604B Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.31	0.16	6.5 - 8.5		7.65	0.12	6.5-8.5	
Arsenic	0.05	0.082	0.014	0.050 [a]	0.11	0.017	0.006	0.021	0.029
Barium	2	0.045	0.013	0.500	0.075	0.044	0.007	0.500	0.058
Cadmium	0.005	nd	n/a	0.0013	0.001	nd	n/a	0.0013	0.001
Chromium	0.1	nd	n/a	0.025	0.010	nd	n/a	0.025	0.010
Copper	1.3	nd	n/a	0.325	0.020	nd	n/a	0.325	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.0125	0.002	nd	n/a	0.0125	0.002
Zinc	5	0.019	0.014	1.25	0.010	0.013	0.01	1.25	0.016
Sulfate	-	461	116	577	700	120	13	150	146
TDS	3000	2257	522	2821	3000	1271	53	1589	1377

TABLE 1 Compliance Monitoring Well Protection Levels

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET646A Class IV: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET646B Class IV: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	6.95	0.18	6.5 - 8.5		7.3	0.13	6.5 - 8.5	
Arsenic	0.05	0.078	0.022	0.078 [a]	0.122	0.137	0.044	0.225	0.225
Barium	2	0.076	0.017	2.00	0.110	0.071	0.01	2.00	0.091
Cadmium	0.005	nd	n/a	0.005	0.001	nd	n/a	0.005	n/a
Chromium	0.1	0.019	0.007	0.100	0.033	0.015	0.005	0.100	0.025
Copper	1.3	0.084	0.025	1.300	0.134	0.093	0.104	1.300	0.301
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	0.003	0.001	0.050	0.002	0.005	0.004	0.050	0.013
Zinc	5	0.028	0.024	5.00	0.076	0.014	0.003	5.00	0.020
Sulfate	-	4276	1807	7890	7890	1159	144	1738	1447
TDS	3000	72000	20185	none	none	41920	2878	none	none

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1380A Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1380B Class II: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.68	0.120	6.5 - 8.5		8.22	0.110	6.5 - 8.5	
Arsenic	0.05	0.012	0.005	0.025	0.022	nd	n/a	0.013	0.005
Barium	2	0.138	0.050	1.00	0.238	0.056	0.007	0.500	0.070
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	0.015	0.006	0.050	0.010	nd	n/a	0.025	0.010
Copper	1.3	nd	n/a	0.650	0.020	nd	n/a	0.325	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.013	0.002
Zinc	5	0.013	0.006	2.50	0.010	nd	n/a	1.25	0.010
Sulfate	-	882	123	1300	1129	7	1.50	15	10
TDS	3000	5500	531	7500	6562	1226	55	1532	1336

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1381A Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1381B Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.84	0.14	6.5 - 8.5		7.5	0.16	6.5 - 8.5	
Arsenic	0.05	0.047	0.012	0.05	0.071	0.131	0.021	0.131 [a]	0.175
Barium	2	0.085	0.011	1.00	0.107	0.072	0.012	1.00	0.1
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.050	0.010
Copper	1.3	nd	n/a	0.650	0.020	nd	n/a	0.650	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	nd	n/a	2.50	0.010	nd	n/a	2.50	0.010
Sulfate	-	524	210	524	735	851	81	1277	1013
TDS	3000	5954	494	8000	6950	10863	979	10000 [b]	12800

TABLE 1 Compliance Monitoring Well Protection Levels UGW350011

Parameter	Utah Ground Water Quality Standard (mg/L)	NET1382A (Class III) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	NET1382B (Class III) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.92	0.21	6.5 - 8.5		8.27	0.170	6.5 - 8.5	
Arsenic	0.05	0.199	0.044	0.206 [a]	0.287	0.322	0.044	0.322 [a]	0.410
Barium	2	0.090	0.030	1.000	0.144	0.063	0.007	1.000	0.077
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.050	0.010
Copper	1.3	nd	n/a	0.650	0.020	nd	n/a	0.650	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	nd	n/a	2.50	0.010	nd	n/a	2.50	0.010
Sulfate	-	188	62	271	305	70	8	94	157
TDS	3000	4839	803	6050	6450	1789	80	2300	2050

Parameter	Utah Ground Water Quality Standard (mg/L)	NET1382C (Class III) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	NET1387 (Class II) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	8.51	0.180	6.5 - 8.5		7.37	0.120	6.5 - 8.5	
Arsenic	0.05	0.459	0.058	0.459 [a]	0.575	0.025	0.008	0.031	0.041
Barium	2	0.048	0.018	1.00	0.084	0.042	0.007	1.00	0.056
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.025	0.010
Copper	1.3	nd	n/a	0.650	0.020	nd	n/a	0.325	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.013	0.002
Zinc	5	0.010	0	2.50	0.010	nd	n/a	1.25	0.010
Sulfate	-	64	7	96	78	319	32	400	383
TDS	3000	1354	193	2000	1741	1486	94	1858	1675

Parameter	Utah Ground Water Quality Standard (mg/L)	NET1383A (Class III) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	NET1383B (Class III) Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.88	0.13	6.5 - 8.5		7.94	0.13	6.5 - 8.5	
Arsenic	0.05	0.220	0.029	0.220 [a]	0.278	0.22	0.037	0.220 [b]	0.294
Barium	2	0.053	0.011	1.00	0.074	0.057	0.01	1.00	0.077
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.050	0.010
Copper	1.3	0.03	0.01	0.650	0.05	nd	n/a	0.650	0.05
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	nd	n/a	2.50	0.010	nd	n/a	2.50	0.010
Sulfate	-	218	29	327	276	186	14	279	215
TDS	3000	7067	162	8834	7391	6558	207	8192	6972

TABLE 1 Compliance Monitoring Well Protection Levels UGW350011

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1384A Class IV: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1384B Class IV: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	6.95	0.21	6.5 - 8.5		7.47	0.16	6.5 - 8.5	
Arsenic	0.05	0.063	0.025	0.063 [a]	0.113	0.187	0.051	0.187 [a]	0.29
Barium	2	0.043	0.02	2	0.083	0.026	0.007	2.00	0.04
Cadmium	0.005	nd	n/a	0.005	0.001	nd	n/a	0.005	0.001
Chromium	0.1	0.018	0.004	0.050	0.01	0.016	0.005	0.100	0.026
Copper	1.3	0.146	0.244	1.3	0.634	0.1	0.055	1.3	0.21
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.05	0.002	nd	n/a	0.05	0.002
Zinc	5	0.024	0.021	5.0	0.066	0.017	0.012	5.00	0.040
Sulfate	-	2850	709	5000	4269	2110	132	3164	2375
TDS	3000	74843	9637	none	none	24000	914	none	none

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1385A Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1385B Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.95	0.12	6.5 - 8.5		7.78	0.15	6.5 - 8.5	
Arsenic	0.05	0.106	0.012	0.106 [a]	0.13	0.139	0.03	0.139 [a]	0.199
Barium	2	0.048	0.01	1.00	0.075	0.061	0.014	1.00	0.089
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010	nd	n/a	0.050	0.010
Copper	1.3	0.028	0.01	0.65	0.05	0.026	0.007	0.65	0.040
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	nd	n/a	2.5	0.010	nd	n/a	2.5	0.010
Sulfate	-	141	12	212	165	166	15	249	196
TDS	3000	4089	282	5112	4652	5839	202	7300	5839

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1386A Class IV: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1386B Class III: Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.68	0.140	6.5 - 8.5		7.59	0.150	6.5 - 8.5	
Arsenic	0.05	0.012	0.009	0.018	0.030	0.057	0.007	0.057 [a]	0.077
Barium	2	1.330	0.140	2	1.161	0.214	0.032	1.00	0.278
Cadmium	0.005	nd	n/a	0.003	0.001	nd	n/a	0.003	0.001
Chromium	0.1	0.016	0.005	0.050	0.026	nd	n/a	0.050	0.010
Copper	1.3	0.040	0.015	0.650	0.070	nd	n/a	0.650	0.050
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	nd	n/a	0.025	0.002	nd	n/a	0.025	0.002
Zinc	5	0.016	0.006	2.50	0.028	nd	n/a	2.5	0.010
Sulfate	-	30	18	150	150	48	10	72	68
TDS	3000	10055	559	none	none	8396	426	10000 [b]	9248

TABLE 1 Compliance Monitoring Well Protection Levels UGW350011

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1393A Class IV Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1393B Class IV Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.65	0.17	6.5 - 8.5		7.55	0.17	6.5 - 8.5	
Arsenic	0.05	0.041	0.015	0.05 [b]	0.071	0.062	0.014	0.062 [a]	0.096
Barium	2	2.21	0.273	2.00 [b]	3.00	0.194	0.035	2.00 [b]	0.264
Cadmium	0.005	nd	n/a	0.005	0.001	nd	n/a	0.005	0.001
Chromium	0.1	nd	n/a	0.100	0.010	nd	n/a	0.100	0.010
Copper	1.3	nd	n/a	1.300	0.05	nd	n/a	1.300	0.05
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	0.024	0.013	0.050	0.05	nd	n/a	0.050	0.002
Zinc	5	nd	n/a	5.00	0.010	nd	n/a	5.00	0.010
Sulfate	-	52	18	150	150	97	19	150	150
TDS	3000	12123	363	none	none	10963	352	none	none

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1490 Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)	Monitoring Well NET1491 Class II Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.17	0.018	6.5 - 8.5		7.17	0.09	6.5 - 8.5	
Arsenic	0.05	0.005	0.001	0.013	0.007	0.006	0.001	0.013	0.008
Barium	2	0.04	0.007	0.500	0.055	0.023	0.003	0.500	0.029
Cadmium	0.005	nd	n/a	0.005	0.001	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.025	0.025	nd	n/a	0.025	0.010
Copper	1.3	nd	n/a	0.325	0.325	nd	n/a	0.325	0.020
Lead	0.015	nd	n/a	0.005	0.008	nd	n/a	0.005	0.008
Se (hydride)	0.05	0.006	0.002	0.013	0.010	0.007	0.002	0.013	0.011
Zinc	5	0.015	0.015	1.25	0.051	nd	n/a	1.25	0.010
Sulfate	-	266	48	333	361	492	158	616	808
TDS	3000	1684	111	2105	1906	2780	251	3000 [b]	3000

Parameter	Utah Ground Water Quality Standard (mg/L)	Monitoring Well NET1492 Class III Background Level (mg/L) mean	stdev	Protection Level (mg/L)	Compliance Limit (mg/L)
pH (units)	6.5-8.5	7.14	0.11	6.5 - 8.5	
Arsenic	0.05	nd	n/a	0.025	0.001
Barium	2	0.022	0.004	0.500	0.03
Cadmium	0.005	nd	n/a	0.003	0.001
Chromium	0.1	nd	n/a	0.050	0.010
Copper	1.3	nd	n/a	0.65	0.05
Lead	0.015	nd	n/a	0.005	0.008
Se (hydride)	0.05	0.006	0.002	0.025	0.010
Zinc	5	nd	n/a	2.5	0.010
Sulfate	-	629	118	943	865
TDS	3000	2998	342	3747	3682

nd = non-detect n/a = not applicable

Protection Level established by the greater of 1.X times the measured background concentration, or 0.X times the Ground Water Quality Standard

Compliance Limits are calculated from the mean of measured concentrations + 2 standard deviations, or method detection limit

Protection Level for Class IV well will be the Ground Water Quality Standard

a - Background value exceeds ground water standard; Protection Level = background (no net increase approach)

b - 1.X times background exceeds ground water quality standard; Protection Level = ground water quality standard

APPENDIX A

ASSESSMENT OF ACIDIFICATION POTENTIAL
KENNECOTT TAILINGS IMPOUNDMENT
(~~January 2011~~**September 2012**)

1.0 MONITORING OBJECTIVES

The objectives of this monitoring plan are as follows:

1. To characterize any potential water quality impacts resulting from potential future acidification of tailings material.

2. To accurately predict the acidification potential that will occur on the impoundment.

3. To present an adequate characterization of acidification potential for the different units of both the existing and **proposed** expansion portion of the Tailings Impoundment.

2.0 MONITORING PLAN

2.1 Acidification Monitoring

The primary objective of this portion of the monitoring program is to determine the acidification potential of both the existing and **proposed** expansion portions of the tailings impoundment, using acid/base accounting (ABA) and Net Acid Generation (NAG) testing (Table 1).

2.1.1 Sampling Locations

The **North** Tailings ~~North Expansion~~**Impoundment** embankment is constructed of coarse underflow material from two cyclone stations (designated East and West Cyclones). The fine-grained overflow material is placed in the interior of the impoundment. The East Cyclone station currently receives material only from the Copperton Concentrator. The West Cyclone Station currently receives Copperton tailings, Power Plant fly ash and inputs from the Smelter slag and hydrometallurgical tailings. In the future, Smelter process waters may be directed to the West Cyclone station as well.

Both slag tailings and the power plant ash contain abundant neutralizing capacity, so there is little to no risk of acid generation from these materials. Hydrometallurgical tailings comprise <0.5% of the flow entering the impoundment from the West Cyclone Station. The West

Cyclone Station material is sampled after all of the tailings streams have been mixed and cycloned in the overflow and underflow samples.

The exterior of the existing south impoundment has been adequately characterized by previous sampling efforts. Sampling locations to characterize the active North Impoundment include the following sites, to be sampled at the frequencies indicated in section 2.1.2.

I. Embankment of the North Impoundment (cycloned tailings underflow)

II. Interior of North Impoundment (cycloned tailings overflow)

2.1.2 Sampling and Analysis for ABA Values

Samples will routinely be collected from a depth interval of 0 to 12 inches for tailings that are in place. However, additional samples may be taken from other depths for evaluation of areas of incipient acidification.

SOP #3 describes the standard protocol for sampling, preservation, chain of custody and archiving of samples. All samples will be archived for at least two years. The locations of the samples from the existing impoundment will be marked in the field with a stake and will be indicated on a reference map.

2.1.2.1 Whole Tailings

A. Copperton Tailings (BCP1483) – A quarterly grab sample will be collected from this tailings stream.

B. Hydromet/Slag Tailings (TLP2593) – A semi-annual grab sample will be collected from this tailings stream

C. North Splitter Box (MCP2536) – A quarterly grab sample will be collected from this tailings stream.

2.1.2.2 Underflow Material in North Embankment

Grab samples of underflow tailings (TLP1485 and TLP1487) will be collected quarterly from each cyclone station (two samples per quarter). The samples will be collected as the underflow is discharged from the cyclone.

2.1.2.3 Overflow Material in the North Impoundment

Grab samples of overflow tailings (TLP1486 and TLP1488) will be collected semi-annually from each cyclone station (two samples every six months). The samples will be collected as the overflow material is discharged from the cyclone.

2.1.3 Testing Methods and Parameters

Samples of tailings solids will be analyzed using methods described in detail in the attached Standard Operating Procedures listed in section 4.0 (SOP's 1, 2, 3 and 4).

2.1.3.1 Static Testing

Samples of tailings solids will be analyzed for acid/base accounting using the protocol for ABA potential in SOP #1.

2.1.3.2 Kinetic Testing

The humidity cell kinetic testing protocol is listed in SOP #2. Routine humidity cell testing has been discontinued but the SOP has been retained in case the test is used on a discretionary basis in the future. The humidity cell test results are of limited usefulness because the kinetics of the sulfide oxidation and acid/base reactions in the test cells are very slow, and no tailings materials ever acidified (even those tested for over a year.) The test results could not be used to predict if a tailings sample would generate acid rock drainage in the future. To overcome this problem, kinetic Net Acid Generation (NAG) testing has been substituted for the humidity cells.

The protocol for the NAG test is listed in SOP #4. The kinetic NAG test involves the addition of a strong oxidizing agent, hydrogen peroxide, to the tailings sample. The hydrogen peroxide oxidizes the available sulfide in the sample at a rapid rate, mimicking years or decades of surface weathering in a matter of hours.

A minimum of six kinetic NAG tests will be completed each year. The tests will be run on samples that have been analyzed by acid/base accounting techniques (SOP #1). The samples will be selected to provide a data set with a broad range of ABA potentials and neutralization potential ratios; however testing emphasis will be placed on samples with NNP values of ±10; the acidification of these samples are typically less predictable.

2.1.4 Quality Assurance

Replicate Samples: Split replicate samples will be included to evaluate the precision of the analyses. At least one replicate sample will be analyzed for every 20 samples (5%). Results will be acceptable if the Relative Percent Differences (RPD) of the ABA values differ by less than 35%.

Reference Samples: A large quantity of Kennecott underflow tailings sample has been collected, dried, homogenized, and archived as a reference material. The reference sample is a composite sample of tailings underflow material that has been thoroughly mixed and split into individual samples. (This is the same material as was used in the previous evaluation of the acidification potential of the tailings). Samples of the reference tailings material will be submitted to the analytical laboratory, together with the unknown samples, to determine the precision and consistency of the laboratory analyses. One reference sample will be submitted per 20 unknown samples. The results will be compared to those obtained for the same reference material in the previous evaluation of potential acidification (Shepherd Miller, Inc. and Schafer and Associates, 1995). If the RPD is within ± 1.5 standard deviations about the mean relative to past results for the same reference materials, the results will be accepted.

2.1.5 Inspection of Tailings North Impoundment Embankment

Annual inspection of the North Embankment will be conducted to visually identify potential "hot-spots." If acidification appears to be developing based upon changes in color or lack of previously cultivated vegetation, the approximate outlines of the site will be marked on a map and a sample collected for soil paste pH and paste conductivity.

2.2 Operational Monitoring

The operational monitoring will be conducted as outlined in Kennecott's Operational Monitoring Plan (see Appendix B).

3.0 REPORTING

An annual report will be submitted by March 31 addressing the previous years monitoring as described in this plan and Appendix B.

The report will include:

- summary tables of the results of the ABA analyses and the analyses of the final kinetic NAG test leachate,
- graphs showing the pH and temperature variation during the kinetic NAG tests,
- a comparison of the past year's geochemical data with the preceding years,
- a comparison between the ABA and kinetic test results (In particular, at what ABA potential and neutralization potential ratio the tailings will acidify),
- a summary of the results of the North Embankment inspection including a map of any areas that have acidified.

- a summary of all surface water, seep, ~~lysimeter~~ and groundwater data collected in accordance with Appendix B.

4.0 STANDARD OPERATING PROCEDURES (SOP's)

The following **Kennecott** SOP~~'~~s are ~~attached to this plan~~**used**:

1. Standard Operating Procedure #1 – The Complete Modified Sobek Acid Base Accounting.

2. Standard Operating Procedure #2 – Kinetic Testing by the Humidity Cell Procedure.

3. Standard Operating Procedure #3 – Sample Collection, Preservation, Chain of Custody, Archiving, and Quality Assurance.

4. Standard Operating Procedure #4 – Kinetic Testing by the Net Acid Generation (NAG) Procedure.

Table 1
Repeat Sample Description

Sample ID	Location	Frequency[1]	Sample Source	Material Type	Analysis Required
BCP1483	Copperton	Quarterly	Sampling Crew	Tailings	ABA, MC
MCP2536	North Splitter Box	Quarterly	Sampling Crew	Tailings	ABA, MC
TLP2593	Smelter Slag/Hydromet	Semi-annual	Sampling Crew	Smelter Tailings	ABA, MC, Total Metals, SPLP
TLP1485	Tailings (East Cyclone)	Quarterly	Sampling Crew	Cycloned Tailings Underflow	ABA, MC, Total Metals, SPLP
TLP1486	Tailings (East Cyclone)	Semi-Annually	Sampling Crew	Cycloned Tailings Overflow	ABA, MC, Total Metals, SPLP
TLP1487	Tailings (West Cyclone)	Quarterly	Sampling Crew	Cycloned Tailings Underflow	ABA, MC, Total Metals, SPLP
TLP1488	Tailings (West Cyclone)	Semi-Annually	Sampling Crew	Cycloned Tailings Overflow	ABA, MC, Total Metals, SPLP

Notes:
[1]Frequency listed for ABA samples, total metals and SPLP analysis are performed semi-annually on all samples.

Abbreviations:
ABA = Acid/Base Accounting
MC = Moisture Content
SPLP = Synthetic Precipitation Leach Procedures

APPENDIX B

COMPLIANCE AND OPERATIONAL MONITORING PLAN

GROUND WATER DISCHARGE PERMIT
PERMIT NO. UGW350011
(~~January 2011~~September 2012)

1.0 INTRODUCTION

This plan presents the sampling, analyses, and quality guidelines for the sampling of operational process discharges to the Tailings Impoundment. Sampling is being done to assure that the tailings inflows and interstitial water within the impoundment are consistent with the Best Available Technology (BAT) performance standards approved in the Tailings Impoundment Ground Water Discharge Permit No. UGW350011. This document satisfies the requirements of Part 1.E.2a and 2b of the permit. This monitoring plan complements the plan for Assessment of Acidification Potential (Appendix A) prepared to satisfy the requirements of Part I.H.1b of the permit.

2.0 MONITORING

Tailings water to be monitored under this plan will characterize the interstitial waters (within the tailings), and seeps. Groundwater monitoring wells located around the perimeter of the impoundment will be monitored to observe trends in local groundwater and determine compliance. Table 1 details the locations and frequency of required monitoring points described in this section. Tailings slurry solids will also be monitored.

2.1 Tailings Water Samples

Tailings water samples will be collected from surface water sites and wells completed within the tailings footprint.

2.1.1 Surface Water Sites

Surficial tailings water samples will be collected from the following locations:

- Clarification Canal (sampling site CLC452) – This site will be sampled quarterly and was selected to show the quality of the tailings water as it returns from the top of the Tailings Impoundment. This location is unaffected by other discharges to the clarification canal and represents nearly the entire return flow from the impoundment. Additionally, this site has a sampling history dating back to 1991~~ and is near the 001 UPDES Outfall~~.

- Toe Collection Ditch (sampling sites TLP1436, and TLP1469) - Will be sampled quarterly. Site TLP1436 is located in the toe collection ditch near the 007 UPDES Outfall and site TLP1469 is located adjacent to the Gypstack.

- Seeps (sampling sites TLS1426) – These seeps are located on the Tailings Impoundment embankment and have been sampled intermittently since 1985. Samples of these seeps will be collected twice per year, once in the spring and in the late summer or early fall. Some of these seeps will eventually be covered with tailings; sampling will be discontinued at that time. The discovery of any new seeps within the tailings embankment should also be sampled and reported in the annual report.

- Waste Water Treatment Plant (sampling point WTS1489) – This site no longer discharges water to the Tailings Impoundment. Should discharges from this site resume, grab samples will be collected from this site quarterly as long as the effluent from the WWTP is discharged directly to the Tailings Impoundment.

The locations of these sampling sites are shown on Figure 1. Samples will be collected using the procedures provided in Kennecott's Standard Operating Procedures for Water Sampling. Protocols for handling samples and obtaining analyses will be as specified for ground water samples in the Ground Water Characterization and Monitoring Plan (GCMP).

2.1.2 Tailings Wells

Tailings wells TLT887, TLT2452, TLT2575A, TLT2575B and NET2596 will be sampled semi-annually. These wells are constructed within the tailings and were selected to include wells located in various portions of the impoundment, both laterally and vertically. The locations of these wells are shown on Figure 1.

Samples collected from these wells will be collected using sampling methods and protocols specified in the GCMP. New well construction will be done as specified in the GCMP.

2.1.3 Compliance Wells

Compliance wells will be sampled according to the schedule listed Table 1. The compliance wells are located around the perimeter of the Tailings Impoundment complex and are completed in the aquifer system that ranges from Class II to Class IV. Additional monitoring and reporting requirements for non-compliance conditions are described in Part I, Section H of the permit. If the concentration of any pollutant exceeds the Compliance Limit ~~(Table 3)~~ in any compliance monitoring well, Kennecott will initiate monthly sampling for the well(s) that have exceeded the Compliance Limit. Monthly sampling will continue for two months or until the compliance of the facility can be determined. Notification to the Executive secretary will be made in the corresponding semi-annual report.

Compliance monitoring wells will be analyzed for those constituents listed in section 2.1.5 below. However, compliance will be determined based on the following parameters: pH, arsenic, barium, cadmium, chromium, copper, selenium, zinc, sulfate and TDS.

~~2.1.4 Lysimeters at the Magna Tailings Impoundment were installed to help determine the behavior of the tailings over time. A lysimeter is an instrument for collecting pore water that percolates through a certain depth of unsaturated soil. Nests of 2-4 lysimeters were installed at three locations on the Magna Tailings Impoundment, which were then included as operational monitoring sites in groundwater discharge permit #UGW350011 (Table 21). Lysimeter samples will be analyzed for the same list of analytes except for TDS. Lysimeter samples produce a limited sample volume, less than 250 mL, and frequently may not produce a sample sufficient to allow a complete suite of analyses on an annual basis. This is a result of soil conditions that cannot be prevented. When insufficient sample volume is present, only a limited number of parameters may be analyzed. The priority for sample analysis will be pH, trace metals and then major ions. Tailings lysimeters will be sampled every five years on the year prior to permit renewal (next sample in 2015).~~

2.1.45 Analytes and Analytical Methods

All surface and tailings well samples will be analyzed for pH, conductivity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), sulfate, chloride, alkalinity, sodium, potassium, magnesium, calcium, arsenic, cadmium, chromium, copper, iron, lead, selenium, silver, and zinc. Water levels will be measured immediately prior to collection of samples from the tailings wells.

The methods used for analyses will be those specified in Table QAPP-2 of the Quality Assurance Project Plan for the Ground Water Characterization and Monitoring Plan (QAPP-GCMP).

2.1.56 Quality Assurance

The quality assurance program for these samples will be as specified in the QAPP-GCMP. This requires a minimum of 20% duplicate, spike, spiked duplicate, equipment and trip blanks. The precision and accuracy objectives will be those specified in Table QAPP-1 of the QAPP-GCMP.

2.2 Solid Samples

2.2.1 Sample Collection

Solid samples will be collected semi-annually to characterize the metals content and metals solubility of materials discharged to the Tailings Impoundment. A total of five samples will be analyzed every six months:

- West cyclone underflow tailings (TLP1485 - quarterly)
- West cyclone overflow tailings (TLP1486 - semiannual)
- East cyclone underflow tailings (TLP1487 - quarterly)
- East cyclone overflow tailings (TLP1488 - semiannual)
- Smelter slag/hydromet tailings (TLP2593 - semiannual)

The ~~Tailings~~ North Tailings embankment is constructed of coarse underflow material from two cyclone stations (designated East and West Cyclones). The fine-grained overflow material is placed in the interior of the impoundment. The East Cyclone station currently receives material only from the Copperton Concentrator. The West Cyclone Station currently receives Copperton tailings, Power Plant fly ash and smelter slag/hydromet tailings. In the future, Smelter process waters may be directed to the West Cyclone station as well.

2.2.2 Analysis and Analytical Methods

All of the solid samples will be analyzed for the following constituents:

- Total Metals – As, Cd, Cr, Cu, Pb, Se and Zn,
- SPLP – As, Cd, Cr, Cu, Pb, Se and Zn.

Total metals analysis will be conducted according to EPA SW846 Method 6010 or 6020. SPLP analysis will be conducted according to EPA SW846 Method 1312.

2.2.3 Quality Assurance

The quality assurance program for these samples will require a minimum rate of 20% for duplicate, spike, spiked duplicate, and blank samples. The precision objectives will require duplicate samples to have Relative Percent Differences (RPD) of less than 25%. Accuracy objective will be spike recoveries between 65% and 135%. Blank samples will show no concentrations above the detection limit. The completeness goal is 100%.

3.0 REPORTING

Results of the water samples and the solid sampling will be reported in the annual monitoring report required and described in Appendix A.

TABLE 1 - SAMPLE SCHEDULE AND WELL CONSTRUCTION DETAILS

DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE FREQUENCY	NORTHING[1]	EASTING[1]	ELEVATION GROUND (ft amsl)[2]	ELEVATION MARK (ft amsl)[2]	CASING DIAMETER (ft)	SCREEN TOP (ft)	SCREEN BOTTOM (ft)	WELL DEPTH (ft)
Surface Water	CLC452	quarterly	7430598	1478952	NA	NA	NA	NA	NA	NA
Toe Ditch	TLP1436	quarterly	7449537	1472811	NA	NA	NA	NA	NA	NA
	TLP1469	quarterly	7443912	1456331	NA	NA	NA	NA	NA	NA
Seeps	TLS1426	semiannual (if flowing)	7430584	1469199	NA	NA	NA	NA	NA	NA
Tailings Wells	NET2596	semiannual	7432501	1475907	4382.23	0.00	0.208	123.0	133.0	135.00
	TLT887	semiannual	7437118	1456907	0.00	NA	NA	NA	NA	NA
	TLT2575B	semiannual	7435211	1476230	0.00	0.00	0.208	233.0	245.0	247.00
	TLT2575A	semiannual	7435232	1476230	0.00	4385.20	0.333	171.0	181.0	177.15
	TLT2452	semiannual	7438543	1478307	NA	0.00	0.000	19.0	0.0	201.00
Compliance Wells	NEL532A	semiannual	7434362	1478810	4225.52	4226.87	0.130	11.0	16.0	19.43
	NEL532B	semiannual	7433998	1478790	4226.53	4226.48	0.130	38.0	43.0	46.00
	NEL536A	annual	7431812	1478851	4231.35	4233.68	0.130	10.3	15.3	17.55
	NEL536B	annual	7431448	1478830	4231.21	4232.66	0.130	34.7	39.7	41.60
	NED604A	semiannual	7429873	1471526	4251.69	4254.76	0.170	15.0	25.0	26.42
	NED604B	semiannual	7429335	1471523	4251.89	4254.74	0.170	65.0	80.0	79.95
	NET646A	semiannual	7447372	1458412	4212.93	4215.33	0.170	5.0	15.0	17.93
	NET646B	semiannual	7447038	1458153	4212.90	4215.37	0.170	39.6	49.6	51.73
	NEM1387	semiannual	7430720	1472930	4245.02	4247.76	0.208	10.0	20.0	21.00
	NET1380A	semiannual	7437100	1454702	4226.14	4227.98	0.208	13.5	23.5	24.50
	NET1380B	annual	7437095	1454707	4226.32	4228.09	0.208	54.0	64.0	65.00
	NET1381A	semiannual	7443041	1479775	4220.39	4222.31	0.208	25.0	35.0	36.00
	NET1381B	semiannual	7443036	1479750	4220.21	4222.21	0.208	44.0	54.0	55.00
	NEL1382A	semiannual	7437371	1480785	4224.20	4225.81	0.208	10.0	20.0	21.00
	NEL1382B	semiannual	7437371	1480785	4224.27	4226.61	0.208	29.0	39.0	40.00
	NEL1382C	semiannual	7437371	1480785	4224.42	4226.51	0.208	88.0	98.0	100.00
	NET1383A	semiannual	7449638	1473603	4214.85	4217.45	0.208	14.0	24.0	25.00
	NET1383B	semiannual	7449659	1474064	4215.49	4217.55	0.208	34.0	44.0	45.00
	NET1384A	semiannual	7449093	1466595	4215.93	4217.94	0.208	13.0	23.0	25.00

TABLE 1 - SAMPLE SCHEDULE AND WELL CONSTRUCTION DETAILS (cont.)

DESCRIPTION	SAMPLE IDENTIFICATION	SAMPLE FREQUENCY	NORTHING[1]	EASTING[1]	ELEVATION GROUND (ft amsl)[2]	ELEVATION MARK (ft amsl)[2]	CASING DIAMETER (ft)	SCREEN TOP (ft)	SCREEN BOTTOM (ft)	WELL DEPTH (ft)
Compliance Wells	NET1385A	semiannual	7446677	1477638	4215.65	4217.94	0.208	14.5	24.5	25.00
	NET1385B	semiannual	7446252	1478003	4215.70	4218.16	0.208	60.0	70.0	71.00
	NET1386A	annual	7441038	1454228	4216.96	4218.67	0.208	29.0	39.0	40.00
	NET1386B	annual	7440466	1453934	4217.05	4218.84	0.208	61.0	71.0	72.00
	NET1393A	semiannual	7443665	1455650	4218.86	4220.68	0.208	29.0	39.0	40.00
	NET1393B	semiannual	7443665	1455650	4219.07	4220.98	0.208	58.0	68.0	70.00
	NET1490	semiannual	7432489	1459150	4333.84	4334.99	0.208	105.4	124.9	130.00
	NET1491	semiannual	7432962	1459180	4340.87	4343.67	0.208	125.8	145.0	149.93
	NET1492	semiannual	7433416	1459256	4346.84	4244.32	0.208	107.4	127.2	128.98
Lysimeters	TLL4100	Every fifth year (2015)	7432117	1473740						
	TLL4101	Every fifth year (2015)	7432117	1473740						
	TLL4102	Every fifth year (2015)	7432117	1473740						
	TLL4103	Every fifth year (2015)	7432117	1473740						
	TLL4128	Every fifth year (2015)	7438687	1459223						
	TLL4129	Every fifth year (2015)	7438687	1459223						
	TLL4133	Every fifth year (2015)	7430575	1456506						
	TLL4134	Every fifth year (2015)	7430575	1456506						
	TLL4135	Every fifth year (2015)	7430575	1456506						

1. Northing and Easting Coordinates in State Plane NAD83

2. Elevations use NGVD29

3. All samples will be analyzed for pH, conductivity, TDS (except lysimeters), TSS, sulfate, chloride, alkalinity, sodium, potassium, magnesium, calcium, arsenic, cadmium, chromium, copper, sulfate, iron, lead selenium, silver and zinc.

~~TABLE 2 - Lysimeter Depths~~

~~Lysimeter~~	~~Depth (ft.)~~	~~Lysimeter~~	~~Depth (ft.)~~	~~Lysimeter~~	~~Depth (ft.)~~
~~TLL4100~~	~~4~~	~~TLL4128~~	~~2~~	~~TLL4133~~	~~3~~
~~TLL4101~~	~~8~~	~~TLL4129~~	~~5~~	~~TLL4134~~	~~5~~
~~TLL4102~~	~~12~~			~~TLL4135~~	~~7~~
~~TLL4103~~	~~20~~				

APPENDIX B
COMPLIANCE MONITORING PLAN
REVISED TABLE 1
SAMPLE SCHEDULE AND WELL CONSTRUCTION DETAILS

DESCRIPTION	SAMPLE LOCATION IDENTIFICATION	SAMPLE FREQUENCY	NORTHING	EASTING	GROUND SURFACE ELEVATION (ft amsl)	WELL CASING TOP ELEVATION (ft amsl)	CASING DIAMETER (ft)	SCREEN TOP (ft)	SCREEN BOTTOM (ft)	WELL DEPTH (ft)
Surface Water	CLC452	quarterly	7431098.763	1477627.026	4236.745	NA	NA	NA	NA	NA
Toe Ditch	TLP1436	quarterly	7448657.891	1475500.588	4213.644	NA	NA	NA	NA	NA
	TLP1469	quarterly	7441822.072	1454049.978	4217.548	NA	NA	NA	NA	NA
Seeps	TLS1426	semiannual (if flowing)	7431247.082	1468939.158	4241.533	NA	NA	NA	NA	NA
Tailings Wells	NET2596	semiannual	7432842.004	1475151.88	4391.111	4392.82	0.208	123.0	133.0	135.00
	TLT887	semiannual	7436977.784	1456314.392	4401.823	4402.31	NA	NA	NA	NA
	TLT2575B	semiannual	7435235.015	1462330.623	4446.748	4448.723	0.208	233.0	245.0	247.00
	TLT2575A	semiannual	7435221.193	1462334.962	4446.893	4449.235	0.333	171.0	181.0	177.15
	TLT2452	semiannual	7437684.781	1476549.873	4407.503	4408.038	0.000	19.0	0.0	201.00
Compliance Wells	NEL532A	semiannual	7434092.934	1477917.371	4229.578	4231.417	0.130	11.0	16.0	19.43
	NEL532B	semiannual	7434091.206	1477910.979	4230.047	4231.951	0.130	38.0	43.0	46.00
	NEL536A	annual	7431250.503	1477963.928	4234.612	4236.084	0.130	10.3	15.3	17.55
	NEL536B	annual	7431251.504	1477957.872	4234.414	4236.473	0.130	34.7	39.7	41.60
	NED604A	semiannual	7430046.865	1470551.826	4254.494	4256.819	0.170	15.0	25.0	26.42
	NED604B	semiannual	7430041.37	1470541.413	4254.495	4257.068	0.170	65.0	80.0	79.95
	NET646A	semiannual	7447418.839	1457511.362	4216.136	4218.493	0.170	5.0	15.0	17.93
	NET646B	semiannual	7447423.34	1457514.227	4215.937	4218.62	0.170	39.6	49.6	51.73
	NEM1387	semiannual	7429854.378	1474135.24	4244.877	4247.571	0.208	10.0	20.0	21.00
	NET1380A	semiannual	7437102.682	1454699.634	4225.739	4227.211	0.208	13.5	23.5	24.50
	NET1380B	annual	7437098.49	1454703.717	4225.51	4227.251	0.208	54.0	64.0	65.00
	NET1381A	semiannual	7443041.228	1479773.311	4219.361	4221.454	0.208	25.0	35.0	36.00
	NET1381B	semiannual	7443040.648	1479779.414	4219.259	4221.438	0.208	44.0	54.0	55.00
	NEL1382A	semiannual	7438541.705	1478982.913	4223.973	4225.585	0.208	10.0	20.0	21.00
	NEL1382B	semiannual	7438545.766	1478984.052	4224.167	4226.41	0.208	29.0	39.0	40.00
	NEL1382C	semiannual	7438550.199	1478984.747	4224.192	4226.222	0.208	88.0	98.0	100.00
	NET1383A	semiannual	7449891.765	1472993.932	4214.667	4216.952	0.208	14.0	24.0	25.00
	NET1383B	semiannual	7449891.675	1473000.303	4215.073	4217.187	0.208	34.0	44.0	45.00
	NET1384A	semiannual	7449876.864	1465846.49	4216.049	4217.85	0.208	13.0	23.0	25.00
	NET1384B	semiannual	7449881.878	1465844.42	4216.178	4218.056	0.208	49.0	59.0	60.00
	NET1385A	semiannual	7446894.687	1476726.326	4214.988	4217.494	0.208	14.5	24.5	25.00
	NET1385B	semiannual	7446898.159	1476718.97	4214.99	4217.181	0.208	60.0	70.0	71.00
	NET1386A	annual	7442034.805	1453574.393	4216.379	4218.221	0.208	29.0	39.0	40.00

APPENDIX B
COMPLIANCE MONITORING PLAN
REVISED TABLE 1
SAMPLE SCHEDULE AND WELL CONSTRUCTION DETAILS

DESCRIPTION	SAMPLE LOCATION IDENTIFICATION	SAMPLE FREQUENCY	NORTHING	EASTING	GROUND SURFACE ELEVATION (ft amsl)	WELL CASING TOP ELEVATION (ft amsl)	CASING DIAMETER (ft)	SCREEN TOP (ft)	SCREEN BOTTOM (ft)	WELL DEPTH (ft)
	NET1386B	annual	7442031.393	1453571.739	4216.493	4218.389	0.208	61.0	71.0	72.00
	NET1393A	semiannual	7444066.516	1454571.437	4218.168	4219.962	0.208	29.0	39.0	40.00
	NET1393B	semiannual	7444059.728	1454567.254	4218.239	4220.23	0.208	58.0	68.0	70.00
	NET1490	semiannual	7432494.375	1459144.501	4333.459	4334.644	0.208	105.4	124.9	130.00
	NET1491	semiannual	7432964.615	1459178.086	4341.192	4343.219	0.208	125.8	145.0	149.93
	NET1492	semiannual	7433411.604	1459252.599	4339.828	4341.573	0.208	107.4	127.2	128.98

amsl = above mean sea level

ft = feet

NA = not applicable

-- = not available

Notes:

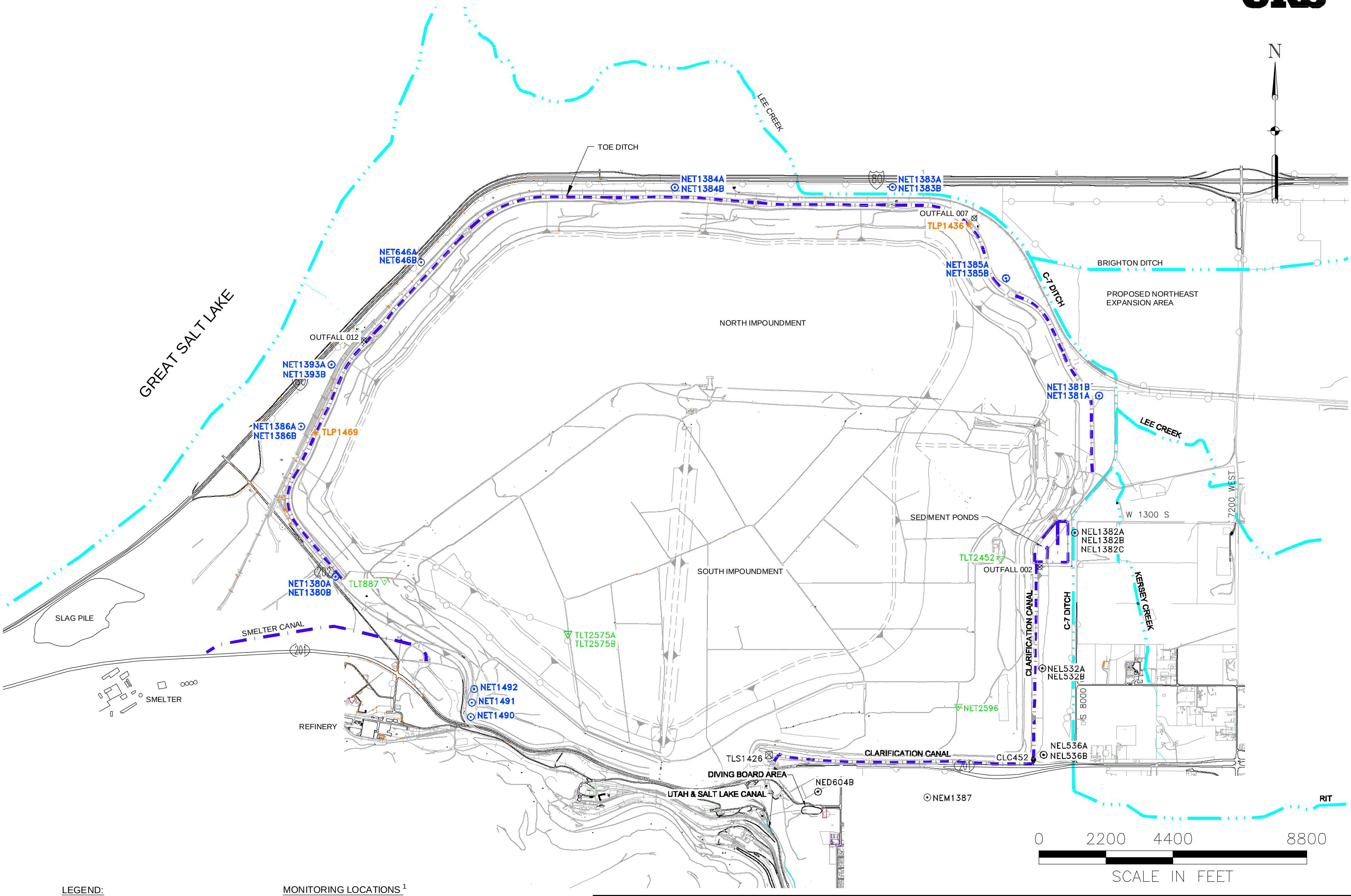
1. Surveying was conducted in January and March 2012.

2. Northing and Easting (N/E) Coordinates are relative to State Plane NAD83 (2007). The N/E was surveyed at the point that well casing top was surveyed.

3. Elevations are relative to NGVD88.

4. The well casing top elevation was surveyed at the point where depth to groundwater is measured. If a mark was located on the well casing top, this mark was surveyed. If there was no mark, the casing top was surveyed on the north side. For wells will a permanent valve system (flowing wells) and/or dedicated pumps, the well casing top was surveyed at the top of the valve on the north side.

5. All samples will be analyzed for pH, conductivity, TDS, TSS, sulfate, chloride, alkalinity, sodium, potassium, magnesium, calcium, arsenic, cadmium, chromium, copper, sulfate, iron, lead selenium, silver and zinc.



LEGEND:

PROPOSED TAILINGS EXPANSION PROJECT

SURFACE WATER DRAINAGES

PROCESS WATER DRAINAGES

⊠ TLS1426 SEEP

MONITORING LOCATIONS [1]

⊙ NEL532A	MONITORING WELL	● CLC452	CLARIFICATION CANAL
✳ TLP1469	TOE DITCH	⊠ OUTFALL 012	OUTFALL
⊙ NET1381A	COMPLIANCE WELL		ROADS
▽ TLT2452	TAILINGS WELL		

[1] LOCATIONS WERE RE-SURVEYED IN JANUARY AND MARCH 2012.

PROJECT NO.
22242186

KENNECOTT TAILINGS
GROUNDWATER DISCHARGE PERMIT

URS

TAILINGS IMPOUNDMENT COMPLIANCE AND OPERATIONAL MONITORING LOCATIONS

FIGURE
1

APPENDIX B

URS DRAWING PATH: W:\Projects\22242186_KUC_GW_Permit_Sup\7.0_CAD_GIS\7.1 CAD\TI COMPLIANCE.dwg

APPENDIX C

PROCESS WATER PIPELINE INSPECTION AND PREVENTATIVE MAINTENANCE PLAN
KENNECOTT TAILINGS IMPOUNDMENT
UGW350011

Kennecott Utah Copper LLC

~~June 2011~~September 2012

1.0 Introduction

The Process Water Pipeline Inspection and Preventative Maintenance Plan is developed in conjunction with the renewal of Permit No. UGW350011 (2011) and is captured here in Appendix C of this groundwater discharge permit. This plan describes inspections, maintenance, replacement, spill avoidance measures, and reporting requirements.

1.1 Facilities Description

The Tailing Impoundment is located on the northern end of the Kennecott Utah Copper **LLC** (KUC) mining operation, immediately north of Magna, Utah and immediately south of the Great Salt Lake. The impoundment consists of the 3,500 acre north impoundment and the 5,700 acre south impoundment as well as several adjacent pumping stations, wells, canals and other facilities associated with mine tailings and water management.

1.2 General Guidance

The various aspects of managing process water at the Tailings Impoundment are detailed in the Spill Prevention Management Standard Operating Procedure (Document #TASOP300.0206). The SOP outlines KUC responsibilities, Health, Safety and Environmental aspects, reference documents, facility description, and procedures related to activities, Monitoring Procedures and record keeping, and reporting requirements. KUC Tailings also maintains a critical pipeline inventory, a spill prevention, control and countermeasures (SPCC) plan and an emergency response plan. The critical pipeline inventory details pipe type, location length, substance conveyed, type of leak detection system and potential environmental risk if a spill occurred.

2.0 Inspection and Maintenance

2.1 Inspection

Facilities that are in operation are monitored on a continuous basis electronically from the Tailings control room. All operating Tailings facilities described in this plan are operated and monitored 24 hours per day, 365 days per year. Process water pipelines, associated pumps, valves and sumps are visually inspected once per shift (twice per day) while areas of critical concern are inspected twice per shift. The assigned operators or inspectors are responsible for correcting any problems discovered in a timely manner. Maintenance and repairs are initiated in response to inspection results or according to preventive maintenance (PM) schedules.

2.1.1 Protocol

A standard inspection protocol is followed for each inspection conducted. An inspection report form is completed and signed by the inspector as well as reviewed and signed by the supervisor. The operational status of each structure is noted along with any needed corrective actions or maintenance items. Any necessary repairs or corrections will be completed within 45 days of the date inspected. A maintenance notification will be submitted and repairs will be tracked and executed through maintenance work orders. KUC uses an electronic system (SAP) to manage maintenance work. See section 2.2 of this Appendix for more detail regarding maintenance protocol.

2.1.2 Record Keeping

Copies of each inspection performed will be maintained on file to document compliance with this program as specified in Part II Section H of the permit for a period of three years. Inspection reports will be available for review by UDWQ representatives during compliance visits. A discussion of inspections, maintenance, replacements and spill avoidance measures should be included in the semi-annual monitoring report required by the permit.

2.2 Maintenance

PM schedules at Tailings are tracked with a computerized maintenance program. Based upon operator inspections and preset maintenance intervals, this program assists in scheduling and planning PMs. Standard Operating Procedures (SOP) are used by the employee or group of employees assigned the responsibility for completing the PM. After the PM is completed, a signed PM checklist is returned to the maintenance scheduler. The maintenance planner notes any items identified during the inspection that require additional repair. A work order is then written and the additional work scheduled. The work-order tracking system is intended to ensure that proper and complete implementation of required repairs occurs in a timely fashion. The system continues to remind maintenance planners periodically until the work-order job is completed and closed out.

2.2.1 Spill Avoidance Measures

Spill avoidance is achieved through systematic monitoring, timely reporting and repair of deficiencies and a preventative maintenance program. The monitoring program is comprised of frequent visual inspections, electronic monitoring from the Tailing control room as well as subsequent documentation. In addition, the following measures are employed to minimize the likelihood of process water spills:

1. Substances conveyed in the pipeline are compatible with piping material;
2. Buried pipeline is non-metallic or is provided with appropriate protective wrapping;
3. Buried pipeline is provided with appropriate cathodic protection as appropriate;
4. Cathodic protection is checked and documented every 2 years;
5. Periodic pressure testing or wall thickness measurements are warranted for piping in areas where facility drainage is such that failure could lead to a major spill;
6. Pipelines carrying extremely hazardous substances are double walled and have leak detection;
7. Pipeline exposed to potential traffic damage are adequately protected;
8. Pipe supports will be designed to minimize abrasion and corrosion and to allow for expansion and contraction;
9. Pipelines subject to excessive settlement are surveyed twice per year to ensure pipelines are not subject to excessive stress; and
10. Operational areas are fenced and gated with the goal of eliminating public access.

3.0 Spills and Overflows

Spills as a result of pipeline releases will be identified by one or more of the following measures:

1. Visual observation by roving operators
2. Tailings control room monitoring of pump status, flows, sump levels and pipeline pressures.

Upon identification of a leak, compromised process water piping is de-energized, shutoff and isolated for repair. In addition, the following plans will direct Tailings operations regarding spill protocol:

1. Tailings Spill Prevention Control and Countermeasures Plan (SPCC plan)
2. KUC Storm Water Pollution Prevention Plan (SWPPP)
3. Tailings Emergency Response Plan

Depending upon the specific circumstances of a particular pipeline release, KUC will refer to the following guidance:

1. Kennecott Tailings Impoundment Groundwater Discharge Permit No. UGW350011
2. Other various Utah Department of Environmental Quality reporting requirements
3. Other various U.S Environmental Protection Agency reporting requirements
4. Rio Tinto/Kennecott Utah Copper internal reporting requirements

4.0 Training

Each employee receives task specific training and mentoring related to job specific duties. In addition, employees receive Standard Operating Procedure (SOP) Training on an annual basis. The training includes the following areas:

1. Air Emissions Control (300.201)
2. Culinary Water Management (300.202)
3. Surface Water Management (300.203)
4. Groundwater Management (300.204)
5. Waste Management (300.205)
6. Spill Prevention Management (300.206)
7. Dam Failure Prevention (300.207)
8. Reclamation (300.208)

5.0 Reporting Requirements

5.1 Semi-annual Reporting

KUC will refer to Part I Section H with respect to reporting frequency and Part I Section I regarding content included in the semi-annual reports.

5.2 Release Reporting

KUC will follow guidance outlined under Part II section I of this permit with respect to Spill Reporting and Part I Section G of this permit with respect to Non-Compliance of Best Available Technology.