**In the Matter of**

**PR Spring Tar Sands Project, Ground Water Discharge Permit-by-Rule**

**No. WQ PR-11-001**

---

# PREPARED DIRECT TESTIMONY

# OF

# ELLIOTT W. LIPS

# ON BEHALF OF

# LIVING RIVERS

**January 20, 2012**

## I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME?

A. My name is Elliott W. Lips

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am the principal engineering geologist of Great Basin Earth Science, Inc. located at 2241 East Bendemere Circle, in Salt Lake City, Utah.

Q. FOR WHOM ARE YOU TESTIFYING IN THIS PROCEEDING?

A. I am testifying on behalf of Living Rivers.

Q. WOULD YOU PLEASE SUMMARIZE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND?

A. I am a Professional Geologist licensed in the State of Utah.

In 1983, I received my Bachelor's degree from Western State College of Colorado with a double major in geology and physics. In 1990, I received my Master's Degree in geology from Colorado State University.

Between 1983 and 1985, I was employed by the U.S. Geological Survey. During this time I participated in, researched, and co-authored several studies relating to ground water movement and landslides, as well as surface water flooding. Most of the investigations were on sites of recent flooding and landslide activity in central Utah.

Between 1985 and 1997, I was employed as a full-time consulting engineering geologist. During this time I conducted approximately 15 investigations for ground water contamination from mines, mills, smelters, tailings ponds, and other industrial facilities in Utah, Colorado, Nevada, and California. I participated in four separate seep and spring surveys for existing and proposed mines in Utah and Nevada, ranging in size between 2 and 50 square miles. I performed hydrology and hydraulics analyses and designed runoff control plans at numerous mine and industrial facilities in Utah and Nevada. I prepared geology, hydrology, and engineering components of mining and reclamation plans and ground-water discharge permits for 21 open-pit and underground mines, mill and concentrator sites, smelters, and tailings impoundments.

Between 1996 and 2006 I was an Adjunct Associate Professor in the Department of Geography at the University of Utah. I taught classes in geomorphology (including surface and ground water systems), environmental studies, climate change, and resource conservation and environmental management.

In the past 26 years, I have assisted in the preparation of geology, hydrology, and engineering portions of mining and reclamation plans at six coal mine facilities in Utah (Knight Mine, Star Point Mine, Soldier Canyon Mine, Sunnyside Mines, Horse Canyon Mine, and the Rilda Canyon Mine). I have also supported permitting activities at five non-coal mine facilities in Utah (Mercur Mine, Kennecott [mine, mill, smelter, and tailings pond], Carr Fork Mine, IS&R [mill site and tailings pond], and the Goldstrike Mine). In addition to permitting activities for the Division of Oil Gas and Mining, I have prepared permit applications for ground- and surface-water discharge.

In the past 14 years, I have provided permitting expertise in the areas of geology and surface and ground water quality and quantity for proposed mines, tailings ponds, dams, highways, and river diversions. These projects have involved review of Ground Water

Discharge Permits, Coal Ash Landfill Permits, NEPA documents, 404 Permit Applications under the Clean Water Act, UPDES Permits, Federal Energy Regulatory Commission (FERC) Applications, and Utah Division of Oil, Gas and Mining and Reclamation Plans.

During my professional career, I have provided consulting services to federal, state, and local governmental agencies, private industry, and non-governmental organizations.

I have prepared reports and provided expert testimony twice in Federal Court and at several hearings before the Utah Board of Oil Gas and Mining.

My Curriculum Vitae is found at Attachment A.

A list of recent cases in which I have testified is found at Attachment B.

Q. ARE YOU FAMILIAR WITH THE PERMITTING DOCUMENTS SUBMITTED BY US OIL SANDS FOR THEIR PROPOSED PR SPRING MINE?

A. Yes. I have reviewed: 1) the Notice of Intention to Commence Large Mining Operations (NOI) submitted to the Utah Division of Oil, Gas and Mining (DOGM) (approved on September 19, 2009); 2) the Ground Water Discharge Permit-by-Rule Demonstration (Demonstration) submitted to the Utah Division of Water Quality (DWQ) on February 21, 2008; 3) the letter dated March 4, 2008 from the DWQ on the ground water discharge permit-by-rule; 4) the Storm Water Pollution Prevention Plan (SWPPP) prepared on March 25, 2009; 5) the letter dated February 8, 2011 from US Oil Sands (USOS) to DWQ; and 6) the letter dated February 15, 2011 from the DWQ on the ground water discharge permit-by-rule. In addition, I am familiar with the DWQ rules for Ground Water Quality Protection (R317-6).

Q. HAVE YOU REVIEWED ANY OTHER DOCUMENTS IN PREPARING THIS TESTIMONY?

A. Yes. I have also reviewed the following:

Holmes, W.F., and Kimball, B.A., 1987, Ground water in the Southeastern Uinta Basin, Utah and Colorado: U.S. Geological Survey Water Supply Paper 2248.

Price, D. and Miller, L., 1975, Hydrologic Reconnaissance of the southern Uinta Basin, Utah and Colorado: Utah Department of Natural Resources, Technical Publication No. 49.

Q. HAVE YOU INSPECTED THE SITE OF THE PROPOSED PR SPRING MINE?

A. Yes, I conducted a one-day reconnaissance of the proposed mine site and surrounding area on August 19, 2010.

## II. <u>PURPOSE AND SUMMARY OF TESTIMONY</u>

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. My testimony will provide evidence that DWQ improperly determined on February 15, 2011 that the proposed mining and bitumen extraction operation should have a *de minimis* potential effect on ground water quality and qualifies for permit-by-rule status under UAC R317-6-6.2A(25).

Q. WOULD YOU PLEASE SUMMARIZE YOUR TESTIMONY?

A. The documents that EER provided to DWQ (Demonstration, DOGM NOI, and February 8, 2011 letter, hereafter referred to collectively as the Documents) do not contain the information on projected impacts to ground water systems that support a *de minimis* determination. Specifically the documents: 1) fail to provide a complete and accurate description of the occurrence or quality of existing ground water; 2) fail to provide a complete and accurate description of the hydraulic properties of the tailings that will be placed in the pits and dumps; 3) fail to evaluate the seepage of water through the tailings; and 4) fail to evaluate the impacts of the seepage of contaminated water on existing ground water quality. Because of these egregious failures, the DWQ *de minimis* determination is unsupported and without basis.

Q. CAN YOU BRIEFLY DESCRIBE THE DISTURBANCE THAT WILL BE ASSOCIATED WITH THE PROPOSED MINE?

A. USOS proposes to disturb a total of 213 acres within their lease boundary. This will consist of open pits (93 acres), waste rock and tailings dumps (70 acres), plant site and processing facilities (15 acres), topsoil storage areas (18 acres), and roads (17 acres) (NOI, pg. 21-22).

## III. <u>FAILURE TO DESCRIBE EXISTING GROUND WATER</u>

Q. COULD YOU BRIEFLY DESCRIBE THE GROUND WATER SYSTEM AT THE PR SPRING MINE?

A. I can describe what is presented by USOS in the Documents, but it is an incomplete description. USOS describes a regional aquifer with a potentiometric surface of 1,500 feet or greater below the ground surface in the general area of the mine (NOI, pg. 38). USOS also describes "localized shallow groundwater likely representing isolated perched aquifers…" (NOI, pg. 30). Several seeps and springs are identified in the Main Canyon watershed, which supports perennial flow for some distance along its main stem (NOI, pg. 35).

Q. CAN YOU EXPLAIN WHY YOU BELIEVE THE DESCRIPTION OF THE GROUND WATER SYSTEM PROVIDED IN THE DOCUMENTS IS INCOMPLETE?

A. First, it is based on drilling to a limited depth. USOS initially drilled 25 holes at the site, but the maximum depth of the holes was 150 feet below the ground surface.

Q. WHY IS THIS NOT DEEP ENOUGH?

A. At a very minimum, USOS should have drilled through all of the strata that they intend to mine under their current plan. None of the drill holes penetrated deeper than the "D" bed, the higher of the two beds of tar sands that USOS proposes to mine. There is no information on the presence or absence of water in the 15 foot thick layer between the "D" and "C" bed or the 24 foot thickness of the "C" bed itself (NOI, pg, 30).

Q. SHOULD USOS HAVE EXTENDED THE DRILL HOLES DEEPER?

A. Yes, because USOS did not drill deeper than 150 feet, there is no supporting data that the regional aquifer is 1,500 below the ground surface at the PR Spring mine site, or that there is no aquifer at a shallower depth. The assumed depth of 1,500 feet comes from a regional report for the southern Uinta Basin in Utah and Colorado (Price and Miller, 1975).

Q. ARE THERE ANY OTHER AREAS IN WHICH THE DESCRIPTION OF THE GROUND WATER SYSTEM PROVIDED IN THE DOCUMENTS IS INCOMPLETE?

A. USOS only described "likely perched aquifers," but provides no information on the depth, thickness, number, areal extent, flow direction or gradient, or water quality of these aquifers.  This information is particularly important because these aquifers are likely to be the first and most impacted aquifers as a result of the mining operation.

Q. IS THERE ANYTHING ELSE LACKING IN THE DESCRIPTION OF THE GROUND WATER SYSTEM?

A. According to the record, USOS did not undertake a seep and spring survey to identify all locations of ground water discharge in the area.  This is a serious lack of information on the presence of ground water.

Q. IS THERE ANYTHING ELSE LACKING IN THE DESCRIPTION OF THE GROUND WATER SYSTEM?

A. USOS provides no maps or cross-sections showing the relationship of the location and elevation of the seeps and springs to the perched aquifers.  Maps and cross-sections are necessary to describe the flow direction and gradient of existing ground water system in order to understand the potential impacts from the proposed mining operation.

Q. ARE THERE ANY DATA OR MEASUREMENTS ON EXISTING GROUND WATER QUALITY IN OR NEAR THE PROPOSED MINE SITE?

A. No.  The Documents contain absolutely no data or measurements of existing ground water quality in or near the proposed mine site.  In fact the Demonstration states "[t]he baseline water quality of ground water underlying the project area is not known…." (pg. 4).

Q. WHY IS BASELINE WATER QUALITY INFORMATION IMPORTANT?

A. Because without having baseline information on the existing water quality, it will be impossible to evaluate any impacts associated with the proposed mining operation.

Q. IN SPITE OF THE INCOMPLETE DESCRIPTION PRESENTED BY USOS, IS IT LIKELY THAT THERE ARE GROUND WATER SYSTEMS IN THE MINE PERMIT AREA?

A. Yes. The Demonstration reports that mining will occur down to and including the "C" tar sand bed which is located in the Douglas Creek Member of the Green River Formation. Furthermore, the Demonstration reports that "[t]he Douglas Creek Member forms the uppermost recognized aquifer in the project area…." and "[t]he Douglas Creek Aquifer receives recharge mainly by infiltration of precipitation and surface water in its outcrop area…." (pg. 2).

Q. ARE THERE OTHER PUBLISHED REPORTS OF AN AQUIFER IN THE DOUGLAS CREEK MEMBER?

A. The Demonstration also cites the BLM reporting that "[t]he Douglas Creek Aquifer receives recharge mainly by infiltration of precipitation and surface water in its outcrop area, with little leakage from underlying bedrock aquifers. It discharges locally to springs in the outcrop area and to alluvium along major drainageways such as the Green and White Rivers…." (pg. 2).

Q. IS THERE OTHER EVIDENCE OF AQUIFERS IN THE DOUGLAS CREEK MEMBER?

A. Yes, aquifers in this geologic unit are confirmed by the presence of numerous seeps and springs in the Meadow Canyon sub-watershed, the Trail Canyon sub-watershed, and the Main

Canyon watershed, all of which are shown to be in the Douglas Creek Member of the Green River Formation (NOI, Figures 5 and 7).

Q. WHAT EVIDENCE IS THERE IN THE RECORD THAT GROUND WATER EXISTS IN SHALLOW, LOCALIZED, ISOLATED, PERCHED AQUIFERS AT OR NEAR THE PROPOSED MINE SITE?

A. The NOI states "[n]earby springs or seeps (shown on Figure 7) provide evidence of very localized, shallow groundwater, likely representing isolated perched aquifers…" (pg. 30). The Demonstration states that "[t]here are several nearby springs and/or seeps that provide evidence of localized, shallow ground water…." (pg. 2).

Q. WERE THE SPRINGS RECOGNIZED AND CONSIDERED BY THE DWQ IN THEIR DETERMINATION?

A. No. The determination by the DWQ is based on an assumption that is contrary to information presented in the Documents. Specifically, the DWQ based their determination, in part, on the statement that "[t]here are no springs in the Earth Energy leased area and the nearest spring is PR Spring located slightly less than a mile east of the project site…" (DWQ letter dated March 4, 2008, pg. 2). However, as clearly shown on Figure 7 of the NOI (submitted with the Demonstration), there are 9 water right filings for seeps or springs and 4 seeps that were identified in the field, all within USOS's lease boundary. DWQ did not correct this error in their subsequent determination on February 15, 2011.

Q. BASED ON THE INFORMATION IN THE PUBLISHED LITERATURE, AND ON REPRESENTATIONS FROM USOS, IS IT YOUR OPINION THAT THE SOURCE OF RECHARGE FOR THESE ISOLATED SHALLOW AQUIFERS IS PRECIPITATION?

A. Yes. The presence of these aquifers provides evidence that in this area, precipitation exceeds evapotranspiration and runoff, and that seepage into the ground does occur.

## IV. FAILURE TO DESCRIBE HYDRAULIC PROPERTIES OF TAILINGS

Q. CAN YOU DESCRIBE THE MATERIALS THAT WILL BE PLACED IN THE BACKFILLED PITS AND WASTE DUMPS?

A. There will be two types of materials placed in the pits and waste dumps. The first material is the overburden/interburden. This will consist of broken sandstones and shales mixed with lesser amounts of fines, with particles varying from fine to coarse rock rubble (run-of-mine) materials potentially as large as one cubic yard (NOI, pg. 37). The second type of material will be the processed sands and fines. USOS has referred to these as “processed sand”, “waste sand”, “produced (clean) sand”, “discharged sand”, and “tailings”; I prefer the use of the word tailings because not all of the material is sand. According to USOS, the processing produces two streams of tailings; a sand size fraction (80%) and a fines fraction (20%) (Demonstration, pg. 8). It is also important to note that all of the material that will be placed in the pits and dumps (both overburden/interburden and tailings) will have a higher porosity than the in-place bedrock. USOS reports a bulking factor of 30 percent for all material for volume calculations (NOI, pgs. 19, 24).

Q. WHAT DOES THE DEMONSTRATION REPORT WITH REGARD TO THE MOISTURE CONTENT OF THE TAILINGS?

A. The Demonstration states "Approximately 85 percent of the total water used during the extraction of bitumen from oil sand will be recycled. The chemically cleaned produced sand is de-watered on a shale shaker (or similar device) and the recovered water is pumped to a holding tank for recycle to the front of the process" ….. "The dewatered sands and fines are placed in a temporary storage pile, from which they are back-hauled to the pit backfill every 24 hours. The dewatered residual solids in the storage pile will contain approximately 15 to 20 percent moisture and when mixed will have a plastic consistency that will not release free water while in the stockpile. This material will be near optimum moisture for compaction when it is returned to the pit" (pg 6). "After processing, the tar sands will be nearly dry (10 to 20-percent moisture remaining from entrained process water)" (pg 8).

Q. WHAT DOES THE NOI REPORT WITH REGARD TO THE MOISTURE CONTENT OF THE TAILINGS?

A. The NOI states that "The clean produced sand is de-watered on a shale shaker (or similar device) and the recovered water is pumped to a holding tank for recycling to the front of the process"…."De-watered sand and clay fines are then conveyed to a stockpile for loading and backhaul to the mine pit. At this point, the discharged sand and clay fines contain between 10 and 20 percent water." (pg. 17) "Waste sand from the processing operation would contain 10 to 20 percent water and will be fairly neutral chemically. Recent process equipment evaluations indicate the moisture content of the blended sand/clay fine tailings will be in the order of 15%. As noted above, this level of moisture content is near optimal for compaction." (pg 32)

Q. WHAT DOES USOS'S FEBRUARY 8, 2011 LETTER TO DWQ REPORT WITH REGARD TO THE MOISTURE CONTENT OF THE TAILINGS?

A. The letter states that "With a global supplier of mine processing equipment, we have identified equipment that will economically recover water from the sand and fines. For the sand, we now expect to use a horizontal belt filter, and for the fines we expect to use a disk filter. With these components, the aggregate water content of the blended tails should be less that 15% by weight – maximizing our recovery of available water while providing a material at near optimum moisture content for compaction."

Q. TAKEN AS A WHOLE, WHAT INFORMATION DOES USOS PROVIDE THAT IS RELAVENT TO THE ABILITY OF WATER TO PERCOLATE THROUGH THE TAILINGS?

A. Unfortunately, most of the information that USOS provides is unsupported by any data, or is irrelevant to the issue of understanding and describing the ability of water to percolate through the tailings. First, USOS reports that the tailings will have a plastic consistency; however, USOS provides no test results to support this statement, and this qualitative description can only be properly understood by having results from Atterberg Limits tests and properly classifying the materials. Second, USOS reports that the tailings will be near optimum moisture for compaction. Again, USOS provides no results of laboratory compaction testing to support this statement. In addition, it is incorrect to state that a material is at optimum moisture for compaction without specifying the degree of compaction (which USOS does not specify). There is no "optimum moisture for compaction" for any material independent of a compaction standard. Third, neither of these qualitative descriptions of the materials provides information relevant to how water moves through the tailings.

Q. WHAT USEFUL INFORMATION DOES USOS PROVIDE?

A. The most important information that USOS provides is in their descriptions of how water will be recovered from the tailings before they are disposed of in the pits and/or dumps. USOS reports that after processing, water will be removed by a horizontal belt filter for the sands, and a disk filter for the fines. Both of these are mechanical dewatering techniques and depend on the ability of the water to drain from the tailings. Only after the tailings have been in the storage piles and the available water that can drain from them by gravity has drained, will the tailings be placed in the pits and/or dumps. This is a clear demonstration by USOS that the moisture content of the tailings immediately prior to being placed in the pits and/or dumps will be at or near field capacity.

Q. WHAT IS FIELD CAPACITY AND WHY IS IT IMPORTANT TO THE ABILITY OF WATER TO PERCOLATE THROUGH THE TAILINGS?

A. Field capacity is the moisture or water content of a material that remains after excess water has drained away under gravitational forces. It is the water content of the soil that remains in the pore space bound to the soil particles. The importance is that when a material, such as the tailings, is at field capacity ANY additional water that is added to it will drain under gravity. This is a necessary result because adding water to a soil at field capacity raises the water content above the field capacity and this water will drain until the water content once again reaches the field capacity.

Q. WHAT IS THE IMPORTANCE OR RELEVANCE OF THE NUMERICAL VALUES OF WATER CONTENT THAT USOS REPORTS FOR THE TAILINGS?

A. The actual moisture content of the tailings that are placed into the pits and dumps is only relevant with regard to the field capacity and how soon additional water will percolate through the tailings.

Q. HOW DOES THE MOISTURE CONTENT OF THE TAILINGS AFFECT THE INFILTRATION OF WATER THROUGH THE PITS AND DUMPS?

A. Water will infiltrate through the tailings regardless of the moisture content when they are placed in the pits or dumps. The only effect moisture content has on this process is how long it will take for water to reach the bottom of the pits or dumps. If the initial moisture content of the tailings is slightly below the field capacity, it will take longer for precipitation to percolate through them; conversely, if the initial moisture content of the tailings is at or above the field capacity, precipitation will percolate sooner. As I discussed below, there is sufficient water available from precipitation alone to infiltrate through the tailings and reach the bottom of the pits or dumps.

Q. WHAT DOES USOS REPORT WITH REGARD TO THE TAILINGS BEING "FREE DRAINING?"

A. The Demonstration states that the dewatered residual solids in the storage pile will not release free water while in the stockpile.

Q. WHAT DOES IT MEAN FOR A SOIL TO BE FREE DRAINING?

A. A soil is free draining if it has the CAPACITY for water to drain through it easily. It is a property of the soil and does not provide any information on the water content – either the initial water content or the water content once the water has drained and the soil is at field capacity.

Q. WILL THE TAILINGS BE FREE DRAINING?

A. Absolutely. This is clearly demonstrated by USOS's reports that water will drain from the tailings as they pass over the horizontal belt and disk filters and that there will be water draining from them as they are in the temporary storage piles. This provides evidence that the tailings will have the capacity for water to drain easily.

Q. WHAT FACTORS DID DWQ CONSIDER WITH REGARD TO THE HYDRAULIC PROPERTIES OF THE TAILINGS IN REACHING THEIR *DE MINIMIS* DETERMINATIONS?

A. In their March 4, 2008 letter, the DWQ listed four factors relevant for determining whether the proposed operation will have a *de minimis* effect on ground water quality or beneficial uses of ground water resources. The third factor stated that "Processed tailings will not be free-draining and will have moisture content in the 10 to 20 percent range." In their February 15, 2011 letter, the DWQ stated "The original proposal was to use a "shale shaker (or similar device)" to produce tailings with a water content ranging from 10 to 20 percent, which would not be free-draining. As the proposed change will still produce tailings within the original estimated range for water content, this change does not affect the determination of *de minimis* effect on ground water quality."

Q. WHAT IS YOUR OPINION ON DWQ'S DETERMINATION WITH REGARD TO THE TAILINGS NOT BEING FREE DRAINING?

A. The DWQ is in error and could only have reached this conclusion by ignoring all the available evidence presented in the Documents that the tailings will drain easily, or because the DWQ does not understand the difference between a free-draining material (one that has the capacity to drain freely), and one where all the water has drained to the point of being at field capacity. Just because the tailings will have drained to their field capacity does not mean that they are not free draining. Any additional water will easily drain from them because they have the capacity for this to occur.

## V. <u>FAILURE TO EVALUATE SEEPAGE OF WATER THROUGH THE TAILINGS</u>

Q. HOW WILL THE TAILINGS BE PLACED IN THE PITS?

A. I cannot answer that question completely because the NOI is internally inconstant and vague, and also conflicts with the description in the Demonstration. The NOI states that the "sand tails" will be alternately combined (blended) with the overburden/interburden materials resulting in a "bulk replacement material" which, when placed in compactable lifts (compaction primarily from haul trucks) will be a more homogeneous mixture (pg. 19). However, the NOI also says that blended sand/clay fine tailings will be placed in relatively thin lifts (estimated at 1-3 feet) (pg. 19). The Demonstration states that the tailings will be placed back into the open pit and layered with overburden and interburden (pg. 8).

Q. DO THE NOI OR DEMONSTRATION DESCRIBE THE "BLENDING" OR COMPACTION?

A. Neither document describes the blending of the sand/clay fine tailings, or the blending of the sand tails with the overburden/interburden materials resulting in a "bulk replacement material". The NOI only says that compaction of the "bulk replacement material" will be primarily from haul trucks. In addition, the equipment list (Appendix D) does not list any compaction equipment.

Q. DOES THE NOI DISCUSS THE POTENTIAL FOR SEEPAGE OF WATER THROUGH THE TAILINGS IN THE BACKFILLED PITS?

A. The NOI simply reports that drainage of the "bulk replacement material" will be comparable to in-situ materials (pg. 19). I take this to mean the various layers of bedrock that existed prior to mining.

Q. WHAT DOES THE DEMONSTRATION STATE WITH REGARD TO THE POTENTIAL FOR SEEPAGE OF WATER THROUGH THE PITS?

A. The Demonstration states "The processed sand will be dry (10-20 percent moisture content), and because of the low rainfall in the area, breakthrough of infiltrating precipitation to the base of the pit waste deposits is not anticipated to occur." (pg. 12).

Q. DOES USOS PROVIDE ANY DATA AND ANALYSIS TO SUPPORT THIS ASSUMPTION?

A. The only data reported to support this assumption is that precipitation in the area is estimated at about 12 inches annually (USOS cites Price and Miller, 1975). However, there are no data on the porosity or permeability of the tailings (or any material placed in the pits), no analysis of the moisture content of the tailings, and no analyses of seepage of precipitation through the backfilled pits.

Q. IS USOS' UNSUPPORTED ASSUMPTION ABOUT SEEPAGE THROUGH THE TAILINGS IN THE BACKFILLED PIT CONSISTANT WITH THE PUBLISHED LITERATURE?

A. No. USOS assumes that there is not enough precipitation to infiltrate through the backfilled pits. One only needs to look at the present condition of precipitation infiltrating into bedrock to evaluate the validity of USOS's assumption. First, Price and Miller (1975) report "[t]he principal source of ground-water recharge is precipitation that falls on the high southern rim of the Uinta Basin. Water from rain and melting snow percolates directly, or from streams, into the underlying sedimentary rocks…." (pg. 27). Given that water from rain and melting snow percolates into underlying sedimentary rocks, it can and will percolate through the material that is placed in the backfilled pits and dumps. Furthermore, the Demonstration reports that [t]he Douglas Creek Member forms the uppermost recognized aquifer in the project area…." and "[t]he Douglas Creek Aquifer receives recharge mainly by infiltration of precipitation and surface water in its outcrop area…." (pg. 2). Again, water from precipitation is currently infiltrating to water bearing horizons (aquifers) and there is absolutely no reason to expect that precipitation in the future would not similarly infiltrate into the backfilled pits and waste dumps, especially when considering that the material backfilled in the pits and placed in the dumps will have a higher porosity than the in-place bedrock.

Q. IN YOUR OPINION, IS USOS' UNSUPPORTED ASSUMPTION ABOUT SEEPAGE THROUGH THE TAILINGS IN THE BACKFILLED PIT CORRECT?

A. No. The statement that breakthrough is not anticipated to occur is unsupported by any data or analyses and is flatly incorrect. Seepage through the backfilled pits will be sufficient to reach the base of the pit. The assumption that precipitation in the area is too low for this to occur completely ignores the fact that precipitation is sufficient to recharge shallow perched aquifers that contribute flow to the numerous seeps and springs in the area. As discussed above, this is a clear demonstration that infiltration of precipitation does occur, and that over time, this infiltration recharges aquifers (even though Price and Miller, 1975 report that a small percentage of precipitation recharges ground water, over time the net result is that there is sufficient quantity to recharge aquifers near the PR Spring Mine). There is no basis to assume that infiltration will not similarly occur in the backfilled pits. As discussed above, the initial moisture content of the tailings when they are placed in the pit simply affects how quickly seepage will occur, not if it will occur.

Q. IS IT YOUR OPINION, BASED ON THE INFORMATION IN THE PUBLISHED LITERATURE, AND ON INFORMATION IN THE RECORD, THAT PRECIPITATION WILL INFILTRATE THROUGH THE TAILINGS IN THE BACKFILLED PITS?

A. For reasons discussed above, I have absolutely no doubt that there is sufficient precipitation for infiltration to occur. The only way that infiltrating water would not reach the bottom of the pits is if the material was impermeable. There is no information in the record on the porosity or permeability of the materials but given the 30 percent bulking factor, the porosity is certainly higher than the various layers in the existing bedrock. Therefore, it is my opinion that precipitation will, over time, percolate through the material in the pits, including the tailings.

Q. DO YOU HAVE AN OPINION AS TO WHAT WILL HAPPEN ONCE THE WATER INFILTRATES THROUGH THE BACKFILLED MATERIAL, INCLUDING THE TAILINGS, AND REACHES THE BOTTOM OF THE PIT?

A. I cannot say with certainty, but one of three things will happen depending on the porosity and permeability of the bedrock exposed in the bottom and sides of the pits. First, it is possible that water will continue to infiltrate into underlying bedrock. Second, it is possible that water will completely saturate the backfilled material and the top of the saturated surface will rise in elevation until it reaches a layer in the side of the pit with sufficient permeability that water flows into that layer. Third, it is possible that the saturated surface continues to rise until the water flows out of the bedrock lip of the pit. Without information on the specific layers that will be exposed, it is not possible to say which of these scenarios is more or less likely to occur.

Q. DO THE DOCUMENTS CONTAIN INFORMATION ON THE LAYERS OF ROCK THAT WILL BE EXPOSED IN THE PIT BOTTOM OR SIDES?

A. No.

Q. IS IT REASONABLE TO ASSUME THAT THERE ARE LAYERS THAT WILL BE EXPOSED IN THE SIDES OF THE PITS THAT WATER COULD INFILTRATE INTO?

A. Yes, and these layers have sufficient porosity and permeability to act as aquifers that recharge the seeps and springs adjacent to the mine. It is reasonable to assume that one, or more, of these layers could transmit water from the pit if it becomes saturated to their elevation.

Q. REGARDLESS OF WHICH OF THE THREE SCENARIOS IS LIKELY TO OCCUR, WHAT IS THE ULTIMATE FATE OF WATER FROM THE PITS?

A. Ultimately, the water will flow out of the pit and into underlying or adjacent rocks and/or unconsolidated sediment. This water will migrate until it reaches an existing aquifer, or discharges at the ground surface as a new seep or spring.

Q. CAN YOU DESCRIBE THE PROPOSED OVERBURDEN DUMPS?

A. USOS proposes to construct two overburden/interburden storage areas (overburden dumps) in two ephemeral drainages above Main Canyon (NOI, pg. 20, Figure 2). These overburden dumps will contain 4.9 million cubic yards of overburden/interburden and sand tailings (NOI, pg. 14, 20, Figure 2a).

Q. HOW WILL THE TAILINGS BE PLACED IN THE DUMPS?

A. The tailings will be placed in “tailings containment cells” or “tailings storage cells” constructed of coarse overburden materials in the upper reaches (flattest) areas of the dumps and then filled with commingled sand and fine tailings (NOI, pg. 20). Each cell will be 15-20 feet high. The NOI does not report that the tailings will be compacted.

Q. WHAT WILL HAPPEN TO PRECIPITATION FALLING ON THESE DUMPS?

A. Similar to what is happening today on the natural ground surface, some of the precipitation (rainfall and snowmelt) that falls on the dump surface will runoff and some will infiltrate into the dumps. The amount of infiltration depends on how fast the water is applied to the dump surface. If it is a slow snowmelt, or a low intensity rainfall event, most or all of the water will infiltrate. Only when there is a rapid snowmelt, or high-intensity rainfall events will the infiltration capacity of the soil be exceeded, resulting in surface water runoff.

Q. CAN YOU DISCUSS THE FLOW OF PRECIPITATION THROUGH THE DUMPS?

A. For all the reasons discussed above with the material in the backfilled pits, precipitation will, over time, percolate through the overburden/interburden material and the tailings in the dumps and will reach the bottom of the dumps. At that point, one of two things will happen; either the water will continue to infiltrate into the underlying pre-existing soils and bedrock, or the water will migrate along the contact of the dumps and the pre-existing surface. Because the permeability of the underlying rock is lower than the materials in the dumps, I think it is more likely that water will flow at the base of the dumps along, or near, the pre-existing surface and ultimately flow out at or near the dump toe as a new seep or spring. Because the toes of the dumps are located at the very edge of the affected area, any water that flows from the toe of the dumps will travel off-site.

Q. DO THE DOCUMENTS DISCUSS THE POTENTIAL FOR SEEPAGE OF WATER THROUGH THE TAILINGS IN THE DUMPS?

A. No. In fact, the Demonstration submitted to DWQ by USOS does not even mention that tailings will be placed in the dumps. In addition, the letter from USOS to DWQ on February 8, 2011 never discusses the potential for seepage of water through the tailings in the dumps.

Q. WHAT DID THE DWQ REPORT WITH REGARD TO SEEPAGE OF WATER THROUGH THE TAILINGS IN THE DUMPS?

A. The letter from DWQ on February 15, 2011 simply stated that the original determination found that natural precipitation leaching through tailings would have *de minimis* effect on ground water quality and that the proposed changes to the original plan should not affect the original determination.

Q. WAS DWQ'S MARCH 4, 2008 DETERMINATION BASED, IN PART, ON THE UNDERSTANDING THAT TAILINGS WOULD ONLY BE PLACED IN THE PIT?

A. Yes, this was expressly addressed in the DWQ March 4, 2008 letter: "[b]ased on these data, the tailings will be disposed by backfilling into the mine pit…."

Q. WHAT DID USOS REPORT TO DWQ IN THEIR FEBRUARY 8, 2011 LETTER WITH REGARD TO THE DISPOSAL OF THE TAILINGS?

A. USOS states that "[i]t is necessary to dispose of **some** processed sands and fines in the overburden/interburden storage areas…." [emphasis added].

Q. DO YOU BELIEVE THAT THIS STATEMENT ACCURATELY INFORMS THE DWQ OF THE INFORMATION THEY SHOULD CONSIDER IN A *DE MINIMIS* DETERMINATION?

A. No, I believe that this statement is misleading.

Q. WHAT IS THE VOLUME OF TAILINGS THAT EER PROPOSES TO DISPOSE OF IN THE WASTE DUMPS?

A. USOS reports that the total volume of tailings that will be disposed of in the pits and dumps is approximately 5,127,000 cubic yards (NOI, pg.24). The NOI does not give a breakdown of the percentage that will be placed in the pits or in the dumps. However, the NOI reports that approximately half of the total amount of material that will be disposed of (tailings and overburden/interburden) will be put into the dumps (pg. 24). Based on this proportioning of the material, a first approximation of the amount of tailings placed in the dumps would be about half of all the tailings, or approximately 2,563,000 cubic yards. This is likely the upper limit of the volume of tailings in the dumps because the dumps may contain a higher percentage of overburden that is generated as the pit is initially developed. Assuming that 25 to 50 percent of all the tailings generated will be disposed in the dumps, the volume would be approximately 1,282,000 to 2,563,000 cubic yards.

Q. IN YOUR OPINION, DOES THE LETTER SUBMITTED TO DWQ BY USOS ON FEBRUARY 8, 2011 PROVIDE ENOUGH INFORMATION FOR DWQ TO MAKE A NEW *DE MINIMIS* DETERMINATION?

A. No, USOS has failed to provide DWQ with the information necessary to evaluate the potential impacts on ground water quality. DWQ must be informed of the actual volume of tailings that will be disposed of in the waste dumps and an analysis of the potential for impacts to ground water quality from leaching of these tailing and the residual processing chemicals.

## VI. <u>FAILURE TO EVALUATE IMPACTS TO GROUND WATER</u>

Q. CAN YOU DISCUSS THE POTENTIAL IMPACTS TO THE GROUND WATER QUALITY AS A RESULT OF THE PROPOSED MINE?

A. The potential impacts to the ground water quality are from the leaching of precipitation through the tailings placed in the backfilled pits and in the overburden dumps. Even though some water is lost to runoff and evaporation, over time, precipitation will percolate through the pits and dumps. As precipitation migrates through the materials in the pits and dumps there will be an increase in total dissolved solids (TDS). In addition, any residual chemical/petrochemical mix from the processing of the tar sands that are mobile will be transported with the migrating water through the pits and dumps.

Q. IS IT POSSIBLE TO DETERMINE THE AMOUNT OF WATER THAT WILL SEEP INTO THE GROUND WATER SYSTEM FROM THE DUMPS?

A. Yes, as I discussed above, once the seepage migrates through the dumps, it may seep into the ground impacting underlying aquifers or it may flow along the preexisting topography and flow out at the toe of the dumps. Seepage modeling can evaluate the geometry of the contact, the material permeabilities, and hydraulic conditions to estimate the amount of water that will seep into the underlying ground.

Q. IS IT POSSIBLE THAT SEEPAGE WILL OCCUR THROUGH THE BACKFILLED PITS?

A. Yes, even though the pits will be backfilled and will not impound surface water after reclamation, over time, precipitation will percolate through the tailings in the backfilled pits and will incorporate residual chemicals and dissolved solids from these materials. Once the material becomes saturated and head builds up, seepage will occur into either adjacent or underlying aquifers, or flow will occur over the lip of the backfilled pit. Modeling of the flow can determine which of these is likely to occur.

Q. WHAT IS THE IMPACT TO THE GROUND WATER QUALITY FROM THIS SEEPAGE?

A. The impact from seepage through the tailings into the ground water system is two-fold. First, the aquifers themselves will be impacted by the water quality of the tailings seepage. Second, where the impacted aquifers discharge to the surface as seeps and/or springs, the surface water flow will be impacted by any chemical/petrochemical mix remaining from the processing and from TDS. These seeps and springs are a potential source of water for wildlife.

Q. WHY IS TDS A CONCERN FOR WATER QUALITY?

A. TDS is a concern for two reasons. First, although Main Canyon is reported to be ephemeral or intermittent, there is a reservoir in Main Canyon approximately 3 miles down stream from the proposed PR Spring Mine. Second, high concentrations of TDS can negatively impact use of the water by down stream agricultural users and/or by wildlife as the ground water discharges to seeps and springs and flows down channels.

Q. ARE THE POTENTIAL IMPACTS TO GROUND WATER QUALITY FROM THE DUMPS EVALUATED IN THE NOI?

A. No.

Q. ARE THE POTENTIAL IMPACTS TO GROUND WATER QUALITY FROM THE DUMPS EVALUATED IN THE DEMONSTRATION?

A. No. The Demonstration does not discuss potential impacts to ground water from seepage of the tailings in the overburden dumps. In fact, the Demonstration, which was prepared and submitted to the DWQ on February 21, 2008, does not even mention that there will be tailings placed in the overburden dumps. Rather, it only reports that the tailings will be placed as backfill in the pit (pgs. 5, 8).

Q. WHAT DOES THE DEMONSTRATION SAY WITH REGARD TO TDS?

A. USOS claims to have investigated the chemical characteristics and leaching potential of the processed tar sands. According to USOS, the results of this analysis show that the processed sand and processed fines will have total dissolved solids (TDS) concentrations of 300 and 6,100 mg/kg as opposed to the unprocessed tar sand with concentrations of 24 mg/kg.

Q. HOW DO YOU INTERPRET THESE RESULTS WITH REGARD TO IMPACTS TO GROUND WATER QUALTIY?

A. Taken as reported by USOS, this would indicate that the leachate would have TDS concentrations of approximately 12 - 254 times the TDS concentration of the unprocessed tar sand.

Q. IN YOUR OPINION, ARE THESE RESULTS SUFFICIENT TO EVALUATE THE PROJECTED IMPACTS TO GROUND WATER QUALITY?

A. No, because USOS states that these results are "from a non-standard analytical method; therefore these results are not considered relevant for estimation of the TDS of leachate from the process residuals. The expected TDS of the leachate that might develop from the processed oil sands is not known …." (Demonstration, pg. 11). However, as I discussed above, USOS does not provide an explanation as to why they believe the results are not relevant, and they do not provide any other results which they believe are relevant. It is possible that the results presented by USOS are representative of the TDS of the leachate.

Q. CAN YOU DESCRIBE THE PROCEDURE THAT A PROFESSIONAL IN YOUR FIELD WOULD FOLLOW IN ORDER TO IDENTIFY AND EVALUATE PROJECTED IMPACTS TO GROUND WATER QUALITY?

A. The first step would be to collect and analyze samples to characterize the existing water quality from the perched aquifers and from seeps and springs in order to establish baseline conditions. Next, one would analyze the tailings and determine the water quality of the expected leachate. Finally, the volume of water that would be expected to leach through the overburden/tailings dump and through the backfilled pits could be determined through modeling.

At the end, one would know the amount of water and its water quality which could be compared to the existing ground water quality.

Q. IS THE DETERMINATION REACHED BY THE DWQ VALID?

A. No, the determination reached by DWQ is flawed due to a lack of data and analysis. It is impossible to support a *de minimus* determination without any data on existing water quality (the fundamental basis for determining impacts), an accurate characterization of water quality of the seepage through the tailings in the pit and dumps, and a complete and accurate analysis of the flow of water through the waste dumps and pits into underlying and/or adjacent aquifers. None of these data and analyses are in the Documents provided by USOS.

Q. HAVE YOU INSPECTED THE LOGS FROM USOS' 2011 CORE DRILLING PROGRAM IN THE PR SPRING AND EAST TAVAPUTS OIL SAND LEASES?

A. Yes, I have inspected the following logs: M-Series, M-1 through M-60; N-Series, N-001 through N-008; E-Series, E-001 through E-027; and R-Series, R-001 through R-093.

Q. WERE THERE ANY LOGS OF CORE HOLES MISSING IN THE SERIES OF LOGS YOU INSPECTED?

A. Yes, there were not logs for core holes M-21, M-26, M-36, M-37, M-59, E-009, E-013, E-021, R-092, or R-094.

Q. DO THE CORE LOGS CONTAIN INFORMATION ON GROUND WATER?

A. No. None of the core logs I inspected contain any information on the presence or absence of ground water.

Q. DO THE LOGS CONTAIN INFORMATION ON THE TYPE OF DRILLING METHOD OR THE FLUIDS USED IN THE DRILLING PROCESS?
A. No.

Q. WERE THE LOGS OF THE CORE HOLES RECORDED ON PREPARED FORMS?
A. Yes.

Q. DID THE FORMS CONTAIN A FIELD SPECIFICALLY FOR THE SYSTEMMATIC RECORDING OF INFORMATION ON THE PRESENCE OR ABSENCE OF GROUND WATER?
A. No.

Q. WAS THERE A LOCATION ON THE FORMS USED FOR THE LOGGING OF THE CORE HOLES WHERE NOTES WERE ENTERED?
A. Yes. In all of the logs I examined the notes pertained primarily to the description of the lithology of the geologic materials and notes on the presence of oil sands.

Q. WERE THERE ANY NOTES ON THE PRESENCE OR ABSENCE OF GROUND WATER?
A. No.

Q. BASED ON THE LOGS YOU INSPECTED ARE YOU ABLE TO DRAW ANY CONCLUSIONS ON THE PRESENCE OR ABSENCE OF GROUND WATER IN THE AREA EXPLORED BY THE DRILLING?

A. No. There was no systematic recording or notes in the geologic logs that provide any information on the presence or absence of ground water. As such it is not possible to draw any conclusions with regard to ground water in the area drilled.

Q. DOES THIS CONCLUDE YOUR TESTIMONY FOR NOW?

A. Yes.

______________________________________

Elliott W. Lips
2241 E. Bendemere Circle
Salt Lake City, Utah 84109
(801) 599-2189
elips@gbearthscience.com

ATTACHMENT A

CURRICULUM VITAE

ELLIOTT W. LIPS

CURRICULUM VITAE

Elliott W. Lips, P.G.
Great Basin Earth Science, Inc.
2241 East Bendemere Circle
Salt Lake City, Utah 84109
(801) 599-2189
elips@gbearthscience.com

**SUMMARY OF EXPERIENCE**

Mr. Lips is a licensed professional geologist with 29 years experience in engineering geology and geomorphology in the western United States. He has conducted research, consulted, taught university classes, and provided expert witness testimony on geologic hazards, engineering geology, dam evaluations, mine reclamation and permitting, Earth surface processes, and environmental studies. Mr. Lips is currently the Principal Engineering Geologist of Great Basin Earth Science, Inc.

**ACADEMIC AND PROFESSIONAL QUALIFICATIONS**

Ph.D. A.B.D., Geography, University of Utah, Salt Lake City, Utah
M.S., Geology, Colorado State University, Fort Collins, Colorado, 1990
Graduate courses in Engineering, University of California, Berkeley, 1984-1985
B.A., Geology and Physics, Western State College, Gunnison, Colorado, 1983
Registered Professional Geologist, State of Wyoming No. 1489
Licensed Professional Geologist, State of Utah No. 5529142-2250
Member, Geologic Peer Review Board, Morgan County, Utah, 2008-present

**PROFESSIONAL HISTORY**

*Great Basin Earth Science, Inc., Principal Engineering Geologist, 1995 - Present*
Responsible for all aspects of providing consulting services for geologic hazard evaluations including faults, landslides, floods, debris flows, and rockfalls; surface and ground water investigations; stream characterization and restoration evaluations; geologic/seismic dam safety evaluations; and paleoenvironmental reconstructions.

*University of Utah, Adjunct Associate Professor, 1999 - 2006; Adj. Assist. Professor, 1996 - 1999*
Responsibilities include developing curriculum and teaching courses on geomorphology and surficial processes, geologic hazards, climate change, environmental studies, and natural resource management.

*AGRA Earth & Environmental, Engineering Geologist, 1992 - 1995*
Project manager for engineering geologic and geologic hazard investigations. Projects were for existing, proposed, and reclaimed mines, proposed subdivisions, utility corridors, commercial developments, and dams.

*JBR Consultants Group, Engineering Geologist, 1985 - 1992*
Project manager for engineering geologic investigations and mine permitting and reclamation projects throughout the western United States. Directed data collection and analysis, and prepared technical reports and permitting documents for new developments, proposed and existing mining operations, and for abandoned mines.

*U.S. Geological Survey, Geologist, 1983 - 1985*
Conducted research on landslides, floods, and debris flows in the western U.S. (primarily in central Utah); prepared publications on processes, recent events, methods of evaluations, and methods of risk assessment.

## REPRESENTATIVE RESEARCH AND CONSULTING EXPERIENCE

### *Geologic Hazards Evaluations*

<u>Landslide Vulnerability Assessment, Project Impact, Salt Lake City, Utah:</u> Served as chair of committee of geologists and engineers and was lead author of final report to Salt Lake City. Project consisted of conducting investigations and assessing the vulnerability for all property within the limits of Salt Lake City that could be impacted by landslides. In addition, lifelines entering the city, which if damaged or destroyed by landslides, would potentially result in loss of life and/or serious economic impact to the residents of the city, were considered.

<u>Geologic Hazards Identification and Evaluation, Draper, Utah:</u> Conducted evaluation of geologic hazards at two sites for a proposed salt storage facility in the Traverse Mountains, Draper, Utah. Hazards evaluated included landslides, debris flows, rock falls and surface fault rupture.

<u>Landslide and Debris-Flow Hazard Evaluation, Central Utah:</u> Evaluated the potential for debris flows and debris floods for a 30-mile portion of the Wasatch Front. Evaluated and rated more than 90 canyons in the project area for their potential to generate an event that could impact residential communities. Conducted reconnaissance of landslides and debris flows throughout central Utah during the period of high landslide activity in 1984. Provided reports to the Utah Geological Survey on conditions of landslides and debris flows that posed hazards, and provided 24-hour emergency assistance to City and County personnel by identifying and evaluating landslides, debris flows and flood hazards.

<u>Geologic Hazards Evaluations, Utah and Wyoming:</u> Evaluated site conditions at approximately 30 individual residential lots and proposed subdivisions (up to 3000 acres in size) to assess geologic hazards including seismic hazards, surface and ground-water impacts, landslides, and collapsible soils. Reports have been prepared in support of obtaining approval for septic drain fields, building permits, and subdivision approval.

***Erosion and Sedimentation Evaluations***

Sediment Yield Evaluation, Grants, New Mexico: Determined erosion rates, soil loss, and sediment yield from an 8,000-acre area disturbed by open-pit uranium mining. Developed a site-specific model that considered soil loss contributions from sheetwash, rill, gully, and stream-bank erosional processes. Sediment yield was evaluated for existing, post-reclamation, and pre-mining conditions at eight locations where drainages exited the mine site. The model results were tested by comparing the estimated sediment yield to the measured sediment accumulation in a downstream reservoir.

Erosion and Sediment Transport Investigation, Central Utah: Performed field measurements in ephemeral channels to document bank erosion, deposition, and impacts from past mining activities. Measured and mapped erosion features on disturbed slopes and mine waste piles, and evaluated their potential as sediment source contributors to the watershed drainage network. Calculated expected erosion rates and volumes, and modeled sediment transported in the stream channels. Assessed historic downstream deposition of tailings material.

***Stream Channel and Floodplain Restoration Designs***

Stream Channel Stability Evaluations and Design, Salina, Utah: Conducted an evaluation of two stream channels at a reclaimed mine site that had been damaged by high-runoff events. Channel stability was evaluated by considering the geomorphic setting, previous channel designs, stable upstream reaches, and examples from the literature. Prepared designs for reconstruction of the channels incorporating a series of buried grade control structures. Provided assistance in permitting the design and developed a program for construction supervision.

Stream Channel and Floodplain Evaluations and Design, Salt Lake City, Utah: Conducted an evaluation of existing hydrology on a 200-acre portion of the Jordan River Floodplain. Surface water features were surveyed and quantified; ground water flow was modeled based on data obtained from shallow bore holes. Designs were prepared for channels that would transfer surface water to dry parts of the floodplain in order to enhance shallow ground water available to plants. The project goals were to reestablish native floodplain vegetation to provide habitat for migratory birds. Channels were also designed to convey runoff from an adjacent site to the project area.

River Restoration, Carbon County, Utah: Designed a realignment and restoration of a 1,500-foot reach of the Price River that had been impacted by coal mining. Reviewed peak flows for various return-interval events, evaluated geomorphic stability, flow hydraulics, sediment transport, aesthetics, wildlife habitat, and costs to develop designs for river and floodplain restoration. Developed several conceptual design alternatives for client review and rated each alternative based on effectiveness, costs, long-term stability, maintenance requirements, permit considerations, and constructability.

***Surface and Ground Water Investigations***

Investigation of Lake Flooding, Southern Utah: Conducted an evaluation of the cause of recent flooding on property adjacent to Quichapa Lake. Investigations consisted of evaluation of aerial photographs, topographic maps, records of historic floods, climate records, vegetation, and playa sediments. Site investigations included flood boundary mapping and surveying, inspection of hydraulic control structures and channel geomorphic features, collection of tree sections for dating, and collection of sediment cores in order to determine cause of flooding and history of flooding in the lake basin.

Investigation of Flood Sources, Central Utah: Conducted an evaluation of the cause of recent flooding on property adjacent to the Sevier River. Investigations consisted of evaluation of aerial photographs, topographic maps, records of historic floods, and determining flood magnitudes and recurrence intervals. Site investigations included floodplain mapping and surveying, aerial reconnaissance during flood events, and inspection of hydraulic control structures in order to determine source of flooding.

Investigation of Potential Sources of Seepage, Great Salt Lake Beach, Utah: Conducted an evaluation of seepage and beach saturation in a complex industrial and hydrogeologic setting. Investigation consisted of reviewing reports of previous investigations, conducting field investigations and surveys, conducting finite element seepage modeling of ground-water flow, and investigating surface-water management of nearby water sources.

Runoff and Sediment Control Plans, Utah and Nevada: Performed the hydrology and hydraulics analyses and designed integrated runoff control plans at numerous mine and industrial facilities ranging in size to 300 acres. Determined runoff volumes, peak flows, and sediment yield. Plans were developed that would: direct up gradient runoff from undisturbed watersheds through the sites; control runoff generated on the sites and prevent it from mixing with the undisturbed area runoff; minimize the potential for on-site runoff to contact pollutants; direct perennial seepage water through the sites; and provide treatment for site runoff prior to its leaving the sites. Structures designed as part of these runoff control networks include earth-lined channels, riprap channels, biodegradable erosion control channel protection, water bars, drop structures, culverted road crossings, synthetic lined channels, spillways, and sedimentation ponds.

***Regulatory Evaluations/Project Reviews***

Building Permit Review, Northern Utah: Served as a member of the Morgan County Geologic Peer Review Board for purpose of reviewing geologic and geotechnical engineering reports submitted by applicants for building permits. Conducted public meetings, performed site inspections, and prepared written comments for Morgan County on several proposed residential developments.

Environmental Impact Statement Review, Northern Utah: Conducted a review of a Draft EIS prepared by the Army Corps of Engineers for a proposed 5,000-acre expansion of a tailings impoundment. Key technical issues were potential impacts to surface and ground water, adjacent wetlands, and the Great Salt Lake. An extensive summary report was prepared identifying specific items that needed clarification and/or additional information.

Environmental Assessment Review, Southern Utah: Conducted a review of an Environmental Assessment prepared by the BLM for a proposed chaining project on public and private land. Evaluated the geologic and hydrologic investigations conducted to support the impact assessment from sedimentation and erosion.

Hydropower Project Permitting Review, Western Colorado: Conducted reviews of the Draft and Final EIS, the Army Corps of Engineers 404 permit application, and supporting technical documents for the proposed AB Lateral Hydropower Project. The proposed project would divert about 900 cfs from the Gunnison River to the Uncompahgre River. Evaluated the impacts to the Uncompahgre River and prepared detailed technical comments on potential changes to stream geomorphology from bed scour and bank erosion.

Dam Permit Application Review, Central Utah: Conducted a review of a Federal Energy Regulatory Commission (FERC) application for a proposed dam and hydroelectric power plant on the Fremont River, near Capitol Reef National Park. Prepared comments on the adequacy of the geologic, geotechnical engineering, and hydrologic investigations conducted as part of the application package, and potential impacts to the river within the park.

Mine Permit Application Review, Southern Utah: Conducted several reviews over a three-year period of mine permit applications submitted to the Utah Division of Oil, Gas and Mining (DOGM) for a proposed coal mine on the Kaiparowits Plateau. The hydrology and geology sections of the permit application were evaluated, written comments were prepared, and expert testimony was provided on the adequacy of the baseline investigations, probable hydrologic consequences, monitoring plans, and impacts to surface and ground water.

Highway Design and Construction Review, Central Utah: Conducted reviews of design drawings, and construction specifications during a three-year period of highway construction for U.S. 189 in Provo Canyon, Utah. The geologic and hydrologic components of the project were evaluated for their compliance with NEPA and the Clean Water Act. Engineering geologic components of the project were evaluated, with emphasis on slope stability of hill slopes, cuts for the roadway, impacts to the Provo River, and mitigative measures. Prepared numerous written documents based on site inspections, surveys, data analysis, and interpretation.

Mine Permit Application Review, Central Utah: Conducted several reviews over a seven-year period of mine permit applications submitted to the Utah Division of Oil, Gas and Mining (DOGM) for a proposed coal mine along the Book Cliffs. The hydrology and geology sections of the permit application were evaluated, written comments were prepared, and expert testimony was provided on the adequacy of the baseline investigations, probable hydrologic consequences, monitoring plans, and impacts to surface and ground water.

Mine Permit Application Review, Southern Utah: Conducted review of a mine permit application submitted to the Utah Division of Oil, Gas and Mining (DOGM) for a proposed strip coal mine near Alton. The hydrology and geology sections of the permit application were evaluated, written comments were prepared, and expert testimony was provided on the adequacy of the baseline investigations, probable hydrologic consequences, monitoring plans, impacts to surface and ground water, and alluvial valley floor determinations.

Mine Permit Application Review, Eastern Utah: Conducted review of a mine permit application submitted to the Utah Division of Oil, Gas and Mining (DOGM) for a proposed tar sand mine in the Uinta Basin. The hydrology and geology sections of the permit application were evaluated, written comments were prepared, and expert testimony was provided on the adequacy of the baseline investigations, monitoring plans, impacts to surface and ground water, and reclamation.

Coal Power Plant Permitting Review, Southern Nevada: Conducted a review of ground water discharge permit, NEPA document, and landfill permit application for a coal power plant in southern Nevada. The hydrology, engineering, and geology sections of the documents were evaluated and written comments and testimony were provided on ground water contamination from evaporation ponds and the landfill.

***Dams and Water Infrastructure***

Engineering Geologic Investigations – Existing Dams, Utah: Conducted investigations at 13 existing high-hazard earthen dams for various water user associations in compliance with Utah Statutes and Administrative Rules for Dam Safety. Investigations have included preparing maps of surface and bedrock geology including landslides and faults; drilling, logging, and sampling test holes in existing dams and abutments; installation and monitoring of piezometers; evaluating liquefaction susceptibility; developing earthquake design parameters from both deterministic and probabilistic methods; and preparation of maps, cross-sections, logs, and reports.

Engineering Geologic Investigations – Monks Hollow Dam Site, Wasatch, County, Utah: Conducted investigation at the site of a proposed concrete arch dam on the Diamond Fork River for the Central Utah Water Conservancy District. Investigations included review of Bureau of Reclamation geologic and seismic reports and design drawings; inspection of exploratory tunnels in abutments, mapping surficial geology and faults, evaluating fault activity, and preparation of presentations and summary report.

Engineering Geologic Investigations – Water Storage Tank, Draper, Utah: Conducted geologic hazards investigations at three sites for a proposed 2.3 million gallon water storage tank in the Traverse Mountains. Hazards evaluated included landslides, debris flows, rock falls and surface fault rupture. Test pits and trenches were excavated, geologic logs were prepared of subsurface geology, landslide and fault activity was evaluated, and reports were prepared and summarized in a presentation to the Draper City Council.

Engineering Geology and Geologic Hazards Evaluations – Canal Enclosure, Utah County, Utah: Project consisted of evaluating engineering geology and geologic hazards for a proposed 22-mile long, 144-inch diameter pipeline along the base of the Wasatch Mountains. Hazards evaluated included landslides, debris-flows, surface-fault rupture, and rock fall. Soil properties were characterized from test hole, test pit, and trench logs according to surficial geologic units. Test holes were drilled, logged, and sampled in a one-mile wide landslide in order to assess landslide characteristics and activity. Active faults were mapped from aerial photographs, and potential rock-fall areas were delineated from field surveys. Results were summarized in a report and presentations were made to the Water Users Association.

***Slope Stability Modeling and Remedial Design***

Landslide Analyses and Remediation, Central Utah: Conducted three separate analyses of recent landslides that occurred on a pipeline right-of-way, a reclaimed mine, and an active mine. Projects including detailed mapping of landslide features, conducting seismic profiles, installing borings and piezometers, collecting samples, conducting laboratory testing, and conducting computer stability analysis. Based on the analyses, remediation designs were developed to increase stability by controlling surface and shallow ground water, and regrading the landslides to stable configurations.

Sediment Pond Stability Evaluation, Salina, Utah: Conducted stability analysis and prepared hydraulic designs for an earth embankment of a sediment pond. Stability was evaluated for full-reservoir and rapid-drawdown conditions under static and pseudo-static scenarios. Based on these analyses, a new embankment was designed and a report was prepared including construction drawings for the embankment as well as for the primary and secondary spillway structures.

***Seismic Hazard Evaluations***

Liquefaction Analysis, Wasatch Front, Utah: Evaluated liquefaction potential for four sites along the Wasatch Front. Factors considered were presence and depth of liquefiable layer of loose sand identified from blow counts in previous geotechnical borings, depth of ground water, and horizontal acceleration of gravity resulting from an earthquake on nearby faults. Probability of liquefaction for specified periods of time, and the amount of settlement that would result was estimated at each site.

Fault Rupture Investigations, Western United States: Conducted aerial photo interpretation, low sun-angle aerial reconnaissance, drill log and core examination, topographic and stream channel profiling, and trench logging as part of investigations of normal and accommodation faults in Arizona, Montana, Nevada, and Utah. Have participated in, or directed, approximately 20 individual surface fault rupture investigations for projects ranging from single-family lots and commercial/industrial facilities to 50-acre subdivisions.

***Paleoenvironmental Reconstruction***

Investigation of Paleolakes, Central Utah: Conducted an investigation to document the presence of lacustrine ecosystems in the southern Bonneville Basin during the Paleoindian period. Sediments were retrieved from deep bore holes in four present day playas and sub basins of Lake Bonneville. Chronological control was established based on radiocarbon analysis. Paleoenvironmental conditions within the region were derived from analysis of biological and geochemical indicators preserved in the sediments.

Paleoenvironmental Reconstruction, Southeastern Wyoming: Conducted investigations to reconstruct paleoenvironmental conditions for the Snowy Range and Carbon Basin during the late Pleistocene and the Holocene. Sediment cores were retrieved from five modern lakes and sediments were analyzed for sedimentological, biological, geochemical, and isotopic indicators of past climate and environmental conditions. Chronological control was established based on radiocarbon analysis.

## PUBLICATIONS

Wieczorek, G. F., Ellen, Stephen, Lips, E. W., Cannon, S. H., and Short, D. N., 1983, Potential for debris flow and debris flood along the Wasatch Front between Salt Lake City and Willard, Utah, and measures for their mitigation: U.S. Geological Survey Open-File Report 83-635, 25 p., map scale 1:100,000, Reprinted in Utah State Bar, 1983, Conference on Legal and Legislative Approaches to Western States Geological Hazards: November 1983, Salt Lake City, p. 53-116.

Lips, E. W., Wieczorek, G. F., and Boschetto, H. B., 1984, Factors influencing debris-flow runout: Delineation of Landslides, Flash Floods and Debris Flow Hazards in Utah, Logan Utah, Abstracts, p. 9.

Wieczorek, G. F., Ellen, Stephen, Lips, E. W., Cannon, S. H., and Short, D. N., 1984, Identification of debris flow and debris flood potential along the Wasatch Front between Salt Lake City and Willard, Utah: Delineation of Landslides, Flash Floods and Debris Flow Hazards in Utah, Logan Utah, Abstracts, p. 9.

Keefer, D. K., Wilson, R. C., Harp, E. L., and Lips, E. W., 1985, Landslides in the Borah Peak, Idaho earthquake of 1983 in Reaveley, L. D., ed. The Borah Peak, Idaho Earthquake of October 28, 1983: Earthquake Engineering Research Institute Reconnaissance Report, p. 91-125.

Lips, E. W., Ellen, S., and Wieczorek, G. F., 1984, Identifying debris flow and debris flood potential along the Wasatch Front between Salt Lake City and Willard, Utah: Geological Society of America, Abstracts with Programs, v.16, no. 6, p. 576.

Lips, E. W., 1985, Landslides and debris flows east of Mount Pleasant, Utah, 1983 and 1984: U.S. Geological Survey open-File Report 85-382, 12 p., map scale 1:24,000.

Lips, E. W., 1988, Grain size parameters of debris flows and hyperconcentrated flows, in Julien, P. J., ed., Essays on River Mechanics: Colorado State University, p. 15-26.

Lips, E. W., and Keaton, J. R., 1988, Slope-a-scope: a convenient tool for rapid topographic profiling: Association of Engineering Geologists, Abstracts with Programs, p. 51.

Wieczorek, G. F., Lips, E. W., and Ellen, S. D., 1989, Debris flows and hyperconcentrated floods along the Wasatch Front, Utah, 1983 and 1984: Bulletin of the Association of Engineering Geologists, v. 26, no. 2, p. 191-208.

Lips, E. W., 1990, Characteristics of debris flows in central Utah, 1983: Fort Collins, Colorado, Colorado State University M.S. thesis, 66 p.

Lips, E. W., and Wieczorek, G. F., 1990, Recurrence of debris flows on an alluvial fan in central Utah in French, R. H., ed., Hydraulics/ Hydrology of Arid Lands: American Society of Civil Engineers, p. 555-560.

Keaton, J. R. and Lips, E. W., 1994, Why probabilistic estimates sometimes exceed deterministic estimates for the maximum earthquake acceleration: Association of Dam Safety Officials, 1994 Western Regional Conference Proceedings, p. 99-104.

Lips, E. W. and Keaton, J. R., 1994, The operating basis earthquake for dams: making sense of the numbers game: Association of Engineering Geologists 37th Annual Meeting, Program and Abstracts, p. 54.

Currey, D., Lips, E. W., Thein, B., Wambeam, T., and Nishazawa, S., 2001, Elevated Younger Dryas lake levels in the Great Basin, western U.S.A.: Geological Society of America, Abstracts v. 33, no. 6, p. A-217.

Lips, E. W., Marchetti, D. W., and Gosse, J., 2005, Revised chronology of late Pleistocene glaciers, Wasatch Mountains, Utah: Geological Society of America, Abstracts v. 37, no. 7, p. 41.

Godsey, H. S., Atwood, G., Lips, E. W., Miller, D. M., Milligan, M., and Oviatt, C. G., 2005, Don R. Currey Memorial Field Trip to the shores of Pleistocene Lake Bonneville: Geological Society of America, Field Trip Guide 6, p. 419-448.

Marchetti, D. W., Cerling, T. E., and Lips, E. W., 2005 A glacial chronology for the Fish Creek drainage of Boulder Mountain, Utah, USA: Quaternary Research 64, p. 263-271.

Laabs, B.J.C, marchetti, D.W., Munroe, J.S., Refsnider, K.A., Gosse, J.C., Lips, E.W., Becker, R.A., Mickleson, D.M., and Singer, B.S., 2011, Chronology of latest Pleistocene mountain glaciation in the western Wasatch Mountains, Utah, U.S.A.: Quaternary Research, vol. 76, pgs. 272-284.

Brunelle, A., Minckley, T., Lips, E., and Burnett, P., 2012, A record of late glacial-Holocene environmental change from a high elevation site in the Intermountain West: Quaternary Research, in press.

# ATTACHMENT B

# TESTIMONY IN RECENT CASES

# ELLIOTT W. LIPS

List of cases in which Elliott Lips has testified at trial or in a deposition within the past four years:

1. Utah Chapter of the Sierra Club, Southern Utah Wilderness Alliance, Natural Resources Defense Council, and National Park Conservation Association vs. Utah Division of Oil Gas & Mining
   2009 - 2010 Hearing before the Utah Board of Oil Gas & Mining
   Expert Witness on geology and hydrology for Petitioners
   Retaining Attorneys: Walton Morris, Steve Bloch
   Opposing Attorneys: Bennett Bayer, Denise Dragoo, Jim Allen, Steve Alder, Fred Donaldson

2. Living Rivers vs. Utah Division of Oil Gas & Mining
   2011 Hearing before the Utah Board of Oil Gas & Mining
   Expert Witness on geology and hydrology for Petitioners
   Retaining Attorneys: Rob Dubuc, Joro Walker
   Opposing Attorney: Steve Alder, Emily Lewis, A. John Davis, Christopher Hogle, Benjamin Machlis

3. Moapa Band of Paiutes and Sierra Club vs. Southern Nevada Health District
   2011-2012 Hearing before the Southern Nevada Health District Board and District Court for Clark County, Nevada
   Expert Witness on geology and hydrology for Petitioners
   Retaining Attorneys: Daniel Galpern, Chris Mixson
   Opposing Attorney: Thomas Woodworth

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on this 20th day of January, 2012, a true and correct copy of the foregoing Pre-Filed Direct Testimony of Mr. Lips and Dr.Johnson was served via e-mail, as follows:

Walter L. Baker, PE
Executive Secretary
Water Quality Board
195 North 1950 West
PO Box 144870
Salt Lake City, UT 84114-4870
wbaker@utah.gov

Paul McConkie
Assistant Attorney General
PO Box 140873
160 East 300 South
Salt Lake City, UT 84114-0873
pmcconkie@utah.gov
Counsel for the Executive Secretary

Sandra K. Allen
Administrative Law Judge
skallen@utah.gov

Christopher R. Hogle
A. John Davis
M. Benjamin Machlis
Holland & Hart
222 South Main Street, Ste 2200
Salt Lake City, UT 84101
crhogle@hollandhart.com
ajdavis@hollandhart.com
mbmachlis@hollandhart.com

DEQ Administrative Proceedings Record Officer
160 East 300 South, 5th Floor
Salt Lake City UT 84111
(via email at deqapro@utah.gov)

Rob Dubuc