UTAH GROUNDWATER DISCHARGE PERMIT APPLICATION

American Sands Energy Corp

BRUIN POINT MINE
CARBON COUNTY, UTAH

April 2015

PREPARED FOR:
Green River Resources, Inc.
201 South Main Street, Suite 1800
Salt Lake City, Utah 84111

PREPARED BY:
URS
756 East Winchester Street, Suite 400
Salt Lake City, Utah 84107
URS Job No. 24585638

This page intentionally left blank.

Table of Contents

List of Tables

List of Exhibits

List of Figures

List of Appendices

Utah Groundwater Discharge Permit Information

For

Green River Resources, Inc.

Bruin Point Mine Project

1. Administrative Information

Applicant Name, Mailing Address, Telephone Number, Contact Information, Designated Agent

Green River Resources, Inc.
201 South Main Street, Suite 1800
Salt Lake City, UT 84111
Phone: (801) 536-6140
Company Representative/Designated Agent: William C. Gibbs

Facility Legal Location

The Bruin Point Mine is located in portions of Sections 2, 3, and 10, Township 14 South, Range 14 East, Salt Lake Base and Meridian (SLBM). All sections are located within Carbon County, Utah.

Owner and Operator Information

The operator information is the same as the applicant information: Green River Resources, Inc. (GRR). Further ownership information may be found in **Appendix A**.

Facility and Contact Information

Bruin Point Mine
Green River Resources, Inc.

The project is located approximately six miles northeast of Sunnyside, Utah. Facilities have not yet been established at the project site, so communication should be directed to the corporate offices until such time that facilities can be established on the site and supervisory staff is hired.

2. Introduction

American Sands Energy Corporation (American Sands/the Company) is a Delaware Company with primary operations in Utah. The Company has acquired rights to oil sands ore covering approximately 1,760 acres (Lease Boundary) of prime oil sands resources (known as the Sunnyside deposit) in the Bruin Point area in the Book Cliffs of Utah. The Company has licensed proprietary extraction technology for a bitumen and hydrocarbon extraction process that separates oil and other hydrocarbons from sand, dirt and other substances on a 99% efficiency basis, without creating environmental hazards. The licensed technology uses no water (except for water consumed for fugitive and underground dust control), produces clean sand and bitumen, and uses a fraction of the heat typically required for extracting fuels from oil sands. Based upon prototype trials and feasibility studies, American Sands is proposing to produce and deliver approximately 5,000-10,000 barrels per day of bitumen extracted from the Green River Formation oil sands.

American Sands acquired GRR, a privately-held company that controls the oil sands ore property in Carbon County, Utah. Through the Green River acquisition, the Company also acquired exclusive use in Utah of the proprietary process mentioned above. GRR will be using this new technology to extract bitumen from ore mined from the deposit. The extraction plant will be located within the Lease Boundary, in eastern Carbon County, Utah as shown in **Figure 1**.

During the first five years of bitumen extraction, sand tailings (clean, dry sand) will be placed in a permanent surface sand tailings disposal area. There is no tailing pond associated with either the process or the surface tailings disposal area. As mining activities advance, sorted sand tailings will be used as underground mine backfill, with no anticipated impact to surface or groundwater resources. Underground disposal of tailings will commence in the sixth year of mining activities.

It is anticipated that there will be no impact to surface or groundwater because the mining and processing activities are designed to be zero discharge. Furthermore, all storm water runoff will be captured and will be left to evaporate, used for dust control, or will be hauled off site by a licensed contractor as further described below. The *de minimis* use of water on-site will not impact groundwater or surface water. As described below, GRR proposes ongoing monitoring of certain seeps and springs to provide additional evidence supporting the lack of impacts to water.

3. Background Information

The Bruin Point Mine is a new mine operation. The Sunnyside deposits are the largest of the Uinta Basin Special Oil Sands Areas defined by the U.S. Geological Survey (USGS). Within the Lease Boundary, GRR has defined a survey boundary for the Bruin Point Mine, where initial baseline surveys were performed. The initial mine development (as described in more detail in the Notice of Intention to Commence Large Mining Operations [NOI] submitted to the Utah Division of Oil, Gas and Mining [DOGM] in March 2015) will take place within the Lease Boundary on approximately 160 acres (referred to throughout this Groundwater Discharge Permit Application as the Affected Area) as shown on **Figure 2**.

Groundwater within the Affected Area is best characterized as shallow (<100 feet below ground surface [bgs]) as evidenced by discharge from North Spring and other seeps near Range Creek. Additional information on the hydrology of the region is included as **Appendix B**, describing the hydrology of North Spring (URS, 2014b). The condition of the spring is noted as being highly disturbed as a result of overgrazing (JBR, 2014; Calkin, 1990). Additionally, the amount of recharge for that system is sparse and directly related to precipitation. The shallow groundwater system follows an annual cycle related to snowmelt, with discharge from springs during the spring at approximately 40 gallons per minute (gpm), decreasing during summer and fall to less than 2 gpm and often times drying up altogether. The studies (reviewed in the hydrologic report [URS, 2014b]) provide consistent evidence that Range Creek is dry in the vicinity of the Affected Area. This is because, in a typical year, there is insufficient precipitation and discharge from springs/seeps to sustain perennial flow in Range Creek near the Affected Area. In turn, the shallow groundwater flow does not move downward. Vertical movement of groundwater from the shallow system to greater depths is inhibited by low permeability shale and oil sand layers, which dominate the stratigraphic column at depths greater than 100 feet bgs.

During the fall of 2013, GRR conducted exploration drilling under Exploration Permit, E/007/0011. Drilling advanced to approximately 1,035 feet bgs. During drilling, groundwater was encountered at approximately 400 to 420 feet bgs within the Garden Gulch Member. The groundwater detected at this depth is anomalous with the reported results from 50+ exploratory borings drilled by Amoco (as reviewed in the hydrologic report [URS, 2014b]), including at least three in the immediate vicinity of the American Sands boring. None of the logs for the Amoco borings (also included in the hydrologic report, in part [URS, 2014b]) reported groundwater at depths below the shallow aquifer in the Parachute Creek Member, approximately 200 feet bgs. Flow from the American Sands boring was estimated at less than 2 gpm. This flow is believed to be from the shallow groundwater system trickling down the Amoco borings to 400-420 feet bgs.

Groundwater in the region will not be affected by the proposed operations because design of the cap and liner for the tailings will seal the surface tailings disposal area from the infiltration of rainfall and snow melt while not materially impacting the ability of this water to recharge North Spring and Range Creek. The design of the system and its ability to control the contact of tailings by surface water while allowing the recharge of North Spring and Range creek is described below. The Hydrologic Evaluation of Landfill Performance (HELP) model predicts minimal infiltration into the shallow groundwater system of less than 1 inch per year (in/yr) (see **Appendix C** for HELP model results [URS, 2014c]). The model was run for a period of 50 years and rerun until the initial and final moisture content for each layer reached a steady-state or equilibrium.

The Range Creek Drainage area will be protected from tailings impoundment-related impacts. The dry tailings impoundment will be designed, constructed and operated to protect the recharge systems related to both North Spring and Range Creek. To ensure that the integrity of the dry tailings impoundment is consistent with its design, HELP modeling will be run on tailings samples collected during construction. The HELP model will be used to demonstrate the water balance in the tailings lining and capping systems. The following briefly describes the tailings impoundment design rationale.

The dry tailings will be constructed with a four foot clay liner, below the tailings; a four foot clay cap on top of the tailings (each with $1x10^{-7}$ centimeters per second [cm/s] permeability); a weeping tile system above the lower clay liner and at the bottom of the tailings; a capillary barrier over the upper clay cap; and 18 inches of growth media on top of the structure. The upper and lower clay caps will prevent infiltration of meteoric water into the tailings pile. The capillary barrier will direct any precipitation to drain off the sides of the dry tailings impoundment and thereby contribute to recharge North Spring and minimize contact of meteoric water with the capped materials.

The weeping tile system will allow any water that infiltrates the clay cap to drain into a high-density polyethylene (HDPE)-lined retention basin at the toe of the tailings impoundment. Water collected in that basin will not be discharged. Instead, the water will be sampled, and if suitable and free from hydrocarbons it will be used for dust control. If it is unsuitable for dust control, it will be disposed of by a licensed contractor.

4. Facility Classification and Type

4.1 Facility Classification

This facility is classified as a mine operation.

4.2 Type of Facility

The new facility will be an oil sands production operation to extract bitumen from mined oil sands. The facility will include underground mine access, office and maintenance facilities, process equipment, tank farms, crushed ore storage, and sand tailings storage.

4.3 SIC/NAICS Codes

The Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes that describe the proposed facility are 1311 (SIC) and 211111 (NAICS) for crude petroleum and natural gas extraction.

4.4 Project Facility Life

The initial life of mining operation is 15 years.

5. Green River Resources, Inc. Oil Sands Mine and Operation Description

5.1 Site Development

The development of full-scale mining operations will begin with preparation of surface facilities and portal development. Vegetation will be cleared and topsoil will be stockpiled for use in reclamation. The site will only be leveled in areas required for operations and equipment. Areas that will be used for truck traffic within the Affected Area will be paved using some of the oil sands ore mixed with road base. Equipment and utility access will be developed from the plant site to the portal. Crushed rock mined from the face of the portal will be used to develop a pad to accommodate mine surface facilities. The pad will be large enough to contain the support facilities including a parts trailer, portable office, substation, fan house, two fuel tanks and two water tanks. Following the initial underground mine development the parts trailer, portable office, substation, and fan house will be the only facilities left outside of the mine and they will be located directly outside of the portal. As mining advances, the balance of the support facilities and equipment will be moved to permanent locations underground. After portal development, underground mining will commence using a room and pillar method. **Figure 2** illustrates the locations of mine and processing plant features.

5.2 Overall Operation Description

The extraction process employed by GRR will use a proprietary solvent to separate bitumen from crushed ore. Mining, maintenance, and processing facilities will be located on-site and mining and processing operations will occur simultaneously. Development of the mine site will follow these general steps:

- Land clearing (where appropriate)
- Soil removal and stockpiling
- Work area preparation (leveling and placement of gravel)

- Portal development
- Entry development

The general mining sequence will consist of the following unit operations:

- Ore extraction (drilling, blasting, and hauling to processing pad)
- Ore crushing and stockpiling
- Solvent treatment/bitumen extraction and solvent recovery
- Placement of sand tailings on surface (and eventually, as backfill underground)

The mine development plan includes clearing and grubbing operations, installation of storm water controls, and salvaging of soil prior to mining the oil sands. Topsoil will be salvaged and stockpiled to be used during the reclamation phase. The mine opening will be developed at approximately 9,100 feet elevation along the cliff face. The road to the portal from the plant site will need to be in place in order for equipment to gain access to the portal location. Once the portal is developed, mining will proceed underground. The initial underground mining will involve the development of four entries. Mining will continue with the development of rooms and pillars shown on the underground mine Materials Handling Plan, **Figure 3**.

The ore will be drilled and blasted to advance an upper bench and an underlying bench. Once the ore has been blasted it will be loaded with front end loaders and hauled using 25- to 40-ton haul trucks. Initially the sizing and sorting equipment and operations will be located at the portal bench. Ore mined during the first year of mining activities will be hauled to the material handling and sizing equipment located near the portal area. After the first year, sizing and sorting operations will be relocated from the portal area to a mined-out area underground. Ore mined will be hauled to the plant site via the mine access road. The material handling system at the mine will consist of screens, crushers, sorter, conveyor belt line, and ore stockpiles.

Crushed, sorted, and mined ore will be transported in haul trucks via the main haul road to the process area and discharged into the material handling equipment at the plant feed stockpile. This plant site stockpile will contain 30,000 tons of ore and will be available to provide feed in the event of disruption of ore supply from the mine.

The processing facilities will be located on the upper bench near Bruin Point. These facilities will be designed to extract bitumen from the ore producing clean, dry sand (tailings) and a liquid bitumen product. The major structures located in this area include the office and associated parking area; warehouse and maintenance shop; process equipment; tank farm; electrical building; and stockpiles of crushed ore and tailings.

The process produces tailings that consist of dry, clean sand as a byproduct. Based on pilot testing results, the sand tailings will contain between 2 and 25 parts per million (ppm) of the proprietary solvent. The consistency of the tailings is coarse-grained sand with very low organic carbon content after processing. The dry sand tailings disposal area will be developed in an area north of the plant site. The area is designed to hold 14 million cubic yards, or five years of dry sand tailings production. The stockpile will feature a compacted base and cover each constructed of 4 feet of impermeable clay material $1x10^{-7}$cm/s. The system will include a capillary barrier on top of the clay cover with 18 inches of growth media above the capillary barrier. A sloped weeping tile will be installed above the clay base and will run downhill from the highest point in sand pile to a lined retention basin (see Map 8 in the General Construction Permit [GRR, 2015b]). A barrier consisting of a berm will be constructed across the interface between the working and capped sections of the pile in order to separate meteoric water deposited on the working portion of the pile from that deposited on the capped section of the pile. Water deposited on the working part of the pile will be collected in the retention basin through the above mentioned weeping tile system. Water deposited on the capped section of the pile will be returned to the North Spring and Range Creek recharge systems through the capillary break feature.

This system will serve the following purposes:

1. The clay cap and liner systems will seal the tailings pile from the environment and prevent the infiltration of meteoric water into the pile.
2. The weeping tile system and lower clay liner will contain any meteoric water, should it infiltrate the pile. The system will collect the water and deliver it to a lined retention basin for analysis and ultimate disposal.
3. The capillary system will direct meteoric water deposited on the tailings pile off to the side of the pile and back into the North Spring and Range Creek Recharge system.
4. The berm dividing the working and capped sections of the pile will serve to prevent meteoric water deposited on the working section of the pile from entering the environment.

The sand tailings will be placed in controlled lifts approximately 10 feet to 50 feet in thickness. As the material is placed from the bottom of the site upwards, when final slopes can be reclaimed, a cover consisting of approximately four feet of sorted waste will be used to cover the sand tailings. Topsoil which has been removed from the site and stored in a designated area will be used to cover the sorted waste to enhance successful revegetation and final reclamation activities. The capillary barrier system will ensure that water collected on the cap will flow off the cap and be available to recharge the groundwater system, described further in **Section 8.4**. A more detailed description of the mine and reclamation plans are in the DOGM, Mine and Reclamation Plan, M/007/0040 (GRR, 2015a).

Soil vapor vents will be included in the final design to remove residual vapors, in any, from the dry tailings material. Spacing will be determined during the design phase.

The system in its entirety will be designed to exclude water from the tailings while collecting water that does enter the tailings, delivering it to the collection basin, and excluding it from the environment. An analysis was conducted to evaluate the behavior of residual solvent remaining in the tailings impoundment. The evaluation consisted of: (1) performing quantitative calculations to estimate the mass of solvent contained in the tailings in the impoundment; (2) estimating the retention capacity of the sand tailings to evaluate how much solvent can be held immobile in the pore space of the sands; (3) comparing the mass of solvent to the retention capacity to estimate whether sufficient mass of solvent will be present to allow downward vertical migration of free phase solvent; and (4) qualitatively evaluating the fate of any free phase solvent that may exist in the impoundment. See the Fate and Transport Evaluation of Residual Solvent in Sand Tailings provided in **Appendix D** [URS, 2015b]**)**.

5.3 Extraction Process

Extraction of bitumen from oil sands ore will take place on-site. Crushed ore from the underground mine will be transported to a crushed ore storage area near the processing area. Storage of crushed ore near the process area allows for volumes of ore to be constantly available as feedstock for the bitumen extraction process. Prior to being fed into the process, recovered ore will be crushed to a size no greater than ¼-inch and fed into a hopper to be mixed with extraction solvent. The material safety data sheet (MSDS) and properties of the proprietary solvent are located in **Appendix E**.

Solvent-wetted sand will then be mixed with additional solvent in an auger system. The wet sand/solvent mixture will flow from the auger to a closed settling tank. In this tank sand will settle to the bottom and solvent bitumen (bitsol) mixture will rise to the top. The liquid will be decanted off the vessel through a filter to remove any fines not separated from it in the decanter tank. Wet sand will be augured from the bottom of the settling tank to a system of drying augers.

The heated drying augers will serve to dry the sand in a sealed system thus removing the solvent by application of heat. The solvent will be evaporated from the sand and the solvent vapors thus generated will be condensed by cross exchange with chilled heat transfer fluid. Condensed solvent will be filtered and sent to a sealed holding tank. Clean, dry sand will be produced from the drying augers to sand tailings storage as detailed elsewhere in this document.

The bitsol stream from the sand washing system will be sent to a water separator. Connate (formation or naturally occurring) water will be separated from bitsol by gravity separation. This water will be sent to a water storage tank for subsequent use as underground dust control. Dry bitsol from the water separator will be heated and sent to a distillation unit.

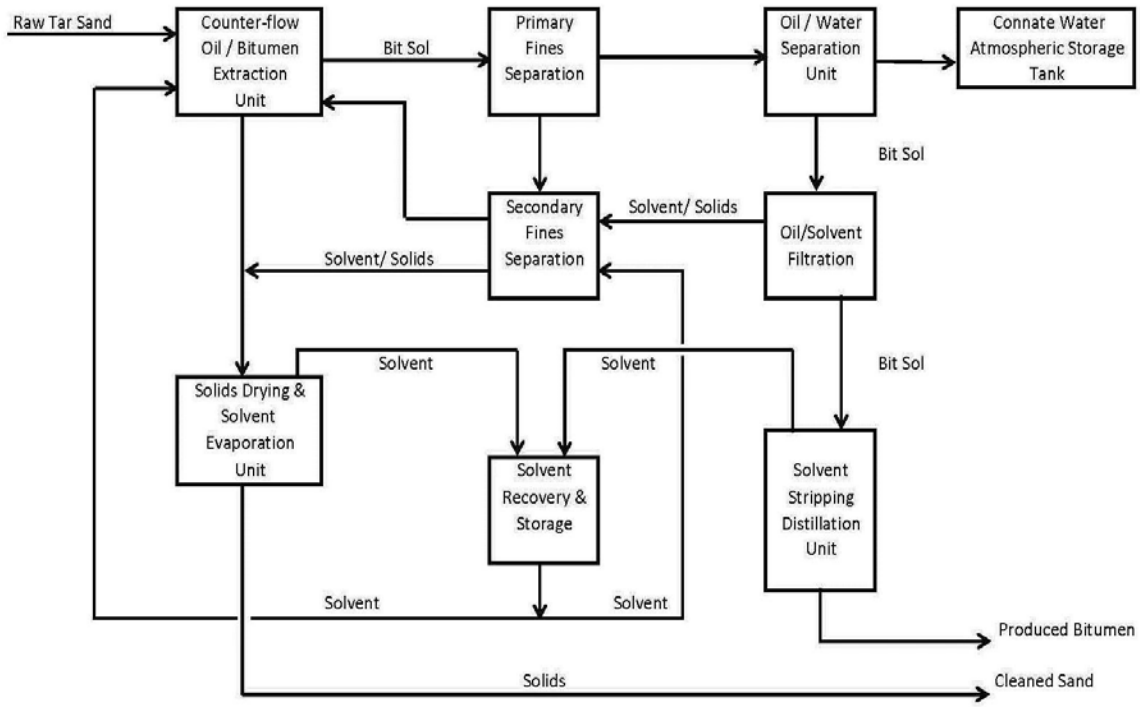
The hot bitsol will be separated into its bitumen and solvent components under vacuum distillation. The distillation system will produce hot liquid bitumen to storage and solvent vapors. The solvent vapors will be condensed to liquid by cross exchange with cool heat transfer medium. The clean dry solvent will be sent to storage along with the solvent recovered off the sand. Solvent will be drawn from storage and used in the sand washing portion of the plant as described above. Bitumen will be stored on-site in tanks and held for transportation to the market.

Solvent used in the operation will be recovered from both the sand and the bitumen. During the pilot testing of the process 2 ppm of solvent remained in the dry sand tailings. Operation of the plant will produce a sand product with no more than 25 ppm of solvent weight to weight (w/w) in the dry sand tailings. Bitumen produced from the process will contain a maximum of 0.5% volume percent (v/v) of solvent. This solvent will be shipped from site with the bitumen product and delivered to a refinery. These two streams (dry sand to storage with a maximum solvent content of 25 ppm and the bitumen product with a solvent content of 0.5%) represent the two streams to which solvent will be lost. All other solvent will be recovered and reused in the process. See the Fate and Transport Evaluation of Residual Solvent in Sand Tailings provided in **Appendix D** (URS, 2015b)**.**

Clean, dry sand or "tailings" will be stored in the above-referenced sand tailings area for the first five years of operation and will be returned to the underground workings as backfill after the sixth year of operation. **Exhibit 5.3.1** below illustrates the process flow sequence for the bitumen extraction from the oil sands.

EXHIBIT 5.3.1 Process Flow Diagram

PROCESS FLOW SEQUENCE - PROCESS FOR EXTRACTION OF OIL & BITUMEN FROM TAR SANDS



All liquid stored on-site including fuel, oil, and lubricants, water, solvent and bitumen will be stored in tanks. The tanks will be constructed with secondary containment consistent with the Spill Prevention, Control and Countermeasure (SPCC) Plan. The total contained volume of the bermed area will be at least 110% of the volume of the largest tank contained in the farm. Tanks will be underlain by impermeable liners, such as HDPE, to prevent migration of spilled or leaked hydrocarbons into the soil. The impermeable liners will be integrated with secondary containment berms and sealed against them. If any spills occur during mining or processing these will be managed as outlined in the SPCC Plan.

All tank connections that have a potential to be open to the atmosphere will be contained inside the tank dykes. Therefore all load lines and drains will terminate inside the dyke. All load stations will also be equipped with spill boxes. These boxes will be connected to the end of the load connections and will seal around them. The boxes will come equipped with a sealed lid designed to keep out rain and snow and will be designed to contain small leaks and drips associated with the normal use of the load connections. The boxes will be inspected on a schedule and cleaned as required. All materials removed from the boxes will be returned to their source tanks or disposed of in a manner in keeping with their identity and condition.

Any spills from the tanks to the bermed areas will be contained by these structures. Liquid collected in the berm areas will be identified and quantified. Material will be returned to the appropriate source tank or disposed of off site by a licensed contractor.

The tanks will be installed in the berms on piles with the bottoms of the tanks elevated off the ground. The tank liner material referred to above will be continuous under the tanks and around the piles and will be sealed against the piles by rubber seals. In this way the underside of the tanks will be kept out of any accumulated rain water and can be subject to periodic inspection for corrosion or damage.

If meteoric water that accumulates inside berms and other such structures is contaminated by spills, the water will be disposed of by a licensed contractor off site. If is it not contained it will be allowed to evaporate or be recovered and used for dust control.

As mentioned above, truck load stations will be located inside the bermed areas. Any spills from loading and unloading operations will be retained within the bermed areas. Spills will be cleaned from the area and returned to the appropriate tank, reprocessed or disposed of off site by a licensed contractor.

6. Issued and Pending Permits

6.1 Permit History

Permit activities include an Exploration Permit (E/007/0011) issued by DOGM in 2013.

6.2 Issued and Potential Permits and Plans

A NOI has been filed with DOGM, March 2015 (GRR, 2015a).

Although the operations will not discharge to jurisdictional surface waters and are exempt from storm water permitting obligations, GRR will obtain a Construction Storm Water General Permit consistent with the Utah Pollutant Discharge Elimination System (UPDES); GRR will plan to obtain UPDES storm water coverage from the Utah Department of Environmental Quality Division of Water Quality (DWQ) for both construction of the facility and to cover facility operations. A construction Storm Water Pollution Prevention Plan (SWPPP) has been prepared (URS, 2014a) and will be kept current as required by the Construction Storm Water General Permit (GRR, 2015b) and modified consistent with the requirements of the Multi-Sector Permit (DWQ, 2008).

A small source exemption registration will be filed with the Utah Division of Air Quality (DAQ) to address air quality issues associated with point source emissions.

Sanitary and solid waste water will be collected and removed from the site by a licensed contractor.

7. Water Information

7.1 Well and Spring Identification

No wells or springs have been or are expected to be impacted by the mining operations at the Bruin Point Mine because they are outside of the Affected Area, and the conservative design of the dry tailings impoundment will retain the small amount of contact water on-site.

Range Creek and North Spring are located outside of the Affected Area but within the Lease Boundary, **Figure 2.** North Spring is located near the northern boundary of the project area, outside of the Affected Area, and approximately 500 feet southeast of the proposed dry tailings area. The source area of North Spring is the upper Range Creek drainage basin west and southwest of the spring. North Spring is fenced, piped, and flows into a stock pond. A culvert runs from the stock pond to Range Creek. The condition of the spring is noted as being highly disturbed as a result of overgrazing (JBR, 2014; Calkin, 1990).

According to online records of the State Engineer's office, (Utah Division of Water Rights [DWRi], 2014) there are four water rights in the vicinity of the Project as shown in **Table 7.1.1** and **Figure 4**. No water rights will be affected by the GRR operations. Furthermore, there are no water rights within the Affected Area. Areas of disturbance will not be near the water right locations. There are no wells identified within a one-mile radius of the facility, likely due to the fact that groundwater is so deep.

Table 7.1.1 Water Rights

Water Right Number	Water Source	Quantity (ft^3/s)	Use	Water Right Owner[1]
91-3054	Range Creek	-	Stock watering directly on stream	Hunt Oil Company (25%) Meany Land & Exploration Inc. (75%)
91-11	Range Creek	-	Livestock	State of Utah DWRi (Application Permanently Lapsed)
91-15	Unnamed Spring	0.1	Stock watering directly on stream	Magnificent Seven, LLC (34.5%) Penta Creek LLC (65.5%)
91-Area	Stock Pond on Range Creek	1.2	Stock watering directly on stream (Expired)	Amoco Production Company

Notes:
[1] http://maps.waterrights.utah.gov/mapserver/scripts/search.asp (DWRi, 2014)
Acronyms:
DWRi - Division of Water Rights
ft^3/s - cubic feet per second

The South Spring/Tributary Spring is approximately 0.5 miles downstream from North Spring in a steep, forested drainage outside of the Affected Area. Water from the South Spring/Tributary Spring was observed coming out of the rock at several places in the drainage and appears to be heavily used by deer. There are no water rights on file with the State Engineers Office associated with this location.

Within Water Canyon, three cliff seeps were identified that contributed to an unnamed fork of Water Canyon. Cliff seeps are located on the far western portion of the Lease Boundary, but outside of the Affected Area where water was found trickling over the cliff edge or seeping from the cliff face. These seeps discharge through stress relief factures with groundwater sourced near the topographic high point of Bruin Point (approximately 1 mile northwest of the American Sands exploratory boring). This water shows signs of infiltrating into the ground and does not flow into Water Canyon. No springs or seeps were observed in the mine portal area within Bear Canyon. There are no water rights on file with the State Engineers Office associated with these locations (DWRi, 2014).

To mitigate potential impacts of the tailings facility to North Spring and Range Creek flows, the facility will be built in six phases, one phase in each of the six consecutive years of the facility's operation. The ground surface up gradient of the active phase will be left undisturbed, leaving infiltration from that area unchanged until the area is needed for tailing placement. The area of the active phase will contribute little if any infiltration during the year of its operation.

As each phase is completed and transitioned from active to inactive, it will be covered and reclaimed, with infiltration and runoff from the reclaimed area being directed off the facility cap to adjacent areas for infiltration to shallow groundwater. Using this method to construct the tailing facility will ensure that at greatest impact of the ultimate tailing facility footprint to the recharge source areas on North Spring and Range Creek will be approximately 26.5% of the source area for North Spring, and only 10.3% of the source area for the nearest perennial reach of Range Creek, will be subject to inhibited infiltration at any given time, Table 7.1.2. After five years, the full area of reclaimed tailings facility will again be available to contribute runoff for infiltration into the shallow groundwater system through the capillary barrier.

Recharge to the shallow aquifer feeding North Spring occurs when water derived from snowmelt infiltrates through the thin site soils and into the underlying fractured bedrock. The estimated drainage contributing to North Spring is shown on attached Figure 2 and is approximately 266 acres. The estimated drainage contributing to Range Creek, at the point where its flow becomes perennial about 1 mile down gradient from the tailing facility, is 681 acres. The footprint of the final tailing facility is approximately 109 acres which represents about 41 % of the drainage area contributing North Spring, and about 16% of the drainage area above the first perennial reach of Range Creek.

Table 7.1.2 Dry Tailings Impoundment Land Status

End of Laydown Year	Tailings Placement Area as a % of the Total Area of the:			Tailings Placement Area (Acres)
	Placement Area	North Spring Recharge Area	Recharge Area of the First Perennial Occurrence of Range Creek	
1	21.70%	8.90%	3.50%	23.6
2	33.20%	13.60%	5.30%	36.2
3	50.70%	20.80%	8.10%	55.3
4	64.60%	26.50%	10.30%	70.4
5	0.00%	0.00%	0.00%	0
Total Tailings Placement area (acres)				**109**
North Spring Recharge Area (acres)				**266**
Range Creek Perennial Reach Recharge Area (acres)				**681**

Notes:
All Values are as end of period.
Tailings placement is complete at end of year 5.
It is assumed that the cover is in place as of the end of period.
Some lag time (a few weeks) is likely between end of period and placement of cover.

The dry tailings will be constructed with a four foot clay liner under the tailings, a four foot clay cap (each with a permeability of $1x10^{-7}$ cm/s) over top of the tailings, a weeping tile system just above the lower clay liner, a capillary barrier above the clay cap, and 18 inches of growth media on top of the structure. The capillary barrier will allow water to drain off the dry tailings impoundment and allow the water to recharge North Spring. The underlying clay liner and clay cap will prevent meteoric water from coming into contact with the tailings. Instead, that water will flow to the sides of the dry tailings area, and will contribute to the recharge of the groundwater system and North Spring. The weeping tile system will ensure any water that contacts the tailings sand will drain into an HDPE-lined retention basin at the toe of the tailings impoundment.

Water that is collected in the retention basin will be analyzed. If it is not contaminated it will be used for dust control or allowed to evaporate. If it is found to be contaminated, it will be hauled off site by a licensed contractor and disposed of in a manner consistent with its contents. Any water that is collected in the HDPE-lined retention basin will not be discharged. These measures will ensure that there will be no impact to groundwater flows and that no solvent will be released to the environment. See **Appendix B** for additional information regarding the hydrology of North Spring (URS, 2014b). Data and field investigations were performed to determine the presence of any wells or springs in the vicinity of the Affected Area. The inventory area and resulting water feature locations are shown on Figure 2 of the Seep and Spring Inventory report, provided in **Appendix F** (JBR, 2014). Results of these investigations are noted below and detailed in **Appendix F**.

As documented in this application and the supporting materials, all mining-related operations will be engineered and conducted to have no impacts to the identified seeps and springs. As described below, the proposed monitoring will also ensure that the quality of these seeps and springs will be assessed throughout the life of the mine.

7.2 Surface Water Body and Drainage Identification

No perennial, intermittent or ephemeral streams or other features have been or are expected to be impacted by the mining operations at the Bruin Point Mine because those waters are outside of and not impacted by flows from the Affected Area. The following briefly identifies surface water features in the general area.

The Lease Boundary (as opposed to the Affected Area) is located within the Book Cliffs and Roan Cliffs area in the Colorado Plateau Physiographic Province. Hydrologically, the Lease Boundary falls within the headwaters of Range Creek Canyon (hydrologic unit code [HUC] 14060005), Lower Grassy Creek (HUC 14060007), Dry Creek (HUC 140600050402), and Cottonwood Canyon (HUC 140600050403), all part of the Colorado River system. **Figure 5** shows watershed boundaries in the Lease Boundary, as well as other water features.

The Affected Area will be located in the Grassy Trail Creek and Range Creek watershed. However, the headwaters of Range Creek and Grassy Creek are outside of the Affected Area. Range Creek eventually drains to the Green River (Uinta Watershed). The south and west sides of the lease area are also outside of the Affected Area and drop steeply off a plateau towards the headwaters of Water Canyon, which eventually drains to the Price River. Storm water flow into the Affected Area will be controlled as described in the above-referenced Construction Storm Water General Permit (GRR, 2015b) and consistent with the requirements of the Multi-Sector Permit (DWQ, 2008). As indicated, there will be no storm water flow from the Affected Area. As previously described, no contact storm water will be conveyed off site; all storm water runoff within the Affected Area will be contained and will be left to evaporate, used for dust control or will be hauled off site by a licensed contractor . The ultimate disposal of accumulated storm water will be dependent on its quality. In addition any storm water collected in the HDPE-lined retention basin below the tailings impoundment area will be allowed to evaporate, used for dust control or hauled off site by a licensed contractor depending on quality.

The named main stem of Water Canyon originates in the western portion of the Lease Boundary and is also outside of the Affected Area. It drains to the southwest, out of the Lease Boundary. The main stem originates at approximately 9,500 feet above mean sea level (amsl) with a small intermittent channel that contained rock outcrops and wet areas in October 2012 (JBR, 2014). The main stem within the Lease Boundary was wet but not flowing in either May or October, (JBR, 2014). Any precipitation that enters the Affected Area from the hillside above will be controlled and contained using drainage controls and Best Management Practices (BMPs) as described in the Construction Storm Water General Permit (GRR, 2015b).

7.3 Well-head Protection Area Identification

No well-head protection areas have been identified within a one-mile radius of the mine operation.

7.4 Drinking Water Source Identification

No drinking water sources have been identified within a one mile radius of the mine operation.

7.5 Well Logs

According to online records of the State Engineer's office, (DWRi, 2014) there are no constructed wells identified within the Affected Area for the purpose of groundwater extraction.

8. General Identification

8.1 Location Identification

As indicated throughout this application, the mining-related facilities have been designed as zero discharge with no potential for any off site mining or process-related flows. There are no point source discharges from the operation and the facility is conservatively designed. All process equipment will be housed in buildings with seal welded steel floors and seal welded lip drips. Any spill from the processing plant will be contained within the buildings with the drip lip acting as a berm to prevent liquid from spilling into the environment. All of the tanks on the site will be constructed with secondary containment structures and will be operated in a manner consistent with the SPCC Plan. GRR will monitor the residual solvent content of the sand tailings, in accordance to the Sampling and Analysis Plan (SAP) as discussed further in **Section 11**.

8.2 No Planned Discharges

This mine is designed to be a zero-discharge operation. Ore processing will occur in a closed system within the tank farm and processing plant. The system will be designed to maximize the solvent recovery and reuse, from both the sand tailings and the bitumen. Storm water will be managed consistent with the facility's Construction Storm Water General Permit (GRR, 2015b).

8.3 No Potential Discharges

This mine operation is designed to be a zero-discharge operation. There is no process water associated with the sand tailings storage area. All tanks will be constructed with secondary containment consistent with the applicable SPCC Plan. Connate water (naturally occurring in the geologic formation water within the tar sands) will be separated during processing and stored in the water (atmospheric) storage tank shown previously in **Exhibit 5.3.1**. That water (approximately 50 barrels or 2100 gallons per day) will be collected and used then for dust control or disposed of by a licensed contractor, depending on quality.

8.4 No Means of Discharge

The extraction process is a closed system designed to retain the solvent mixture until all of the solvent can be reused. The nature of the closed system also prevents outside contaminates from entering the processing stream.

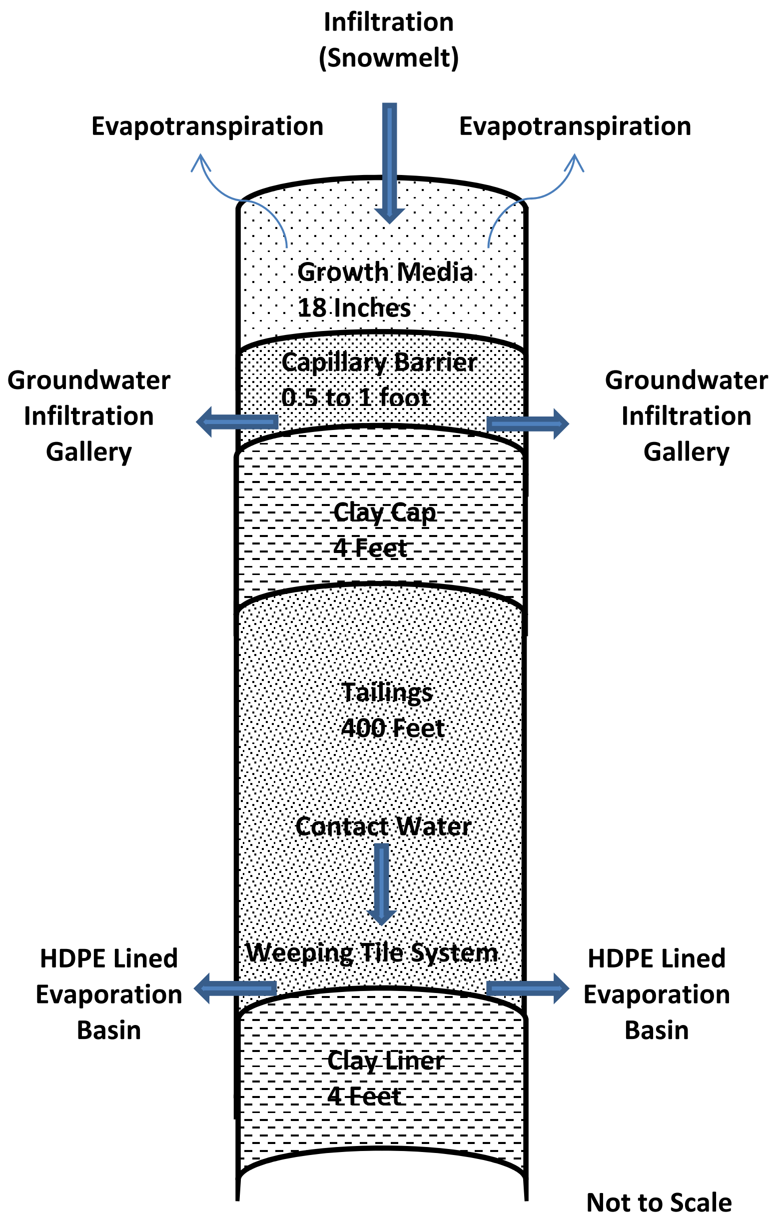
Stockpiles of mined ore will be covered and maintained adjacent to the processing plant, to maintain a constant supply of feedstock for the processing system. The stockpiles will be covered so storm water cannot come into contact with the ore or tailings sand. Should any storm water come in contact with the stockpiles, that water will be retained on-site and/or managed in accordance with the facility's Construction Storm Water General Permit SWPPP (URS, 2014a). Storm water will not be discharged and will evaporate, used for dust control, or will be hauled off site by a licensed contractor for disposal.

Areas used for stockpiles, sand tailings, and processing facilities will be bermed and graded higher than surrounding areas to prevent contamination of storm water within the Bruin Point Mine area. In addition, the working platforms that make up the mining areas will be bermed to meet Mine Safety and Health Administration regulations, and act as a containment area where runoff will remain until it evaporates. To capture and contain all runoff during a 100-year, 6-hour storm event, retention basins were designed on preliminary calculations for the site and assuming a 72-hour holding time. Retention basins will be constructed with clay lined bottoms, as shown in **Appendix G** (URS, 2015a).

The Preliminary Stability and Hydrology Analyses in **Appendix G** identify the design criteria and specify how the berms and the dry tailings cap and liner will be constructed (URS, 2015a). The berms will be constructed using a stable configuration that meets the State Engineers required factors of safety, as applicable. The dry tailings liner under the tailings pile and cap will be installed to minimize water infiltrating through the dry tailings. Permeability tests were performed on a single partings sample that will be used to construct the liner ($1x10^{-7}$cm/s). Permeability results for this sample were 2.3 x 10^{-7}cm/s, meaning that $1x10^{-7}$ cm/s is achievable. Engineered controls will be utilized so the Affected Area will not have an impact to groundwater. In addition (and as referenced above), the major lithologies (shale, tar sand) in the subsurface have low permeability and do not allow for groundwater recharge of the Garden Gulch and Douglas Creek hydrologic units within the area of operations via vertical infiltration. The high bitumen content layers within the Affected Area inhibit downward movement of groundwater from the shallow groundwater system to lower units by semi-sealing fractures/joints. In addition to the clay liner and clay cover, a capillary barrier and 18 inches of topsoil will be placed over the clay cover.

The capillary barrier is an engineered earthen cover designed and constructed to direct water off the sand pile and into the recharge system for North Spring and Range Creek. The Capillary System will be designed to intercept and move water laterally across the top of the clay cap to infiltration galleries for groundwater recharge. The capillary barrier is a coarse-grained layer underlying a fine-grained growth media (see **Exhibit 8.4.1** below). The contrast in capillary pressure between the fine- and coarse-grained layers inhibits movement of water across the interface between the two layers because pore water is at a lower energy state in the fine-grained material (capillary suction) than in the coarse-grained material. The fine-grained growth medium will have enough storage capacity to hold the infiltration that occurs during the winter, when the highest precipitation occurs; the water held in storage is then consumed by evapotranspiration during the growing season. Capillary suction within the top layer (growth media) will be less than atmospheric (negative pressure) and will counteract the downward force of gravity until the media becomes fully saturated. At this point, gravity overcomes the capillary forces and water drains into the capillary barrier. If infiltration does reach into the capillary barrier, the high conductivity material would act as a preferential flow path to move water laterally, across the top of the clay cap and topographically down slope to infiltration galleries for infiltration into the undisturbed subsurface. Infiltration within the capillary barrier will continue until it contacts the top of the clay cap, where infiltration will laterally spread topographically down slope by gravitational forces to designed infiltration galleries around the perimeter of the tailings impoundment. These infiltration galleries will be in contact with fractured bedrock allowing recharge of the shallow groundwater system and North Spring.

EXHIBIT 8.4.1 Typical Cap Schematic Showing Infiltration



Storm water (including storm water intercepted by haul road and access roads) will be managed on-site using BMPs as described in the applicable permit and Construction Storm Water General Permit SWPPP (URS, 2014a). If erosion is observed, GRR is committed to using appropriate water and erosion control measures including properly installed filter fence, straw bales check damns, dirt berms, log berms, (<0.1 acre-foot) sediment retention sumps and rock check dams.

8.5 Treatment Processes and Technology

All production flows will be contained within the processing plant and tanks. There will be no liquid discharges from the facility. After bitumen has been washed from the ore, the sand will be dried to recover the solvent; the sand tailings will then be placed in the dry tailings area. Liquid components of the extraction process will be separated into its bitumen and solvent constituents as the final step of extraction. Bitumen will be stored in tanks for eventual transportation to a refinery and the solvent will be returned to the process stream. Truck loading will be in compliance with the SPCC Plan.

8.6 No Discharge Effluent Characteristics

This mine operation is designed to be a zero-discharge operation. There is no planned discharge of water or other liquid from the operation.

9. Hydrology Report

9.1 Regional Geology and Landform

The Bruin Point Mine is located within the Book Cliffs and Roan Cliffs area in the Colorado Plateau Physiographic Province (Stokes, 1986) and falls along the southern border of the Uinta Basin (Blackett, 1996), also known as the West Colorado River Basin. The topography in the area is mountainous and rugged, with nearly 2,000 feet of relief. Elevations within the Lease Boundary range from approximately 8,200 feet amsl at the southern end of the Lease Boundary, to over 10,000 feet amsl at Bruin Point at the northwest corner of the Lease Boundary.

Blackett (1996) notes the formation of the Uinta Basin was the result of simultaneous subsidence within the basin and uplift on all sides in what is now Utah, Colorado, and Wyoming beginning in the early Tertiary period. The structure of the sandstone and shale deposits within the basin suggests the rate of subsidence during this time was relatively high. Development of the basin ended in the late Eocene or early Oligocene but some additional uplifting within the region occurred during the middle Miocene.

9.2 Area Specific Geology

The oil sands deposits on the south end of the Uinta Basin are referred to as the Sunnyside deposit (Blackett, 1996). Regionally, these deposits dip 3 to 12 degrees to the northeast. Deposition of the Sunnyside deposit is the result of several stacked channels, down cutting, and subsequent in-filling. The sandstones of this deposit were deposited in meandering stream and fluvial environments at the margin of Lake Uinta. The oil sands within the Sunnyside deposit are as much as 680 feet (210 meters) thick and are overlain with about 400 feet (122 meters) of fine-grained rock. Studies of the relations of the different units suggest a correlation between the strata in the Sunnyside deposits with the Douglas Creek, Garden Gulch and Parachute Creek members in the eastern Uinta Basin (Campbell and Ritzma, 1979).

The oil sands to be mined for this project occur in the upper part of the Colter Formation and the lower part of the Green River Formation (Garden Gulch and Douglas Creek Members). The Colter Formation is composed of nonmarine, fluvial and deltaic sandstone interbedded with red and green shale, mudstone, and thin limestone (Morrison Knudsen, 1984). The fluvial sandstone is the host rock for the bitumen. The Green River Formation overlies the Colter Formation and consists of freshwater marlstone, oil shale, limestone, siltstone, sandstone, oil sands, and shale deposited in a lacustrine environment. The distinction between the Colter and the Green River Formations is difficult to discern because the two formations are intertongued and have very similar lithological types (Blackett, 1996). Bitumen occurs chiefly in the sandstone beds of the Colter Formation and the lower members of the Green River Formation. The Sunnyside deposit is the most exposed deposit of the southwest Uinta Basin deposits with exposures along the Roan and Book Cliffs (Campbell and Ritzma, 1979). **Figure 6** is a geological map of the Lease Boundary and the surrounding area.

9.3 Area Surface Water

The Lease Boundary falls within the watersheds of Range Creek Canyon, Lower Grassy Creek, Dry Creek, and Cottonwood Canyon, which are all part of the Colorado River system. The Affected Area for the mine is confined to the Lower Grassy Creek and Range Creek watersheds.

Precipitation in this area is estimated at about 10.12 inches annually, with September having the highest levels, (NOAA, 2014). This is not sufficient to sustain perennial flow in the watersheds in this region.

The USGS does not maintain any gauging stations in the area surrounding the Lease Boundary.

9.4 Area Groundwater

9.4.1 Area Groundwater Setting

Groundwater within the Affected Area is best characterized as shallow (<100 feet bgs) as evidenced by discharge from North Spring and other seeps near Range Creek. Additional information on the hydrology of the region is included as **Appendix B**, describing the hydrology of North Spring. Additionally, the amount of recharge for that system is sparse and directly related to precipitation. The shallow groundwater system follows an annual cycle related to snowmelt, with discharge from springs during the spring, and decreasing during summer and fall to less than 2 gpm and often times drying up altogether. The studies (reviewed in the hydrologic report [URS, 2014b]) provide consistent evidence that Range Creek is dry in the vicinity of the Affected Area. This is because, in a typical year, there is insufficient precipitation and discharge from springs/seeps to sustain perennial flow in Range Creek near the Affected Area. In turn, the shallow groundwater flow does not move downward. Vertical movement of groundwater from the shallow system to greater depths is inhibited by low permeability shale and oil sand layers, which dominate the stratigraphic column at depths greater than 100 feet bgs. Even in an atypical year where precipitation exceeds the historical averages, the design of the mine operations will be such that contact water is retained on-site and non-contact water diverted to enhance the recharge of the shallow groundwater system.

9.4.2 Affected Area Hydrology

During exploratory drilling in November 2013, GRR encountered groundwater at 400 to 420 feet flowing at less than two gpm. This is anomalous with 50+ exploratory borings drilled by Amoco (as reviewed in the hydrologic report [URS, 2014b]), including at least three in the immediate vicinity of the American Sands boring. None of the logs for the Amoco borings (also included in the hydrologic report, in part [URs, 2014]) reported groundwater at depths below the shallow aquifer in the Parachute Creek Member. Flow from the American Sands boring is believed to be from the shallow groundwater system trickling down the Amoco borings to 400-420 feet bgs.

Nearby seeps and springs, as described in **Section 7.1**, provide evidence of localized, shallow groundwater, representing an isolated perched aquifer (JBR, 2014). The source area of North Spring is the upper Range Creek drainage basin northwest of the spring (see **Appendix B** [URS, 2014b]).

The mining and process activities are designed to be zero discharge. All storm water will be collected and captured and will either be left to evaporate, used for dust control (if free from visible sheen) or will be hauled off site by a licensed contractor for disposal as further described above. The *de minimis* use of water on-site will not impact groundwater or surface water because the facility and tailings cap and cover will be designed to provide adequate controls on infiltration into the shallow groundwater. There will be ongoing monitoring of the seeps and springs within the Lease Boundary, as detailed in the SAP and Quality Assurance Project Plan (QAPP) provided in **Appendix H** (URS, 2015 d,e)**.**

9.4.3 Area Surface and Groundwater Quality

Samples to determine baseline water quality at seeps and springs within the Lease Boundary were collected during the initial hydrologic survey in May 2012. **Tables 9.4.3.1** and **9.4.3.2** show water quality data from this investigation (JBR, 2014). The complete American West Analytical Laboratories (AWAL) report is included in **Appendix F.**

Table 9.4.3.1 General Water Chemistry and Nutrients

General Water Chemistry (mg/L except where noted)				
	Range Creek Lower Green – Desolation Canyon Watershed		**Lower Grassy Trail Creek and Tributaries** Price Watershed	
	North Spring	**Range Creek (Flume)**	**Cliff Seep (#1)**	**Water Canyon**
Acidity	<15.0	<15.0	<15.0	<15.0
Alkalinity as $CaCO_3$	181	221	254	348
Bicarbonate as $CaCO_3$	181	221	240	348
Carbonate as $CaCO_3$	<20.0	<20.0	<20.0	<20.0
Chloride	0.471	0.676	2.05	3.85
Specific conductance (µmhos/cm)	338	389	504	860
Hardness as CaCO3	166	192	218	395
pH @ 25º C (std units)	7.68	8.21	8.28	8.14
Sulfate	8.34	12.1	35	160
Total Dissolved Solids	176	192	276	520
Total Suspended Solids	<3.00	<3.00	<3.00	<3.00
Nutrients (mg/L)				
Ammonia as N	<0.0500	<0.0500	<0.0500	<0.0500
Nitrate as N	0.396	0.206	<0.0100	0.0458
Nitrite as N	<0.0100	<0.0100	<0.0100	<0.0100
Total Orthophosphate as P	<0.0500	<0.0500	<0.0500	<0.0500

Acronyms:
µmhos/cm - micromhos per centimeter
mg/L - milligrams per Liter
std - standard

Table 9.4.3.2 Metals and Metalloids (in mg/L)

	Range Creek Lower Green – Desolation Canyon Watershed HUC 14060005				Lower Grassy Trail Creek and Tributaries Price Watershed HUC 14060007			
	North Spring		Range Creek (Flume)		Cliff Seep (#1)		Water Canyon	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.042	<0.100
Arsenic	0.00241	0.00284	0.00297	0.00305	0.000796	0.000855	0.00135	0.00106
Boron	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Cadmium	<0.00018	<0.00018	<0.00018	<0.00018	<0.00018	<0.00018	<0.00018	<0.00018
Calcium	--	40.8	--	44.7	--	46.3	--	62.4
Copper	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080
Iron	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.424	<0.100
Lead	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00042	<0.00040
Magnesium	--	15.6	--	19.5	--	24.8	--	58
Manganese	<0.00120	<0.00120	0.00149	0.00127	<0.00120	0.00165	0.03	0.0154
Molybdenum	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200
Potassium	--	<1.00	--	<1.00	--	<1.00	--	1.45
Selenium	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	0.00139	<0.00080
Sodium	--	5.33	--	6.34	--	22.1	--	45.2
Zinc	0.00585	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500

Acronyms:
HUC - hydrologic unit code
mg/L - milligrams per Liter

9.5 Affected Area Groundwater Investigation

9.5.1 Seep and Spring Inventory

The seep and spring inventory area was based on the Lease Boundary for the proposed Bruin Point Mine. **Appendix F** contains the entire Seep and Spring Inventory report (JBR, 2014). Observations and conclusions are summarized below.

Field work was carried out in early October 2012. The work was carried out by two hydrogeologists. The intent of the inventory was to obtain baseline seep and spring locations. The seep and spring resources were sparse in the vicinity of the proposed mine operations; only two springs and three cliff seeps were found in addition to several dry features (at the time of the inventory), which may constitute seeps and springs during runoff. None of these features are affected by the project, because they are not within the Affected Area and/or because the design of the cover, cap, and liner for the proposed tailings demonstrates adequate control of infiltration into the shallow groundwater and retention of water for consumption by the vegetated cover using the design parameters as described above (JBR, 2014). **Appendix F** presents all the data and information collected.

10. Groundwater Discharge Control Plan

The zero-discharge design of the tanks is described in detail in **Section 8**. However, to determine the possible contaminants present in the sand tailings, samples of sand tailings were analyzed for leachable constituents, as described below.

In September 2012, GRR pilot processed three samples of raw tar sands from the Sunnyside, Utah ore body. The samples were processed using American Sands' proprietary solvent in a manner designed to emulate, as accurately as possible, the process that the company plans to use on a production scale at the mine site. The processed samples replicate, the sand tailings that will be generated by the production facility when the site is in operation. Properties of the proprietary solvent are in **Appendix E**.

Three tailing samples and one raw tar sands sample were collected and sent to AWAL in Salt Lake City, Utah for analysis. Each sample was analyzed using U.S. Environmental Protection Agency (EPA) Method 1312, the Synthetic Precipitation Leaching Procedure (SPLP), which simulates rainfall and snowmelt that might infiltrate a stockpile of the sample material and the resulting leachate that might seep out of the stockpile. The purpose of this SPLP procedure is to estimate the maximum level of contaminants with the potential to leach from the stockpile into soil, and potentially groundwater, underneath.

Table 10.1 shows the September 2012 results for inorganic analytes, which are primarily metals (JBR, 2014). The samples labeled U-001A, U-002A, and U-003A are the processed ore, and the sample labeled U-004B is raw tar sands. **Table 10.1** also shows several other parameters, including pH, oil and grease, total dissolved solids (TDS), total organic carbon (TOC), and total recoverable hydrocarbons (TRPH).

Table 10.2 shows the results for organic analytes that were above their respective detection limits in at least one sample (13 analytes out of 106 total) plus total petroleum hydrocarbons, diesel range organics (TPH-DRO). Three of these analytes (m,p-xylene, xylenes (Total), and methylene chloride) were at detectable levels in one of the lab's quality control method blank. Since these three analytes were detected at less than five times the method blank concentrations, it can be assumed laboratory contamination was present and the concentrations are estimated quantities.

Table 10.3 shows Utah groundwater quality standards as codified in R317-6-2. **Table 10.3** also shows the Utah Initial Screening Levels (DWQ, 2014) for groundwater, which constitute the action level for leaking underground storage tanks; these action levels are not applicable to sand tailings or stockpiles, but are included to provide a standard for comparison.

Results of the lab analyses show very low levels of constituents in the leachate. The majority of analyses were below detection limits; the few analyses that showed detectable levels of analytes were orders of magnitude below the applicable standards. Benzene, toluene, ethylbenzene, and xylenes (BTEX), compounds are below analytical reporting limits. Note that the pH of the leaching solution under the SPLP method is 4.2, which explains why the pH results are below the standard range of 6.5-8.5; pH 4.2 is designed to simulate the pH of rainfall in the mountain region of the U.S. The lab analytical results also help demonstrate that stockpiles of raw tar sand or sand tailings produced by GRR process will not impact groundwater. The complete AWAL report is included in **Appendix I**.

Sand tailings will be stored in a designated area placed on a compacted liner designed to meet site-specific BMPs (i.e., with a constructed permeability of 1×10^{-7} cm/s). Infiltration is anticipated to be less than 1 in/yr and will be captured in the retention basin. The HELP model, which was developed by the EPA for evaluation of landfill designs, was used for modeling the cover system to the tailings. Weather, soil and design criteria were used to model the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil and liner. The modeling demonstrates that the cover provides adequate control on infiltration into the shallow groundwater for the vegetated cover using the design parameters. The model was run for a period of 50 years and rerun until the initial and final moisture content for each layer reached a steady-state or equilibrium (URS, 2014c). See **Appendix C** for the full results of the HELP model.

After construction of the dry tailings impoundment has started, tailing samples will be collected and evaluated using the HELP model to determine the time required for water to infiltrate through the tailings down to the bottom compacted liner. The dry tailings impoundment will be constructed so that there will not be impact to Range Creek. The dry tailings will be constructed with a four foot clay liner under the sand, a four foot clay cap (both with a maximum permeability of $1x10^{-7}$ cm/s), a weeping tile system immediately above the underlying clay liner draining to a retention basin at the base of the pile, and a capillary barrier and 18 inches of growth media on top of the clay cap. The capillary barrier will allow any water to drain off the dry tailings impoundment; therefore allowing the water to be discharged to the sides of the dry tailings storage for recharge of the groundwater system and North Spring. The weeping tile system will allow any contacted water to drain into an HDPE-lined retention basin at the toe of the tailings impoundment. This water will be collected and allowed to evaporate, used for dust control or disposed of by a licensed contractor for disposal. The ultimate destination of this water will be dependent on its volume and quality. Any water that is collected in the HDPE-lined retention basin will not be discharged. These measures will ensure that there will be minimal impact to groundwater flows and that no solvent will be released to the environment.

At startup, the sand will be sampled daily and analyzed. Operating data will also be collected daily and recorded against the results of the analysis of each sand sample thereby establishing a correlation between sand quality and plant operating conditions. After a record of successful sand quality has been established showing sand is being produced with a residual solvent concentration of 25 ppm or less, the operating data collected to that point will be analyzed and a correlation will be established between good sand quality and operating conditions (see Tailings Quality Control provided in **Appendix D** [URS, 2015c]). If needed, sand drying operating conditions will be adjusted to match the successful operating conditions observed in the system startup period. In addition to operating in compliance with the operating procedures established above, sand tailings will be inspected and free of moisture prior to being placed in the dry tailings impoundment. A moisture probe will be used to inspect and record the moisture content of each load of sand moved from the plant to the tailings pile. In this way, an inspection will be performed for every 60 tons of sand produced resulting in 166 such inspections being performed each day. Sand will also be inspected hourly by operations personnel. Gas detection equipment will collect solvent vapor concentration readings above the sand pile and archive those to a server. At time of writing, best available technology (BAT) is based on gas chromatography and can detect solvent vapors in air down to 50 ppm with a minimum sampling time of 5 minutes. Using the then current BAT, if solvent is found in the air at the minimum detectable concentration, an alarm will sound and operators will intervene to reestablish proper sand drying practices. All plant alarms will be logged electronically.

Table 10.1 Inorganic Analytical Report

Compound	Units	Analytical Result SPLP Metals Method 1312			
		Sample U-001A	Sample U-002A	Sample U-003A	Sample U-004B
Antimony	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Arsenic	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Barium	mg/L	0.0413	0.0401	0.0353	0.0266
Beryllium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Boron	mg/L	<0.500	<0.500	<0.500	<0.500
Cadmium	mg/L	<0.000500	<0.000500	<0.000500	0.000924
Calcium	mg/L	2.81	2.62	2.24	5.42
Chromium	mg/L	<0.0100	<0.0100	<0.0100	<0.0100
Copper	mg/L	<0.00200	0.00302	0.00252	0.0176
Iron	mg/L	1.17	1.18	1.17	0.3
Lead	mg/L	<0.0100	<0.0100	<0.0100	<0.0100
Lithium	mg/L	<0.100 ~	<0.100 ~	<0.100 ~	<0.100 ~
Magnesium	mg/L	<1.00	<1.00	<1.00	<1.00
Manganese	mg/L	0.684	0.614	0.457	0.0669
Mercury	mg/L	<0.00100	<0.00100	<0.00100	<0.00100
Molybdenum	mg/L	<0.0200	<0.0200	<0.0200	<0.0200
Nickel	mg/L	0.0277	0.0283	0.0243	0.0309
Potassium	mg/L	<1.00	<1.00	<1.00	<1.00
Selenium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Silver	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Sodium	mg/L	<1.00	1.24	1.5	1.48
Strontium	mg/L	<0.0500	<0.0500	<0.0500	<0.0500
Thallium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Tin	mg/L	<0.500	<0.500	<0.500	<0.500
Vanadium	mg/L	<0.0500	<0.0500	<0.0500	<0.0500
Zinc	mg/L	<0.100	<0.100	<0.100	0.306
Alkalinity (as $CaCO_3$)	mg/L	<10.0	<10.0	<10.0	<10.0
Chloride	mg/L	<5.00	<5.00	<5.00	<5.00
Oil & Grease	mg/L	<3.00	<3.00	<3.00	<3.00
pH	S.U.	6.27	5.89	4.51	3.6
Sulfate	mg/L	11.2	9.03	7.95	22.1
Total Dissolved Solids	mg/L	14.0 #	14	20	46
Total Organic Carbon	mg/L	6.69 B	7.14 B	6.90 B	2.83 B
Total Recoverable Hydrocarbons	mg/L	<3.00	<3.00	<3.00	<3.00

Notes:
~ Result was not performed in accordance with National Environmental Laboratory Accreditation Program (NELAP) requirements
# High relative percent difference (RPD) due to low analyte concentration. In this range high RPDs are expected.
B This analyte was also detected in the SPLP method blank above the practical quantification limit (PQL) at 1.0056 mg/L. The batch method blank was below the PQL.
Acronyms:
mg/L - milligrams per Liter
SPLP - Synthetic Precipitation Leaching Procedure
S.U. - standard unit

Table 10.2 Organic Analytical Report

Compound	Units	Analytical Result VOCs SPLP*			
		Sample 001A	Sample 003A	Sample 005A	Sample 007A
1,2,3-Trimethylbenzene	mg/L	<0.00200	<0.00200	0.00281	<0.00200
1,2,4-Trimethylbenzene	mg/L	<0.00200	0.0175	0.00425	<0.00200
1,3,5 Trimethylbenzene	mg/L	<0.00200	0.011	0.00245	<0.00200
2-Butanone	mg/L	0.0101	<0.0100	0.0118	<0.00200
Ethylbenzene	mg/L	<0.00200	0.00209	<0.00200	<0.00200
m,p-Xylene	mg/L	<0.00200 B	0.0156 B	<0.00200 B	<0.00200 B
Methylene chloride	mg/L	0.00329 B	0.00327 B	0.00268 B	0.00304 B
n-Hexane	mg/L	0.0129	0.015	0.0138	<0.00200
Naphthalene	mg/L	<0.00200	0.0035	0.00351	<0.00200
o-Xylene	mg/L	<0.00200	0.00569	<0.00200	<0.00200
Toluene	mg/L	<0.00200	0.00466	<0.00200	<0.00200
Xylenes, Total	mg/L	<0.00200 B	0.0213 B	<0.00200 B	<0.00200 B
TPH-DRO	mg/L	<0.0200	<0.0200	<0.0200	<0.0200
TPH-GRO	mg/L	0.0971	0.19	0.162	<0.0200

Notes:
B - This analyte was also detected in MB-SPLP-21377, which was a method blank
* VOCs SPLP 1312 List by GC/MS Method 8260C/5030C
Total # of analytes = 106. All analytes not listed above were non-detect for all samples.
Acronyms:
mg/L - milligrams per Liter
SPLP - Synthetic Precipitation Leaching Procedure
TPH-DRO - total petroleum hydrocarbons, diesel range organics
TPH-GRO - total petroleum hydrocarbons, gasoline range organics
VOCs - volatile organic compounds

Table 10.3 Utah Groundwater Quality Standards (R317-6-2)[1] & Initial Screening Levels[2]

Parameter	Units	Standard[1]	Parameter	Units	Screening Level
pH	S.U.	6.5-8.5			
Metals			*Volatile Organics[1]*		
Antimony	mg/L	0.006	Benzene	mg/L	0.005
Arsenic	mg/L	0.05	Toluene	mg/L	1
Barium	mg/L	2	Ethylbenzene	mg/L	0.7
Beryllium	mg/L	0.004	Xylenes (Total)	mg/L	10
Cadmium	mg/L	0.005	*Initial Screening Levels – Groundwater [2]*		
Chromium	mg/L	0.1	TPH-GRO	mg/L	1
Copper	mg/L	1.3	TPH-DRO	mg/L	1
Lead	mg/L	0.015	Oil & Grease *or* TRPH	mg/L	10
Mercury	mg/L	0.002	Methyl t-butyl ether (MTBE)	mg/L	0.2
Selenium	mg/L	0.05	Naphthalene	mg/L	0.7
Silver	mg/L	0.1			
Thallium	mg/L	0.002			
Zinc	mg/L	5			

Notes:
[1]http://www.waterquality.utah.gov/GroundWater/gwstandards.htm (DWQ, 2014)
[2]http://undergroundtanks.utah.gov/docs/cleanupLevels.pdf (DERR, 2005)
Acronyms:
mg/L - milligrams per Liter
S.U. - standard unit
TPH-DRO - total petroleum hydrocarbons, diesel range organics
TPH-GRO - total petroleum hydrocarbons, gasoline range organics
TRPH - total recoverable hydrocarbons

11. Compliance Monitoring Plan

Throughout production, closure, and reclamation, measures will be taken to ensure that material does not impact surface water or groundwater. Production facilities on the site have seal welded steel floors and seal welded drip lips to contain any spills, and all tanks within the tank farm will be constructed with secondary containment structures.

GRR has developed a monitoring plan (consistent with the terms of its permit) that will include monitoring and sampling of surface water, groundwater, retention basin and dry materials. Eight groundwater monitoring wells are proposed to be installed. Wells are proposed to be installed at the edges of the tailings storage facility and the processing area.

Groundwater monitoring will be conducted during the first year, prior to operation, in order to establish background conditions at the site. Each monitoring well will be sampled eight times during the first year for a total of up to 64 data points. Statistical analysis will then be conducted to establish background conditions as detailed in the QAPP (URS, 2015d). After the first year, groundwater monitoring will be conducted during the spring, summer, and fall quarters at each of the monitoring wells. Sampling will not be conducted during the winter quarter, because the sampling locations will be inaccessible due to weather conditions. The location of monitoring wells, described below, was determined based on topographic and hydrologic gradients and locations of proposed future operations. The proposed monitoring well locations are shown in **Figure 2**.

Tailings Monitoring Wells

Up to five tailings monitoring wells are proposed to be installed on the northern, eastern, and southern edges of the proposed tailings storage area.

Process Monitoring Wells

Up to three process monitoring wells are proposed to be installed on the eastern and western edges of the processing area.

Dry Material Impoundment (DMI) Area

DMI located in northwestern area of Lease Boundary, used to store dry material.

Sampling from the DMI area will occur during the first and second quarter that dry materials are produced. Dry material samples locations will be determined using Microsoft® Excel's Random Number Generator. In addition, the retention basin (if water is present) will be sampled at the same time as the groundwater monitoring wells. See **Appendix H** for the SAP and QAPP (URS, 2015d,e).

Groundwater monitoring will continue post closure on an annual basis. In addition an air sample will be taken from the weeping tile system at the retention basin point and an analysis for the solvent vapors. Post closure monitoring will continue for a period of 10 years on an annual basis; however, four samples with no detectable solvent vapors would be a reason to discontinue groundwater monitoring, after the 10-year period is over.

Groundwater entering the underground workings is not anticipated because groundwater in the area is deep or in the shallow groundwater system above sealed off by the oils layers that have created aquitards. However, the underground workings will be monitored and inspected for groundwater entering the mine. If groundwater is present GRR will immediately notify DWQ, investigate the source, and develop a plan for mitigation.

12. Reclamation and Closure Evaluation

Upon completion of mining activities, the mine and processing facility sites will be reclaimed with the goal of creating open space and wildlife habitat, consistent with current land use. Equipment and facilities will be removed from the site and the site will be regraded, topsoiled, and reseeded to create a safe, stable, and environmentally functioning site.

As part of the reclamation process, all buildings and facilities will be removed from the site. The office, maintenance building, warehouse, change house, substation, fan house, materials handling equipment, support and mining equipment, and tanks will be hauled away to a licensed disposal facility. The mine office and power center are modular pieces of equipment and will be hauled off as intact structures. Approximately 67% of the underground mine workings will be backfilled with the material from the sand tailings temporary storage area, including reserve and reject ore and sand and fine tails. The permanent dry sand tailings storage area will be regraded to at least a 2.5-3H:1V slope to achieve a natural-looking landscape. Maintenance and haul roads will be deep-ripped to relieve compaction, regraded to match site topography, then topsoiled and seeded.

After equipment and facilities have been removed and the site has been regraded, stockpiled topsoil will be redistributed around the site, except in those areas where armored drainage channels have been installed, and beyond a practical distance on the upper slope. The newly placed topsoil will be ripped on the contour to provide a roughened surface to retain seeds and enable root penetration. Vegetative matter that was salvaged during topsoil storage will be spread with topsoil to provide additional organic matter and aid in water retention. Seeds will be broadcast as soon as possible following seedbed preparation. Fertilizer and mulch are not anticipated for use in reclamation efforts.

Visual inspections will be performed during the course of reclamation activities to ensure that reclamation goals are being met. Additional visual inspections will be performed by DOGM personnel to ensure that GRR is meeting reclamation obligations under the Utah Mined Land Reclamation Act and associated rules.

After reclamation construction and until the bond is released, GRR will monitor for noxious weeds and provide weed control measures according to County directives should noxious weeds pose a problem. Weed monitoring will consist of visual surveys of the site during early summer months by a biologist familiar with noxious weeds. In addition, GRR will qualitatively and visually monitor revegetation success during the growing season for the first two years after reclamation construction. During the third year, a quantitative vegetation survey will be conducted to assess revegetation success and to determine if revegetation has achieved 70% of pre-mining cover as required by R647-4-111.13.11.

13. Contingency Plan

The processing facility has been designed as a zero-discharge operation. Process buildings will have seal welded floors and drip edges to prevent spills into the environment. However, in the event of a spill that escapes these confines, contaminated material will be isolated and either treated or disposed of in a manner that prevents degradation to the environment. In addition, corrective actions will be undertaken to prevent a similar spill event from occurring again. The facility will have a SWPPP developed to comply with a Construction Storm Water General Permit and a SPCC Plan. Both plans contain additional management details that will be followed.

14. 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.

______________________________ NAME & OFFICIAL TITLE (type or print)

______________________________ PHONE NO. (area code & no.)

______________________________ SIGNATURE

______________________________ DATE SIGNED

15. References

Blackett, Robert E., 1996. Tar-Sand Resources of the Uinta Basin, Utah. A Catalog of Deposits. Utah Geological Survey, Open File Report 335. May 1996.

Calkin, Wm. S., 1990. Geologic Summary Report of the 1989 Exploration Program Sunnyside Tar Sands Project Carbon County Utah. For Amoco Corporation, Solid Resources.

Campbell, Jock A., and Howard R. Ritzma, 1979. Geology and Petroleum Resources of the Major Oil-Impregnated Sandstone Deposits of Utah. Utah Geological and Mineral Survey, Special Studies 50. August 1979.

Utah Department of Environmental Quality, Division of Environmental Response and Remediation (DERR), 2005. Initial Screening Levels and Tier 1 Screening Criteria. November 1, 2005. http://undergroundtanks.utah.gov/docs/cleanupLevels.pdf

Utah Department of Environmental Quality, Division of Water Quality (DWQ), 2008. Multi-Sector General Permit (MSGP) for Storm Water Discharges Associated with Industrial Activities. Dated December 12, 2008. http://www.waterquality.utah.gov/UPDES/docs/2008/12Dec/msgp_we1.pdf

DWQ, 2014. Utah Ground Water Quality Standards – Table 1 of R317-6-2.1. Last Updated June 17, 2014. http://www.waterquality.utah.gov/GroundWater/gwstandards.htm

Utah Department of Natural Resources, Division of Water Rights (DWRi), 2014. Map Search. http://maps.waterrights.utah.gov/mapserver/scripts/search.asp

Green River Resources (GRR), 2015a. Notice of Intention to Commence Large Mining Operations, Green River Resources, Inc., Bruin Point Mine, M/007/0040. March 2015.

GRR, 2015b. Construction Storm Water General Permit, Green River Resources, Inc., Bruin Point Mine. April 2015.

JBR Environmental Consultants (JBR), 2014. American Sands Energy Corporation Proposed Bruin Point Mine Seep and Spring Inventory. February 2014.

Morrison Knudsen, 1984. Mono Power Company, Sunnyside Tar Sands Project – 1983 geologic evaluation.

NOAA, 2014. National Oceanic and Atmospheric Administration. National Operational Hydrologic Remote Sensing Center Interactive Snow Information. Station SHEF ID: BRPU1. http://www.nohrsc.noaa.gov/interactive/html/graph.html?station=BRPU1>.

Stokes,W.L., 1986. Geology of Utah. Utah Museum of Natural History and Utah Geological and Minerals Survey.

URS, 2014a. Stormwater Pollution and Prevention Plan (SWPPP), Bruin Point Mine. September 2014.

URS, 2014b. Hydrology of North Spring and Bruin Point Utah. September 18, 2014.

URS, 2014c. Summary of Preliminary HELP Model Results, Green River Resources – Bruin Point Mine. September 30, 2014.

URS, 2015a. Final Report Revision 1, Preliminary Stability and Hydrology Analyses, Bruin Point Mine. February 4, 2015.

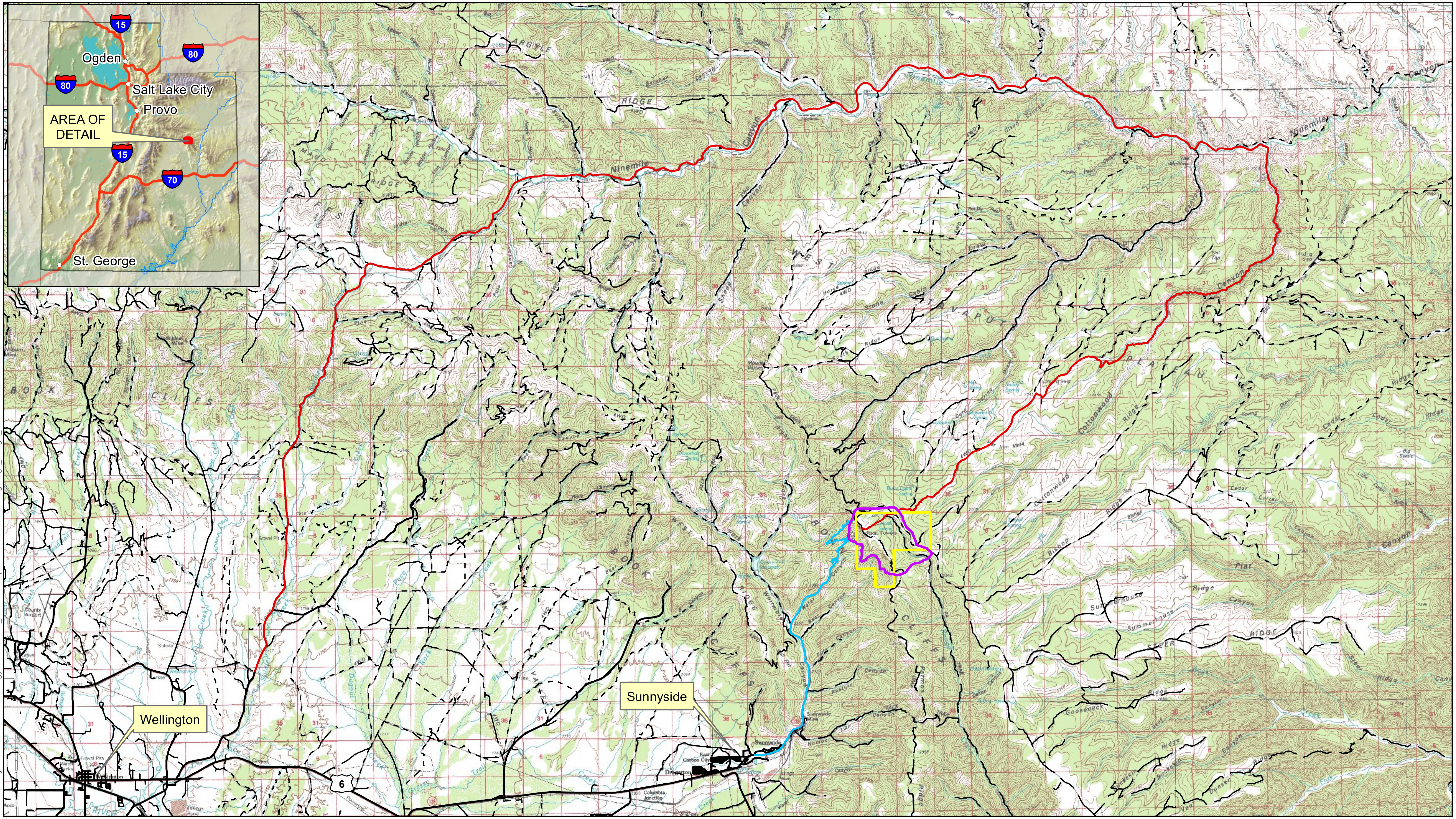
URS, 2015b. American Sands Energy Corporation Fate and Transport Evaluation of Residual Solvent in Sand Tailings. March 2015.

URS, 2015c. American Sands Energy Corporation Tailings Quality Control. March 2015.

URS, 2015d. Quality Assurance Project Plan (QAPP), Bruin Point Mine. April 2015.

URS, 2015e. Sampling and Analysis Plan (SAP), Bruin Point Mine. April 2015.

FIGURES



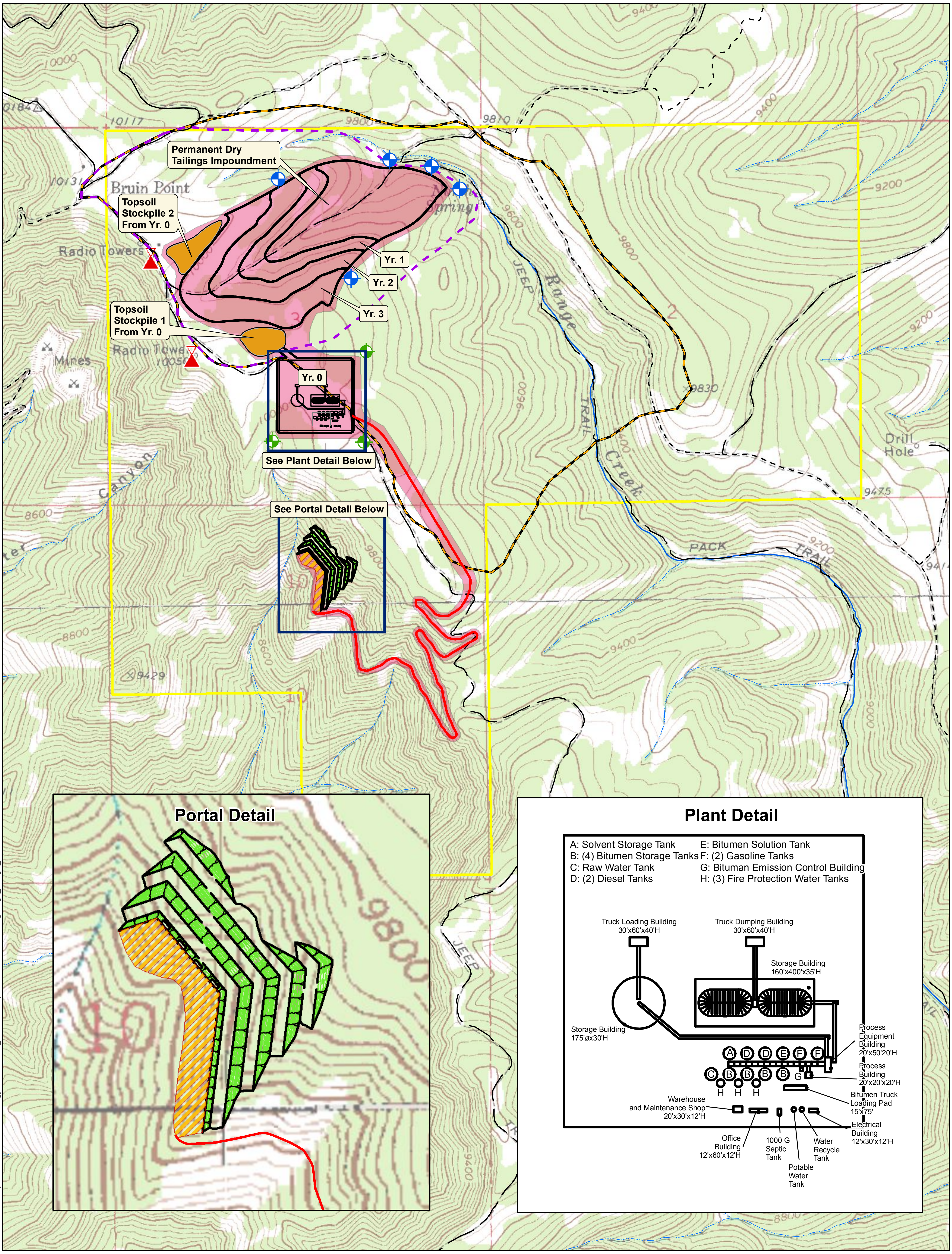
Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Groundwater Discharge\Fig1_ASEgw_Location.mxd

- Site Access Road
- Additional Access Route to Site
- Paved Road
- Improved Road
- Dirt Road
- Road (Conditions Unknown)
- Lease Boundary
- Survey Boundary (area in which baseline surveys were conducted i.e., soils vegetation, wildlife, cultural, raptor)

N

2.5 0 2.5 5 Miles

Title:	Location Map
Bruin Point Mine Groundwater Discharge Permit Application	Proj No: 24585638
	Figure: 1
American Sands Energy Corp	Date: March 2015
	URS



Lease Boundary

Mine Haul Road

Perennial Stream

Intermittent Stream

North Spring Potential Source Area

Perennial Reach of Range Creek Source Area

Top Soil Removal (yr.#: years in which topsoil is removed)

Portal Pad

Topsoil Stockpile

Improved Road

Dirt Road

Road (Conditions Unknown)

Dry Material Impoundment Monitoring Well

Process Area Monitoring Well

Affected Area

Radio Tower

N

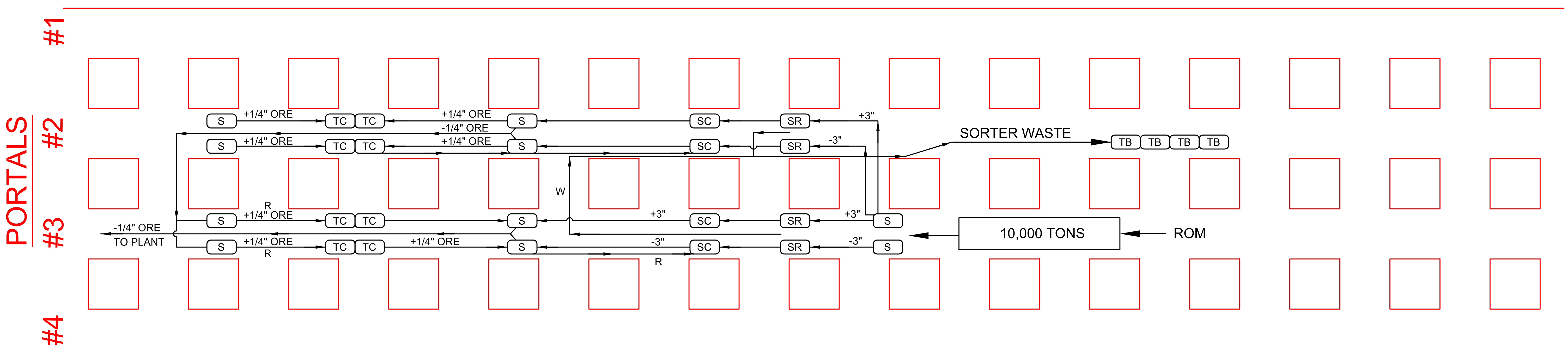
625 0 625 1,250 Feet

Title:	Mine Plan Map
Bruin Point Mine Groundwater Discharge Permit Application	Proj No: 24585638
	Figure: 2
American Sands Energy Corp	Date: March 2015
	URS

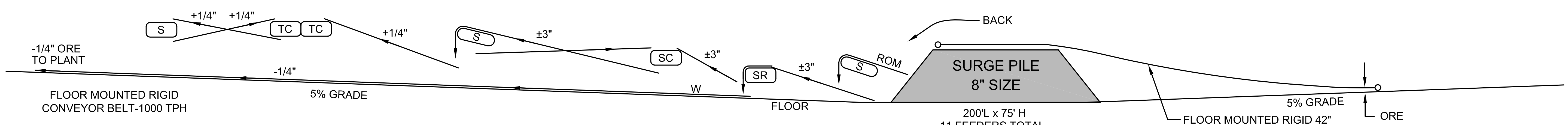
TYPICAL LAYOUT OF CRUSHING PLANT
U/G - 2 - 500TPH CIRCUITS
1 INSTALLED OUTSIDE
1 INSTALLED U/G #3 HEADING & THE OUTSIDE
UNIT MOVED U/G #2 HEADING

SCALE: 1" = 100'-0"

2 - PRIMARY SCREENS
2 - SETS OF SORTER EQUIPMENT @ 500TPH EACH
4 - SECONDARY CRUSHERS
4 - SECONDARY SCREENS
8 - FINE CRUSHERS
4 - FINE SCREENS
2 - PRIMARY CRUSHERS-IN EACH MINING AREA
1 - 10,000 TON LIVE SURGE PILE U/G, REST OF
STORAGE IS IN HEADINGS / BENCHES~60,000 TONS



PLAN VIEW



X-SECTION

TB - TRUCK BIN
ROM 12" FROM PRIMARY CUSHERS
NEED 50'x1500' FOR CRUSHING PLAN AT PORTAL TO
START WITH +PRIMARY CRUSH+1/4" ORE LOADING /
BINS / STOCKPILE.

SR - SORTER +3" -3"
S - SCREEN SIZING DEVICE
SC - SECONDARY CRUSHER
R - RETURN TO CRUSHER
TC - FINE CRUSHING

NOTE:
SEE MINE PLAN FIGURE 2 FOR
LOCATION AND ORIENTATION

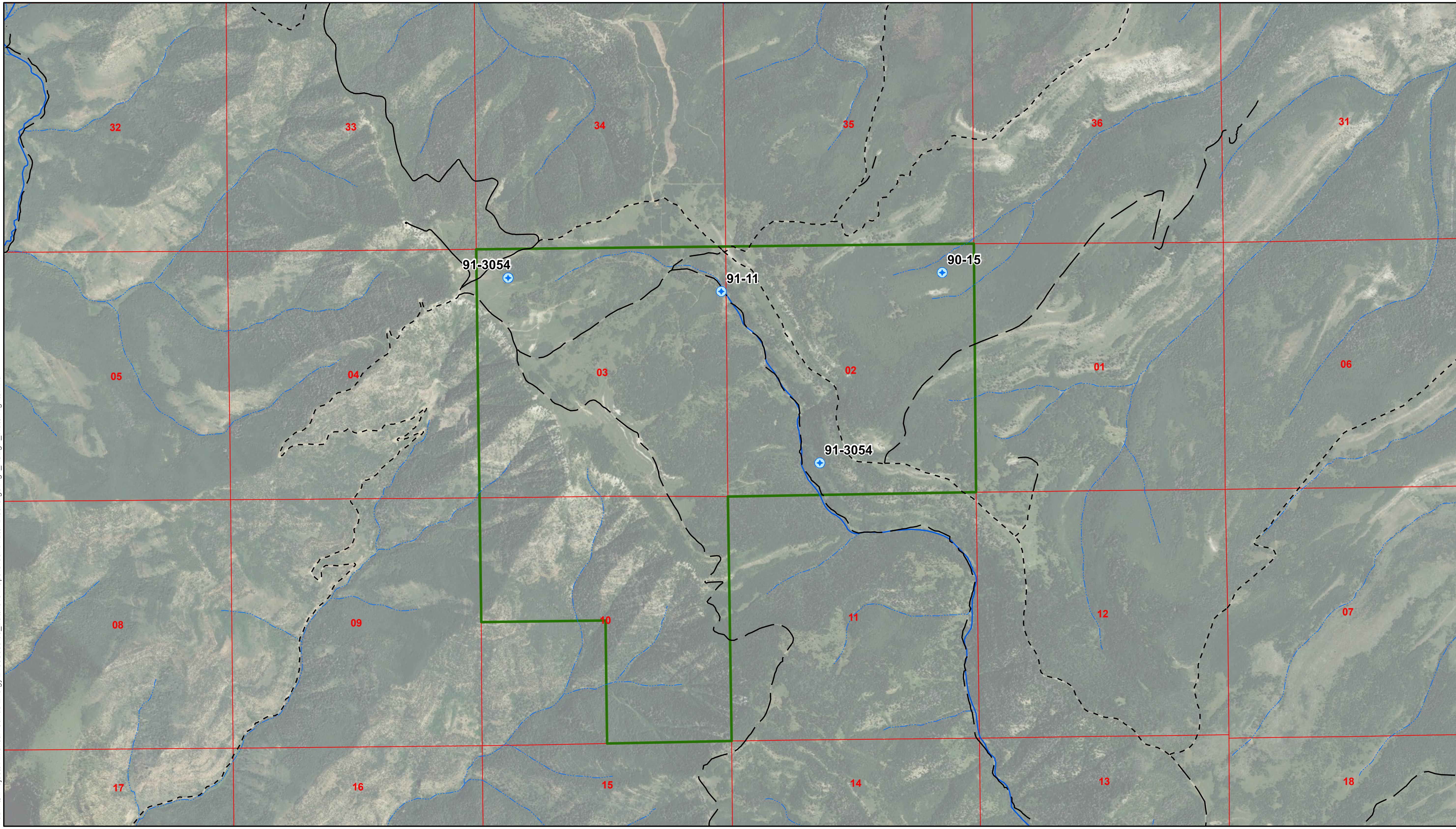
Title: MATERIAL HANDLING PLAN

Bruin Point Mine
Groundwater Discharge
Permit Application

American Sands Energy Corp

Proj No: 24585638
Figure: 3
Date: MAY 2014

Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Groundwater Discharge\Fig4_ASEgw_WaterRights.mxd



Water Rights (within 500' of project boundary)
State of Utah, Department of Natural Resources, Division of Water Rights, 2011

Lease Boundary

Perennial Stream

Intermittent Stream

Public Land Survey System (PLSS) Section Number

Improved Road

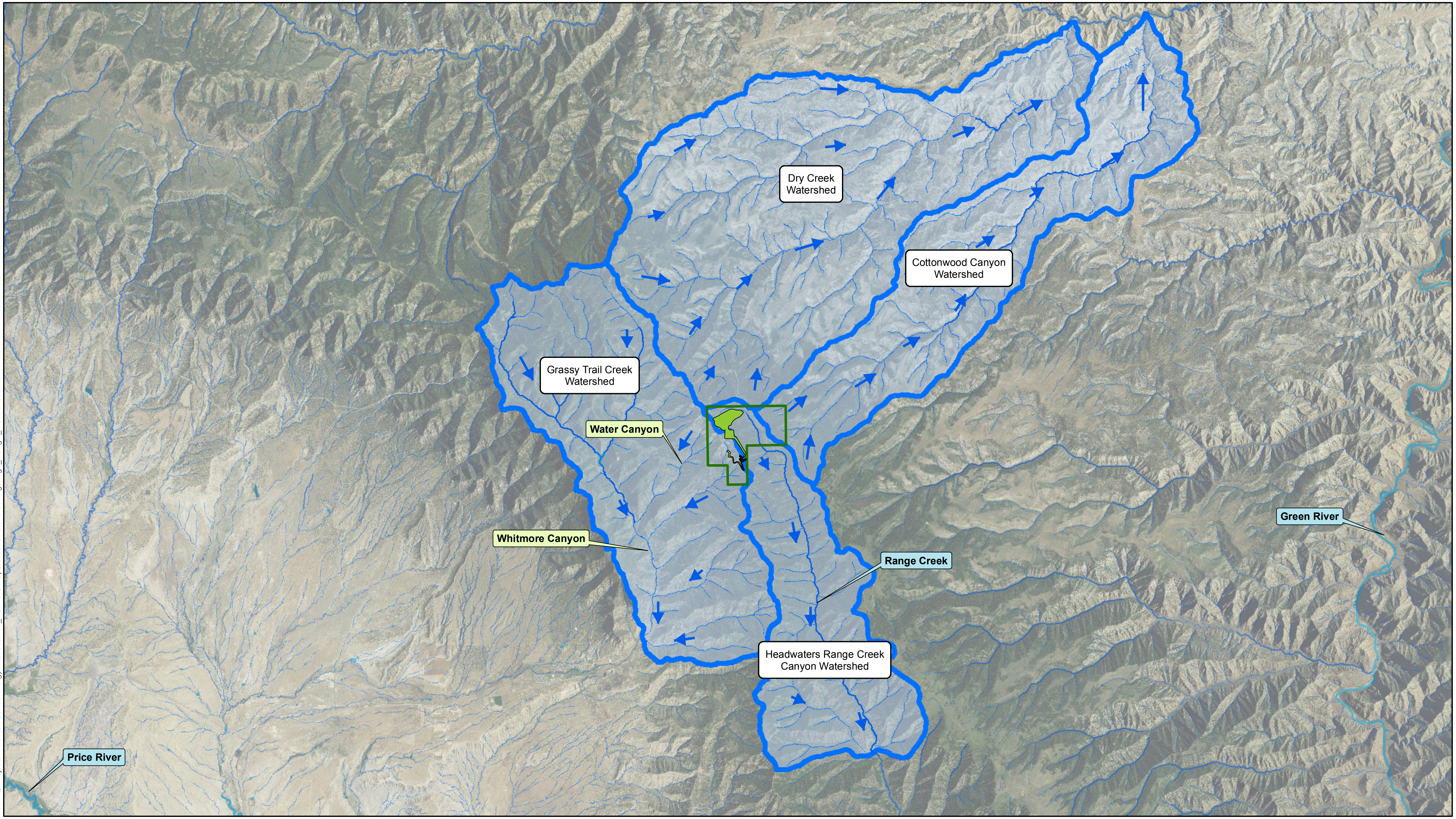
Dirt Road

Road (Conditions Unknown)

N

1,000 0 1,000 2,000 Feet

Title: Utah Water Rights	
Bruin Point Mine Groundwater Discharge Permit Application	Proj No: 24585638
	Figure: 4
American Sands Energy Corp	Date: March 2015
	URS



Path: O:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Groundwater Discharge\Fig5_ASEgw_Watershed.mxd

Perennial Stream

Intermittent Stream

Surface Water Flow Direction

Hydrologic Unit Code (HUC) 12 Watershed

Lease Boundary

Affected Area

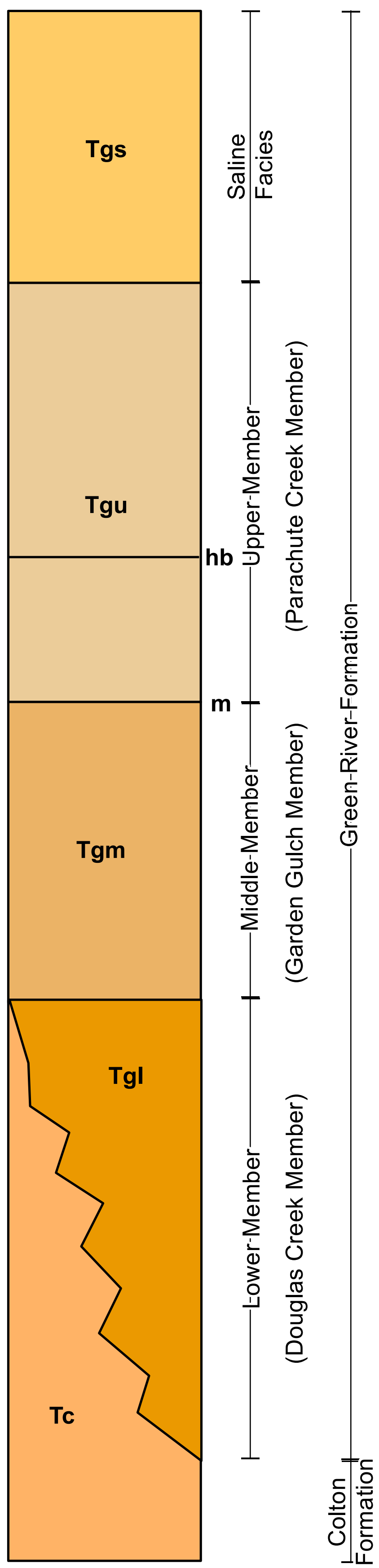
N

6,250 0 6,250 12,500

Feet

Title:	Watershed Map
Bruin Point Mine Groundwater Discharge Permit Application	Proj No: 24585638
	Figure: 5
American Sands Energy Corp	Date: March 2015
	URS

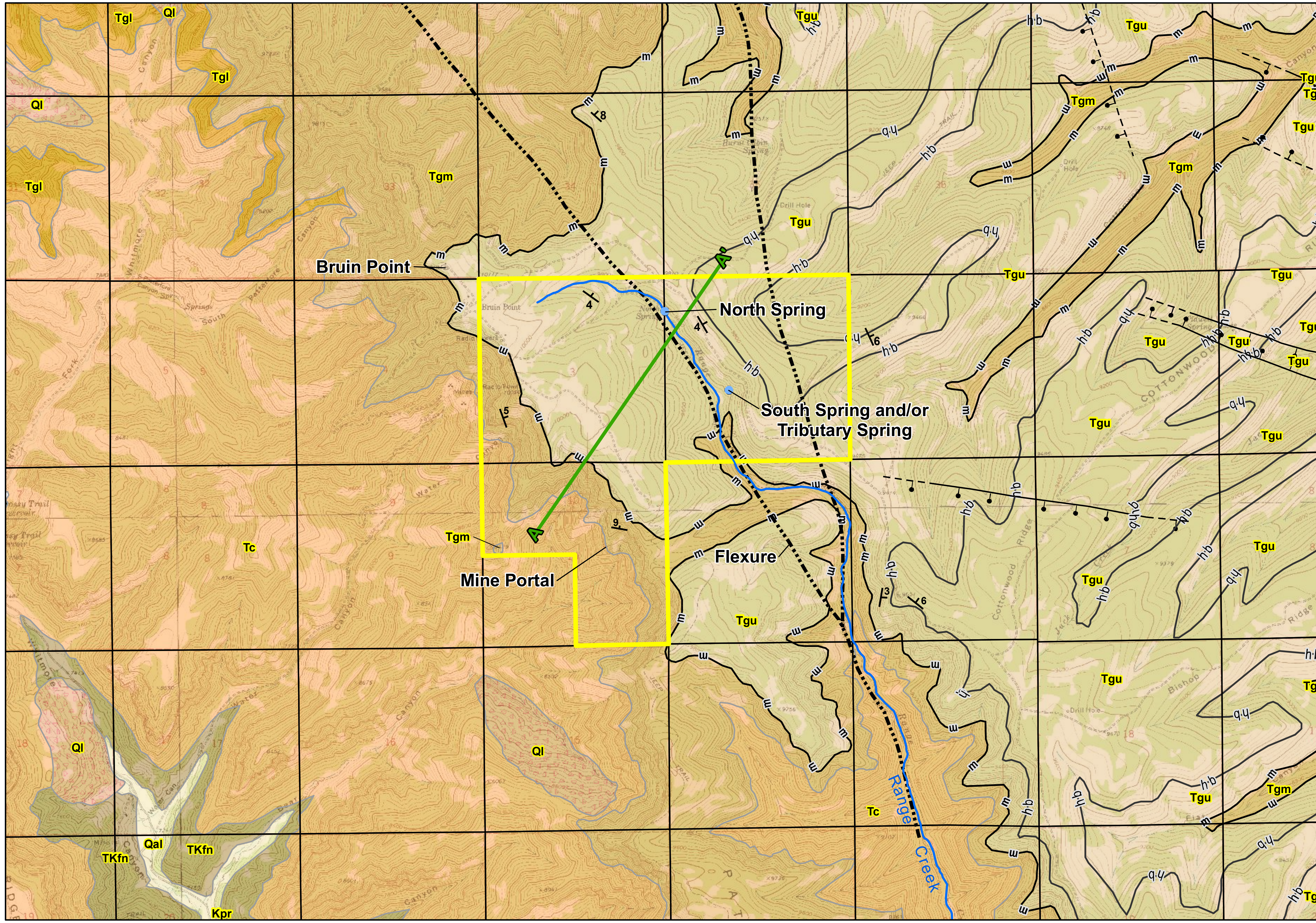
Typical Site Stratigraphic Column



hb Horsebench Sandstone Bed
m Top of Mahogany Bed

Reference: Geologic map and stratigraphic column complied from Regional Map Sunnyside, Tar Sands, Carbon County, Utah, 1990. Calkin, WM. S. and Geologic map of Price 30'x60' quadrangle Carbon, Duchesne, Uinta, Utah, and Wasatch counties, Utah, 1990. Weiss, M. P., Witkind, C. J., and Cashion, W. K., USGS 1-1981

Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Groundwater Discharge\Fig6_ASEgw_Geology.mxd



Geologic Units

Qal	Alluvium
Ql	Landslide deposits
Tgu	Upper member of the Green River Formation
Tgm	Middle member of the Green River Formation
Tgl	Lower member of the Green River Formation
Tc	Colton Formation
TKfn	Flagstaff Limestone and North Horn Formation

Spring

Fault
Dashed where approximately located, ball rests on downthrown block

Contact - Approximately Located or Inferred

m — Top of Mahogany Bed

h·b — Horsebench Sandstone Bed

6 Strike and Dip

Lease Boundary

N

1,500 0 1,500 3,000
Feet

Title:	Natural Surface Geologic Map	
Bruin Point Mine Groundwater Discharge Permit Application	Proj No:	24585638
	Figure:	6
American Sands Energy Corp	Date:	March 2015
	URS	

APPENDIX A

OWNERSHIP INFORMATION

INVOICE

Professional Title Services

107 South 100 East • Price, Utah 84501
(435) 637-2320 • (435) 637-2323
order@ptsfirst.net

ATTN: WILLIAM GIBBS
AMERICAN SANDS ENERGY CORP.

Date 02-18-14
Case No. 7710
Name OIL SANDS CORP. et al
Legal SUNNYSIDE NO. 4,5,6&7, S10 T14SR
Your File No: N/A

Owners Policy of Title Insurance	$
Lenders Policy of Title Insurance	
Endorsements #	
Recording Fees	
Deeds	
Trust Deed	
Releases	
Assignments	
Other	
Reconveyance Fee	
Document Preparation	
Escrow Fees	
Courier Fees	
Wire Fees	
Cancellation Fee	
Foreclosure/Litigation Report	
Plats and Copies	50.00
Other Fees UPDATED REPORT & MINERAL OWNERSHIP	500.00
Other Fees	
Other Fees	
TOTAL DUE	$ 550.00

17991

Representing *STEWART TITLE GUARANTY COMPANY*
"Please Return Yellow Copy With Payment"

ALTA Commitment Form

COMMITMENT FOR TITLE INSURANCE

Issued by

stewart title guaranty company

Stewart Title Guaranty Company, a Texas Corporation ("Company"), for a valuable consideration, commits to issue its policy or policies of title insurance, as identified in Schedule A, in favor of the Proposed Insured named in Schedule A, as owner or mortgagee of the estate or interest in the land described or referred to in Schedule A, upon payment of the premiums and charges and compliance with the Requirements; all subject to the provisions of Schedules A and B and to the Conditions of this Commitment.

This Commitment shall be effective only when the identity of the Proposed Insured and the amount of the policy or policies committed for have been inserted in Schedule A by the Company.

All liability and obligation under this Commitment shall cease and terminate six months after the Effective Date or when the policy or policies committed for shall issue, whichever first occurs, provided that the failure to issue the policy or policies is not the fault of the Company.

The Company will provide a sample of the policy form upon request.

This commitment shall not be valid or binding until countersigned by a validating officer or authorized signatory.

IN WITNESS WHEREOF, Stewart Title Guaranty Company has caused its corporate name and seal to be hereunto affixed by its duly authorized officers on the date shown in Schedule A.

Countersigned:

Authorized Countersignature

Professional Title Services
Company Name

Price, UT
City, State

stewart title guaranty company

STEWART TITLE GUARANTY CO. INCORPORATED 1908 TEXAS

Senior Chairman of the Board

Chairman of the Board

President

SCHEDULE A

Order Number: 7710

Commitment Number: N/A

1. Effective Date: February 7, 2014 at 08:00 AM

2. Policy or Policies to be issued:

Amount of Insurance

(a) A.L.T.A. Owner's Premium: $

Proposed Insured:

(b) A.L.T.A. Mortgagee's Premium: $

Proposed Insured:

(c) Endorsement Premium: $0.00
Endorsements

UPDATED SPECIAL REPORT
CHARGE: $500.00
This report should not be considered as a Commitment for Title Insurance, but is given for informational purpoes only.

3. The estate or interest in the land described or referred to in this Commitment and covered herein is:
Fee Simple

4. Title to the above estate or interest in said land is at the effective date hereof vested in:
SURFACE OWNERS:
----

13 1/3% Interest: OIL SANDS CORPORATION of UTAH, a Wyoming Corporation

5% Interest: WILLIAM G. GIBBS

71 2/3% Interest: RESOURCE ASSOCIATES, LLC

10% Interest: HELENE E. RICHARDS, as Trustee of THE HELENE E. RICHARDS TRUST, dated January 6, 2009

MINERAL OWNERS:
----

13 1/3% Interest: OIL SANDS CORPORATION of UTAH, a Wyoming Corporation

5% Interest: WILLIAM G. GIBBS

16 2/3% Interest: MEANY FAMILY LLC

27 1/2% Interest: ROBERT SCHONLAU

27 1/2% Interest: NANCY SCHONLAU

10% Interest: HELENE E. RICHARDS, as Trustee of THE HELENE E. RICHARDS TRUST, dated January 6, 2009

5. The land referred to in the Commitment is described as follows:
(Continued)

SCHEDULE A
(Continued)

Order Number: 7710

Commitment Number: N/A

That certain mining claim or premises, known as the Sunnyside No. 4, Sunnyside No. 5, Sunnyside No. 6, and Sunnyside No. 7, placer mining claims, described as follows: the Sunnyside No. 4 claim comprising the Northwest Quarter of Section 10 in Township 14 South of Range 14 East, of the Salt Lake Meridian; the Sunnyside No. 5 claim comprising the Northeast Quarter of said Section 10, the Sunnyside No. 6 claim comprising the Southeast Quarter of said Section 10, and the Sunnyside No. 7 claim comprising the Southwest Quarter of Section 3, said Township and Range.

(Tax ID # 2A-1356-A, 2A-1366-A, SA-516, SA-9515-1, SA-9670-1 and SA-9567-1)
Situate in Carbon County, State of Utah.

SCHEDULE B - SECTION 1

Order Number: 7710

Commitment Number: N/A

REQUIREMENTS

The following are the requirements to be complied with:

NOTE: ANY MATTER IN DISPUTE BETWEEN YOU AND THE COMPANY MAY BE SUBJECT TO ARBITRATION AS AN ALTERNATIVE TO COURT ACTION PURSUANT TO THE TITLE INSURANCE RULES OF THE AMERICAN ARBITRATION ASSOCIATION, A COPY OF WHICH IS AVAILABLE FROM THE COMPANY. ANY DECISION REACHED BY ARBITRATION SHALL BE BINDING UPON BOTH YOU AND THE COMPANY. THE ARBITRATION AWARD MAY INCLUDE ATTORNEY'S FEES IF ALLOWED BY THE STATE LAW AND MAY BE ENTERED AS A JUDGEMENT IN ANY COURT OF PROPER JURISDICTION.

NOTICE TO APPLICANT: The land described in this commitment may be serviced by services provided by Cities, Towns, pubic utility companies and other firms providing municipal type services which do not constitute liens upon the land and for which no notice of the existence of such service charges are evidenced in the Public Records. The applicant should directly contact all entities providing such services and make the necessary arrangements to insure payment for such services and continuation of services to the land.

NOTICE TO APPLICANT: If you require copies of any documents identified in this Commitment for Title Insurance, the Company will furnish the same upon request, either free of charge, or for the actual cost of duplication for those copies requiring payment by the Company to obtain.

SCHEDULE B - SECTION 2

Order Number: 7710

Commitment Number: N/A

The policy or policies to be issued will contain exceptions to the following unless the same are disposed of to the satisfaction of the Company:

1. Taxes or assessments which are not shown as existing liens by the records of any taxing authority that levies taxes or assessments on real property or by the Public Records. Proceedings by a public agency which may result in taxes or assessments, or notices of such proceedings, whether or not shown by the records of such agency or by the Public Records.

2. Any facts, rights, interests or claims which are not shown by the Public Records but which could be ascertained by an inspection of the land or by making inquiry of persons in possession thereof.

3. Easements, liens or encumbrances, or claims thereof, which are not shown by the Public Records.

4. Any encroachment, encumbrance, violation, variation, or adverse circumstance affecting the Title that would be disclosed by an accurate and complete land survey of the Land and not shown by the Public Records.

5. (a) Unpatented mining claims; (b) reservations or exceptions in patents or in Acts authorizing the issuance thereof; (c) water rights, claims or title to water, whether or not the matters excepted under (a), (b) or (c) are shown by the Public Records.

6. Any lien, or right to a lien, for services, labor or material heretofore or hereafter furnished, imposed by law and not shown by the Public Records.

7. Taxes for the year 2014 and subsequent years, not yet due and payable. Taxes for the year 2013 have been paid as to Serial Numbers 2A-1356-A, 2A-1366-A, SA-516, SA-9515-1, SA-9670-1 and SA-9567-1.

8. The property described herein does not front on any dedicated street or right of way, and therefore lacks public access thereto.

9. A perpetual easement in favor of Mountain Fuel Supply Company, its successors and/or assigns, to construct, operate, maintain, repair, and remove a microwave equipment building, tower, and other related facilities within a portion of said Section 3, together with all rights and privileges incident thereto, as reserved in that certain Warranty Deed recorded November 10, 1961, as Entry No. 96628, in that certain Warranty Deed recorded November 10, 1961, as Entry No. 96628, in Book 75 at Page 278, and as granted in those certain Grants of Easement recorded November 29, 1961, as Entry No. 96799, in Book 75 at Page 435 and recorded March 18, 1964, as Entry No. 105729, in Book 89, at Page 266, of Official Records.

10. Agreement Not to Sell, Transfer or Encumber said land executed by William S. Batchelder and Jessie M. Batchelder, his wife, in favor of First National Beach Bank, Jacksonville Beach dated June 13, 1967, recorded July 29, 1968, as Entry No. 117139, in Book 113, at Page 173, of Official Records.

11. A Mortgage to secure an indebtedness of the amount stated herein and any other amounts payable under the terms thereof:
    Dated: January 10, 1981
    Executed by: AMOCO PRODUCTION COMPANY, a Delaware Corporation
    Amount: 1,485,000.00
    In Favor Of: PETER W. RICHARDS
    Recorded: January 12, 1981 as Entry No. 156791 in Book 203 at Page 780 of Official Records.

Order Number: 7710 Commitment Number: N/A

12. Obligations, conditions, and any other matter set forth in that certain Decree of Divorce recorded January 4, 1988, as Entry No. 19410, in Book 277, at Page 812, filed November 30, 1987 in the records of the Circuit Court, Third Judicial Circuit, in and for Suwannee County, Florida, entitled WILLIAM STEWART BATCHELDER, husband, vs. PATRICIA S. BATCHELDER, Wife; Case No. 85-299-CA.

13. A claim of Lien, Notice of which was filed by THE STEWART - THOMAS COMPANY, INC., as Claimant, recorded November 28, 1988 as Entry No. 22373 in Book 284 at Page 587 of Official Records. Amount of claim $11,525.00, and subsequent Hold Harmless Agreement recorded February 23, 1998 as Entry No. 64482 in Book 403 at Page 509 of Official Records.

14. Reservations regarding some minerals, mining and other matters as contained in the Patent to said lands recorded January 3, 1929, as Entry No. 17592, in Book 6A, at Page 135, of Official Records.

15. Tar Sand Lease dated May 1, 1979 by and between BARBARA P. SCHONLAU and WILLIAM G. GIBBS, as Lessors, and W.H. HUDSON, as Lessee, and Amendment thereto dated September 15, 1981, as disclosed by that certain Memorandum of Tar Sand Lease and Amendment recorded November 12, 1982, as Entry No. 166018 and 166019, in Book 222, at Page 645 and 653, and any assignment and other agreements relating to Lessee's interest therein.

16. Any Claim based on the assertion or assumption that, of that certain Deed recorded December 22, 1997, as Entry No. 63454, in Book 400, at Page 361, of Official Records did not pass after-acquired title. (Grantor, Amoco Production Company acquired title by that certain Quit Claim Deed dated April 21, 1998, recorded October 6, 1998, as Entry No. 69224, in Book 418, at Page 454, of Official Records.)

17. "Subject to the terms of an unrecorded Letter Agreement dated December 17, 1997" as disclosed by that certain Deed recorded December 22, 1997, as Entry No. 63454, in Book 400, at Page 361, of Official Records.

18. Any claim based on any inadequacy of or misrepresentation by William S. Batchelder as to his right or ability to convey the interest of Justin C. Montgomery and Jessie M. Batchelder, Trustees under the provisions of a certain Trust Indenture dated September 26, 1968, to Oil Sands Corporation of Utah, a Wyoming corporation, in that certain Disclaimer and Quit Claim Deed recorded May 19, 2005, as Entry No. 111507, in Book 591, at Page 146 and that certain Quit Claim Deed recorded June 9, 2005 as Entry No. 111840 in Book 592 at Page 561.

19. A Memorandum of Lease giving notice of a Lease Agreement dated as of January 14, 2005, by and between Meany Land & Exploration, Inc., as Lessor, and Bleeding Rock LLC, a Utah company, as Lessee, recorded November 10, 2005 as Entry No. 114400 in Book 606 at Page 22; a Notice of Assignment by Bleeding Rock LLC to Green River Resources, Inc. of said Lease Agreement, recorded November 10, 2005 as Entry No. 114401, in Book 606 at Page 23 of Official Records.

20. Oil and Gas Lease dated May 8, 2006, from MEANY LAND & EXPLORATION, INC., a Colorado Corporation, to PETRO-CANADA RESOURCES (USA) INC., for a term of 5 years from May 8, 2006, and so long thereafter as oil and gas are produced in paying quantities upon the terms, conditions an covenants therein provided, recorded September 29, 2006, as Entry No. 119668, in Book 629, at Page 686, of the Official Records, and any subsequent Assignments, Modifications, etc., thereof; an Assignment, Bill of Sale and Conveyance from Petro-Canada Resources (USA) Inc., a Colorado Corporation, to Questar Exploration and Production Company, recorded April 13, 2010 as Entry No. 805291 in Book 720 at Page 266.

SCHEDULE B - SECTION 2
(Continued)

Order Number: 7710

Commitment Number: N/A

21. An Acknowledgement and Notice of Acknowledgement by The State of Utah regarding "Dry Canyon Road", the same as may traverse a portion of said land, recorded June 23, 2008 as Entry No. 129761 in Book 676 at Page 54, of Official Records.

22. A Memorandum of Lease giving notice of a Lease Agreement dated as of October 22, 2009, by and between William G. Gibbs, as Lessor, and Green River Resources, Inc., a Utah company as Lessee, recorded October 29, 2009 as Entry No. 803350 in Book 711 at Page 137 of Official Records.

CONDITIONS

1. The term mortgage, when used herein, shall include deed of trust, trust deed, or other security instrument.

2. If the proposed Insured has or acquired actual knowledge of any defect, lien, encumbrance, adverse claim or other matter affecting the estate or interest or mortgage thereon covered by this Commitment other than those shown in Schedule B hereof, and shall fail to disclose such knowledge to the Company in writing, the Company shall be relieved from liability for any loss or damage resulting from any act of reliance hereon to the extent the Company is prejudiced by failure to so disclose such knowledge. If the proposed Insured shall disclose such knowledge to the Company, or if the Company otherwise acquires actual knowledge of any such defect, lien, encumbrance, adverse claim or other matter, the Company at its option may amend Schedule B of this Commitment accordingly, but such amendment shall not relieve the Company from liability previously incurred pursuant to paragraph 3 of these Conditions.

3. Liability of the Company under this Commitment shall be only to the named proposed Insured and such parties included under the definition of Insured in the form of policy or policies committed for and only for actual loss incurred in reliance hereon in undertaking in good faith (a) to comply with the requirements hereof, or (b) to eliminate exceptions shown in Schedule B, or (c) to acquire or create the estate or interest or mortgage thereon covered by this Commitment. In no event shall such liability exceed the amount stated in Schedule A for the policy or policies committed for and such liability is subject to the insuring provisions and Conditions and the Exclusions from Coverage of the form of policy or policies committed for in favor of the proposed Insured which are hereby incorporated by reference and are made a part of this Commitment except as expressly modified herein.

4. This Commitment is a contract to issue one or more title insurance policies and is not an abstract of title or a report of the condition of title. Any action or actions or rights of action that the proposed Insured may have or may bring against the Company arising out of the status of the title to the estate or interest or the status of the mortgage thereon covered by this Commitment must be based on and are subject to the provisions of this Commitment.

5. *The policy to be issued contains an arbitration clause. All arbitrable matters when the Amount of Insurance is $2,000,000 or less shall be arbitrated at the option of either the Company or the Insured as the exclusive remedy of the parties. You may review a copy of the arbitration rules at< http://www.alta.org/>.*

stewart title guaranty company

All notices required to be given the Company and any statement in writing required to be furnished the Company shall be addressed to it at P.O. Box 2029, Houston, Texas 77252.

CARBON COUNTY CORPORATION

Tax Roll Master Record

February 13, 2014 11:06:10AM

Parcel:	SA-0516-0000	Entry:	
Name:	OIL SANDS CORP OF UTAH	Property Address:	
c/o Name:	TAX DEPARTMENT		
Address 1:	P O BOX 9549		
Address 2:			
City State Zip:	JACKSON WY 83002-0000	Acres:	0.00
Mortgage Co:			
Status:	**Active**	Year: **2014**	District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Owners	Interest	Entry	Date of Filing	Comment
OIL SANDS CORP OF UTAH				

Property Information	2014 Values & Taxes Units/Acres	Market	Taxable	Taxes	2013 Values & Taxes Market	Taxable	Taxes
LP01 LATE PENALTY	0.00	0	0	0.00	0	0	10.00
PU07 NON-METALLIFEROUS MINING	0.00	21,332	21,332	229.19	21,332	21,332	229.19
Totals:	0.00	21,332	21,332	229.19	21,332	21,332	239.19

****** SPECIAL NOTE ******

Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	229.19	2013 Taxes:	229.19
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	229.19	**NO BACK TAXES!**	

01/13/2014	10:34 AM	0129682	2013	WILLIAM BATCHELDER	Redemption - Check	10.00 colosimo
					Total Payments:	10.00

Back Tax Summary

Year	Principal	Specials Total	Penalty	Interest Due	Interest Rate	Total Payments	Total Due
2013	0.00	0.00	0.00	0.00	7.00%	10.00	0.00
Totals:	0.00	0.00	0.00	0.00		10.00	0.00

Legal Description

°°°STATE ASSESSED PROPERTY°°°

History

Original Account/Serial Number:9000516 SA-0516

CARBON COUNTY CORPORATION

Tax Roll Master Record

February 13, 2014 — 11:06:19AM

Parcel: SA-9515-0001 — Entry:
Name: GIBBS WILLIAM G
c/o Name:
Address 1: 657 18TH AVE
Address 2:
City State Zip: SALT LAKE CITY UT 84103-0000
Mortgage Co:
Status: **Active** — Year: **2014** — District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Property Address:
Acres: 0.00

Owners	Interest	Entry	Date of Filing	Comment
GIBBS WILLIAM G				

Property Information	2014 Values & Taxes Units/Acres	Market	Taxable	Taxes	2013 Values & Taxes Market	Taxable	Taxes
LP01 LATE PENALTY	0.00	0	0	0.00	0	0	10.00
PU07 NON-METALLIFEROUS MINING	0.00	11,000	11,000	118.18	11,000	11,000	118.18
Totals:	0.00	11,000	11,000	118.18	11,000	11,000	128.18

****** SPECIAL NOTE ******

Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	118.18	2013 Taxes:	118.18
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	118.18	**NO BACK TAXES!**	

01/15/2014	10:07 AM	0129724	2012	GIBBS WILLIAM G	Interest - Check	8.11	colosimo
01/15/2014	10:07 AM	0129724	2012	GIBBS WILLIAM G	Penalty - Check	10.00	colosimo
01/15/2014	10:07 AM	0129724	2012	GIBBS WILLIAM G	Redemption - Check	114.81	colosimo
01/15/2014	10:07 AM	0129724	2013	GIBBS WILLIAM G	Penalty - Check	10.00	colosimo
01/15/2014	10:07 AM	0129724	2013	GIBBS WILLIAM G	Redemption - Check	118.18	colosimo
					Total Payments:	261.10	

Back Tax Summary

Year	Principal	Specials Total	Penalty	Interest Due	Interest Rate	Total Payments	Total Due
2013	0.00	0.00	0.00	0.00	7.00%	128.18	0.00
2012	0.00	0.00	0.00	0.00	7.00%	132.92	0.00
Totals:	0.00	0.00	0.00	0.00		261.10	0.00

Legal Description

°°°°STATE ASSESSED°°°°

CARBON COUNTY CORPORATION

February 13, 2014

Tax Roll Master Record

11:07:08AM

Parcel: SA-9670-0001

Entry:

Name: RESOURCE ASSOCIATES

c/o Name: ROBERT SCHONLAU

Address 1: PO BOX 219

Address 2:

City State Zip: WALLSBURG UT 84082-0000

Mortgage Co:

Property Address:

Acres: 0.00

Status: **Active** Year: **2014** District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Owners	Interest	Entry	Date of Filing	Comment
RESOURCE ASSOCIATES	1/0			ENTRY NOT FOUND

Property Information	2014 Values & Taxes				2013 Values & Taxes		
	Units/Acres	Market	Taxable	Taxes	Market	Taxable	Taxes
PU07 NON-METALLIFEROUS MINING	0.00	114,672	114,672	1,232.04	114,672	114,672	1,232.04
Totals:	0.00	114,672	114,672	1,232.04	114,672	114,672	1,232.04

****** SPECIAL NOTE ******

Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	1,232.04	2013 Taxes:	1,232.04
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	1,232.04	**NO BACK TAXES!**	

Legal Description

STATE ASSESSED

CARBON COUNTY CORPORATION

Tax Roll Master Record

February 13, 2014 11:07:26AM

Parcel: SA-9567-0001
Name: RICHARDS HELENE E TRUST
c/o Name: %KATHY OHLAND
Address 1: PO BOX 530482 DEBARY
Address 2:
City State Zip: DEBARY FL 32713-0000
Mortgage Co
Status: **Active**

Entry:

Property Address:

Acres: 0.00

Year: **2014**

District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Owners	Interest	Entry	Date of Filing	Comment
RICHARDS HELENE E TRUST	1/0			ENTRY NOT FOUND

Property Information	2014 Values & Taxes Units/Acres	Market	Taxable	Taxes	2013 Values & Taxes Market	Taxable	Taxes
PU07 NON-METALLIFEROUS MINING	0.00	16,000	16,000	171.90	16,000	16,000	171.90
Totals:	0.00	16,000	16,000	171.90	16,000	16,000	171.90

****** SPECIAL NOTE ******

Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	171.90	2013 Taxes:	171.90
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	171.90	**NO BACK TAXES!**	

Legal Description

°°STATE ASSESSED PROPERTY°°

CARBON COUNTY CORPORATION

February 13, 2014

Tax Roll Master Record

10:42:47AM

Parcel:	2A-1366-000A		Entry: 121611
Name:	RESOURCE ASSOCIATES LLC		Property Address:
c/o Name:			
Address 1:	PO BOX 219		
Address 2:			
City State Zip:	WALLSBURG	UT 84082-0000	Acres: 480.00
Mortgage Co:			
Status:	**State Assessed**	Year: **2014**	District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Owners	Interest	Entry	Date of Filing	Comment
RESOURCE ASSOCIATES LLC	55%	121611	02/01/2007	(0528/0263)
BATCHELDER WM S, ETAL	20%			
GIBBS WM G	5%			(0199/0723)
RICHARDS PETER W	10%	132083	12/03/2008	(0687/0109)
RICHARDS HELENE E TR	10%	133034	02/18/2009	(0692/0194)

****** SPECIAL NOTE ******

Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	0.00	2013 Taxes:	0.00
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	0.00	**NO BACK TAXES!**	

Legal Description

NW4 (SUNNYSIDE #4) NE4 (SUNNYSIDE #5) SE4 (SUNNYSIDE #6) SEC 10, T14S, R14E, SLB&M. 480.00 AC

History

Original Account/Serial Number:0133365 2A-1366-00A

CARBON COUNTY CORPORATION

Tax Roll Master Record

February 13, 2014 10:43:01AM

Parcel: 2A-1356-000A Entry: 121611
Name: RESOURCE ASSOCIATES LLC
c/o Name:
Address 1: PO BOX 219
Address 2:
City State Zip: WALLSBURG UT 84082-0000
Mortgage Co
Status: **State Assessed** Year: **2014** District: **009 COUNTY OUTSIDE DISTRICT 0.010744**

Property Address:

Acres: 160.00

Owners	Interest	Entry	Date of Filing	Comment
RESOURCE ASSOCIATES LLC	55%	121611	02/01/2007	(0528/0263)
BATCHELDER WM S, ETAL	20%			
GIBBS WM G	5%			(0199/723)
RICHARDS PETER W	10%	132083	12/03/2008	(0687/0109)
RICHARDS HELENE E TR	10%	133034	02/18/2009	(0692/0194)

****** SPECIAL NOTE ******
Tax Rates for 2014 have NOT been set or approved. Any levied taxes or values shown on this printout for the year 2014 are subject to change!!

2014 Taxes:	0.00	2013 Taxes:	0.00
Special Taxes:	0.00		
Penalty:	0.00		
Abatements:	(0.00)		
Payments:	(0.00)		
Amount Due:	0.00	**NO BACK TAXES!**	

Legal Description

SW4 SEC 3, T14S, R14E, SLB&M. (SUNNYSIDE #7) 160.00 AC

History

Original Account/Serial Number:0133340 2A-1356-00A

MEMORANDUM OF LEASE

This Memorandum of Lease is to give notice of a Lease Agreement ("Lease") dated as of the 22 day of October, 2009, by and between William G. Gibbs ("Lessor") and GreenRiver Resources, Inc., a Utah company ("Lessee"). General information regarding the lease is as follows:

1. Real Property involved:

Township 14 South, Range 14 East, SLM
Section 3: SW/4
Section 10: E/2, NW/4
Containing 640.00 acres, more or less

2. Term of Lease: The term of the lease is years 6 years, with provisions for extending the lease, beginning at the end of the initial term and extending so long thereafter as at least 500 barrels of bitumen per day are produced. The lease may be earlier terminated by default in its terms.

Lessee:

GreenRiver Resources Inc.

Ent 803350 Bk 711 Pg 137
Date: 29-OCT-2009 4:17PM
Fee: $10.00 Charge
Filed By: KR
VIKKI BARNETT, Recorder
CARBON COUNTY CORPORATION
For: PROFESSIONAL TITLE SERVICES

By: [signature]
William C. Gibbs, President

PROFESSIONAL TITLE SERVICES 7710

STATE OF UTAH }

} ss.

COUNTY OF SALT LAKE}

The foregoing instrument was acknowledged before me this __ day of October, 2009 by William C. Gibbs, known to me to be the person described in and who executed the within and foregoing instrument and acknowledged to me that he executed the same on behalf of GreenRiver Resources, Inc..

NOTARY PUBLIC
LINDSAY RENCHER
4641 S 2300 E
Holladay, Utah 84117
My Commission Expires
October 17, 2010
STATE OF UTAH

[signature]
Notary Public
Residing at: Holladay, Utah

My Commission Expires:
10/17/2010

ACCOMMODATION RECORDING ONLY
PROFESSIONAL TITLE SERVICES
NOT RESPONSIBLE FOR FORM,
PREPARATION, CONTENT, EFFECT

Ent 805291 Bk 720 Pg 266
Date: 13-APR-2010 2:17:14PM
Fee: $515.00 Check
Filed By: VB
VIKKI BARNETT, Recorder
CARBON COUNTY CORPORATION
For: THE OIL & GAS ASSET CLEARI
SE

ASSIGNMENT, BILL OF SALE ANI

P O BOX 671787
HOUSTON, TX 77267-1787

THIS ASSIGNMENT, BILL OF SALE AND CONVEYANCE ("Assignment"), dated effective April 1, 2010 at 12:01 AM (the "Effective Time"), is from Petro-Canada Resources (USA) Inc., a Colorado corporation, whose address is 999 18th Street, Suite 600, Denver, Colorado 80202 ("Assignor"), to QUESTAR EXPLORATION & PRODUCTION COMPANY, whose address is 1050 17TH STREET, SUITE 500, DENVER, CO. 80265 ("Assignee"):

For $10.00 and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Assignor hereby sells, assigns, transfers, grants, bargains, conveys to Assignee all of Assignor's right, title and interest, in and to the following (all of which are called the "Assets"):

1. The oil and gas leases specifically described in Exhibit A ("Leases") insofar and only insofar as the Leases cover the lands specifically described on Exhibit A ("Lands"), subject to all pre-existing depth or other limitations, if any and whether or not set forth on Exhibit A; the royalties, overriding royalties, net profits interests, production payments and other interests, if any, owned by Assignor burdening the Leases, and all right, title and interest in and to the oil, gas and all other hydrocarbons in, on or under the Lands and non-hydrocarbons and other products, whether liquid or gaseous, produced in association therewith ("Hydrocarbons") after the Effective Time, and the fee surface interests and fee mineral interests, if any, described on Exhibit A or otherwise relating solely to the Leases and Lands or leases and lands pooled or unitized therewith (the "Fee Interests").

2. All oil and gas wells, injection wells, disposal wells and any other wells located on the Leases as to the Lands, or on lands pooled or unitized therewith, including, without limitation, the oil and gas wells specifically described in Exhibit B, whether producing, non-producing or plugged and whether fully or properly described or not ("Wells"), and all personal property and equipment located on and used in the operation of the Wells as of the Effective Time, but excluding all vehicles, tools, administrative computer equipment and other personal property of Assignor not intended by Assignor to be included in the Assets.

3. The rights, to the extent transferable, in and to all existing and effective unitization, pooling and communitization agreements, declarations and orders, and the properties covered and the units created thereby to the extent that they relate to or affect any of Assignor's properties and interests described in Paragraphs 1 and 2 or the production of Hydrocarbons, if any, attributable to said properties and interests after the Effective Time.

4. The rights, to the extent transferable, in and to existing and effective oil, gas, liquids, condensate, casinghead gas and natural gas sales, purchase, exchange, gathering, transportation and processing contracts, operating agreements, balancing agreements, joint venture agreements, partnership agreements, farmout agreements and other contracts, agreements and instruments insofar and only insofar as they relate to any of Assignor's properties and interests described in Paragraphs 1, 2 and 3, excluding, however, any bonds or insurance contracts.

5. All of the personal property, fixtures, improvements, permits, licenses, approvals, servitudes, rights-of-way and easements, including, without limitation, the rights-of-way and easements set forth on Exhibit A, if any, surface leases and other surface rights (including, but not limited to, any wells, tanks, boilers, buildings, injection facilities, saltwater disposal facilities, compression facilities, gathering systems, other appurtenances and facilities), if any, located on and used exclusively in connection with or otherwise related to the exploration for or production, gathering, treatment, processing, storing, sale, treatment, processing or disposal of Hydrocarbons or water produced from the properties and interests described in Paragraphs 1 through 4 to the extent that they are located on and used in the operation of such properties and interests as of the Effective Time, and all contract rights (including rights under leases to third parties) related thereto, but excluding all vehicles, tools, administrative computer equipment and other personal property of Assignor not intended by Assignor to be included in the Assets.

Sale No. 235C
Lot No. 56

#1452902 v1 den

6. The files, records, data and information relating to the items described in Paragraphs 1 through 5, maintained by Assignor ("Records"), but excluding the following: (i) all of Assignor's internal appraisals and interpretive data related to the Fee Interests, Leases, Lands and Wells, (ii) all information and data under contractual restrictions on assignment, (iii) all geological and seismic data, (iv) all privileged information and intellectual property, (v) Assignor's corporate, financial, employee and general tax records that do not relate exclusively to the Assets, and (vi) all accounting files that do not relate exclusively to the Assets.

TO HAVE AND TO HOLD the Assets unto Assignee and its successors and assigns forever.

This Assignment is made and accepted expressly subject to the following terms and conditions:

A. THIS ASSIGNMENT IS MADE WITHOUT WARRANTY OF TITLE AND WITHOUT WARRANTY OF ANY OTHER KIND, EITHER EXPRESS, IMPLIED OR STATUTORY. ASSIGNEE ACKNOWLEDGES AND AFFIRMS THAT THE ASSETS HAVE BEEN UTILIZED FOR THE PURPOSE OF EXPLORATION, PRODUCTION AND DEVELOPMENT OF OIL AND GAS, AND THAT THE ASSETS ARE CONVEYED IN THEIR "AS IS, WHERE IS" CONDITION, WITH ALL EXISTING FAULTS. ASSIGNOR EXPRESSLY DISCLAIMS AND NEGATES ANY WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO THE CONDITION OF ANY PERSONAL PROPERTY, EQUIPMENT, FIXTURES AND ITEMS OF MOVABLE PROPERTY COMPRISING ANY PART OF THE ASSETS, INCLUDING (i) MERCHANTABILITY OR CONDITION, (ii) FITNESS FOR A PARTICULAR PURPOSE, (iii) CONFORMITY TO MODELS OR SAMPLES OF MATERIALS, (iv) ANY RIGHTS OF ASSIGNEE UNDER APPLICABLE STATUTES TO CLAIM DIMINUTION OF CONSIDERATION, AND (v) ANY CLAIM BY ASSIGNEE FOR DAMAGES BECAUSE OF DEFECTS, WHETHER KNOWN OR UNKNOWN, IT BEING EXPRESSLY UNDERSTOOD BY ASSIGNEE THAT SAID PERSONAL PROPERTY, FIXTURES, EQUIPMENT, AND ITEMS ARE BEING CONVEYED TO ASSIGNEE "AS IS," "WHERE IS," WITH ALL FAULTS, AND IN THEIR PRESENT CONDITION AND STATE OF REPAIR.

ASSIGNOR IS EXPERIENCED AND KNOWLEDGEABLE IN THE OIL AND GAS BUSINESS AND IS AWARE OF ITS RISKS. IN ENTERING INTO THIS ASSIGNMENT, ASSIGNEE ACKNOWLEDGES THAT IT HAS RELIED SOLELY ON ITS INDEPENDENT ANALYSIS, EVALUATION AND INVESTIGATION OF AND JUDGMENT WITH RESPECT TO THE BUSINESS, ECONOMIC, LEGAL, TAX AND/OR OTHER CONSEQUENCES OF THIS ASSIGNMENT, INCLUDING ITS OWN ESTIMATE AND APPRAISAL OF THE EXTENT AND VALUE OF THE PETROLEUM, NATURAL GAS AND OTHER RESERVES OF THE ASSETS. ASSIGNEE ACKNOWLEDGES THAT IT HAS REVIEWED THE MATERIALS MADE AVAILABLE BY ASSIGNOR IN CONNECTION WITH THE TRANSACTION CONTEMPLATED BY THIS ASSIGNMENT ("MATERIALS") AND THAT ASSIGNOR MAKES NO REPRESENTATION OR WARRANTY WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE MATERIALS. THE MATERIALS, CONTRACTS AFFECTING THE ASSETS, AND/OR DOCUMENTS AFFECTING THE ASSETS MAY CONTAIN RESTRICTIONS THAT AFFECT THE LEASES AND LANDS, AND ASSIGNEE ACCEPTS THE ASSETS SUBJECT TO ANY AND ALL SUCH RESTRICTIONS.

B. Notwithstanding the disclaimer of warranties set forth in Paragraph A above, if within 10 days after the execution by Assignee of this Assignment and the payment by Assignee of the consideration for the Assets, Assignee gives Assignor written notice at the address set forth above that the Assets conveyed by this Assignment are less than the interests described for sale in the Materials, then within 30 days after receipt by Assignor of adequate proof of such claim, Assignor shall the option to either (i) cure the defect giving rise to such interest discrepancy to Assignee's reasonable satisfaction; (ii) refund to Assignee the consideration paid by Assignee to Assignor for the Assets in exchange for a mutually acceptable, recordable reassignment of the Assets, effective as of the Effective Time, and containing a warranty of title by Assignee against claims arising by, through or under Assignee, but not otherwise; or (iii) refund to Assignee a proportionate part of the consideration paid by Assignee to Assignor for the Assets, as mutually agreed between Assignor and Assignee.

C. To the extent permitted by law, Assignee shall be subrogated to Assignor's rights in and to representations, warranties and covenants given by others with respect to the Assets. Assignor hereby grants and transfers to Assignee, its successors and assigns, to the extent so transferable and permitted by law, the benefit of and the right to enforce such covenants, representations and warranties, if any, which Assignor is entitled to enforce with respect to the Assets, but only to the extent not enforced by Assignor.

D. Assignee accepts the Assets subject to and assumes and agrees to pay, perform, fulfill and discharge all claims, costs, expenses, liabilities and obligations accruing or relating to (i) gas imbalances; (ii) any change in condition or diminution in the value of the Assets or casualty loss, including, but not limited to the period between the execution of this Assignment by Assignor and the Effective Time, and (iii) all environmental matters and obligations, including but not limited to (a) the violation of, or compliance with past, present or future laws (including common law), rules, regulations and orders, (b) remediation and restoration of the Assets, including, without limitation, plugging and abandonment of the Wells and reclamation of the Well sites, (c) normally occurring radioactive materials, (d) man-made material fibers, (e) laws relating to public or employee health and safety; and (f) damage or injury to persons or property on account of chemicals or industrial, toxic or hazardous substances, in any way associated with or related to the Assets, for all periods before, on and after the Effective Time, including, without limitation including but not limited to, all obligations arising under all agreements covering or relating to the Assets. Assignee agrees to defend, indemnify, save and hold harmless Assignor and its affiliates, officers, directors, shareholders, representatives, employees, agents, successors and assigns forever from and against all claims, costs, expenses, losses, damages and liabilities incurred by any such indemnified party for any of the matters enumerated in this Paragraph D arising in connection with the Assets, regardless of whether incurred with respect to events occurring before, on or after the Effective Time and regardless whether such liabilities and obligations may have been caused by the active or passive, joint, sole or concurrent negligence of Assignor.

E. In addition to the assumption and indemnification obligations of Assignee set forth in Paragraph D, Assignee accepts the Assets subject to and also assumes and agrees to pay, perform, fulfill and discharge any and all other claims, costs, expenses, liabilities and obligations accruing or relating to the owning, developing, exploring, operating or maintaining of the Assets or the producing, transporting and marketing of Hydrocarbons from the Assets, relating to periods before, on and after the Effective Time, including, without limitation, obligations arising under all agreements covering or relating to the Assets, regardless of whether incurred with respect to events occurring before, on or after the Effective Time and regardless whether such liabilities and obligations may have been caused by the active or passive, joint, sole or concurrent negligence of Assignor. Provided, however, that for a limited period of thirty (30) days following the Effective Time Assignor shall be responsible for the payment of any unpaid normal and recurring joint interest billing expenses associated with the ownership or operation of the Assets prior to the Effective Time *other than and excluding* those expenses relating to the matters enumerated in Paragraph D above. Subject only to Assignor's agreement to pay certain pre-Effective Time expenses pursuant to the immediately preceding sentence, Assignee agrees to defend, indemnify, save and hold harmless Assignor and its affiliates, officers, directors, shareholders, representatives, employees, agents, successors and assigns forever from and against all claims, costs, expenses, losses, damages and liabilities incurred by any such indemnified party for any of the matters set forth in the first sentence of this Paragraph E, arising in connection with the Assets whether arising before, on, or after the Effective Time regardless of whether incurred with respect to events occurring before, on or after the Effective Time and regardless whether such liabilities and obligations may have been caused by the active or passive, joint, sole or concurrent negligence of Assignor.

F. Unless provided otherwise, all recording references in the Exhibits hereto are to the official real property records of the county in which the Assets are located.

G. Separate governmental form assignments of the Assets may be executed on officially approved forms by Assignor to Assignee, in sufficient counterparts to satisfy applicable statutory and regulatory requirements. Those assignments shall be deemed to contain all of the exceptions, warranties, rights, titles, power and privileges set forth herein as fully as though they were set forth in each such assignment. The interests conveyed by such separate assignments are the same as, and not in addition to, the interest in the Assets conveyed herein.

H. This Assignment binds and inures to the benefit of Assignor and Assignee and their respective successors and assigns.

I. This Assignment may be executed in any number of counterparts, each of which shall be deemed to be an original instrument, but all of which together shall constitute but one instrument.

J. Assignee shall be responsible for and shall bear and pay all applicable sales taxes, transfer taxes, and documentary, filing and recording fees required by or associated with the conveyance of the Assets hereby. Following recording, Assignee shall promptly furnish Assignor with a photocopy of this recorded Assignment.

K. For a period of six years after this Assignment, Assignor reserves the right to review the Records at Assignee's offices, during normal business hours and on reasonable notice to Assignee. If Assignees desires to destroy or dispose of the Records before that time, Assignee agrees to give Assignor prior written notice of Assignee's intent to dispose of or destroy the Records and give Assignor the opportunity to either copy the Records or take possession of the Records.

L. The Assets may include funds being held by Assignor in suspense for the benefit of a third party or parties. Assignor shall transfer and pay to Assignee, and Assignee agrees to accept from Assignor and hold for the benefit of Assignor and the party or parties entitled to receive payment therefore, and any and all such monies representing the value or proceeds of production removed or sold from the Assets and then held by Assignor for accounts from which payment has been suspended. Assignee shall be responsible for the proper distribution of such monies to the party or parties entitled to receive payment of same, and shall defend, indemnify and hold Assignor harmless from any claims, costs, expenses, liabilities and obligations resulting therefrom.

EXECUTED on the dates contained in the acknowledgments of this instrument, to be effective for all purposes as of the Effective Time.

ASSIGNOR:

Petro-Canada Resources (USA) Inc.

By: [signature]
Name: Dennis J. Gustafson
Title: Vice President

ACKNOWLEDGMENT

STATE OF COLORADO §
CITY AND §
COUNTY OF DENVER §

The foregoing instrument was acknowledged before me this 24th day of February, 2010, by Dennis J. Gustafson, as Vice President of Petro-Canada Resources (USA) Inc., a Colorado corporation, on behalf of such corporation.

Witness my hand and official seal.

My commission expires:

KATHLEEN R. VIGIL NOTARY PUBLIC STATE OF COLORADO My Commission Expires 9/6/2013

[signature]
Notary Public: Kathleen R. Vigil

#1452903 v1 den

Ent 805291 Bk 0720 Pg 0269

ASSIGNEE:

QUESTAR EXPLORATION & PRODUCTION COMPANY

By:
Name: J.B. Neese, Executive Vice President
Title:

ACKNOWLEDGMENTS

STATE OF Colorado §
§
COUNTY OF Denver §

Before me, the undersigned, a Notary Public in and for said County and State, on this day personally appeared J. B. Neese, as Executive Vice President of Questar Exploration and Production, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he/she executed the same for the purposes and consideration therein expressed and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this 5 day of April, 2010.

My commission expires:

4-29-2012

NICOLE A. RUIZ NOTARY PUBLIC STATE OF COLORADO My Commission Expires April 29, 2012

Notary Public:

#1452902 v1 den

235-156

Ent 805291 Bk 0720 Pg 0270

2D

Lessor Name	Lessee Name	Lease Description	Lease Date	County	Book	Page	Entry
GREG JENSEN, PRESIDENT OF THE OSTERBROEN FAMILY LIMITED PARTNERSHIP	PETRO-CANADA RESOURCES (USA) INC.	TOWNSHIP 14 SOUTH, RANGE 14 EAST, SLB&M SEC. 2: LOTS 1(40.03-NENE), 2(39.97-NWNE), 3(39.91-NENW), 4(39.85-NWNW), S/2N/2, S/2 (ALL) SEC. 3: LOTS 1(39.84-NENE), 2(39.89-NWNE), 3(39.93-NENW), 4(39.98-NWNW), S/2N/2, SE/4	6/1/2006	CARBON	629	692	119670
GARY PESTORIOUS AND DAWN PESTORIOUS, HUSBAND AND WIFE	PETRO-CANADA RESOURCES (USA) INC.	TOWNSHIP 14 SOUTH, RANGE 14 EAST, SLB&M SEC. 2: LOTS 1(40.03-NENE), 2(39.97-NWNE), 3(39.91-NENW), 4(39.85-NWNW), S/2N/2, S/2 (ALL) SEC. 3: LOTS 1(39.84-NENE), 2(39.89-NWNE), 3(39.93-NENW), 4(39.98-NWNW), S/2N/2, SE/4	6/1/2006	CARBON	629	698	119672
STEVEN A. LADLIE AND PENNIE S. LADLIE, HUSBAND AND WIFE	PETRO-CANADA RESOURCES (USA) INC.	TOWNSHIP 14 SOUTH, RANGE 14 EAST, SLB&M SEC. 2: LOTS 1(40.03-NENE), 2(39.97-NWNE), 3(39.91-NENW), 4(39.85-NWNW), S/2N/2, S/2 (ALL) SEC. 3: LOTS 1(39.84-NENE), 2(39.89-NWNE), 3(39.93-NENW), 4(39.98-NWNW), S/2N/2, SE/4	6/2/2006	CARBON	629	695	119671
JEFFREY G. DRESS AND WILLIAM G. DRESS, INDIVIDUALLY, AND AS PARTNERS OF DRESS INVESTMENTS	PETRO-CANADA RESOURCES (USA) INC.	TOWNSHIP 14 SOUTH, RANGE 14 EAST, SLB&M SEC. 2: LOTS 1(40.03-NENE), 2(39.97-NWNE), 3(39.91-NENW), 4(39.85-NWNW), S/2N/2, S/2 (ALL) SEC. 3: LOTS 1(39.84-NENE), 2(39.89-NWNE), 3(39.93-NENW), 4(39.98-NWNW), S/2N/2, SE/4	6/5/2006	CARBON	633	192-194	120400
MEANY LAND & EXPLORATION, INC., A COLORADO CORP.	PETRO-CANADA RESOURCES (USA) INC.	TOWNSHIP 14 SOUTH, RANGE 14 EAST, SLB&M SEC. 3: SW/4 SEC. 10: N/2, SE/4	5/8/2006	CARBON	629	686	119668
UTU-84624	LAND GROUP	T13S-R14E Sec. 22: ALL Sec. 23: N/2, SW/4, NW/4SE/4 Sec. 26: W/2 Sec. 27: SE/4	7/1/2006	CARBON	630	763	119909
UTU-84625	LAND GROUP	T13S-R14E SEC. 31: LOTS 2-4, S/2NE/4, SE/4NW/4, E/2SW/4, SE/4 SEC. 33: S/2NE/4NE/4, S/2N/2, N/2S/2, SW/4SW/4	7/1/2006	CARBON	630	769	119911

Ent 805291 Bk 0720 Pg 0272

Ent 815998 Bk 775 Pg 672
Date: 13-AUG-2012 12:01:29PM
Fee: $12.00 Check
Filed By: VB
VIKKI BARNETT, Recorder
CARBON COUNTY CORPORATION
For: MEANY LAND & EXPLORATION INC

MINERAL DEED

KNOW ALL MEN BY THESE PRESENTS THAT Meany Land & Exploration, Inc., of 410 17th Street Suite 1300 Denver, Colorado 80202 hereinafter called Grantor, (whether one or more) for and in consideration of the sum of TEN AND MORE dollars ($10.00+) cash in hand paid and other good and valuable considerations, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell, convey, transfer, assign and deliver unto **Meany Family LLC**, of 4719 E. Pinewood Cr. Centennial, Colorado 80121 hereinafter called Grantee, all of the interests owned by said Meany Land & Exploration, Inc., as set forth below, in and to all of the oil, gas and other minerals in and under and that may be produced from the following described lands situated in Carbon County, State of Utah, to-wit:
Township 14 South, Range 14 East, SLM
Section 2: All
Section 3: N/2, SE/4
Township 14 South, Range 14 East, SLM
Section 3: SW/4 (Sunnyside #7 Placer Mining Claim)
Section 10: N/2, SE/4 (Sunnyside 4,5,6, Placer Mining Claims)

Containing 1,760.00 acres, more or less, together with the right of ingress and egress at all times for the purpose of mining, drilling, exploring, operating and developing said lands for oil, gas, and other minerals, and storing, handling, transporting and marketing the same therefrom with the right to remove from said land all of Grantee's property and improvements.

This sale is made subject to any rights now existing to any lessee or assigns under any valid and subsisting oil and gas lease of record heretofore executed; it being understood and agreed that said Grantee shall have, receive, and enjoy the herein granted interests in and to all bonuses, rents, royalties and other benefits which may accrue under the terms of said lease insofar as it covers the above described land from and after the date hereof, precisely as if the Grantee herein had been at the date of the making of said lease the owner of similar interests in and to the lands described and Grantee one of the lessors therein.

Grantor agrees to execute such further assurances as may be requisite for the full and complete enjoyment of the rights herein granted and likewise agrees that Grantee herein shall have the right at any time to redeem for said Grantor by payment, any mortgage, taxes, or other liens on the above described land, upon default in payment by Grantor, and be subrogated to the rights of the holder thereof.

TO HAVE AND TO HOLD, The above described property and easement with all and singular the rights, privileges, and appurtenances thereunto or in any wise belonging to the said Grantee herein its heirs, successors, personal representatives, administrators, executors, and assigns forever, and Grantor does hereby warrant said title to Grantee its heirs, executors, administrators, personal representatives, successors and assigns forever and does hereby agree to defend all and singular the said property unto the said Grantee herein its heirs, successors, executors, personal representatives, and assigns against every person whomsoever claiming or to claim the same on any part thereof.

WITNESS my hand this 9th day of August, 2012.

Meany Land & Exploration, Inc.

BY: [signature]
E. Michael Meany, President

State of Colorado }
} ss.
County of Denver }

The foregoing instrument was acknowledged before me this 9th day of August, 2012, by E. Michael Meany, president of Meany Land n & Exploration, Inc

My commission expires:
03/05/14

[signature]
Notary Public

1400 Broadway Denver CO 80202
Address of Notary Public

ALLISON HERRERA
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 03/05/14

APPENDIX B

HYDROLOGY OF NORTH SPRING AND BRUIN POINT

URS

HYDROLOGY OF NORTH SPRING AND BRUIN POINT

BRUIN POINT MINE

For

American Sands Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

September 18, 2014

Hydrology of North Spring And Bruin Point Utah

Prepared for:

American Sands Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

Prepared by:

URS Corporation
756 East Winchester, Suite 400
Salt Lake City, UT 84107

LICENSED PROFESSIONAL GEOLOGIST
9/18/14
HYRUM L. CANNON
5397600-2250
STATE OF UTAH

H. Lawrence Cannon, P.G.
Project Geologist

Stephen H. Snelgrove
Senior Hydrogeologist
Vice President

TABLE OF CONTENTS

ACRONYMS

ASEC	American Sands Energy Corporation
BGS	Below Ground Surface
GPM	Gallons Per Minute
GRF	Green River Formation
GRR	Green River Resources Inc.
JBR	JBR Environmental Consultants, Inc.
NOAA	National Oceanic and Atmospheric Administration
USDA	U.S. Department of Agriculture
URS	URS Corporation
USGS	United States Geological Survey

1.0 INTRODUCTION

Green River Resources Inc. (GRR) proposes to mine and process oil sand resources located on private property approximately 6 miles northeast of Sunnyside, Utah, and approximately 100 miles southeast of Salt Lake City, Utah as illustrated in Figure 1. The proposed facilities include a subsurface mine to extract oil sand materials from deposits approximately 800-900 feet below the ground surface (bgs); a processing plant on the surface to extract bitumen from the oil sands; a surface impoundment to store dry materials derived from the processing plant; and associated haul roads used to move materials between the mine, processing plant, and the dry material surface impoundment.

2.0 HYDROGEOLOGY

The project area is in the Roan Cliffs and comprises 1,760 acres of private parcels located in Township 14 South, Range 14 East, Sections 2, 3, and 10, Salt Lake Meridian (Figure 1). The area is in mountainous terrain; elevations range from approximately 8,000 feet to over 10,150 feet at Bruin Point, near the northwest corner of the project area.

Much of the project area is within the Range Creek drainage (Figure 1). Although numerous studies conducted by Amoco, JBR and others indicate that Range Creek is generally dry in the vicinity of the project, North Spring, located near the northern boundary of project area and approximately 500 feet southeast of the proposed dry materials surface impoundment, discharges into the Range Creek drainage, indicating the presence of groundwater (JBR, 2014; Calkin, 1990A). Several factors affect the occurrence and movement of groundwater near the project, primarily the climate and topography of the project location, which controls the fraction of annual precipitation that infiltrates into the subsurface and when the infiltration occurs; the subsurface stratigraphy, which inhibits the percolation of shallow groundwater into deeper units; and the structural geology, which provides mechanisms for shallow groundwater storage, movement, and the direction of flow. Each of these factors is discussed below, followed n a conceptual model of the groundwater in the project area that describes how these factors interact.

2.1 Climate and Topography

Few climate data are readily available that are directly applicable to the project area. The nearest relevant information is from the National Oceanic and Atmospheric Administration (NOAA) Bruin Point Station (SHEF ID: BRPU1), approximately 1.5 miles southeast of the project area, at an elevation of 9,341 feet (NOAA, 2014). (Climate data available for Sunnyside, UT, at an elevation of 6,414 feet, are not applicable to the project site because the difference in elevation results in a difference in precipitation and snowpack.) Data for the NOAA BRPU1 station were downloaded for the dates of October 2007 – August 2014. Table 1 lists the monthly and cumulative precipitation, beginning in October 2007; Figure 2 shows time series plots of the data, including temperature data. Assuming that the past seven years of data are representative of the typical behavior and variability of climate in the project area, the average annual precipitation is 10.12 inches.

Snowmelt is an important mechanism for in-place groundwater recharge in mountainous terrain because the evapotranspiration potential is considerably smaller than the amount of water available for infiltration into the subsurface during the period when the snowpack melts, and during which subsurface moisture conditions are conducive to recharge (Wilson and Guan, 2004; Flint et al., 2008). The snowpack is in direct contact with the ground surface and provides a near-continuous source of water during the snowmelt season. Conditions for infiltration in the project area are further enhanced because the eastern portion of the project area is on a slope with a northeastern aspect, between the ridge crest to the west and Range Creek to the east, and thus protected from direct insolation during much of the snowmelt period, thereby prolonging the snowmelt period in comparison with slopes with a southern aspect (see Figure 1). The northeastern aspect of the project area would allow snowpack to melt slowly over a prolonged period, allowing a significant amount of snowmelt water to infiltrate into the subsurface and recharge the shallow groundwater system.

The majority of the precipitation occurring during the late spring, summer, and early fall is consumed by evapotranspiration and provides only an insignificant contribution to recharge.

2.2 Subsurface Stratigraphy

Soil cover in the project area is thin, ranging from zero to a few feet (<4 feet) thick (see Attachment A, Photographs 1, 2, and 4). Infiltration of surface water is therefore controlled to a large extent by the fractured bedrock stratigraphy. Surface outcrops are primarily of the Parachute Creek Member of the Eocene-age (56 to 34 million years before present) Green River Formation (GRF).

Lithologic logs from a series of exploratory wells in the project area drilled by Amoco in the 1980s (see Attachment B) indicate that the upper (approximately) 100 feet of the subsurface consists primarily of shale, with occasional thin (<1 feet) oil shale, tar sand, siltstone, and sandstone layers (see, for example, Amoco No. 14, located in the area of the planned dry materials storage area and approximately 2,000 feet west of North Spring). Below 100 feet bgs, in the Garden Gulch and Douglas Creek Members of the GRF, the lithology continues to be dominated by shale layers, often massive, with occasional thin limestone, siltstone, and sandstone layers. In addition, numerous thick (>10 feet and up to 100 feet) tar sand layers with high bitumen content occur beginning at approximately 400 feet bgs and ending approximately 900 feet bgs.

The major lithologies (shale, tar sand) present in the subsurface tend to have low permeability, which would impede vertical infiltration. Except in the upper (approximately) 100 feet of the subsurface, where relief fractures provide voids for both groundwater storage and flow (discussed below), there is little opportunity for groundwater recharge via vertical infiltration.

The higher bitumen content of the tar sands and oil shales beneath the Parachute Creek Member within the western segment of the Mount Bartles-Bruin Point flexure (discussed below) form significant aquicludes beneath the proposed dry material impoundment and processing plant. The steeper dips of the western segment of the flexure would also promote shallow groundwater movement down dip toward North Spring and Range Creek, and would preclude downward movement of shallow groundwater associated with the Parachute Creek Member from moving downward into the hydrogeologic units of the Garden Gulch and Douglas Creek Members.

2.3 Structural Factors

Two aspects of the structural geology in the project area influence groundwater storage and flow: near-surface relief fractures and a subsurface structural flexure.

Relief fractures occur when compressional stress on underlying rocks is removed by the erosion of overlying rock layers (Wyrick and Borchers, 1981). The relief of stress on exposed material on valley/canyon walls and floors results in predictable pattern of shallow, interconnected vertical and horizontal fractures. Secondary permeability provided by the fractures is often more significant than primary permeability through intergranular pore spaces (Wyrick and Borchers, 1981); this is the case in the project area given that the subsurface lithology is dominated by shale and tar sand. Fractures also provide groundwater storage capacity (Wilson and Guan, 2004). Thus the relief fractures provide the means for vertical infiltration of snowmelt into the subsurface, storage capacity for the infiltrated water, and conduits for groundwater flow.

The Mount Bartles-Bruin Point flexure, a large north-west segmented monoclinal dip slope (Calkin, 1990A), has been mapped in the project area and is shown on Figure 3 and is also depicted on Figure 4. The southern part of the flexure zone follows the pronounced topographic lineament of the upper portion of Range Creek. The flexure has divided the project area into three segments as shown on Figure 3. Each segment is characterized by different dips and bitumen content. The eastern segment is characterized by shallow 3-5° northeast dips and sandstones that contain low weight percent of bitumen (0-4%). The central segment is characterized by 4-7° northeast dips and sandstones that contain slightly higher weight percentages of bitumen (4-7%). The western segment exists along the Roan Cliffs and is characterized by steeper 4-12° northeast dips with sandstones that contain high weight percentages of bitumen (4-12%). Thus, this northwest trending flexure has gentle dips of 3-4° NE on the downthrown side and steeper dips of 4-12° NE on the upthrown side (Calkin, 1990A). As discussed below, the transition from comparatively steeper dips west of Range Creek to gentler dips at the flexure enhances discharge from the shallow groundwater system to North Spring. The elevated bitumen content to the west inhibits vertical movement of groundwater.

2.4 Groundwater

The three factors discussed above – climate/topography, stratigraphy, and structure – are the key elements of a conceptual model of the groundwater system that supplies water to North Spring. Recharge to the system occurs at the higher elevations of the upper Range Creek drainage northwest of the spring (Figure 1, Figure 4, and Appendix A, Photograph 6). Recharge is derived primarily from snowmelt that infiltrates and is stored in near-surface (<100 feet below ground surface) fractures in geologic units above oil shale and tar sand beds. Water percolates downward through the preferential pathways provided by the fractures until encountering a competent and low permeability oil shale or tar sand bed (e.g., the R-2 oil shale). As the volume of water in storage increases, hydraulic head is also increasing, driving flow down-dip toward Range Creek, where groundwater discharges from North Spring and other smaller seeps within the Range Creek channel near North Spring (JBR, 2014). The volume of water in storage, hydraulic head, and discharge from springs are interrelated and seasonal. In the springtime, when storage and head are high, flow from the spring is at a maximum; storage and flow steadily decline during summer and fall, and reach a minimum in winter; the cycle starts again with the accumulation and eventual melting of new snowpack.

Groundwater moving from the western segment into the central segment of the flexure would be impeded when it encounters the shallower dip of the central segment of the flexure (as noted above, the hinge line of the flexure, where the change in dip occurs, is coincident with Range Creek). This enhances discharge from springs and seeps because groundwater would follow the preferential flow path of the shallow, near-surface fractures and discharge to the surface as springs and seeps (North Spring) near the boundary of the western and central segments of the flexure (Range Creek).

Groundwater flow in upper Range Creek basin is confined to the Parachute Creek Member of the Green River Formation just above the R-2 and R-5 oil-shale intervals (Calkin, 1990A). The R-2 and R-5 oil-shale units serve as aquicludes impeding vertical movement of groundwater. Sedimentary rocks (calcareous shale/sandstone) of the Parachute Creek Member above the R-2 and R-5 oil-shale units are generally more permeable (largely due to secondary porosity of factures), and the groundwater preferentially passes through and is stored in these more permeable near-surface beds. In general, bitumen contained within the underlying oil shale and tar sand beds of the Garden Gulch and Douglas Creek Members inhibits downward movement of groundwater to lower units by semi-sealing fractures/joints. Amoco did not report encountering groundwater below the Parachute Creek Member in any of the exploratory borings drilled in the 1980s (UGS, 2010). In the Sunnyside Tar Sands area, North Spring and South Spring/Tributary Spring are located just above the R-2 oil shale interval and the Stone Cabin Spring is located just above the R-5 oil shale unit (Calkin, 1990A).

Observed flow from North Spring ranges from approximately 40 gallons per minute (gpm) in the springtime to 3 gpm or less in the fall (Calkin, 1990A and JBR, 2014). During the August 2014 geotechnical investigation of the dry material impoundment area, flow from North Spring was measured at 1.8 gpm. A water quality sample collected in May 2012 from the discharge from North Spring indicated the water quality is high (JBR, 2014) with low concentration of total dissolved solids (176 mg/L).

Note that the shallow groundwater system and North Spring are considerably higher (>500 feet) in elevation and east of the region where the T-38 member will be mined to obtain tar sand for bitumen extraction (Figure 4).

Amoco reported artesian groundwater within the parachute Creek Member at boring locations A-14 and A-17. During drilling activities at boring A-14, artesian groundwater was encountered at 65 feet bgs within the Parachute Creek Member. In A-17 artesian groundwater was encountered at 70 feet bgs, also within the Parachute Creek Member. Flow at A-14 was reported at approximately 300 gallons per minute (gpm) and at boring A-17 at 50 gpm. These boring are located topographically up dip from North Spring and within the recharge area of the shallow groundwater system. Boring logs can be found in Appendix B for borings A-14 and A-17.

ASEC encountered groundwater in a recent boring at 400 to 420 feet bgs within the Garden Gulch Member. This is anomalous with respect to the 50+ exploratory borings drilled by Amoco, including at least three in the immediate vicinity of the ASEC boring. None of logs for the Amoco borings reported groundwater at depths below the shallow aquifer in the Parachute Creek Member. Flow at the ASEC boring was reported at 2 gpm. Based on available documents, it is unclear whether this water is derived from higher in the boring within the Parachute Creek Member and trickles down the bore hole, or whether it is formation water within the Garden Gulch Member. If the water encountered were formation water, it would have to traverse numerous tar sand aquicludes before reaching the proposed mine workings.

surface location of the boring, the water may find preferential pathways northwest toward through stress relief fractures and discharge on the face of the Roan Cliffs. Three cliff face seeps were observed in the upper reaches of Water Canyon near Bruin Point (JBR, 2014). These seeps discharge through stress relief factures with groundwater sourced near the topographic high point of Bruin Point (approximately 1 mile northwest of the boring). No spring or seeps were observed during the July 29, 2014 site inspections of the mine portal area within the head waters of Bear Canyon. The head water of Bear Canyon is located within the Roan Cliff directly west of the ASEC boring.

North Spring originates from groundwater discharging from fractures sets located approximately 10 feet above Range Creek channel from the southwest side of the canyon (Appendix A, Photograph 3). Fractured bedrock was observed approximately 10-50 feet northwest of North Spring with a fracture orientation of 95° southeast and near vertical dip of 85-90° to the northeast (Appendix A, Photograph 4). Bedrock exposed at the surface in Range Creek, located approximately 200-300 feet north of North Spring, exhibits conjugate joint sets (Appendix A, Photograph 5). The orientation of these conjugate joints are 95° and 138° to the south east and near vertical dip of 85-90° to the northeast. The orientation of the calcareous shale/sandstone beds near North Spring strike approximately 290° and dip approximately 9° to the northeast.

3.0 CONCLUSIONS

The source area of North Spring is the upper Range Creek drainage basin northwest of the spring (see Appendix A, Photograph 6). Recharge to the shallow aquifer feeding North Spring occurs when water derived from snowmelt, soaks through the thin site soils and fractured bedrock covering the topographically-elevated drainage. Water percolates down-dip through preferential pathways in the fractured calcareous sandstone and shale beds of the Parachute Creek Member until an oil shale confining bed is reached (R-2 oil shale). Infiltrated water is stored in fractures. As storage from infiltration increases hydraulic head also increases, driving flow down-dip toward Range Creek, where subtle changes in dip angle associated with a structural flexure causes groundwater to discharge from North Spring near Range Creek. Fractured calcareous sandstone and shales bed allow groundwater to move down slope in a stair step pattern.

High bitumen-content layers within the western segment of the flexure (underlying oil shale and tar sand beds of the Garden Gulch and Douglas Creek Members) inhibit downward movement of groundwater from the shallow groundwater system to lower units by semi-sealing fractures/joints. Amoco did not report encountering groundwater below the Parachute Creek Member in any of the exploratory borings drilled in the 1980s.

4.0 REFERENCES

Calkin, WM. S. 1990A. Geologic Summary Report of the 1989 Exploration Program Sunnyside Tar Sands Project Carbon County Utah. *For* Amoco Corporation, Solid Resources.

Calkin, WM. S. 1990B. Regional Map Sunnyside Tar Sands, Carbon County, Utah. *For* Amoco Corporation, Solid Resources.

Flint, A.L., L.E. Flint, and M.D. Dettinger. 2008. Modeling soil moisture processes and recharge under a melting snowpack. Vadose Zone Journal, 7:350-357.

JBR. 2014. American Sands Energy Corporation Proposed Bruin Point Mine, Seep and Spring Inventory.

NOAA, 2014. National Oceanic and Atmospheric Administration. National Operational Hydrologic Remote Sensing Center Interactive Snow Information. Station SHEF ID: BRPU1. <http://www.nohrsc.noaa.gov/interactive/html/graph.html?station=BRPU1>.

UGS. 2010. Utah Geological Survey Open-File Report 566. 2010

Weiss, M.P., Witkind, C.J., and Cashion, W.K. 1981. Geologic Map of Price Quadrangle, Carbon, Duchesne, Uinta, Utah, and Wasatch Counties, Utah, USGS 1-1981.

Wilson, J.L., and H. Guan. 2004. Mountain-block hydrology and mountain-front recharge. p. 113–137. In J.F. Hogan, F.M. Phillips, and B.R. Scanlon (ed.) Groundwater recharge in a desert environment: The southwestern United States. Water Science and Applications Ser. Vol. 9. American Geophysical Union, Washington, DC.

Wyrick, G.G., and J.W. Borchers. 1981. Hydrologic effects of stress-relief fracturing in an Appalachian Valley. US Geological Survey Water-Supply Paper 2177, US Government Printing Office.

TABLES

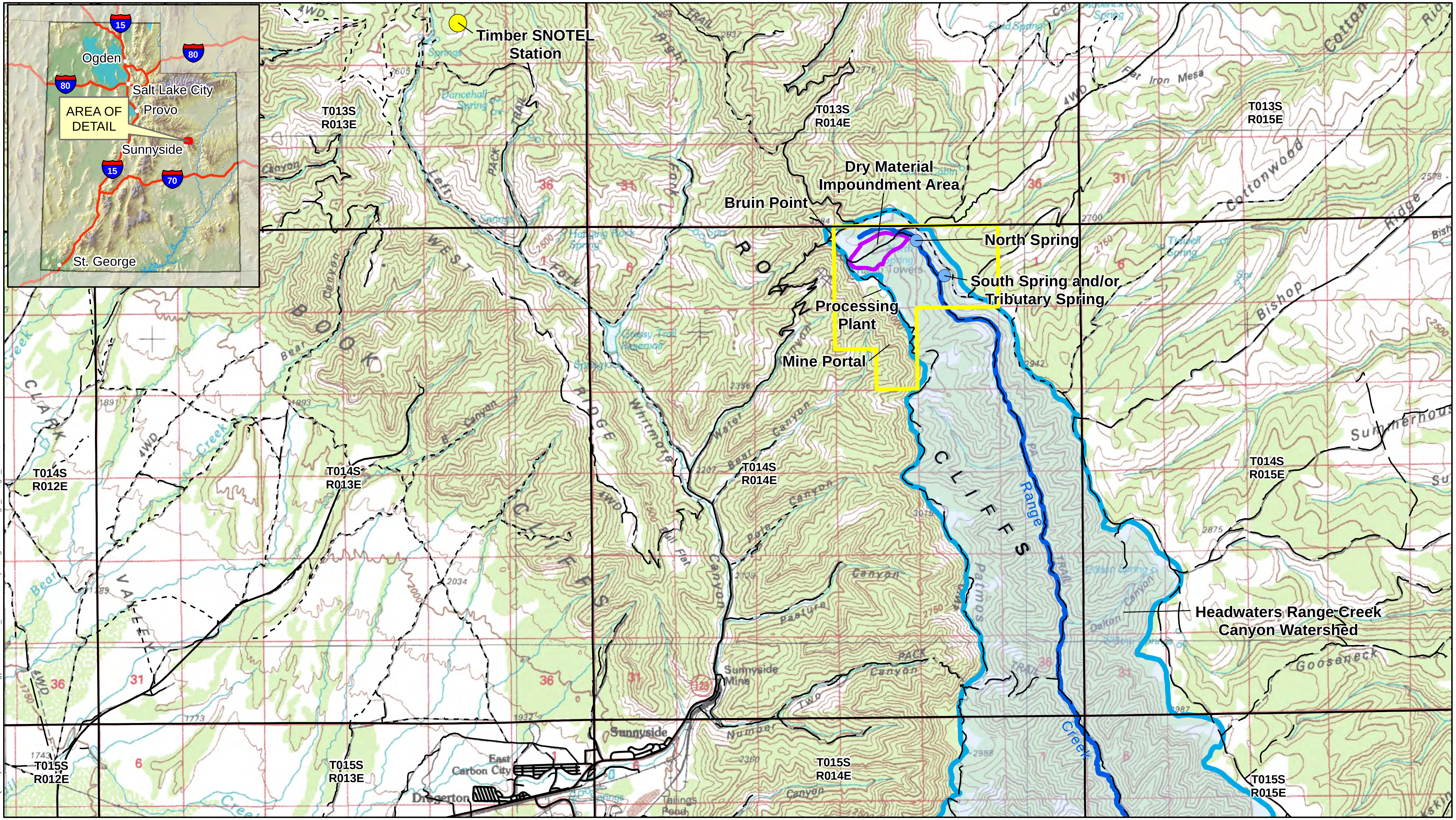
Table 1
NOAA Station BRPU1 Bruin Point Precipitation Data

	Monthly Precipitation (in)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2008	0.2	0.01	0.05	0.01	0.2	0.11	0.16	0.76	0.18	0	0.22	1.19
2009	1.48	0.17	0.07	0.1	0.29	0.11	0.21	2.26	2.1	0.86	0.47	0.75
2010	1.06	0.21	0.08	0.21	0.18	0.99	0.63	0.38	0.79	1.23	2.23	0.29
2011	3.96	0.08	0.15	0.65	0.16	0.7	1.53	1.51	1.29	3.32	1.16	1.72
2012	0.79	0.31	0.26	0.14	0.53	0.53	1.32	0.04	0	1.98	0.34	1.76
2013	0.57	0.38	0.27	0.8	0.88	0.75	2.09	1.34	0.15	1.48	0	0.53
2014	1.44	1.13	0.46	0.08	0.53	0.97	1.31	1.3	0.25	1.59	3.76	

	Cumulative Precipitation (in)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2008	0.20	0.21	0.26	0.27	0.47	0.58	0.74	1.50	1.68	1.68	1.90	3.09
2009	1.48	1.65	1.72	1.82	2.11	2.22	2.43	4.69	6.79	7.65	8.12	8.87
2010	1.06	1.27	1.35	1.56	1.74	2.73	3.36	3.74	4.53	5.76	7.99	8.28
2011	3.96	4.04	4.19	4.84	5.00	5.70	7.23	8.74	10.03	13.35	14.51	16.23
2012	0.79	1.10	1.36	1.50	2.03	2.56	3.88	3.92	3.92	5.90	6.24	8.00
2013	0.57	0.95	1.22	2.02	2.90	3.65	5.74	7.08	7.23	8.71	8.71	9.24
2014	1.44	2.57	3.03	3.11	3.64	4.61	5.92	7.22	7.47	9.06	12.82	

	Average Temperature (°F)											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2008	37.5	31.5	14.8	13.2	20.5	25.0	31.6	39.9	53.9	63.2	59.8	50.5
2009	39.8	31.5	18.0	23.7	22.5	27.7	32.8	45.6	49.2	62.3	59.0	52.0
2010	33.1	30.5	14.4	21.6	18.9	26.7	33.5	38.3	54.8	61.1	56.9	54.2
2011	38.7	23.8	23.5	20.2	17.5	27.2	31.3	37.8	52.4	59.0	61.5	51.6
2012	38.4	26.0	21.1	24.1	19.6	33.2	38.2	47.5	60.7	61.4	61.8	53.1
2013	40.0	32.2	18.4	19.8	19.1	30.4	33.2	44.5	60.0	62.1	57.9	48.9
2014	35.1	27.7	19.1	24.6	22.8	28.6	33.6	44.0	54.7	61.9	54.3	

FIGURES



Spring
Access Road
Paved Road
Improved Road
Dirt Road
Road (Conditions Unknown)
Permit Boundary

Dry Material Storage Impoundment
Range Creek Watershed
PLSS Township & Range

Note:
Elevation in meters above mean sea level

N

1 0 1 2 Miles

Title:	Location Map	
American Sands Energy Project	Proj No: 24585638	
	Figure: 1	
American Sands Energy Corp	Date: May 2014	
	URS	

Figure 2
NOAA Station BRPU1 Bruin Point Precipitation Charts

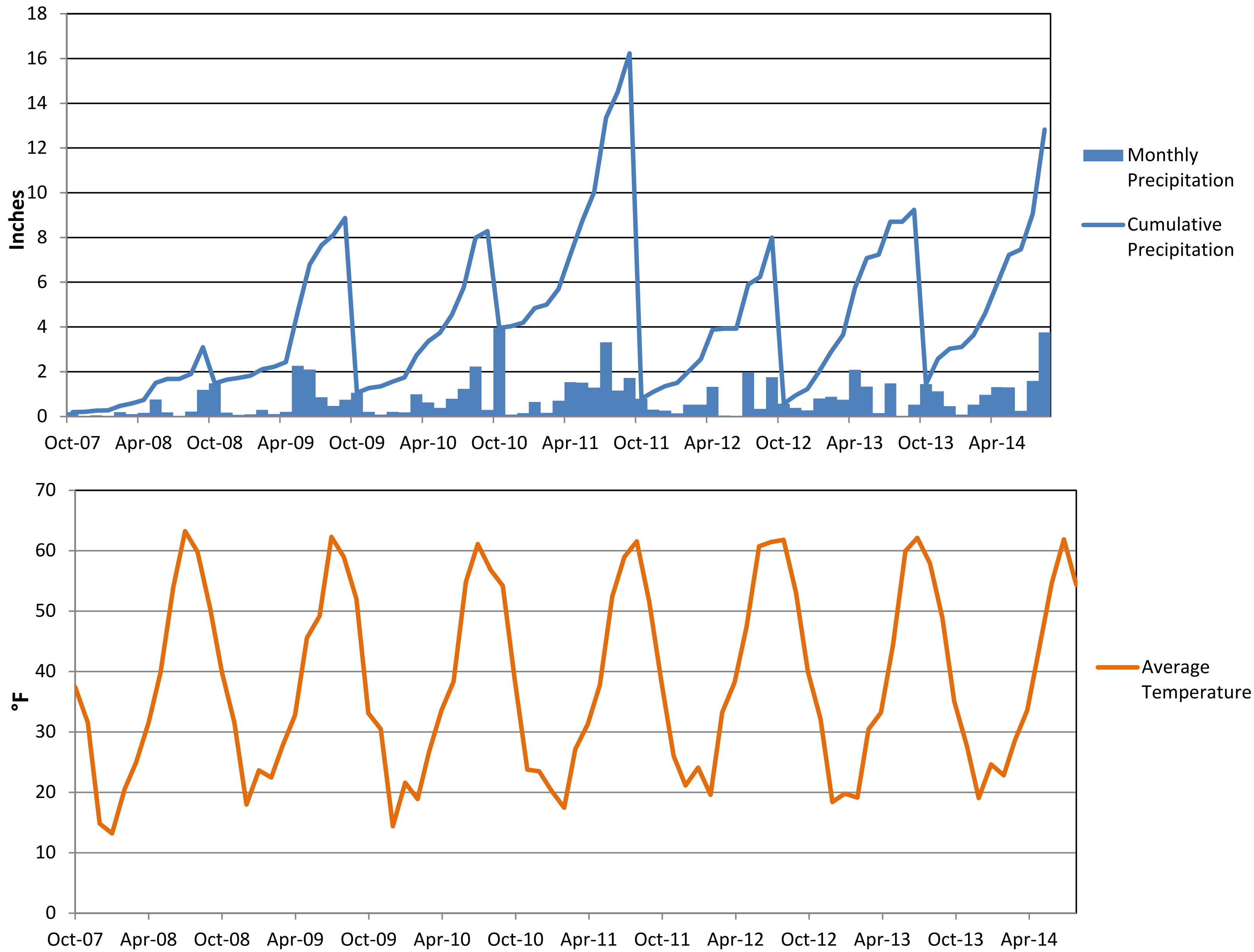
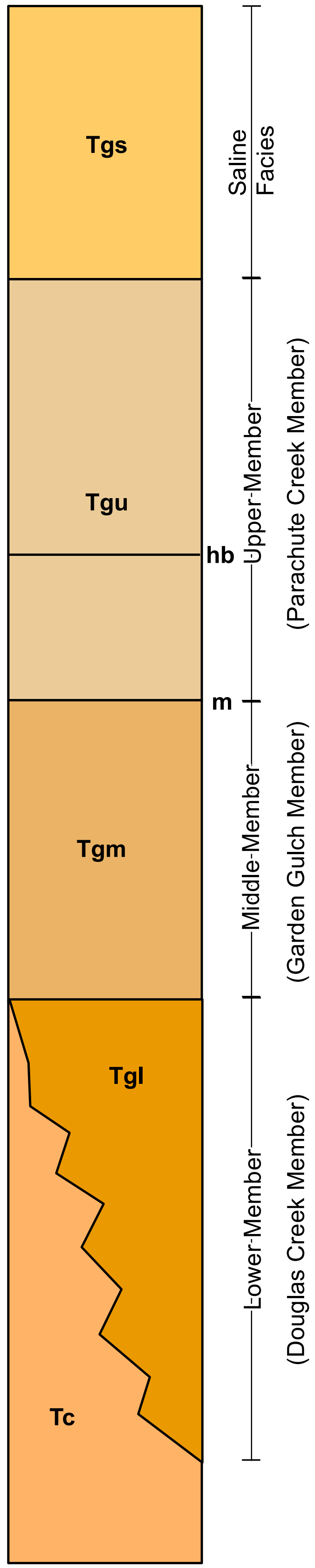


Figure 2: Precipitation, Snow depth, and Temperature data from October 2007 – August 2014, NOAA Bruin Point Station BRPU1

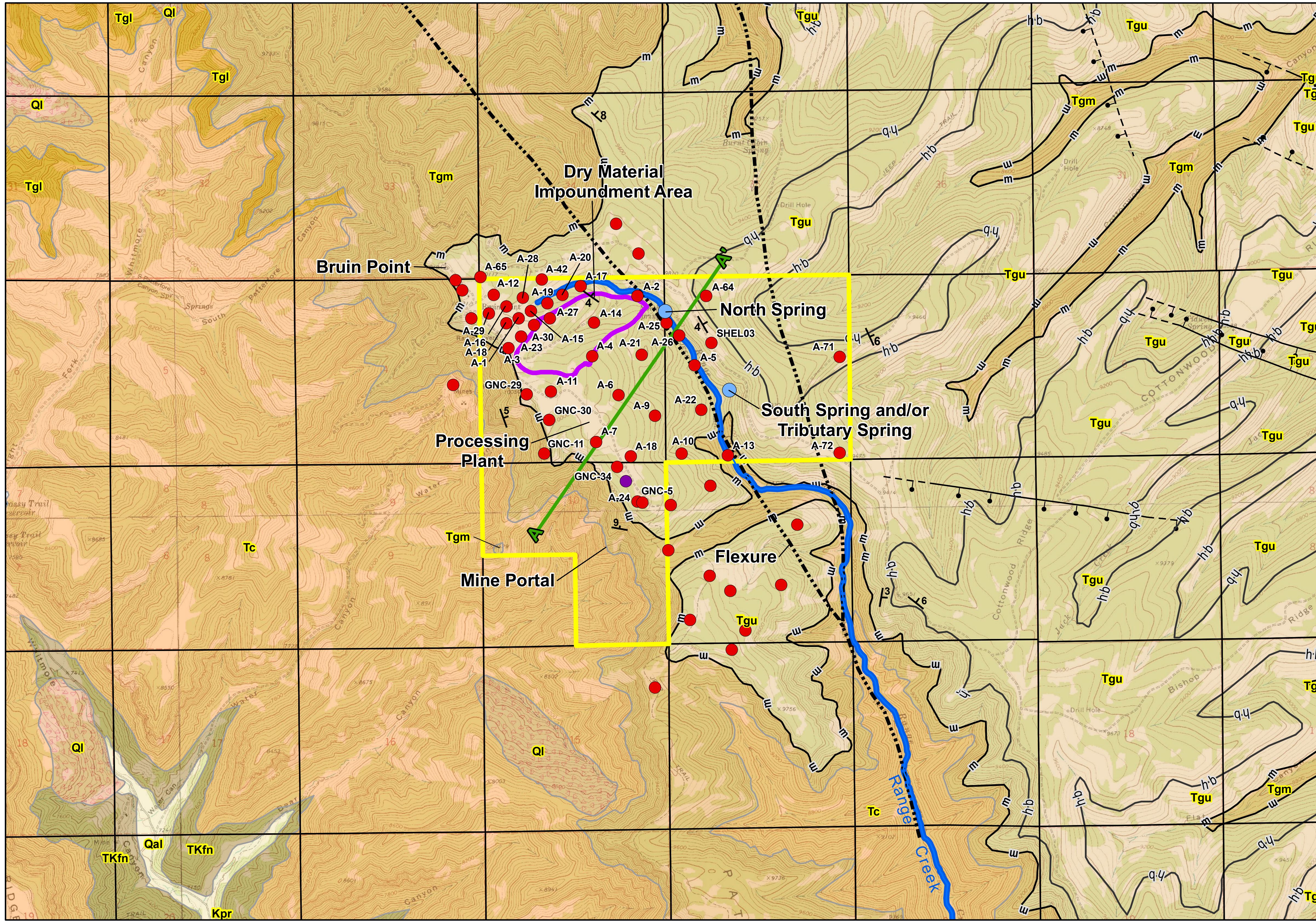
Typical Site Stratigraphic Column



hb Horsebench Sandstone Bed
m Top of Mahogany Bed

Reference: Geologic map and stratigraphic column complied from Regional Map Sunnyside, Tar Sands, Carbon County, Utah, 1990. Calkin, WM. S. and Geologic map of Price 30'x60' quadrangle Carbon, Duchesne, Uinta, Utah, and Wasatch counties, Utah, 1990. Weiss, M. P., Witkind, C. J., and Cashion, W. K., USGS 1-1981

Path: Q:\Projects\American Sands Energy\24585638\09 Data\GIS\Maps\August 2014\Fig2_ASE_Geology.mxd



Geologic Units

Qal	Alluvium
Ql	Landslide deposits
Tgu	Upper member of the Green River Formation
Tgm	Middle member of the Green River Formation
Tgl	Lower member of the Green River Formation
Tc	Colton Formation
TKfn	Flagstaff Limestone and North Horn Formation

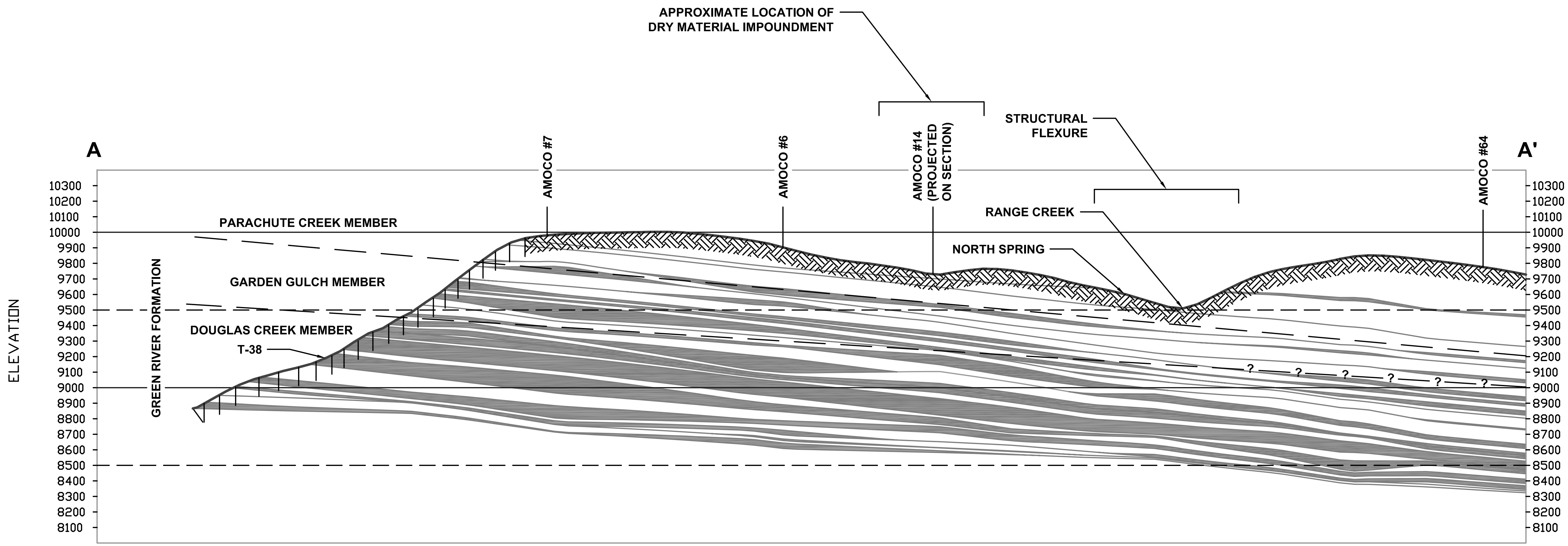
- Spring
- Amaco Boring Location
- Fault — Dashed where approximately located, ball rests on downthrown block
- Contact - Approximately Located or Inferred
- m — Top of Mahogany Bed
- hb — Horsebench Sandstone Bed
- American Sands Boring Location
- Strike and Dip
- Permit Boundary

N

1,500 0 1,500 3,000 Feet

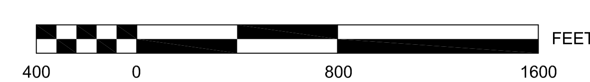
Title:	Geologic Map	
Bruin Point Mine DOGM Permit Application	Proj No: 24585638	
	Figure: 3	
American Sands Energy Corp	Date: May 2014	
	URS	

STRUCTURAL FACTORS AFFECTING GROUND WATER



GENERALIZED CROSS SECTION A-A'

SCALE=1"=800'
2 X VERTICAL EXAGGERATION



LEGEND

TAR SANDS BITUMINOUS ZONE, > 10 GAL/TON

STRESS RELIEF FRACTURES

COORDINATE SYSTEM:

UT83-CF
UTAH STATE PLANES: NAD 83 DATUM, CENTRAL ZONE, US FOOT.

No.	REVISION	DATE	BY	CHKD

American Sands Energy Corp

American Sands Energy Corp.
201 South Main 1800
Salt Lake City, UT 84111

Title: GENERALIZED CROSS SECTION A–A'

Scale:	Date:	Design By:	Drawn By:	Approved By:
1"=800'				

URS
756 East Winchester Street Ste 400
Salt Lake City, Utah 84107
Phone: (801) 904-4000

FIGURE 4

APPENDIX A
PHOTOGRAPH LOG

URS

PHOTOGRAPHIC LOG

	Bruin Point and North Spring Hydrology Bruin Point, Utah	URS Project No. 24585638

Photo No. 1	Date: 07/29/14

Direction Photograph Taken:

Looking down and northwest.

Description:

Bedrock outcropping on access road northeast of proposed processing plant area.

Note the thin surface soil layer on the right and left side of road.

Bedrock contains numerous fractures, likely stress relief fractures.

Photo No. 2	Date: 07/29/14

Direction Photograph Taken:

Looking down and west.

Description:

Bedrock outcropping on access road northeast of proposed processing plant area.

Note the thin surface soil layer on the right and left side of road.

Bedrock contains numerous fractures, likely stress relief fractures.

PHOTOGRAPHIC LOG

	Bruin Point and North Spring Hydrology Bruin Point, Utah	**URS Project No.** 24585638

Photo No. **3**	Date: 07/29/14	
Direction Photograph Taken: Looking down and west.		
Description: North Spring discharging from fractured bedrock.		

Photo No. **4**	Date: 07/29/14	
Direction Photograph Taken: Looking down and west.		
Description: Jointed and fractured bedrock approximately 10-50 feet northwest of North Spring.		

URS

PHOTOGRAPHIC LOG

	Bruin Point and North Spring Hydrology Bruin Point, Utah	URS Project No. 24585638

Photo No. 5 | **Date:** 07/29/14

Direction Photograph Taken:

Looking down and northwest.

Description:

Jointed and fractured bedrock within Range Creek approximately 200-300 feet north of North Spring.

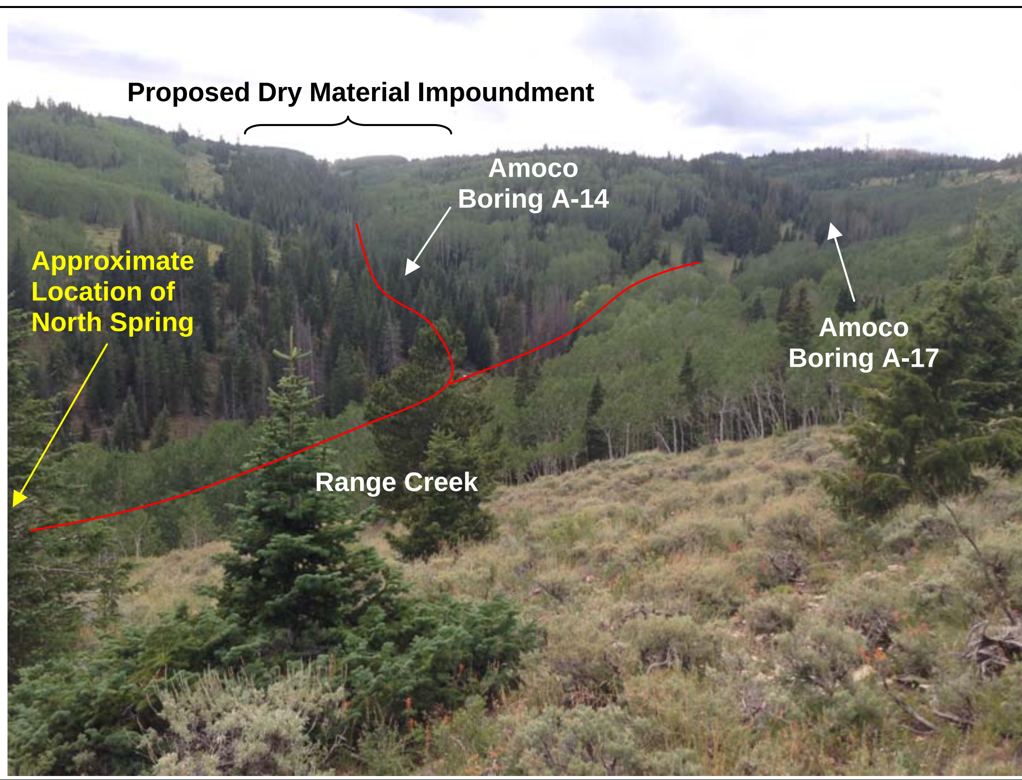
Photo No. 6 | Date: 07/29/14

Direction Photograph Taken:

Looking northwest.

Description:

Upper Range Creek drainage basin.



APENDIX B
AMOCO BORING LOGS

Amoco Minerals Company
Denver Division

PROJECT: SUNNYSIDE TAR SANDS
T. 14S R. 14E SEC. 3 COUNTY: CARBON STATE: UTAH
HOLE NO. AMOCO NO. 14 COLLAR COORDINATES N. 477,958.9 E. 2,328,740.1
STARTED: 6-30-81 COMPLETED: 7-25-81 ELEVATION: 9760.1 FT (GROUND)
INCLINATION: VERTICAL BEARING: TOTAL DEPTH: 1077 FT
CONTRACTOR: LONGYEAR CORE SIZE: NQ LOGGED BY: W. CALKIN & R. ROY
SCALE: 1" = 50 FT AVE. CORE REC'Y / HOLE: 97.2% SHEET 1 OF 1
COMMENTS: DATA CONDENSED FROM ORIGINAL LOG AT SCALE 1" = 10 FT.

Legend		
GAS ZONE	NONSAT = NONSATURATED	ALGAL ZONE
TAR ZONE	BIT = BITUMINOUS	OSTRACODS
OIL SHALE	NONBIT = NONBITUMINOUS	BONE FRAGMENT
SS = SANDSTONE	XB = CROSS BEDDED	FISH SCALES
SL = SILTSTONE	XB 20 = CROSS BEDDING @ 20°	FISH FOSSILS
SH = SHALE	BP = BEDDING PLANE	OOLITE
LS = LIMESTONE	CCO = COMPOSITE CHANNEL ORIENTATION	BIOTURBATED
CG = CONGLOMERATE	MUSC = MUSCOVITE	ROOTLET
IFC = INTRAFORMATIONAL CONGLOMERATE	LAM = LAMINATED	PLANT DEBRIS
SAT = SATURATED	MASS = MASSIVE	COAL

ELEVATION | FOOTAGE | FORMATION | MEMBER | TAR ZONE > 10' | LITHOLOGY | DETAILED DESCRIPTION | GROSS LITHOLOGY | ENVIRONMENT OF DEPOSITION (MINOR / MAJOR)

FORMATION: GREEN RIVER FORMATION
MEMBERS: PARACHUTE CREEK MBR; GARDEN GULCH MEMBER; DOUGLAS CREEK MEMBER

Elevation scale: 9700, 9600, 9500, 9400, 9300, 9200, 9100, 9000, 8900, 8800, 8700
Footage scale: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400

DETAILED DESCRIPTION	GROSS LITHOLOGY	MINOR	MAJOR
OVERBURDEN-NO RECOVERY THIN LAMINATED TAN SHALES 2" OIL SHALE ZONE 9" OIL SHALE ZONE LAMINATED TAN TO LT GREEN SH	SH_{100}	PRODELTA	LACUSTRINE
SAT SL-BIT VFG QTZ SS AT 65' STRONG ARTESIAN FLOW-300 gpm 6" & 9" OIL SH ZONES LAMINATED LT GREEN-GRAY SH OSTRACOD & ALGAL BIT MICRITE	SS_3 SL_{10} SH_{87}	DELTA FRONT	
LT GREEN LAMINATED SH BONE FRAG-COALIFIED PLANT DEBRIS LAMINATED TO MASSIVE LT GREEN SH VFG BIT QTZ SS & BIT MICRITE MASSIVE TO LAMINATED			
LT GREEN SH & BIT MICRITE INTERLAMINATED BIT SL & SH BIT SL-BONE FRAC MASSIVE MOTTLED GREEN SH WK BIOTURB			
WK VARIEGATED-OLIVE GREEN-PURPLE BIT MICRITE-BONE FRAGS-FISH SCALES LAMINATED LT GREEN SH WH NONBIT MICRITE STREAKY SAT SL	SS_1 SL_7 SH_{71} LS_{21}	SHOREFACE	
BIT MICRITE TO SPARITE OSTRACODAL MICRITE-FISH SCALE BIT MICRITE & BIT SL DK GREEN-OLIVE DRAB-GRAY SH BIT OSTRACODAL MICRITE			
BIT OSTRACODAL MICRITES LT GRAY-GREEN LAMINATED SH STREAKY SAT SL-LAMINATED SH BIT OSTRACODAL MICRITE LT GREEN SH-SAT SL			
BIT MICRITE-5" BASAL ALGAL ZONE MOTTLED MAROON SH	SH_{100}	BAY	
BIT SL VFG BIT QTZ SS CLIMBING RIPPLES-PLANAR BEDDING	SS_{70} SL_{23} CG_7	CHANNEL MOUTH BAR	
18" IFC-SL CLASTS-FISH SCALES BIT ALGAL $MICRITE_{95}$ $SPARITE_5$	SH_{72} LS_{28}	SHOREFACE	
PALE GREEN LAMINATED SH MAROON-PURPLE-OLIVE DRAB SH PALE GREEN MASSIVE & LAMIN SH	SL_{13} SH_{87}	BAY	
MODERATELY BIOTURB SL GREEN-OLIVE DRAB SH NONBIT BIOMICRITE-BIOTURB SL SLUMPED LAMINAE-GREEN SH GRAY-PALE PURPLE SH-OSTRA-PLANTS	SL_{31} SH_{52} LS_{17}	SHOREFACE	
BIT OSTRACODAL LS-PARTLY COQUINA LAMINATED PALE GREEN SH BIT OSTRACODAL MICRITE PALE GREEN MASSIVE SH WK BIT-WK BIOTURB SL BIT VFG QTZ SS & ALGAL LS	SS_{90} SH_{10}	BEACH BAR SHOREFACE	LACUSTRINE & DELTA
BIT VFG QTZ SS-1% FG MUSC PLANAR BEDDING	SL_{18} SH_{55} LS_{27} SS_{92} SH_2 CG_6	CHANNEL MOUTH BAR	
2 FT IFC-BIOTA TRASH BIOTURB SL	$SS_{12}SL_{32}SH_{47}LS_9$	SHOREFACE	
INTERBEDDED SH-SL-SS BIT MICRITE RED MOTTLED SH	SL_2 SH_{98}	MARSH	
BIT SL & GRAY LAMINATED SH BIT SL-CLIMBING RIPPLES	SS_2 SL_{81} SH_{17}	LEVEE	
BIT VFG QTZ SS-PLANAR BEDDING BIT VFG QTZ SS-CURRENT RIPPLES GRAY NONBIT SL-9" IFC	$SS_{59}SL_{25}SH_{13}CG_3$	MINOR CHANNEL	
MED GRAY TO PYRITIC SH 3 FT IFC-SL CLASTS INTERBEDDED SL-SS-CG	SH_{100}	MARSH	
FG BIT QTZ SS INTERBEDDED SH-SS-SL DISTORTED BEDDING BIT FG QTZ SS-PLANAR BEDDING 1 FT IFC-COAL CHUNK 1"Wx2"Lx0.5"H			
BIT FG QTZ SS-1% FG MUSC BEDDING FEATURES OBLITERATED PLANAR BEDDING INTERBEDDED SH-SL-SS-CG FG QTZ SS-1% MUSC	$SS_{76}SL_{11}SH_6CG_7$	MAJOR CHANNEL	
SMALL SCALE TROUGH XB TWO SEPARATE 4" SH ZONES CLIMBING RIPPLES-FG QTZ SS PLANAR XB-BIT FG QTZ SS BIOTURB WK SAT SL BIT VFG QTZ-CURRENT RIPPLES			
STREAKY SAT SL FG QTZ SS-RICH BIT NONBIT VFG QTZ SS STREAKY SAT VFG QTZ SS-3 FT IFC BIT VFG QTZ SS-SLIGHT GAS 4.5 FT IFC-SL CLASTS			
BIT VFG QTZ SS-STREAKY SAT SL VFG BIT QTZ SS-PLANAR BEDDING GREEN-RED-GRAY PYRITIC SH WH NONBIT SL			
RED MOTTLED SH WH NONBIT SL & RED SH RED SH & NONBIT SL RED MOTTLED SH WH NONBIT SL	SL_{43} SH_{57}	MARSH	
BIT SL & PALE GRAY PYRITIC SH NONBIT OSTRACODAL LS	SS_{12} SH_{25} LS_{63}	SHOREFACE	LACUSTRINE
CO_2 ODOR-VFG QTZ SS-BIT & NONBIT	SS_{100}	BEACH BAR	
6" NONBIT OSTRA LS-PYRITIC SH NONBIT QTZ SS	$SS_8SL_{24}SH_{66}LS_2$	SHOREFACE	
PALE GRAY GREEN SH WH NONBIT SL NONBIT VFG QTZ SS	SS_{100}	BEACH BAR	

T.D. 1077'

Amoco Minerals Company
Denver Division

PROJECT SUNNYSIDE TAR SANDS
T. 14S **R.** 14E **SEC.** 3 **COUNTY** CARBON **STATE** UTAH
HOLE NO. AMOCO NO. 17 **COLLAR COORDINATES** N. 478,995.0 (appx.) E. 2,328,340.0 (appx.)
STARTED 7-19-81 **COMPLETED** 8-18-81 **ELEVATION** 9781.0 FT (APPRX GROUND
INCLINATION VERTICAL **BEARING** **TOTAL DEPTH** 1015 FT
CONTRACTOR LONGYEAR **CORE SIZE** NQ **LOGGED BY** W. CALKIN & R. ROY
SCALE 1" = 10 FT **AVE. CORE REC'Y / HOLE** **SHEET** **OF**
COMMENTS DATA CONDENSED FROM ORIGINAL LOG AT SCALE 1" = 10 FT.

GAS ZONE
TAR ZONE
OIL SHALE
SS = SANDSTONE
SL = SILTSTONE
SH = SHALE
LS = LIMESTONE
CG = CONGLOMERATE
IFC = INTRAFORMATIONAL CONGLOMERATE
SAT = SATURATED

NONSAT = NONSATURATED
BIT = BITUMINOUS
NONBIT = NONBITUMINOUS
XB = CROSS BEDDED
XB 20 = CROSS BEDDING @ 20°
BP = BEDDING PLANE
CCO = COMPOSITE CHANNEL ORIENTATION
MUSC = MUSCOVITE
LAM = LAMINATED
MASS = MASSIVE

ALGAL ZONE
OSTRACODS
BONE FRAGMENT
FISH SCALES
FISH FOSSILS
OOLITE
BIOTURBATED
ROOTLET
PLANT DEBRIS
COAL

Columns: ELEVATION | FOOTAGE | FORMATION | MEMBER | TAR ZONE > 10' | LITHOLOGY | DETAILED DESCRIPTION | GROSS LITHOLOGY | ENVIRONMENT OF DEPOSITION (MINOR, MAJOR)

Elevation scale: 9700, 9600, 9500, 9400, 9300, 9200, 9100, 9000, 8900, 8800
Footage scale: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100

Formation: GREEN RIVER FORMATION
Members: PARACHUTE CREEK MBR; GARDEN GULCH MEMBER; DOUGLAS CREEK MEMBER
Major environment: LACUSTRINE; LACUSTRINE AND DELTA; DELTA

DETAILED DESCRIPTION	GROSS LITHOLOGY	ENVIRONMENT OF DEPOSITION (MINOR)
NO CORE RECOVERY OVERBURDEN SLUMPED & DISTORTED BEDDING THINLY LAMINATED GRAY SH		PRODELTA TO DELTA FRONT
DISTURBED BEDDING-LAMINATED BIT SL ARTESIAN FLOW AT 70 FT-50 gpm VFG BIT QTZ SS-COALIFIED DEBRIS LT TAN LAMINATED SH BIT BIOMICRITE	SS_8 SL_2 SH_{90}	
LT GREEN MASSIVE SH DISTURBED INTERLAMINATED BIT SL BIT SL BIT VFG QTZ SS-WK BIOTURB	$SS_{TR}SL_3SH_{91}LS_6$	SHOREFACE
PLANAR BEDDING 20 DEFORMED STRUCTURE-GAS HEAVE 18" IFC-LS CLASTS LT GREEN MASSIVE SH	SS_{84} SL_{11} CG_5	CHANNEL MOUTH BAR
BIT OOLITIC LS-PALE GREEN SH	SL_5 SH_{91} LS_4	SHOREFACE
MED GREEN MOTTLED SH-THIN SL LT GREEN MASSIVE SH-WK BIOTURB SL VFG BIT QTZ SS-1% FG MUSC PLANAR BEDDING & CLIMBING RIPPLES BIT FG QTZ SS-LS IFC-WH MICRITE	SS_{100}	BEACH BAR
LAMINATED LT GREEN SH BIT WH-TAN MICRITE-GREEN SH BIT MICRITE-PALE GREEN SH-BIT SL BIOMICRITE-LT GRAY SH BIT SL-CLIMBING RIPPLES		
GREEN-OLIVE DRAB SH-BIT SS & SL MOTTLED MASSIVE-GREEN-OLIVE DRAB SH BIT BIOMICRITE-FISH SCALES IN SH BIT BIOMICRITE TO COQUINA MED GREEN MASSIVE SH	$SS_5SL_{10}SH_{58}LS_{27}$	SHOREFACE
BIT OSTRACOD COQUINA BIT BIOMICRITES-LT GREEN SH WK BIT VFG QTZ SS MASSIVE LT GREEN SH MOTTLED GREEN-OLIVE DRAB SH		
LT MAROON-GREEN SH BIT SL-CURRENT RIPPLE LAMINATIONS BIT FG-MG QTZ SS-PLANAR BEDDING 2 FT IFC-LS CLASTS-FISH SCALES BIT BIOMICRITE-LT GREEN SH	SS_{100} SS_{76} SH_9 CG_{15}	LEVEE CHANNEL MOUTH BAR
OSTRACODAL LS-GREEN SH MAROON-GRAY-OLIVE DRAB SH MOTTLED GREEN-OLIVE DRAB SH BIOTURB NONBIT SL FISH SCALES-BIT MICRITE-BIOTURB SL	SL_{19} SH_{69} LS_{12}	SHOREFACE
LT GRAY-MAROON-GREEN SH BIT SL-MOTTLED MAROON SH OSTRACOD COQUINA-GRAY SH VFG BIT QTZ SS OSTRACOD COQUINA	SL_6 SH_{94}	MARSH SHOREFACE
GRAY-GREEN MOTTLED SH-BIT SL BIT BIOMICRITE-BASAL 3" ALGAL ZONE LT GREEN MOTTLED SH-BIOTURB SL VFG BIT QTZ SS-1% FG MUSC BIOSPARITE-OSTRACODAL SS	$SS_8SL_{25}SH_{49}LS_{18}$ $SS_{79}SL_{14}LS_4CG_3$	CHANNEL MOUTH BAR
8" IFC-SL CLASTS LT GRAY-GREEN MASSIVE SH BIT OSTRACODAL LS-BIT SL BIT SL & BIT VFG QTZ SS MOTTLED MAROON SH-BIT SL	$SS_{14}SL_{22}SH_{60}LS_4$	SHOREFACE
THINLY BEDDED MAROON & GRAY SH	SL_9 SH_{91}	BAY
FG BIT QTZ SS-1% FG MUSC-LS TWO 4" IFC'S-SL CLASTS PLANAR BEDDING	SS_{96} LS_2 CG_2	CHANNEL MOUTH BAR
GRAY GREEN MASSIVE SH IRREGULAR SAT-BIOTURB SL	SL_{31} SH_{69}	BAY
FG BIT QTZ SS-1% PYR-1% MUSC MED SCALE HIGH ANGLE THROUGH XB 1 FT IFC-NONBIT SL CLASTS	SS_{89} SL_8 SH_1 CG_2	CHANNEL MOUTH BAR
WK SAT-NONSAT BIOTURB SL BIT FG QTZ SS-PLANAR BEDDING GRAY-TAN SH-BIOTURB SL-BIT SS 1 FT IFC-SL CLASTS VFG BIT QTZ SS-1% DISS PYR	SS_8 SL_{71} SH_{21}	LEVEE
6" IFC-ANGULAR SL CLASTS 7" SH PARTING & 3" IFC-SH CLASTS VFG BIT QTZ SS STREAKY SAT SL-CURRENT RIPPLES PLANAR BEDDING-BIT VFG QTZ SS	SS_{85} SL_7 SH_4 CG_4	CHANNEL MOUTH BAR
LT GRAY SH-BIOTURB SL-WK BIT STREAKY SAT SL & SS-CURRENT RIPPLES BIT VFG QTZ SS-PLANAR BEDDING BIT VFG QTZ SS-PLANAR BEDDING	SS_{22} SL_{33} SH_{45}	LEVEE
AT 905'-ARTESIAN FLOW 50-75 gpm & CO_2 GAS BUBBLES OUT HOLE VFG BIT QTZ SS-PLANAR BEDDING-LTD CURRENT RIPPLES INTERBEDDED BIT SS-BIT SL-SH STREAKY SAT-CURRENT RIPPLES	SS_{87} SL_4 SH_9	CHANNEL MOUTH BAR
VFG BIT QTZ SS-PLANAR BEDDING GRAY-GREEN-MAROON SH SPARITE-LTD OSTRACODS MAROON MASSIVE SH LT GRAY LAMINATED SH-PLANT DEBRIS	$SS_1SL_{17}SH_{79}LS_3$	MARSH
NONBIT PYRITIC SL-3" LS ZONE NONBIT SL-MAROON SH		

T.D. 1015 FT

00197

APPENDIX C

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP) MODEL RESULTS

URS

Memorandum

Date: September 30, 2014

To: American Sands Energy
Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

From: Robert Snow, PE, Bryan Franke, EIT
URS Corporation
756 East Winchester, Suite 400
Salt Lake City, UT 84107

Subject: **Summary of Preliminary HELP Model Results**
Green River Resources – Bruin Point Mine
URS Project No.: 24585638

Introduction

This memorandum summarizes the input, assumptions, and results, associated with the proposed tailings cap at the Green River Resources (GRR) Bruin Point Mine site. The performance of this preliminary design was analyzed using the Hydrologic Evaluation of Landfill Performance (HELP) model v. 3.07 (Schroeder et al., 1994). The HELP model is a widely-used application used to evaluate landfill liner and cap performance.

The proposed method for permanent closure of the tailings site includes placement of a final cap consisting of a low-permeability barrier soil overlain by a layer of vegetated topsoil. This is a common form of closure cap designed to minimize moisture infiltration from the surface into the tailings below by means of runoff and evapotranspiration from the vegetated cover. This document will summarize applicable parameters and assumptions used in the analysis.

Description of Proposed Cover

We anticipate that a single large tailings stockpile will remain at the conclusion of mining activities. Cross sections of the permanent tailings stockpile were based on AutoCAD drawing geometries, which were provided to URS by GRR. The proposed stockpile is anticipated to be up to 430feet (ft) in height, 3,600 ft in length, 2,000ft in width, and cover an area of approximately 93.5 acres. At the crest of the tailings stockpile, we anticipate a minimum slope angle of 3%.

The preliminary cover design is proposed to consist of a 4-ft-thick, low-permeability ($k \leq 1 \times 10^{-7}$ cm/s) soil layer [cap] immediately above the tailings sand stockpile overlain by 18 inches (in) of topsoil [growth layer] ($k \approx 6 \times 10^{-5}$ cm/s). A summary of the model layers is shown in Table 1.

Table 1. Summary of Model Layers

Model Layer	Layer Thickness *(in)*	Represents *(-)*
1	18.0	Topsoil or Growth Layer
2	48.0	Low-Permeability Cap

It was assumed that sufficient topsoil will be stripped from the site (prior to beginning mining operations) to provide sufficient topsoil to construct Layer 1 and that Layer 2 will consist of topsoil and/or mine partings. The cap soil should have an in situ permeability of at least that of the liner ($k \leq 1 \times 10^{-7}$ cm/s) following placement and compaction to prevent pooling of water at the liner interface, or “bathtub effect.”

Model Weather Data

Moisture infiltration is highly dependent on weather patterns and growing seasons. To simulate weather-related impacts, the HELP model uses four types of weather data in the analysis. The following inputs are required:

a. Evapotranspiration

b. Precipitation

c. Temperature

d. Solar Radiation

To assist the user, the HELP model contains weather data and information for various cities across the country. Based on site-specific data for each of the cities, the HELP model can generate from 1 to 100 years of synthetic data stochastically for any of these locations.

The HELP model contains city-specific data for three separate cities in the state of Utah. These cities include Salt Lake City, Milford, and Cedar City. The data available in the HELP model for these three cities are dissimilar to weather and climate conditions at the proposed Bruin Point Mine site.

To adequately simulate conditions at the site, weather data from a nearby weather station was obtained for the period between January 1, 2007, and September 15, 2014. The weather station is located approximately 3.5 miles from the proposed tailings stockpile site (at N 39° 36' 35" W 110° 17' 40", with and elevation of 9,341 ft) with similar elevation and topography. The mean monthly weather values measured at the weather station were used by the HELP model to stochastically generate daily synthetic data.

General Climatic Parameters

A summary of general climatic parameters is provided in Table 2 and parameters from the three cities in Utah provided in the HELP model are shown for comparison. Temperatures typically remain relatively mild throughout the summer at such a high elevation resulting in a shorter growing season. Based on weather station temperature data, the growing season was generally defined as the period where the mean daily temperature exceeded 50 to 55 degrees Fahrenheit.

The average wind speed (shown in miles per hour or mph) was determined using approximately 7 years of weather data obtained from the nearby weather station. The calculated average wind speed is low based on the altitude of the site and compared to the values provided for the nearby cities. The quarterly relative humidity was obtained from regional weather station readings and is consistent with values contained within the HELP model. The difference between the elevation of the site and the city-specific data provided in the HELP model was significant; consequently, the use of site-specific data was believed to provide a more reasonable estimation of climatic factors.

The Maximum Leaf Area Index (LAI) was based on the understanding of local vegetation. Pictures obtained from site visits show abundant grass. In similar conditions, a weak stand of grass might be expected. Therefore, a relatively low LAI was selected to reflect the limited presence of trees and shrubs anticipated for the growth layer of the cap.

Table 2. General Parameters

Parameter	Bruin Point Mine Site[1]	Salt Lake City, Utah	Milford, Utah	Cedar City, Utah
Latitude	39.64	40.76	38.26	37.50
Growing Season Start Day	148	117	126	125
Growing Season End Day	274	289	282	284
Growing Season Length (days)	126	172	156	159
Average Wind Speed (mph)	2.0	8.8	8.8	8.8
1st Quarter Relative Humidity	63.7	67.0	64.0	64.0
2nd Quarter Relative Humidity	45.3	48.0	36.0	36.0
3rd Quarter Relative Humidity	41.8	39.0	34.0	34.0
4th Quarter Relative Humidity	59.6	65.0	58.0	58.0
Elevation [NOT from HELP] (ft)	~ 10,000	~ 4,300	~ 5,000	~ 5,800
Maximum Leaf Area Index (LAI)	1.0	1.6	1.6	1.6

1. Values calculated or assumed from site-specific weather data, NOT determined using city-specific data provided in the HELP model.

Precipitation Data

The mean monthly precipitation for the project site is shown in Table 3. The values are based on a 7-year average weather data obtained from the weather station located approximately 3.5 miles away. The data provided in the HELP model for Salt Lake City, Utah, and Milford, Utah, is also shown in Table 3 for comparison. In general, magnitudes appear to be comparable to data provided in the HELP model. Considering the relatively small period for which weather data is available near the site, averages from the site-specific data may be affected by dry or wet years. Consequently, modeling results may be affected.

The total annual precipitation shown in Table 3was calculated as the sum of monthly averages; however, the stochastic approach may result in more or less precipitation than this amount in a particular year. Using the stochastic approach available in the HELP model for synthetic weather generation, the relatively intense periods of precipitation and annual variation provided a reasonable representation of precipitation at the site, even though the annual average used in HELP is slightly higher than the average value measured at the site. To generate the synthetic precipitation data for the modeling period, the site-specific values of mean monthly precipitation were used in conjunction with the Milford, Utah, coefficients.

Table 3. Mean Monthly Precipitation (inches)

Month	Bruin Point Mine Site[1]	Salt Lake City, Utah	Milford, Utah
January	0.26	1.35	0.69
February	0.36	1.33	0.74
March	0.57	1.72	0.99
April	0.96	2.21	0.96
May	0.97	1.47	0.73
June	0.60	0.97	0.42
July	1.42	0.72	0.61
August	1.12	0.92	0.71
September	0.94	0.89	0.69
October	1.36	1.14	0.73
November	0.33	1.22	0.69
December	0.19	1.37	0.63
Total	8.89	15.31	8.59

Temperature Data

Temperature data is provided in the HELP model for two nearby cities: Salt Lake City, Utah, and Milford, Utah. As a result of the significantly higher elevation at the site, the temperature at the project site was expected to be cooler, on average, than these two cities. Table 4 shows the mean monthly temperature recorded at the previously-mentioned nearby weather station as well as the two HELP model cities for comparison. The measured temperatures follow the general trend shown for the two cities provided in the HELP model. The summer months are warmest and remaining relatively consistent throughout the winter months.

To generate the synthetic temperature data for the modeling period, the site-specific values of mean monthly temperature were used in conjunction with the Milford, Utah, coefficients. Although the temperatures were consistently higher in Milford, Utah, the general temperature trends most-closely matched the site-specific data.

Table 4. Mean Monthly Temperature (Fahrenheit)

Month	Bruin Point Mine Site[1]	Salt Lake City, Utah	Milford, Utah
January	20.6	28.6	26.4
February	19.7	34.1	32.1
March	27.9	40.7	38.2
April	33.4	49.2	46.3
May	41.7	58.8	55.9
June	54.0	68.3	65.8
July	61.4	77.5	74.3
August	59.9	74.9	72.1
September	52.3	65.0	62.6
October	37.1	53.0	50.3
November	29.0	39.7	36.8
December	19.3	30.3	28.2

Evapotranspiration

The evaporative zone was assumed to extend to a depth of approximately 12 inches. This is roughly the depth of root penetration by native grasses at the site. If similar grasses are used for vegetation above the cap, 12 inches would be considered the minimum anticipated evaporative depth.

An LAI value of 1.0 was chosen to explore a moderate case where a poor grass stand develops above the cap in the long term.

Solar Radiation

The site specific latitude was used with the Milford, Utah, coefficient to generate daily solar radiation values for the modeling period.

Cap Layers and Parameters

The cap consists of two components previously described. This section further describes the layers with relation to the HELP model. Input parameters and assumptions associated with each layer are also identified in this section. Default soil types are defined within the HELP model. Soil Type 11 and Barrier Soil were used to model the clayey topsoil layer cap materials respectively.

The topsoil and low-permeability cap were the only components considered in the model and no leachate collection or drainage systems were considered. It was assumed that any infiltration through the tailings cap will ultimately reach the top of the liner. A summary of assumed soil parameters is shown in Table 5.

Table 5. Model Soil Parameters

Parameter	Soil Layer	
	1 - Topsoil or Growth Layer	2 - Low-Permeability Cap
Thickness (in)	18	48
HELP Model Layer Type	1	3
HELP Model Soil Texture No.	11	16
HELP Model Soil Description	Clay	Barrier Soil
Total Porosity (vol/vol)	0.464	0.427
Field Capacity (vol/vol)	0.310	0.418
Wilting Point (vol/vol)	0.187	0.367
Initial Soil Water Content (vol/vol)	0.234	0.418
Saturated Hydraulic Conductivity (cm/s)	6.4×10^{-5}	1.0×10^{-7}

Notes: HELP model layer types are defined as follows: 1) Vertical Percolation Layer & 3) Barrier Soil Liner

Topsoil is anticipated to be stockpiled onsite and later used for cap construction. The hydraulic conductivity of native topsoil was not tested with samples obtained from GRR. Consequently, a hydraulic conductivity was inferred based on the soils index testing. Topsoil samples contained between 20 and 80 percent clay, which will largely control the rate of infiltration. Therefore, the HELP model soil texture 11 (clay) was selected to represent the growth layer above the cap.

The cap material was largely based on results from the permeability testing performed on crushed mine partings; however, the cap must be no more permeable than the tailings liner. Because the tailings liner was specified to be at least 1×10^{-7} cm/s, the tailings cap was also modeled at 1×10^{-7} cm/s.

Model Results

The help model was run for a period of 50 years and rerun until the initial and final moisture contents for each of the layers had reached a steady-state or equilibrium. The model results are provided in Table 6. The model results indicate less than 1 inches of surface water infiltration through the cap based on the selected parameters. Variations in precipitation, temperature, and permeability will impact these results.

Table 6. Model Results

Average Annual Totals (inches) for Years 1 through 50				
Precipitation	Runoff	Evapotranspiration	Percolation through Cap	Average Head on Barrier Layer
9.44	0.446	8.542	0.456	1.150

Attachment 1: HELP Model Output File

References

Schroeder, P. R., Dozier, T.S., Zappi, P. A., McEnroe, B. M., Sjostrom, J.W., and Peyton, R. L. (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Attachment 1

HELP Model Output File

```
♀
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\DATA\DATA4.D4
TEMPERATURE DATA FILE:       C:\HELP3\DATA\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\DATA\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\DATA\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\DATA\SOILS.D10
OUTPUT DATA FILE:            C:\HELP3\DATA\OUTPUT.OUT


TIME:  17:26     DATE:   9/29/2014


******************************************************************************

     TITLE:  AMERICAN SANDS ENERGY - BRUIN POINT MINE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  11
           THICKNESS                 =     18.00   INCHES
           POROSITY                  =      0.4640 VOL/VOL
           FIELD CAPACITY            =      0.3100 VOL/VOL
           WILTING POINT             =      0.1870 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.2359 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------
```

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	48.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #11 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 2000. FEET.

SCS RUNOFF CURVE NUMBER	=	90.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.831	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.568	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.244	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	24.742	INCHES
TOTAL INITIAL WATER	=	24.742	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BRUIN POINT UTAH

STATION LATITUDE	=	39.64	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	148	
END OF GROWING SEASON (JULIAN DATE)	=	274	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	2.00	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	63.70	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	45.30	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	41.80	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	59.60	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MILFORD UTAH

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.26	0.36	0.57	0.96	0.97	0.60
1.42	1.12	0.94	1.36	0.33	0.19

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MILFORD UTAH

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
20.60	19.70	27.90	33.40	41.70	54.00
61.40	59.90	52.30	38.10	29.00	19.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MILFORD UTAH
AND STATION LATITUDE = 38.26 DEGREES

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.27	26390.104	100.00
RUNOFF	0.205	742.802	2.81
EVAPOTRANSPIRATION	6.367	23112.344	87.58
PERC./LEAKAGE THROUGH LAYER 2	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.698	2534.945	9.61
SOIL WATER AT START OF YEAR	24.742	89814.008	
SOIL WATER AT END OF YEAR	25.440	92348.953	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.013	0.00

****

****

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.42	41454.605	100.00
RUNOFF	0.228	829.348	2.00

EVAPOTRANSPIRATION	9.811	35613.426	85.91
PERC./LEAKAGE THROUGH LAYER 2	0.231270	839.511	2.03
AVG. HEAD ON TOP OF LAYER 2	0.5215		
CHANGE IN WATER STORAGE	1.149	4172.304	10.06
SOIL WATER AT START OF YEAR	25.440	92348.953	
SOIL WATER AT END OF YEAR	26.590	96521.258	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.017	0.00

****

****

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.88	35864.406	100.00
RUNOFF	0.131	475.509	1.33
EVAPOTRANSPIRATION	10.528	38217.687	106.56
PERC./LEAKAGE THROUGH LAYER 2	0.832377	3021.530	8.42
AVG. HEAD ON TOP OF LAYER 2	0.8875		
CHANGE IN WATER STORAGE	-1.612	-5850.314	-16.31
SOIL WATER AT START OF YEAR	26.590	96521.258	
SOIL WATER AT END OF YEAR	24.763	89888.937	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.215	782.006	2.18
ANNUAL WATER BUDGET BALANCE	0.0000	-0.006	0.00

****

****

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.93	36045.902	100.00

RUNOFF	0.500	1814.673	5.03
EVAPOTRANSPIRATION	9.452	34310.867	95.19
PERC./LEAKAGE THROUGH LAYER 2	0.057994	210.517	0.58
AVG. HEAD ON TOP OF LAYER 2	0.0054		
CHANGE IN WATER STORAGE	-0.080	-290.169	-0.80
SOIL WATER AT START OF YEAR	24.763	89888.937	
SOIL WATER AT END OF YEAR	24.898	90380.773	
SNOW WATER AT START OF YEAR	0.215	782.006	2.17
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.014	0.00

****

****

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.41	41418.305	100.00
RUNOFF	0.265	963.429	2.33
EVAPOTRANSPIRATION	11.101	40295.914	97.29
PERC./LEAKAGE THROUGH LAYER 2	0.005891	21.386	0.05
AVG. HEAD ON TOP OF LAYER 2	0.0001		
CHANGE IN WATER STORAGE	0.038	137.560	0.33
SOIL WATER AT START OF YEAR	24.898	90380.773	
SOIL WATER AT END OF YEAR	24.936	90518.336	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.019	0.00

****

****

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.75	31762.496	100.00
RUNOFF	0.264	956.648	3.01
EVAPOTRANSPIRATION	7.549	27401.473	86.27
PERC./LEAKAGE THROUGH LAYER 2	0.000250	0.908	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.938	3403.478	10.72
SOIL WATER AT START OF YEAR	24.936	90518.336	
SOIL WATER AT END OF YEAR	25.874	93921.812	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

****

****

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.69	31544.705	100.00
RUNOFF	0.134	485.751	1.54
EVAPOTRANSPIRATION	9.570	34738.910	110.13
PERC./LEAKAGE THROUGH LAYER 2	0.003498	12.699	0.04
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	-1.017	-3692.666	-11.71
SOIL WATER AT START OF YEAR	25.874	93921.812	
SOIL WATER AT END OF YEAR	24.857	90229.148	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.013	0.00

****

****

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.85	35755.508	100.00
RUNOFF	0.161	585.894	1.64
EVAPOTRANSPIRATION	9.799	35568.969	99.48
PERC./LEAKAGE THROUGH LAYER 2	0.001640	5.954	0.02
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	-0.112	-405.296	-1.13
SOIL WATER AT START OF YEAR	24.857	90229.148	
SOIL WATER AT END OF YEAR	24.600	89297.773	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.145	526.077	1.47
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.72	31653.607	100.00
RUNOFF	0.299	1086.009	3.43
EVAPOTRANSPIRATION	8.443	30648.566	96.82
PERC./LEAKAGE THROUGH LAYER 2	0.119312	433.103	1.37
AVG. HEAD ON TOP OF LAYER 2	0.0287		
CHANGE IN WATER STORAGE	-0.142	-514.074	-1.62
SOIL WATER AT START OF YEAR	24.600	89297.773	
SOIL WATER AT END OF YEAR	24.600	89297.828	
SNOW WATER AT START OF YEAR	0.145	526.077	1.66
SNOW WATER AT END OF YEAR	0.003	11.947	0.04
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.51	38151.312	100.00
RUNOFF	0.881	3196.598	8.38
EVAPOTRANSPIRATION	6.155	22343.750	58.57
PERC./LEAKAGE THROUGH LAYER 2	0.677494	2459.303	6.45
AVG. HEAD ON TOP OF LAYER 2	2.3279		
CHANGE IN WATER STORAGE	2.797	10151.659	26.61
SOIL WATER AT START OF YEAR	24.600	89297.828	
SOIL WATER AT END OF YEAR	27.150	98555.914	
SNOW WATER AT START OF YEAR	0.003	11.947	0.03
SNOW WATER AT END OF YEAR	0.249	905.523	2.37
ANNUAL WATER BUDGET BALANCE	0.0000	0.002	0.00

****

****

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.40	30492.002	100.00
RUNOFF	0.467	1696.126	5.56
EVAPOTRANSPIRATION	8.956	32509.250	106.62
PERC./LEAKAGE THROUGH LAYER 2	1.322270	4799.838	15.74
AVG. HEAD ON TOP OF LAYER 2	3.1147		
CHANGE IN WATER STORAGE	-2.345	-8513.202	-27.92
SOIL WATER AT START OF YEAR	27.150	98555.914	
SOIL WATER AT END OF YEAR	25.055	90948.234	
SNOW WATER AT START OF YEAR	0.249	905.523	2.97
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.009	0.00

****

****

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.41	34158.305	100.00
RUNOFF	0.498	1808.742	5.30
EVAPOTRANSPIRATION	8.656	31419.516	91.98
PERC./LEAKAGE THROUGH LAYER 2	0.345108	1252.741	3.67
AVG. HEAD ON TOP OF LAYER 2	0.1453		
CHANGE IN WATER STORAGE	-0.089	-322.689	-0.94
SOIL WATER AT START OF YEAR	25.055	90948.234	
SOIL WATER AT END OF YEAR	24.948	90562.281	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.017	63.264	0.19
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

****

****

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.04	25555.201	100.00
RUNOFF	0.043	154.638	0.61
EVAPOTRANSPIRATION	7.188	26092.275	102.10
PERC./LEAKAGE THROUGH LAYER 2	0.001021	3.708	0.01
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	-0.192	-695.431	-2.72
SOIL WATER AT START OF YEAR	24.948	90562.281	
SOIL WATER AT END OF YEAR	24.774	89930.109	
SNOW WATER AT START OF YEAR	0.017	63.264	0.25
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.009	0.00

****

****

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.65	27769.512	100.00
RUNOFF	0.064	231.291	0.83
EVAPOTRANSPIRATION	6.977	25327.107	91.20
PERC./LEAKAGE THROUGH LAYER 2	0.000010	0.035	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.609	2211.061	7.96
SOIL WATER AT START OF YEAR	24.774	89930.109	
SOIL WATER AT END OF YEAR	25.344	91997.680	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.040	143.492	0.52
ANNUAL WATER BUDGET BALANCE	0.0000	0.018	0.00

****

****

ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.04	25555.203	100.00
RUNOFF	0.129	466.677	1.83
EVAPOTRANSPIRATION	6.361	23091.707	90.36
PERC./LEAKAGE THROUGH LAYER 2	0.001826	6.630	0.03
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.548	1990.177	7.79
SOIL WATER AT START OF YEAR	25.344	91997.680	
SOIL WATER AT END OF YEAR	25.932	94131.352	
SNOW WATER AT START OF YEAR	0.040	143.492	0.56
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

****

****

ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.15	25954.500	100.00
RUNOFF	0.358	1298.916	5.00
EVAPOTRANSPIRATION	6.779	24607.064	94.81
PERC./LEAKAGE THROUGH LAYER 2	0.273748	993.707	3.83
AVG. HEAD ON TOP OF LAYER 2	0.2540		
CHANGE IN WATER STORAGE	-0.260	-945.172	-3.64
SOIL WATER AT START OF YEAR	25.932	94131.352	
SOIL WATER AT END OF YEAR	25.671	93186.180	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.016	0.00

****

****

ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.84	28459.203	100.00
RUNOFF	0.234	848.040	2.98
EVAPOTRANSPIRATION	8.453	30683.162	107.81
PERC./LEAKAGE THROUGH LAYER 2	0.146095	530.326	1.86
AVG. HEAD ON TOP OF LAYER 2	0.0512		
CHANGE IN WATER STORAGE	-0.992	-3602.329	-12.66
SOIL WATER AT START OF YEAR	25.671	93186.180	
SOIL WATER AT END OF YEAR	24.600	89297.773	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.079	286.076	1.01

ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

****

****

ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.15	36844.500	100.00
RUNOFF	0.645	2340.801	6.35
EVAPOTRANSPIRATION	9.154	33230.668	90.19
PERC./LEAKAGE THROUGH LAYER 2	0.002876	10.441	0.03
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.348	1262.598	3.43
SOIL WATER AT START OF YEAR	24.600	89297.773	
SOIL WATER AT END OF YEAR	25.027	90846.445	
SNOW WATER AT START OF YEAR	0.079	286.076	0.78
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

****

****

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.93	39675.906	100.00
RUNOFF	0.396	1436.737	3.62
EVAPOTRANSPIRATION	6.729	24426.051	61.56
PERC./LEAKAGE THROUGH LAYER 2	0.598995	2174.352	5.48
AVG. HEAD ON TOP OF LAYER 2	1.9838		
CHANGE IN WATER STORAGE	3.206	11638.768	29.33
SOIL WATER AT START OF YEAR	25.027	90846.445	
SOIL WATER AT END OF YEAR	28.233	102485.211	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00

SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.003	0.00

****

****

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.01	29076.305	100.00
RUNOFF	0.126	457.136	1.57
EVAPOTRANSPIRATION	8.821	32019.504	110.12
PERC./LEAKAGE THROUGH LAYER 2	1.368154	4966.400	17.08
AVG. HEAD ON TOP OF LAYER 2	4.7525		
CHANGE IN WATER STORAGE	-2.305	-8366.748	-28.78
SOIL WATER AT START OF YEAR	28.233	102485.211	
SOIL WATER AT END OF YEAR	25.777	93572.117	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.151	546.349	1.88
ANNUAL WATER BUDGET BALANCE	0.0000	0.012	0.00

****

****

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.99	21743.701	100.00
RUNOFF	0.252	913.338	4.20
EVAPOTRANSPIRATION	6.810	24719.799	113.69
PERC./LEAKAGE THROUGH LAYER 2	0.245018	889.414	4.09
AVG. HEAD ON TOP OF LAYER 2	0.1497		
CHANGE IN WATER STORAGE	-1.316	-4778.854	-21.98
SOIL WATER AT START OF YEAR	25.777	93572.117	
SOIL WATER AT END OF YEAR	24.611	89339.609	

SNOW WATER AT START OF YEAR	0.151	546.349	2.51
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

****

****

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	5.13	18621.906	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	4.739	17202.768	92.38
PERC./LEAKAGE THROUGH LAYER 2	0.000010	0.036	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	0.391	1419.097	7.62
SOIL WATER AT START OF YEAR	24.611	89339.609	
SOIL WATER AT END OF YEAR	25.002	90758.711	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

****

****

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.26	48133.797	100.00
RUNOFF	1.302	4725.676	9.82
EVAPOTRANSPIRATION	8.694	31557.410	65.56
PERC./LEAKAGE THROUGH LAYER 2	0.581057	2109.238	4.38
AVG. HEAD ON TOP OF LAYER 2	1.6099		
CHANGE IN WATER STORAGE	2.684	9741.484	20.24
SOIL WATER AT START OF YEAR	25.002	90758.711	

SOIL WATER AT END OF YEAR	27.645	100352.641	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.041	147.554	0.31
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

****

****

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.63	31326.904	100.00
RUNOFF	0.474	1721.444	5.50
EVAPOTRANSPIRATION	8.980	32596.387	104.05
PERC./LEAKAGE THROUGH LAYER 2	1.348091	4893.570	15.62
AVG. HEAD ON TOP OF LAYER 2	3.9781		
CHANGE IN WATER STORAGE	-2.172	-7884.506	-25.17
SOIL WATER AT START OF YEAR	27.645	100352.641	
SOIL WATER AT END OF YEAR	25.514	92615.687	
SNOW WATER AT START OF YEAR	0.041	147.554	0.47
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

****

****

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.29	30092.703	100.00
RUNOFF	0.843	3059.697	10.17
EVAPOTRANSPIRATION	7.246	26301.535	87.40
PERC./LEAKAGE THROUGH LAYER 2	0.122796	445.748	1.48
AVG. HEAD ON TOP OF LAYER 2	0.0386		
CHANGE IN WATER STORAGE	0.079	285.721	0.95

SOIL WATER AT START OF YEAR	25.514	92615.687	
SOIL WATER AT END OF YEAR	25.571	92821.539	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.022	79.874	0.27
ANNUAL WATER BUDGET BALANCE	0.0000	0.001	0.00

****

****

ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.38	37679.410	100.00
RUNOFF	0.646	2345.705	6.23
EVAPOTRANSPIRATION	9.906	35960.168	95.44
PERC./LEAKAGE THROUGH LAYER 2	0.403701	1465.434	3.89
AVG. HEAD ON TOP OF LAYER 2	0.3953		
CHANGE IN WATER STORAGE	-0.576	-2091.901	-5.55
SOIL WATER AT START OF YEAR	25.571	92821.539	
SOIL WATER AT END OF YEAR	25.016	90809.508	
SNOW WATER AT START OF YEAR	0.022	79.874	0.21
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

****

****

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.63	27696.902	100.00
RUNOFF	0.011	38.890	0.14
EVAPOTRANSPIRATION	7.423	26943.918	97.28
PERC./LEAKAGE THROUGH LAYER 2	0.275986	1001.828	3.62
AVG. HEAD ON TOP OF LAYER 2	0.3022		

CHANGE IN WATER STORAGE	-0.079	-287.741	-1.04
SOIL WATER AT START OF YEAR	25.016	90809.508	
SOIL WATER AT END OF YEAR	24.937	90521.766	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.008	0.00

****

****

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	11.53	41853.898	100.00
RUNOFF	0.445	1616.159	3.86
EVAPOTRANSPIRATION	8.653	31409.248	75.04
PERC./LEAKAGE THROUGH LAYER 2	0.400599	1454.175	3.47
AVG. HEAD ON TOP OF LAYER 2	1.3278		
CHANGE IN WATER STORAGE	2.031	7374.310	17.62
SOIL WATER AT START OF YEAR	24.937	90521.766	
SOIL WATER AT END OF YEAR	26.969	97896.078	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.008	0.00

****

****

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.44	23377.203	100.00
RUNOFF	0.002	5.875	0.03
EVAPOTRANSPIRATION	7.339	26639.320	113.95
PERC./LEAKAGE THROUGH LAYER 2	1.244176	4516.360	19.32

AVG. HEAD ON TOP OF LAYER 2	3.1321		
CHANGE IN WATER STORAGE	-2.144	-7784.357	-33.30
SOIL WATER AT START OF YEAR	26.969	97896.078	
SOIL WATER AT END OF YEAR	24.824	90111.719	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

****

****

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.20	44286.000	100.00
RUNOFF	0.394	1431.892	3.23
EVAPOTRANSPIRATION	9.582	34782.082	78.54
PERC./LEAKAGE THROUGH LAYER 2	0.361932	1313.812	2.97
AVG. HEAD ON TOP OF LAYER 2	0.7462		
CHANGE IN WATER STORAGE	1.862	6758.224	15.26
SOIL WATER AT START OF YEAR	24.824	90111.719	
SOIL WATER AT END OF YEAR	26.675	96830.828	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.011	39.115	0.09
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

****

****

ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	12.16	44140.805	100.00
RUNOFF	1.612	5850.303	13.25
EVAPOTRANSPIRATION	8.563	31082.187	70.42

PERC./LEAKAGE THROUGH LAYER 2	1.333929	4842.162	10.97
AVG. HEAD ON TOP OF LAYER 2	3.5695		
CHANGE IN WATER STORAGE	0.652	2366.164	5.36
SOIL WATER AT START OF YEAR	26.675	96830.828	
SOIL WATER AT END OF YEAR	27.050	98191.164	
SNOW WATER AT START OF YEAR	0.011	39.115	0.09
SNOW WATER AT END OF YEAR	0.288	1044.943	2.37
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

****

****

ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.28	55466.406	100.00
RUNOFF	2.515	9129.822	16.46
EVAPOTRANSPIRATION	10.661	38697.625	69.77
PERC./LEAKAGE THROUGH LAYER 2	1.378678	5004.601	9.02
AVG. HEAD ON TOP OF LAYER 2	5.1613		
CHANGE IN WATER STORAGE	0.726	2634.338	4.75
SOIL WATER AT START OF YEAR	27.050	98191.164	
SOIL WATER AT END OF YEAR	27.941	101424.727	
SNOW WATER AT START OF YEAR	0.288	1044.943	1.88
SNOW WATER AT END OF YEAR	0.123	445.717	0.80
ANNUAL WATER BUDGET BALANCE	0.0000	0.020	0.00

****

****

ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.75	39022.500	100.00
RUNOFF	0.764	2772.525	7.10

EVAPOTRANSPIRATION	9.938	36074.867	92.45
PERC./LEAKAGE THROUGH LAYER 2	1.378016	5002.197	12.82
AVG. HEAD ON TOP OF LAYER 2	5.2701		
CHANGE IN WATER STORAGE	-1.330	-4827.095	-12.37
SOIL WATER AT START OF YEAR	27.941	101424.727	
SOIL WATER AT END OF YEAR	26.353	95661.477	
SNOW WATER AT START OF YEAR	0.123	445.717	1.14
SNOW WATER AT END OF YEAR	0.381	1381.875	3.54
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

****

****

ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.01	29076.305	100.00
RUNOFF	0.178	647.872	2.23
EVAPOTRANSPIRATION	8.832	32058.682	110.26
PERC./LEAKAGE THROUGH LAYER 2	0.609094	2211.010	7.60
AVG. HEAD ON TOP OF LAYER 2	0.6193		
CHANGE IN WATER STORAGE	-1.609	-5841.262	-20.09
SOIL WATER AT START OF YEAR	26.353	95661.477	
SOIL WATER AT END OF YEAR	25.125	91202.086	
SNOW WATER AT START OF YEAR	0.381	1381.875	4.75
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

****

****

ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.14	36808.211	100.00

RUNOFF	0.266	964.556	2.62
EVAPOTRANSPIRATION	10.168	36911.430	100.28
PERC./LEAKAGE THROUGH LAYER 2	0.000232	0.844	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0000		
CHANGE IN WATER STORAGE	-0.294	-1068.640	-2.90
SOIL WATER AT START OF YEAR	25.125	91202.086	
SOIL WATER AT END OF YEAR	24.819	90091.953	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.011	41.495	0.11
ANNUAL WATER BUDGET BALANCE	0.0000	0.022	0.00

****

****

ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.39	30455.697	100.00
RUNOFF	0.063	229.611	0.75
EVAPOTRANSPIRATION	7.654	27784.623	91.23
PERC./LEAKAGE THROUGH LAYER 2	0.219564	797.018	2.62
AVG. HEAD ON TOP OF LAYER 2	0.0996		
CHANGE IN WATER STORAGE	0.453	1644.462	5.40
SOIL WATER AT START OF YEAR	24.819	90091.953	
SOIL WATER AT END OF YEAR	25.283	91777.906	
SNOW WATER AT START OF YEAR	0.011	41.495	0.14
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.017	0.00

****

****

ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT

PRECIPITATION	7.91	28713.303	100.00
RUNOFF	0.119	432.742	1.51
EVAPOTRANSPIRATION	8.387	30444.686	106.03
PERC./LEAKAGE THROUGH LAYER 2	0.022421	81.390	0.28
AVG. HEAD ON TOP OF LAYER 2	0.0006		
CHANGE IN WATER STORAGE	-0.619	-2245.521	-7.82
SOIL WATER AT START OF YEAR	25.283	91777.906	
SOIL WATER AT END OF YEAR	24.665	89532.391	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

****

****

ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.75	31762.500	100.00
RUNOFF	0.116	421.041	1.33
EVAPOTRANSPIRATION	8.168	29651.246	93.35
PERC./LEAKAGE THROUGH LAYER 2	0.009320	33.833	0.11
AVG. HEAD ON TOP OF LAYER 2	0.0001		
CHANGE IN WATER STORAGE	0.456	1656.392	5.21
SOIL WATER AT START OF YEAR	24.665	89532.391	
SOIL WATER AT END OF YEAR	25.121	91188.781	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.013	0.00

****

****

ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.28	30056.398	100.00
RUNOFF	0.602	2186.522	7.27
EVAPOTRANSPIRATION	7.159	25988.699	86.47
PERC./LEAKAGE THROUGH LAYER 2	0.312657	1134.945	3.78
AVG. HEAD ON TOP OF LAYER 2	0.8785		
CHANGE IN WATER STORAGE	0.206	746.237	2.48
SOIL WATER AT START OF YEAR	25.121	91188.781	
SOIL WATER AT END OF YEAR	25.297	91828.344	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	106.676	0.35
ANNUAL WATER BUDGET BALANCE	0.0000	-0.005	0.00

****

****

ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.61	23994.305	100.00
RUNOFF	0.161	582.656	2.43
EVAPOTRANSPIRATION	5.504	19981.035	83.27
PERC./LEAKAGE THROUGH LAYER 2	0.469465	1704.158	7.10
AVG. HEAD ON TOP OF LAYER 2	0.5498		
CHANGE IN WATER STORAGE	0.476	1726.450	7.20
SOIL WATER AT START OF YEAR	25.297	91828.344	
SOIL WATER AT END OF YEAR	25.802	93661.469	
SNOW WATER AT START OF YEAR	0.029	106.676	0.44
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

****

****

ANNUAL TOTALS FOR YEAR 41

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.26	37243.801	100.00
RUNOFF	0.363	1318.303	3.54
EVAPOTRANSPIRATION	9.248	33571.070	90.14
PERC./LEAKAGE THROUGH LAYER 2	0.028681	104.113	0.28
AVG. HEAD ON TOP OF LAYER 2	0.0005		
CHANGE IN WATER STORAGE	0.620	2250.317	6.04
SOIL WATER AT START OF YEAR	25.802	93661.469	
SOIL WATER AT END OF YEAR	26.206	95127.477	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.216	784.305	2.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.004	0.00

****

****

ANNUAL TOTALS FOR YEAR 42

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.49	34448.703	100.00
RUNOFF	0.095	346.658	1.01
EVAPOTRANSPIRATION	10.499	38112.969	110.64
PERC./LEAKAGE THROUGH LAYER 2	0.246538	894.933	2.60
AVG. HEAD ON TOP OF LAYER 2	0.0746		
CHANGE IN WATER STORAGE	-1.351	-4905.841	-14.24
SOIL WATER AT START OF YEAR	26.206	95127.477	
SOIL WATER AT END OF YEAR	24.991	90716.367	
SNOW WATER AT START OF YEAR	0.216	784.305	2.28
SNOW WATER AT END OF YEAR	0.080	289.580	0.84
ANNUAL WATER BUDGET BALANCE	0.0000	-0.015	0.00

****

****

ANNUAL TOTALS FOR YEAR 43

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.42	34194.605	100.00
RUNOFF	0.231	837.253	2.45
EVAPOTRANSPIRATION	8.326	30224.561	88.39
PERC./LEAKAGE THROUGH LAYER 2	0.246056	893.185	2.61
AVG. HEAD ON TOP OF LAYER 2	0.1096		
CHANGE IN WATER STORAGE	0.617	2239.611	6.55
SOIL WATER AT START OF YEAR	24.991	90716.367	
SOIL WATER AT END OF YEAR	25.687	93245.555	
SNOW WATER AT START OF YEAR	0.080	289.580	0.85
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.006	0.00

****

****

ANNUAL TOTALS FOR YEAR 44

	INCHES	CU. FEET	PERCENT
PRECIPITATION	6.99	25373.703	100.00
RUNOFF	0.133	483.779	1.91
EVAPOTRANSPIRATION	7.590	27550.518	108.58
PERC./LEAKAGE THROUGH LAYER 2	0.009088	32.990	0.13
AVG. HEAD ON TOP OF LAYER 2	0.0002		
CHANGE IN WATER STORAGE	-0.742	-2693.587	-10.62
SOIL WATER AT START OF YEAR	25.687	93245.555	
SOIL WATER AT END OF YEAR	24.945	90551.969	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.002	0.00

****

****

ANNUAL TOTALS FOR YEAR 45

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.06	47407.797	100.00
RUNOFF	1.022	3708.819	7.82
EVAPOTRANSPIRATION	10.107	36687.531	77.39
PERC./LEAKAGE THROUGH LAYER 2	0.261829	950.440	2.00
AVG. HEAD ON TOP OF LAYER 2	1.3212		
CHANGE IN WATER STORAGE	1.670	6061.027	12.78
SOIL WATER AT START OF YEAR	24.945	90551.969	
SOIL WATER AT END OF YEAR	26.615	96613.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.020	0.00

****

****

ANNUAL TOTALS FOR YEAR 46

	INCHES	CU. FEET	PERCENT
PRECIPITATION	10.02	36372.605	100.00
RUNOFF	0.689	2499.377	6.87
EVAPOTRANSPIRATION	9.791	35540.922	97.71
PERC./LEAKAGE THROUGH LAYER 2	1.208018	4385.106	12.06
AVG. HEAD ON TOP OF LAYER 2	2.9061		
CHANGE IN WATER STORAGE	-1.667	-6052.788	-16.64
SOIL WATER AT START OF YEAR	26.615	96613.000	
SOIL WATER AT END OF YEAR	24.948	90560.211	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.013	0.00

****

****

ANNUAL TOTALS FOR YEAR 47

	INCHES	CU. FEET	PERCENT
PRECIPITATION	13.81	50130.301	100.00
RUNOFF	1.079	3915.139	7.81
EVAPOTRANSPIRATION	10.973	39832.051	79.46
PERC./LEAKAGE THROUGH LAYER 2	0.575141	2087.761	4.16
AVG. HEAD ON TOP OF LAYER 2	2.0007		
CHANGE IN WATER STORAGE	1.183	4295.331	8.57
SOIL WATER AT START OF YEAR	24.948	90560.211	
SOIL WATER AT END OF YEAR	26.131	94855.539	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.021	0.00

****

****

ANNUAL TOTALS FOR YEAR 48

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.51	27261.301	100.00
RUNOFF	0.088	317.894	1.17
EVAPOTRANSPIRATION	7.324	26584.881	97.52
PERC./LEAKAGE THROUGH LAYER 2	0.964041	3499.469	12.84
AVG. HEAD ON TOP OF LAYER 2	1.0808		
CHANGE IN WATER STORAGE	-0.865	-3140.946	-11.52
SOIL WATER AT START OF YEAR	26.131	94855.539	
SOIL WATER AT END OF YEAR	25.266	91714.594	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.003	0.00

****

****

ANNUAL TOTALS FOR YEAR 49

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.47	67046.109	100.00
RUNOFF	1.564	5676.140	8.47
EVAPOTRANSPIRATION	13.675	49640.437	74.04
PERC./LEAKAGE THROUGH LAYER 2	0.864157	3136.891	4.68
AVG. HEAD ON TOP OF LAYER 2	2.9650		
CHANGE IN WATER STORAGE	2.367	8592.638	12.82
SOIL WATER AT START OF YEAR	25.266	91714.594	
SOIL WATER AT END OF YEAR	27.619	100257.672	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	49.556	0.07
ANNUAL WATER BUDGET BALANCE	0.0000	0.005	0.00

****

****

ANNUAL TOTALS FOR YEAR 50

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.31	26535.301	100.00
RUNOFF	0.249	902.295	3.40
EVAPOTRANSPIRATION	8.612	31260.748	117.81
PERC./LEAKAGE THROUGH LAYER 2	1.337610	4855.524	18.30
AVG. HEAD ON TOP OF LAYER 2	3.7169		
CHANGE IN WATER STORAGE	-2.888	-10483.251	-39.51
SOIL WATER AT START OF YEAR	27.619	100257.672	
SOIL WATER AT END OF YEAR	24.745	89823.977	
SNOW WATER AT START OF YEAR	0.014	49.556	0.19
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE   0.0000   -0.015   0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS   1 THROUGH   50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.25	0.30	0.58	0.97	1.07	0.52
	1.61	1.05	0.92	1.53	0.44	0.20
STD. DEVIATIONS	0.16	0.14	0.32	0.62	0.88	0.45
	1.29	0.67	0.69	1.35	0.32	0.13
RUNOFF						
TOTALS	0.000	0.002	0.041	0.134	0.026	0.004
	0.090	0.008	0.026	0.094	0.022	0.000
STD. DEVIATIONS	0.001	0.010	0.088	0.270	0.058	0.021
	0.193	0.021	0.051	0.270	0.103	0.001
EVAPOTRANSPIRATION						
TOTALS	0.238	0.295	0.504	0.994	1.157	0.574
	1.369	1.215	0.738	0.790	0.453	0.220
STD. DEVIATIONS	0.121	0.115	0.234	0.525	0.763	0.343
	0.975	0.751	0.579	0.384	0.197	0.124
PERCOLATION/LEAKAGE THROUGH LAYER 2						
TOTALS	0.0408	0.0304	0.0299	0.0308	0.0327	0.0307
	0.0303	0.0388	0.0363	0.0474	0.0539	0.0469
STD. DEVIATIONS	0.0537	0.0459	0.0493	0.0486	0.0494	0.0472
	0.0473	0.0543	0.0504	0.0522	0.0547	0.0550

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	1.0610	0.8283	0.7607	1.0680	1.1210	0.9401
	1.0310	1.2595	0.9848	1.1076	1.9361	1.3605
STD. DEVIATIONS	1.7580	1.4785	1.4836	2.2757	2.3125	1.9432
	1.8957	2.0745	1.6459	1.6912	3.1091	2.0759

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	INCHES	CU. FEET	PERCENT
PRECIPITATION	9.44 (2.493)	34278.1	100.00
RUNOFF	0.446 (0.4871)	1619.15	4.724
EVAPOTRANSPIRATION	8.548 (1.6436)	31029.04	90.521
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.44895 (0.48258)	1629.705	4.75436
AVERAGE HEAD ON TOP OF LAYER 2	1.122 (1.547)		
CHANGE IN WATER STORAGE	0.000 (1.3907)	0.20	0.001

****

♀
****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 50

	(INCHES)	(CU. FT.)
PRECIPITATION	2.22	8058.600
RUNOFF	1.003	3641.5430
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.004677	16.97779
AVERAGE HEAD ON TOP OF LAYER 2	18.000	
SNOW WATER	1.73	6284.2925
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4640	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1870	

****

♀
****

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(INCHES)	(VOL/VOL)
1	4.2489	0.2360
2	20.4960	0.4270

SNOW WATER 0.000

****
****

APPENDIX D

FATE AND TRANSPORT EVALUATION OF RESIDUAL SOLVENT IN SAND TAILINGS
AND
TAILINGS QUALITY CONTROL

FATE AND TRANSPORT EVALUATION OF RESIDUAL SOLVENT IN SAND TAILINGS

American Sands Energy Corporation (American Sands) has developed a proprietary extraction process to separate crude oil from oil sands using a proprietary solvent. This solvent is denser than water and has a low water solubility. The process produces tailings that consist of dry, clean sand as a byproduct. Based on pilot testing results, the sand tailings will contain between 2 and 25 parts per million (ppm) of the proprietary solvent. The consistency of the tailings is coarse grained sand with a very low organic carbon content after processing. It is estimated that approximately 14 million tons of sand tailings will be generated and placed in the permanent tailings impoundment over a five year period. American Sands plans to place the sand tailings into a lined impoundment that is sloped toward a leachate collection basin and is equipped with a weeping tile system designed to collect fluid accumulating within the impoundment area delivering it to the collection basin. The impoundment liner will consist of a clay barrier with very low permeability (10^{-7} cm/sec). The system in its entirety will be designed to exclude water from the tailings while collecting water that does enter the tailings and delivering it to the collection basin and thereby excluding it from the environment. An analysis was conducted to evaluate the behavior of residual solvent remaining in the tailings impoundment. The evaluation consisted of: (1) performing quantitative calculations to estimate the mass of solvent contained in the tailings in the impoundment, (2) estimating the retention capacity of the sand tailings to evaluate how much solvent can be held immobile in the pore space of the sands, (3) comparing the mass of solvent to the retention capacity to estimate whether sufficient mass of solvent will be present to allow downward vertical migration of free phase solvent, and (4) qualitatively evaluating the fate of any free phase solvent that may exist in the impoundment.

Mass of Solvent in Tailings Impoundment

The mass of solvent (M_S) in the tailings impoundment was estimated using the total mass of tailings anticipated to be produced over the five-year lifetime of the tailings impoundment (M_T) and the concentration of solvent in the tailings at the maximum allowable level (25 ppm) as opposed to that level measured during pilot testing (2 ppm). This was accomplished by multiplying the total mass of sand tailings by the maximum solvent concentration as follows:

$$M_T = (14 \times 10^6 \text{ tons})(2000 \text{ lb/ton})(453.6 \text{ g/lb})(1 \text{ kg}/1000 \text{ g}) = 13 \times 10^9 \text{ kg tailings}$$

$$M_S = (13 \times 10^9 \text{ kg})(25 \text{ mg/kg solvent})(1 \text{ kg}/10^6 \text{ mg}) = 3.3 \times 10^5 \text{ kg solvent}$$

Therefore, the total mass of solvent in the tailings impoundment is estimated to be <u>3.3×10^5 kg</u> at the conclusion of the tailings impoundment based on the assumption that the process will operate producing sand with the maximum allowable residual solvent concentration (25 ppm) as opposed to that measured during pilot plant operations (2 ppm). Assuming the continuous production of sand over the 5 year period with a residual solvent concentration as observed in pilot plant operations (2 ppm), the total mass of solvent in the tailings impoundment would be 2.6×10^4 kg. It is therefore fair to assume that the actual solvent content of the tailings pile will be between 3.3×10^5 kg and 2.6×10^4 kg.

Retention Capacity of Impoundment Sand Tailings

The Retention Capacity is the volume of solvent that will be held immobilized in the pore space of the sand tailings (Liters solvent/m^3 porous media). A certain quantity of free phase solvent will be immobilized due to interfacial tension within the sand pore space. According to Adamski, et al (2013), Retention Capacity (RC) in unsaturated conditions can be calculated as follows:

$$RC = (S_{or})\eta \times 1000,$$

where, S_{or} = Residual Saturation
η = Soil Porosity

Residual saturation is defined as the volume of non-aqueous phase liquid/volume of voids in the porous media. Residual saturation values have been measured in multiple laboratory experiments (Adamski, et al, 2013). Residual saturation and porosity values from experiments conducted by Wilson et al (1990) were used in these calculations because the experiments were conducted on disturbed, unsaturated sands with low organic carbon content. Of all the experiments reviewed, these conditions appear to best represent the conditions anticipated for the American Sands tailings. These literature values estimate residual saturation and porosity values of 0.091 and 0.33, respectively for these conditions. Using these values, the Retention Capacity was calculated as follows:

$$RC = (0.091)(0.33) \times 1000 = 30 \text{ Liters solvent/m}^3 \text{ tailings}$$

The volume of solvent (V_S) that can remain trapped in the pore space was calculated by multiplying the Retention Capacity by the volume of tailings. The volume of tailings (V_T) was calculated by dividing the tailings mass by its bulk density (ρ_T) and applying the appropriate conversion factors. Tailings bulk density was measured by Inberg Miller Engineers and found to range from a minimum of 89.3 lb/ft^3 to a maximum of 94.7 lb/ft^3 (see attached laboratory report). An average of the maximum and minimum values was used for the calculations (ρ_T = 92 lb/ft^3). The unit conversion for bulk density was performed as follows:

$$\rho_T = (92 \text{ lb/ft}^3)(1 \text{ ft/12 in})^3(1 \text{ in/ 2.54cm})^3(453.6 \text{ g/lb}) = 1.5 \text{ g/cm}^3$$

The volume of tailings was calculated using the measured average bulk density as follows:

$$V_T = (13 \times 10^9 \text{ kg})(1 \text{ cm}^3/1.5 \text{ g})(1000 \text{ g/kg})(1 \text{ m/100 cm})^3 = 8.7 \times 10^6 \text{ m}^3 \text{ tailings}$$

Volume of solvent residual is therefore:

$$V_R = (RC)V_T = (30 \text{ L/m}^3)(8.7 \times 10^6 \text{ m}^3) = 2.6 \times 10^8 \text{ L}$$

Converting to mass using the solvent density of 1.33 kg/L obtained from the MSDS provided by American Sands:

$$M_{RC} = V_R \rho_S = (2.6 \times 10^8 \text{ L})(1.33 \text{ kg/L}) = 3.5 \times 10^8 \text{ kg}$$

Therefore, the capacity of the sand tailings for immobilizing the solvent is 3.5×10^8 kg of immobile solvent, i.e. the solvent should be held in the pore space but unable to drain under the force of gravity.

Comparison of Tailings Retention Capacity to Actual Solvent Mass

Comparing the estimated mass of solvent in the tailings after processing, which is from 2.6×10^4 kg to 3.3×10^5 kg, to the retention capacity of the sand tailings (3.5×10^8 kg), the calculations indicate that the capacity for immobilizing the solvent far exceeds the actual amount of solvent anticipated to be present. Therefore, it is reasonable to conclude that any residual solvent will remain immobile in the sand tailings and will not travel to the bottom of the impoundment.

Free Phase Solvent Behavior

Free phase solvent is very unlikely to be introduced at sufficient quantities to allow downward vertical migration. However, if mobile free phase solvent does enter the impoundment, or if heterogeneities or any other phenomena exist that allow free phase solvent migration, the impoundment is designed to allow preferential flow of all liquids into the retention basin. The impoundment liner will consist of a clay barrier with very low permeability (10^{-7} cm/sec). A weeping tile drain will be placed above the clay liner at the bottom of the impoundment. These structures provide an effective barrier against downward vertical migration and a preferential flow path (weeping tile drain) that will direct liquid flow into the retention basin. The construction phase of the project will have very strict quality assurance/quality control program to ensure proper construction. Therefore, based on a qualitative evaluation, it is unlikely that free phase solvent will migrate vertically past the clay liner. Any liquids draining from the impoundment will be collected in the retention basin.

References

Adamski, Kremesec, and Charbeneau, *Residual Saturation: What is it? How is it measured? How should we use it?*, Group Environmental Management (BP Affiliate), March 2013.

Wilson, Conrad, Mason, Peplinski, and Hagan, *Laboratory Investigation of Residual Liquid Organics*, EPA/600/6-90/004, April 1990.

US Department of Labor, Occupational Health Administration, *Material Safety Data Sheet (MSDS), Product UOR-1776*, September 22, 2014.

Aggregate-Soil Testing Summary

Inberg-Miller Engineers
350 Parsley Blvd
Cheyenne WY 82001
Ph: 307-635-6827
Fax: 307-635-2713
cheyenne@inberg-miller.com

Client:	Mine Engineers, Inc.	**IME Sample No:**	**16484-2**
Address:	3901 South Industrial Rd.	**Sampled By:**	Client
	Cheyenne, WY 82007	**Sample Date:**	
		Date Received in Lab:	12/19/2013
Attention:	Eldon Strid	**Type of Material:**	
		Source:	American Sands Energy - Utah
IME Project No:	16484-HM	**Sample Description:**	Light brown fine SAND
Project Name:	General Testing		
Project Location:			
		Report Date:	1/15/14
Sample Location/ID:	American Sands Energy - Utah	**Reviewed By:**	MTJ

Particle Size Analysis
ASTM C117 & C136

Sieve	% Passing	Specification
2 1/2" (63.5mm)		
2" (50.8mm)		
1 1/2" (37.5mm)		
1" (25mm)		
3/4" (19mm)		
1/2" (12.5mm)		
3/8" (9.5mm)		
No. 4 (4.75mm)	100%	
No. 8 (2.36mm)	100%	
No. 16 (1.18mm)	99%	
No. 30 (600µm)	98%	
No. 40 (425µm)		
No. 50 (300µm)	87%	
No. 100 (150µm)	21%	
No. 200 (75µm)	9.6%	
0.020 mm (20µm)		

Atterberg Limits
ASTM D4318

Test	Result	Specification
Liquid Limit (%)		
Plastic Limit (%)		
Plasticity Index (%)		

Remarks:

Other Testing

Test	Result	Specifications /Notes	ASTM
Fineness Modulus:	0.95		C136
Moisture Content (%):	0.1%	(from sieve sample)	D2216
Relative Density (pcf)			D4254
Minimum Density	89.3		
Maximum Density	94.7		
Angle of Repose			
Moisture Content (%)			
0%	26.5°		
4%	33.8°		
6%	37.7°		
Specific Gravity	**Fine /**	**Coarse**	
Absorption %			C128/C127
Bulk (Dry)			C128/C127
Bulk (SSD)			C128/C127
Apparent			C128/C127

TAILINGS QUALITY CONTROL

<u>Objectives:</u>

One of our system's objectives is to evaporate the solvent off the sand and condense and reuse the solvent, before the sand is disposed into the dry tailings impoundment. To do so, we will implement two operating practices to help minimize solvent losses: 1) Process sand with a large margin between the minimum required and actual operating conditions and 2) Continuously monitor sand quality through instrumentation and operator observation. These quality controls will help confirm the sand solvent content.

<u>Process:</u>

Sand will be dried under a vacuum (-6 psig) at an elevated temperature (300°F). This will drive all solvent and any trace water in the sand to the vapor state. Solvent vapors driven off the sand will be condensed and used in the process, as described in the Groundwater Discharge Permit Application. Water driven off the sand will be condensed and used for dust control.

Figure 1 demonstrates the required and actual sand operating conditions. Specifically, it demonstrates two boiling-point curves: one for the solvent and one for water. Sand fed to the dryers will be wetted with solvent from the washing process but will have little or no water on it. The figure also indicates the point at which a process alarm will inform personnel of an upset condition, such as a drop in temperature or a rise in pressure. The following operating parameters are shown on Figure 1:

1. Sand will be processed at 300°F and -6 psig
2. Water boils off at 186 °F at -6 psig
3. Solvent boils off at 127 °F at -6 psig
4. The system will be equipped with alarms at the following set points:
    i. Low temp alarm: 275°F (and falling)
    ii. High pressure alarm: -5 psig (and rising)
5. At the normal operating temperature, the system will operate with 173 °F of superheat, with respect to the solvent
6. At the low temperature alarm, the system will operate with 148 °F of superheat with respect to the solvent
7. At the high pressure alarm, the system will operate with 169 °F of superheat with respect to the solvent

The low temperature and high pressure alarm systems will be used as process safeguards, to help guarantee proper operation conditions and to maintain a clean sand product. As explained at the end of this document, the final sand product will be subject to quality assurance checks prior to moving from the plant to the sand pile.

As shown in Figure 1, the system will continuously operate above the temperature required to evaporate the solvent off the sand. In addition, at the normal operating pressure, the boiling point of water is 60°F above the boiling point of the solvent. With these operating parameters and safe-guards in place, there will always be several indicators available to demonstrate the solvent is evaporated from the sand. These indications are as follows:

1. **Sand Water Content:** We will monitor the water content of the sand using a probe system (see attached). When the probe system indicates the sand is dry with respect to water, it can safely be assumed that the sand is also free of solvent. As can be seen from figure 1, the solvent will evaporate off before the water does, or the water will only evaporate after the solvent. This assumption is valid due to the lower boiling temperature of the solvent when compared to water. Pilot plant operations have shown that if the process produces wet sand, the flow of sand and the process will stop. Due to constraint, the production of solvent wet sand will not occur.
2. **Sand Odor:** Operations will inspect the sand on an hourly basis, log their observations and take measures as needed should sand quality not be sufficient to meet the companies commitments.
3. **Gas Detection:** The sand storage pile will be equipped with a gas detection system (see attached) capable of detecting solvent vapors in the air above the sand down to a minimum concentration of 50 ppm (in air). Reading's will be collected every five minutes and logged electronically into a data logging system. Should a reading of 50 ppm be detected, an alarm will be sounded and operations shall take the necessary measures to maintain a clean sand product.

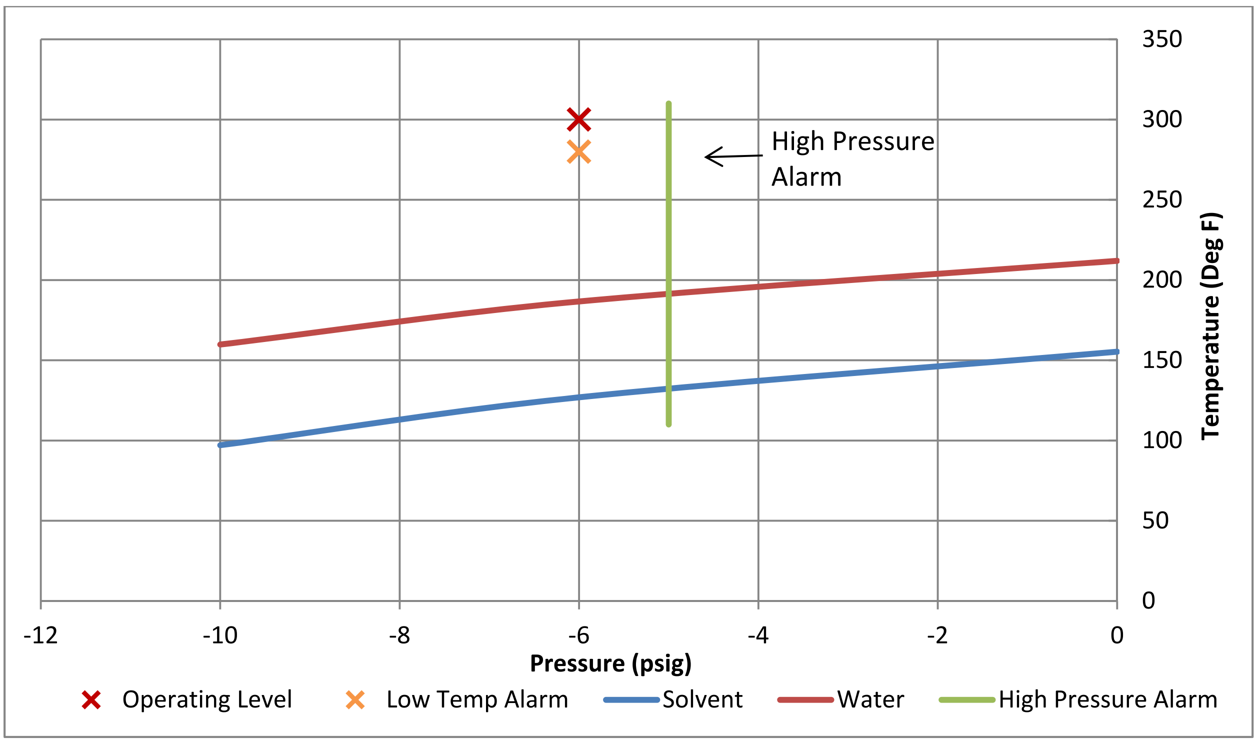


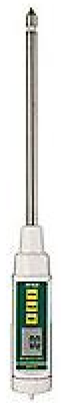
Figure 1: Solvent and Water Boiling-Point Curves vs. Pressure

Quality Assurance Processes:

1. The moisture probe will be used to inspect and record the moisture content of each load of sand moved from the plant to the tailings pile. In this way, an inspection will be performed for every 60 tons of sand produced resulting in 166 such inspections being performed each day. Moisture is not to exceed 10%. If moisture content exceeds 10% operations will be adjusted. Additional tailings sampling is further discuss in the Sample and Analysis Plan (SAP) in the Groundwater

Discharge Permit Application, Appendix F. Actual moisture readings will be recorded as observed.

2. Hourly the sand will be inspected by operations personal. The observed quality of the sand recorded in the plant operating logs.
3. Gas detection equipment will collect solvent vapor concentration readings above the sand pile and archive those to a server for at least a year. Best available technology (BAT) will be used to detect solvent vapors in air. At time of writing, BAT is based on gas chromatography and can detect solvent vapors in air down to 50 ppm in air with a minimum sampling time of 5 minutes. Using the then current BAT, if a solvent is found in the air at the minimum detectable concentration, an alarm will sound and operators will intervene to reestablish proper sand drying practices. All plant alarms will be logged electronically.
4. A sand sampling and analysis program will be established prior to startup to provide a statistically relevant analysis of the sand quality and provide a record of the solvent deposited to the disposed sand. It is anticipated that upon startup the sand will be sampled daily and analyzed. Operating data will also be collected daily and recorded against the results of the analysis of each sample thereby establishing a correlation between sand quality and plant operating conditions. After a record of successful sand quality has been established showing sand is being produced with a residual solvent concentration of 25 ppm or less, the operating data collected to that point will be analyzed and a correlation will be established between good sand quality and operating conditions. These operating conditions if more stringent that those outlined herein will be adopted as the new operating envelope for the process. Following the completion of that work, the program will revert to a second tier of testing frequency. It is anticipated that at that point every quarter a series of samples will be taken from the sand pile and subjected to analysis for the presence of solvent by an independent laboratory. The sampling and analysis program will be designed to collect samples in a pattern and quantity in order to produce a statistically significant addition to the quality assurance program. The details of this program will be documented and submitted to the department for approval prior to startup.



Rollover image to zoom detail

EXTECH

EXTECH® Soil Moisture Meter

Showing **1** results refined by **a search term**.

Tough on Equipment? This Heavy Duty Probe Takes What You Dish Out!
Fast, handy and ready to perform! ***Extech Soil Moisture Meter*** lets you check for over-watering and overall moisture content in soil and compost to give you a leg up on healthy plant growth. ...

See more details »

Item #: 174744

Write a Review

Mfr. Model #: MO750

In stock!

$266.50

Qty

Add To Cart

Add to Shopping List

100% Satisfaction Guaranteed
Hassle free returns, no restocking fees

DETAILS

EXTECH® Soil Moisture Meter

Tough on Equipment? This Heavy Duty Probe Takes What You Dish Out!

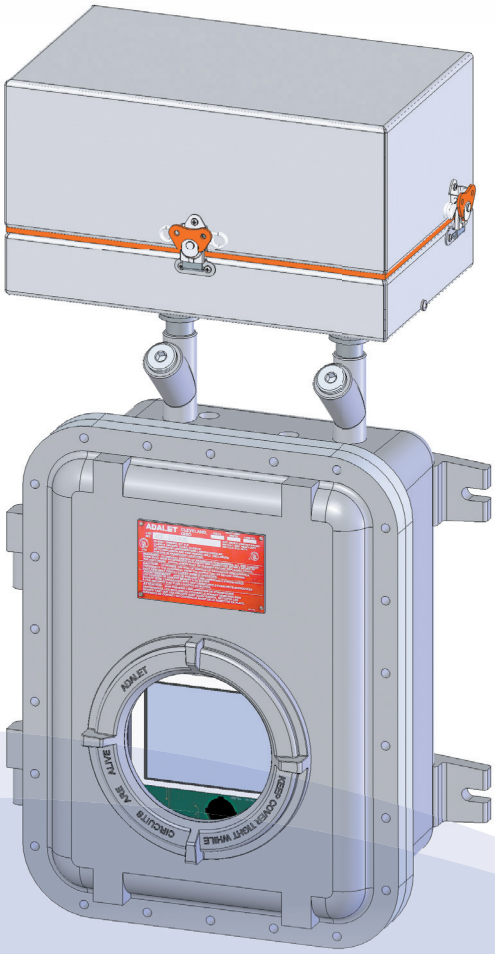
Fast, handy and ready to perform! ***Extech Soil Moisture Meter*** lets you check for over-watering and overall moisture content in soil and compost to give you a leg up on healthy plant growth. Functions with three simple buttons: Power, Hold and Record. Hold freezes reading on display so you can see what you get if you need to measure in a place where you can't see the unit in use. Record allows you to save min./max. moisture readings. Water-resistant housing. Range: 0 to 50%. Resolution: 0.1%. Accuracy: ±(5% + 5 digits) full scale. Includes 4AAA batteries and sensor cap. Measures 14.7"L overall.

Need Help / More Info?

Email us or call a **Product Pro™** at 1-800-241-6401.

This item appears on page 240 of the Ben Meadows Company (JB5) catalog. View in eCatalog.

Galvanic Applied Sciences Inc.



PLGC3 NATURAL GAS CHROMATOGRAPH

Rugged

Custody Transfer

Easy to Service

Precise

Fast

Easy to Use

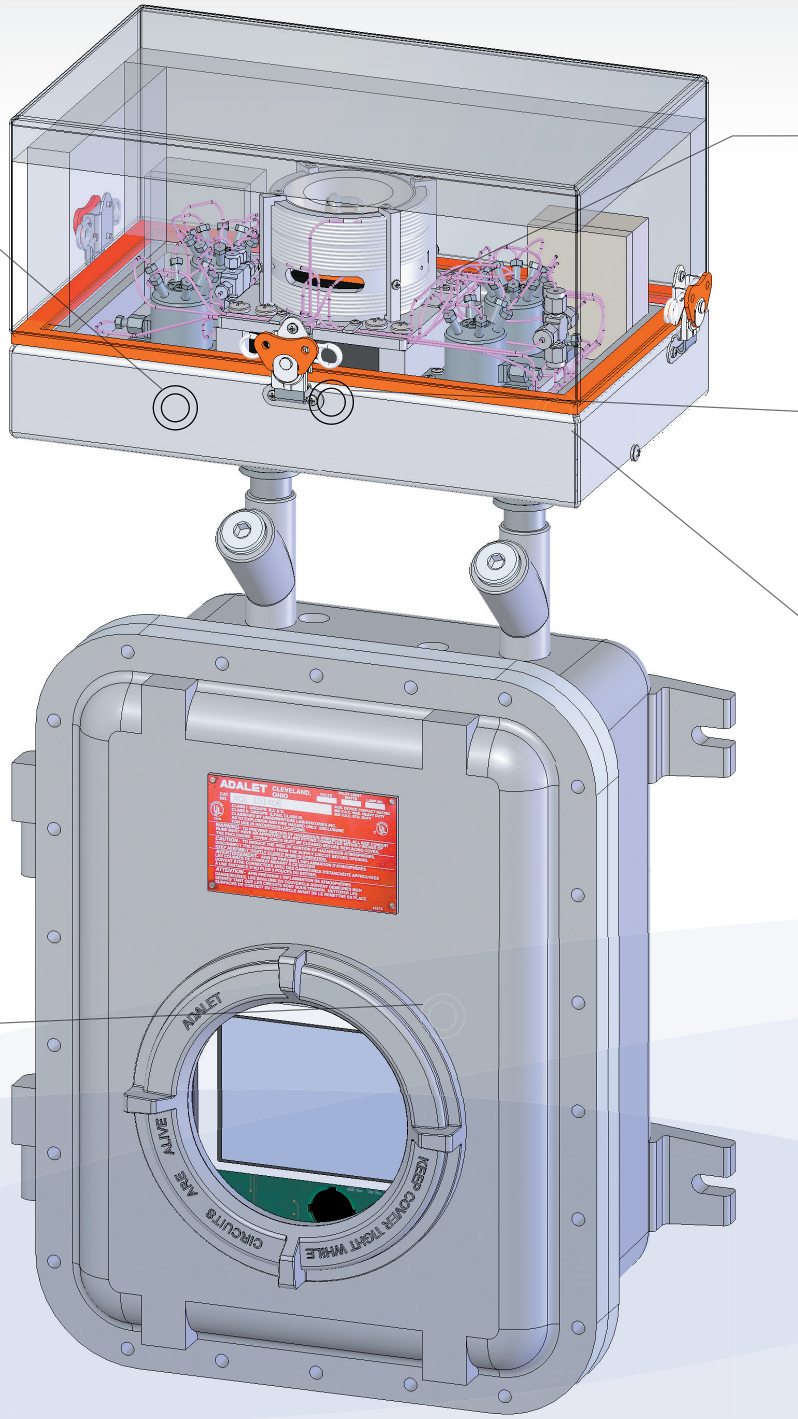
Value

Multi-Stream

Low Maintenance

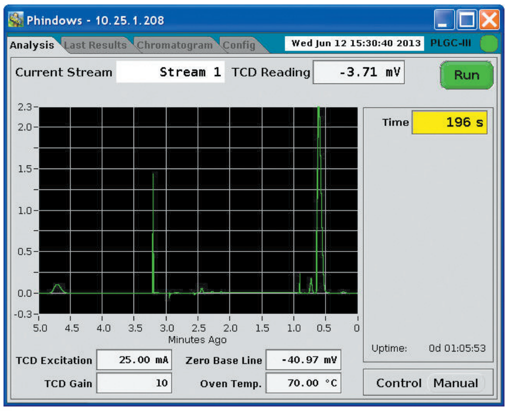
Single, Compact Unit

FEATURES



Rugged Thermistor Based Detector.

The PLGC3 thermal conductivity detector (TCD) is less susceptible to fouling as compared to micro-machined technology. The TCD will not burn out on loss of carrier gas and it is able to withstand corrosive compounds such as H_2S.

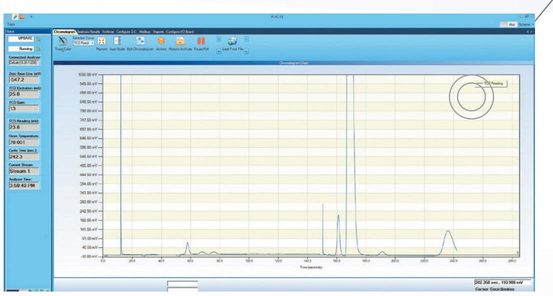


High Resolution Display.

A high resolution 640 x 480 VGA color display provides operator with at a glance status and results. Items such as chromatograms, analysis results, previous calibration information, and alarm statuses can be viewed. Menu access is done via an intrinsically safe Keypad.

Operator Interface .

The Windows based software provides a powerful tool for operation, diagnostics and data handling. The operator can view and save chromatograms and analysis results, review or modify analysis settings, set up networking, generate reports, as well as several other parameters.



Analyzer Networking and Data Communications.

The PLGC3 will support Ethernet Modbus TCP/IP as well as up to 8 additional serial ports. A standard industry compliant modbus list may be selected or customized modbus lists may also be easily generated. Multiple Modbus lists can be created and acccessed via Scada. The TCP port can be operated as either master or slave.

Data Archiving.

The PLGC3 has expandable memory capability up to 32 GB for the storage of individual analysis, hourly averages, daily averages and chromatograms. Calibration/validation chromatograms may also be stored for later viewing. A complete audit trail is also incorporated.

Airless Heat Sink Oven.

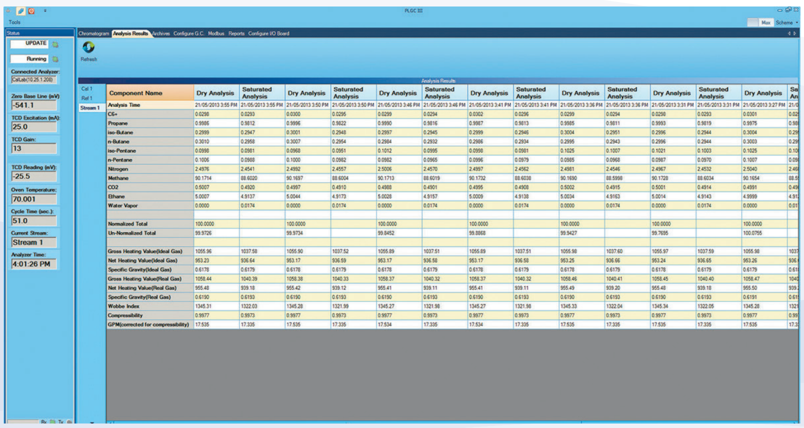
An airless heat sink oven maintains a constant temperature of columns, valves and TCD for reliable and accurate results.

Durable Valves.

The chromatograph uses industry-leading valves. Tough and long lasting, the valves are rated for up to 1 million injections. Simple mechanical design makes it easy and inexpensive to service.

Micro-packed Columns.

Columns are manufactured by Galvanic to ensure quality and consistency. Consistent and reproducible product ensures reliable results over the lifetime of the chromatograph.



Reporting.

A report generating feature allows users to produce printable reports of standard measured and calculated values based on GPA or ISO standards. These reports can also be customized to included location, technician name and comments.

Auto Calibration and Validation.

The PLGC3 supports auto calibration as well as validation. The validation feature allows the user to analyze the calibration standard without adjusting response factors or retention times. The PLGC3 will support two calibration standards for enhanced measurement of streams with widely varying hydrocarbon concentrations.

BENEFITS

PRECISE	Excellent repeatability across full operating temperature range providing +/- 0.25 Btu per MCF.
FAST	Rapid 3-4 minute response time.
RUGGED	Field proven design that is fully field serviceable.
LOW MAINTENANCE	Uses durable valves and Galvanic micro-packed columns. Minimal maintenance required.
EASY TO USE	Windows-based graphical-user interface PC software allows local or remote operation.
EASY TO SERVICE	Oven design provides easy access to all components. Each component is fully serviceable reducing costly module replacement.
MULTI -STREAM	Powerful electronics platform and unique design allows up to 8 streams of varying compositions.
VALUE	Flexibility , Ease of Use, Field Serviceability and rugged design provide a cost effective solution.

APPLICATIONS

Transmission / Custody Transfer

> Custody transfer stations
> Metering stations

Distribution

> City gate measurement
> Large industrial / commercial consumers

Gas Processing

> Inlet Gas
> Sales / Outlet Gas

Upstream / Field Gathering

> Sour Gas Pipeline Blending

NGL, GTL and LNG Plants

> De-ethernizer
> De-propenizer unit
> De-butzanizer unit
> Liquids / condensate unit

Bio-Gas Plants, Land-Fill Gas Recovery Units, Power Plants

> Power Generation
> Gas Turbine Control

Amine Units

> Acid Gas

PLGC3 SPECIFICATIONS

Analysis Configurations	C6+: Methane, Ethane, Propane, iso-Butane, n-Butane, iso-Pentane, n-Pentane, Hexanes Plus, Nitrogen, Carbon Dioxide C6+ plus Oxygen and Carbon Monoxide: Methane, Ethane, Propane, iso-Butane, n-Butane, iso-Pentane, n-Pentane, Hexanes Plus, Oxygen, Nitrogen, Carbon Dioxide, Carbon Monoxide C7+: Methane, Ethane, Propane, iso-Butane, n-Butane, iso-Pentane, n-Pentane, Hexanes, Heptanes Plus, Nitrogen, Carbon Dioxide C7+ plus Oxygen and Carbon Monoxide: Methane, Ethane, Propane, iso-Butane, n-Butane, iso-Pentane, n-Pentane, Hexanes, Heptanes Plus, Oxygen, Nitrogen, Carbon Dioxide, Carbon Monoxide neo-Pentane: Can be added to any of the above configurations H_2S: Can be added to any of the above configurations
Measurement Range	800 -1500 BTU/scf (29.8 MJ/m3 to 55.9 MJ/m3)
Calculations	GPA2172-09 (or newest) and GPA2145-09 (or newest) or ISO6976
Analysis Time	4 to 5 minutes
Repeatability	+/- 0.25 BTU/scf per 1000 BTU/scf (+/- 0.0093 MJ/m3 per 37.3 MJ/m3) over temperature range of 0 oF to 130 oF (-18 oC to +55 oC)
Environment	0 oF to 130 oF (-18 oC to +55 oC) 0 – 95 % relative humidity non-condensing
Input Voltage	24 VDC Standard 90 – 240 VAC 50/60 Hz Optional
Power Consumption	100 watts startup, 50 watts running
Communication	3 – Serial Ports (2 RS 232, 1 RS 485), Modbus RTU or Modbus ASCII compliant (up to 5 additional serial ports optional) 1 – Ethernet port, Modbus TCP Compliant 1 – Ethernet port for local GUI (Direct Connect)

Modbus Protocols	Modicon 16 Modicon 32 (with floating point) Enron/Daniel
Outputs	4 – Field Replaceable Form C Relays (SPDT 8A 250 VAC) 4 - 4-20 mA (User selectable, loop powered or self powered with 3 way isolation) 1 – PID controller with PWM control 3A/280VAC or 60VDC max.
Inputs	3 – Universal Analog Inputs with programmable gain and excitation (RTD, pressure transducer, 4-20mA etc.) 2 – Isolated Digital Inputs WET 12-24VDC 2 – Digital Inputs DRY
Local Display	Industrial VGA 640 x 480, 5.7”, color TFT display with intrinsically safe keypad (20 keys), and 8 LED status indicators.
Data Storage	2 GB for analysis results, hourly averages, daily averages, chromatograms
Oven	Airless heat sink oven
Valves	6 port Valco DV22 10 port Valco DV22
Detector	Thermistor based Thermal Conductivity Detector (TCD), with software programmable excitation, gain/attenuation, and zero offset.
Streams	Up to 8 plus calibration
Certifications	CSA Class 1, Division 1, Groups BCD CSA Class 1, Division 2, Groups BCD
Dimensions	Class 1 Division 1: 33” (838 mm) H x 27” (686 mm) W x 11” (279 mm) D Class 1 Division 2: 33” (838 mm) H x 27” (686 mm) W x 11” (279 mm) D
Weight	Class 1 Division 1: 120 lbs (54.4 kg) Class 1 Division 2: 85 lbs (38.6 kg)
Carrier Gas	UHP Helium, 80 to 100 psig (5.5 barg to 6.9 barg), 0.042 scfh (20 cc/min) or UHP Hydrogen, 80 to 100 psig (5.5 barg to 6.9 barg), 0.042 scfh (20 cc/min)

REV AUGUST 2013

ISO 9001:2000
Certified System
QMI-SAI Global
0020422:800260

GALVANIC APPLIED SCIENCES INC.

C US

7000 Fisher Road SE, Calgary, Alberta T2H 0W3
Tel: 403-252-8470 Fax: 403-255-6287 Email: info@galvanic.com

www.galvanic.com

APPENDIX E

SOLVENT MSDS SHEET

U.S. Department of Labor
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

SECTION I: - PRODUCTION INFORMATION

Product Name/Identifier:	UOR-1776
Product Number:	TS-101
Product Use:	Hydrocarbon Extraction Solvent
SUPPLIER:	UNIVERSAL OIL RECOVERY LLC 26027 S. Nottingham Dr. Sun Lakes, Arizona, 85248
EMERGENCY PHONE NUMBER:	(480) 239-7700
DATE PREPARED:	February 02, 2012, Revised Sept 22 2014

Read this MSDS prior to use or disposal of the product. Share this information with employees, customers, and other users of this product.

SECTION II: - CHEMICAL COMPOSITION

This product is a blend of various chemical components that are based upon and composed of non-carcinogenic chemical compounds.

None of these components or compounds are identified on the Ca1EPA List of Lists, Dated November 1991, or in the National Toxicology Program Annual Report on Carcinogens, Twelfth Edition 2011.

This chemical compound and its various applications are considered Trade Secrets and may be the subject of patents or patent applications. Upon the granting of the patent(s) related to the compound, the identity of the components may be released. Based upon the foregoing, at this time the identity of the components are considered to be protected as proprietary under the Uniform Trade Secrets Act.

Use maximum protection when handling the product, as detailed below.

SECTION III: - HAZARDS IDENTIFICATION

UOR-1776 is non-flammable and does not have a flash point, but its vapors can form a mixture that could be flammable at >4.0%-9.0% volume concentration with air.

INHALATION	May irritate nose, throat, and respiratory systems, with symptoms of headache, nausea, dizziness, coughing or shortness of breath. Prolonged overexposure may adversely affect the liver, kidney and respiratory, reproductive and central nervous systems.
EYES	May cause irritation with symptoms of redness, tearing, stinging
SKIN	Through cuts, punctures and abrasions; may cause irritation with symptoms of rash, burning, itching or swelling
INGESTION	Through accidental drinking or swallowing; may cause irritation of mouth and intestinal tract, with symptoms of nausea, vomiting or headaches. Aspiration into the lungs after ingestion could result in lung damage.

SECTION IV: - FIRST AID MEASURES

INHALATION	Immediately remove person to fresh air. If breathing stops, provide CPR rescue breathing. If breathing is difficult, administer oxygen by qualified personnel. Obtain medical attention immediately.
EYES	For direct eye contact, flush eyes with large quantities of running water for at least 15 minutes and obtain medical attention: 1) for external areas, treat as a burn due to the fact that the epidermal layer may blister from rapid de-oiling; 2) for direct eye contact, treat as an eye abrasion.
SKIN	Remove contaminated clothing and wash skin with mild soap and running water. If irritation persists, obtain medical attention. Wash clothing before re-use. For dry skin, apply hand lotion. Drying of exposed skin can be mitigated with a high oil / high lanolin / vitamin E lotion treatment.
INGESTION	If swallowed, DO NOT induce vomiting. Obtain medical attention immediately.

SECTION V: - FIRE-FIGHTING MEASURES

FLASH POINT:	None, per ASTM Methods
FLAMMABLE LIMITS:	4.0%-9.0% by volume in air
METHOD USED:	OSHA 29 CFR 1910.106 criteria
AUTO-IGNITION TEMPERATURE	>480° C
EXTINGUISHING MEDIA:	Water may not be effective Use carbon dioxide, dry chemical powder, alcohol foam or polymer foam
SPECIAL FIRE FIGHTING PROCEDURES	Wear NIOSH/MSHA-approved self-contained breathing apparatus and protective fire-retardant clothing to prevent eye and skin contact. Water may be used to cool containers and equipment exposed to heat or flame. Dike area to prevent runoff.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	Vapor may form a flammable mixture in a concentration of 4.0%-9.0% by volume in air. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion. Containers exposed to intense heat or flame may explode due to increased internal pressures.

SECTION VI: - ACCIDENTAL RELEASE MEASURES

Cordon off spill site and warn all people in vicinity. For large spills, evacuate and ventilate the effected site. If the product has contaminated the ground water, inform the appropriate authority. Wear self-contained breathing apparatus and recommended personal protective equipment. Contain spillage or leakage with dams or absorbent material to prevent migration into sewer, waterway or confined spaces. Dam and absorb spillages with earth, sand, or other non-combustible absorbent material (sawdust or vermiculite) and sweep into sealable containers for disposal in accordance with local, state, and federal disposal regulations.

SECTION VII: - HANDLING AND STORAGE

HANDLING	Avoid inhalation, skin and eye contact by wearing protective clothing, including safety glasses and non-rubber gloves. Use full face plastic shield to avoid injury from accidental splashing. Always wash hands and face thoroughly before eating, drinking, and smoking. Do not eat in the vicinity of operations.
STORAGE	Store in dry, ventilated, cool area in clearly labeled closed containers away from ignition sources and other incompatible chemicals

SECTION VIII: - EXPOSURE CONTROLS AND PERSONAL PROTECTION

EXPOSURE CONTROLS	Do not use in confined spaces without use of ambient or mechanical exhaust ventilation.
EXPOSURE LIMITS	OSHA Permissible Exposure Limit not established. A workplace exposure guideline of 99 ppm 8 hour time weighted average (TWA) is recommended based on information for compounds contained in the product.
EYE PROTECTION	Use safety goggles or full face shield.
RESPIRATORY PROTECTION	Use NIOSH-approved vapor respirators with carbon filters or self-contained breathing apparatus with full face shield, due to possible exposure to other reactive agents, if ventilation is insufficient or depending on concentration of product in air.
GLOVES AND CLOTHING	Wear cover-all uniforms and use non-rubber gloves that are resistant to the product (Teflon or polyethylene gloves)
OTHER PROTECTIONS	On-site safety-shower and eye-wash station

SECTION IX: - PHYSICAL AND CHEMICAL PROPERTIES

CHEMICAL FAMILY:	Trade-Secret Chemical Blend
APPEARANCE:	Clear, colorless or yellow liquid; mild odor
BOILING POINT (Degrees F):	<175° F
VAPOR PRESSURE: (mm Hg):	~110-114 mm fig at 20° C
VAPOR DENSITY (Air=1):	~4.2-44
SOLUBILITY IN WATER:	~0.22-0.27 g/100ml at 20° C
SPECIFIC GRAVITY (H_20 = 1)	1.30-1.33 at 20° C
MELTING/FREEZING POINT:	Less than at -74° F
FLASH POINT:	None
AUTO IGNITION TEMPERATURE:	>450° C

SECTION X: - REACTIVITY AND STABILITY DATA

STABILITY:	Stable under recommended storage and handling
CONDITIONS TO AVOID:	Avoid all sources of ignition, oxidation and sunlight
INCOMPATIBILITY:	May react with strong oxidizing agents, alkalis, bases, reactive metals and natural rubber.
HAZARDOUS DECOMPOSITION OR BY-PRODUCTS:	Carbon monoxide, carbon dioxide

SECTION XI: - TOXICOLOGICAL INFORMATION

Exposure may cause eye, nose and respiratory irritation.

LD50 Oral – Rat	>4000 mg/kg
LC50 Inhalation – Rat	>235,000 mg per m^3/one-half hour
Ames Test	Negative (no harmful results)
Eyes	Irritates
Skin	Irritates
Ingestion	Irritates mucous membranes
Inhalation	Irritates respiratory system
NTP / IARC / OSHA Listing	None (not on list of carcinogens)
Pre-existing Disorders	Pre-existing skin, lung, liver and kidney disorders may be aggravated by exposure

Component data showed no known teratogen, mutagen or other reproductive effects or genetic impairment.

SECTION XII: - ECOLOGICAL INFORMATION

The product is heavier than, and is immiscible in water. It should not be used or disposed of in any manner where it can enter or be mixed with ground or surface water.

SECTION XIII: - WASTE DISPOSAL

The product is heavier than, and is immiscible in water. It should not be used or disposed of in any manner where it can enter or be mixed with ground or surface water. All materials containing the product as well as the product itself, should be sealed in containers for disposal in accordance with all applicable local, state and federal regulations.

SECTION XIV – TRANSPORTATION INFORMATION

Shipping Information:
Not regulated as dangerous goods according to TDG Regulations or DOT Hazard Class. Not regulated as hazardous material according to 49 CFR Hazardous Materials Regulations.
Not regulated as dangerous goods according to ICAO Technical Instructions or IATA Regulations.

SECTION XV – REGULATORY INFORMATION

See Section XIV. This product's components are listed in and comply with TSCA requirements.

SECTION XVI – OTHER INFORMATION

The information presented herein is based on data from the component chemical suppliers, which is considered to be accurate to the best knowledge of Universal Oil Recovery LLC, as of the date of this Material Safety Data Sheet. Universal Oil Recovery disclaims all expressed or implied warranties or representations of any kind, including but not limited to the completeness of the foregoing data and safety information or applicability of the product for a specific use. Universal Oil Recovery LLC assumes no responsibility or liability for any damage or injury resulting from reliance on this information or from the use or misuse of this product or from any failure to adhere to recommended practices detailed herein. The user is responsible for determining if the product is suitable for the user's intended use, and assumes all risk and liability for such use and for ultimate disposal of the product, in compliance with all applicable federal, state and local regulations.

END OF MSDS

Avg. Liq. Density [lbmole/ft3]	0.606532
Cost Based on Flow [Cost/s]	0
Cp/(Cp - R)	1.060829
Cp/Cv	1.425443
Cp/Cv (Ent. Method)	1.317154
Cv [Btu/lbmole-F]	24.29583
Cv (Ent. Method) [Btu/lbmole-F]	26.29331
Cv (Semi-Ideal) [Btu/lbmole-F]	32.64648
Heat Capacity [Btu/lbmole-F]	34.63233
Heat of Vap. [Btu/lbmole]	13046.29
Kinematic Viscosity [cSt]	0.365614
Liq. Mass Density (Std. Cond) [lb/ft3]	68.01687
Liq. Vol. Flow (Std. Cond) [barrel/day]	0.992885
Liq. Vol. Flow - Sum(Std. Cond) [barrel/day]	0.992885
Liquid Fraction	1
Mass Cv [Btu/lb-F]	0.218207
Mass Cv (Ent. Method) [Btu/lb-F]	0.236147
Mass Cv (Semi-Ideal) [Btu/lb-F]	0.293207
Mass Density [lb/ft3]	67.96754
Mass Enthalpy [Btu/lb]	-566.892
Mass Entropy [Btu/lb-F]	0.194906
Mass Heat Capacity [Btu/lb-F]	0.311042
Mass Heat of Vap. [Btu/lb]	117.1722
Molar Density [lbmole/ft3]	0.610435
Molar Volume [ft3/lbmole]	1.638178
Molecular Weight	111.3429
Partial Pressure of CO2 [psia]	0
Partial Pressure of H2S [psia]	0
Phase Fraction [Act. Vol. Basis]	0
Phase Fraction [Mass Basis]	0
Phase Fraction [Molar Basis]	0
Phase Fraction [Vol. Basis]	0
Reid VP at 37.8 C [psia]	4.827108
Specific Heat [Btu/lbmole-F]	34.63233
Std. Gas Flow [MMSCFD]	1.29E-03
Std. Ideal Liq. Mass Density [lb/ft3]	67.53296
Surface Tension [dyne/cm]	25.48794
Thermal Conductivity [Btu/hr-ft-F]	6.63E-02
True VP at 37.8 C [psia]	4.827478
Viscosity [cP]	0.398057
Viscosity Index	-16.2888
Watson K	7.858378
Z Factor	3.97E-03

APPENDIX F

SEEP AND SPRING INVENTORY

AMERICAN SANDS ENERGY CORPORATION
PROPOSED BRUIN POINT MINE

SEEP AND SPRING INVENTORY

February 2014

American Sands Energy Corporation
4760 South Highland Drive, Suite 341
Salt Lake City, Utah 84117
(403) 650-5384

Prepared by:

JBR Environmental Consultants, Inc.
8160 South Highland Drive
Sandy, Utah 84093
(801) 943-4144

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level	cfs	cubic feet per second
GRR	Green River Resources	JBR	JBR Environmental Consultants
Ma	million years	NOI	Notice of Intent
UDOGM	Utah Division of Oil, Gas, and Mining		

GREEN RIVER RESOURCES
PROPOSED BRUIN POINT MINE

SEEP AND SPRING INVENTORY

Introduction

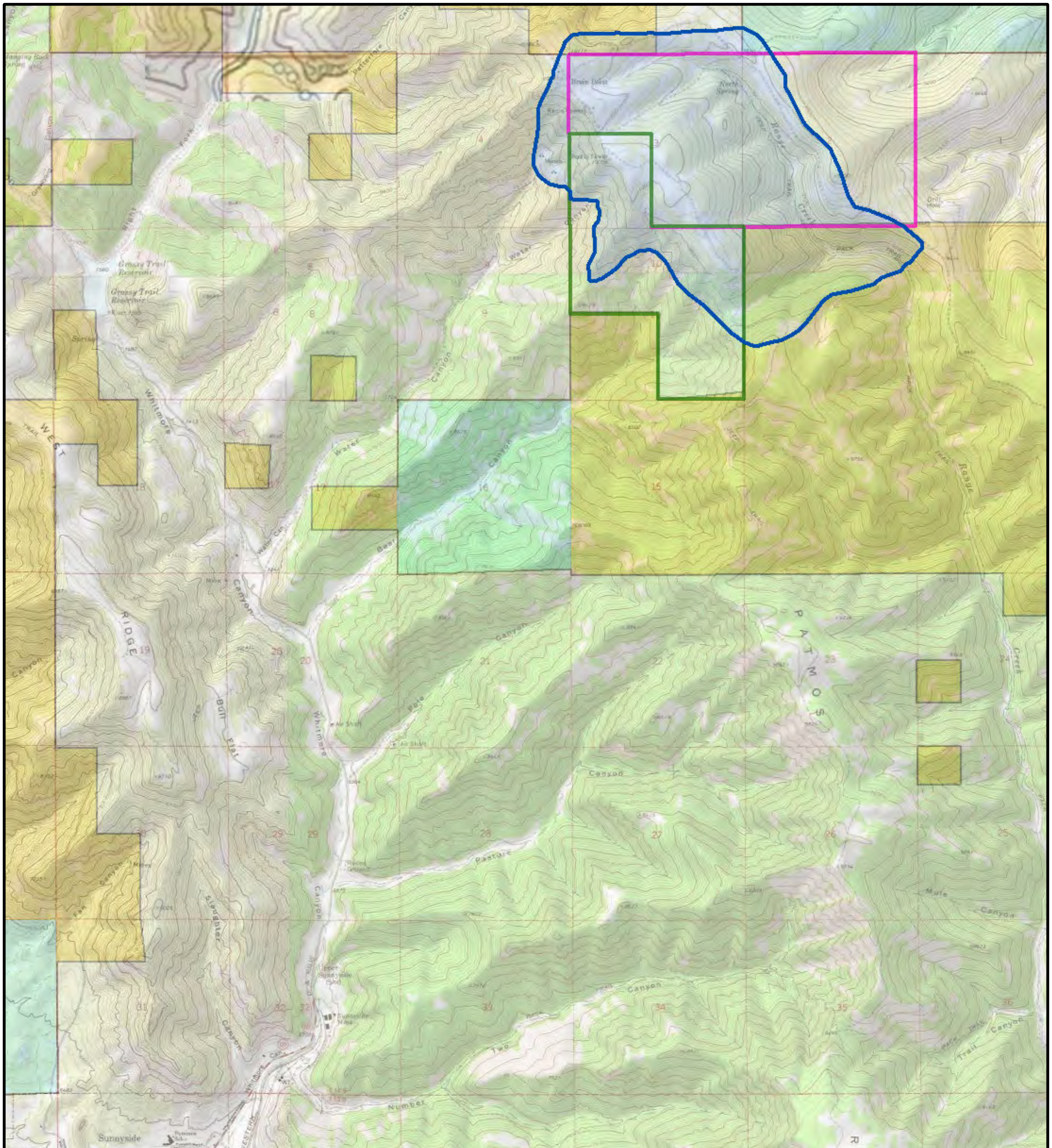
American Sands Energy Corporation (ASEC), a Utah corporation, is preparing a Notice of Intent (NOI) to commence large mining activities, to be submitted for review to the Utah Division of Oil, Gas, and Mining (UDOGM). ASEC proposes to develop an oil sands mine and an associated processing facility within a contiguous 1,760-acre lease area. ASEC plans to restrict their activities and development to private lands within the lease area. The limited amounts of water required for construction, mining, or processing operations would be purchased and trucked in for use at the site.

The ASEC lease area is located approximately six miles northeast of Sunnyside, Utah, in Carbon County, on Patmos Ridge directly east of Bruin Point (located at 39° 38' 38.87"N, 110° 20' 53.06"W). The property is located in the southwest portion of the Uinta Basin and consists of two adjacent parcels identified as the Hunt Lease and the Gibbs Lease. Both parcels are located in Township 14 South, Range 14 East, Salt Lake Base and Meridian. The Hunt Lease comprises all of Section 2 and the northwest, northeast and southeast quarter-sections of Section 3 (totaling approximately 1,120 acres). The Gibbs Lease consists of the southwest quarter-section of Section 3 and the northwest, northeast and southeast quarter-sections of Section 10 (totaling approximately 640 acres; **Figure 1**). The combined area of the two parcels totals approximately 1,760 acres).

This report presents the results of the seep and spring inventory in the ASEC lease area, conducted in October 2012. Relevant data from an initial hydrologic survey and sampling event in May 2012 is also included.

Inventory Boundary

The area included in the seep and spring inventory was determined by observations made during an initial hydrologic survey by JBR hydrologists in May 2012, as well as current knowledge of the proposed project surface disturbances and the extent of proposed underground mining. The latter information was approximated through standard angle of draw measurements applied to ASEC's summer 2012 mine plan. A conservative assumption was made that regardless of cover depth and geologic conditions, all lands above the mined area and extending outside it to a 30º angle of draw (UDOGM's default as stipulated under Utah regulations R645-301-525) were included. This analysis extended the Inventory Area to non-ASEC property to the north, east, and west of the property. Further, a buffer was applied to the west, east, and south to accommodate natural borders, property boundaries, and other physical features (**Figure 1**).



BASE MAP: USGS 1:24,000 TOPOGRAPHIC MAP (Accesseed at ArcGis.com)

Inventory Area

Gibbs Lease

Hunt Lease

Bureau of Land Management

Private

State

N

0.5 0.25 0 0.5 Miles

AMERICAN SANDS ENERGY CORP SUNNYSIDE TAR SANDS PERMITTING

FIGURE 1
SEEP AND SPRING INVENTORY BOUNDARY

JBR

DRAWN BY STopham	DATE DRAWN 10/09/12
SCALE 1 in = 1 miles	

This document is for reference purposes only and should not be used as a legal document. JBR makes no guarantees to the accuracy of the data contained herein or any loss resulting therefrom.

File Path:C:\Users\stopham\Documents\PROJECTS\American Sand\GIS\MXD\Working\AmericanSand_Figure1_Report.mxd

Background

The Sunnyside Tar Sands Area is located in central-east Utah, and was known from small commercial asphalt operations dating back to the 1890s and intermittent bitumen exploration programs by major oil and gas companies from the 1950s through 1980s.

ASEC and JBR Environmental Consultants, Inc. (JBR), met with UDOGM representatives in September of 2011 to kick off the project. During the meeting, ASEC presented its general mining strategy, and UDOGM and JBR discussed the requisite baseline data gathering. The UDOGM representatives referred to baseline requirements for underground coal mining permits in the vicinity of Sunnyside. In addition, intense scrutiny is expected for the Division of Water Quality (DWQ) permit, thus an inventory of seeps and springs within the Inventory Area was recommended. ASEC wishes to avoid any streams, wetlands, springs, or other waters of the U.S.

An initial hydrologic survey and water sampling event was conducted by two JBR hydrologists on May 30 and 31st 2012. The purpose of the sampling was to document flow conditions and water quality of the known major surface water occurrences in and near the lease areas. Other areas that were relatively easy to access were also observed for the presence or absence of surface water, in preparation for the seep and spring inventory.

Environmental Setting

General

The Inventory Area is located within the Book Cliffs and Roan Cliffs area in the Colorado Plateau Physiographic Province. The topography in the Inventory Area is mountainous, with nearly 2,000' of relief. Elevations range from approximately 8,200' above mean sea level (amsl) at the southern extreme of the property, to over 10,150' amsl at Bruin Point in the northwest. The area has an annual average temperature range from 15^{o} F to 88^{o} F, with local climate classified as sub-humid to semi-arid. Average annual precipitation includes 12.5" of rainfall, with September having the highest levels, and an additional 20" of snowfall occurring from November through March.

Geology

The Sunnyside Tar Sands are located along the crest of the Roan Cliffs near Bruin Point, which crests at an elevation of 10,131' amsl. The Roan Cliffs contain rocks of Paleocene and Eocene age (ca. 60-40 Ma). In the early stages of this time period a mountain range existed in central Utah while a sea was located in eastern Utah and Colorado. During a period of sea level regression the marine environment was replaced by a coastal plains fluvial environment. During subsequent orogenic events a large lake, Lake Uinta, formed in an intermontane basin. Sediment deposited in Lake Unita during the middle Eocene epoch (ca. 50-40 Ma) formed the sandstone and shale of the Green River Formation. The Green River Formation sandstones would later become the reservoir rocks for the bitumen of the Sunnyside Tar Sands.

The Green River Formation consists of three formal members subdivided on the basis of depositional environment: Parachute Creek Member (lake facies); Garden Gulch Member (shore facies); and Douglas Creek Member (delta facies). The Parachute Creek Member (lake facies) is dominated by gray shale and oil shale and contains limited volumes of bituminous sandstone. The member exists at the top of the Roan Cliffs and is up to 600' thick. The Garden Gulch Member (shore facies) is dominated by green shale and fossiliferous limestone containing ostracods, algal structures, and garpike fish scales and contains minor volumes of bituminous sandstone. The member is commonly 300' to 500' thick. The Douglas Creek Member (delta facies) is dominated by red shale, bituminous sandstone, non-bituminous sandstone, and minor fossiliferous limestone. The member is 1,500' to 2,000' thick.

Soils

Soils within the Inventory Area are comprised predominantly of the Senchert family, which is associated with natural grassland areas, and the Uintah-Toze families complex, which is associated with the naturally wooded areas of the Inventory Area (NRCS 2009). The Senchert family soils are found on plateaus and ridges and are generally 20 to 40 inches deep with parent material derived from colluvium and slope alluvium over residuum weathered from sandstone and shale. Soils are well-drained and organic matter is as high as eight percent. The soils are in the High Mountain Loam (Thurber fescue) ecological site (R048AY515UT) (NRCS 2009). The Uinta-Toze families complex soils are generally 40 to 60 inches or deeper. They are found on mountain slopes of 35 to 70 percent. Parent material of both soil families is derived from colluviums derived from sandstone, shale and siltstone. Soils are well-drained and organic matter is as high as eight percent. Both soil families are in the High Mountain Loam (Engelmann spruce) ecological site (R048AY532UT) (NRCS 2009).

Vegetation

Vegetation in the Inventory Area varies with elevation, aspect, and soil characteristics. The pleateau is dominated by mixed conifer forests including Engelmann spruce (*Picea engelmanii*) and subalpine fir (*Abies lasiocarpa*), open grassland-shrublands, and occasional aspen (*Populus tremuloides*) stands. Some previously logged areas are currently dominated by grasses. Small, localized corridors of riparian-type vegetation are associated with drainages in the Inventory Area; wetland grasses and shrubs can be found in association with springs and other seeps/wallows.

Water

The headwaters of Range Creek, which flows near the eastern boundary of the Inventory Area, and eventually drains to the Green River (Uinta Watershed), are located within the Inventory Area boundary. Range Creek is not within the area proposed for disturbance.

The south and west side of the lease area drops steeply off a plateau into the headwaters of Water Canyon, which drains to Whitmore Canyon (i.e., Grassy Trail Creek; Price Watershed; **Figure 1**) above the town of Sunnyside. Grassy Trail Creek eventually drains to the Price River before joining the Green River.

Water Quality

Tables 1 and **2** show water quality data collected in and around the lease areas during the initial hydrologic survey (May 2012). Site locations correspond with sample locations described in this report (see Inventory Results section). Complete lab results are contained in **Appendix A**.

Table 1. General Water Chemistry and Nutrients

General Water Chemistry (mg/L except where noted)				
	Range Creek Lower Green – Desolation Canyon Watershed		**Lower Grassy Trail Creek and Tributaries** Price Watershed	
	North Spring	Range Creek (Flume)	Cliff Seep (#1)	Water Canyon
Acidity	<15.0	<15.0	<15.0	<15.0
Alkalinity as $CaCO_3$	181	221	254	348
Bicarbonate as $CaCO_3$	181	221	240	348
Carbonate as $CaCO_3$	<20.0	<20.0	<20.0	<40.0
Chloride	0.471	0.676	2.05	3.85
Specific conductance (umhos/cm)	338	389	504	860
Hardness as $CaCO_3$	166	192	218	395
pH @ 25º C (std units)	7.68	8.21	8.28	8.14
Sulfate	8.34	12.1	35.0	160
Total Dissolved Solids	176	192	276	520
Total Suspended Solids	<3.00	<3.00	<3.00	<3.00
Nutrients (mg/L)				
Ammonia as N	<0.0500	<0.0500	<0.0500	<0.0500
Nitrate as N	0.396	0.206	<0.0100	0.0458
Nitrite as N	<0.0100	<0.0100	<0.0100	<0.0100
Total Orthophosphate as P	<0.0500	<0.0500	<0.0500	<0.0500

State-designated beneficial uses for Range Creek and its tributaries (Lower Green – Desolation Canyon Watershed, HUC 14060005) are 1C (domestic purposes), 2B (secondary contact recreation), 3A (cold water game fish and aquatic life), and 4 (agriculture). State-designated beneficial uses for Lower Grassy Trail Creek and its tributaries (including Water Canyon; Price Watershed, HUC 14060007) are 2B (secondary contact recreation), 3C (non-game fish and other aquatic life), and 4 (agriculture). The latest 305(d) report to Congress (UDWQ 2006) indicates that there is insufficient data to determine whether the stream beneficial uses are being met for either Lower Grassy Trail Creek or Range Creek. The 2010 integrated report indicated that Upper Range Creek had not been assessed (UDWQ 2010).

Grassy Trail Creek was listed as impaired for pH in the 2002 and 2008 303(d) List. However, the 2010 integrated report was amended to state that a review of the data showed no pH impairment (UDWQ 2010).

Table 2. Metals and Metalloids (mg/L)

	Range Creek Lower Green – Desolation Canyon Watershed HUC 14060005				**Lower Grassy Trail Creek and Tributaries** Price Watershed HUC 14060007			
	North Spring		**Range Creek (Flume)**		**Cliff Seep (#1)**		**Water Canyon**	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.420	<0.100
Arsenic	0.00241	0.00284	0.00297	0.00305	0.000796	0.000855	0.00135	0.00106
Boron	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
Cadmium	<0.000180	<0.000180	<0.000180	<0.000180	<0.000180	<0.000180	<0.000180	<0.000180
Calcium	--	40.8	--	44.7	--	46.3	--	62.4
Copper	<0.000800	<0.00160	<0.000800	<0.00160	0.00104	<0.00160	0.00173	0.00242
Iron	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.424	<0.100
Lead	<0.000400	<0.000400	<0.000400	<0.000400	<0.000400	<0.000400	0.000420	<0.000400
Magnesium	--	15.6	--	19.5	--	24.8	--	58.0
Manganese	<0.00120	<0.00120	0.00149	0.00127	<0.00120	0.00165	0.0300	0.0154
Molybdenum	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200
Potassium	--	<1.00	--	<1.00	--	<1.00	--	1.45
Selenium	<0.000800	<0.000800	<0.000800	<0.000800	<0.000800	<0.000800	0.00139	<0.000800
Sodium	--	5.33	--	6.34	--	22.1	--	45.2
Zinc	0.00585	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500

Inventory Methods

Initial data gathering included: water rights research; aerial photograph review; literature research; general site reconnaissance; and discussions with adjacent property owners and others familiar with the area. The literature review included geologic reports, mine records, and USGS and state water resources reports. Three water rights for stock-watering use on point-to-point reaches of Range Creek were located within the Inventory Area boundary.

An initial hydrologic survey and surface water sampling was conducted by two JBR hydrologists on May 30 and 31st, 2012. The purpose of the sampling was to document flow conditions and water quality of the known major surface water occurrences in and near the lease areas. Other areas that were relatively easy to access were also observed for the presence or absence of surface water, in preparation for the seep and spring inventory. During the May survey, four water samples (North Spring, Range Creek (2 locations), and a cliff seep) were collected from the Bruin Point area, and flow velocity measurements were made where possible using a March-McBirney Flo-Mate portable velocity meter with discharge reported as cubic feet per second (cfs).

The seep and spring inventory was conducted by four JBR aquatic biologists or hydrologists on October 1-3rd, 2012. All data collected in 2012 represent the flow and water quality characteristics after a lower-than-normal winter snow pack.

The rugged Inventory Area was covered primarily on foot. Where appropriate, binocular scoping was used to scan cliff faces and other inaccessible terrain. Drainage bottoms and major side channels, including headwater areas, were covered on foot because those areas were thought to be the most likely locations for spring occurrences and because of the expected localized nature of those water sources.

Each member of an inventory team carried a topographic map, gps unit, binoculars, camera, flagging, field notebook, ph meter, conductivity meter, water thermometer, and flow measuring equipment (stop watch, container, piping, and shovel). Where no springs or seeps were identified within a given area of coverage, field notes reflected the lack. Sites were recorded where, based upon vegetation indicators, a seasonal spring may be present, even if currently dry. Where springs were identified, the site was flagged and photographed, and the following was recorded:

- Site name or assigned site number;
- Location (using gps where sky coverage allows, verified by map reading, or map reading alone where a gps reading was not possible);
- Photographs of the site;
- Geologic, topographic, landscape features;
- Vegetation type and extent;
- Type of development if the site had been developed as part of a water right;
- Usage (wildlife or livestock sign);

- Field parameters, including pH, conductivity, water temperature, and flow rate; and
- Where flow rate could not be measured, it was estimated and noted as such.

Water temperature, pH, and conductivity were measured in the field using equipment properly maintained and calibrated. These field parameters were measured as near to the source as possible.

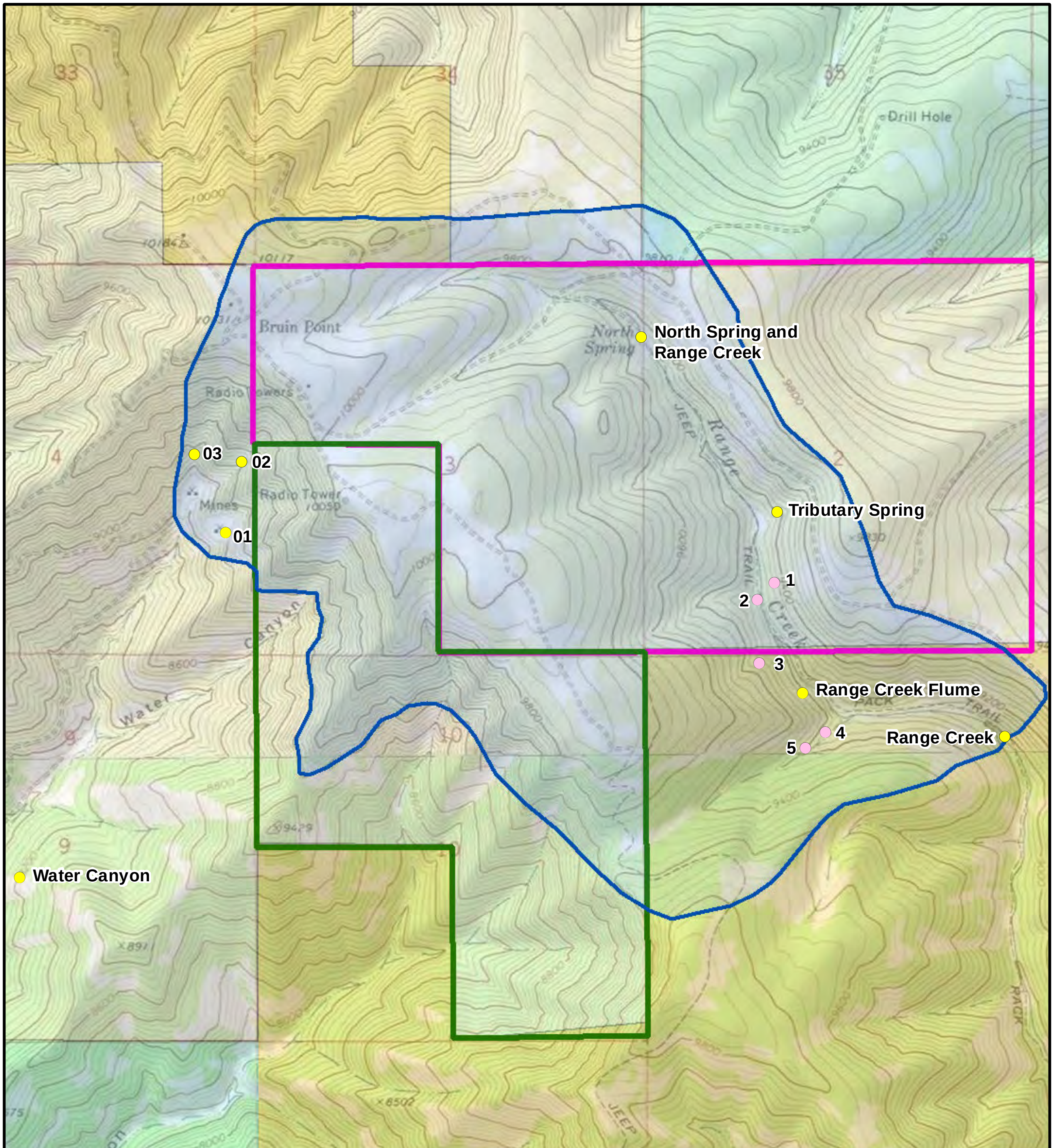
Flow rate was measured at all accessible spring sites using equipment and methods appropriate for the amount of flow, using the standard velocity-area method outlined in Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994). Springs and streams were measured volumetrically with piping, a known-volume container, and a stopwatch. If flow rate was so reduced that it was not possible to measure (i.e. at a seasonal spring where saturated areas are present but no flow is visible), or if no flow was occurring (i.e. at an ephemeral stream site), notes were made describing the site condition (saturation, ponding, dry but recent flows apparent, etc.)

Inventory Results

Water features in the Inventory Area were confined to Water Canyon and tributaries on the west side of the plateau and Range Creek on the east side. The plateau area in the north and central portion of the Inventory Area, including the Range Creek headwaters, as well as the drainages southeast of Water Canyon (southeast portion of the Inventory Area) were dry.

Flow measurements and water samples were taken in five areas within Range Creek. These areas are two springs that contribute to Range Creek flows, and three points along the Range Creek mainstem. Flow measurements were also taken in two areas within Water Canyon and its tributaries: a cluster of cliff seeps that drain to an unnamed tributary to Water Canyon, and one point along the Water Canyon mainstem (flowing only outside the Inventory Area).

Sample areas are described in the following sections. **Figure 2** shows sample locations.



BASE MAP: USGS 1:24,000 TOPOGRAPHIC MAP (Accesseed at ArcGis.com)

Potential Seep or Spring

Sample Point

Inventory Area

Bureau of Land Management

Private

State

Gibbs Lease

Hunt Lease

N

1,200 600 0 1,200 Feet

AMERICAN SANDS ENERGY CORP
SUNNYSIDE TAR SANDS PERMITTING

FIGURE 2
INVENTORY RESULTS AND SAMPLING LOCATIONS

DRAWN BY	DATE DRAWN
STopham	10/09/12
SCALE	1 in = 1,923 feet

This document is for reference purposes only and should not be used as a legal document. JBR makes no guarantees to the accuracy of the data contained herein or any loss resulting therefrom.

Range Creek

The upper headwater area of Range Creek (north end of the Inventory Area) consisted of open areas that were heavily grazed, and forested areas with sloping side hills (no steep drainages; **Photo 1, Appendix B**). Two springs (North Spring and Tributary Spring) that contribute to Range Creek were identified in the Inventory Area further downstream. Several potential seep or spring areas were also identified downstream of these springs.

Sample results for the two springs and three locations on the Range Creek mainstem are described below, in addition to a summary of potential seep and spring areas that were encountered.

Potential seeps and springs (October)

Three potential seeps and two potential springs were found in the Range Creek drainage area during the inventory (October). Locations are numbered on **Figure 2** ("01" to "05" starting upstream), and shown in **Photos 2-6** in **Appendix B** (potential seeps in **Photos 2-4**; potential springs in **Photos 5 and 6**). All five areas contained some wetland grasses that indicated saturated conditions during the growing season. Some contained evidence of cattle or big game use when wet. The three potential seeps were located on side hills near the Range Creek canyon bottom, and did not have associated drainage channels. Both potential springs were marked by depression/slump areas that resembled spring heads, and contained channels (dry in October) downslope to the Range Creek mainstem.

North Spring (May)

North Spring is located in the north-central portion of the Hunt Lease (**Figure 2**). This spring was serving as the headwaters of Range Creek In May, although the Range Creek channel initiates further upstream. North Spring issues adjacent to Range Creek and is fenced, piped, and flows are directed to a small, dammed stock pond (**Photo 7, Appendix B**), before continuing to Range Creek through a culvert. The general condition of North Spring was disturbed and overgrazed with an entrenched channel. Vegetation consisted of (grazed) riparian grasses. In the adjacent Range Creek channel, seepage was also emanating from the channel bottom in May. North Spring was sampled from where it issues inside the fenced area (**Photo 8, Appendix B**).

Flow was calculated at 0.045 cfs. Conductivity was measured at 340 μS, pH at 8.10 std. units, and water temperature at 7º C. There is no water right record on file with the State Engineers Office that appears to be associated with this location.

Tributary Spring (October)

Tributary Spring is located about 0.5-mile downstream from North Spring (**Figure 2**). Tributary Spring is in a steep, mostly forested drainage upslope (east) from the Range

Creek jeep trail (**Photo 9, Appendix B**). In October, water was observed coming out of the rock in several places about halfway up the drainage (**Photo 10, Appendix B**). This spring appeared to be heavily used by deer.

Flow was calculated at 0.010 cfs. Conductivity was measured at 400 µS, pH at 6.71 std. units, and water temperature at 6º C. There is no water right record on file with the State Engineers Office that appears to be associated with this location.

Upper Range Creek – Mainstem (May and October)

Flows in upper Range Creek from North Spring downstream to the Inventory Area boundary fluctuate with influent and effluent tributary reaches from the east. Many reaches of the Range Creek mainstem are dry. In May, flows were strongest for approximately 1,000 feet below the confluence with Tributary Spring (**Photo 11, Appendix B**). Along this flowing reach, many pools, runs, and drops were observed over an entrenched channel. In October, flows were present for approximately 100 feet at the downstream end of this previously flowing reach. Water was flowing in one other location along Range Creek in October, at about 1,000 feet (upstream) from the Inventory Area boundary, for approximately 200 feet.

Range Creek was sampled in three locations between May and October: 1) below the confluence from North Spring (May), 2) near the southern lease boundary where a nonfunctional flume is present (May; **Photos 12 and 13, Appendix B**), and 3) at the southeastern boundary of the Inventory Area (October; **Photo 14, Appendix B**). Sampling results are summarized in **Table 3**.

Table 3. Upper Range Creek sampling results

Range Creek Sample Location	Flow (cfs)	Cond (µS)	pH	Temp (ºC)
North Spring (May)	0.094	350	7.86	9
Flume (May)	0.092	390	8.37	13
Inventory Area boundary (October)	0.017	470	7.25	7

There are three water rights on file with the State Engineers Office associated with Range Creek within the inventory boundary. All are point-to-point rights along the Range Creek mainstem for the purposes of stock watering (UDWR 2011). None correspond to sampling locations.

Water Canyon

The named mainstem of Water Canyon originates on the northern portion of the Gibbs Lease and drains southwest, out of the Inventory Area. Water Canyon is mapped on US Geological Service maps as intermittent or ephemeral. The mainstem originates at approx 9,500' with a small intermittent channel that contained rock outcrops and wet areas in October, within the Inventory Area. The mainstem within the Inventory Area was wet but not flowing in either May or October. Thus, a Water Canyon mainstem sample was taken outside the Inventory Area boundary (described below).

Several cliff seeps were identified that contributed to an unnamed fork of Water Canyon (containing a historic mining area, approximately 0.25-mile down-canyon from the cliffs; **Figure 2**). Sample results for cliff seeps are described below.

Cliff Seeps (May and October)

A large cliff seepage area is located in the far western portion of the Inventory Area, near the boundary of both leases, where water was cascading in several pour-overs from the cliffs. Several sources appeared to be seeping or flowing over the cliffs. In addition, water also appeared to be seeping out of the rock face near the base of several pour-overs. The cliff seeps drain to an unnamed fork of Water Canyon. Vegetation was varied, but contained mostly mosses at rock outcroppings and Douglas-fir with scattered willows where there was soil.

In May, it was not clear whether the water in this area simply reflected the tail end of snowmelt runoff, or a series of seeps or small springs. At that time it was not possible to scale the cliffs and locate the source(s) of the seepage. The largest seepage occurrence (Cliff Seep #1, **Photos 15 and 16, Appendix B**) was sampled in May. Flow data was not collected from Cliff Seep #1 due to the wide outcrop area over which the water flowed. In October, the sources of several cliff seeps were located above the cliffs, originating in intermittent channels (dry in most places) that flowed down and over the cliffs. Sampling at these upper locations was not possible, thus all cliff seep samples were collected as the water cascaded over the cliff or below the cliff. Two different pour-over locations – Cliff Seep #2 and #3 – were sampled in October (shown in **Photo 17, Appendix B**). Results are summarized in **Table 4**.

Table 4. Cliff seep sampling results

	Flow (cfs)	Cond (µS)	pH	Temp (ºC)
Cliff Seep #1 (May)	(not collected)	490	8.49	19
Cliff Seep #2 (October)	0.0002	720	8.47	5
Cliff Seep #3 (October)	0.00002	570	8.85	5

Water Canyon – Mainstem–(May)

The named mainstem of Water Canyon joins the previously mentioned unnamed fork in which the cliff seeps and old mining area are located, and then continues southwest to join Grassy Trail Creek (which drains to the Green River). During the May 2012 sampling visit, flow was present at the confluence of the Water Canyon mainstem and the unnamed fork (**Photo 18, Appendix B**); at that time, flow originated from the unnamed fork and the mainstem fork was dry. The Water Canyon mainstem sample was collected about 1/3-mile downstream from this confluence. A small amount of water was also being contributed from flow crossing the road, from a small tributary drainage. Vegetation consisted mainly of horsetail and wetland grasses at the sampling location.

Flow was calculated at 0.052 cfs. Conductivity was measured at 850 µS, pH at 8.26 std. units, and water temperature at 13º C. There is no water right record on file with the

State Engineers Office that appears to be associated with this location and no evidence of wildlife or stock usage.

Summary

JBR conducted a seep and spring inventory for ASEC in early October 2012, in the vicinity of the planned mining operations. The intent of this inventory was to obtain baseline seep and spring locations to be avoided in support of a mine permit application. Seep and spring resources were sparse in the vicinity of proposed mine operations: only two springs and a cluster of cliff seeps were found in addition to several dry features (at the time of the inventory), which may constitute seeps or springs during runoff.

This report also summarizes the results from an initial hydrologic survey and water sampling event conducted by JBR in late May 2012, during which flow conditions and water quality of the known major surface waters were sampled. The two main surface waters in the vicinity of proposed mine operations are Water Canyon (drains to Grassy Trail Creek) and Range Creek.

Table 5 provides a summary of the field parameter data collected from major surface waters and all flowing springs or seeps in the vicinity of proposed mine operations.

Table 5. Data Summary

Sample Location		Flow (cfs)	Cond (µS)	pH	Temp (ºC)
Range Creek	North Spring	0.045	340	8.10	7
	Tributary Spring	0.010	400	6.71	6
	Mainstem (North Spring)	0.094	350	7.86	9
	Mainstem (Flume)	0.092	390	8.37	13
	Mainstem (Inventory Area boundary)	0.017	470	7.25	7
Water Canyon	Cliff Seep #1	--	490	8.49	19
	Cliff Seep #2	0.0002	720	8.47	5
	Cliff Seep #3	0.00002	570	8.85	5
	Mainstem (Outside Inventory Area)	0.052	850	8.26	13

References

Harrelson, C. C., C. L. Rawlins, and J. P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. General Technical Report RM-245. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Natural Resource Conservation Service (NRCS). 2009. Soil Survey Geographic (SSURGO) Database. Available online at http://soildatamart.nrcs.usda.gov.

Utah Division of Water Quality (UDWQ). 2006. Utah's 2006 305(b) Integrated Report Water Quality Assessment Report to Congress. June 15, 2006

Utah Division of Water Quality (UDWQ). 2010. Water Quality Assessment: Utah's 2010 Integrated Report. Available online at http://www.waterquality.utah.gov/WQAssess/currentIR.htm.

Utah Division of Water Rights (UDWR). 2011. Water rights database for Utah, accessed online October 11, 2011 at http://www.waterrights.utah.gov/wrinfo/query.asp

APPENDIX A
WATER QUALITY ANALYTICAL REPORTS

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

William Gibbs
American Sands Energy Corp.
2610 Hillsden Dr.
Salt Lake City, UT 84117
TEL: (801) 699-3966

RE: Bruin Point Project

Dear William Gibbs: Lab Set ID: 1206001

American West Analytical Laboratories received 4 sample(s) on 6/1/2012 for the analyses presented in the following report.

All analyses were performed in accordance to The NELAC Institute protocols unless noted otherwise. American West Analytical Laboratories is accredited by The NELAC Institute in Utah and Texas; and is state accredited in Colorado, Idaho, and Missouri. Accreditation documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

Thank You,

Kyle F. Gross

Digitally signed by Kyle F. Gross
DN: cn=Kyle F. Gross, o=AWAL, ou=AWAL, email=kyle@awal-labs.com, c=US
Date: 2012.06.18 12:04:52 -06'00'

Approved by:

Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Bruin Point Project
Lab Sample ID: 1206001-001
Client Sample ID: Old Mine Canyon #1
Collection Date: 5/30/2012 1340h
Received Date: 6/1/2012 700h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/14/2012 1408h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.000600	**0.000796**	
Boron	mg/L	6/1/2012 1520h	6/13/2012 2119h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.000180	< 0.000180	
Copper	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.000800	**0.00104**	
Iron	mg/L	6/1/2012 1520h	6/14/2012 1408h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.000400	< 0.000400	
Manganese	mg/L	6/1/2012 1520h	6/12/2012 432h	E200.8	0.00120	< 0.00120	
Molybdenum	mg/L	6/1/2012 1520h	6/13/2012 2119h	E200.7	0.0200	< 0.0200	
Selenium	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.000800	< 0.000800	
Zinc	mg/L	6/1/2012 1520h	6/6/2012 836h	E200.8	0.00500	< 0.00500	

INORGANIC ANALYTICAL REPORT

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Bruin Point Project
Lab Sample ID: 1206001-002
Client Sample ID: Water Canyon #1
Collection Date: 5/30/2012 1750h
Received Date: 6/1/2012 700h

Analytical Results TOTAL METALS

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/14/2012 1420h	E200.7	0.100	**0.420**	
Arsenic	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.000600	**0.00135**	
Boron	mg/L	6/1/2012 1520h	6/13/2012 2152h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.000180	< 0.000180	
Copper	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.000800	**0.00173**	
Iron	mg/L	6/1/2012 1520h	6/14/2012 1420h	E200.7	0.100	**0.424**	
Lead	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.000400	**0.000420**	
Manganese	mg/L	6/1/2012 1520h	6/12/2012 453h	E200.8	0.00120	**0.0300**	
Molybdenum	mg/L	6/1/2012 1520h	6/13/2012 2152h	E200.7	0.0200	< 0.0200	
Selenium	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.000800	**0.00139**	
Zinc	mg/L	6/1/2012 1520h	6/6/2012 924h	E200.8	0.00500	< 0.00500	

INORGANIC ANALYTICAL REPORT

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-003		
Client Sample ID:	North Spring		
Collection Date:	5/31/2012 945h		
Received Date:	6/1/2012 700h		

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/14/2012 1424h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.000600	**0.00241**	
Boron	mg/L	6/1/2012 1520h	6/13/2012 2156h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.000180	< 0.000180	
Copper	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.000800	< 0.000800	
Iron	mg/L	6/1/2012 1520h	6/14/2012 1424h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.000400	< 0.000400	
Manganese	mg/L	6/1/2012 1520h	6/12/2012 500h	E200.8	0.00120	< 0.00120	
Molybdenum	mg/L	6/1/2012 1520h	6/13/2012 2156h	E200.7	0.0200	< 0.0200	
Selenium	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.000800	< 0.000800	
Zinc	mg/L	6/1/2012 1520h	6/6/2012 929h	E200.8	0.00500	**0.00585**	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Bruin Point Project
Lab Sample ID: 1206001-004
Client Sample ID: Range Creek Flume
Collection Date: 5/31/2012 1155h
Received Date: 6/1/2012 700h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/14/2012 1440h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.000600	**0.00297**	
Boron	mg/L	6/1/2012 1520h	6/13/2012 2200h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.000180	< 0.000180	
Copper	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.000800	< 0.000800	
Iron	mg/L	6/1/2012 1520h	6/14/2012 1440h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.000400	< 0.000400	
Manganese	mg/L	6/1/2012 1520h	6/12/2012 507h	E200.8	0.00120	**0.00149**	
Molybdenum	mg/L	6/1/2012 1520h	6/13/2012 2200h	E200.7	0.0200	< 0.0200	
Selenium	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.000800	< 0.000800	
Zinc	mg/L	6/1/2012 1520h	6/6/2012 934h	E200.8	0.00500	< 0.00500	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-001		
Client Sample ID:	Old Mine Canyon #1		
Collection Date:	5/30/2012 1340h		
Received Date:	6/1/2012 700h		

Analytical Results DISSOL□ED METALS

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/16/2012 1556h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/13/2012 2302h	E200.8	0.000600	**0.000855**	
Boron	mg/L	6/1/2012 1520h	6/16/2012 1556h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/13/2012 2302h	E200.8	0.000180	< 0.000180	
Calcium	mg/L	6/1/2012 1520h	6/16/2012 1441h	E200.7	10.0	**46.3**	
Copper	mg/L	6/1/2012 1520h	6/15/2012 1459h	E200.8	0.00160	< 0.00160	
Iron	mg/L	6/1/2012 1520h	6/16/2012 1556h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/15/2012 1008h	E200.8	0.000400	< 0.000400	
Magnesium	mg/L	6/1/2012 1520h	6/16/2012 1441h	E200.7	10.0	**24.8**	
Manganese	mg/L	6/1/2012 1520h	6/15/2012 1008h	E200.8	0.00120	**0.00165**	
Molybdenum	mg/L	6/1/2012 1520h	6/16/2012 1556h	E200.7	0.0200	< 0.0200	
Potassium	mg/L	6/1/2012 1520h	6/16/2012 1556h	E200.7	1.00	< 1.00	
Selenium	mg/L	6/1/2012 1520h	6/13/2012 2302h	E200.8	0.000800	< 0.000800	
Sodium	mg/L	6/1/2012 1520h	6/16/2012 1441h	E200.7	10.0	**22.1**	
Zinc	mg/L	6/1/2012 1520h	6/13/2012 2302h	E200.8	0.00500	< 0.00500	

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Bruin Point Project
Lab Sample ID: 1206001-002
Client Sample ID: Water Canyon #1
Collection Date: 5/30/2012 1750h
Received Date: 6/1/2012 700h

Analytical Results DISSOL□ED METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/16/2012 1620h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/13/2012 2355h	E200.8	0.000600	**0.00106**	
Boron	mg/L	6/1/2012 1520h	6/16/2012 1620h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/13/2012 2355h	E200.8	0.000180	< 0.000180	
Calcium	mg/L	6/1/2012 1520h	6/16/2012 1457h	E200.7	10.0	**62.4**	
Copper	mg/L	6/1/2012 1520h	6/15/2012 1507h	E200.8	0.00160	**0.00242**	
Iron	mg/L	6/1/2012 1520h	6/16/2012 1620h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/15/2012 1048h	E200.8	0.000400	< 0.000400	
Magnesium	mg/L	6/1/2012 1520h	6/16/2012 1457h	E200.7	10.0	**58.0**	
Manganese	mg/L	6/1/2012 1520h	6/15/2012 1048h	E200.8	0.00120	**0.0154**	
Molybdenum	mg/L	6/1/2012 1520h	6/16/2012 1620h	E200.7	0.0200	< 0.0200	
Potassium	mg/L	6/1/2012 1520h	6/16/2012 1620h	E200.7	1.00	**1.45**	
Selenium	mg/L	6/1/2012 1520h	6/13/2012 2355h	E200.8	0.000800	< 0.000800	
Sodium	mg/L	6/1/2012 1520h	6/16/2012 1457h	E200.7	10.0	**45.2**	
Zinc	mg/L	6/1/2012 1520h	6/13/2012 2355h	E200.8	0.00500	< 0.00500	

INORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-003		
Client Sample ID:	North Spring		
Collection Date:	5/31/2012 945h		
Received Date:	6/1/2012 700h		

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results DISSOL□ED METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/14/2012 000h	E200.8	0.000600	**0.00284**	
Boron	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/14/2012 000h	E200.8	0.000180	< 0.000180	
Calcium	mg/L	6/1/2012 1520h	6/16/2012 1501h	E200.7	10.0	**40.8**	
Copper	mg/L	6/1/2012 1520h	6/15/2012 1510h	E200.8	0.00160	< 0.00160	
Iron	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/15/2012 1052h	E200.8	0.000400	< 0.000400	
Magnesium	mg/L	6/1/2012 1520h	6/16/2012 1501h	E200.7	10.0	**15.6**	
Manganese	mg/L	6/1/2012 1520h	6/15/2012 1052h	E200.8	0.00120	< 0.00120	
Molybdenum	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	0.0200	< 0.0200	
Potassium	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	1.00	< 1.00	
Selenium	mg/L	6/1/2012 1520h	6/14/2012 000h	E200.8	0.000800	< 0.000800	
Sodium	mg/L	6/1/2012 1520h	6/16/2012 1624h	E200.7	1.00	**5.33**	
Zinc	mg/L	6/1/2012 1520h	6/14/2012 000h	E200.8	0.00500	< 0.00500	

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-004		
Client Sample ID:	Range Creek Flume		
Collection Date:	5/31/2012 1155h		
Received Date:	6/1/2012 700h		

Analytical Results DISSOL□ED METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Aluminum	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	0.100	< 0.100	
Arsenic	mg/L	6/1/2012 1520h	6/14/2012 005h	E200.8	0.000600	**0.00305**	
Boron	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	0.500	< 0.500	
Cadmium	mg/L	6/1/2012 1520h	6/14/2012 005h	E200.8	0.000180	< 0.000180	
Calcium	mg/L	6/1/2012 1520h	6/16/2012 1505h	E200.7	10.0	**44.7**	
Copper	mg/L	6/1/2012 1520h	6/15/2012 1513h	E200.8	0.00160	< 0.00160	
Iron	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	0.100	< 0.100	
Lead	mg/L	6/1/2012 1520h	6/15/2012 1056h	E200.8	0.000400	< 0.000400	
Magnesium	mg/L	6/1/2012 1520h	6/16/2012 1505h	E200.7	10.0	**19.5**	
Manganese	mg/L	6/1/2012 1520h	6/15/2012 1056h	E200.8	0.00120	**0.00127**	
Molybdenum	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	0.0200	< 0.0200	
Potassium	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	1.00	< 1.00	
Selenium	mg/L	6/1/2012 1520h	6/14/2012 005h	E200.8	0.000800	< 0.000800	
Sodium	mg/L	6/1/2012 1520h	6/16/2012 1628h	E200.7	1.00	**6.34**	
Zinc	mg/L	6/1/2012 1520h	6/14/2012 005h	E200.8	0.00500	< 0.00500	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Bruin Point Project
Lab Sample ID: 1206001-001
Client Sample ID: Old Mine Canyon #1
Collection Date: 5/30/2012 1340h
Received Date: 6/1/2012 700h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Acidity	mg/L		6/4/2012 606h	SM2310B	15.0	< 15.0	
Alkalinity (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**254**	
Ammonia (as N)	mg/L	6/8/2012 1142h	6/8/2012 1808h	E350.1	0.0500	< 0.0500	
Bicarbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**240**	
Carbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	< 20.0	
Chloride	mg/L		6/11/2012 2026h	E300.0	0.100	**2.05**	
Conductivity	□mhos/cm		6/1/2012 1152h	SM2510B	2.00	**504**	
□ardness (as CaCO3)	mg/L		6/18/2012	SM2340B	10.0	**218**	
Ion Balance	□		6/18/2012	Calc.	-15.0	**-4.73**	
Nitrate (as N)	mg/L		6/1/2012 1515h	E353.2	0.0100	< 0.0100	
Nitrite (as N)	mg/L		6/1/2012 1256h	E353.2	0.0100	< 0.0100	
p□ @ 25□C	p□ Units		6/1/2012 1600h	SM4500-□□B	1.00	**8.28**	□
Phosphate, Total Ortho (as P)	mg/L		6/1/2012 1108h	E365.1	0.0500	< 0.0500	
Sulfate	mg/L		6/8/2012 1200h	E300.0	7.50	**35.0**	
Total Dissolved Solids	mg/L		6/4/2012 1500h	SM2540C	20.0	**276**	
Total Suspended Solids	mg/L		6/1/2012 1615h	SM2540D	3.00	< 3.00	

H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-002		
Client Sample ID:	Water Canyon #1		
Collection Date:	5/30/2012 1750h		
Received Date:	6/1/2012 700h		

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Acidity	mg/L		6/4/2012 606h	SM2310B	15.0	< 15.0	
Alkalinity (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	40.0	**348**	
Ammonia (as N)	mg/L	6/8/2012 1142h	6/8/2012 1812h	E350.1	0.0500	< 0.0500	
Bicarbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	40.0	**348**	
Carbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	40.0	< 40.0	
Chloride	mg/L		6/8/2012 1222h	E300.0	1.00	**3.85**	
Conductivity	□mhos/cm		6/1/2012 1152h	SM2510B	2.00	**860**	
□ardness (as CaCO3)	mg/L		6/18/2012	SM2340B	10.0	**395**	
Ion Balance	□		6/18/2012	Calc.	-15.0	**-2.56**	
Nitrate (as N)	mg/L		6/1/2012 1519h	E353.2	0.0100	**0.0458**	
Nitrite (as N)	mg/L		6/1/2012 1300h	E353.2	0.0100	< 0.0100	
p□ @ 25□C	p□ Units		6/1/2012 1600h	SM4500-□□B	1.00	**8.14**	□
Phosphate, Total Ortho (as P)	mg/L		6/1/2012 1111h	E365.1	0.0500	< 0.0500	
Sulfate	mg/L		6/8/2012 1222h	E300.0	7.50	**160**	
Total Dissolved Solids	mg/L		6/4/2012 1500h	SM2540C	20.0	**520**	
Total Suspended Solids	mg/L		6/1/2012 1615h	SM2540D	3.00	< 3.00	

H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-003		
Client Sample ID:	North Spring		
Collection Date:	5/31/2012 945h		
Received Date:	6/1/2012 700h		

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Acidity	mg/L		6/4/2012 606h	SM2310B	15.0	< 15.0	
Alkalinity (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**181**	
Ammonia (as N)	mg/L	6/8/2012 1142h	6/8/2012 1813h	E350.1	0.0500	< 0.0500	
Bicarbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**181**	
Carbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	< 20.0	
Chloride	mg/L		6/11/2012 2046h	E300.0	0.100	**0.471**	
Conductivity	□mhos/cm		6/1/2012 1152h	SM2510B	2.00	**338**	
□ardness (as CaCO3)	mg/L		6/18/2012	SM2340B	10.0	**166**	
Ion Balance	□		6/18/2012	Calc.	-15.0	**-4.02**	
Nitrate (as N)	mg/L		6/1/2012 1520h	E353.2	0.0100	**0.396**	
Nitrite (as N)	mg/L		6/1/2012 1301h	E353.2	0.0100	< 0.0100	
p□ @ 25□C	p□ Units		6/1/2012 1600h	SM4500-□□B	1.00	**7.68**	□
Phosphate, Total Ortho (as P)	mg/L		6/1/2012 1112h	E365.1	0.0500	< 0.0500	
Sulfate	mg/L		6/11/2012 2046h	E300.0	0.750	**8.34**	
Total Dissolved Solids	mg/L		6/4/2012 1500h	SM2540C	20.0	**176**	
Total Suspended Solids	mg/L		6/1/2012 1615h	SM2540D	3.00	< 3.00	

H - Sample was received outside of the holding time.

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client:	American Sands Energy Corp.	**Contact:**	William Gibbs
Project:	Bruin Point Project		
Lab Sample ID:	1206001-004		
Client Sample ID:	Range Creek Flume		
Collection Date:	5/31/2012 1155h		
Received Date:	6/1/2012 700h		

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Acidity	mg/L		6/4/2012 606h	SM2310B	15.0	< 15.0	
Alkalinity (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**221**	
Ammonia (as N)	mg/L	6/8/2012 1142h	6/8/2012 1814h	E350.1	0.0500	< 0.0500	
Bicarbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	**221**	
Carbonate (as CaCO3)	mg/L		6/1/2012 1035h	SM2320B	20.0	< 20.0	
Chloride	mg/L		6/11/2012 2106h	E300.0	0.100	**0.676**	
Conductivity	□mhos/cm		6/1/2012 1152h	SM2510B	2.00	**389**	
□ardness (as CaCO3)	mg/L		6/18/2012	SM2340B	10.0	**192**	
Ion Balance	□		6/18/2012	Calc.	-15.0	**-6.84**	
Nitrate (as N)	mg/L		6/1/2012 1522h	E353.2	0.0100	**0.206**	
Nitrite (as N)	mg/L		6/1/2012 1303h	E353.2	0.0100	< 0.0100	
p□ @ 25□C	p□ Units		6/1/2012 1600h	SM4500-□□B	1.00	**8.21**	□
Phosphate, Total Ortho (as P)	mg/L		6/1/2012 1112h	E365.1	0.0500	< 0.0500	
Sulfate	mg/L		6/11/2012 2106h	E300.0	0.750	**12.1**	
Total Dissolved Solids	mg/L		6/4/2012 1500h	SM2540C	20.0	**192**	
Total Suspended Solids	mg/L		6/1/2012 1615h	SM2540D	3.00	< 3.00	

H - Sample was received outside of the holding time.

American West Analytical Laboratories

D

WORK ORDER Summary

Work Order: 1206001
Page 1 of 5 6/1/2012

Client: American Sands Energy Corp.
Client ID: WALKIN
Contact: William Gibbs
Project: Bruin Point Project
QC Level: LEVEL I
WO Type: Standard
Comments: Do not release w/o Financial Arrangements! / send results to both William and Karla Knoop @ JBR. Dissolved metals samples have been field filtered. Footnote report, pH received outside of hold.;

HOK-AC

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1206001-001A	Old Mine Canyon #1 **SEL Analytes: CL SO4**	5/30/2012 1340h	6/1/2012 0700h	6/15/2012	Aqueous	300.0-W	☑	df / wc	1
						ACIDITY-W-2310B	☐	df / wc	
	SEL Analytes: ALK ALKB ALKC					ALK-W-2320B	☑	df / wc	
						COND-W-2510B	☐	df / wc	
						NO2-W-353.2	☐	df / wc	
						NO3-W-353.2	☐	df / wc	
						PH-4500H+B	☐	df / wc	
						PO4-O-365.1	☐	df / wc	
1206001-001B						NH3-W-350.1	☐	df / nh3	
						NH3-W-PR	☐	df / nh3	
1206001-001C						TSS-W-2540D	☐	ww - tss	
1206001-001D						TDS-W-2540C	☐	ww - tds	
1206001-001E	**SEL Analytes: AL B CA FE MG MO K NA**					200.7-DIS	☑	df / dis metals	
						200.7-DIS-PR	☐	df / dis metals	
	SEL Analytes: AS CD CU PB MN SE ZN					200.8-DIS	☑	df / dis metals	
						200.8-DIS-PR	☐	df / dis metals	
						HARD-2340B	☐	df / dis metals	
1206001-001F	**SEL Analytes: AL B FE MO**					200.7-W	☑	df / total metals	
						200.7-W-PR	☐	df / total metals	

WORK ORDER Summary

Client: American Sands Energy Corp.

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage
1206001-001F	Old Mine Canyon #1	5/30/2012 1340h	6/1/2012 0700h	6/15/2012	Aqueous	200.8-W	☑	df / total metals
	SEL Analytes: AS CD CU PB MN SE ZN							
						200.8-W-PR	☐	df / total metals
						IONBALANCE	☐	df / total metals
1206001-002A	Water Canyon #1	5/30/2012 1750h				300.0-W	☑	df / wc
	SEL Analytes: CL SO4							
						ACIDITY-W-2310B	☐	df / wc
						ALK-W-2320B	☑	df / wc
	SEL Analytes: ALK ALKB ALKC							
						COND-W-2510B	☐	df / wc
						NO2-W-353.2	☐	df / wc
						NO3-W-353.2	☐	df / wc
						PH-4500H+B	☐	df / wc
						PO4-O-365.1	☐	df / wc
1206001-002B						NH3-W-350.1	☐	df / nh3
						NH3-W-PR	☐	df / nh3
1206001-002C						TSS-W-2540D	☐	ww - tss
1206001-002D						TDS-W-2540C	☐	ww - tds
1206001-002E						200.7-DIS	☑	df / dis metals
	SEL Analytes: AL B CA FE MG MO K NA							
						200.7-DIS-PR	☐	df / dis metals
						200.8-DIS	☑	df / dis metals
	SEL Analytes: AS CD CU PB MN SE ZN							
						200.8-DIS-PR	☐	df / dis metals
						HARD-2340B	☐	df / dis metals
1206001-002F						200.7-W	☑	df / total metals
	SEL Analytes: AL B FE MO							
						200.7-W-PR	☐	df / total metals

WORK ORDER Summary

Client: American Sands Energy Corp.

Work Order: **1206001**

6/5/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1206001-002F	Water Canyon #1 **SEL Analytes: AS CD CU PB MN SE ZN**	5/30/2012 1750h	6/1/2012 0700h	6/15/2012	Aqueous	200.8-W	☑	df / total metals	1
						200.8-W-PR	☐	df / total metals	
						IONBALANCE	☐	df / total metals	
1206001-003A	North Spring **SEL Analytes: CL SO4**	5/31/2012 0945h				300.0-W	☑	df / wc	
						ACIDITY-W-2310B	☐	df / wc	
	SEL Analytes: ALK ALKB ALKC					ALK-W-2320B	☑	df / wc	
						COND-W-2510B	☐	df / wc	
						NO2-W-353.2	☐	df / wc	
						NO3-W-353.2	☐	df / wc	
						PH-4500H+B	☐	df / wc	
						PO4-O-365.1	☐	df / wc	
1206001-003B						NH3-W-350.1	☐	df / nh3	
						NH3-W-PR	☐	df / nh3	
1206001-003C						TSS-W-2540D	☐	ww - tss	
1206001-003D						TDS-W-2540C	☐	ww - tds	
1206001-003E	**SEL Analytes: AL B CA FE MG MO K NA**					200.7-DIS	☑	df / dis metals	
						200.7-DIS-PR	☐	df / dis metals	
	SEL Analytes: AS CD CU PB MN SE ZN					200.8-DIS	☑	df / dis metals	
						200.8-DIS-PR	☐	df / dis metals	
						HARD-2340B	☐	df / dis metals	
1206001-003F	**SEL Analytes: AL B FE MO**					200.7-W	☑	df / total metals	
						200.7-W-PR	☐	df / total metals	

WORK ORDER Summary

Client: American Sands Energy Corp.

Work Order: **1206001**

6/5/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage
1206001-003F	North Spring **SEL Analytes: AS CD CU PB MN SE ZN**	5/31/2012 0945h	6/1/2012 0700h	6/15/2012	Aqueous	200.8-W	☑	df / total metals
						200.8-W-PR	☐	df / total metals
						IONBALANCE	☐	df / total metals
1206001-004A	Range Creek Flume **SEL Analytes: CL SO4**	5/31/2012 1155h				300.0-W	☑	df / wc
						ACIDITY-W-2310B	☐	df / wc
	SEL Analytes: ALK ALKB ALKC					ALK-W-2320B	☑	df / wc
						COND-W-2510B	☐	df / wc
						NO2-W-353.2	☐	df / wc
						NO3-W-353.2	☐	df / wc
						PH-4500H+B	☐	df / wc
						PO4-O-365.1	☐	df / wc
1206001-004B						NH3-W-350.1	☐	df / nh3
						NH3-W-PR	☐	df / nh3
1206001-004C						TSS-W-2540D	☐	ww - tss
1206001-004D						TDS-W-2540C	☐	ww - tds
1206001-004E	**SEL Analytes: AL B CA FE MG MO K NA**					200.7-DIS	☑	df / dis metals
						200.7-DIS-PR	☐	df / dis metals
	SEL Analytes: AS CD CU PB MN SE ZN					200.8-DIS	☑	df / dis metals
						200.8-DIS-PR	☐	df / dis metals
						HARD-2340B	☐	df / dis metals
1206001-004F	**SEL Analytes: AL B FE MO**					200.7-W	☑	df / total metals
						200.7-W-PR	☐	df / total metals

WORK ORDER Summary

Client: American Sands Energy Corp.

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1206001-004F	Range Creek Flume	5/31/2012 1155h	6/1/2012 0700h	6/15/2012	Aqueous	200.8-W	☑	df / total metals	1
	SEL Analytes: AS CD CU PB MN SE ZN								
						200.8-W-PR	☐	df / total metals	
						IONBALANCE	☐	df / total metals	

Client American Sands Energy Corp

Address 2610 Hillsden Dr

Salt Lake City (City) UT (State) 84117 (Zip)

Phone 801 699 3966 Fax 801 277 7888

Contact William Gibbs

E-mail wgibbs@americansandsenergy.com

Project Name Bruin Point Project

Project Number/P.O.#

Sampler Name K. Knoop

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115
(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email:awal@awal-labs.com

CHAIN OF CUSTODY

Lab Sample Set # 1206001

Page ____ of ____

Turn Around Time (Circle One)

1 day 2 day 3 day 4 day 5 day (Standard) — circled

QC LEVEL: (1) — circled, 2, 2+, 3, 3+, 4

Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	General (see attached list)	Nutrients (see attached list)	Metals	COMMENTS
Old Mine Canyon #1	5/30/12 1340	W	6	X	X	X	Problems with
Water Canyon #1	5/30/12 1750	W	6	X	X	X	acidified bottles
North Spring	5/31/12 0945	W	6	X	X	X	leaking - sample
Range Creek Flume	5/31/12 1155	W	6	X	X	X	IDs put on lids

Relinquished By: Signature	Date / Time	Received By: Signature	Date / Time
[signature]; PRINT NAME Karla Knoop	Date 6/1/12; Time 7:00	[signature]; PRINT NAME Lynn Turner	Date 6-1-12; Time 7:00
PRINT NAME	Date; Time	PRINT NAME	Date; Time
PRINT NAME	Date; Time	PRINT NAME	Date; Time
PRINT NAME	Date; Time	PRINT NAME	Date; Time

Special Instructions:

BILL AMERICAN SANDS, NOT JBR

Send results report to client + to JBR (kknoop@jbrenv.com)

Questions - Karla Knoop, JBR, 801 438 2245

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered (circled)
Notes:

2 Ambient or Chilled (circled)
Notes:

3 Temperature 3.2

4 Received Broken/Leaking (Improperly Sealed)
Y N (circled)
Notes:

5 Properly Preserved
Y (circled) N
Checked at Bench
Y N
Notes:

6 Received Within Holding Times
Y N (circled)
Notes: pH rec. outside of hold.

COC Tape Was:

1 Present on Outer Package
Y N NA (circled)

2 Unbroken on Outer Package
Y N NA (circled)

3 Present on Sample
Y N NA (circled)

4 Unbroken on Sample
Y N NA (circled)

Discrepancies Between Sample Labels and COC Record?
Y N (circled)
Notes:

Acidity $25.00	Arsenic (dissolved and total) 10.00/each
Alkalinity 19.00	Aluminum (dissolved and total) 10.00/each
Bicarbonate (included in alkalinity)	Boron (dissolved and total) 10.00/each
Carbonate (included in alkalinity)	Cadmium (dissolved and total) 10.00/each
Calcium (dissolved) 10.00	Copper (dissolved and total) 10.00/each
Chloride 13.00	Iron (total and dissolved) 10.00/each
Magnesium (dissolved)10.00	Lead (dissolved and total) 10.00/each
Potassium (dissolved)10.00	Manganese (total and dissolved) 10.00/each
Sodium (dissolved) 10.00	Molybednum (dissolved and total) 10.00/each
Sulfate 13.00	Selenium (dissolved and total) 10.00/each
Total Dissolved Solids 15.00	Zinc (dissolved and total) 10.00/each
Hardness 22.00	Total Suspended Solids 15.00
Ammonia 38.00	pH 13.00
Nitrate 13.00	Conductivity 12.00
Nitrite 13.00	Cation/anion balance 13.00
Orthophosphate 13.00	Metals Prep 20.00
	Metals – dissolved (15+prep)= $170.00
	Metals – Totals (11+prep)= $130.00
Totals out to $537.00 per sample	

Sample Set: 120600/

Preservation Check Sheet

Sample Set Extension and pH

Bottle Type	Preservative	All OK	~~Except~~ 1	~~Except~~ 2	~~Except~~ 3	~~Except~~ 4	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~	~~Except~~
Ammonia	pH <2 H_2SO_4		Yes	Yes	Yes	Yes											
COD	pH <2 H_2SO_4																
Cyanide	PH >12 NaOH																
Metals	pH <2 HNO_3		Yes	Yes	Yes	Yes											
NO_2 & NO_3	pH <2 H_2SO_4																
Nutrients	pH <2 H_2SO_4																
O & G	pH <2 HCL																
Phenols	pH <2 H_2SO_4																
Sulfide	pH > 9NaOH, Zn Acetate																
TKN	pH <2 H_2SO_4																
TOC	pH <2 H_3PO_4																
TOX	pH <2 H_2SO_4																
T PO_4	pH <2 H_2SO_4																
TPH	pH <2 HCL																

[initials] 8/1/12

Procedure:

1) Pour a small amount of sample in the sample lid
2) Pour sample from Lid gently over wide range pH paper
3) **Do Not** dip the pH paper in the sample bottle or lid
4) If sample is not preserved properly list its extension and receiving pH in the appropriate column above
5) Flag COC, notify client if requested
6) Place client conversation on COC
7) Samples may be adjusted

Frequency: All samples requiring preservation

APPENDIX B
PHOTOGRAPHS

Photo 1 Headwaters of Range Creek (dry); October 2012.

Photo 2 Potential Seep 01 (see **Figure 2**); October 2012.

Photo 3 Potential Seep 03 (see **Figure 2**); October 2012.

Photo 4 Potential Seep 05 (see **Figure 2**); October 2012.

Photo 5 Potential Spring 02 (see **Figure 2**); October 2012.

Photo 6 Potential Spring 04 (see **Figure 2**); October 2012.

Photo 7 Piped outflow from North Spring to stock pond; culvert in background leads to Range Creek; May 2012.

Photo 8 North Spring sampling location; May 2012.

Photo 9 Tributary Spring drainage; October 2012.

Photo 10 Source area of Tributary Spring; October 2012.

Photo 11 Range Creek mainstem sample point below North Spring; May 2012.

Photo 12 Range Creek mainstem sample point at flume (nonfunctional); May 2012.

Photo 13 Range Creek downstream from flume; May 2012.

Photo 14 Range Creek mainstem sample point at boundary of Inventory Area; October 2012.

Photo 15 Cliff Seep #1 sample point; May 2012.

Photo 16 Long view of Cliff Seep #1; May 2012.

Photo 17 Cliff Seep #2 and #3 sample points; October 2012.

Photo 18 Unnamed fork of Water Canyon (flowing); May 2012.

APPENDIX G

PRELIMINARY STABILITY AND HYDROLOGY ANALYSES

URS

FINAL REPORT Revision 1

PRELIMINARY STABILITY AND HYDROLOGY ANALYSES

BRUIN POINT MINE

For

American Sands Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

February 4, 2015

Preliminary Stability and Hydrology Analyses
Bruin Point Utah

Prepared for:

American Sands
Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

Prepared by:

URS Corporation
756 East Winchester, Suite 400
Salt Lake City, UT 84107

LICENSED PROFESSIONAL ENGINEER
2-4-15
No. 7718142
ROBERT W.
SNOW II
STATE OF UTAH

Robert Snow, P.E.
URS Civil-Geotechnical Engineer

Licensed Professional Engineer
2-4-15
Curtis J. Tanner
No. 184573
State of Utah

Curtis Tanner, P.E.
URS Civil-Geotechnical Engineer

TABLE OF CONTENTS

FIGURES

APPENDICES

ACRONYMS

ASE	American Sands Energy Corporation
ASTM	American Society for Testing and Materials
BGS	Below Ground Surface
CFS	Cubic Feet per Second
CN	Curve Numbers
DEG	Degrees
DOGM	Utah Division of Oil, Gas and Mining
FT	Feet
GPS	Global Positioning System
HEC-HMS	Hydrologic Modeling System
KSF	Kips per Square Foot
LL	Liquid Limit
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NP	Non-Plastic
PCF	Pounds per Cubic Foot
P.G.	Professional Geologist
PGA	Peak Horizontal Ground Acceleration
PI	Plasticity Index
PL	Plastic Limit
PSF	Pounds per Square Foot
SCS	Soil Conservation Service
URS	URS Corporation
USCS	Unified Soil Classification System
USGS	United States Geological Survey

1.0 INTRODUCTION

1.1 Project Description

Green River Resources (GRR) is proposing to develop the Bruin Point Mine Site in the mountains east of Sunnyside, Utah. URS Corporation (URS) understands that if approved, development of the site will include the following surface features: construction of office space and associated parking, a warehouse and maintenance shop, a tank farm, an electrical building, a graded material processing area for associated covered ore stockpiles, topsoil stockpiles, permanent tailings stockpile, and underground mine portal.

URS understands that the Utah Division of Oil, Gas and Mining (DOGM) has requested additional design information regarding the Bruin Point Mine (Utah DOGM M&RP M/007/0040) to demonstrate that the proposed surface structures can be constructed to prevent harm to nearby natural resources.

Design criteria were prepared to address potential impacts to Range Creek and are supported by slope stability analyses and preliminary analyses of erosion control measures. These analyses are based on material properties measured during the field investigation and engineering judgment. The purpose of the design criteria and analyses are to demonstrate the technical feasibility of slope stability and erosion controls to be incorporated into facility design and allow DOGM approval of the Notice of Intent (NOI) (URS, 2014). Our scope of services is based on our understanding of the assumptions noted in this report and does not include any foundation investigation for buildings or structures.

1.2 Purpose, Authorization, and Work Scope

This report presents the results of work performed by URS. The purpose of this work was to gather subsurface information and develop geotechnical criteria for stockpiling of topsoil and mine tailings derived from the Bruin Point Mine, and to provide criteria for surface contact-water retention regarding the specific size, type, functionality, and purpose of the water retention facilities.

The scope of work performed was presented in our proposal dated July 8, 2014, and authorized on July 23, 2014. The scope of work, as completed, consisted of four tasks:

- Review documents provided to URS including mine layout, drainage plans, and proposed stockpile slopes.
- Investigate subsurface conditions by means of test pit excavations and perform laboratory testing of select soil specimens.
- Develop geotechnical and erosion control design criteria.
- Project Management including administrative tasks, client meetings, and reporting.

As part of its work, URS also developed and implemented a safe work plan prior to the beginning of field work which included a task-specific hazard analysis.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 General

Field investigations were performed at the site in two phases. The first phase consisted of a site visit for geological and hydrological reconnaissance and to assess the suitability of the site for drilling or excavation of test pits. The second phase consisted of excavating test pits to investigate subsurface materials.

The project area is in the Roan Cliffs and comprises 1,760 acres of private parcels located in Township 14 South, Range 14 East, Sections 2, 3, and 10, Salt Lake Meridian (Figure 1). The area is in mountainous terrain; elevations range from approximately 8,000 feet to over 10,150 feet at Bruin Point, near the northwest corner of the project area. Access to the site is gained through improved gravel roads to two large antenna arrays present at the site.

2.2 Field Investigation

2.2.1 Geological and Hydrological Reconnaissance

A site visit was performed at the site on July 31, 2014, by a URS Professional Geologist (P.G.) and hydrologist to observe general geologic and hydrologic conditions of the mine portal, processing plant, and topsoil/tailings stockpile areas. Major fractures were measured in the rock outcropping at the proposed mine portal area. The topography of the site is variable with some areas of steep rugged terrain and areas of gradual slopes on the plateau consisting of native clayey topsoil, moderate vegetation, and sandstone or limestone outcroppings.

Thin surface soils (0-4 ft [feet] thick) were observed at the surface of the plateau (Bruin Point). The Parachute Creek Member of the Green River Formation was observed exposed on the improved gravel roads and is covered with stress relief factures as shown in Photo 1. Relief fractures occur when compressional stress on underlying rocks is removed by the erosion of overlying rock layers (Wyrick and Borchers, 1981). The relief of stress on exposed material on valley/canyon walls and floors results in a predictable pattern of shallow, interconnected vertical and horizontal fractures.

Photo 1. Improved gravel road covered with stress relief fractures.

The mine portal area is located within the head waters of Bear Canyon on the Roan Cliffs. The proposed portal is located on steep rugged terrain (slopes between 30-50 degrees) approximately 800-900 feet below the top of the Plateau. There are no roads to the proposed mine portal area and access is by foot. Portal area is covered with thin layer (2-6 inches) of soil and vegetation debris mixture with steeper slopes (> 30°) barren of soil/vegetation debris. The area between the proposed mine portal to the top of the plateau contains loss rock and with high rock fall hazard.

The proposed mine portal area was not highly fractured with the majority of the fractures observed located in bitumen barren sandstone units. The fracture observed within the mine portal area has an orientation of 70° to 105° southeast with near vertical dip of 85-90° to the northeast as shown in Photo 2.

Photo 2. Fracture observed within mine portal area.

The high bitumen sandstone units within the mine portal area appear to contain stress relief exfoliation-like fractures as shown in Photo 3. These stress relief exfoliation-like fractures are likely related to the stress of the overburden units pressing downward and laterally releasing the stress outward away from the cliff face.

Photo 3. Stress relief exfoliation in high bitumen sandstone units.

The surface of the ore body (high bitumen containing sandstones) is covered with desiccation-like texture as shown in Photo 4. This texture is likely related to the dry/oxidation of the bitumen on the surface sub sequential differential erosion of the surface.

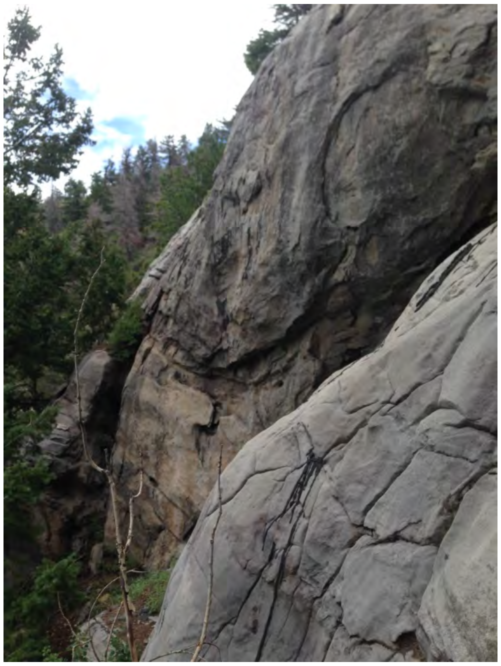


Photo 4. Surface of high-bitumen sandstone covered with desiccation-like texture.

2.2.2 Test Pit Excavations

Eight sites were selected (TH14-01 through TH14-08) at which test pit explorations were to be completed. One planned exploration test pit, identified as TH14-02 in Figure 2, was not performed because locked gates prevented access to the test pit location. However, based on the consistency of the surrounding test pits, the exclusion of TH14-02 was not significant. All test pits for this study were excavated using a Bobcat E45 compact excavator. A Garmin Rino650, hand-held Global Positioning System (GPS) equipment was used to locate test pit sites in the field. Where possible, the sites were collocated with historic drilling sites to reduce ground disturbance at the site. Associated equipment and excavation services were provided on August 11, 2014, by Direct Push Services, LLC, of Salt Lake City, Utah, under subcontract to URS. Each test pit was excavated to refusal, which was encountered at various depths as indicated on the Surface and Shallow Soil Sampling Logs (test pit logs) presented in Appendix A.

Test pit excavations were observed, logged, and sampled, by a URS field engineer. In general, samples were collected from the wall of the excavation by hand-digging/shovel use. Some samples were selectively collected from the excavator bucket where depth of excavation precluded entry for hand-sampling. The investigation locations are shown in Figure 2 and summarized in Table 1.

Table 1. Test Pit Location Summary

Test Pit ID	**Exploration Depth**[1] *(ft)*	**Northing** *(ft)*	**Easting** *(ft)*	**Surface Elevation** *(ft)*
TP14-1	2.4	7,039,763	1,967,721	9,982
TP14-2	N/A[2]	7,039,641	1,968,988	9,762
TP14-3	3.8	7,039,242	1,966,905	10,035
TP14-4	6	7,038,686	1,968,936	9,977
TP14-5	8	7,038,699	1,967,445	9,925
TP14-6	1.7	7,037,679	1,967,755	10,056
TP14-7	5.8	7,037,320	1,968,517	10,027
TP14-8	5.3	7,037,026	1,968,918	10,015

Notes: State Plane Coordinates (Utah Central NAD 83); ft = feet

1. The depth was measured from the ground surface.
2. The site was inaccessible and exploration was not performed; identified coordinates were proposed.

Groundwater was not encountered during test pit exploration.

2.3 Laboratory Testing

Laboratory testing was performed on select soil specimens obtained during the field investigation to assist in their classification as well as to evaluate engineering properties. Testing was performed by IGES of Salt Lake City, Utah, in general accordance with ASTM International (ASTM) standards. Laboratory tests included: fines content (ASTM D1140); Atterberg limits (ASTM D4318), and natural moisture content (ASTM D2216). Strength and permeability testing was performed in remolded samples. Laboratory test results sheets are presented in Appendix B.

2.3.1 Index Properties

The results of index tests performed in each test pit are summarized in Table 2, and also shown on the logs in Appendix A, and included in the Laboratory Test Results in Appendix B.

Table 2. Summary of Index Testing

Location	Approximate Depth BGS *(ft)*	USCS Classification[1] *(-)*	Fines Content *(%)*	LL *(%)*	PI *(%)*	Moisture Content *(%)*
TH14-03	1	CH	82.0	57	31	16.4
TH14-04	1.5	SC	45.2	35	11	7.9
TH14-04	3	SC	26.1	37	14	13.1
TH14-05	3.75	CL	60.5	40	19	16.7
Tailings[2]	N/A	SP-SM	9.1	NP	NP	--
Partings[2]	N/A	SC	38.2	29	8	--

Notes: BGS = Below Ground Surface; USCS = Unified Soil Classification System; ft = feet; LL = Liquid Limit; PI = Plasticity Index; NP = Non-plastic

1. The classification was based on ASTM D2487.
2. The sample was provided to URS by ASE.

2.3.2 Direct Shear Testing

Strength testing was performed on remolded samples from test pit TH14-04 and on tailings and partings samples provided to URS by ASE. Strength testing consisted of a series of direct shear tests under drained conditions in general accordance to ASTM D3080. The results of the strength testing are also provided in Appendix B.

Direct shear testing was performed on a sample from testing pit TH14-04 at a moisture content (after conditioning) of approximately 16 percent and a target dry density of 105 pounds per cubic foot (pcf). A vertical confining stress of approximately 8 kips per square foot (ksf) was selected to simulate the weight of the stockpile embankment above the shear surface resulting in a one-point drained strength of 31 degrees.

Direct shear testing was performed on processed and moisture conditioned tailings sand obtained from ASE at a target dry density of 105 pcf. The vertical confining stresses of 4, 8, and 16 ksf, were selected to simulate the anticipated stress conditions in the field resulting in a measured drained strength of 33 degrees with a cohesion intercept of 129 pounds per square foot (psf).

Additionally, direct shear testing was performed on the partings sample obtained from ASE. The partings material is anticipated to be used as a liner material below the tailings stockpile and was provided in the form of a rock-core. The rock-core sample was modified by IGES to create field-form samples in two steps. Beginning with rock cores obtained from the target layer, the partings were crushed using a proctor hammer until all crushed rock particles were finer than the No. 4 sieve. The particles were then pulverized further using a cast iron mortar and pestle. After moisture conditioning the partings to 16 percent, samples were compacted to a dry density of 110 pcf. Shear testing was performed at confining pressures of 4, 8, and 16 ksf, to simulate anticipated stress conditions within the liner.

2.3.3 Permeability Testing

Permeability testing was performed on a single partings sample provided to URS by ASE in general accordance with ASTM D5084. The procedure for crushing, pulverizing, moisture conditioning, and compacting, the partings sample was performed in the same manner as described in Section 2.3.2. The results of the test provided an average hydraulic conductivity of 2.3×10^{-7} cm/s using a flexible wall permeameter. The results of this test are also provided in Appendix B.

3.0 SITE CONDITIONS

3.1 Regional Geologic Setting

The Bruin Point Mine is located in eastern Utah in the Book Cliff-Roan Plateau section of the Colorado Plateau physiographic province (Stokes, 1986) in rugged, mountainous terrain with steep slopes. The mine is located approximately 25 miles east of Price near the headwaters of Dry Creek and Range Creek at elevations between 9,200 and 10,200 feet above mean sea level.

The bitumen sand deposits at the mine site are within what is collectively known as the Sunnyside tar sands. The deposits occur in late Paleocene/early Eocene (circa 60-40 million years ago) rocks in the upper part of the Colton Formation and the lower part of the Green River Formation, both of Eocene age. Both are derived from deposition into Lake Uinta, a prehistoric lake that persisted for 15 million years in a large intermontane basin occupying the regions of the present-day Uinta and Piceance Basins. These units consist of interbedded, fine-grained shales and sandstones. Bitumen has migrated from the shale into the sand units.

The Green River Formation overlies the Colton Formation. This formation consists of freshwater marlstone, oil shale, limestone, siltstone, sandstone, tar sands, and shale. The contact between the Colton and Green River Formations is identified as the horizon where dominantly fluvial strata below give way to dominantly lacustrine strata above (Morrison Knudsen, 1984). The tar sands beds occurring in the lower part of the Green River are similar in origin and appearance to the tar sands beds of the Colton Formation.

Bitumen occurs chiefly in the sandstone beds of the Colton and lower part of the Green River Formations. The tar sands beds outcrop conspicuously along the west face of the Book Cliffs, locally known as Bruin Point near the headwaters of Range Creek. Tar sands outcrops are persistent for over nine miles along the west face of the Book Cliffs (Morrison Knudsen, 1984).

3.2 Specific Site Conditions

3.2.1 General

A site plan for the Bruin Pont Mine site showing the locations of test pit explorations is provided in Figure 2. Details of the field investigations performed at this site and laboratory test results are presented in Section 2.

3.2.2 Soil Conditions

In large part, the ground surface was observed in the test pit excavations to consist of approximately 1 foot of dark-colored topsoil containing roots, fibrous matter, and/or other organic components. The topsoil is generally unsuitable for engineering purposes. The surface is vegetated with grasses and sage, with patches of pine and aspen trees. The surficial soil (topsoil) is generally underlain by brown clayey sand (SC) or clay (CL, CH) with varying amounts of sand and increasing gravel and cobble content with depth. Cobbles encountered were generally observed to be less than 10 inches in diameter. The clayey soils are underlain by bedrock materials. See the test pit logs in Appendix A.

4.0 DESIGN CRITERIA

4.1 General

The project site is located at the headwaters of Range Creek. Range Creek is a natural water way, which flows into the Green and Colorado Rivers. The following design criteria are required and provided to outline the standard of care for protection of groundwater and surface water in Range Creek. The criteria are based on the slope stability analyses and preliminary hydrological assessments performed for the site and proposed surface structures. Design criteria are provided below for each of the primary surface structures.

All hydrological criteria provide below are based on consideration of the site as a zero discharge facility based on the 100-year preliminary storm event calculations provided herein, 150-foot disturbance zone around Range Creek, lining of all pond and drainage swales with properly compacted mine partings, a 3-foot minimum freeboard limit for all ponds, and regular maintenance.

4.2 Mine Portal

Geotechnical

- Orient portal openings parallel to strike and dip of predominant joints and fractures.
- Provide benching of upslope rock/soil face.
- Provide mesh and / or rock catchment above portals.
- Provide patterned rock bolting with cable mesh at portal face.

Hydrological

- Provide drainage berms and channels around the plant site to direct any surface water away from the site and contain on-site storm water and erosion. The berms will be constructed as described in Section 5.
- Direct process and on-site storm water to a retention pond.

4.3 Plant Site

The plant site will contain the process equipment for the bitumen extraction process along with an ore stockpile that will be covered.

Geotechnical

- Provide a clay liner of mine partings material that is adequately broken down and compacted according to the project specifications.
- Provide compacted gravel working surface above the clay liner.
- The slope angles of stockpiles formed with conveyor discharge will likely vary depending on the moisture content of the stockpiled material.
- Angle of repose data for ore produced at the mine are not available.

Hydrological

- Provide clay liner below the plant site to minimize infiltration of process and storm water into the bedrock and on-site soils.
- Provide drainage berms and channels around the plant site to direct any surface water away from the site and contain on-site storm water and erosion. Construct the berms as described in Section 5.
- Direct process and on-site storm water to a retention pond.

4.4 Topsoil Stockpiles

The surface soils at the site consist of topsoil underlain by a 1 to 7-foot layer of clayey soils. Topsoil and clayey soils are proposed to be stripped from the large tailings stockpile area and stockpiled separately. The clayey soils may later be mixed with clayey mine partings, and used as cover for the proposed tailings stockpile.

Geotechnical

- Screen topsoil and clayey surficial soils to remove cobble or large size rocks to facilitate compaction. Stockpile for later use of this material as cap or cover for the tailings stockpile. Mine partings materials may be mixed with topsoil and surficial clayey soils.
- Provide compaction of the clayey surficial soils using the compaction criteria provided in the project specifications. Topsoil will be placed under reduced compaction criteria as specified in the field because the compaction criteria outlined in the specifications will be difficult to implement in topsoil with high organic content.
- Construct compacted topsoil stockpiles at slopes no steeper than 2.25H:1V to meet appropriate factors of safety based on stability modeling discussed in the stability section of this report.
- Do not stockpile snow on, or near slopes.

Hydrological

- Provide drainage berms and channels around the stockpiles to direct any surface water away from the site and contain storm water and eroded soils within the site. The berms will be constructed as described in Section 5.
- Direct process and on-site storm water to a retention pond.

4.5 Tailings Stockpile

A permanent stockpile is proposed for long-term storage of tar sand tailings material. The tailings will be mechanically transported to the permanent tailings stockpile, moisture conditioned to achieve specified compaction criteria, and mechanically compacted using conventional compaction equipment. No hydraulic transportation or deposition of tailings will be performed. Strip surface soils below the stockpile as outlined below and a clay liner will be constructed before mechanical placement of tailings begins.

Geotechnical

- Strip topsoil and surficial clayey soils in sufficient quantity to provide a suitable cover or cap material during reclamation. This includes all surficial soils with significant organic matter (greater than approximately 5% organics by volume), debris, deleterious or loose material, or high-plasticity soils (LL>50).

- Provide compaction of the tailings stockpiles using the compaction criteria provided in the project specifications.
- Construct compacted tailings stockpiles at slopes no steeper than 2.25H:1V to meet appropriate factors of safety based on stability modeling discussed in the stability section of this report.
- Do not stockpile snow on, or near slopes.

Hydrological

- Provide clay liner below the tailings stockpile to prevent infiltration of process and storm water into bedrock. The liner will be constructed according to the requirements in the project specifications.
- Provide cap or cover for the tailings facility as soon as possible to reduce infiltration into the stockpile.
- Provide single or multiple retention basins to contain storm water that falls within the tailing stockpile. This water can be used as process water.
- Provide drainage berms and channels around the tailings stockpile to direct any surface water away from the site and contain on-site storm water and erosion. The berms will be constructed as described in Section 5.
- Provide check dams to reduce erosion potential. The check dams will be constructed as described in Section 5.
- Direct process and on-site storm water to a retention pond.

5.0 HYDROLOGY

5.1 Hydrology

The existing terrain at the site is mountainous with steep slopes and the area is subject to high intensity, high frequency storm events. The majority of the project is situated within the Range Creek Watershed and a lesser portion of the project lies within the Grassy Trail Creek Watershed (see Appendix C for the Watershed Map). During the previously noted July 31, 2014, site visit, the existing land cover terrain, soil type, and topographic features were verified. Precipitation for this area was acquired from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 for the area east of Sunnyside, Utah, at the Bruin Point on Patmos Ridge (The exact location is 39.6343 latitude and -110.3391 longitude with an elevation of 10,073 feet). Precipitation for the 10- and 100-year storm events (over 24 hours) are 2.22 and 3.25 inches, respectively. The Soil Conservation Service (SCS) type II storm event was analyzed using Hydrologic Modeling-System (HEC-HMS) v4.0 for the 10- and 100-year events.

The amount of rainfall that contributes to runoff can be calculated based on empirical relationships referred to as runoff curve numbers (CN). The CN values are related to soil type, soil infiltration capacity, land use, and depth to the phreatic surface and were chosen for the site based on field observations, laboratory test data, and engineering judgment. The site can be characterized using three CN groups including areas as follows:

1. Minor disturbance including the topsoil stockpiles, road shoulders, staging areas, and other areas of infrequent access.
2. Significant disturbance such as roads, structures and the immediate mine portal access vicinity.
3. Tailings site exhibiting a high level of compaction with little interstitial space.

The site soils and tailings materials were available for visual inspection. The results of the hydrologic analysis are provided in Appendix C.

Retention basins are required at various locations around the site and will be sized with appropriate safety factors to contain all surface water and prevent any discharge off the site based on the 100-year storm event discussed above. Disturbance from this project will be considered as a minimum of one hundred fifty feet away from Range Creek.

To minimize any infiltration, the retention basins must be lined with mine partings or other form of equivalent protection. The basins will maintain minimum of 3 ft of freeboard and will be regularly maintained to ensure design capacity.

To capture and contain all runoff during the 100-year storm event, eight retention basins were designed based on preliminary calculations for the site and assuming a 72-hr (hour) holding time. Table 3 presents the preliminary Q100 volume and peak inflow for each basin. These eight basins are shown on Figure 3. The ultimate configuration and detailed design will require a cursory review from State of Utah Department of Dam Safety. A more detailed analysis will need to be completed to verify assumptions made in this analysis at the design level. Operational control will allow the placement of retention facilities to be strategically placed based on site layout and these basins may be split into multiple locations.

Table 3. Summary of Hydrologic Results

Basin	Location	Peak Inflow 100-YR *(cfs)*	Total Volume 100-YR *(acre-ft)*
1	Mine Portal	5.0	0.4
2-5	Haul Road	5.1	0.4
6	Plant Site West	22.6	1.9
7	Plant Site East	22.6	1.9
8	Tailings	89.0	18.7

Notes: cfs = cubic feet per second; ft = feet

5.2 Erosion Control

Water that falls within the project areas will be separated from rainfall outside the project area using earthen berms with clay lining or suitable geomembrane. The earthen berms were conceptually designed for both containment of drainage runoff within the project area and to divert offsite flow. The preliminary conceptual design of the berms did not consider the effects of significant erosion or slope failure of any kind. Final engineering design of berms and ditches should be performed during final design.

Construct 4-ft high, earthen berms of clean native or import soil around the perimeter of any disturbance to ensure all runoff within the project area is diverted to a retention pond. Construct the berms with a 2-ft wide flat top with 2H:1V side slopes and be lined with a clean 2-ft thick clay liner. As an alternative, the berms may also be lined with a geo-membrane of suitable thickness to minimize ripping or puncture. The berms will not be constructed of topsoil and will be free of organic material. Channels to divert surface water will be integrated into the perimeter berms to minimize infiltration.

The tailings material and other disturbed soils have a very high potential to be suspended in runoff and erode quickly. Construct check dams to block sediment transport down the face of the tailings stockpile. Construct check dams measuring 3-ft in height of suitable rock. Inspect routinely and maintain as needed to insure proper performance. After the life of project is complete, construct a cap over the tailings material.

6.0 SLOPE STABILITY ANALYSIS RESULTS

6.1 Slope Stability Analysis Results

6.1.1 General

Slope stability analyses were performed for the maximum cross sections of the topsoil and permanent tailings stockpiles at the Bruin Point Mine Site. Two orthogonal sections of the permanent tailings stockpile and four sections of the topsoil stockpiles were examined using limit-equilibrium analyses.

The limit-equilibrium computer program Slide, version 6.005 by Rocscience, Inc. of Toronto, Canada, and Spencer's method of slices were used for the analyses. Spencer's method satisfies all conditions of static equilibrium, including horizontal and vertical force imbalance and moment imbalance. Search routines available within the software package were used to define circular trial shear surfaces. Additional noncircular trial shear surfaces were also examined to locate critical shear surfaces.

Preliminary conceptual drawings of the tailings and topsoil stockpiles were provided to URS by ASE. These drawings included cross sections of each stockpile (identified as A-A and/or B-B for each stockpile). Additional cross sections were developed by URS to include more critical stability cases (identified as A-A' and/or B-B'). The slope stability cross section locations used in the analyses are shown in Figure 4. Some of the preliminary conceptual A-A and B-B stockpile cross sections showed discontinuities and localized slope variations that are not typical of stockpile construction. Thus, some interpretation and line smoothing was performed in stability model development.

At final completion, the proposed tailings stockpile will be on the order of 430-ft high, 3,600-ft long, and 2,000-ft wide. The north and south topsoil stockpiles will be approximately 30- and 50-ft high, respectively.

Temporary plant site stockpile configurations were not provided to URS. However, plant stockpiles are anticipated to consist of loose or uncompacted mine tailings or tar sand ore awaiting processing or transportation to permanent stockpiles. As such, stability can be considered based on the angle of repose. The angle of repose is defined as the largest possible angle of incline for a slope of loose material or soil, which can be maintained without sliding under the force of gravity. This slope depends only on material properties (moisture, particle size, etc.) and is not affected by vertical confining pressure. Furthermore, slope failures tend to consist of sliding surficial particles or material rather than a larger slump failure. The mine tailings angle of repose was measured under various moisture conditions as provided to URS and included in Appendix B; however, a sample or measurement of the tar sand ore angle of repose was not provided to URS.

The local phreatic surface was presumed to be located in bedrock below each stockpile as no groundwater was observed in the subsurface explorations. Therefore, it is not expected to impact the stability of each stockpile. Furthermore, anticipated rain/snowfall in the area and the free-draining nature of the stockpile materials is believed to preclude the possibility of significant moisture accumulation in, or beneath, the stockpile or liner material.

6.1.2 Material Strength Characterization

A material strength characterization was performed to estimate the unit weight and drained-strength parameters of each material considered in the modeling process. The unit weight, drained cohesion, and drained friction angle of the materials were obtained from values measured in laboratory tests. Because soils at the site are expected to be unsaturated and stockpile construction above the clay liner is expected to take years to be completed, drained-strength parameters were used in the analyses to consider long-term loading conditions with the stockpiles in-place. A summary of material strength properties used to develop the stability model is provided in Table 4. In the case of seismic stability, the strength parameters of the clay liner were reduced by approximately 20 percent to conservatively account for cyclical softening of the clay due to ground shaking. The strength parameters of the bedrock, native topsoil, and tailings sand, were not reduced.

The strength parameters for bedrock were assumed based on published geologic descriptions of rock types in the area (limestone, siltstone, mudstone, sandstone, and shale). This is a conservative assumption as bedrock strength is unlikely to be the determining factor in stockpile stability. A minimum setback distance from the edge of the plateau of 25 feet was calculated based on rock mass dipping planes measured at the site. However, it is likely that operation constraints will dictate a larger setback distance.

During field investigations, native topsoil samples were collected on which laboratory tests were later performed. Because only one sample was tested, the cohesion was back-calculated from the laboratory test data assuming a drained friction angle, ϕ', of 28 degrees.

Preliminary direct shear testing was performed on tailings sand and proposed clay-liner samples provided to URS by ASE. The laboratory test results were used to estimate drained-strength parameters for the tailings sand and clay liner; however, the proposed clay-liner strength parameters are contingent on achieving acceptable permeability using proposed production methods and also based on very limited testing. As such, additional testing and analyses should be performed to provide higher reliability of the final design. If another suitable material must be selected to achieve adequate liner permeability, these analyses may no longer be appropriate.

Table 4. Material Properties for Slope Stability Analyses

Material Description	**Unit Weight** *(pcf)*	**Cohesion, c′** *(psf)*	**Drained Friction Angle, ϕ′** *(deg)*
Bedrock	140	5,000	30
Native Topsoil	120	600	28
Tailings Sand	120	130	33
Clay Liner (Crushed Mine Partings)	125	735 / 590[1]	30 / 24[1]

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; deg = degrees

1. Strength parameters (c′ and ϕ′) were reduced by 20% in seismic-case stability analyses.

6.1.3 Slope Stability Results

Slope stability was considered for general stability of stockpile materials for large continuous uniform slopes, and for the preliminary conceptual cross sections as provided by ASE and discussed in Section 6.1.1. Each case also considered seismic stability for a 2,475-year seismic event (2% probability of exceedance in 50 years). The associated peak horizontal ground acceleration, PGA, was determined to be 0.174g (USGS, 2014). Seismic cases were modeled using a pseudo-static analysis, where dynamic earthquake loading simulated using a static force equal to the soil weight multiplied by a seismic coefficient, k. For the seismic analyses, the pseudo-static seismic coefficient was calculated as half the PGA.

6.1.3.1 Stability Results for Required Slope Angles

For each stockpile material, cross sections were developed with various slope angles to identify a required acceptable slope for each stockpile. The required slopes determined from each of the general stability models and associated factors of safety, by stockpile type, are presented in Table 5. Source information for Table 5 is included in Appendix D, Figures D1 through D4. The slope constraints shown in Table 5 should be applied to existing and future drawings and cross sections. The general slope analysis and results in Table 5 supersede all other analyses. See Sections 4.4 and 4.5 for more information about required slope angles.

Table 5. General Slope Stability Results

Stockpile Description	Slope	Static Factor of Safety	Seismic Factor of Safety
Native Topsoil	2.25H:1V or flatter	1.55	1.26
Tailings Sand	2.25H:1V or flatter	1.51	1.22

Notes: Target Static Factor of Safety = 1.5; Target Seismic Factor of Safety = 1.2

6.1.3.2 Stability Results of Preliminary Conceptual Cross Sections

For each of the three stockpiles (2 native topsoil stockpiles; 1 tailings stockpile), slope stability analyses were performed based on preliminary conceptual cross sections provided by the client and additional cross sections developed by URS as discussed in Section 6.1.1. On average, the preliminary conceptual tailings and topsoil stockpile slopes are flatter than the acceptable slope 2.25H:1V. However, the preliminary conceptual drawings should be revised to reflect the required 2.25H:1V slopes during final design.

Because a clay liner is expected to be constructed beneath the tailings stockpile, a well-defined planar layer will exist between the tailings stockpile and the natural bedrock. The clay liner should be expected to provide adequate resistance against sliding of the entire stockpile and noncircular failure surfaces shearing along the liner interface. To examine this case, a thin 4-foot-thick clay layer was modeled beneath the tailings stockpile extending well beyond the head and toe of the stockpile. An automated search for failure surfaces, which intersect all or part of the clay liner beneath the stockpile, was performed.

The results for both static and seismic loading of the preliminary conceptual cross sections provided by the client are presented in Table 6. Source information for Table 6 is included in Appendix D, Figures D5 through D20.

Table 6. Slope Stability Results of Proposed Conceptual Cross Sections

Stockpile Description	Section	Static Factor of Safety	Seismic Factor of Safety
Topsoil Stockpile No. 1	B-B	>3.0	2.70
Topsoil Stockpile No. 1	B-B′	2.57	2.05
Topsoil Stockpile No. 2	A-A	>3.0	>3.0
Topsoil Stockpile No. 2	A-A′	>3.0	2.74
Tailings Stockpile	A-A	1.51	1.23
Tailing Stockpile (Liner)[1]	A-A	1.72	1.24
Tailings Stockpile	B-B	1.82	1.44
Tailing Stockpile (Liner)[1]	B-B	2.91	1.96

Notes: Target Static Factor of Safety = 1.5; Target Seismic Factor of Safety = 1.2

1. For these cases the shear surfaces were forced to pass through the liner at the base of the tailings stockpile. This resulted in higher factors of safety compared to shear surfaces evaluated higher up in the model. See Appendix D for more information.

6.2 Kinematic Analysis Results

6.2.1 General

A preliminary kinematic analysis of the predominate joints and fractures was performed based on observations collected in the field. The mine portal will be constructed in accordance with MSHA regulations and constructed in a way to prevent any rockfall.

6.2.2 Mine Portal Opening Orientation

The mine portal opening will be aligned parallel to the strike of the predominant joint set and the dip of the portal face will also be designed to parallel the predominant dip of the near-vertical fractures. Detailed drawings of the portal orientation were not available for review at the time of this report. The mine portal opening will be constructed in a way that meets MSHA standards.

Due to the exfoliation visible at the surface, pattern-rock bolting and cable mesh will be incorporated into the design of the portal face. Stabilization using shotcrete is not recommended because of the potential to building pore pressure behind the shotcrete over time.

6.2.3 Mine Portal Opening Protection

Mine portal protection is paramount for safe operations in the vicinity of the mine entrance. The mine portal will be prepared and developed by removal and stabilization of loose and fractured surface rock, with which may include the following:

- Benching of the upslope rock/soil face.
- Installation of high-resistance and high-capacity rockfall catchment fences and containment wire mesh positioned upslope of the mine portal.

7.0 CONCLUSION

The design criteria contained in this report are based on URS field investigations, preliminary stability and hydrologic analyses, and engineering judgment. The design criteria may be utilized to provide response to DOGM in support of approval of the NOI (URS, 2014). However, the engineering analyses provided herein are not adequate for final design and construction as they are based on initial data and preliminary design information.

7.1 LIMITATIONS

The recommendations contained in this report are based on the limited field investigation and laboratory testing agreed to in the project scope, and on our understanding of the proposed preliminary construction plans provided to us. There is an inherent potential for variability in the subsurface materials and conditions that exist between points investigated as well as in the properties of the materials themselves. It is not practical or possible to obtain a large enough sampling to eliminate the risk of variation. Logs of subsurface conditions, collected samples, and test results should be considered a limited sampling of existing materials that may not fully represent the actual range of conditions.

Additional engineering services are recommended to assist in design optimization for the project. These services should include additional investigation, sampling and testing to better characterize subsurface material and conditions and reduce the risk of significant variation. URS represents that its services are performed within the limitations prescribed by ASE, in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation to the American Sands Energy Corp., expressed or implied, and no warranty or guarantee is included or intended. URS does not assume responsibility for the accuracy of project information provided by others.

This report may not contain sufficient information for purposes of other parties or for other uses. This information is not to be used for bidding purposes. The scope of work did not include an investigation of potential geoenvironmental hazards such as soil and/or groundwater contamination, or the potential for hazardous materials at the site.

8.0 REFERENCES

Morrison Knudsen. 1984. Sunnyside Tar Sands Project: 1983 Geologic Evaluation. Boise, Idaho.

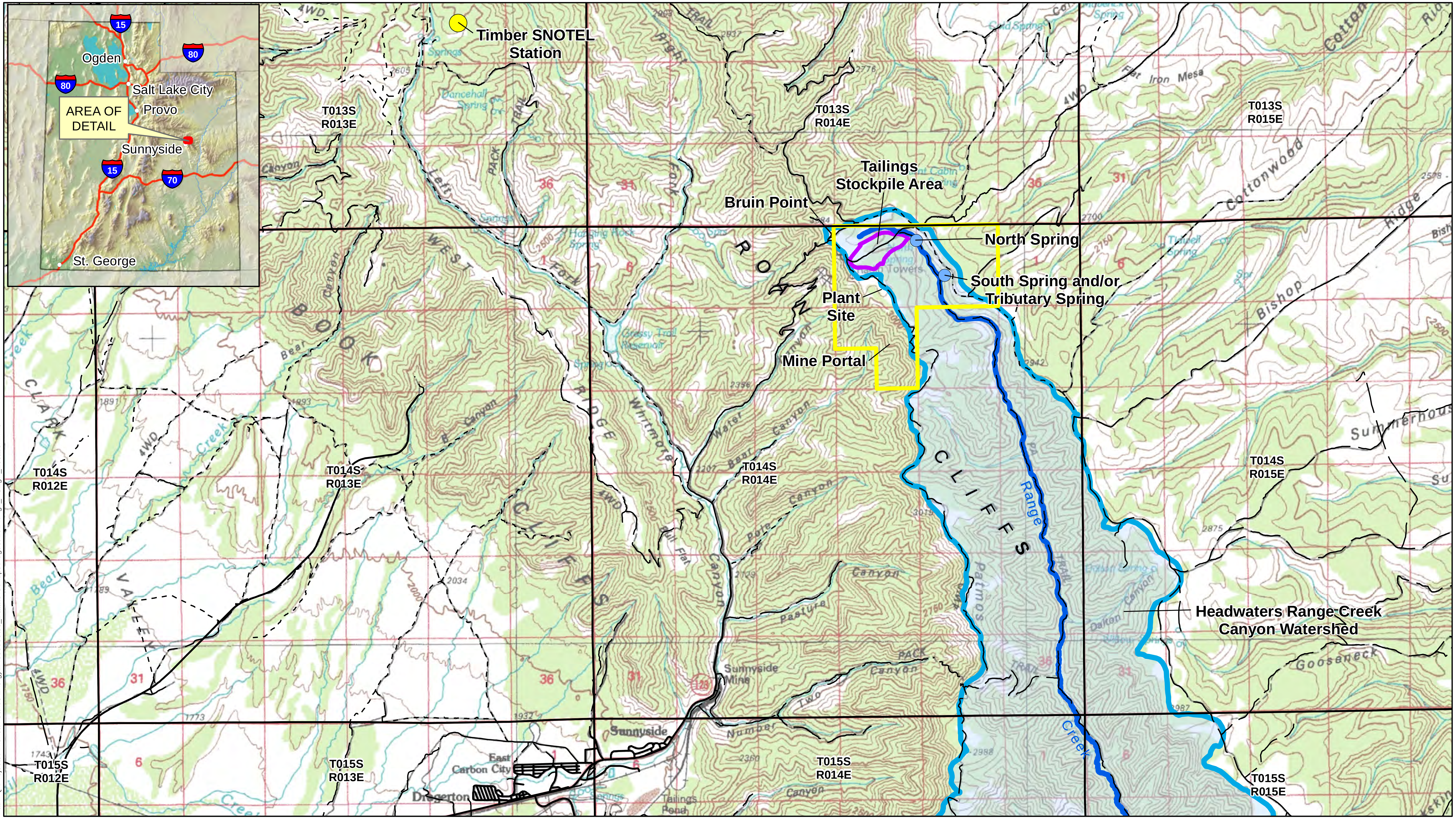
Stokes, William Lee. 1986. Geology of Utah. 1st ed. Salt Lake City, Utah: Utah Museum of Natural History and Utah Geological and Mineral Survey.

United States Geological Survey (USGS). 2014. "2008 Interactive Deaggregations." http://geohazards.usgs.gov/deaggint/2008/.

URS Corporation, and Mine Engineers, Inc. 2014. "Notice of Intention To Commence Large Mining Operations: Bruin Point Mine". Salt Lake City, Utah: American Sands Energy Corporation.

Wyrick, G.G., and J.W. Borchers. 1981. Hydrologic effects of stress-relief fracturing in an Appalachian Valley. US Geological Survey Water-Supply Paper 2177, US Government Printing Office.

FIGURES



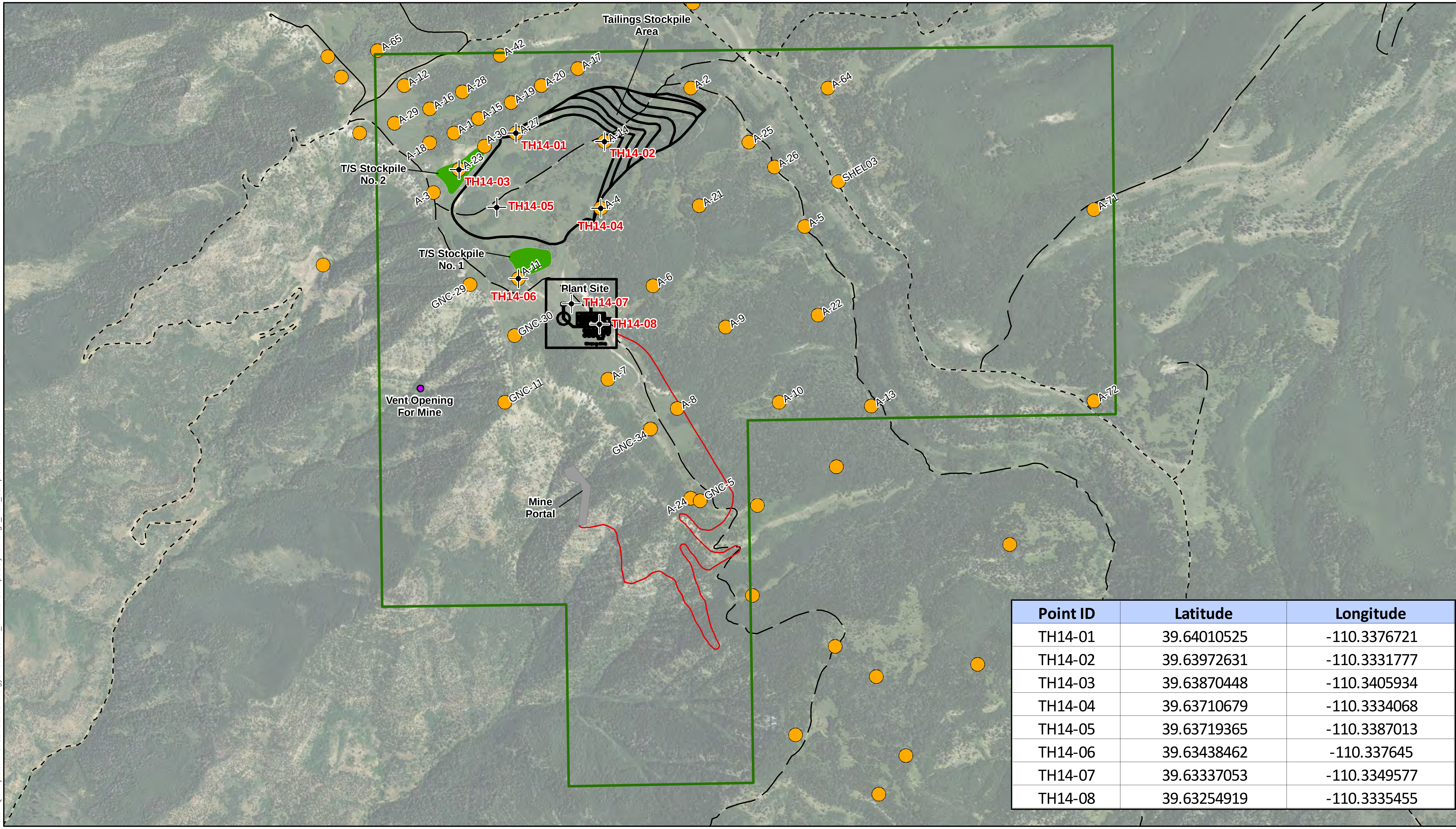
Legend	
Spring	Dry Material Storage Impoundment
Access Road	Range Creek Watershed
Paved Road	PLSS Township & Range
Improved Road	
Dirt Road	
Road (Conditions Unknown)	
Permit Boundary	

Note:
Elevation in meters above mean sea level

N

1 0 1 2 Miles

Title:	Site Plan and Vicinity Map	
Bruin Point Mine	Proj No: 24585638	
	Figure: 1	
American Sands Energy Corp	Date: Sept 2014	
	URS	



Point ID	Latitude	Longitude
TH14-01	39.64010525	-110.3376721
TH14-02	39.63972631	-110.3331777
TH14-03	39.63870448	-110.3405934
TH14-04	39.63710679	-110.3334068
TH14-05	39.63719365	-110.3387013
TH14-06	39.63438462	-110.337645
TH14-07	39.63337053	-110.3349577
TH14-08	39.63254919	-110.3335455

Sample Point
Investigation Location 2014
Improved Road
Dirt Road
Road (Conditions Unknown)
Mine Haul Road
40 foot Contour Line
Elevation Data from 5m DEM Utah AGRC

Topsoil Stockpile
Topsoil Removal / Tailings Stockpile
Permit Boundary

Title: Investigation Location Map

Bruin Point Mine

Proj No: 24585638

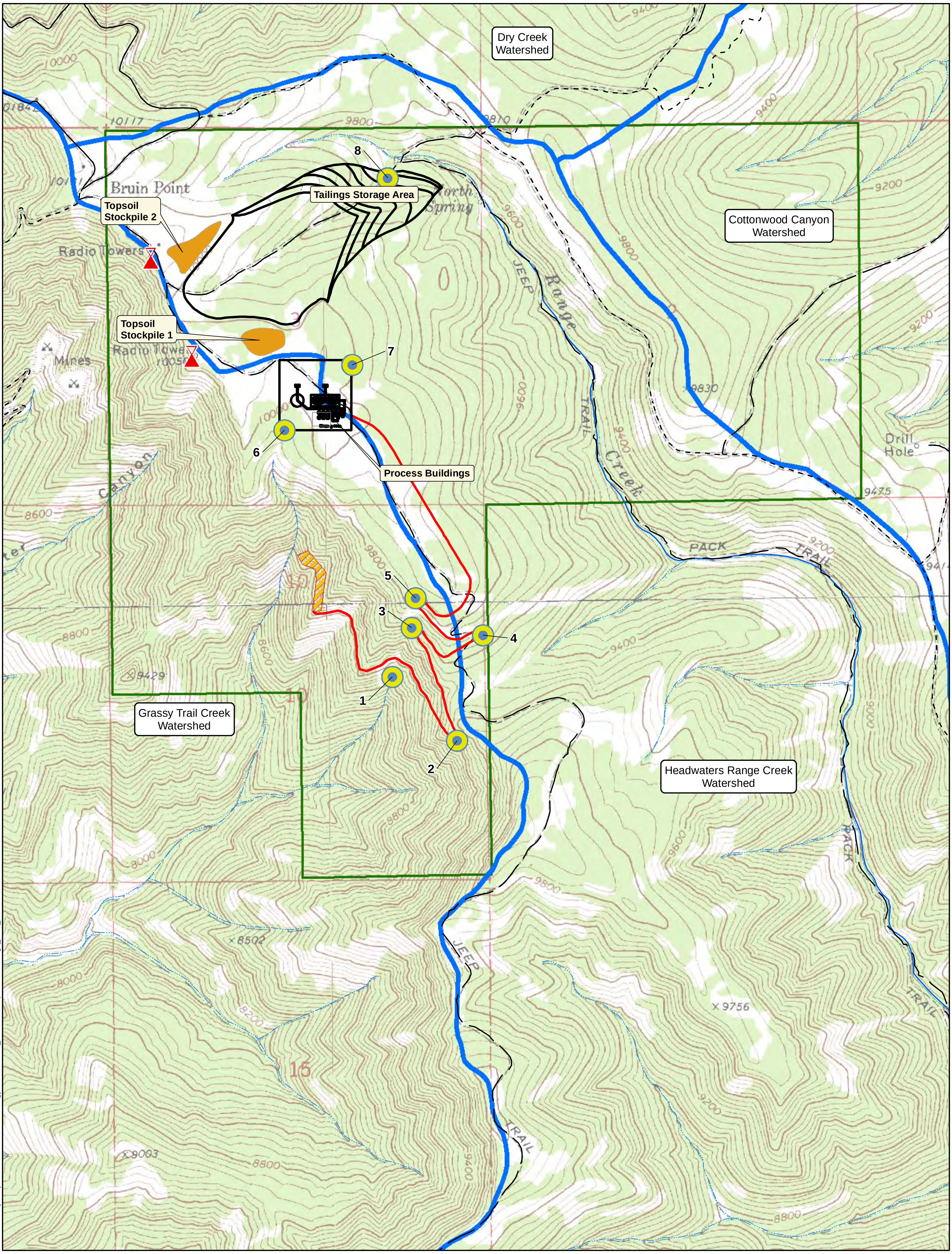
Figure: 2

Date: February 2015

American Sands Energy Corp

URS

Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\July2014\Fig2_ASE_SamplePoints.mxd



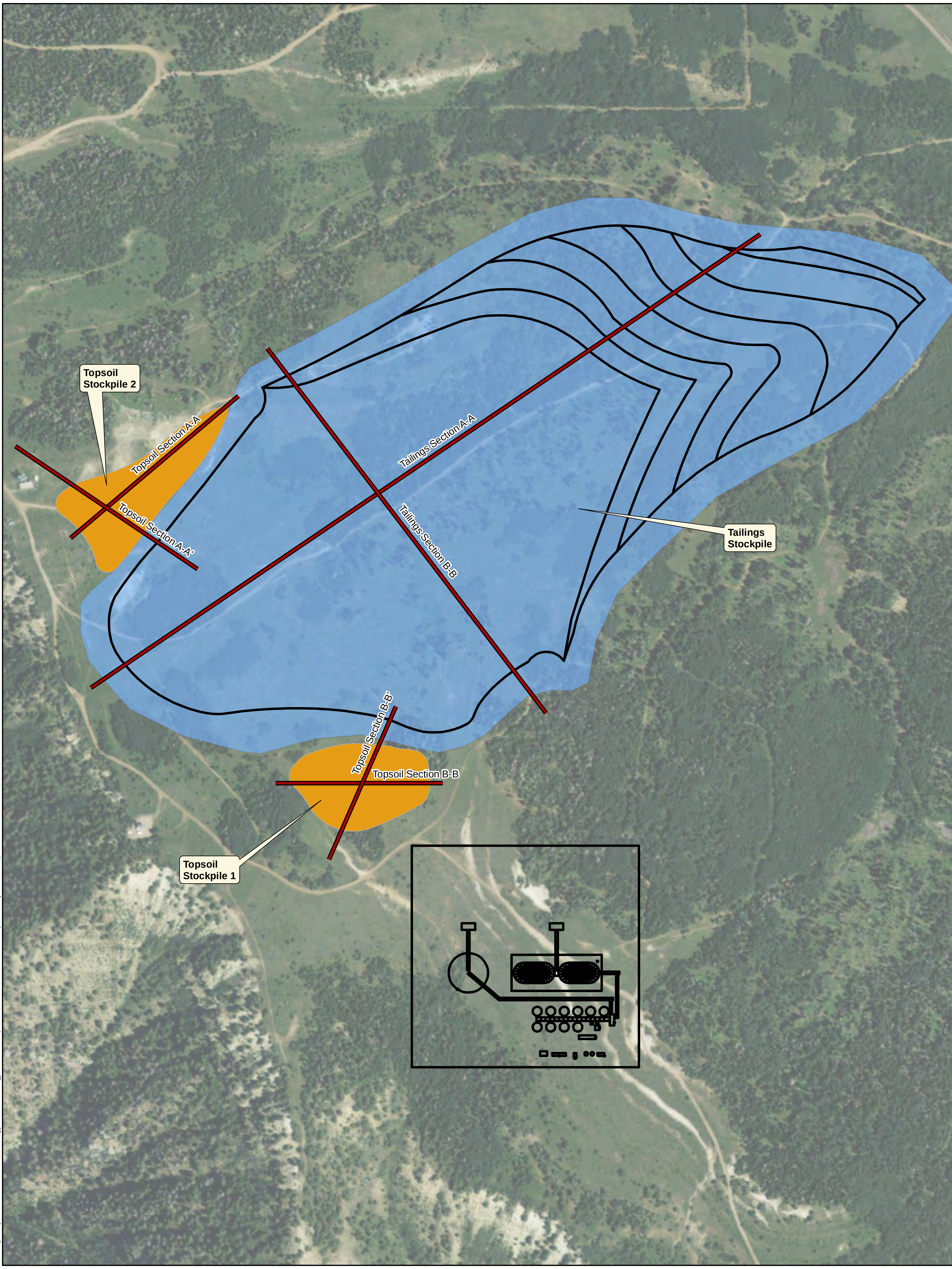
Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Geotech\Fig3_ASE_RetentionLocations.mxd

Affected Area
Mine Haul Road
Perennial Stream
Intermittent Stream
Watershed Boundary
Top Soil Removal
Portal Pad
Topsoil Stockpile
Improved Road
Dirt Road
Road (Conditions Unknown)
Radio Tower
Retention Basin

N

625 0 625 1,250 Feet

Title:	Mine Plan Map
Bruin Point Mine Retention Basin Locations	Proj No: 24585638
	Figure: 3
American Sands Energy Corp	Date: February 2015
	URS



Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\Geotech\Cross Sections\SlopeStabilitySectionMap.mxd

Aerial Imagery Source: USDA NAIP 1-meter, 2011

Topsoil Stockpile

Tailings Stockpile

Slope Stabilitiy Cross-Section Line

0 400 800 Feet

N

Title:	**Slope Stability Cross-Section Map**	
Bruin Point Mine	**Proj No:**	**24585638**
	Figure:	**4**
American Sands Energy Corp	**Date:**	**February 2015**
	URS	

APPENDIX A
TEST PIT LOGS

Surface and Shallow Soil Sampling Log

Log ID: TH14-01	
US State Plane, Utah Central, NAD 83	
Northing: 7,039,763 ft	
Easting: 1,967,721 ft	**Elevation:** 9,982 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.64010525, -110.3376721; Vicinity of A-27		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 29”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-7	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
7-12	Dark Brown to Brown, Fat CLAY (CH), trace to little fine sand , moist	Bag Sample Collected @1’
12-29	Interbedded Clay (CH) and Claystone/MudStone, horizontally bedded, 2-4” thicknesses, moist	
29	Rock	Refusal/ Terminated @ 29”

Photograph/Sketch

Description

View of test pit TH14-01.

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-03	
US State Plane, Utah Central, NAD 83	
Northing: 7,039,242 ft	
Easting: 1,966,905 ft	**Elevation:** 10,035 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63870448, -110.3405934; Vicinity of A-23		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 46”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-9	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
9-46	Brown, Fat CLAY (CH), trace to little fine sand, trace cobble 3-10” diameter, semi-angular, moist	Bag Sample Collected @ 1’ W=16.4%, F= 82.0%, LL=57, PL=26, PI=31
46	Rock	Refusal/ Terminated @ 46” Sample Collected – Fragmented Rock

Photograph/Sketch

Description

View of test pit TH14-03.

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-04
US State Plane, Utah Central, NAD 83
Northing: 7,038,686 ft
Easting: 1,968,936 ft | **Elevation:** 9,977 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63710679, -110.3334068; Vicinity of A-4		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 72”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-7	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
7-24	Brown, Clayey SAND (SC), little fine to coarse gravel, moist	Bag Sample Collected @ 1’ W=7.9%, F=45.2%, LL=35, PL=24, PI=11
24-72	Brown, Clayey SAND (SC), little fine to coarse gravel, contains cobble 3-10” diameter , moist	Bag Sample Collected @ 3’ W=13.1%, F=26.1%, LL=37, PL=23, PI=14
72	Rock	Refusal/Boring Terminated @ 6’ Sample Collected – Fragmented Rock

Photograph/Sketch

Description

View of test pit TH14-04.

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-05
US State Plane, Utah Central, NAD 83
Northing: 7,038,699 ft
Easting: 1,967,445 ft | **Elevation:** 9,925 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63719365, -110.3387013		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 96"	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-8	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
8-42	Brown, Clayey SAND (SC), little fine to coarse gravel, moist	
42-96 @66 Below 66"	Light Tan to Gray, LEAN CLAY (CL), trace fine sand, trace fine to coarse gravel, moist -2-3" thick rock shelf, moderately soft siltstone -same: Lean Clay (CL) contains small 2-4" angular siltstone and cobble below 66", moist	Bag Sample Collected @ 3.75' W=16.7%, F=60.5%, LL=40, PL=21, PI=19
96	Rock	Boring Terminated @ 8'

Photograph/Sketch

Description
View of test pit TH14-05

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-06
US State Plane, Utah Central, NAD 83
Northing: 7,037,679 ft
Easting: 1,967,755 ft | **Elevation:** 10,056 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63438462, -110.3376450; Vicinity of A-11		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 20”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-10	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
10-12	Brown, Clayey SAND (SC), trace fine to coarse gravel, moist	
12-20	Tan to Brown to Dark Brown Mudstone, moist	Bag Sample Collected @ 1.5’
20	Rock	Refusal/ Terminated @ 20”

Photograph/Sketch

Description

View of test pit TH14-06.

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-07

US State Plane, Utah Central, NAD 83

Northing: 7,037,320 ft

Easting: 1,968,517 ft | **Elevation:** 10,027 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63337053, -110.3349577; Vicinity of Proposed Plant Site		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 69”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-10	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs, dry to moist	
10-36	Tan to White, Calcareous Sandstone shelf, highly weathered, ripable with excavator bucket, dry to moist	
36-69	Soft Siltstone/Mudstone, moist	Sample collected @ 3.5’
69	Rock	Refusal/ Terminated @ 5’9”

Photograph/Sketch

Description

View of test pit TH14-07.

Left Photo: Top of sandstone shelf at 10”

Right Photo: To bottom of excavation

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

Surface and Shallow Soil Sampling Log

URS

Log ID: TH14-08
US State Plane, Utah Central, NAD 83
Northing: 7,037,026 ft
Easting: 1,968,918 ft | **Elevation:** 10,015 ft

General Information

Project Number: 24585638	**Project Name:** Bruin Point Mine	**Page:** 1 of 1
Location: 39.63254919, -110.3335455; Vicinity of Proposed Plant Site		**Date:** 08/11/14
Field Investigator: Ethan Lamiman		
Sampling Excavation Method: Bobcat E45 Excavator	**Sampling Method:** Grab	
Depth of Excavation: 64”	**Depth to Water:** Not Encountered	**Backfill Material:** Spoils

Sample Information

Depth (in)	Lithologic Description	Comments /Analysis Results
0-7	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs	
7-12	Fine to coarse gravel, unnaturally bedded: possible disturbed material	Subsurface observed to be disturbed, offset 15’ ESE into vegetated area.
0-10	**Surficial Soil**, Dark Brown Clay with little sand, trace organics and root hairs	
10-36	Brown, Clayey SAND (SC), little fine to coarse gravel, moist	
36-64	Tan to White, Calcareous Sandstone shelf, highly weathered, ripable with excavator bucket, dry to moist	Bag Sample Collected @ 3’
64	Rock	Refusal/ Terminated @ 5’4”

Photograph/Sketch

Description

View of test pit TH14-08.

Recorded By: E. Lamiman	Date 08/11/14	Checked By: D. Pond	Date: 8/24/14

APENDIX B

LABORATORY TEST RESULTS

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: JDF

Sample Info.	Boring No.	TH14-03	TH14-04	TH14-04	TH14-05					
	Sample	3	4	5	6					
	Depth	1'	1.5'	3'	3.75'					
	Split	No	Yes	Yes	Yes					
	Split sieve		No.4	3/4"	3/8"					
	Total sample (g)		568.29	1274.42	880.96					
	Moist coarse fraction (g)		87.50	357.03	66.36					
	Moist split fraction (g)		480.79	917.39	814.60					
	Sample height, H (in)									
	Sample diameter, D (in)									
	Mass rings + wet soil (g)									
	Mass rings/tare (g)									
	Moist unit wt., γ_m (pcf)									
Coarse Fraction	Wet soil + tare (g)		212.47	478.43	194.45					
	Dry soil + tare (g)		208.63	444.90	190.81					
	Tare (g)		124.96	121.41	128.08					
	Water content (%)		4.6	10.4	5.8					
Split Fraction	Wet soil + tare (g)	363.41	259.65	618.44	550.74					
	Dry soil + tare (g)	330.33	249.25	559.18	486.98					
	Tare (g)	128.53	127.05	140.31	126.79					
	Water content (%)	16.4	8.5	14.1	17.7					
	Water Content, w (%)	**16.4**	**7.9**	**13.1**	**16.7**					
	Dry Unit Wt., γ_d (pcf)									

Entered by:___________

Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[MDv2.xlsx]1

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: BRR

Boring No.: TH14-03
Sample: 3
Depth: 1'
Description: Brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint

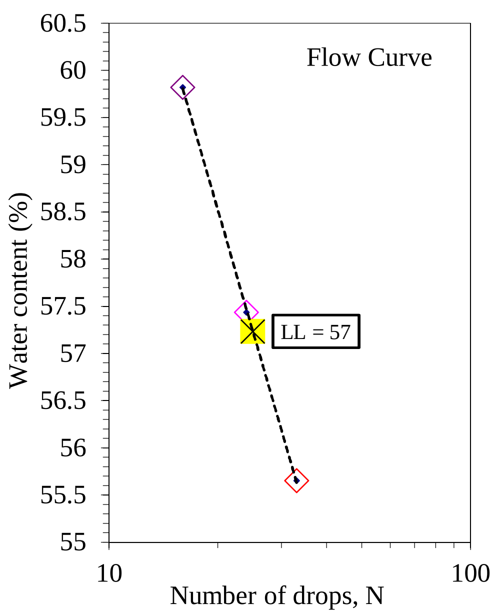
Plastic Limit

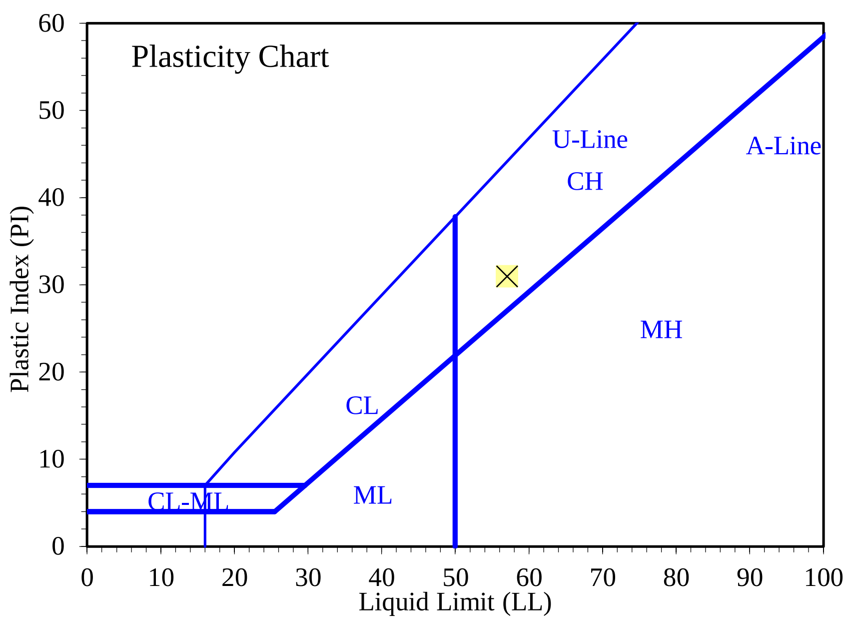
Determination No	1	2				
Wet Soil + Tare (g)	31.30	29.24				
Dry Soil + Tare (g)	29.41	27.77				
Water Loss (g)	1.89	1.47				
Tare (g)	22.11	22.18				
Dry Soil (g)	7.30	5.59				
Water Content, w (%)	25.89	26.30				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	33	24	16			
Wet Soil + Tare (g)	29.14	30.42	28.93			
Dry Soil + Tare (g)	26.58	27.37	26.25			
Water Loss (g)	2.56	3.05	2.68			
Tare (g)	21.98	22.06	21.77			
Dry Soil (g)	4.60	5.31	4.48			
Water Content, w (%)	55.65	57.44	59.82			
One-Point LL (%)		57				

Liquid Limit, LL (%)	**57**
Plastic Limit, PL (%)	**26**
Plasticity Index, PI (%)	**31**





Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[ALv1.xlsm]1

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: BRR

Boring No.: TH14-04
Sample: 4
Depth: 1.5'
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

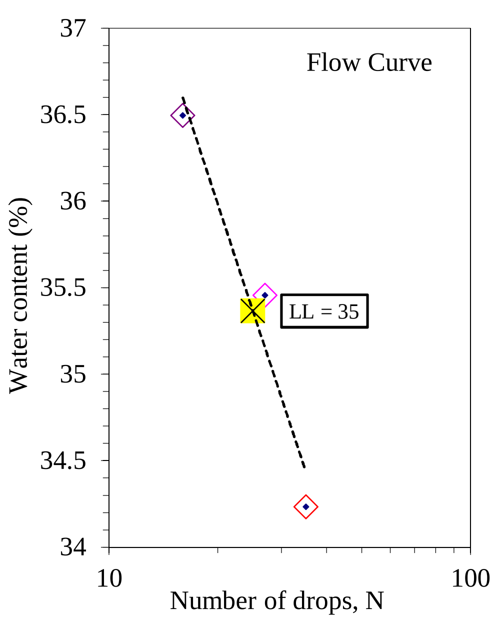
Plastic Limit

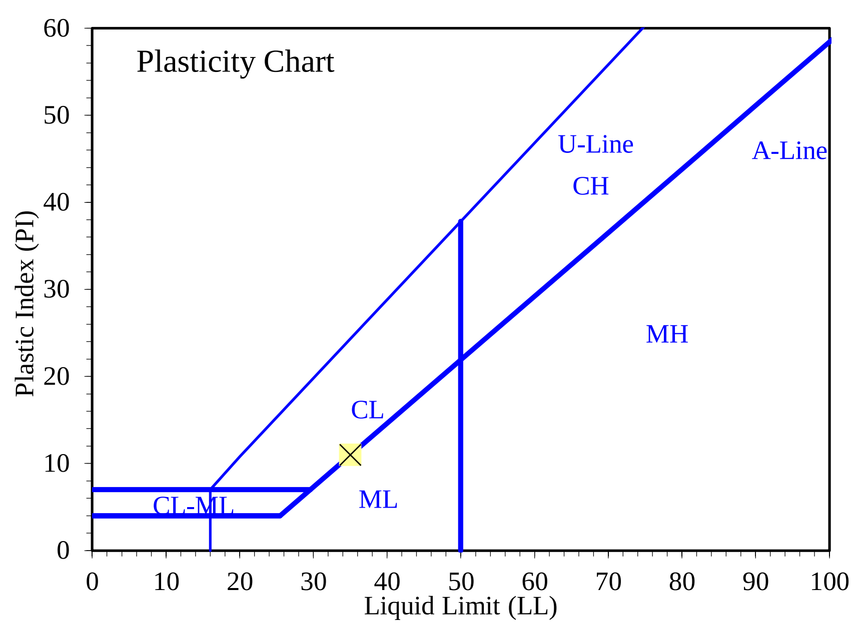
Determination No	1	2				
Wet Soil + Tare (g)	30.39	31.14				
Dry Soil + Tare (g)	28.74	29.34				
Water Loss (g)	1.65	1.80				
Tare (g)	21.80	21.65				
Dry Soil (g)	6.94	7.69				
Water Content, w (%)	23.78	23.41				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	27	16			
Wet Soil + Tare (g)	30.83	28.32	30.34			
Dry Soil + Tare (g)	28.55	26.65	28.11			
Water Loss (g)	2.28	1.67	2.23			
Tare (g)	21.89	21.94	22.00			
Dry Soil (g)	6.66	4.71	6.11			
Water Content, w (%)	34.23	35.46	36.50			
One-Point LL (%)		36				

Liquid Limit, LL (%)	**35**
Plastic Limit, PL (%)	**24**
Plasticity Index, PI (%)	**11**





Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[ALv1.xlsm]2

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: BRR

Boring No.: TH14-04
Sample: 5
Depth: 3'
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

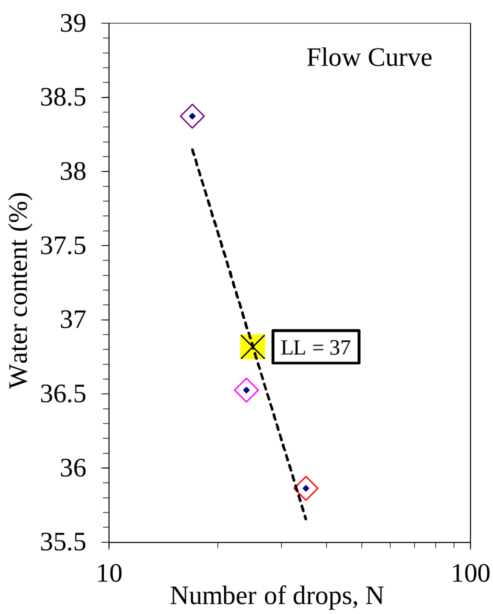
Plastic Limit

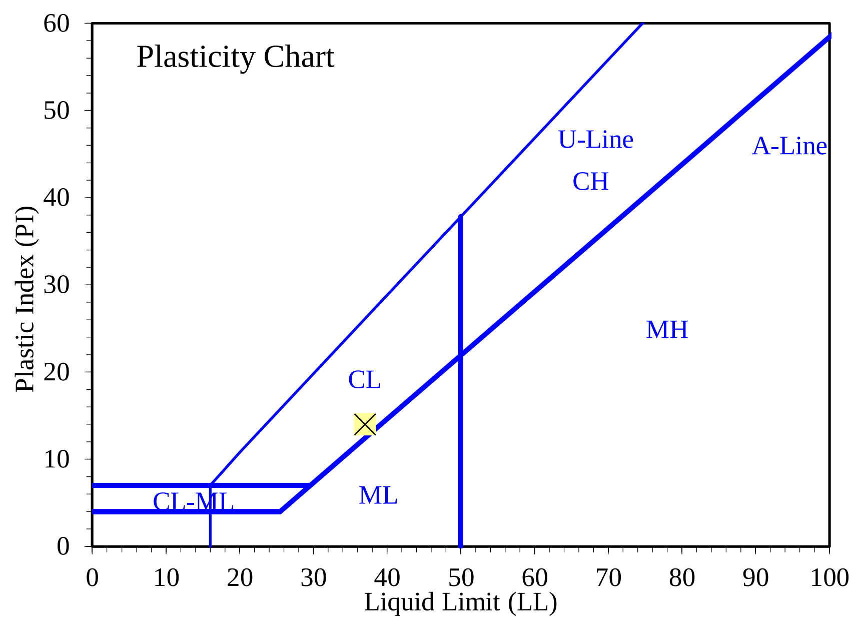
Determination No	1	2				
Wet Soil + Tare (g)	30.58	31.42				
Dry Soil + Tare (g)	28.99	29.55				
Water Loss (g)	1.59	1.87				
Tare (g)	22.16	21.47				
Dry Soil (g)	6.83	8.08				
Water Content, w (%)	23.28	23.14				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	24	17			
Wet Soil + Tare (g)	30.47	30.50	30.49			
Dry Soil + Tare (g)	28.25	28.25	28.13			
Water Loss (g)	2.22	2.25	2.36			
Tare (g)	22.06	22.09	21.98			
Dry Soil (g)	6.19	6.16	6.15			
Water Content, w (%)	35.86	36.53	38.37			
One-Point LL (%)		36				

Liquid Limit, LL (%)	**37**
Plastic Limit, PL (%)	**23**
Plasticity Index, PI (%)	**14**





Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[ALv1.xlsm]3

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: BRR

Boring No.: TH14-05
Sample: 6
Depth: 3.75'
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

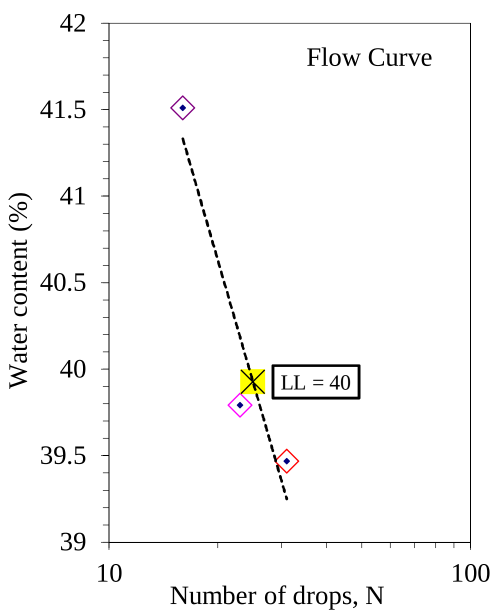
Plastic Limit

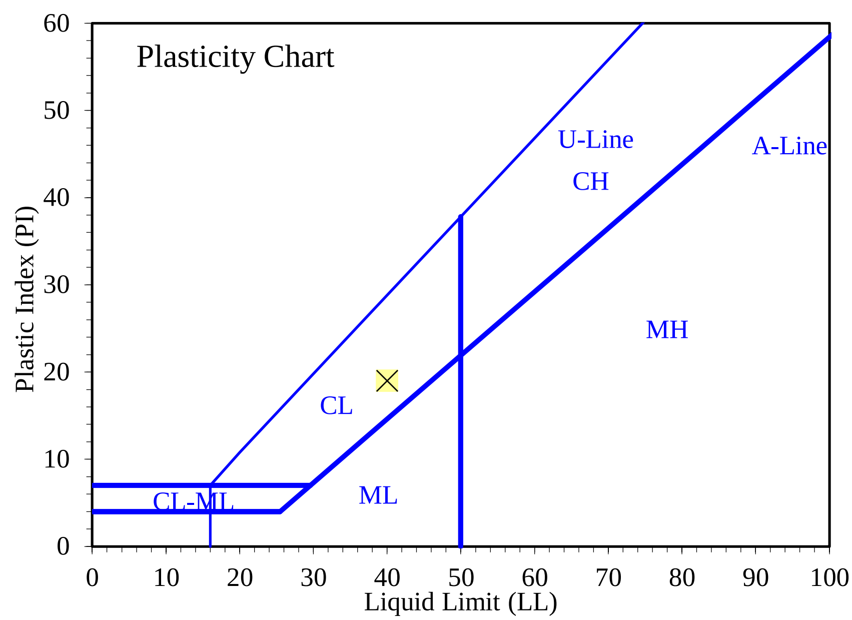
Determination No	1	2				
Wet Soil + Tare (g)	29.19	29.93				
Dry Soil + Tare (g)	27.94	28.59				
Water Loss (g)	1.25	1.34				
Tare (g)	22.01	22.20				
Dry Soil (g)	5.93	6.39				
Water Content, w (%)	21.08	20.97				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	31	23	16			
Wet Soil + Tare (g)	30.59	29.96	30.93			
Dry Soil + Tare (g)	28.21	27.66	28.24			
Water Loss (g)	2.38	2.30	2.69			
Tare (g)	22.18	21.88	21.76			
Dry Soil (g)	6.03	5.78	6.48			
Water Content, w (%)	39.47	39.79	41.51			
One-Point LL (%)		39				

Liquid Limit, LL (%)	**40**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**19**





Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[ALv1.xlsm]4

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/25/2014
By: BRR

Boring No.: Parting
Sample: 1
Depth:
Description: Grey lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

Plastic Limit

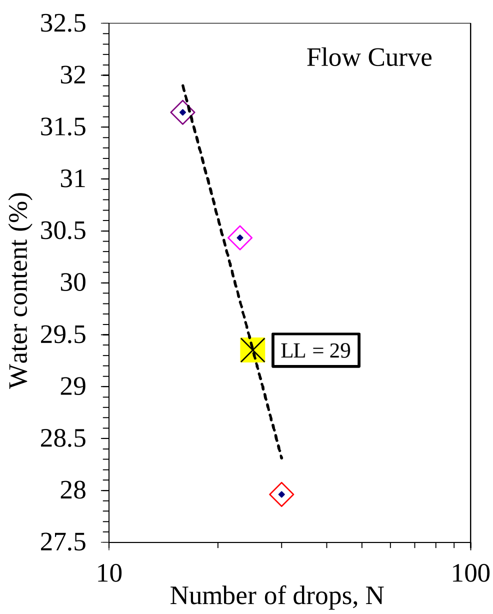
Determination No	1	2				
Wet Soil + Tare (g)	31.71	29.70				
Dry Soil + Tare (g)	30.09	28.43				
Water Loss (g)	1.62	1.27				
Tare (g)	22.25	22.26				
Dry Soil (g)	7.84	6.17				
Water Content, w (%)	20.66	20.58				

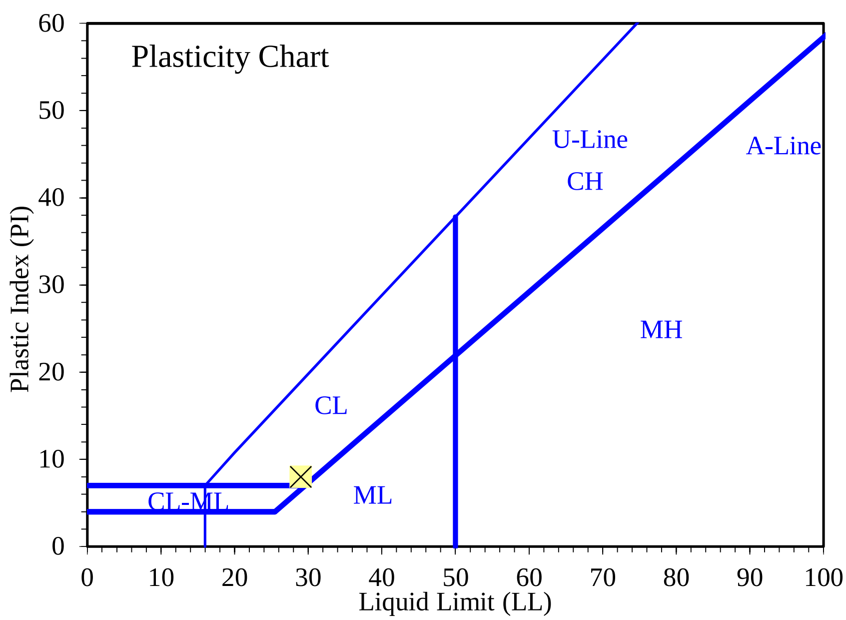
Liquid Limit

Determination No	1	2	3			
Number of Drops, N	30	23	16			
Wet Soil + Tare (g)	30.45	30.63	31.37			
Dry Soil + Tare (g)	28.49	28.60	29.06			
Water Loss (g)	1.96	2.03	2.31			
Tare (g)	21.48	21.93	21.76			
Dry Soil (g)	7.01	6.67	7.30			
Water Content, w (%)	27.96	30.43	31.64			
One-Point LL (%)	29	30				

Liquid Limit, LL (%)	**29**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**8**

Comments:
Test specimen created by crushing core sample.





Entered by:____________
Reviewed:____________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[ALv1.xlsm]5

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/22/2014
By: NB

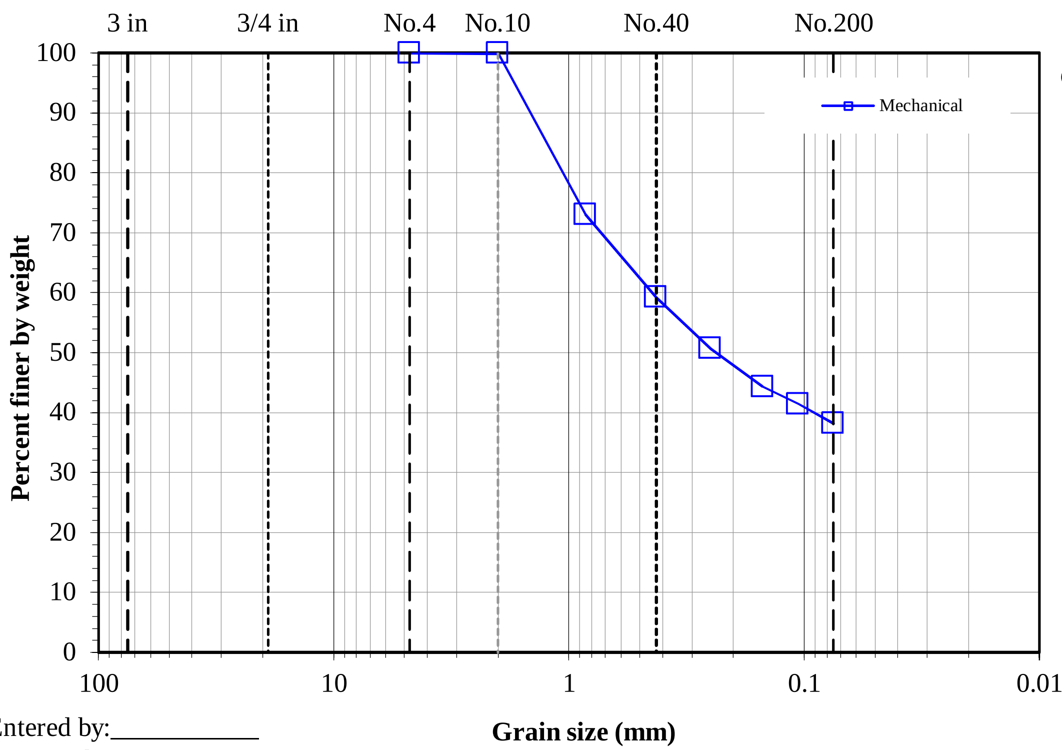
Boring No.: Parting
Sample: 1
Depth:
Description: Light grey clayey sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	129.79	124.68
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	596.81
Dry soil + tare (g):	-	591.70
Tare (g):	-	467.02
Water content (%):	0.0	4.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	100.0
No.10	0.12	2	99.9
No.20	33.63	0.85	73.0
No.40	50.87	0.425	59.2
No.60	61.53	0.25	50.6
No.100	69.43	0.15	44.3
No.140	73.04	0.106	41.4
No.200	77.05	0.075	38.2



Gravel (%): 0.0
Sand (%): 61.8
Fines (%): 38.2

Comments:
Test specimen created by crushing core sample.

Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[GSDv2.xls]1

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/22/2014
By: NB

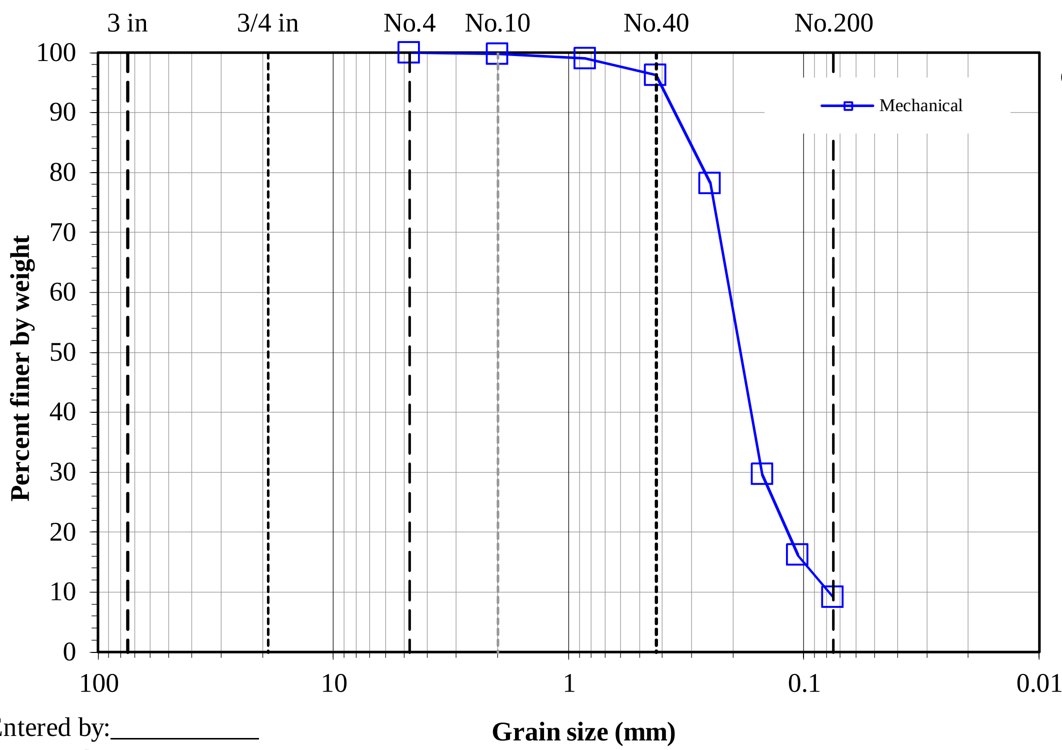
Boring No.: Tailings
Sample: 2
Depth:
Description: Brown sand with silt

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	293.32	289.04
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	624.08
Dry soil + tare (g):	-	619.80
Tare (g):	-	330.76
Water content (%):	0.0	1.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	100.0
No.10	0.74	2	99.7
No.20	2.85	0.85	99.0
No.40	10.91	0.425	96.2
No.60	63.00	0.25	78.2
No.100	203.45	0.15	29.6
No.140	242.34	0.106	16.2
No.200	262.62	0.075	9.1



Gravel (%): 0.0
Sand (%): 90.9
Fines (%): 9.1

Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[GSDv2.xls]2

Amount of Material in Soil Finer than the No. 200 (75μm) Sieve

(ASTM D1140)

IGES

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: JDF

Sample Info.	Boring No.	TH14-03	TH14-04	TH14-04	TH14-05				
	Sample	3	4	5	6				
	Depth	1'	1.5'	3'	3.75'				
	Split	No	Yes	Yes	Yes				
	Split Sieve*		No. 4	3/4"	3/8"				
	Method	A	A	A	A				
	Moist total sample wt. (g)	234.88	568.30	1274.42	880.96				
	Moist coarse fraction (g)		85.06	350.52	65.48				
	Moist split fraction + tare (g)		259.65	618.44	550.74				
	Split fraction tare (g)		127.05	140.31	126.79				
	Dry split fraction (g)		122.20	418.87	360.19				
	Dry retained No. 200 + tare (g)	164.82	183.92	406.70	249.78				
	Wash tare (g)	128.53	127.05	140.31	126.79				
	No. 200 Dry wt. retained (g)	36.29	56.87	266.39	122.99				
	Split sieve* Dry wt. retained (g)		81.33	317.60	61.89				
	Dry total sample wt. (g)	201.80	526.67	1126.99	754.72				
Coarse Fraction	Moist soil + tare (g)		212.47	478.43	194.45				
	Dry soil + tare (g)		208.63	444.90	190.81				
	Tare (g)		124.96	121.41	128.08				
	Water content (%)		4.59	10.37	5.80				
Split Fraction	Moist soil + tare (g)	363.41	259.65	618.44	550.74				
	Dry soil + tare (g)	330.33	249.25	559.18	486.98				
	Tare (g)	128.53	127.05	140.31	126.79				
	Water content (%)	16.39	8.51	14.15	17.70				
	Percent passing split sieve* (%)		**84.6**	**71.8**	**91.8**				
	Percent passing No. 200 sieve (%)	**82.0**	**45.2**	**26.1**	**60.5**				

Entered by:___________

Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[FINESv3.xlsx]1

Specific Gravity of Soil Solids by Water Pycnometer

(ASTM D854)

Project: **URS**
No: **M00100-180 (24585638.1)**
Location: American Sands Energy
Date: 8/27/2014
By: DKS

Drill hole / Sample:	Parting	Tailings				
Sample No:	1	2				
Depth (ft)						
Engineering Classification	Not req.	Not req.				
Method	A	A				
Material passing No. 4 seive, *P* (%)	100	100				
Pycnometer No.	8	1				
Mass of pycnometer (g)	188.92	167.64				
Mass of pycnometer, soil, and water, $M_{\rho ws,t}$ (g)	721.54	711.16				
Temperature, T_t (°C)	21.2	21.2				
Mass of pycnometer and water at test temperature, $M_{pw,t}$ (g)	687.61	666.08				
Mass of tare + dry soil (g)	382.76	401.44				
Mass of tare (g)	328.33	328.97				
Mass of soil, M_s (g)	54.43	72.47				
Specific gravity of soil solids at test temperature, G_t	2.655	2.646				
Temperature coefficient, *K*	0.99974	0.99974				
Specific gravity of soil solids at 20°C, $G_{20°C}$	**2.654**	**2.645**				
Apparent specific gravity of solids retained on No. 4, $G_{1@20°C}$						
Average specific gravity at 20°C, $G_{avg @20°C}$						

Tested by:___________

Reviewed by:___________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/20/2014
By: JDF

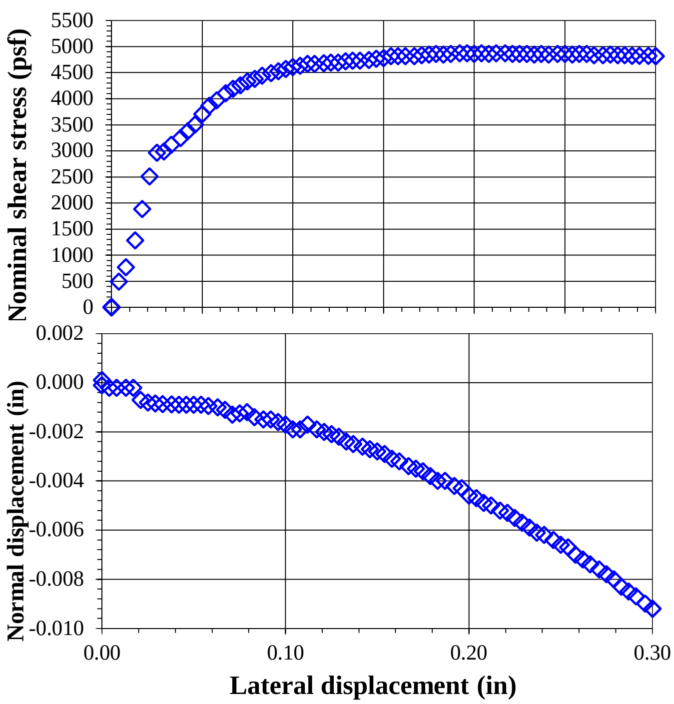
Boring No.: TH14-04
Sample: 4
Depth: 1.5'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 105 pcf
at 16 (%) w
Compaction specifications: Provided by client

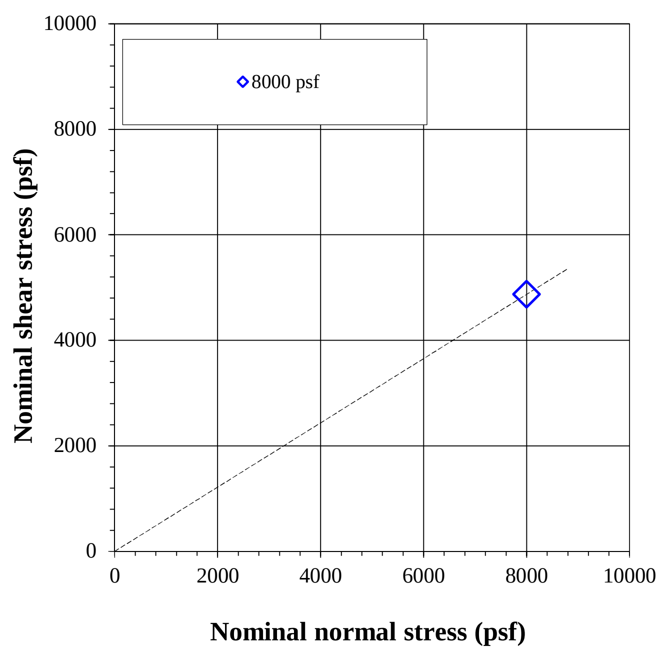
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0035
Specific gravity, Gs: 2.65 Assumed

	Sample 1	
Nominal normal stress (psf)	8000	
Peak shear stress (psf)	4872	
Lateral displacement at peak (in)	0.192	
Load Duration (min)	195	
	Initial	Pre-shear
Sample height (in)	1.0000	0.9803
Sample diameter (in)	2.416	2.416
Wt. rings + wet soil (g)	189.37	195.07
Wt. rings (g)	42.67	42.67
Wet soil + tare (g)	222.94	
Dry soil + tare (g)	209.61	
Tare (g)	126.19	
Water content (%)	16.0	20.5
Dry unit weight (pcf)	105.1	107.2
Void ratio, e, for assumed Gs	0.57	0.54
Saturation (%)*	73.8	100.0

ϕ' (deg)	31
c' (psf)	0

*Pre-shear saturation set to 100% for phase calculations





Entered by:___________
Reviewed:___________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy

Boring No.: TH14-04
Sample: 4
Depth: 1.5'

Nominal normal stress = 8000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000
0.000	12	0.000
0.004	492	0.000
0.008	768	0.000
0.013	1284	0.000
0.017	1884	0.000
0.021	2508	-0.001
0.025	2964	-0.001
0.029	2988	-0.001
0.033	3117	-0.001
0.038	3246	-0.001
0.042	3375	-0.001
0.046	3504	-0.001
0.050	3708	-0.001
0.054	3864	-0.001
0.058	3972	-0.001
0.063	4104	-0.001
0.067	4188	-0.001
0.071	4260	-0.001
0.075	4332	-0.001
0.079	4380	-0.001
0.083	4440	-0.001
0.088	4488	-0.002
0.092	4524	-0.002
0.096	4572	-0.002
0.100	4608	-0.002
0.104	4632	-0.002
0.108	4668	-0.002
0.112	4668	-0.002
0.117	4680	-0.002
0.121	4692	-0.002
0.125	4692	-0.002
0.129	4716	-0.002
0.133	4728	-0.002
0.137	4728	-0.003
0.142	4740	-0.003
0.146	4764	-0.003
0.150	4776	-0.003
0.154	4812	-0.003
0.158	4812	-0.003
0.162	4812	-0.003
0.167	4812	-0.003
0.171	4836	-0.004
0.175	4848	-0.004
0.179	4860	-0.004
0.183	4848	-0.004
0.187	4860	-0.004
0.192	4872	-0.004
0.196	4872	-0.004
0.200	4860	-0.005
0.204	4872	-0.005
0.208	4860	-0.005
0.212	4872	-0.005
0.217	4872	-0.005
0.221	4860	-0.005
0.225	4860	-0.006
0.229	4860	-0.006
0.233	4848	-0.006
0.237	4860	-0.006
0.241	4848	-0.006
0.246	4860	-0.006
0.250	4860	-0.007
0.254	4848	-0.007
0.258	4860	-0.007
0.262	4860	-0.007

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: **URS**
No: **M00100-180 (24585638.1)**
Location: American Sands Energy

Boring No.: **TH14-04**
Sample: **4**
Depth: **1.5'**

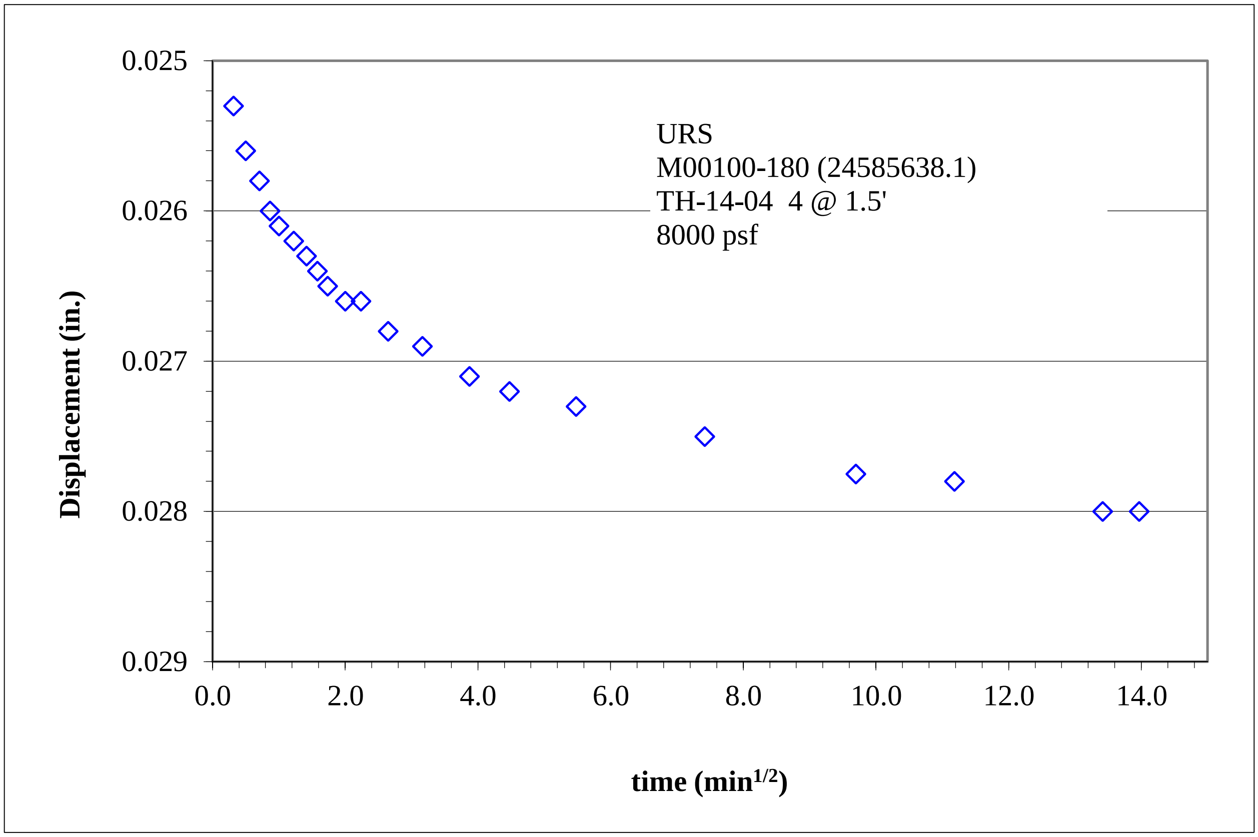
Nominal normal stress = 8000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.266	4836	-0.007
0.271	4836	-0.008
0.275	4848	-0.008
0.279	4836	-0.008
0.283	4836	-0.008
0.287	4824	-0.009
0.291	4824	-0.009
0.296	4824	-0.009
0.300	4812	-0.009
0.300	4812	-0.009

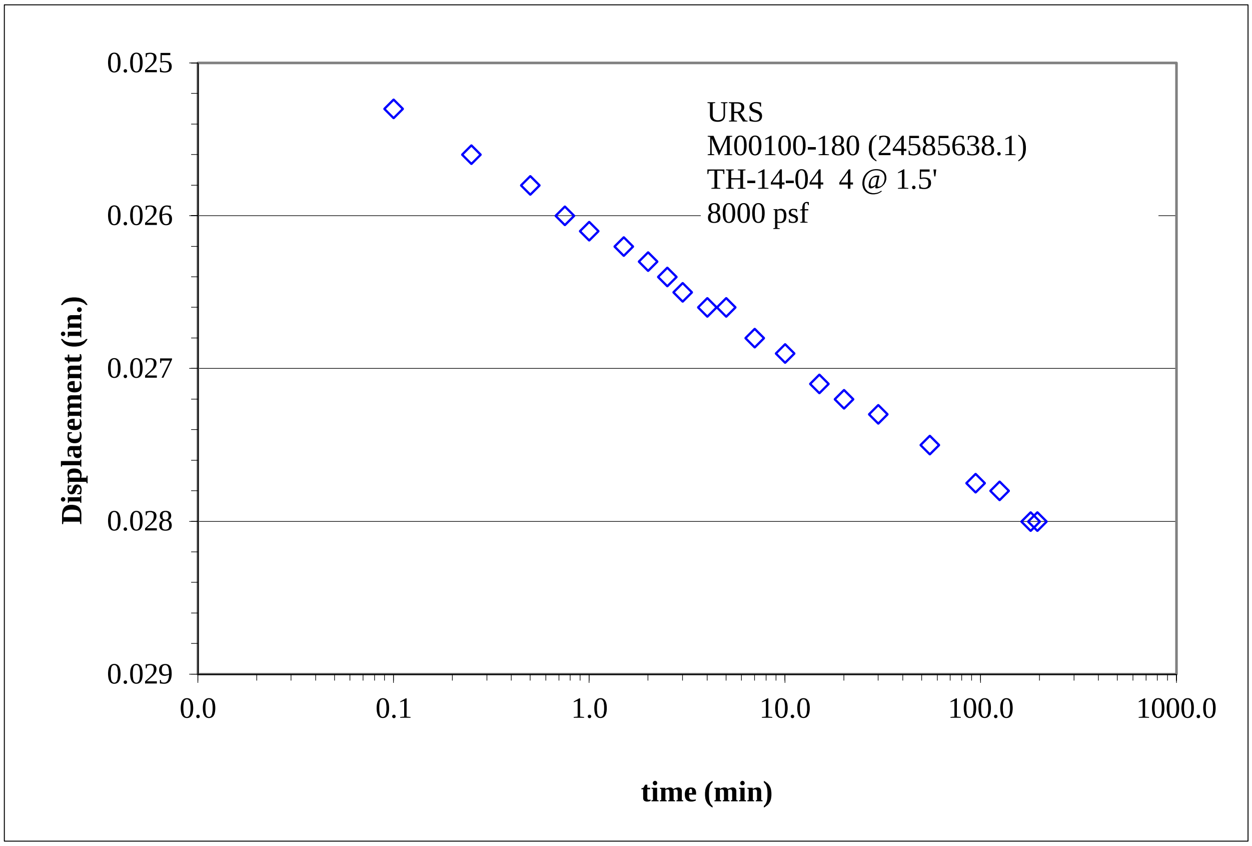
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy

Boring No.: TH14-04
Sample: 4
Depth: 1.5'





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/25/2014
By: NB

Boring No.: Parting
Sample: 1
Depth:
Sample Description: Light grey clayey sand
Sample type: Laboratory compacted
Dry unit weight 110 pcf
at 16 (%) w
Compaction specifications: Provided by client

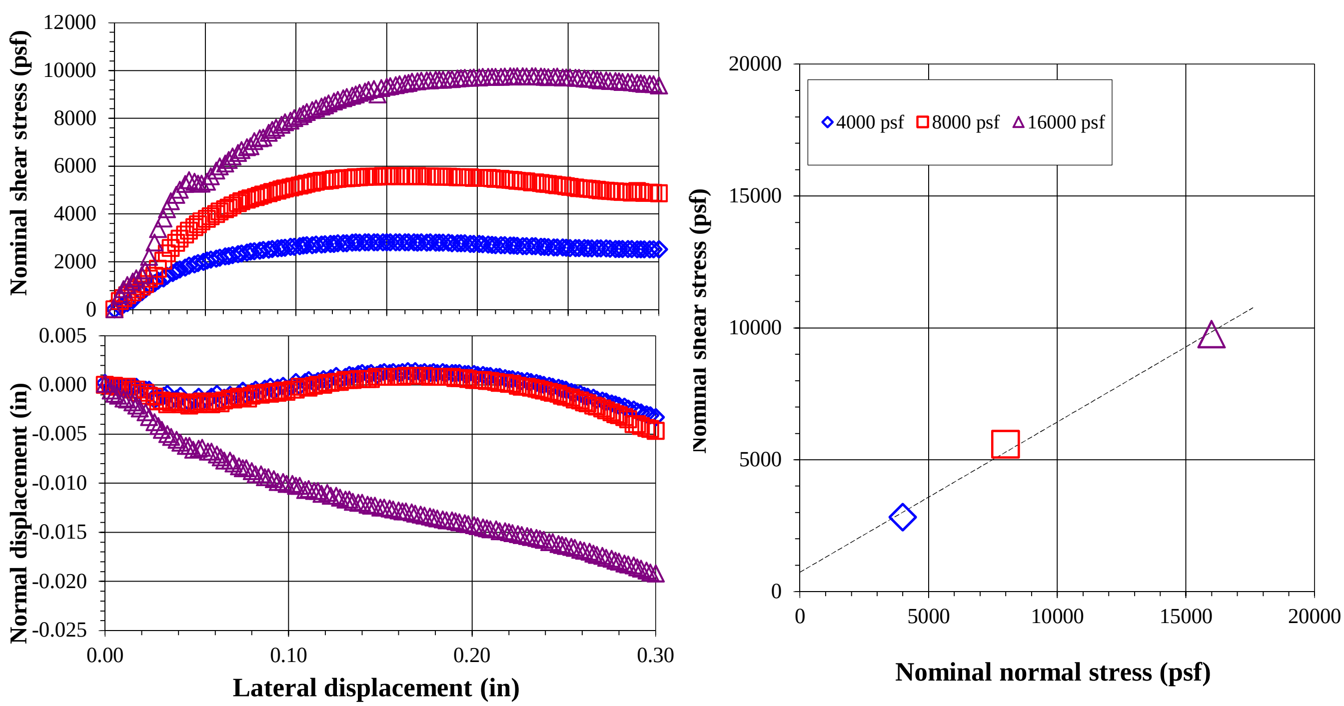
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0035
Specific gravity, Gs: 2.654 Determined

	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	4000		8000		16000	
Peak shear stress (psf)	2820		5580		9755	
Lateral displacement at peak (in)	0.138		0.148		0.218	
Load Duration (min)	1387		1499		460	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9817	1.0000	0.9623	1.0000	0.9464
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	199.17	201.42	196.62	197.41	198.35	197.95
Wt. rings (g)	45.48	45.48	42.93	42.93	44.66	44.66
Wet soil + tare (g)	509.87		509.87		509.87	
Dry soil + tare (g)	461.38		461.38		461.38	
Tare (g)	168.11		168.11		168.11	
Water content (%)	16.5	18.2	16.5	17.1	16.5	16.2
Dry unit weight (pcf)	109.6	111.6	109.6	113.8	109.6	115.7
Void ratio, e	0.51	0.48	0.51	0.45	0.51	0.43
Saturation (%)*	85.7	100.0	85.7	100.0	85.7	100.0

ϕ' (deg)	30
c' (psf)	733

Average of 3 samples	Initial	Pre-shear
Water content (%)	16.5	17.2
Dry unit weight (pcf)	109.6	113.7

*Pre-shear saturation set to 100% for phase calculations



Entered by:___________
Reviewed:___________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS **Boring No.:** Parting

No: M00100-180 (24585638.1) **Sample:** 1

Location: American Sands Energy **Depth:**

Nominal normal stress = 4000 psf			Nominal normal stress = 8000 psf			Nominal normal stress = 16000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.003	132	0.000	0.003	360	0.000	0.003	600	-0.001
0.005	204	0.000	0.005	480	0.000	0.005	852	-0.001
0.007	276	0.000	0.007	600	0.000	0.007	1020	-0.001
0.010	396	0.000	0.010	720	0.000	0.010	1176	-0.001
0.012	576	0.000	0.012	840	0.000	0.012	1308	-0.002
0.015	732	0.000	0.015	960	-0.001	0.015	1440	-0.002
0.017	852	0.000	0.017	1068	-0.001	0.017	1644	-0.002
0.019	984	-0.001	0.019	1296	-0.001	0.019	2196	-0.002
0.022	1104	-0.001	0.022	1404	-0.001	0.022	2796	-0.003
0.024	1212	-0.001	0.024	1704	-0.001	0.024	3360	-0.003
0.027	1308	-0.002	0.027	2040	-0.001	0.027	3804	-0.004
0.029	1416	-0.001	0.029	2340	-0.002	0.029	4188	-0.004
0.032	1524	-0.001	0.031	2580	-0.002	0.031	4524	-0.005
0.034	1608	-0.001	0.034	2784	-0.002	0.034	4788	-0.005
0.036	1680	-0.002	0.036	2964	-0.002	0.036	5004	-0.005
0.039	1752	-0.001	0.039	3132	-0.002	0.039	5244	-0.006
0.041	1836	-0.001	0.041	3300	-0.002	0.041	5412	-0.006
0.044	1896	-0.002	0.044	3444	-0.002	0.044	5340	-0.006
0.046	1944	-0.002	0.046	3564	-0.002	0.046	5268	-0.006
0.049	2004	-0.002	0.048	3684	-0.002	0.048	5268	-0.007
0.051	2052	-0.001	0.051	3792	-0.002	0.051	5340	-0.007
0.053	2088	-0.002	0.053	3900	-0.002	0.053	5568	-0.006
0.056	2136	-0.002	0.056	3996	-0.002	0.056	5808	-0.007
0.058	2172	-0.001	0.058	4092	-0.002	0.058	5988	-0.007
0.061	2220	-0.001	0.061	4188	-0.002	0.061	6108	-0.007
0.063	2244	-0.002	0.063	4260	-0.002	0.063	6252	-0.007
0.065	2280	-0.001	0.065	4356	-0.002	0.065	6396	-0.008
0.068	2316	-0.001	0.068	4440	-0.001	0.068	6540	-0.008
0.070	2352	-0.001	0.070	4524	-0.002	0.070	6660	-0.008
0.073	2388	-0.001	0.073	4596	-0.001	0.073	6792	-0.008
0.075	2424	-0.001	0.075	4644	-0.001	0.075	6828	-0.009
0.077	2436	-0.001	0.078	4704	-0.001	0.077	7044	-0.009
0.080	2460	-0.001	0.080	4752	-0.001	0.080	7164	-0.009
0.082	2496	-0.001	0.082	4812	-0.001	0.082	7188	-0.009
0.085	2508	-0.001	0.085	4860	-0.001	0.085	7392	-0.009
0.087	2532	0.000	0.087	4920	-0.001	0.087	7512	-0.009
0.090	2556	0.000	0.090	4968	-0.001	0.089	7596	-0.009
0.092	2568	-0.001	0.092	5016	-0.001	0.092	7716	-0.010
0.094	2592	0.000	0.094	5064	-0.001	0.094	7824	-0.010
0.097	2628	0.000	0.097	5100	-0.001	0.097	7896	-0.010
0.099	2628	0.000	0.099	5136	-0.001	0.099	8004	-0.010
0.102	2652	0.000	0.102	5184	-0.001	0.102	8088	-0.010
0.104	2676	0.000	0.104	5220	-0.001	0.104	8172	-0.010
0.106	2688	0.000	0.106	5268	0.000	0.106	8255	-0.010
0.109	2700	0.000	0.109	5304	0.000	0.109	8339	-0.011
0.111	2724	0.001	0.111	5340	0.000	0.111	8399	-0.011
0.114	2724	0.000	0.114	5376	0.000	0.114	8483	-0.011
0.116	2736	0.000	0.116	5388	0.000	0.116	8543	-0.011
0.119	2748	0.001	0.119	5412	0.000	0.118	8615	-0.011
0.121	2748	0.000	0.121	5448	0.000	0.121	8699	-0.011
0.123	2772	0.001	0.123	5460	0.000	0.123	8759	-0.011
0.126	2772	0.001	0.126	5484	0.000	0.126	8831	-0.011
0.128	2772	0.001	0.128	5484	0.000	0.128	8891	-0.012
0.131	2796	0.001	0.131	5508	0.001	0.131	8939	-0.012
0.133	2808	0.001	0.133	5532	0.001	0.133	8999	-0.012
0.135	2796	0.001	0.135	5532	0.001	0.135	9059	-0.012
0.138	2820	0.001	0.138	5544	0.001	0.138	9119	-0.012
0.140	2820	0.001	0.140	5556	0.001	0.140	9179	-0.012
0.143	2820	0.001	0.143	5556	0.001	0.143	9215	-0.012
0.145	2820	0.001	0.145	5556	0.001	0.145	8987	-0.012
0.148	2820	0.001	0.148	5580	0.001	0.147	9263	-0.012
0.150	2820	0.001	0.150	5568	0.001	0.150	9311	-0.013
0.152	2820	0.001	0.152	5580	0.001	0.152	9347	-0.013
0.155	2808	0.001	0.155	5580	0.001	0.155	9383	-0.013

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

© IGES 2009, 2014

Project: URS

No: M00100-180 (24585638.1)

Location: American Sands Energy

Boring No.: Parting

Sample: 1

Depth:

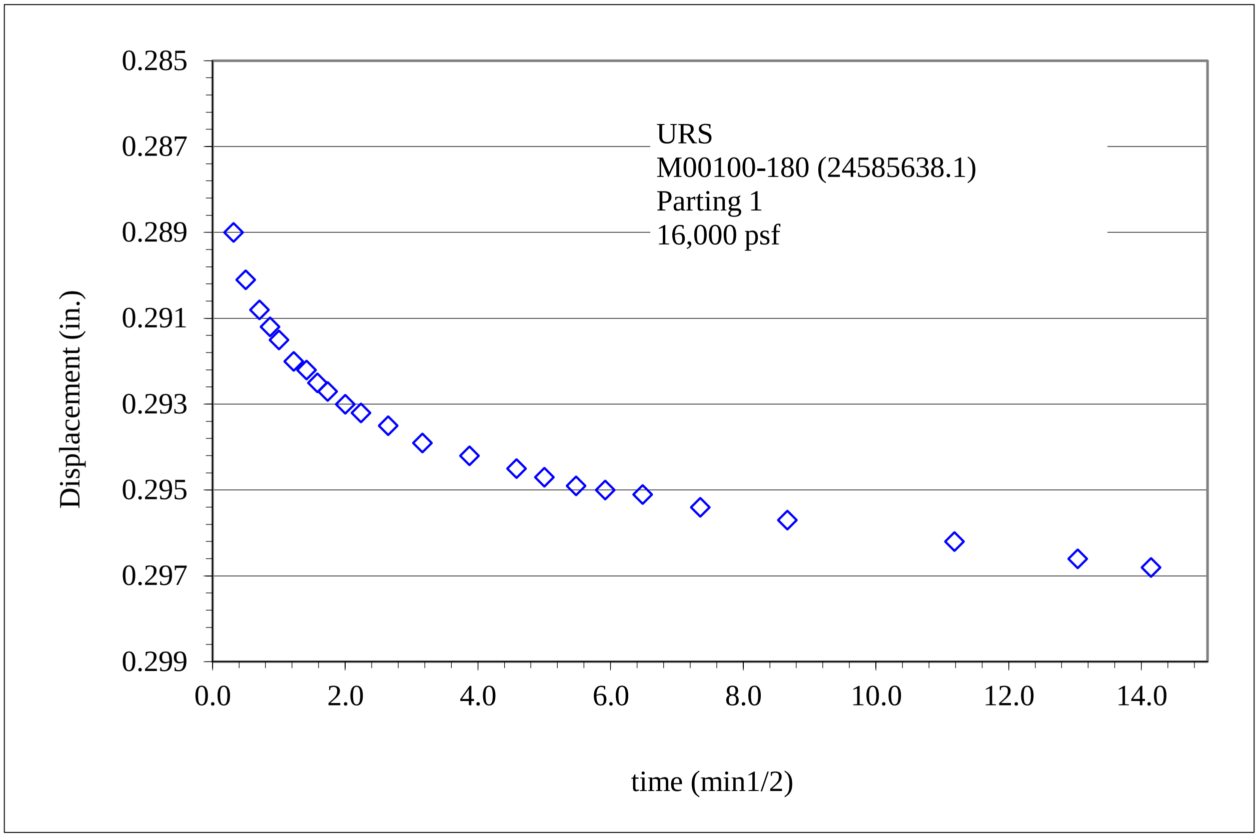
Nominal normal stress = 4000 psf			Nominal normal stress = 8000 psf			Nominal normal stress = 16000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.157	2820	0.001	0.157	5568	0.001	0.157	9419	-0.013
0.160	2808	0.001	0.160	5580	0.001	0.160	9443	-0.013
0.162	2820	0.001	0.162	5568	0.001	0.162	9479	-0.013
0.165	2820	0.001	0.164	5568	0.001	0.164	9527	-0.013
0.167	2796	0.001	0.167	5580	0.001	0.167	9539	-0.013
0.169	2808	0.001	0.169	5568	0.001	0.169	9563	-0.013
0.172	2796	0.001	0.172	5568	0.001	0.172	9587	-0.013
0.174	2808	0.001	0.174	5568	0.001	0.174	9587	-0.013
0.177	2796	0.001	0.177	5556	0.001	0.177	9611	-0.013
0.179	2796	0.001	0.179	5556	0.001	0.179	9611	-0.014
0.181	2796	0.001	0.181	5556	0.001	0.181	9611	-0.014
0.184	2796	0.001	0.184	5556	0.001	0.184	9635	-0.014
0.186	2772	0.001	0.186	5544	0.001	0.186	9635	-0.014
0.189	2772	0.001	0.189	5532	0.001	0.189	9659	-0.014
0.191	2772	0.001	0.191	5532	0.001	0.191	9671	-0.014
0.193	2772	0.001	0.193	5532	0.001	0.193	9683	-0.014
0.196	2748	0.001	0.196	5532	0.001	0.196	9683	-0.014
0.198	2748	0.001	0.198	5508	0.001	0.198	9695	-0.014
0.201	2748	0.001	0.201	5508	0.001	0.201	9707	-0.014
0.203	2736	0.001	0.203	5508	0.001	0.203	9731	-0.014
0.206	2724	0.001	0.206	5508	0.001	0.206	9731	-0.015
0.208	2712	0.001	0.208	5484	0.000	0.208	9731	-0.015
0.210	2700	0.001	0.210	5460	0.000	0.210	9731	-0.015
0.213	2700	0.001	0.213	5460	0.000	0.213	9731	-0.015
0.215	2700	0.001	0.215	5436	0.000	0.215	9743	-0.015
0.218	2676	0.001	0.218	5424	0.000	0.218	9755	-0.015
0.220	2676	0.001	0.220	5412	0.000	0.220	9743	-0.015
0.222	2664	0.001	0.222	5388	0.000	0.222	9755	-0.015
0.225	2652	0.001	0.225	5364	0.000	0.225	9755	-0.015
0.227	2652	0.000	0.227	5352	0.000	0.227	9743	-0.015
0.230	2652	0.000	0.230	5316	0.000	0.230	9755	-0.015
0.232	2652	0.000	0.232	5316	0.000	0.232	9755	-0.016
0.235	2628	0.000	0.235	5292	0.000	0.235	9743	-0.016
0.237	2628	0.000	0.237	5268	-0.001	0.237	9731	-0.016
0.239	2616	0.000	0.239	5244	-0.001	0.239	9719	-0.016
0.242	2604	0.000	0.242	5220	-0.001	0.242	9731	-0.016
0.244	2604	0.000	0.244	5196	-0.001	0.244	9743	-0.016
0.247	2604	0.000	0.247	5184	-0.001	0.247	9707	-0.016
0.249	2592	0.000	0.249	5148	-0.001	0.249	9707	-0.016
0.251	2580	-0.001	0.251	5124	-0.001	0.251	9695	-0.016
0.254	2580	-0.001	0.254	5100	-0.001	0.254	9683	-0.017
0.256	2580	-0.001	0.256	5076	-0.002	0.256	9683	-0.017
0.259	2568	-0.001	0.259	5064	-0.002	0.259	9659	-0.017
0.261	2556	-0.001	0.261	5052	-0.002	0.261	9647	-0.017
0.263	2556	-0.001	0.263	5028	-0.002	0.264	9647	-0.017
0.266	2556	-0.001	0.266	5004	-0.002	0.266	9611	-0.017
0.268	2556	-0.002	0.268	4980	-0.002	0.268	9587	-0.017
0.271	2556	-0.002	0.271	4968	-0.002	0.271	9575	-0.017
0.273	2544	-0.002	0.273	4956	-0.003	0.273	9551	-0.018
0.276	2532	-0.002	0.276	4944	-0.003	0.276	9551	-0.018
0.278	2532	-0.002	0.278	4932	-0.003	0.278	9539	-0.018
0.280	2532	-0.002	0.280	4920	-0.003	0.280	9515	-0.018
0.283	2532	-0.002	0.283	4908	-0.003	0.283	9515	-0.018
0.285	2532	-0.002	0.285	4884	-0.004	0.285	9503	-0.018
0.288	2520	-0.003	0.288	4956	-0.004	0.288	9479	-0.018
0.290	2520	-0.003	0.290	4908	-0.004	0.290	9467	-0.019
0.292	2520	-0.003	0.292	4872	-0.004	0.292	9431	-0.019
0.295	2520	-0.003	0.295	4884	-0.004	0.295	9431	-0.019
0.297	2520	-0.003	0.297	4872	-0.005	0.297	9419	-0.019
0.300	2520	-0.003	0.300	4860	-0.005	0.300	9371	-0.019
0.300	2520	-0.003	0.300	4860	-0.005	0.300	9371	-0.019

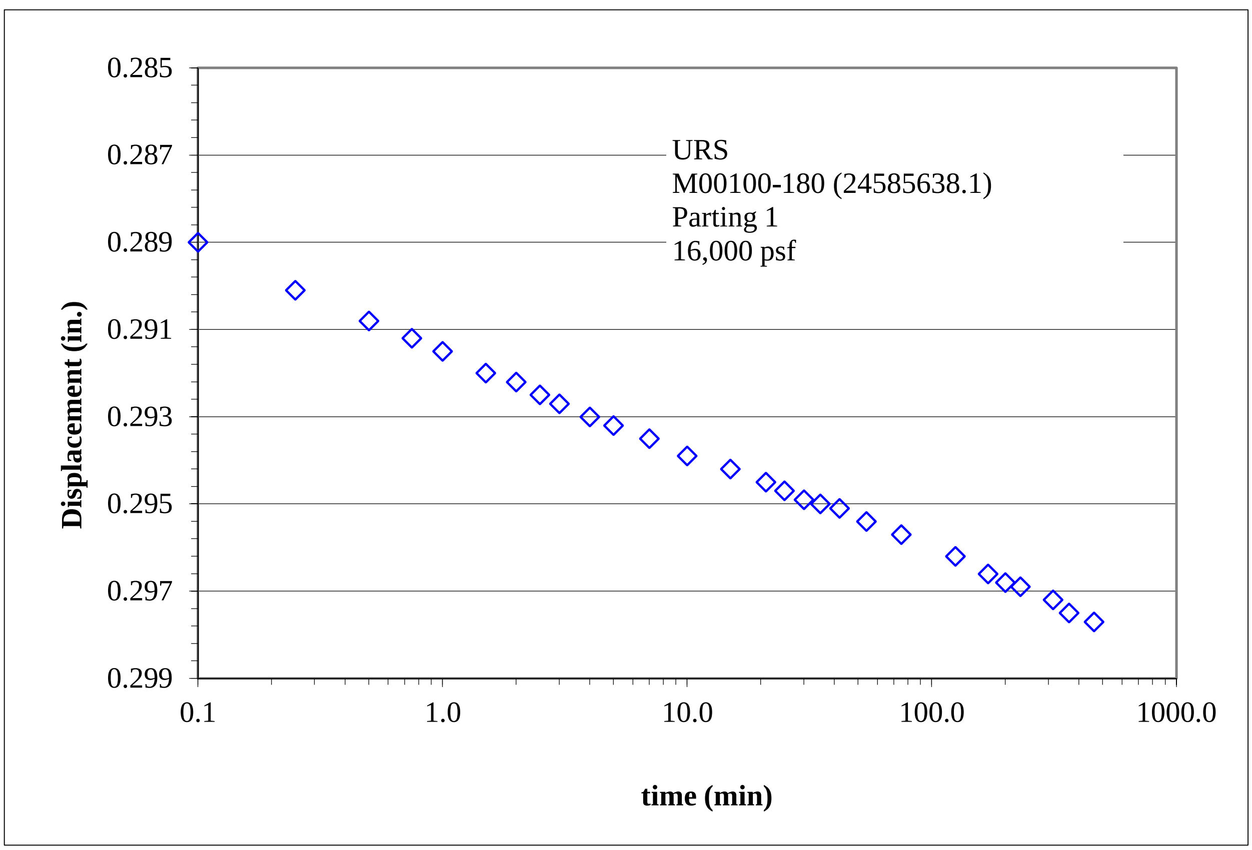
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy

Boring No.: Parting
Sample: 1
Depth:





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/25/2014
By: NB

Boring No.: Tailings
Sample: 2
Depth:
Sample Description: Brown sand with silt
Sample type: Laboratory compacted
Dry unit weight 90 pcf
at 3 (%) w
Compaction specifications: Provided by client

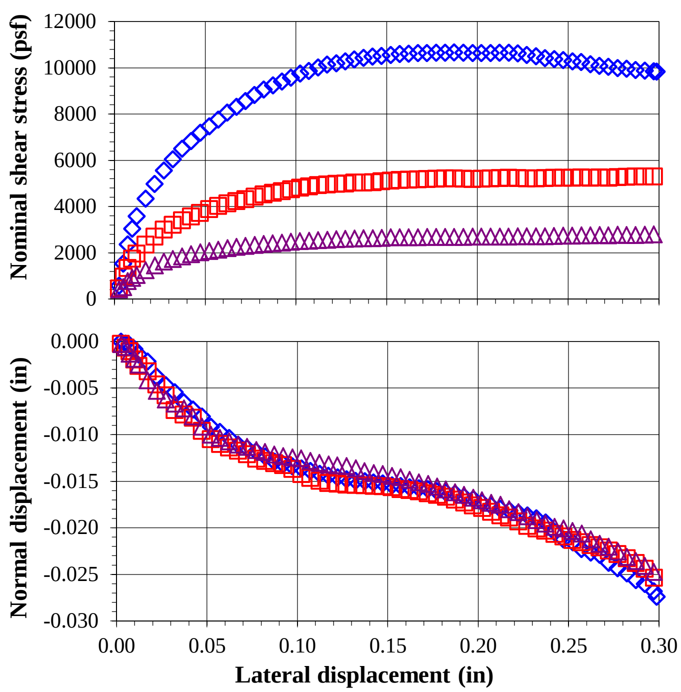
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.645 Determined

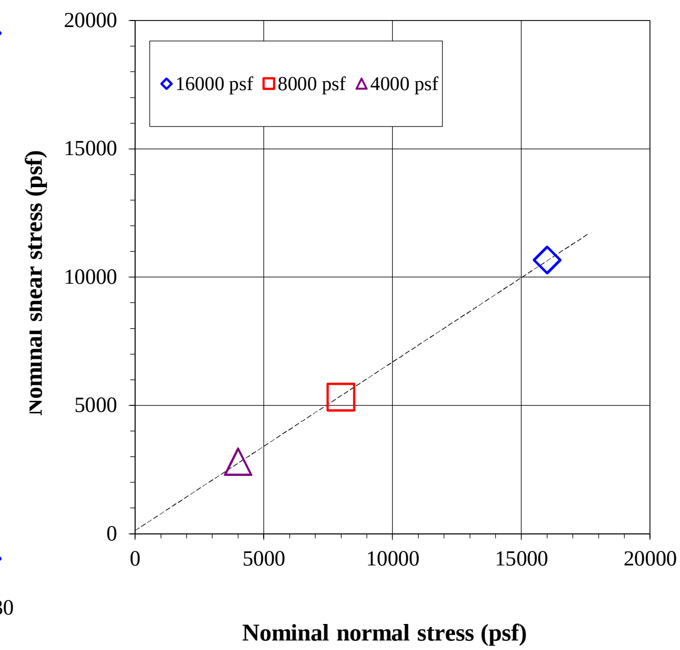
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	16000		8000		4000	
Peak shear stress (psf)	10670		5315		2807	
Lateral displacement at peak (in)	0.187		0.301		0.300	
Load Duration (min)	3698		3731		3731	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9319	1.0000	0.9497	1.0000	0.9618
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	153.03	178.97	153.93	181.21	154.05	182.24
Wt. rings (g)	41.38	41.38	42.28	42.28	42.40	42.40
Wet soil + tare (g)	440.39		440.39		440.39	
Dry soil + tare (g)	431.91		431.91		431.91	
Tare (g)	122.78		122.78		122.78	
Water content (%)	2.7	26.6	2.7	27.8	2.7	28.7
Dry unit weight (pcf)	90.3	96.9	90.3	95.0	90.3	93.8
Void ratio, e	0.83	0.70	0.83	0.74	0.83	0.76
Saturation (%)*	8.8	100.0	8.8	100.0	8.8	100.0

ϕ' (deg)	33
c' (psf)	129

Average of 3 samples	Initial	Pre-shear
Water content (%)	2.7	27.7
Dry unit weight (pcf)	90.3	95.3

*Pre-shear saturation set to 100% for phase calculations





Entered by:___________
Reviewed:___________

Z:\PROJECTS\M00100_URS\180_Am._Sands\[DSv4.xlsm]3

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS　　**Boring No.:** Tailings

No: M00100-180 (24585638.1)　　**Sample:** 2

Location: American Sands Energy　　**Depth:**

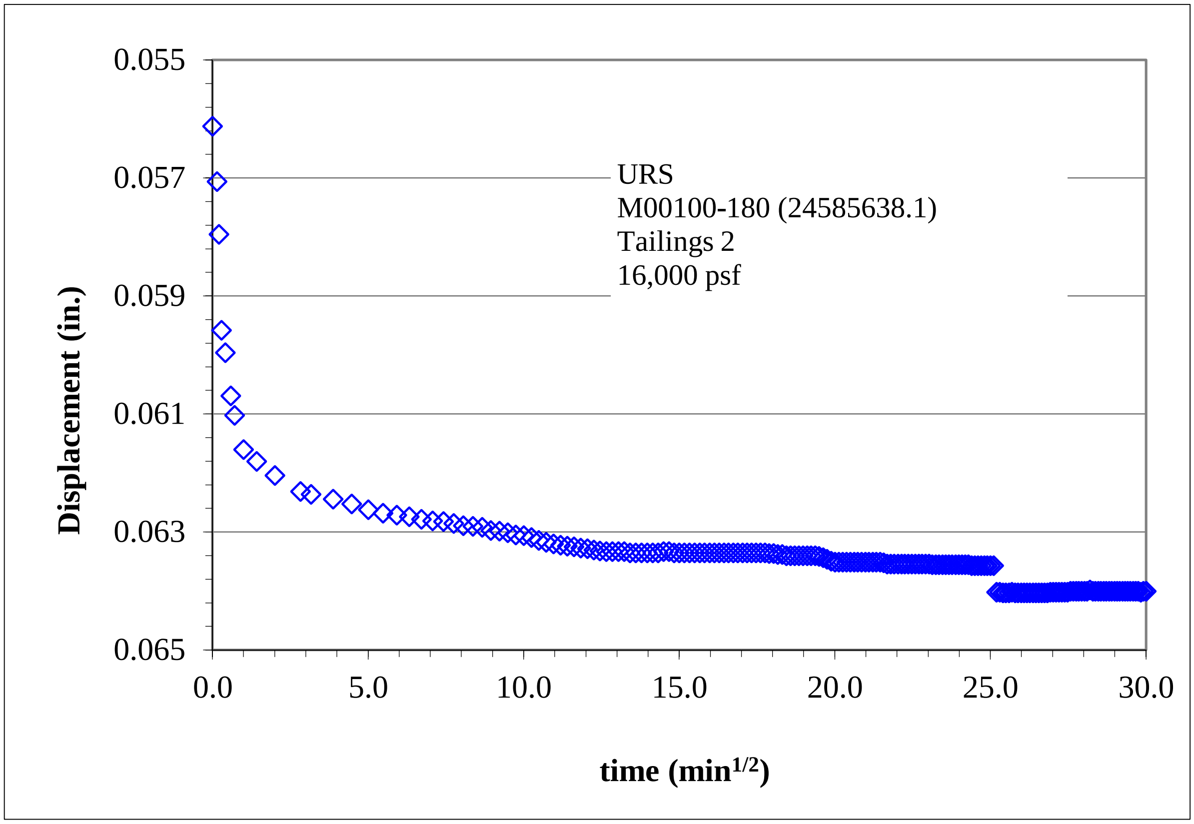
Nominal normal stress = 16000 psf			Nominal normal stress = 8000 psf			Nominal normal stress = 4000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.002	579	0.000	0.002	458	0.000	0.002	415	0.000
0.005	1541	0.000	0.005	979	-0.001	0.005	521	-0.001
0.007	2369	0.000	0.007	1339	-0.001	0.007	774	-0.001
0.010	3049	-0.001	0.010	1742	-0.002	0.010	922	-0.002
0.012	3589	-0.001	0.012	1966	-0.003	0.012	1040	-0.002
0.017	4345	-0.002	0.017	2351	-0.003	0.017	1255	-0.004
0.022	4978	-0.004	0.022	2700	-0.005	0.022	1454	-0.005
0.027	5559	-0.005	0.027	3007	-0.006	0.027	1621	-0.006
0.032	6048	-0.005	0.032	3212	-0.007	0.032	1736	-0.007
0.037	6501	-0.006	0.037	3401	-0.008	0.037	1841	-0.007
0.042	6841	-0.007	0.042	3567	-0.008	0.042	1935	-0.008
0.047	7203	-0.008	0.047	3726	-0.010	0.047	2019	-0.009
0.052	7476	-0.009	0.052	3889	-0.010	0.052	2081	-0.010
0.057	7759	-0.010	0.057	4030	-0.011	0.057	2140	-0.010
0.062	8070	-0.010	0.062	4136	-0.011	0.062	2199	-0.011
0.067	8315	-0.011	0.067	4231	-0.012	0.067	2254	-0.011
0.072	8572	-0.011	0.072	4325	-0.012	0.072	2299	-0.011
0.077	8837	-0.012	0.077	4432	-0.013	0.077	2345	-0.012
0.082	9063	-0.012	0.082	4531	-0.013	0.082	2384	-0.012
0.087	9246	-0.013	0.087	4595	-0.013	0.087	2418	-0.012
0.092	9408	-0.013	0.092	4665	-0.013	0.092	2440	-0.012
0.097	9578	-0.013	0.097	4751	-0.014	0.097	2477	-0.012
0.102	9753	-0.014	0.102	4815	-0.014	0.102	2502	-0.013
0.107	9874	-0.014	0.107	4880	-0.015	0.107	2522	-0.013
0.112	10020	-0.014	0.112	4926	-0.015	0.112	2547	-0.013
0.117	10140	-0.014	0.117	4961	-0.015	0.117	2565	-0.013
0.122	10200	-0.015	0.122	4984	-0.015	0.122	2587	-0.013
0.127	10290	-0.015	0.127	4992	-0.015	0.127	2605	-0.013
0.132	10370	-0.015	0.132	5036	-0.015	0.132	2619	-0.014
0.137	10430	-0.015	0.137	5047	-0.015	0.137	2634	-0.014
0.142	10490	-0.015	0.142	5060	-0.015	0.142	2636	-0.014
0.147	10520	-0.015	0.147	5091	-0.016	0.147	2650	-0.014
0.152	10560	-0.015	0.152	5120	-0.016	0.152	2668	-0.014
0.157	10600	-0.016	0.157	5144	-0.016	0.157	2668	-0.015
0.162	10620	-0.016	0.162	5162	-0.016	0.162	2679	-0.015
0.167	10640	-0.016	0.167	5176	-0.016	0.167	2681	-0.015
0.172	10650	-0.016	0.172	5194	-0.016	0.172	2684	-0.015
0.177	10660	-0.016	0.177	5211	-0.016	0.177	2687	-0.016
0.182	10660	-0.016	0.182	5219	-0.017	0.182	2688	-0.016
0.187	10670	-0.016	0.187	5215	-0.017	0.187	2688	-0.016
0.192	10660	-0.017	0.192	5208	-0.017	0.192	2693	-0.016
0.197	10640	-0.017	0.197	5196	-0.018	0.197	2699	-0.017
0.202	10640	-0.017	0.202	5204	-0.018	0.202	2704	-0.017
0.207	10650	-0.018	0.207	5221	-0.018	0.207	2704	-0.017
0.212	10660	-0.018	0.212	5230	-0.019	0.212	2703	-0.018
0.217	10660	-0.018	0.217	5241	-0.019	0.217	2706	-0.018
0.222	10630	-0.018	0.222	5238	-0.019	0.222	2713	-0.018
0.227	10560	-0.019	0.227	5224	-0.020	0.227	2715	-0.019
0.232	10500	-0.019	0.232	5219	-0.020	0.232	2718	-0.019
0.237	10420	-0.019	0.237	5231	-0.020	0.237	2719	-0.020
0.242	10380	-0.020	0.242	5241	-0.021	0.242	2736	-0.020
0.247	10340	-0.021	0.247	5247	-0.021	0.247	2740	-0.020
0.252	10290	-0.022	0.252	5245	-0.021	0.252	2748	-0.020
0.257	10250	-0.022	0.257	5260	-0.022	0.257	2751	-0.021
0.262	10160	-0.023	0.262	5245	-0.022	0.262	2756	-0.021
0.267	10090	-0.023	0.267	5256	-0.022	0.267	2766	-0.022
0.272	10050	-0.024	0.272	5250	-0.022	0.272	2764	-0.022
0.277	9992	-0.024	0.277	5270	-0.023	0.277	2780	-0.023
0.282	9959	-0.025	0.282	5286	-0.023	0.282	2771	-0.023
0.287	9907	-0.026	0.287	5297	-0.024	0.287	2766	-0.024
0.292	9881	-0.026	0.292	5300	-0.024	0.292	2782	-0.024
0.297	9853	-0.027	0.297	5306	-0.025	0.297	2801	-0.025
0.299	9843	-0.027	0.301	5315	-0.026	0.300	2807	-0.025

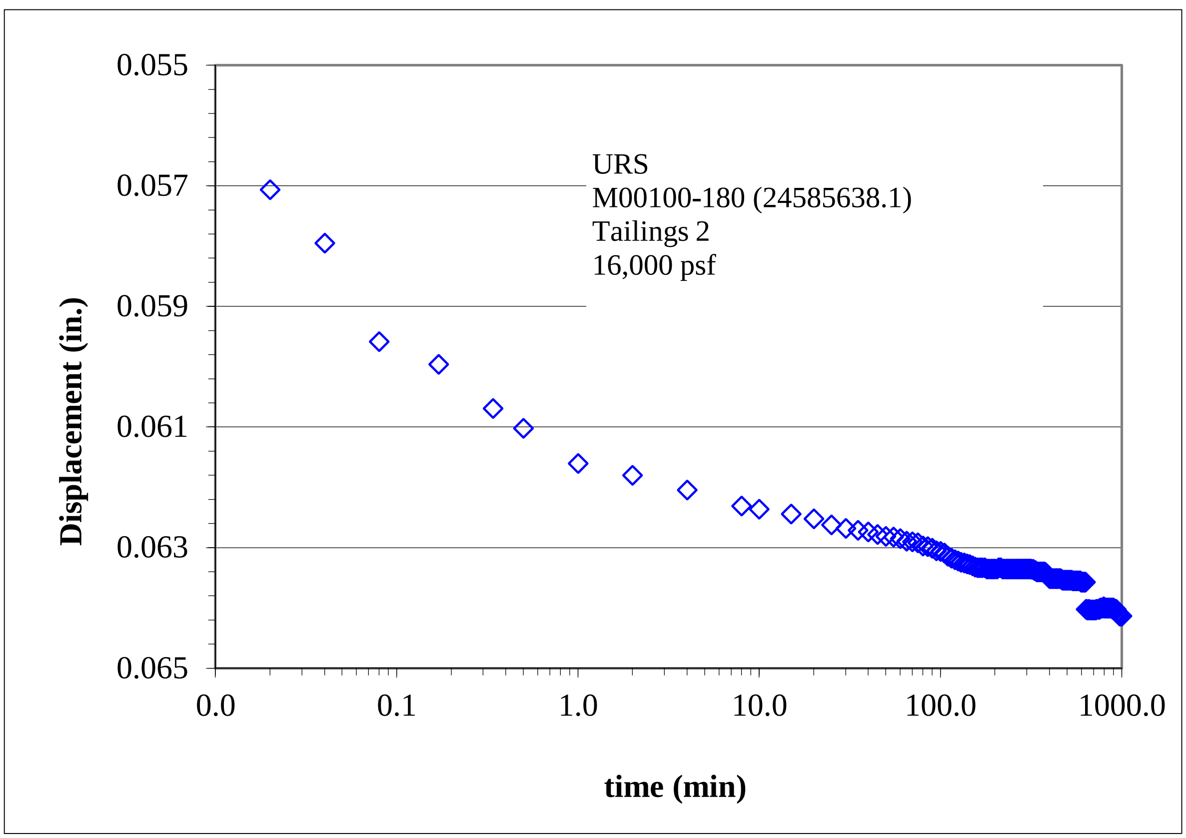
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy

Boring No.: Tailings
Sample: 2
Depth:





Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

Project: URS
No: M00100-180 (24585638.1)
Location: American Sands Energy
Date: 8/26/2014
By: JDF

Boring No.: Parting
Sample: 1
Depth:
Sample Description: Light grey clayey sand
Sample Type: Remolded
Compaction Specifications: 110 pcf at 16 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.128	3.101
Sample Diameter, D (in)	2.863	2.80
Sample Length, L (cm)	7.945	7.877
Sample Area, A (cm^2)	41.534	39.649
Sample Volume, V (cm^3)	329.99	312.32
Wt. Rings + Wet Soil (g)	674.13	673.69
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	127.5	134.7
Wet Soil + Tare (g)	509.87	991.29
Dry Soil + Tare (g)	461.38	895.94
Tare (g)	168.11	316.57
Weight of solids, Ws (g)	578.48	578.48
Water Content, w (%)	16.53	16.46
Dry Unit Wt, γ_d (pcf)	109.4	115.6
Void ratio, e	0.51	0.44
Saturation (%)	85.4	100 [a]
Average K[b] (cm/sec)	**2.3E-07**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Gs	2.654	Determined
Cell No.	4	
Station No.	2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	20	
Effective horiz. consolidation stress (psi)	55.6	
Effective vert. consolidation stress (psi)	55.6	

	Initial (o)	Final (f)
B value	0.54	0.96
External Burette (cm^3)	12.80	42.20
Cell Pressure (psi)	0.0	75.6

Backpressure bottom (psi)	21.0
Backpressure top (psi)	20.0
System volume coefficient (cm^3/psi)	0.155
System volume change (cm^3)	11.73
Net sample volume change (cm^3)	-17.67
Bottom burette ground length, l_b (cm)	81.99
Top burette ground length, l_t (cm)	81.97
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 8/25/14 9:01

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
1440.0	0.10 0.30	9.94 9.74	120.28	118.25	2.3E-07	22.8	0.93	2.2E-07
2580.0	0.30 0.68	9.74 9.36	118.25	114.39	2.5E-07	22.9	0.93	2.3E-07
2220.0	0.68 0.99	9.36 9.02	114.39	111.09	2.6E-07	22.8	0.93	2.4E-07
3240.0	0.99 1.42	9.02 8.58	111.09	106.67	2.5E-07	24.0	0.91	2.2E-07
6060.0	1.42 2.20	8.58 7.76	106.67	98.55	2.6E-07	25.0	0.89	2.3E-07
4800.0	2.20 2.80	7.76 7.15	98.55	92.41	2.6E-07	24.3	0.90	2.4E-07

Entered by:___________
Reviewed:___________

Aggregate-Soil Testing Summary

Inberg-Miller Engineers
350 Parsley Blvd
Cheyenne WY 82001
Ph: 307-635-6827
Fax: 307-635-2713
cheyenne@inberg-miller.com

Client:	Mine Engineers, Inc.	**IME Sample No:**	**16484-2**
Address:	3901 South Industrial Rd. Cheyenne, WY 82007	**Sampled By:**	Client
		Sample Date:	
		Date Received in Lab:	12/19/2013
Attention:	Eldon Strid	**Type of Material:**	
		Source:	American Sands Energy - Utah
IME Project No:	16484-HM	**Sample Description:**	Light brown fine SAND
Project Name:	General Testing		
Project Location:			
		Report Date:	1/15/14
Sample Location/ID:	American Sands Energy - Utah	**Reviewed By:**	MJJ

Particle Size Analysis
ASTM C117 & C136

Sieve	% Passing	Specification
2 1/2" (63.5mm)		
2" (50.8mm)		
1 1/2" (37.5mm)		
1" (25mm)		
3/4" (19mm)		
1/2" (12.5mm)		
3/8" (9.5mm)		
No. 4 (4.75mm)	100%	
No. 8 (2.36mm)	100%	
No. 16 (1.18mm)	99%	
No. 30 (600μm)	98%	
No. 40 (425μm)		
No. 50 (300μm)	87%	
No. 100 (150μm)	21%	
No. 200 (75μm)	9.6%	
0.020 mm (20μm)		

Atterberg Limits
ASTM D4318

Test	Result	Specification
Liquid Limit (%)		
Plastic Limit (%)		
Plasticity Index (%)		

Remarks:
Mine Engineers, Inc.

Other Testing

Test	Result	Specifications /Notes	ASTM
Fineness Modulus:	0.95		C136
Moisture Content (%):	0.1%	(from sieve sample)	D2216
Relative Density (pcf)			D4254
Minimum Density	89.3		
Maximum Density	94.7		
Angle of Repose			
Moisture Content (%)			
0%	26.5°		
4%	33.8°		
6%	37.7°		
Specific Gravity	**Fine /**	**Coarse**	
Absorption %			C128/C127
Bulk (Dry)			C128/C127
Bulk (SSD)			C128/C127
Apparent			C128/C127

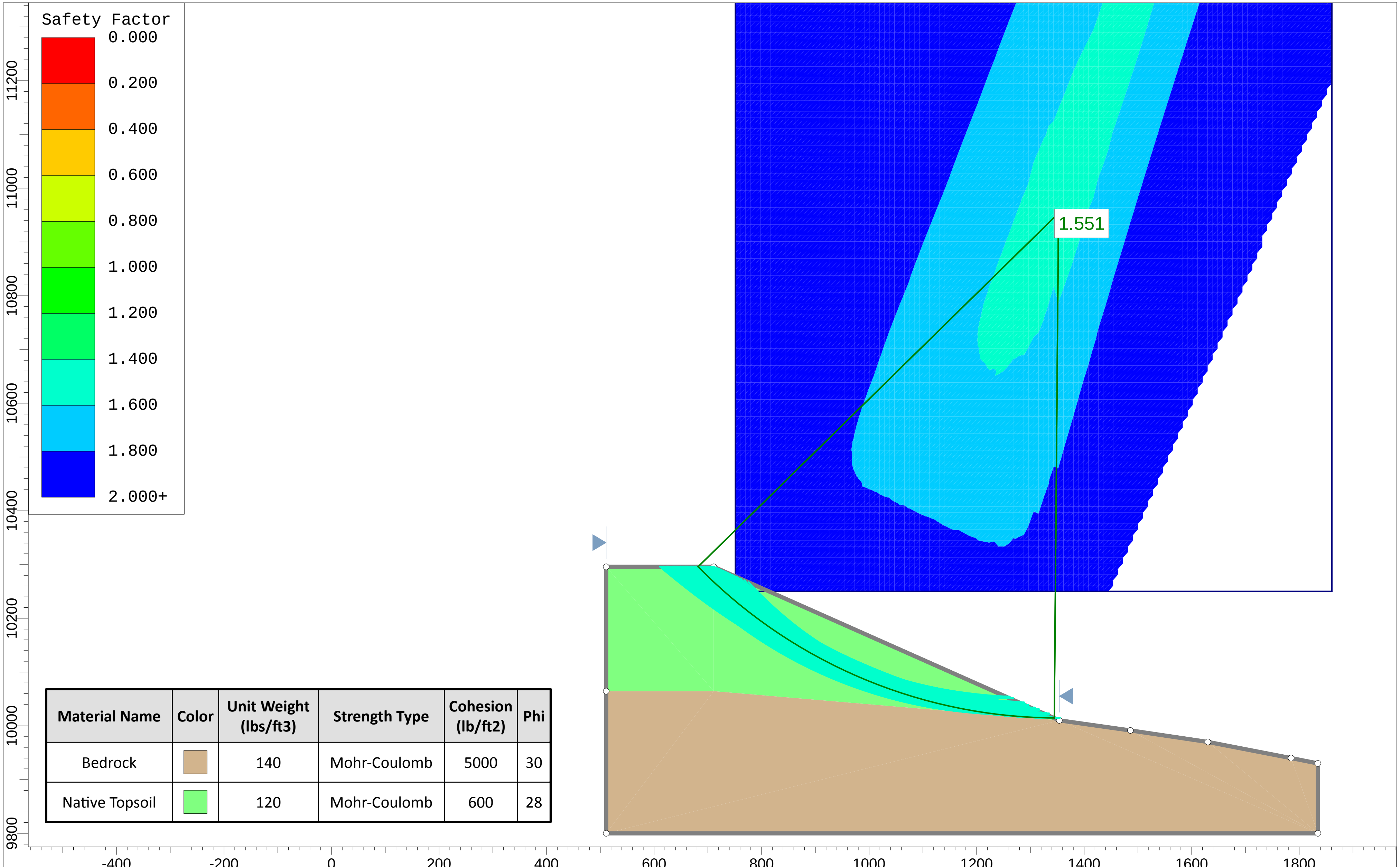
APPENDIX C
HYDROLOGY RESULTS

10YR

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin 1	0.0045312	2.4	01Jan2014, 13:00	0.2
Basin 2-5	0.0040680	2.7	01Jan2014, 13:00	0.2
Basin 6	0.0190000	12.1	01Jan2014, 13:00	1.0
Basin 7	0.0190000	12.1	01Jan2014, 13:00	1.0
Basin 8	0.1870000	47.1	01Jan2014, 13:45	10.2

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin 1	0.0045312	5.0	01Jan2014, 13:00	0.4
Basin 2-5	0.0040680	5.1	01Jan2014, 13:00	0.4
Basin 6	0.0190000	22.6	01Jan2014, 13:00	1.9
Basin 7	0.0190000	22.6	01Jan2014, 13:00	1.9
Basin 8	0.1870000	89.0	01Jan2014, 13:45	18.7

APPENDIX D
SLOPE STABILITY RESULTS



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: General Topsoil Slope 2.25H:1V

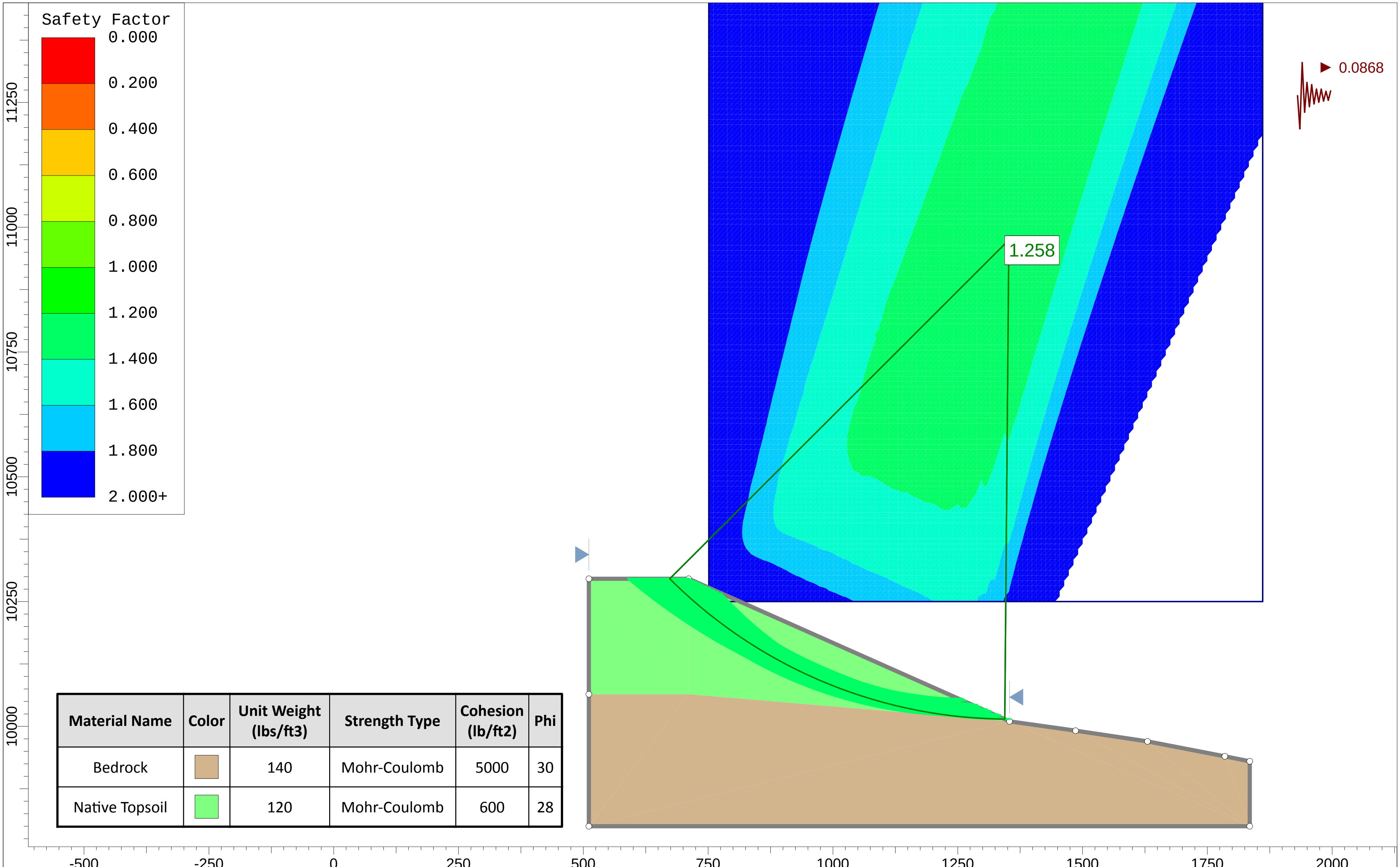
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D1

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Top Soil\Top Soil A-A-Prime (2.25 to 1.0) [Larger Slope].slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: General Topsoil Slope [Seismic]

Project: American Sands Bruin Point

Date: January 2015

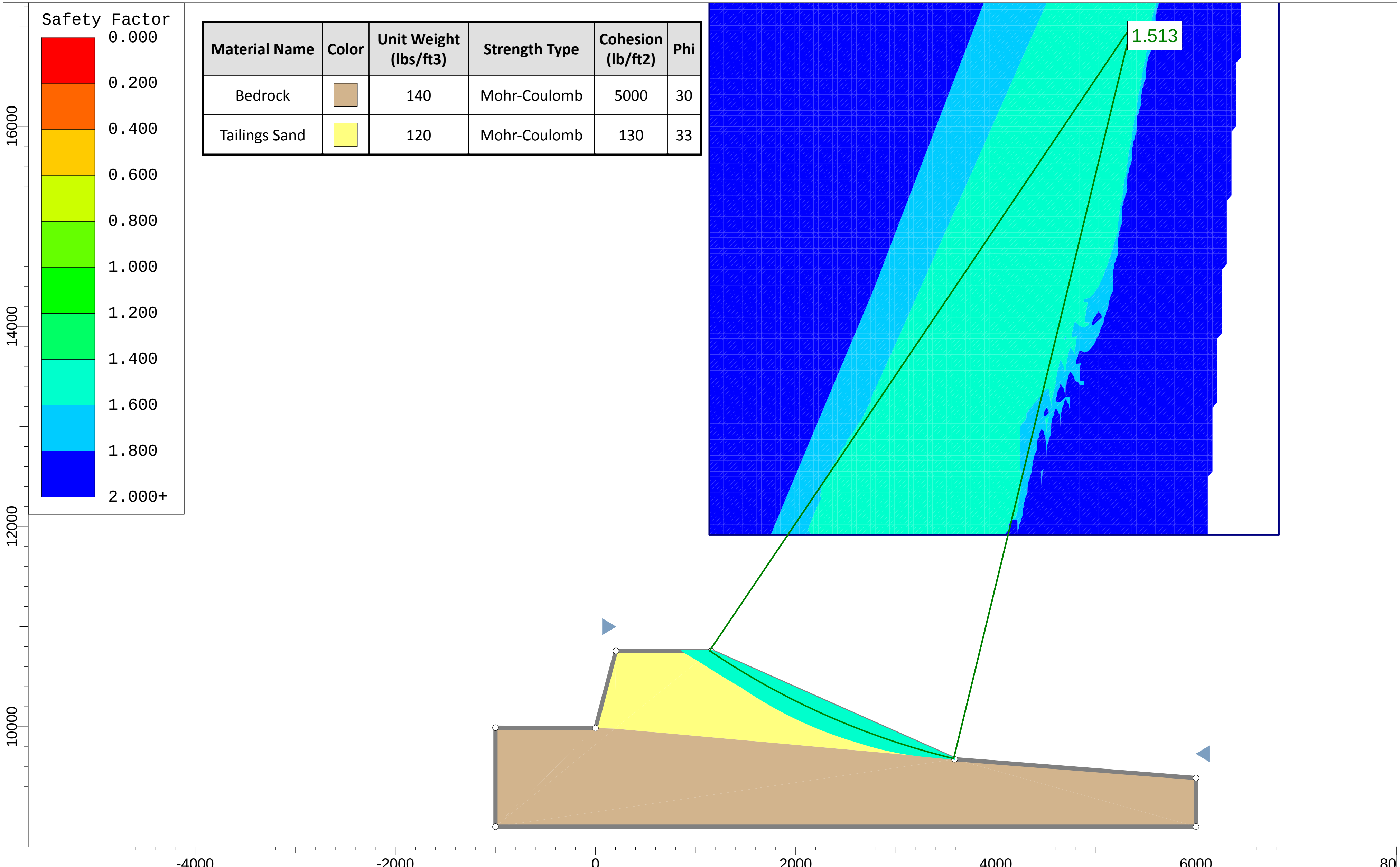
Project No.: 24585638

Figure: D2

URS Carbon County, Utah

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Top Soil\Top Soil A-A-Prime (2.25 to 1.0) [Larger Slope]_Seismic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 | **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: General Tailings Slope 2.25H:1V

Project: American Sands Bruin Point

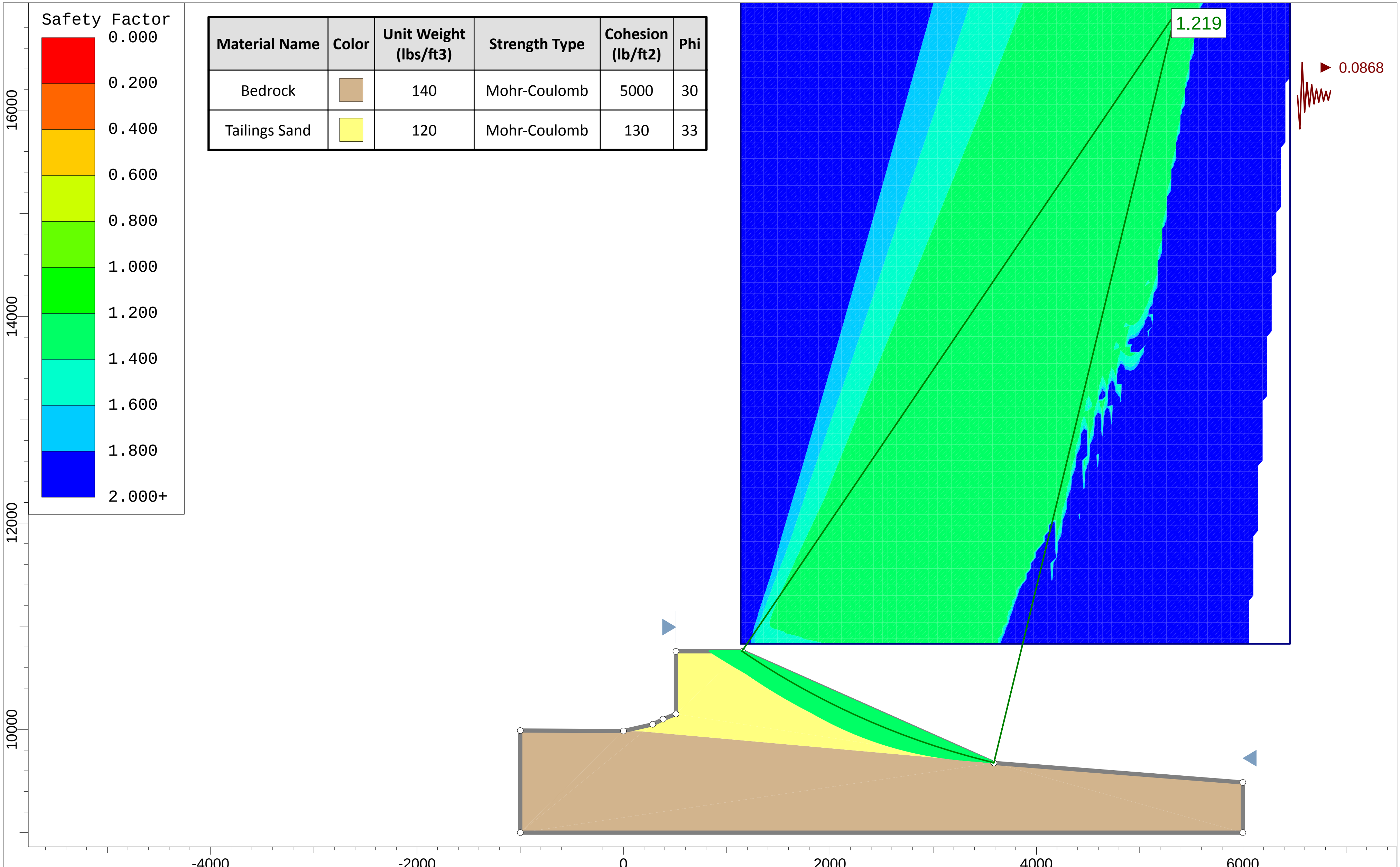
Date: January 2015

Project No.: 24585638

Figure: D3

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Tailings (c = 100) psf\Tailings Slope PHI=33deg, c=130 psf (2.25 to 1.0).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: General Tailings Slope [Seismic]

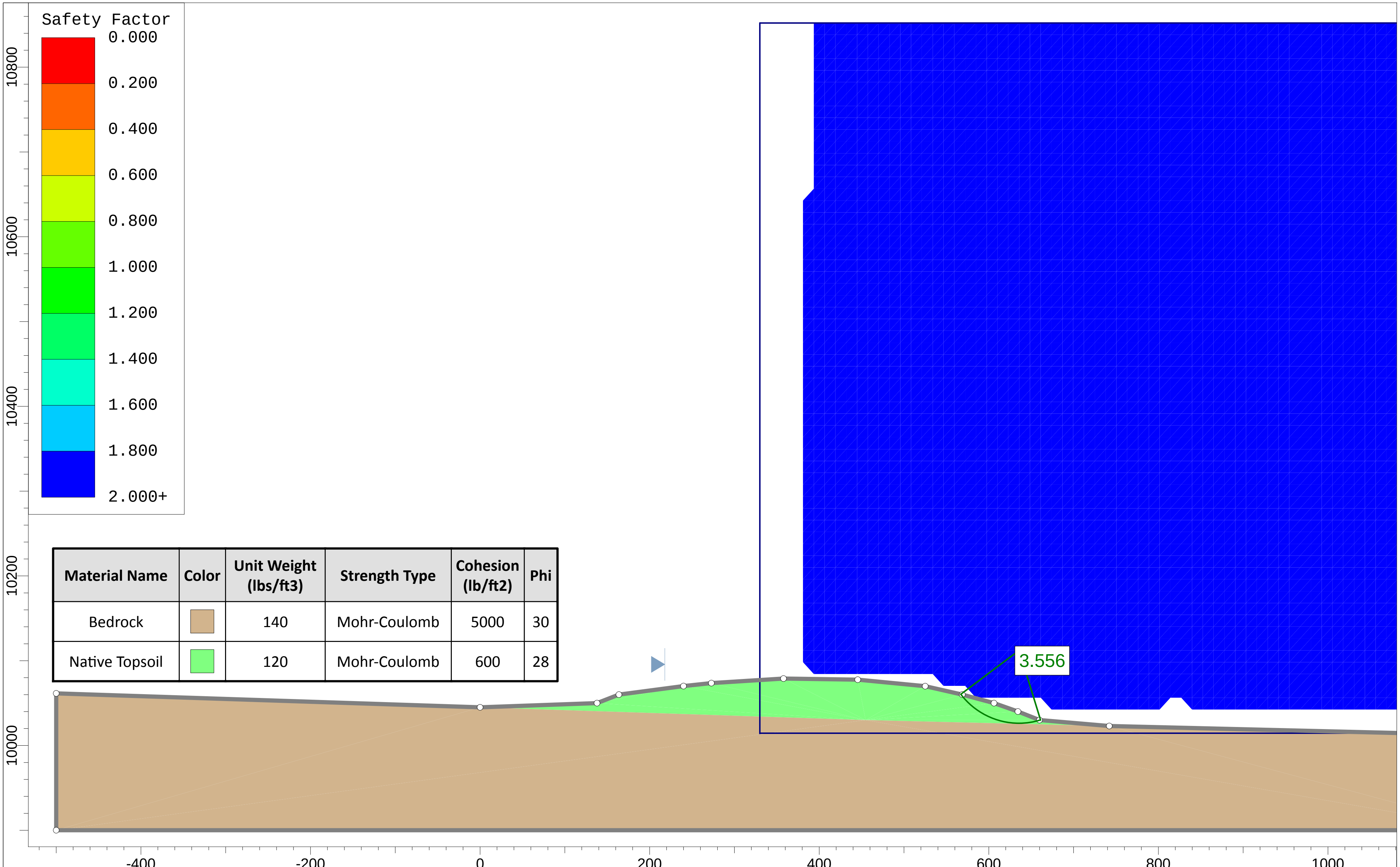
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D4

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Tailings (c = 100) psf\Tailings Slope PHI=33deg, c=130 psf (2.25 to 1.0)_Seismic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 1 (B-B)

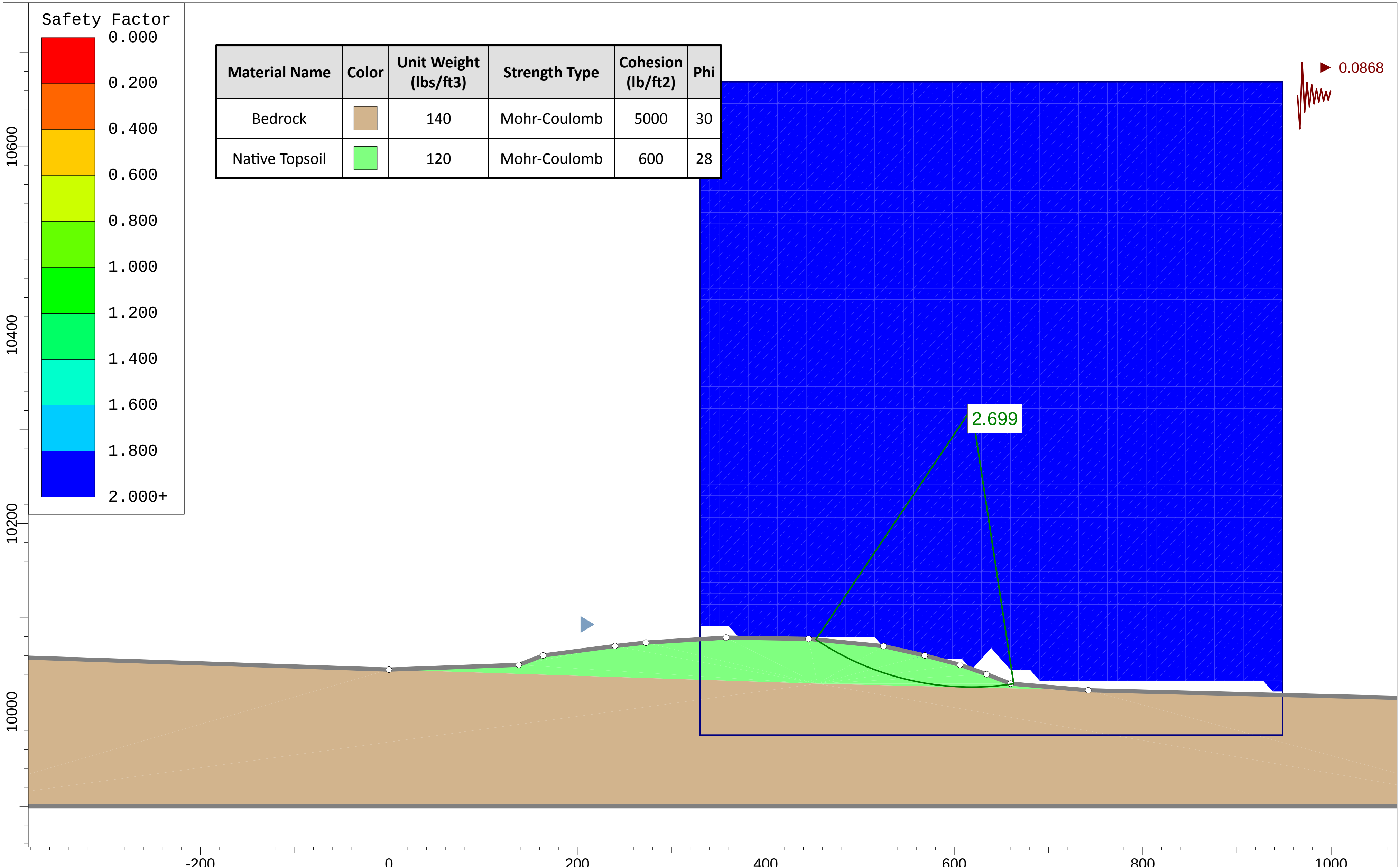
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D5

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Top Soil B-B (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 | **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 1 (B-B) [Seismic]

Project: American Sands Bruin Point

Date: January 2015

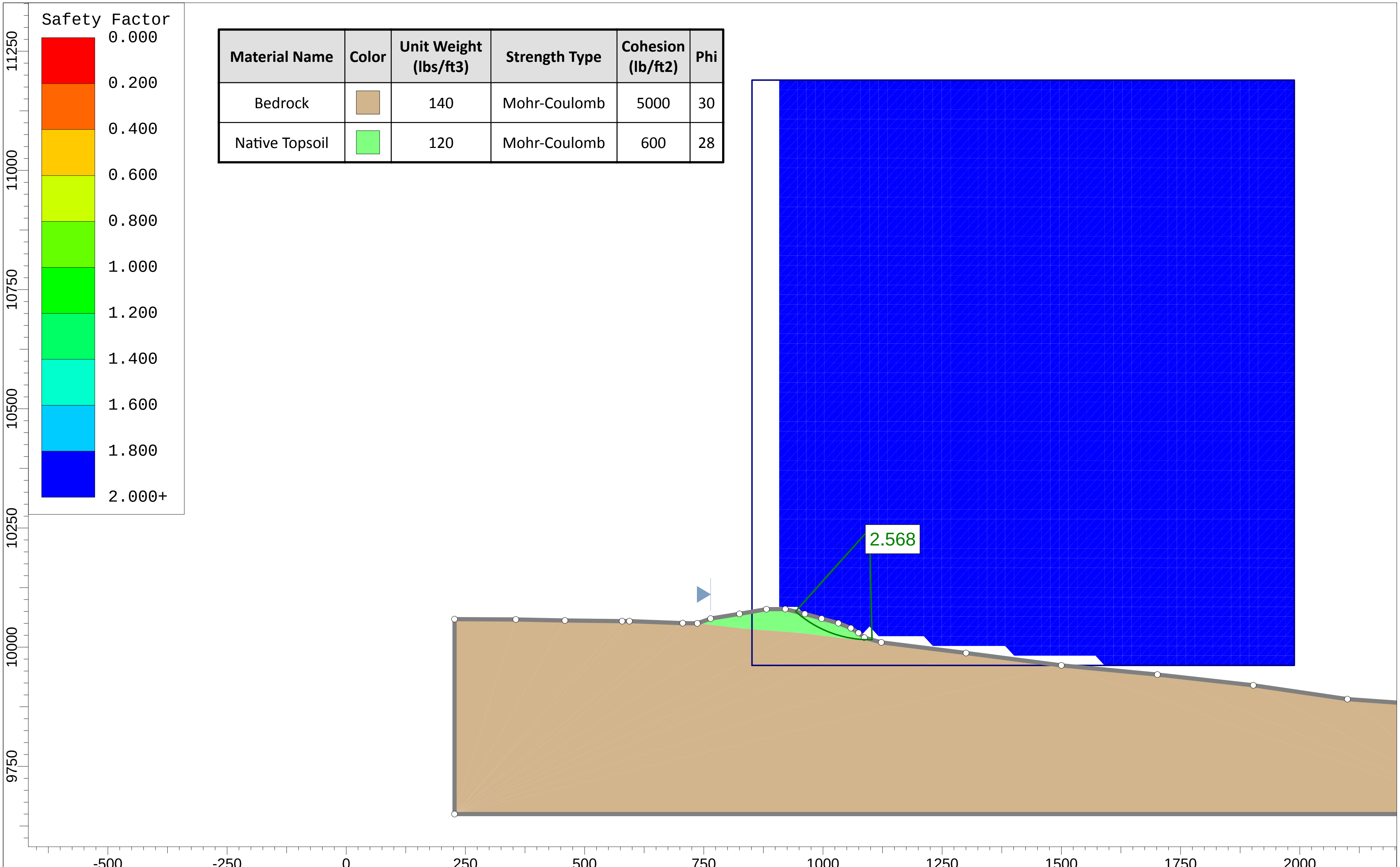
Project No.: 24585638

Figure: D6

URS

Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Top Soil B-B (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 1 (B-B')

Project: American Sands Bruin Point

Date: January 2015

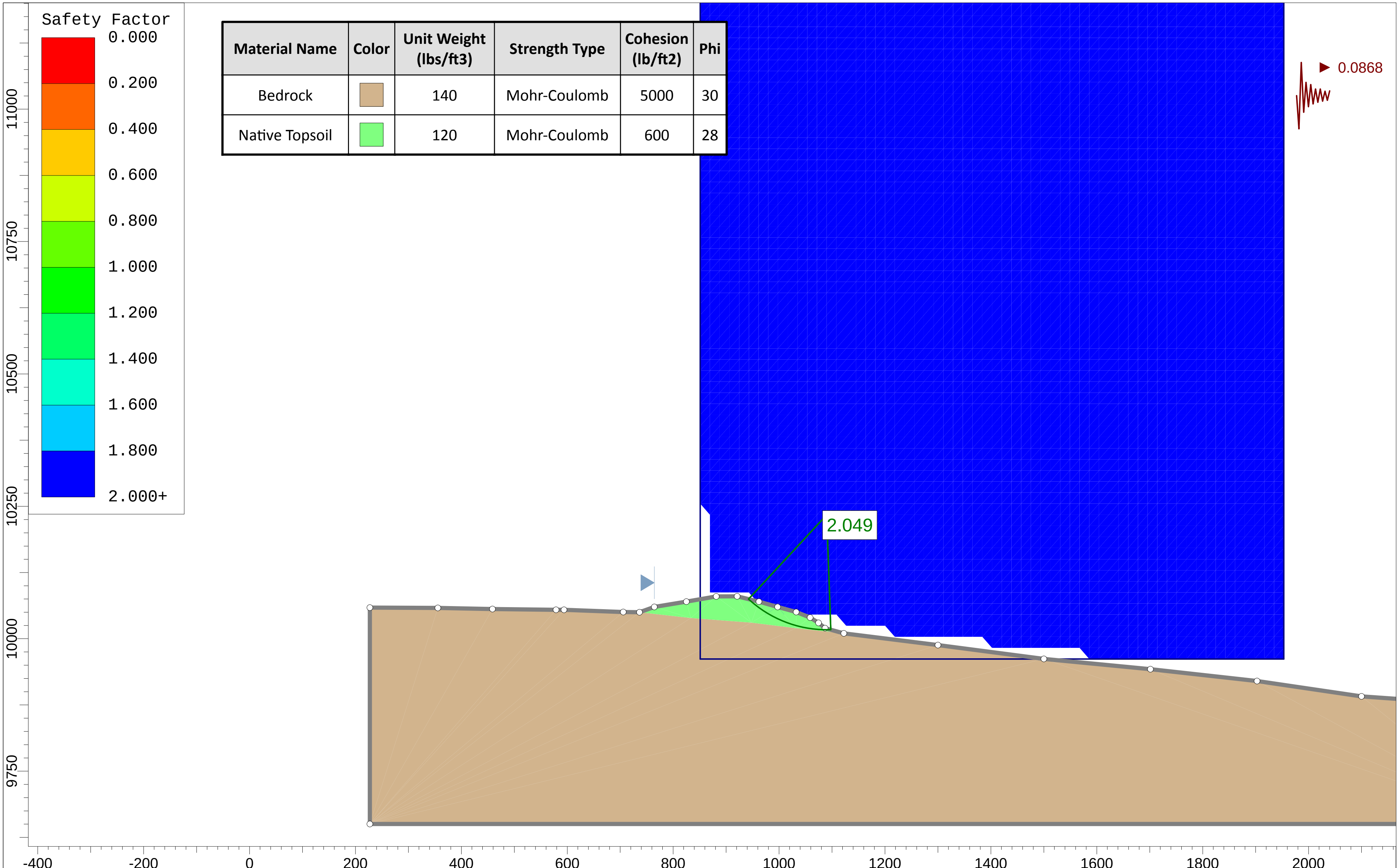
Project No.: 24585638

Figure: D7

URS Carbon County, Utah

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Top Soil B-B-Prime.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 1 (B-B') [Seismic]

Project: American Sands Bruin Point

Date: January 2015

Project No.: 24585638

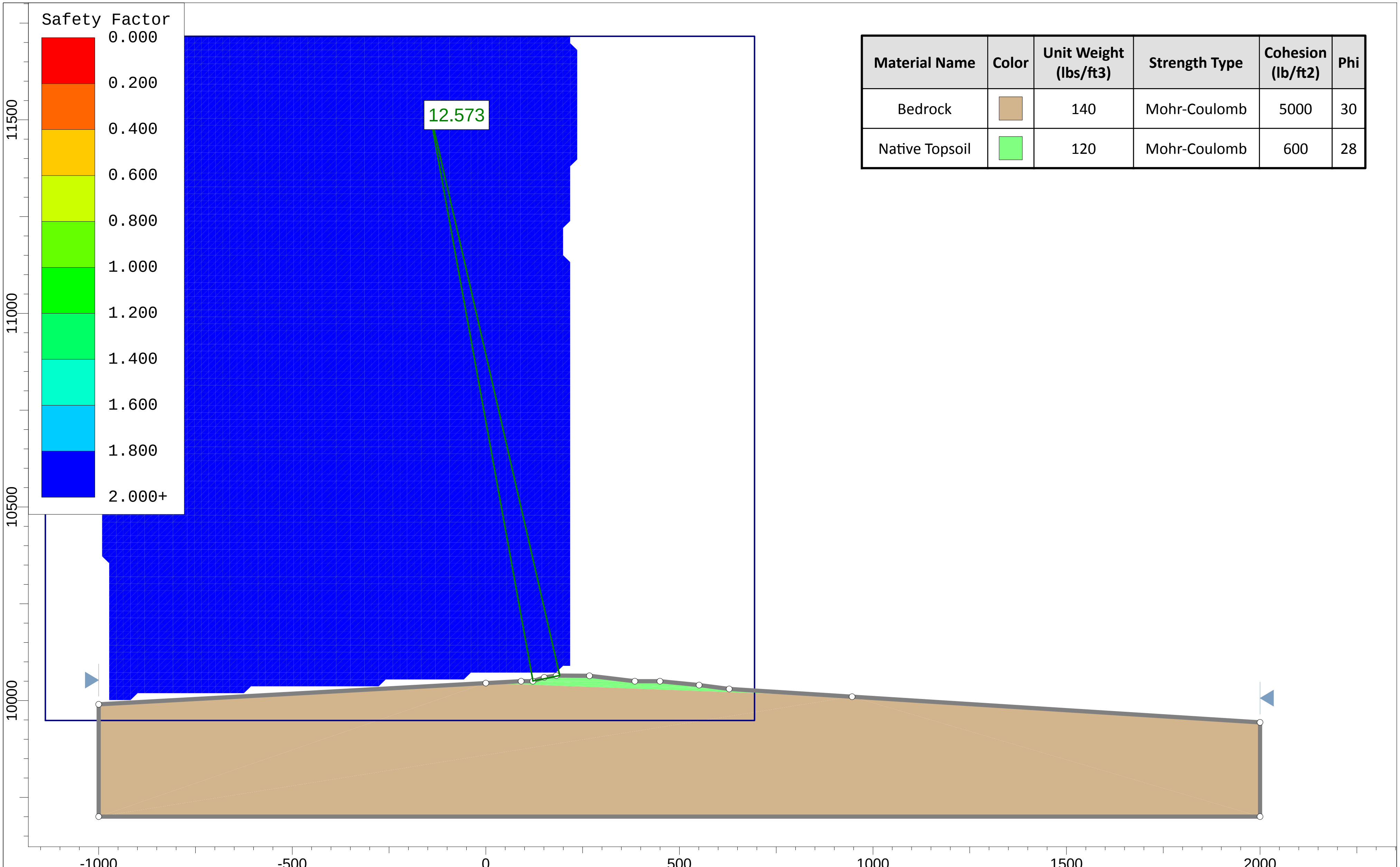
Figure: D8

URS

Carbon County, Utah

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Top Soil B-B-Prime.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 2 (A-A)

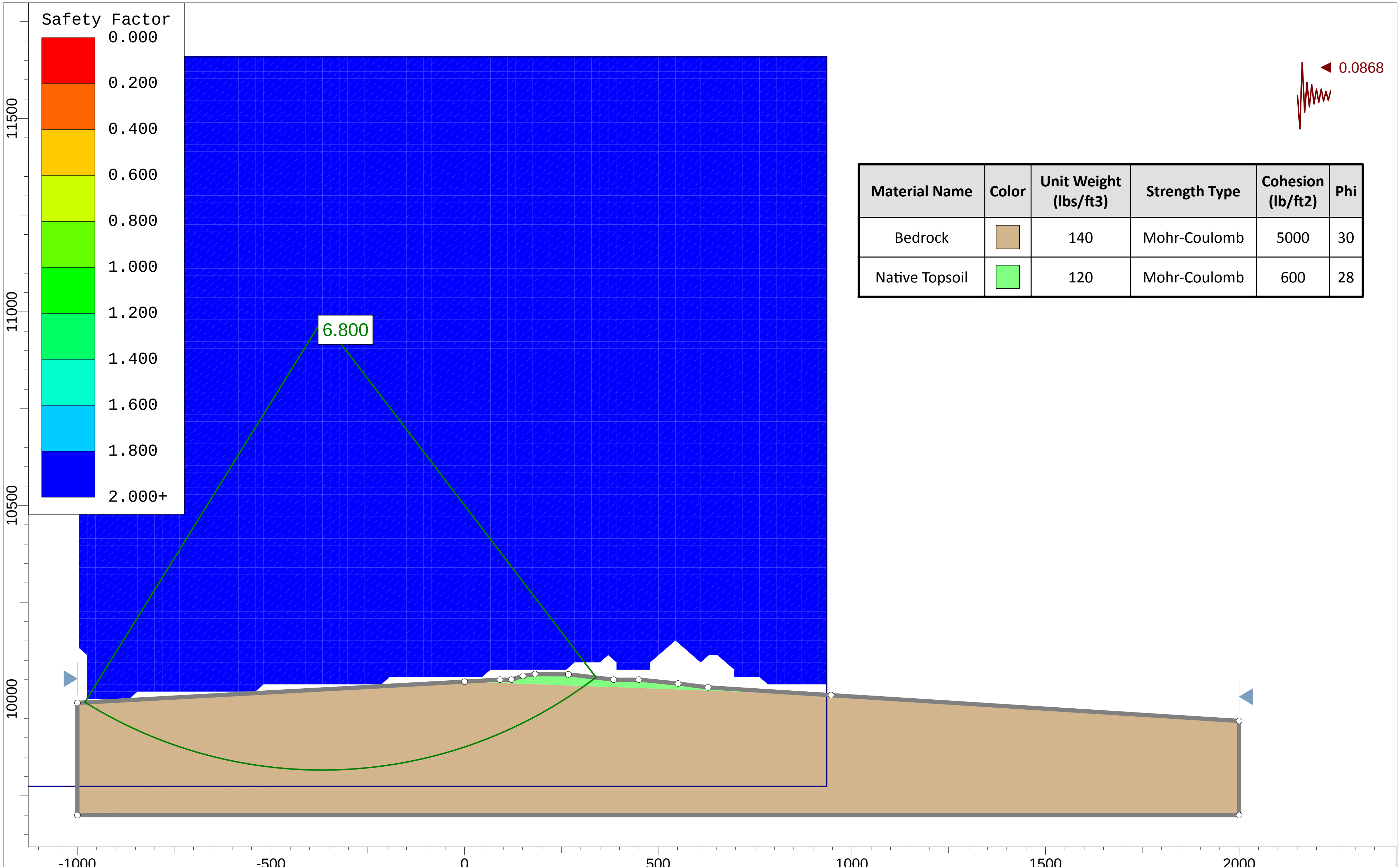
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D9

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Top Soil A-A.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 2 (A-A) [Seismic]

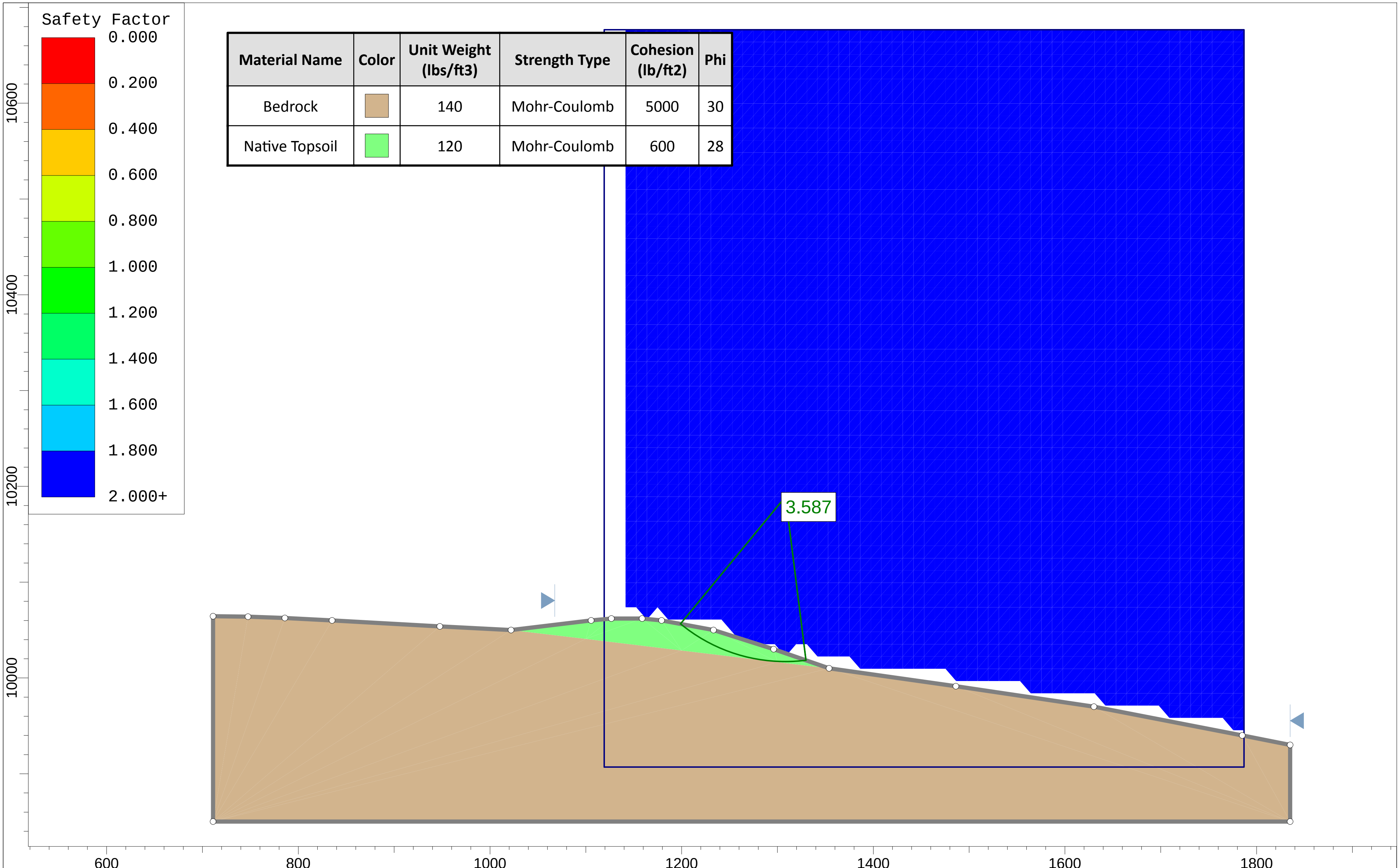
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D10

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Top Soil A-A.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 2 Section A-A'

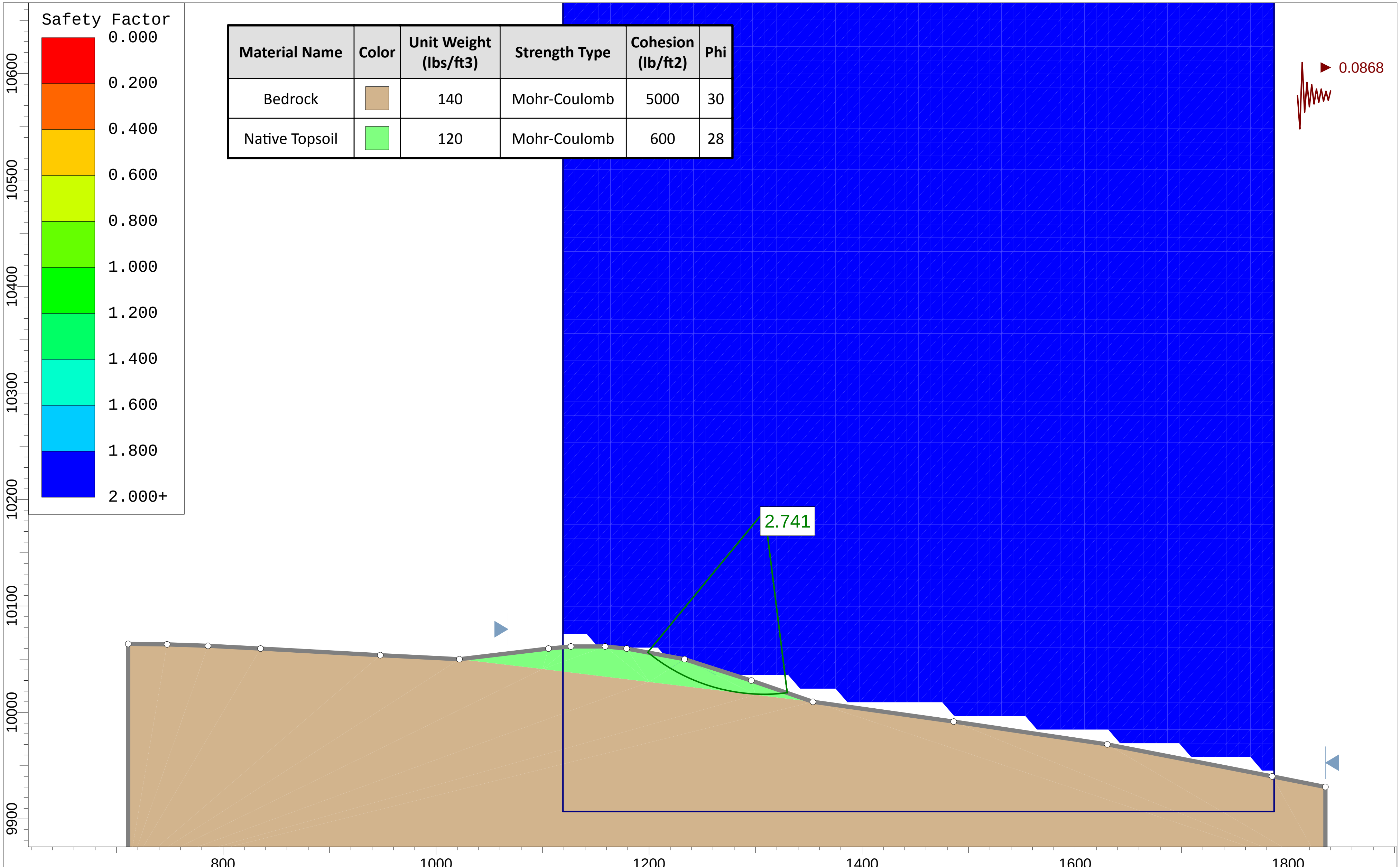
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D11

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Top Soil A-A-Prime.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Native Topsoil		120	Mohr-Coulomb	600	28

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 | **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Topsoil Stockpile No. 2 (A-A') [Seismic]

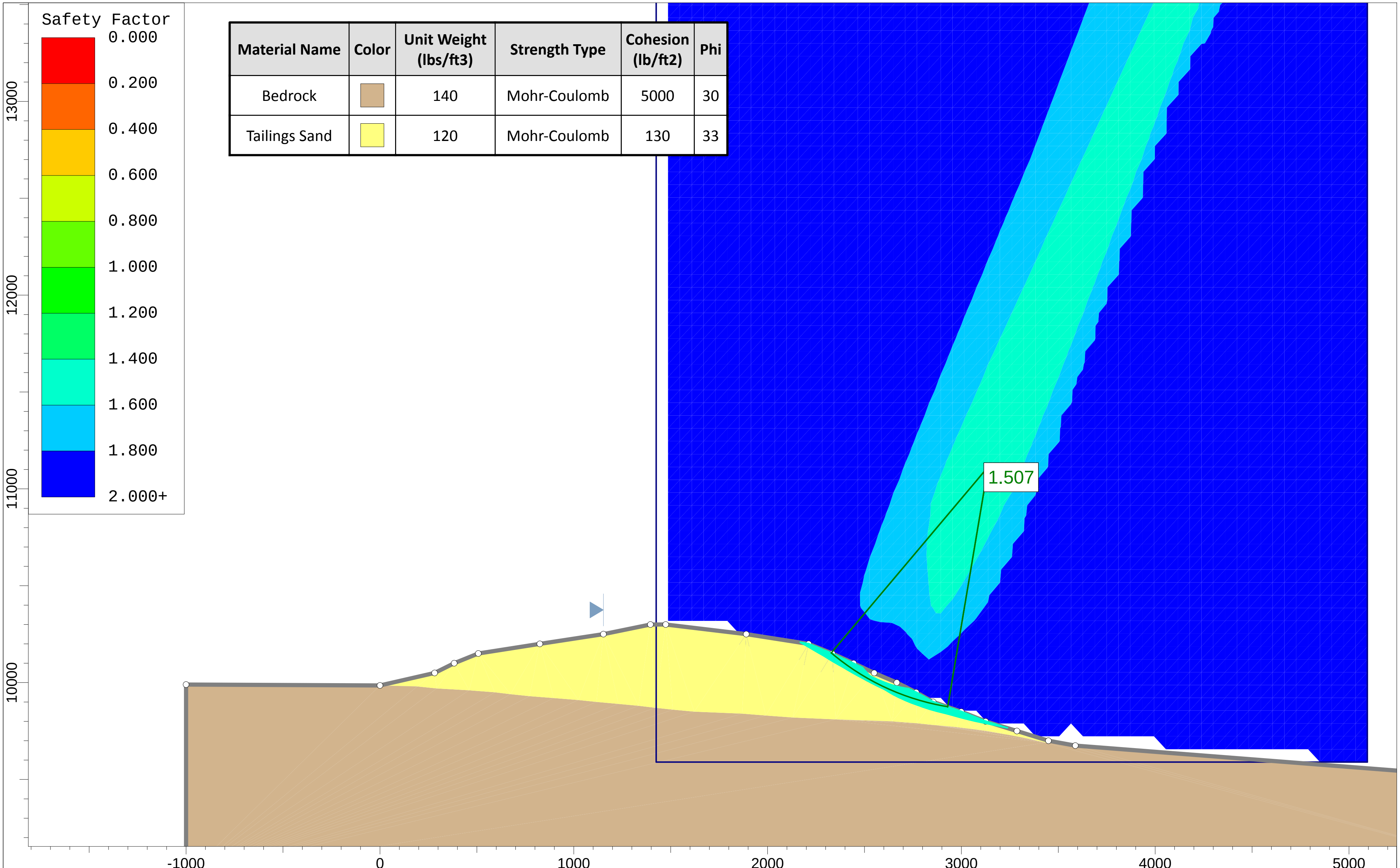
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D12

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Top Soil A-A-Prime.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: Tailings Stockpile (A-A)

Project: American Sands Bruin Point

Date: January 2015

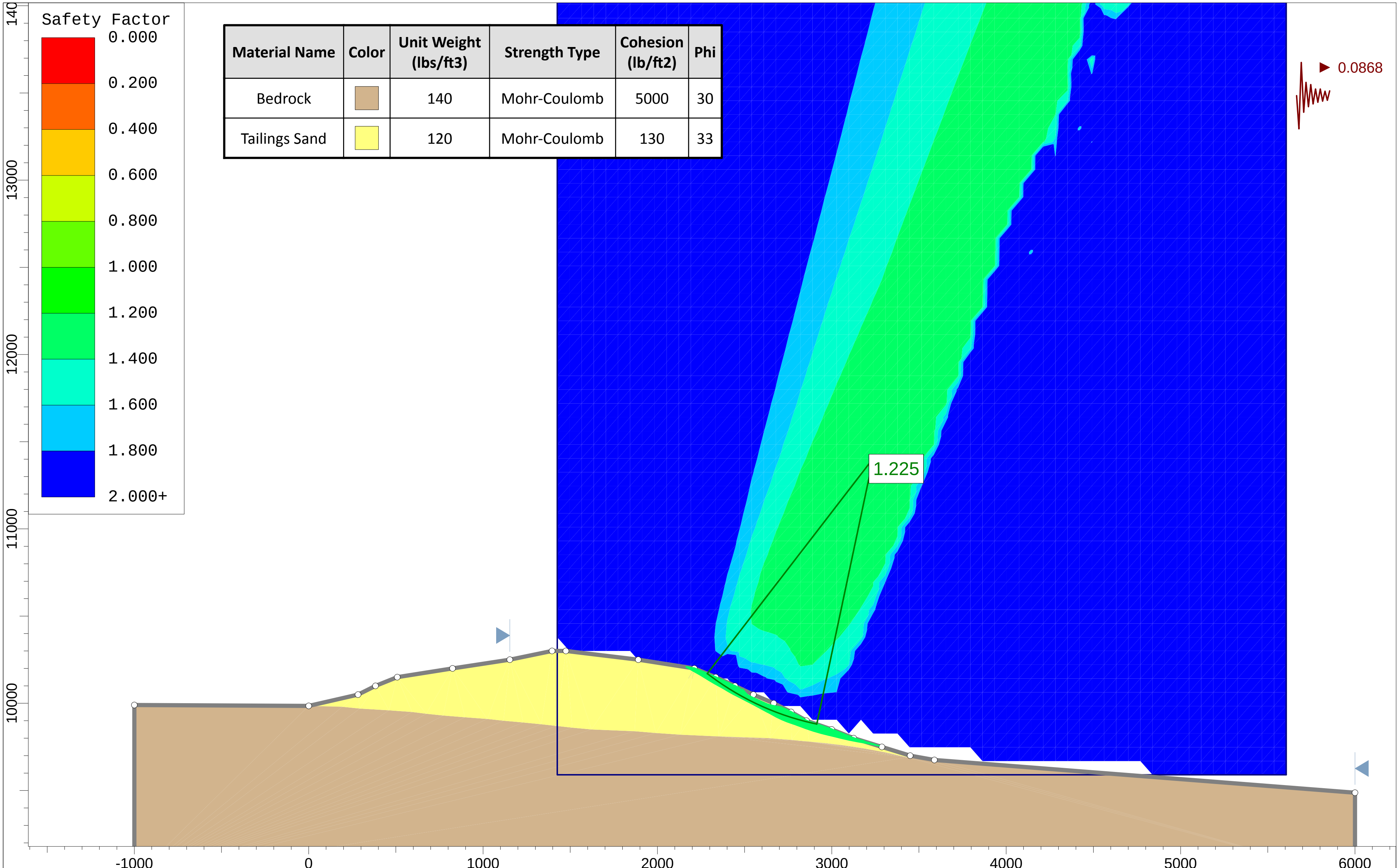
Project No.: 24585638

Figure: D13

URS Carbon County, Utah

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Tailings A-A (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Tailings Stockpile (A-A) [Seismic]

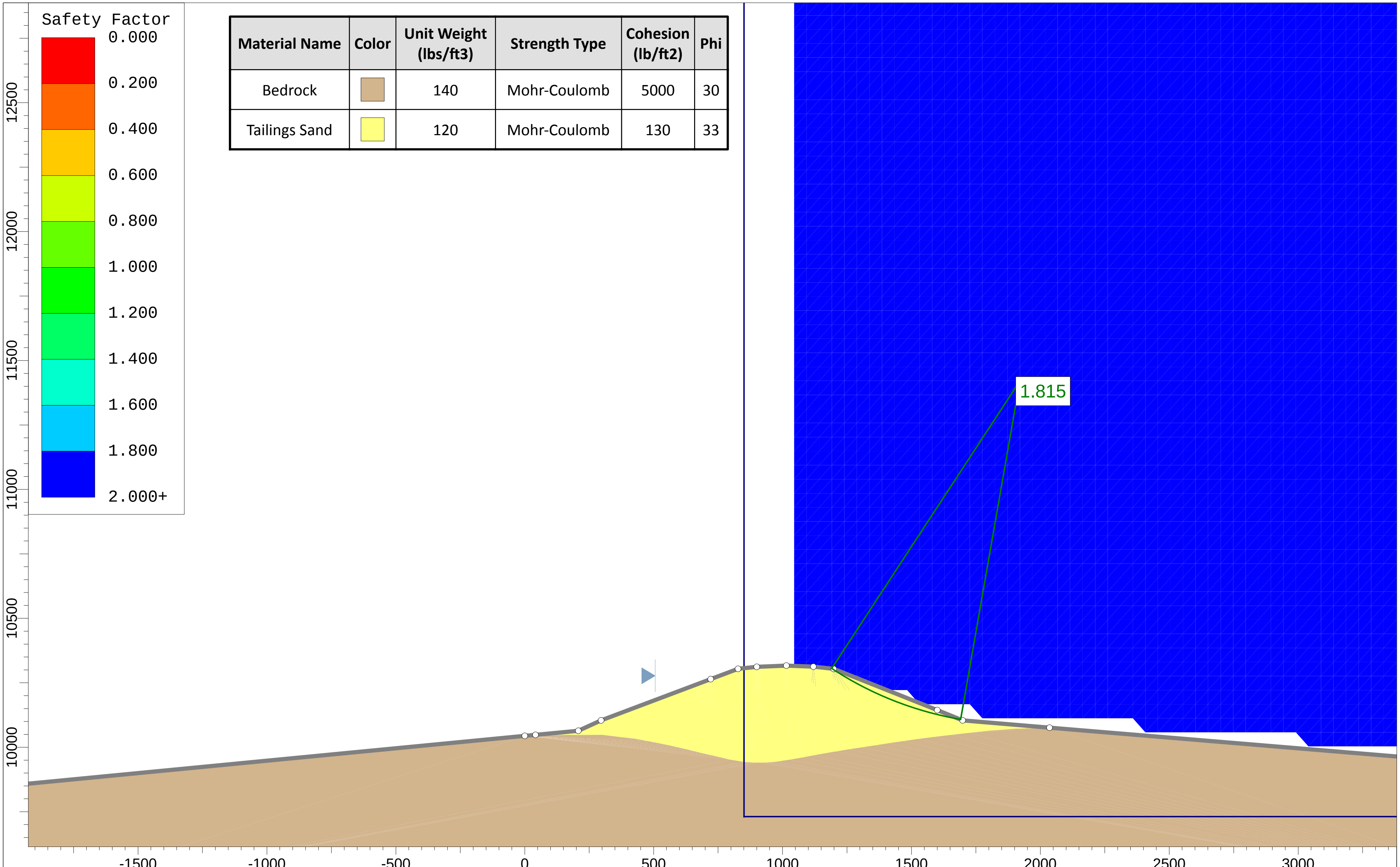
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D14

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Tailings A-A (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Tailings Stockpile (B-B)

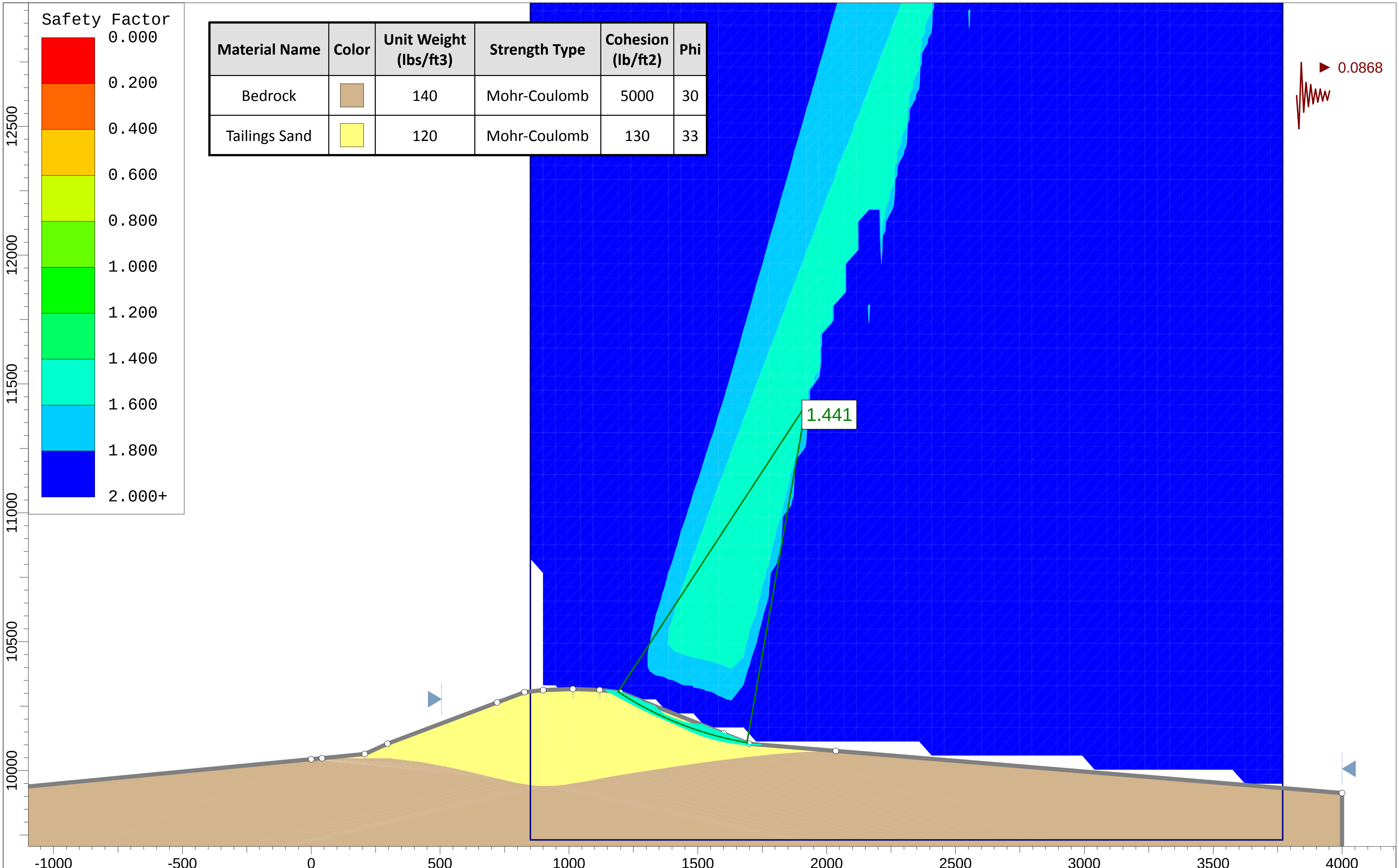
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D15

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Tailings B-B (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Tailings Stockpile (B-B) [Seismic]

Project: American Sands Bruin Point

Date: January 2015

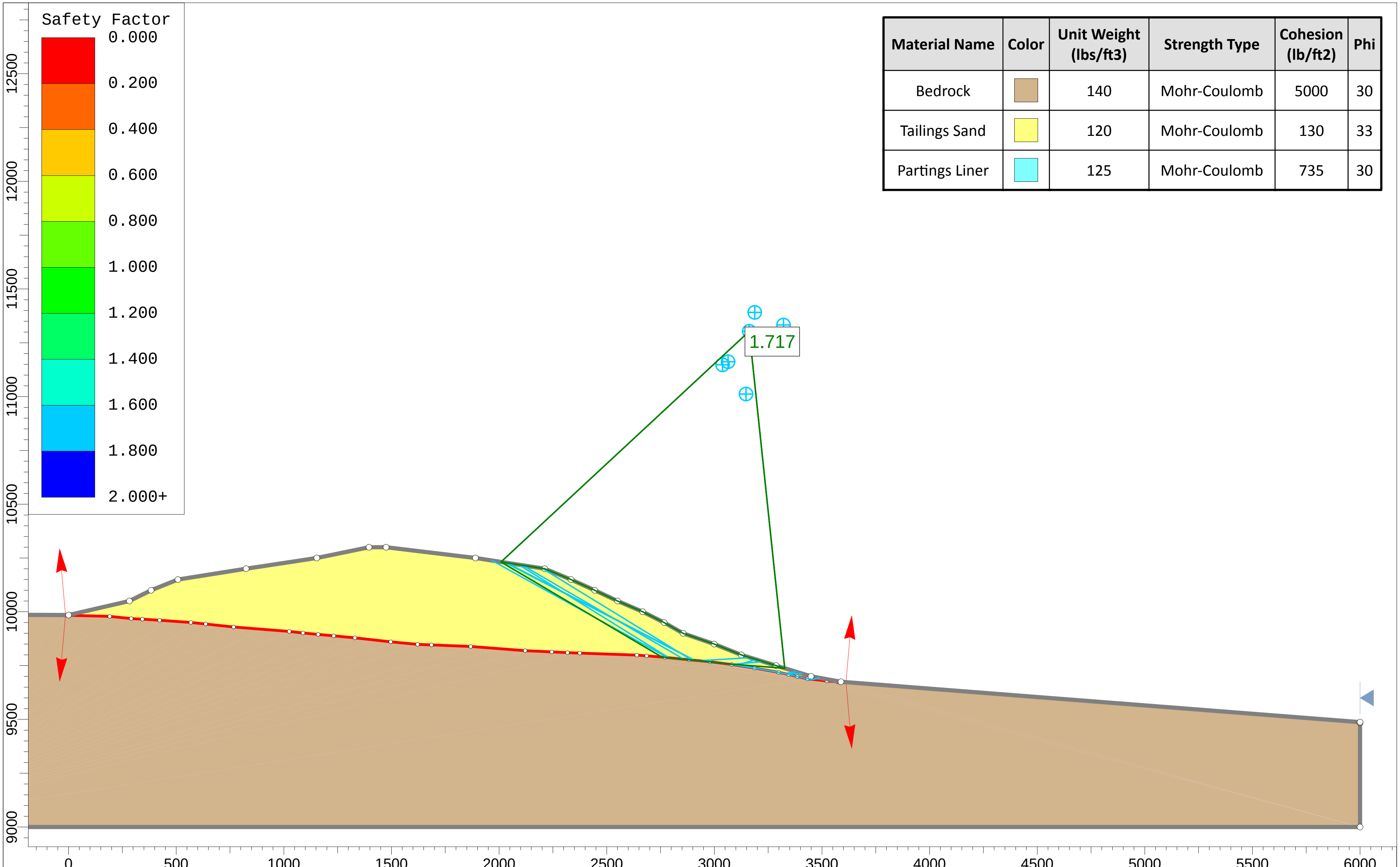
Project No.: 24585638

Figure: D16

URS

Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Seismic\Tailings B-B (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33
Partings Liner		125	Mohr-Coulomb	735	30

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: Tailings with Liner (A-A)

Project: American Sands Bruin Point

Date: January 2015

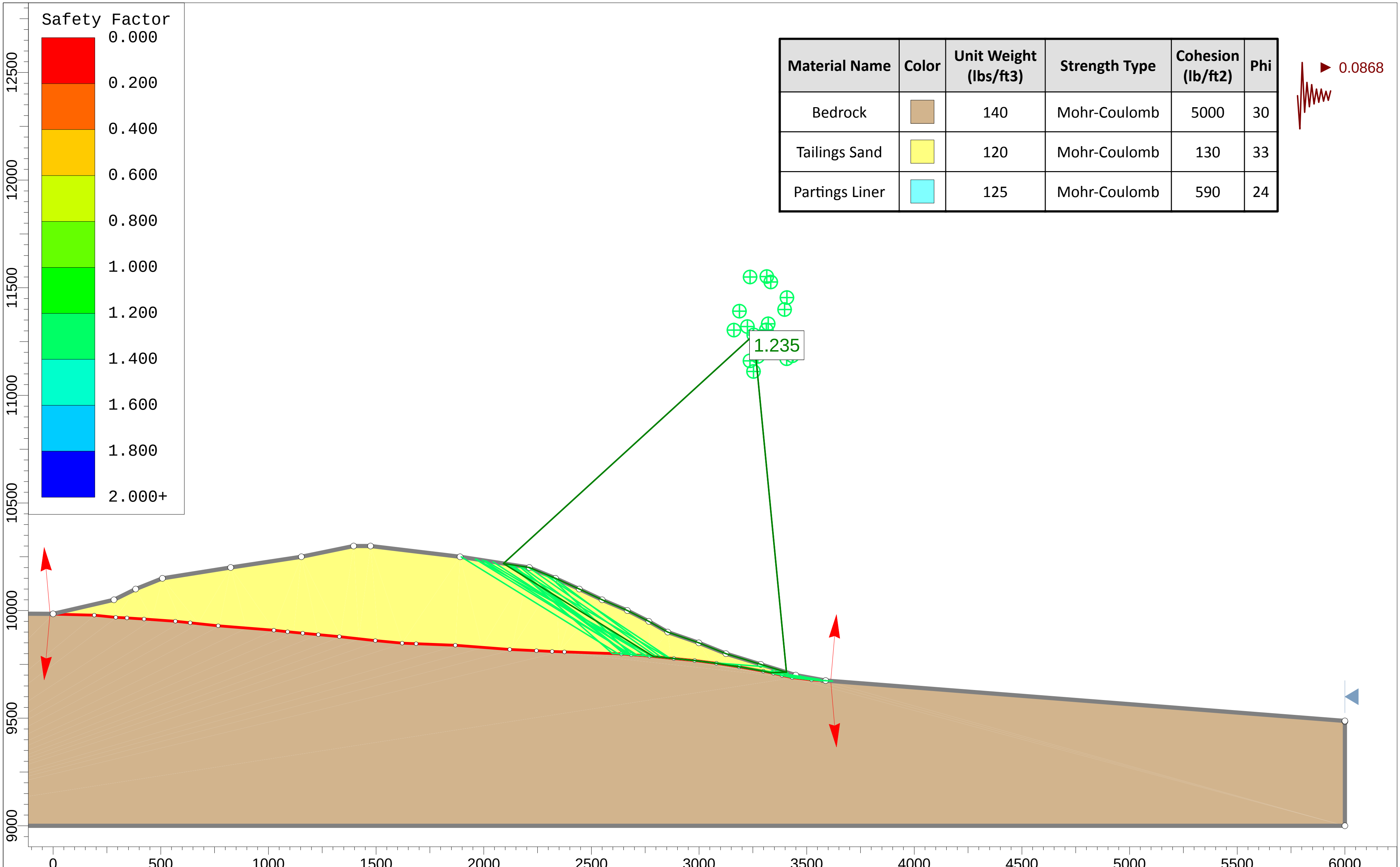
Project No.: 24585638

Figure: D17

URS Carbon County, Utah

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Clay Liner\Tailings A-A (Right).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33
Partings Liner		125	Mohr-Coulomb	590	24

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 9/2/2014 **Checked:** ECL 9/2/2014

Client: American Sands Energy Corp

Title: Tailings with Liner (A-A) [Seismic]

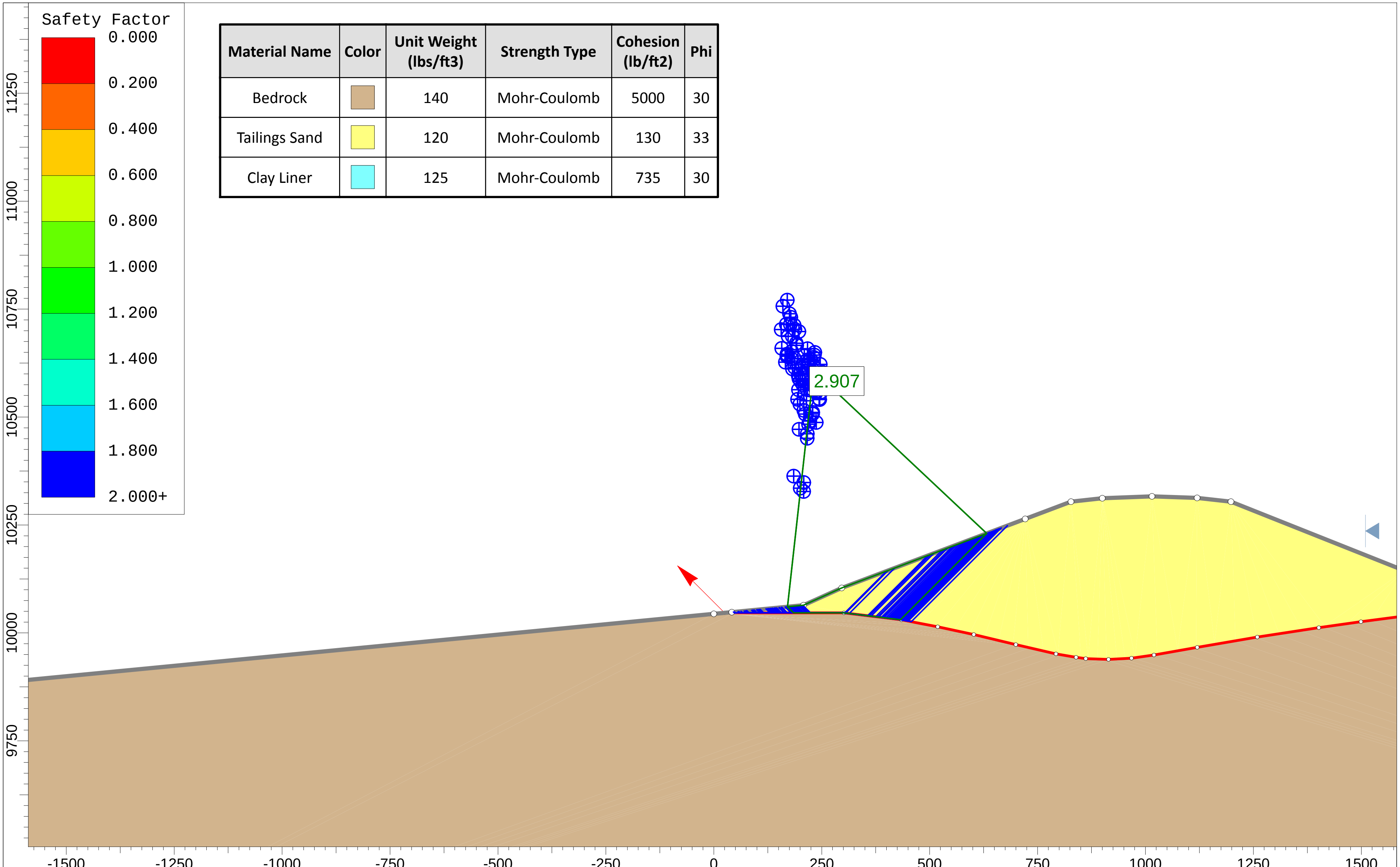
Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D18

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Clay Liner\Tailings A-A (Right)_Seismic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33
Clay Liner		125	Mohr-Coulomb	735	30

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

Client: American Sands Energy Corp

Title: Tailings with Liner (B-B)

Project: American Sands Bruin Point

Date: January 2015

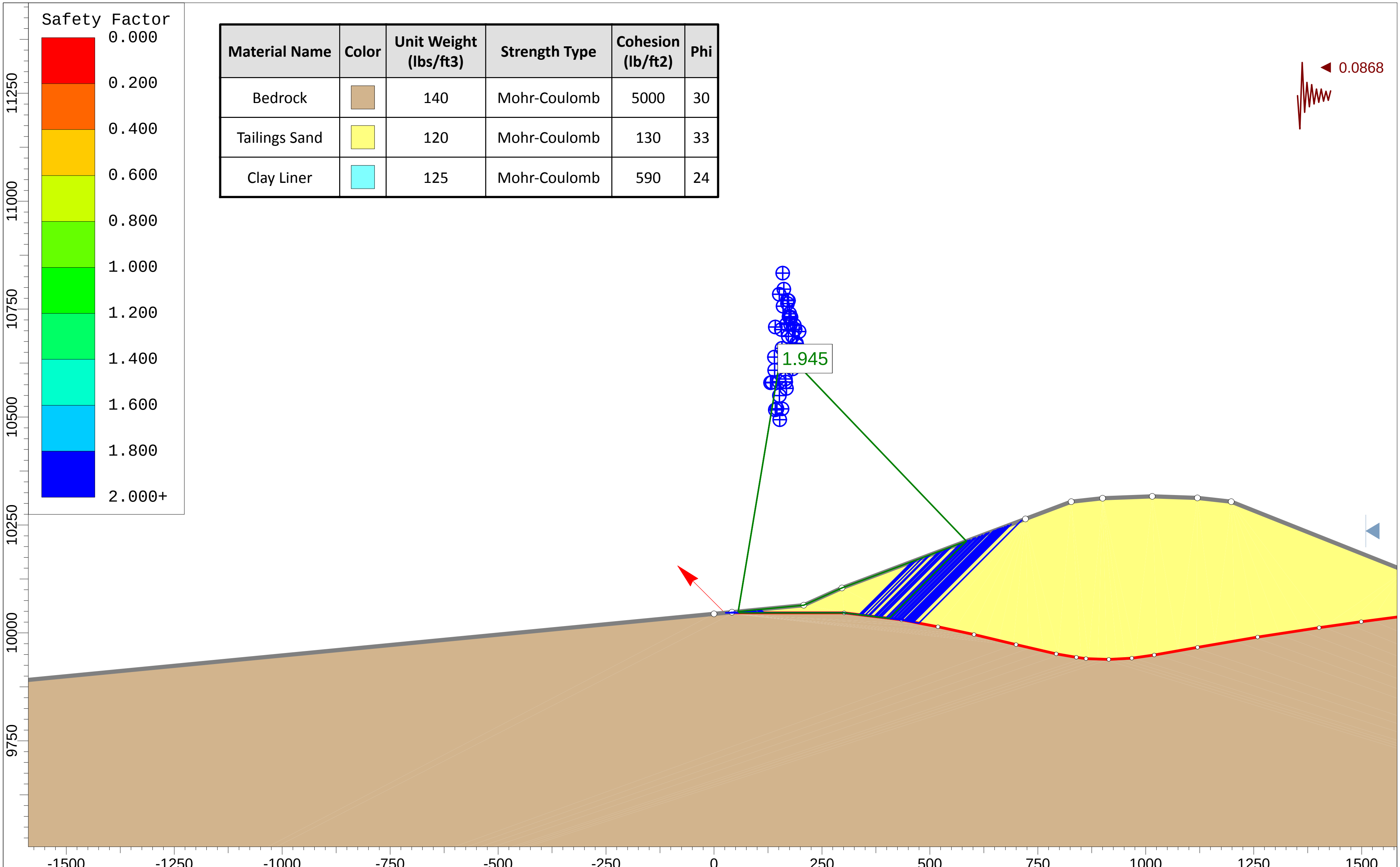
Project No.: 24585638

Figure: D19

URS Carbon County, Utah

By: BWF 1/20/2015 **Checked:** ECL 1/20/2015

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Clay Liner\Tailings B-B (Left).slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi
Bedrock		140	Mohr-Coulomb	5000	30
Tailings Sand		120	Mohr-Coulomb	130	33
Clay Liner		125	Mohr-Coulomb	590	24

Description/Notes:

Stability analysis was performed using Slide v. 6.005 by Rocscience, Inc., of Toronto, Canada, and Spencer's Method of Slices.

By: BWF 1/20/2015 **Checked:** ECL 1/20/2015

Client: American Sands Energy Corp

Title: Tailings with Liner (B-B) [Seismic]

Project: American Sands Bruin Point

Date: January 2015 **Project No.:** 24585638

Figure: D20

URS Carbon County, Utah

Q:\Projects\American Sands Energy\24585638\05_Analysis and Engineering\Geotech\Stability Analysis\Proposed Geometry\Clay Liner\Tailings B-B (Left)_Seismic.slim

APPENDIX H

SAMPLING AND ANALYSIS PLAN
AND
QUALITY AND ASSURANCE PROJECT PLAN

SAMPLING AND ANALYSIS PLAN

BRUIN POINT MINE
CARBON COUNTY, UTAH

Prepared for:

American Sands Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

April 2015

Prepared by:

URS

URS Corporation
756 East Winchester, Suite 400
Salt Lake City, Utah 84107

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

BP	Bruin Point
DO	dissolved oxygen
DOGM	Division of Oil Gas and Mining
DMI	Dry Material Impoundment
EPA	Environmental Protection Agency
gpm	gallons per minute
GRR	Green River Resources, Inc.
ID	identification
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NOI	Notice of Intention
ORP	oxidation reduction potential
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedures
VOC	volatile organic compound

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) provides descriptions of the procedures and methodologies for data collection to be conducted at the Green River Resources, Inc. (GRR) proposed Bruin Point Mine (the Site) in Carbon County, UT. This SAP outlines the samples to be collected, sample collection procedures, field sample analysis, and laboratory sample analysis to be performed. The companion plan to this SAP is the GRR Quality Assurance Project Plan (QAPP) (URS, 2014).

1.1 Site Background

GRR proposes to develop an oil sands mine and an associated processing facility within a contiguous 1,760-acre lease area. Mining activities are described in more detail in the Notice of Intention to Commence Large Mining Operations (NOI) submitted to the Utah Division of Oil Gas and Mining (DOGM) on March 4, 2014 (GRR, 2014).

The site area is located approximately six miles northeast of Sunnyside, UT, in Carbon County, directly east of Bruin Point (located at 39° 38' 38.87"N, 110° 20' 53.06"W). The property is located in the southwest portion of the Uinta Basin (**Figure 1-1**) and the area is currently largely undeveloped. Solvent used in the operating will be recovered from both the sand and the bitumen. The dry sand tailings will not contain more than 25 parts per million (ppm) of solvent (weight/weight).

1.2 Report Organization

This SAP is organized into four sections, including this introduction. **Section 2.0** of this report provides the sample collection procedures and **Section 3.0** presents the details of the sampling handling and analysis. **Section 4.0** includes the references.

2.0 SAMPLE COLLECTION

Sample collection, as described in this SAP, includes collection of surface water, groundwater, and dry materials. The goal of the surface water sampling is to monitor for potential impacts to surface water adjacent to the proposed mining and ore processing activities. The goal of groundwater sampling is to monitor for potential impacts to groundwater downgradient of proposed processing and stockpiling operations. The goal of dry materials sampling is to monitor for potential environmental impacts in the Dry Material Impoundment (DMI) area. This section provides the scope of the sampling to be performed to meet the objectives stated above.

2.1 Sampling Schedule and Locations

Surface water sampling will be performed during the spring, summer, and fall quarters. Sampling will not be conducted during the winter quarter, in which the sampling locations will be inaccessible due to weather conditions. Four surface water sampling locations, described below, were determined based on the Seep and Spring Inventory Report performed by JBR Environmental Consultants, Inc. (JBR, 2014). The fifth surface water sampling location is located at the Stormwater Retention Pond. The proposed surface water sample locations are shown in **Figure 2-1.**

<u>Location #1– North Spring</u>

North Spring is located in the north-central region of the permit boundary. It contributes to Range Creek.

<u>Location #2 – South Spring/Tributary Spring</u>

South Spring/Tributary Spring is southeast of North Spring and flows into Range Creek.

<u>Location #3 – Range Creek Flume</u>

Range Creek Flume is directly south of South Spring/Tributary Spring and lies near the southeastern boundary of the permit area. A non-functional flume is present at this sampling location.

<u>Location #4 – Cliff Seep</u>

Cliff seep, located on the western edge of the permit area, contributes to an unnamed fork of Water Canyon, containing a historic mining area.

<u>Location #5 – Stormwater Retention Pond</u>

The Stormwater Retention Pond is located south of the Process Area.

Up to eight groundwater monitoring wells are proposed to be installed based on correspondence with the Utah Department of Environmental Quality. The monitoring wells will be installed and registered in accordance with Utah Administrative Code (UAC) R655-4 and as described in the Well Installation and Development Standard Operating Procedure (SOP) included in **Appendix A**. Wells are proposed to be installed at the edges of the dry material impoundment and processing areas.

Groundwater monitoring will be conducted during the first year, prior to operation, in order to establish background conditions at the site. Each monitoring well will be sampled eight times during the first year for a total of up to 64 data points. Statistical analysis will then be conducted to establish background conditions as detailed in the QAPP (URS, 2014).

Following the first year, groundwater monitoring will be conducted during the spring, summer, and fall quarters at each of the monitoring wells. Sampling will not be conducted during the winter quarter, in which the sampling locations will be inaccessible due to weather conditions. The location of monitoring wells, described below, was determined based on topographic and hydrologic gradients and locations of proposed future operations. The proposed monitoring well locations are shown in **Figure 2-1**.

Dry Material Impoundment Monitoring Wells

Up to five dry material impoundment monitoring wells are proposed to be installed on the northern, eastern, and southern edges of the proposed dry material impoundment area.

Process Monitoring Wells

Up to three process monitoring wells are proposed to be installed on the eastern and western edges of the processing area.

Sampling from the DMI area will occur during the first and second quarter that dry materials are produced (**Figure 2-1**). Dry material samples locations will be determined using Microsoft Excel's Random Number Generator.

Dry Material Impoundment (DMI) Area

DMI located in northwestern area of permit boundary, used to store dry material.

2.2 Surface Water Sampling Procedure

Surface water samples will be collected using a properly decontaminated long-handled sampler or the water will be collected directly into the laboratory provided glassware, when appropriate. All SOP protocols in **Appendix A** will be followed. Surface water samples will be transferred into the appropriate, new, certified-clean, sample containers supplied by the analytical laboratory, as described in the GRR QAPP (URS, 2014). If the sampler must stand in the water, samples will be collected upstream of the sampler's location. Surface water sampling activities will be recorded on the Surface Water Sampling Form included in **Appendix B**. A summary of the sampling, measurements, and analytical programs is provided in **Table 2-1.**

2.3 Groundwater Sampling Procedure

Groundwater samples will be collected using a properly decontaminated peristaltic pump, submersible pump, or bladder pump, or the water will be collected directly into the laboratory provided glassware if artesian conditions are observed. All SOP protocols in **Appendix A** will be followed. Groundwater samples will be transferred into the appropriate, new, certified-clean, sample containers supplied by the analytical laboratory, as described in the GRR QAPP (URS, 2014). Groundwater sampling activities will be recorded on the Groundwater Sampling Form included in **Appendix B**. A summary of the sampling, measurements, and analytical programs is provided in **Table 2-1.**

2.4 Dry Material Impoundment Sampling Procedure

Composite samples will not be collected due to the potential dilution effect in the composite sampling procedure. Discrete samples will be collected using disposable equipment for each sample. At each random location, samples will be collected at approximately one foot below the surface and placed into new, certified-clean, sample containers supplied by the analytical laboratory. All field notes will be recorded on the Surface and Shallow Soil Sampling Log, provided in **Appendix B.** A summary of the sampling, measurements, and analytical programs is provided in **Table 2-1.**

Table 2-1
Summary of Measurement, Sampling, and Analytical Program

Matrix	Sample Locations	Measurement	Field or Lab	Number of Normal Samples per Event	Number of QA/QC samples per Event	Frequency of Event
Surface Water	See Figure 2-1	Flow	Field	5	NA	Quarterly[2]
		Water Quality Parameters[1]	Field	5	NA	Quarterly[2]
		Table 3-1 Analytes	Lab	5	6 (FD at 10%, FB at 5%, & MS/MSD at 5% or per sampling event, whichever is greater. EB at one per sampling event, TB at one per cooler, only when samples analyzed for VOCs)	Quarterly[2]
Ground water	See Figure 2-1	Water Quality Parameters[1]	Field	9	NA	Quarterly[2]
		Table 3-1 Analytes	Lab	9	6 (FD at 10%, FB at 5%, & MS/MSD at 5% or per sampling event, whichever is greater. EB at one per sampling event, TB at one per cooler, only when samples analyzed for VOCs)	Quarterly[2]
Dry Material	Randomly Selected	Table 3-2 Analytes	Lab	1	5 (FD at 10%, FB at 5%, & MS/MSD at 5% or per sampling event, whichever is greater. TB at one per cooler, only when samples analyzed for VOCs)	Quarterly[3]

Notes:
FD = field duplicate
MS/MSD = matrix spike/matrix spike duplicate, which constitute two samples
TB = trip blank
EB = equipment blank
FB = field blank
NA = Not Applicable
QA/QC = Quality Assurance/Quality Control
VOCs = volatile organic compounds
(1) - Water Quality Parameters include: temperature, pH, specific conductance, oxidation reduction potential (ORP), and dissolved oxygen (DO)
(2) - Sampling will occur 3 out of 4 quarters due to the inability to sample during the winter quarter.
(3) - Dry material sampling will occur only during the first and second quarter that dry materials are produced.

2.5 Water Level Measurement Procedure

Water levels will be measured at each groundwater monitoring well prior to groundwater sample collection, using a properly decontaminated water level meter. All SOP protocols in **Appendix A** will be followed. Water level measurements will be recorded on the Water Level Form included in **Appendix B**.

2.6 Water Quality Measurements

Field water quality parameters will be measured at each surface water and groundwater sample location using a portable water quality meter, as described in the Water Quality Measurements SOP included in **Appendix A**. Field water quality measurements will consist of: pH, conductivity, temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP). Data will be recorded on the sample forms included in **Appendix B**. The water quality meter will be properly maintained and calibrated in accordance with the manufacturer's instructions. Calibration information will be recorded on the Equipment Calibration Form included in **Appendix B**.

2.7 Surface Water Flow Measurement

Surface water flow will be measured concurrent with sample collection at four of the five surface water locations, as described below. Flow will not be measured in the Stormwater Retention Basin.

<u>Site #1 – North Spring (Estimated Flow: 3 - 42 gallons per minute (gpm))</u>

Flow will be measured by using a five-gallon bucket and determining the time it takes the spring to fill the bucket. This will be repeated three times and the average of the readings will be used as the flow.

<u>Site #2 – South Spring/Tributary Spring (Estimated Flow: 4.5 - 70 gpm)</u>

Flow will be measured by using a five-gallon bucket and determining the time it takes the spring to fill the bucket. This will be repeated three times and the average of the readings will be used as the flow.

<u>Site #3 – Range Creek Flume (Estimated Flow: 42 gpm)</u>

The existing flume will be inspected and cleaned out, as necessary. If possible, the flow will be measured following standard methods using the existing Parshall flume installed at the creek. If not, the bucket-method used at the North and South/Tributary Springs will be implemented.

<u>Site #4 – Cliff Seep (Estimated Flow: Unknown)</u>

Flow will be measured by using a 100-milliliter (mL) graduated cylinder and determining the time it takes the water to fill the cylinder. This will be repeated three times and the average of the readings will be used as the flow.

2.8 Decontamination

All non-dedicated sampling equipment (i.e., long-handled sampler, water quality meter, or pump) will be decontaminated before the start of each sampling or data collection event and between sample collection at each location. Decontamination will be performed using a weak phosphate-free detergent (Liquinox) and triple distilled water rinse. The sampler will wear a new pair of disposable gloves at each sampling location, before and after decontamination, and before collection quality control samples. Where possible, dedicated or disposable equipment will be used at each sample location to avoid cross-contamination. Decontamination will not be required for dry material sampling, as all equipment will be new and disposable.

2.9 Sample Identification

All sample containers will be labeled at the time of sample collection. Labels will be completed with permanent ink and will include the sample identification (ID), date and time of collection, project name, name of collector, analysis requested, and preservative.

Samples will be identified with a sample ID that consists of three fields. The first field indicates the site name and will consist of BP (for Bruin Point). The second field indicates the sample location and will consist of the location ID; NS for North Spring, SS for South Spring, RC for Range Creek Flume, CS for Cliff Seep, DMI for Dry Material Impoundment, and MW-X for monitoring wells, where “X” is the well identification number. The third field indicates the sampling event, represented by Q1, Q2, or Q3, for each quarter. Therefore, if the South Spring is sampled during the third quarter of sampling, the sample ID will be written as BP-SS-Q3.

For Quality Assurance/Quality Control (QA/QC) samples, consisting of field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples, the IDs will follow the same format as above, except that they will include a fifth field, to designate the type of QA/QC sample, as follows:

- Field duplicate samples: -Y (Example: BP-SS-Q3-Y)
- MS samples: -MS (Example: BP-SS-Q3-MS)
- MSD samples: -MSD (Example: BP-SS-Q3-MSD)

When not using dedicated or disposable sampling equipment, equipment blanks will be labeled with “EB,” the date of sampling, and the sample ID of the sample obtained immediately before the equipment blank was collected. The field blank will be labeled similarly, with “FB” and the date of sampling. Trip blanks will also accompany the samples, but they are lab prepared samples and placed in the cooler with volatile organic compounds (VOCs) samples. They remain unopened throughout the sampling event.

2.10 Quality Control / Quality Assurance (QA/QC) Samples

QA/QC sampling procedures will be followed to reduce cross contamination and sampling errors, as outlined in the GRR QAPP (URS, 2014). All sampling equipment will be stored and sealed in areas free of contamination.

Field duplicates and MS/MSD samples will be collected in the field at a frequency of 10% and 5%, respectively, or one per sampling event, whichever is greater for each sample type. Equipment blanks will each be collected once per sampling event when designated or disposable equipment is unavailable. Equipment blanks will not be collected during DMI sampling events since new, disposable equipment will be used each time. Field blanks will be collected at 5% or once per sampling event. Field blanks are to ensure reagent integrity and to check for environmental contamination. Field blanks will contain lab distilled water, be transported to the field, transferred to sample containers, and preserved identical to the normal samples.

A trip blank will only be included when samples are collected and analyzed for VOCs. The trip blank will be included in each cooler that contains the VOC samples. The trip blank, prepared by the laboratory, will indicate if sample contamination has occurred from the time samples are collected to the time they reach the laboratory. QA/QC sampling is further discussed in the GRR QAPP (URS, 2014).

2.11 Field Documentation

Documentation of field activities consists of the information recorded in the field log book and on the sample forms. The following subsections provide details regarding each type of documentation.

2.11.1 Field Log Book

The field logbook provides a means for recording observations and activities at a site. Field logbooks are intended to provide sufficient data and observation notes to enable participants to reconstruct events which occurred while performing field activities. Field logbooks are not intended to be used as the sole source of project or sampling information and, as such, are supplemented by field forms. Sufficient logbooks will be assigned to a project to ensure that each field team has a logbook with it at all times. If a logbook is not available, field forms should be used until a field log book becomes available.

Entries into the log book may contain a variety of information. At a minimum, log book entries must include the following information at the beginning of each day:

- Date;
- Start time;
- Weather;

- All field personnel present and directly involved;
- All visitors to the site;
- Field activities performed;
- Samples collected;
- Reference to any field forms used;
- Any field calculations not associated with a field form;
- Any significant events;
- Initials of personnel performing documentation at bottom of each page.

All log book entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed and dated by the originator.

2.11.2 Field Forms

Specific field activities related to sample collection and equipment calibration will be recorded on the field forms included in **Appendix B**. Field forms should be filled out completely and should include notes indicating any pertinent information regarding each specific sample. All field calculations associated with a measurement or sample that is being recorded on a field form should also be recorded on the appropriate field form.

3.0 SAMPLE HANDLING AND ANALYSIS

3.1 Chain-of-Custody Procedures

The possession and handling of all environmental samples will be traceable from the time of collection, through analysis, until final disposition using a Chain-of-Custody Form. The Chain-of-Custody Form will be completed by sampling and laboratory personnel and will accompany every sample drop-off. The Chain-of-Custody protocol is explained in greater detail in the GRR QAPP (URS, 2014).

3.2 Custody Seals

Custody seals will be used for any samples shipped to a laboratory and will be attached to all shipping containers before the samples leave the custody of sampling personnel. Custody seals will bear the signature of the collector and the date signed, and will be attached so that they must be broken in order to open shipping containers. Custody seals will not be required for containers taken directly to the laboratory by the sampling personnel. Refer to the GRR QAPP (URS, 2014) for additional information.

3.3 Sample Analysis

All surface water and groundwater samples will be submitted to a Utah certified laboratory and analyzed for the analytes and listed in **Table 3-1.** For the DMI samples, all potential proprietary solvent constituents will undergo a total analysis. Semi-volatile organic compounds (SVOCs), VOCs, and metals will also be analyzed using the Synthetic Precipitation Leaching Procedure (SPLP) procedure. All other analytes unable to be analyzed via SPLP will undergo a total analysis. The analytes are listed in **Table 3-2.** Refer to the GRR QAPP (URS, 2014) for the appropriate sample containers, holding times, preservation, and methods for analytes listed in **Table 3-1** and **Table 3-2.**

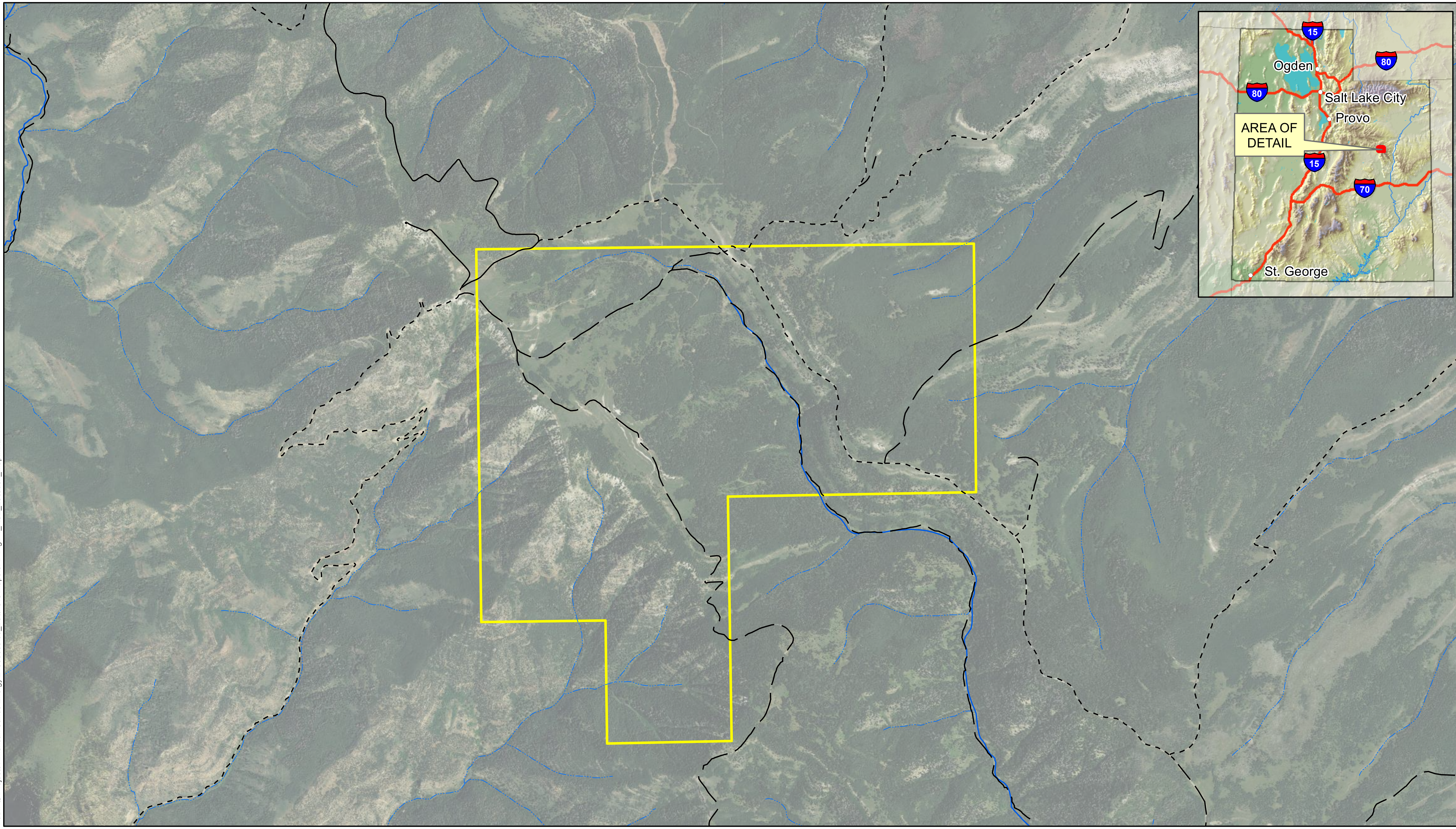
4.0 REFERENCES

Green River Resources (GRR), 2014. Notice of Intention to Commence Large Mining Operations, Green River Resources, Inc., Bruin Point Mine. March, 2014.

JBR Environmental Consultants (JBR), 2014. American Sands Energy Corporation Proposed Bruin Point Mine Seep and Spring Inventory. February, 2014.

URS Corporation (URS), 2014. Quality Assurance Project Plan, Green River Resources Inc. Bruin Point Mine, Carbon County, UT. August 2014

FIGURES

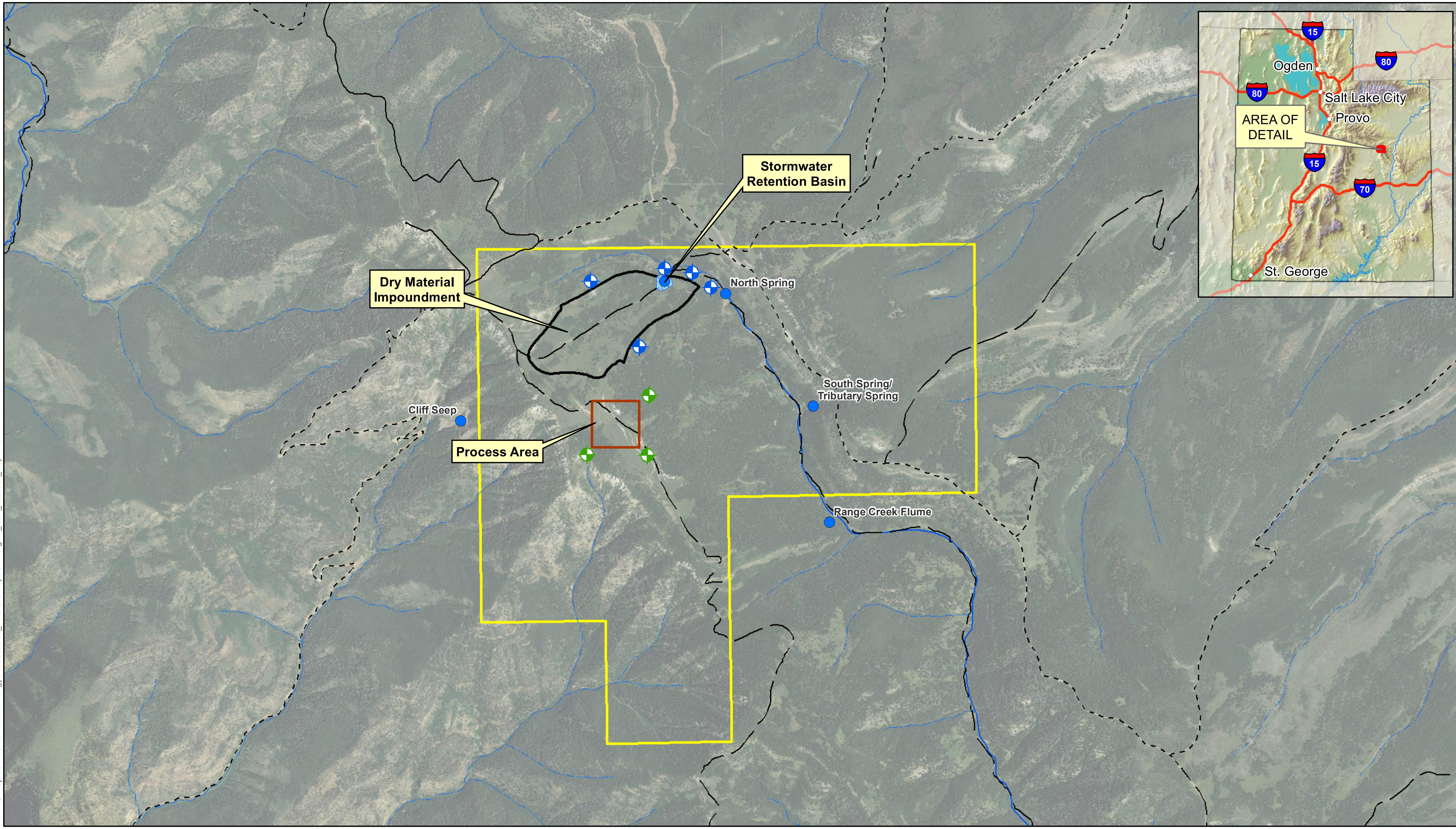


- Perennial Stream
- Intermittent Stream
- Improved Road
- Dirt Road
- Road (Conditions Unknown)
- Lease Boundary

N

1,000 0 1,000 2,000 Feet

Title:	Site Location Map
Bruin Point Mine Sampling and Analysis Plan	Proj No: 24585638
	Figure: 1-1
American Sands Energy Corp	Date: April 2015
	URS



Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\SAP\Fig2-1_ASE_Location_Map.mxd

- Perennial Stream
- Intermittent Stream
- Improved Road
- Dirt Road
- Road (Conditions Unknown)
- Lease Boundary
- Dry Material Impoundment
- Surface Water Sampling Location
- Process Area Monitoring Well
- Dry Material Impoundment Monitoring Well

N

1,000 0 1,000 2,000 Feet

Title:	Sampling Locations
Bruin Point Mine Sampling and Analysis Plan	Proj No: 24585638
	Figure: 2-1
American Sands Energy Corp	Date: April 2015
	URS

TABLES

Table 3-1
Surface Water and Groundwater Analytes

Analyte	Laboratory Method[(1)]
General Water Chemistry	
Alkalinity as $CaCO_3$	SM 2320B
Ammonia as N	EPA 350.1
Bicarbonate as $CaCO_3$	SM 2320B
Carbonate as $CaCO_3$	
Chloride	EPA 300.0
Sulfate	
Hardness as $CaCO_3$	SM 2340C
Nitrate as N	EPA 300.0
Nitrate/Nitrite as N	EPA 353.2
Nitrite as N	EPA 300.0
Specific Conductance	SM 2510B
Total Dissolved Solids	SM 2540C
Total Suspended Solids	SM 2540D
Total Organic Carbon	SM5310B
Benzene	SW846 8260B/RSK 175
Toluene	
Xylenes, Total	
Naphthalene	
TPH-GRO	SW846 8015C
TPH-DRO	SW846 8015C
HEM, SGT-HEM	1664
Barium	6020A
Cadmium	
Copper	
Manganese	
Iron	6010C
Nickel	6020A
1,2,3-Trimethylbenzene	8260B
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
2-Butanone	
Methylene chloride	
Potential Proprietary Solvent Constituents[(2)]	
Benzoic Acid	SW846 8270D
Ethanol	SW846 8015B
Propanol	
1,3-Dichloropropane	SW846 8260B/RSK 175
Butane	
Ethylbenzene	
Hexanes	
Isopropyl alcohol	
Methyl t-butyl ether	
Pentane	
Isopentane	TBD
n-Propylbromide	TBD

Notes:

(1) – Or equivalent method

(2) – Proprietary solvent is a mixture of some, but not all, of these constituents

mg - milligrams
S/m - siemens per meter
SGT - Silica Gel Treated
HEM - Hexane Extractable Material
TPH – Total Petroleum Hydrocarbons
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
SM – Standard Method
TBD - To be determined
EPA – Environmental Protection Agency

Table 3-2
Dry Material Analytes

Analytes	Laboratory Method[(1)]
Analyzed using SPLP Procedure[1,2]	
Metals	
Antimony	SW 846 1312/6020
Arsenic	
Barium	
Beryllium	
Cadmium	
Chromium	
Copper	
Lead	
Mercury	SW 846 1312/7470
Major cations	SW 846 1312 /6010
Aluminum	
Calcium	
Iron	
Magnesium	
Manganese	
Potassium	
Sodium	
Selenium	SW 846 1312/6020
Silver	
Thallium	
Zinc	
SVOC Organics	
Pentachlorophenol	SW 846 1312/8270
Di(2-ethylhexyl)adipate	
Benzo(a)pyrene	
Hexachlorocyclopentadiene	
Di(2-ethylhexyl)phthalate	
VOCs	
1,1-Dichloroethylene	SW 846 1312/8260B
1,2 Dichloropropane	
1,2,4-Trichlorobenzene	
1,2-Dichlorobenzene	
1,4-Dichlorobenzene	
Benzene	
Carbon tetrachloride	
cis-1,2 dichloroethylene	
Dichloromethane	
Ethylene Dibromide	
Heptane	
Hexachlorobenzene	
Monochlorobenzene	
Naphthalene	
Styrene	
Tetrachloroethylene	
Toluene	
trans-1,2 dichloroethylene	
Trichloroethylene	
Vinyl Chloride	
Xylenes, Total	
1,2,3-Trimethylbenzene	
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
2-Butanone	
Methylene chloride	

Table 3-2
Dry Material Analytes

Analytes	Laboratory Method[1]
Potential Proprietary Solvent Constituents[2,3]	
Benzoic Acid	SW 846 1312/8270D
1,3-Dichloropropane	SW 846 1312/8260
Ethylbenzene	
Methyl t-butyl ether	
n-Propylbromide	TBD
Analyzed using Total Analysis Procedure[2]	
Non-Halogenated Organics	
TPH-DRO	8015C
TPH-GRO	8015C
HEM, SGT-HEM	9071B
Others	
Ammonia as N	350.1
Chloride	9056A
Sulfate	9056A
Nitrate as N	9056A
Nitrite as N	9056A
Total Organic Carbon	9060A
Total Nitrate/Nitrite as N	9056A
Potential Proprietary Solvent Constituents[2, 3]	
Ethanol	8015B
Hexanes	8260B
Isopentane	TBD
Isopropyl alcohol	8015B
Propanol	8015B
Pentane	Modified ASTM 1945
Butane	Modified ASTM 1945
1,3-Dichloropropane	8260B
Benzoic Acid	8270D
Ethylbenzene	8260B
Methyl t-butyl ether	8260B
n-Propylbromide	TBD

Notes:

(1) – Or equivalent method

(2) – Only SVOCs, VOCs, and metals can be analyzed using the SPLP procedure.

All other analytes shall undergo a total analysis.

(3) – Proprietary solvent is a mixture of some, but not all, of these constituents

oz. - ounce
ASTM - American Society for Testing and Materials
RL - Reporting Limit
MDL - Method Detection Limit
SW – Solid Waste
SOP – Standard Operating Procedure
SPLP– Synthetic Precipitation Leaching Procedure
SGT - Silica Gel Treated
HEM - Hexane Extractable Material
HCL- Hydrochloric Acid
ml - milliliter
kg- kilogram
ug- microgram
L - Liter
mg - milligram

APPENDIX A

STANDARD OPERATING PROCEDURES (SOPS)

Water Quality Measurements
Surface Water Sampling
Groundwater Sampling
Water Level Measurements
Well Installation and Development

STANDARD OPERATING PROCEDURE

WATER QUALITY MEASUREMENTS

1.0 PURPOSE

This procedure outlines the types of field measurements and data requirements associated with the collection of surface water and groundwater samples. Water quality parameters will be collected to assess surface water and groundwater chemistry at the site.

This procedure provides guidance for quarterly surface water and groundwater sampling at the Green River Resources, Inc. (GRR) Bruin Point Mine.

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Not applicable.

2.2 Abbreviations

mS/cm	millisiemens per centimeter
GRR	Green River Resources, Inc.
ORP	Oxidation and Reduction Potential
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure

3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The URS Project Manager or an approved designee is responsible for checking all work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing the GRR Field Sampling and Analysis Plan (SAP) and all applicable standard operating procedures (SOPs).

4.0 PROCEDURES

- Read and follow the specific manufacturer's operating instructions before using any equipment.
- Calibrate all equipment as specified below prior to and at the commencement of sampling activities to ensure proper equipment operation. Record these measurements in the Equipment Calibration Form (**Appendix B**).

4.1 Temperature

- Calibrate electronic thermometers (if applicable) according to their manufacturer's specifications.
- Record actual and meter reading on the Equipment Calibration Form.
- Collect the sample in a clean flask or beaker and insert the temperature probe into the water as per the manufacturer's specifications.
- Read the temperature from the meter and record the reading on the Surface Water Sampling form (**Appendix B**).
- Discard the sample and rinse the probe with Liquinox wash and distilled water rinse.

4.2 pH

- Thoroughly decontaminate the pH probe prior to use with Liquinox wash and distilled water rinse.
- Use a two point calibration, at a minimum, using pH 7.0 and 10.0 buffer solutions according to the manufacturer's specifications.
- Record meter reading in pH buffer solutions 7.0 and 10.0 on the Equipment Calibration Form. If reading is greater than ± 0.2 units, recalibrate the meter.
- Collect the sample in a clean flask or beaker and insert the pH probe into the water according to the manufacturer's specifications.
- If appropriate, the probe may be inserted directly into the water, according to the manufacturer's specifications.
- Read the pH measurement from the meter approximately one minute from the time the sample was collected and record the reading on the Surface Water Sampling form.
- Discard the sample and decontaminate the probe with Liquinox wash and distilled water rinse.

4.3 Conductivity

- Thoroughly decontaminate the conductivity probe prior to use with Liquinox wash and distilled water rinse. Calibrate the conductivity meter according to the manufacturer's specifications.
- Record meter reading in a known specific conductance calibration solution (such as 1.412 millisiemens per centimeter (mS/cm)) on the Equipment Calibration Form. If reading is greater than ± 10 percent, recalibrate the meter.
- Collect the water sample in a clean flask or beaker and insert the conductivity probe into the water according to the manufacturer's specifications.
- Wait for the reading to stabilize and record the reading on Surface Water Sampling Form.
- Discard the sample and decontaminate the probe with Liquinox wash and distilled water rinse.

4.4 Dissolved Oxygen

- Decontaminate the dissolved oxygen probe according to the manufacturer's specifications with Liquinox wash and distilled water rinse. Because the probe membrane is very fragile and susceptible to dryness, keep it moist at all times.
- Calibrate the dissolved oxygen meter according to the manufacturer's specifications and record the results on the Equipment Calibration Form.

- Collect the water sample as close to the source as possible and place it in a clean flask or beaker.
- Be careful to minimize sample aeration during collection and transfer into the flask or beaker.
- Insert the dissolved oxygen probe into the sample so that the membrane is fully submerged. Very gently stir the probe through the sample. Do not agitate the probe as air bubbles cause erroneous measurements.
- When the reading stabilizes, record the reading on Surface Water Sampling form.
- Decontaminate the dissolved oxygen probe according to the manufacturer's specifications with Liquinox wash and distilled water rinse.

4.5 Oxidation Reduction Potential

- Decontaminate the oxidation reduction potential (ORP) probe according to the manufacturer's specifications with Liquinox wash and distilled water rinse.
- Calibrate the ORP probe according to the manufacturer's specifications. Correct for temperature according the calibration solutions specifications.
- Record meter reading in a known ORP calibration solution (corrected for temperature) on the Equipment Calibration Form. If reading is greater than ± 10 percent, recalibrate the meter. Collect the water sample in a clean flask or beaker and insert the ORP probe into the water
- according to the manufacturer's specifications
- When the reading stabilizes, record the reading on Surface Water Sampling form.
- Decontaminate the ORP probe according to the manufacturer's specifications with Liquinox wash and distilled water rinse.

4.6 Review

The reviewer shall check Surface Water Forms for completeness and accuracy. Any discrepancies will be noted and the forms will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the Surface Water Sampling Forms.

5.0 FORMS (Appendix B)

- Equipment Calibration Form
- Surface Water Sampling Form

STANDARD OPERATING PROCEDURE

SURFACE WATER SAMPLING

1.0 PURPOSE

The purpose of this procedure is to describe the equipment and operations for sampling surface water at the Green River Resources, Inc. (GRR) Bruin Point Mine. This procedure outlines methods for surface water sample collection using a long-handled sampler or directly into the lab provided glassware.

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Blank: An artificial sample designed to monitor the introduction of contaminants into a process. For aqueous samples, lab provided water is used as a blank matrix.

2.2 Abbreviations

°C	degrees Celsius
COC	Chain-of-Custody Form
GRR	Green River Resources, Inc.
ID	identification
ORP	Oxidation Reduction Potential
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure

3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The URS Project Manager or an approved designee is responsible for checking all work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing GRR Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP).

4.0 PROCEDURES

- Prior to initiating sampling, check that equipment to be used is in good operating condition.
- If possible and where applicable, start at those locations that are the least contaminated and proceed to those locations that are the most contaminated.

- Thoroughly decontaminate all equipment entering surface water according to the SAP.
- Collect surface water sample as described below.

4.1 Surface Water Sample Collection

Prior to initiating surface water sampling, record the following parameters on the Surface Water Sampling Form (**Appendix B**):

- Project Name;
- Sample Location;
- Sample Date;
- Field Investigator;
- Chain-of-Custody (COC) number;
- Surface Water Sampling Method;
- Additional sampling comments;
- Sample ID;
- Quality Assurance/Quality Control (QA/QC) sample collected (type and ID);
- Sample Date and Time;
- Water Quality Meter Type;
- Water Color and Clarity;
- Water Quality Parameters; and
- Field Drawn Map

Surface water samples will be collected using a properly decontaminated long-handled sampler or directly into the lab provided glassware from each of the four locations (**Figure 2-1**). Surface water samples will be transferred in appropriate new, certified-clean, sample containers supplied by the analytical laboratory. If the sampler must stand in the water, samples will be collected upstream of the sampler's location. Surface water sampling activities will be recorded on the Surface Water Sampling Form included in **Appendix B**. The sampler will properly and thoroughly decontaminate sampling equipment prior to any sampling and between samples according to the methods outlined in the SAP. In addition, equipment blanks will be collected as outlined in the QAPP to verify that cross-contamination has not occurred.

Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet quickly as possible to ensure a representative sample. Collect water quality parameters immediately after sampling to minimized disturbance of bottom sediments. Water quality parameters shall consist of pH, specific conductance, temperature, dissolved oxygen, and oxidation reduction potential (ORP) and shall be recorded on the Surface Water Sampling Form.

After sample collection, sample shipping shall include the following:

- Package samples and ship or deliver to the laboratory within 48 hours of sample collection under standard chain-of-custody protocol.
- Place samples on ice in an insulated cooler for shipment so that they will be cooled to the required temperature of 4°C ± 2°C as quickly as possible.
- Package samples properly prior to transportation and shipment.
- Sign custody seals and attach to all shipping containers before the samples leave the

custody of sampling personnel.

4.2 Sample Containers

The proper sample containers and preservatives to be used for specific analyses are outlined in the QAPP.

4.3 Chain-of-Custody

All samples shall be accompanied by a COC at the time of transfer. The procedures for filling out a COC, transporting samples, and transferring custody of samples are outlined in the QAPP.

4.4 Sample Labeling

Label all samples according to the methods outlined in the SAP.

4.5 Review

The reviewer shall check Surface Water Sampling Forms, log book, and COCs for completeness and accuracy. Any discrepancies will be noted and the forms will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the forms.

5.0 FORMS (Appendix B)

- Surface Water Sampling Form
- Chain-of-Custody Form
- Equipment Calibration Form

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING

1.0 PURPOSE

The purpose of this procedure is to describe the equipment and operations for sampling groundwater at the Green River Resources, Inc. (GRR) Bruin Point Mine. This procedure outlines methods for groundwater sample collection including purging, sample collection, and filtration when using peristaltic pumps, submersible pumps, or bladder pumps. Water will be collected directly into the laboratory provided glassware if artesian conditions are observed.

The monitoring wells will be purged and sampled with a peristaltic pump, submersible pump, or bladder pump using dedicated or disposable tubing. Groundwater samples will be collected in appropriate containers. Groundwater quality data will be collected in the field and will consist of pH, specific conductivity, temperature, dissolved oxygen, and oxidation reduction potential (ORP) using calibrated field water-quality meters as discussed in the SOP for Water Quality Measurements. Static water level and total well depth will be measured with an electronic water-level meter as discussed in the SOP for Water Level Measurements. All field instruments will be calibrated according to the manufacturer's recommendations prior to use and documented in an Equipment Calibration Form (**Appendix B**).

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Blank: An artificial sample designed to monitor the introduction of contaminants into a process. For aqueous samples, lab provided water is used as a blank matrix.

Equipment Blanks: Blanks prepared in the field from reagent-grade water that is poured over or passed through the sample collection device after the device has been decontaminated, then collected in a sample container and returned to the laboratory for analysis. Equipment blanks check the effectiveness of decontamination procedures.

2.2 Abbreviations

BGS	Below Ground Surface
ml/min	Milliliters per minute
ORP	Oxidation Reduction Potential
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure

3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The URS Project Manager or an approved designee is responsible for checking all work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing GRR Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP).

4.0 PROCEDURES

- Read and follow the specific manufacturer's operating instructions before using any equipment.
- Prior to initiating sampling of a groundwater, check that all equipment to be used is in good operating condition.
- If possible and where applicable, start at those locations that are the least contaminated and proceed to those locations that are the most contaminated.
- Thoroughly decontaminate all equipment entering each well according to the SAP.
- Remove the well cap, noting in the log book the following: personnel, well identification number, date, time, and weather conditions, as well as any evidence of damage or disturbance to the well head.
- Check water level as per the SOP for Water Level Measurements.
- Purge as per Section 4.1, Purging.
- Collect field water quality measurements as detailed in the SOP for Water Quality Measurements.
- Sample as per Section 4.2, Sample Collection.

4.1 Purging

In order to obtain a representative sample, groundwater within the monitoring well must be purged until water quality parameters stabilize as outlined in the SOP for Water Quality Measurements. This procedure allows for sampling of representative formation water.

- Purge and sample wells using “low-stress” techniques.
- To ensure groundwater is representative of the aquifer before samples are collected, purge each well at a maximum rate of 500 milliliters per minute (ml/min) until field-measured parameters stabilize.
- Exercise care during purging to not reduce the water column by more than 50% of initial height, to the extent practical.
- At a minimum, monitor pH, specific conductivity, temperature, dissolved oxygen, and ORP during purging using portable meters as outlined in the SOP for Water Quality Measurements. Take at least five readings during purging.
- At least three consecutive field measurements made three minutes apart shall fall within the ranges stated below before field parameters will be considered stabilized:

    - pH = ± 0.2 units,
    - Specific Conductance = ± 10 percent,
    - Temperature = ± 1° C,

- Dissolved Oxygen =± 0.2 mg/L or 10 percent, and

Prior to initiating purging, record the following groundwater parameters on a Groundwater Sampling Form (**Appendix B**):

- Project Name,
- Sample Location,
- Sample ID,
- Sample Date,
- Water Quality Meter and Serial Number,
- Depth of Pump Intake,
- Total Depth,
- Static Water Level,
- Water Column, and
- Sampling Method.

4.2 Sample Collection

With the exception of low-yield wells, groundwater samples shall be collected immediately after field-measured parameters have stabilized. Groundwater samples shall be collected in containers supplied by the analytical laboratory. Specific sample collection procedures include:

- Locate the pump intake approximately midway in the water column, within the screened interval, during purging and sample collection;
- Set the sampling flow rate at 500 ml/min or less during purging;
- Collect samples after field parameters (pH, specific conductance, temperature, and dissolved oxygen) have stabilized; and
- Wells that have a slow recovery, and are purged dry during the purging process, shall be considered adequately purged. Sample wells having a slow recovery once the water level reaches at least 70% of the original static water level, or within 24 hours of being purged dry.

Immediately after the sample is collected, record the following information on the Groundwater Sampling Form:

- Sample Time;
- QA/QC Sample Type and ID; and
- Actual Purge Volume.

Sample shipping shall include the following:

- Package samples and ship or deliver to the laboratory within 48 hours of sample collection under standard chain-of-custody protocol.
- Place samples on ice in an insulated cooler for shipment so that they will be cooled to the required temperature of 4°C ±2°C as quickly as possible.

- Package samples properly prior to transportation and shipment.
- Sign custody seals and attach to all shipping containers before the samples leave the custody of sampling personnel.

To ensure the groundwater sample is representative of formation water, it is important to minimize the possibility of cross-contamination by performing the following steps:

- Use only new or dedicated silicon and polyethylene discharge tubing.
- Thoroughly decontaminate sampling equipment prior to any sampling and between samples according to the methods outlined in the SAP.
- Collect equipment blanks as outlined in the QAPP to verify that cross-contamination has not occurred.

4.3 Sample Containers

The proper sample containers and preservatives to be used for specific analyses are outlined in the QAPP.

4.4 Chain-of-Custody

All samples shall be accompanied by a COC at the time of transfer. The procedures for filling out a COC, transporting samples, and transferring custody of samples are outlined in the QAPP.

4.5 Sample Labeling

Label all samples according to the methods outlined in the SAP.

4.6 Investigative Derived Waste

Investigative Derived Waste (IDW) including purged groundwater and decontamination fluids will be thin spread at a location at least 10 feet downgradient of the well. If in the future, analytes are detected in the groundwater at concentrations exceeding regulatory levels, a determination will be made regarding the method for IDW to be containerized and properly disposed of.

4.7 Review

The reviewer shall check Groundwater Sampling Forms, log book, and COCs for completeness and accuracy. Any discrepancies will be noted and the forms will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the forms.

5.0 FORMS (Appendix B)

- Groundwater Sampling Form
- Chain-of-Custody Form
- Equipment Calibration Form

STANDARD OPERATING PROCEDURE

WATER LEVEL MEASUREMENTS

1.0 PURPOSE

The purpose of this procedure is to describe the methods used for obtaining accurate water level measurements from groundwater wells. This procedure outlines the equipment available for water level measurement and its operation.

This procedure provides guidance for water level measurements at the Green River Resources, Inc. (GRR) Bruin Point Mine.

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Not applicable.

2.2 Abbreviations

QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure

3.0 RESPONSIBILITIES

Personnel obtaining water level measurements are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects.

The URS Project Manager or an approved designee is responsible for checking all work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing GRR Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP).

4.0 PROCEDURE

4.1 Introduction

Accurate groundwater level measurements are a fundamental requirement of any characterization study. Groundwater level measurements are used to construct water table maps, to determine gradient, to provide basic data during aquifer testing, to determine permeability and hydrologic conductivity, and to determine purge volume for well development and sampling. Collect water level measurements as described below.

- Collect all groundwater level measurements with an electronic water level indicator. Read and follow the specific manufacturer's operating instructions before using any equipment.
- Measure water levels in wells in order of increasing contaminant level, where levels of contamination can be determined.
- Measure static water levels before the wells are disturbed by any other sampling or monitoring activities. Water levels should be taken within as short a time span as possible to ensure comparable readings.
- If there is a rush of air in or out of the well when the well cap is removed, take water level readings every two minutes until the water level stabilizes with three consecutive readings within 0.1 foot.
- Record the depth to water and total depth of the well to the nearest 0.01 foot on the Water Level Form (**Appendix B**), along with any observation such as sediment on bottom or damage to the well.

A measuring point is marked on each well casing stickup, either by an impressed mark or paint mark. All measurements should be taken from this measuring point. If a measuring point is not marked, then the water levels should be taken from the north side of the casing stickup. The measuring point used to obtain the water level reading (mark or north side of casing) should be noted in the field log book.

4.2 Electrical Water Level Indicator

An electrical water level indicator consists of a metallic probe on the end of a plastic tape graduated in fractions of feet or meters. The tape contains wires that transmit the probe's signals to a reel containing an audible alarm or light.

The probe is used by lowering it into the well or surface water measuring point until the alarm activates. The alarm should be tested prior to use. The depth on the tape is then compared with the measuring point and the depth is recorded on the Water Level Form. The probe can then be lowered until it touches the bottom of the well to determine the height of the water column.

4.3 Inspection and Decontamination

It is important to check the condition of electrical lines for nicks or breaks before each use. Breaks must be repaired before attempting to use the equipment. Periodically, the scale on the instrument tape should be compared to a tape of known accuracy as stretching of the instrument tape may occur after prolonged use.

All probes and tapes must be decontaminated after each use. The tape will be decontaminated at the beginning of each day and after each use. This is best accomplished as described below:

- Wipe tape with laboratory-grade detergent solution saturated cloth, and
- Wipe with distilled water saturated cloth.

Connections between the tape and probe, are often agitated up and down at the water interfaces and again at the bottom of the well to estimate sediment accumulation on the well bottom. Particles and fluids can lodge in the connections, so special considerations must be made to clean these areas.

4.4 Review

The reviewer will review the Water Level Forms for completeness and accuracy. Any discrepancies will be noted and the forms will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the forms.

5.0 FORMS (Appendix B)

Water Level Form

STANDARD OPERATING PROCEDURE

WELL INSTALLATION AND DEVELOPMENT

1.0 PURPOSE

The purpose of this procedure is to describe the methods for groundwater monitoring well installation and development. It describes designs, procedures, and materials that will be used to construct monitoring wells that will produce accurate groundwater level measurements and representative groundwater samples.

This procedure provides guidance for monitoring well installation and development at the Green River Resources, Inc. (GRR) Bruin Point Mine.

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Annulus/Annular Space: The space between the borehole wall and well casing, or the space between a casing pipe and liner pipe.

Saturated Borehole Volume: The volume of the finished well that included the wet casing volume plus the saturated annulus assuming 30 percent porosity.

Bridging: The development of gaps or obstructions in either grout or filter pack materials during emplacement or development.

Conductor Casing: Outer casing used to stabilize or seal off a formation to prevent formation collapse or vertical cross-contamination within the well.

Filter Pack: Sand, gravel, or glass beads that are uniform, clean, and well-rounded that are placed in the annulus of the well between the borehole wall and the well intake to prevent formation material from entering through the well intake, and to stabilize the formation.

Grout: A fluid mixture of neat cement and water possibly with various additives or bentonite of a consistency that can be forced through a pipe and emplaced in the annular space between the borehole and casing to form a seal.

Hydraulic Conductivity (K): A standardized measure of the flow of a liquid through a porous medium. Hydraulic conductivity is generally expressed in terms of a unit hydraulic gradient so that different media can be compared with one another.

Hydraulic Gradient: A pressure gradient. Applied to an aquifer, it is the rate of change in pressure head per unit distance of flow at a given point and in a given direction (ft/ft).

Permeability: Capacity of a rock or soil to transmit fluid, such as water, under a hydraulic gradient.

Turbidity: Cloudiness in water due to suspended and colloidal organic and inorganic material.

Schedule Pipe: The standardization of casing diameters and wall thicknesses where casing wall thickness increases as the schedule number increases.

Screen/Well Intake: A screening device used to keep materials other than formation fluids from entering the well.

Slot Size: The width of the slots machined into a slotted casing (screen) that allows formation fluids into the well.

2.2 Abbreviations

bgs	Below Ground Surface
EPA	U.S. Environmental Protection Agency
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure

3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects.

The URS Project Manager or an approved designee is responsible for checking all work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing GRR Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP).

4.0 PROCEDURE

4.1 Introduction

Groundwater monitoring wells are proposed in the tailings storage area of the Bruin Point Mine to monitor for potential impacts to groundwater. According to available data, depth to groundwater can range from approximately 60 to 400 feet below ground surface (bgs). Installation of wells will be accomplished using a sonic, air rotary, or equivalent drilling method based on the depth and geology.

Up to eight groundwater monitoring wells will be installed using a sonic, air rotary, or equivalent drilling method by a Utah licensed well driller. Ideally, the wells will be installed in the late spring/early summer, during a period of high groundwater levels. All wells will be screened across the water table, taking into consideration its seasonal fluctuation. If artisan conditions are encountered, then the wells will be screened across the water producing unit/fractures.

Contamination of the water bearing zone by drilling equipment, or cross-contamination of wells during the drilling process must be avoided. Vertical seepage of surface water into the wells must also be minimized.

In order to maintain quality control and obtain accurate formation information, a field geologist will be on the site during well installation to log subsurface conditions and construction details for each well.

4.2 Precautions

Use the following precautions during well installation operations:

- Conduct all activities in conformance with the Site Health and Safety Plan;
- Underground and overhead utilities may exist at the site. Underground utilities shall be cleared by Blue Stakes of Utah and the property owner representative; and
- Make every attempt to minimize the transfer of potentially contaminated material to downhole equipment and well materials, or to any equipment and supplies stored on the site. The outer drill casing will act as conductor casing and will prevent the boring from collapse and prevent cuttings from flowing into the bore hole while drilling.

4.3 Drill Cuttings

Spread drill cuttings evenly across the area where each monitoring well is installed. Cuttings should not be placed such that mounds or piles are created. Following well completion, the general topography of the area should be relatively unchanged.

4.4 Decontamination

Thoroughly decontaminate all down-hole equipment that is used directly in the well installation (i.e., casing, screen, tremie pipe, rods, etc.) prior to use or installation in each well. Decontamination equipment such as steam cleaners and high pressure, hot water cleaners effectively remove potential contaminants left on casings and screens during the manufacturing process.

4.5 Well Installation

- Wells that are completed to a depth greater than 30 feet below ground surface are required to be installed and registered as per Utah Administrative Code (UAC) R655-4.

- Install wells using a sonic, air rotary, or equivalent drilling method. Wells will be screened across the first water bearing fractures, total depth of well and screen length will be determined in the field, based on observed conditions.

- Continuously log soil profiles during installation of the wells. Record soil lithologic descriptions on the Boring Log Form (**Appendix B**).

- Construct wells from 2 to 4-inch Schedule (80) 0.020 slotted PVC well screens and 2 to 4-inch Schedule 80 PVC casing, or equivalent. An end cap shall be placed at the bottom of each screen.

- Slowly retract the drilling equipment and add filter pack to the annular space in a slow and methodical process that will limit bridging of the filter media (10-20 silica sand, or pea gravel if significant artesian conditions are observed). The filter pack shall extend approximately 2-3 feet above the well screen. After the filter pack has been placed, place granular bentonite or bentonite slurry above the sand to approximately 10 feet bgs and hydrate the bentonite. Place Portland cement from 0-10 feet bgs. Record well completion information on the Boring Log Form. The wells shall be installed according to general specification below and EPA's March 1991 Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells (http://www.epa.gov/oust/cat/wwelldct.pdf). Allow the well to stabilize for at least 24-hours before development.

- Well centralizers should be installed as appropriate based on the field conditions observed, depth of wells, and recommendations of the field geologist.

4.6 General Well Specification

- 2 to 4-inch schedule 80 PVC casing
- 2 to 4-inch schedule 80 PVC well screen (0.020 slots)
- Threaded bottom cap
- Lockable pressure cap on top
- 10-20 silica or pea gravel filter pack
- Hydrated bentonite seal from 10-feet to the top of the filter pack
- Portland cement from 0-10-feet
- Stick-up well protector with protective bollards, high visibility flagging, or concrete barriers/boulders

4.7 Well Development

Development of newly installed wells shall be performed as soon as practical after installation, but no sooner than 24 hours after installation and annular seal placement is complete.

Development is necessary to repair damage done to the formation during drilling so that the natural hydraulic properties are restored; to remove clays, silts, and fine sands (fines) from the filter pack and screen; and to remove any remnant drilling fluids or drilling-introduced contaminants.

Development will be performed using the following method:

- Lower a submersible pump and surge block down the well until it contacts the bottom of the well. Use short strokes near the bottom of the well to help to produce a sediment slurry that can be removed.
- After a majority of the sediment is removed and well has been surged sufficiently to mobilize fines from filter pack, raise and lower the pump intake through the screened section of the well to continue to remove fines from the filter pack.
- Measure temperature, turbidity, pH, and specific conductivity using portable monitoring equipment during well development. Collect a minimum of 5 measurements during development (one per saturated borehole volume) and record the results on the Well Development Log.

Development shall continue until the following conditions are met:

- Sediment which rapidly settles out of solution is no longer present in water samples;
- At least 3 saturated borehole volumes have been removed; and
- Two consecutive water quality measurements (one per saturated borehole volume) meet the following criteria:

  - ➢ pH: < 10 percent difference in consecutive readings,
  - ➢ Temperature: < 10 percent difference in consecutive readings,
  - ➢ Specific conductivity: < 10 percent difference in consecutive readings, and
  - ➢ Turbidity: ≤ 10 nephelometric turbidity units (NTUs) or stable (+/- 10%).

If groundwater recharge is so slow that the required volume cannot be met within 24 hours, or water quality criteria cannot be met, the Project Manager will determine how development should continue.

Calibrate meters used for water quality measurements on each day of use according to the manufacturer's specifications. Recalibrate the meters any time meter drift is suspected. Document instrument calibration in the field logbook and/or on the Equipment Calibration Form.

Record pertinent information collected during development on the Well Development Log. Pertinent information required includes:

- Well identification,
- Date and time of development,
- Field personnel,
- Method of development,
- Meters used to measure water quality parameters,
- Measured water quality parameters,
- Estimated discharge rates,

- Amount of water evacuated from the well (in gallons),
- Beginning and ending water level, and
- Total well depth measurements.

No water, dispersing agents, acids, disinfectants, or other additives shall be introduced to the well after the annular seal is installed and during development. Development water will be thin spread at a location at least 10 feet downgradient of the well.

4.8 Review

The reviewer shall check Boring Log Forms and Well Development Logs for completeness and accuracy. Any discrepancies will be noted and the forms will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the forms.

5.0 FORMS (Appendix B)

Boring Log Form
Well Development Log
Equipment Calibration Form

APPENDIX B

FIELD FORMS

Equipment Calibration Form
Surface Water Sampling Form
Chain-of-Custody Form
Surface and Shallow Soil Sampling Log
Groundwater Sampling Form
Water Level Form
Boring Log Form
Well Development Log

Surface Water Sampling Form

Log of:	
Northing:	**Easting:**
Surface Elevation:	

General Information		
	Project Name:	**Page:** 1 of 1
	Sample Location:	**Date:**
	Field Investigator:	**C of C#:**
	Surface Water Sampling Method:	

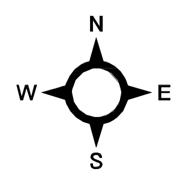
Sample Information

Comments

Surface Water Sample ID:

Surface Water					
	Sample Filtered: (Y/N) **Analyte:**__________ **Filter Manufacturer:** **Filter Size:**__________		**QA/QC Sample (Type & ID):** __________ **Sample Date and Time:** __________		**Water Quality Meter:** __________ **Water Color & Clarity:** __________
pH	**Conductivity (mS/cm)**	**Temperature (^oC)**	**ORP (mV)**	**Dissolved Oxygen (mg/L)**	**Additional Notes:**

Plan View



(Not to scale)

Recorded By	Date	Checked By	Date

URS

Surface and Shallow Soil Sampling Log

Log of:	
Coordinate System:	
Northing:	**Easting:**
Surface Elevation:	

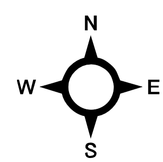
General Information

Project Number:	**Project Name:**	**Page:** 1 of 1
Location:		**Date:**
Field Investigator:		**C of C#:**
Sampling Excavation Method:	**Sampling Method**:	
Depth of Excavation:	**Depth to Water:**	**Backfill Material:**

Sample Information

Sample Number	Depth (ft)	Lithologic Description	Comments /Analysis Requested

Plan View



(Not to scale)

Recorded By	Date	Checked By	Date

URS

Equipment Calibration Form

Project: ______________________________

Project Number: ______________________________

Instrument: ______________________________

Model/Serial Number: ______________________________

Weather: ______________________________

Calibration					
Date	Time	Calibration Standard	Standard Expiration Date	Meter Reading	Comments

Calibration Checks					
Date	Time	Calibration Standard	Standard Expiration Date	Meter Reading	Comments

Calibration Personnel: ______________________________

URS

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

URS Corporation ● 756 East Winchester Street, Suite 400, Salt Lake City, UT 84107 ● 801-904-4000 ● Fax 801-904-4100

Project Name:	Project Number:
Project Manager: Report CC:	
Project Location:	
Phone #	FAX #
Sampler's Signature	Sampler's Printed Name

ANALYSIS REQUESTED

FIELD SAMPLE ID	SAMPLE		MATRIX	MS/MSD	Total Number of Containers																		REMARKS
	DATE	TIME																					

INVOICE INFORMATION BILL TO: URS CORPORATION	Matrix Key: GW = Ground Water SW = Surface Water O = Other ________________	SPECIAL INSTRUCTIONS/COMMENTS

SAMPLE RECEIPT: CONDITION/COOLER TEMP:__________________ CUSTODY SEALS: Y N

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name
Date/Time	Date/Time	Date/Time	Date/Time

White and Yellow to lab **Pink – sample management** **Cooler ______ of ______**

GROUNDWATER SAMPLING FORM

Project Name: ______________________ **Total Depth (ft BTOC):** ______________________
Sample Location: ______________________ **Static Water Level (ft BTOC):** ______________________
Sample ID: ______________________ **Water Column (ft):** ______________________ = Hwc
Sample Date: ______________________ **Purge Vol (gal):** ______________________
Sample Time: ______________________ **Sample Method:** ______________________
QA/QC Sample (Type and ID): ______________________ **Water Quality Meter:** ______________________
Sampling Personnel: ______________________ **Depth of Pump Intake (ft BTOC):** ______________________

Time	Vol (gal)	pH	Cond (mS/cm)	Temp (°C)	DO (mg/L)	ORP (mV)	Turb (NTU)	Notes and Comments

Recorded by: ______________________ Approved by: ______________________

URS

Page_____ of _____

URS

Water Level Form

Site: ______________________________ **Personnel:** ____

Location ID	Date	Time	Depth to Water (ft BTOC)	Total Depth (ft BTOC)	Comment

Recorded by: ________________________ Approved: __________________________ Page ______ of ______

WELL DEVELOPMENT LOG

Project: ____________________

Piezometer Number: ____________________

Date: ____________________

Start of Purging: ____________________

End of Purging: ____________________

Water Quality Meter: ____________________

Development Personnel: ____________________

____

____

Location: ____________________

Initial Total Depth (ft BTOC): ____________________

Initial Depth to Water (ft BTOC): ____________________

Final Total depth (ft BTOC) ____________________

Final Depth to Water (ft BTOC) ____________________

Casing Diameter (in): ____________________

Saturated Borehole Volume (gal): ____________________

Method/Equipment: ____________________

____

Time	Vol. (gal)	Clarity/ Color	pH	Temp (^{o}C)	Cond (ms/cm)	Turb (NTU)	Notes and Comments

Recorded by: ____________________ Approved by: ____________________

URS

Page_____ of _____

Project:	Log of: ________	
Project Location:	North:	East:
Project Number:	Surf Elev:	Casing Elevation:

Date(s) Drilled	Logged By	Approved By
Drilling Method	Diameter of Borehole	Approximate Ground Water Elevation
Drill Rig Type	Drilling Company	Total Depth
Driller's Name	Sampler Type	
Comments		

Depth, Feet	PID	Blow Count	Percent Recovery	USCS Class	LITHOLOGIC DESCRIPTION (USCS NAME; COLOR; SIZE AND ANGULARITY OF EACH COMPONENT OR PLASTICITY; DENSITY; MOISTURE CONTENT; ADDITIONAL FACTS)	REMARKS/ OTHER TESTS	WELL: Well Material	WELL	WELL: Pack Material	Depth, Feet
0										0
5										5
10										10
15										15

URS

Project: Project Location: Project Number:	**Log of: ________**	
	North:	East:
	Surf Elev:	Casing Elevation:

Depth, Feet	PID	Blow Count	Percent Recovery	USCS Classification	LITHOLOGIC DESCRIPTION (USCS NAME; COLOR; SIZE AND ANGULARITY OF EACH COMPONENT OR PLASTICITY; DENSITY; MOISTURE CONTENT; ADDITIONAL FACTS)	REMARKS/ OTHER TESTS	WELL: Well Material	WELL	WELL: Pack Material	Depth, feet
15										15
20										20
25										25
30										30

Sheet ____ of _____

URS

Project:
Project Location:
Project Number:

Log of: ________

North:	East:
Surf Elev:	Casing Elevation:

Depth, Feet	PID	Blow Count	Percent Recovery	USCS Classification	LITHOLOGIC DESCRIPTION (USCS NAME; COLOR; SIZE AND ANGULARITY OF EACH COMPONENT OR PLASTICITY; DENSITY; MOISTURE CONTENT; ADDITIONAL FACTS)	REMARKS/ OTHER TESTS	WELL: Well Material	WELL	WELL: Pack Material	Depth, feet
35										35
40										40
45										45
50										50

Sheet ____ of _____

URS

QUALITY ASSURANCE PROJECT PLAN

BRUIN POINT MINE
CARBON COUNTY, UTAH

Prepared for:

American Sands Energy Corp

Green River Resources Inc.
201 South Main 1800
Salt Lake City, UT 84111

April 2015

Prepared by:

URS

URS Corporation
756 E Winchester Street Suite 400
Salt Lake City, UT 84107

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

%R	percent recovery
DMI	Dry Material Impoundment
DO	dissolved oxygen
DOGM	Division of Oil Gas and Mining
DQOs	data quality objectives
DWS	Drinking water standards
FB	field blank
FD	field duplicate
GRR	Green River Resources, Inc.
GWS	Groundwater Drinking Standards
ID	identification
LCS	laboratory control spikes
MDL	Method Detection Limit
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NOI	Notice of Intention
ORP	oxidation reduction potential
ppm	parts per million
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RL	Reporting Limit
RSL	Risk-Based Screening Level
SAP	Sampling and Analysis Plan
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	semi-volatile organic compound
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared for the Green River Resources, Inc. (GRR) surface water, groundwater, and dry material sampling activities to be performed at the Bruin Point Mine, in Carbon County, UT. The purpose of this QAPP is to ensure representative data is collected and analyzed to support the project data quality objectives DQOs during surface water and groundwater sampling, flow measurements, and dry material sampling. This plan outlines policies, organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities designed to achieve DQOs of the project.

2.0 PROJECT DESCRIPTION

GRR proposes to develop an oil sands mine and an associated processing facility within a contiguous 1,760-acre lease area. Mining activities are described in more detail in the Notice of Intention to Commence Large Mining Operations (NOI) submitted to the Utah Division of Oil Gas and Mining (DOGM) on March 4, 2014 (GRR, 2014).

The mining site area is located approximately six miles northeast of Sunnyside, Utah, in Carbon County (**Figure 2-1**), directly east of Bruin Point (located at 39° 38’ 38.87”N, 110° 20’ 53.06”W). The property is positioned in the southwest portion of the Uinta Basin and the area is currently largely undeveloped. Solvent used in the operating will be recovered from both the sand and the bitumen. The dry sand tailings will not contain more than 25 parts per million (ppm) of solvent (weight/weight).

This QAPP is meant as a guide for all surface water, groundwater, and dry material sampling that will occur at the Site, as part of the Green River Resources, Inc. Groundwater Discharge Permit Application (Permit No. UGW070003). This QAPP is intended to ensure that all information, data, and resulting decisions are technically sound, statistically valid, and properly documented.

3.0 DATA QUALITY OBJECTIVES

DQOs are established to promote collection of data that are sufficient and of adequate quality for their intended uses. Data quality will be assessed during data validation in terms of its precision, accuracy, representativeness, completeness, and comparability. Data validation will be conducted following receipt of the full analytical data package after each sampling event. The objectives are defined in the following paragraphs.

3.1 Precision

Precision is the degree of reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a pair of measurements compared to their average value, expressed as relative percent difference (RPD). Matrix spike (MS)/matrix spike duplicate (MSD) and field duplicate (FD) data will be reviewed to evaluate precision. FDs will be collected at a ten percent frequency for normal samples or one per sampling event, whichever is greater. FDs will be analyzed for the same analytes as the associated normal sample. MSD samples will be collected at a five percent frequency or one per sampling event, whichever is greater.

RPD will be calculated according to the following equation, where A and B represent normal/duplicate sample results:

$$RPD\ (\%) = \frac{|A-B|}{(A+B)/2} \times 100$$

3.2 Accuracy

Accuracy is a measure of bias in a measurement system. Laboratory accuracy will be evaluated by comparing the analytical difference of measurements to reference values. Laboratory accuracy will be expressed as percent recovery (%R). The accuracy of data collected will be assessed in the following manner:

- Calculation of the %R of MS and laboratory control spikes (LCS).
- Evaluation of the concentrations of target analytes present, if any, in blanks.

Percent recovery will be calculated according to the following calculations:

$$\text{For MSs:} \quad \%R = \left(\frac{Spiked\ Sample\ Result - Sample\ Result}{Spike\ Added}\right) \times 100$$

$$\text{For LCSs:} \quad \%R = \left(\frac{Analyzed\ Result}{True\ Value}\right) \times 100$$

3.3 Sensitivity

Sensitivity is evaluated by comparing the reporting limits – also referred to as reporting limits (RLs) and method detection limits (MDLs) – to the regulatory standards being used for the project. Laboratory reporting limits will be below regulatory limits. **Table 3-1** includes a list of analytes and applicable regulatory limits. Many of the compounds analyzed for do not have Utah Groundwater Drinking Standards (GWS) or USEPA Risk-Based Screening Levels (RSLs) (EPA, 2014). For the analytes without established groundwater standards, laboratory reporting limits will be compared to site-specific background levels.

3.4 Representativeness

Representativeness indicates the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. This QAPP is intended to ensure environmental conditions at the site are represented through the samples collected.

3.5 Comparability

Comparability is a qualitative parameter that indicates the confidence with which one data set can be compared to another. Comparability will be promoted by using approved sampling plans, standardizing analytical and field procedures, and reporting data in uniform units. Data will be grouped and evaluated according to sampling media and laboratory analytical methods.

3.6 Completeness

Completeness is defined as the percentage of the total number of measurements judged to be acceptable for their intended use under normal conditions. Under normal sampling and analysis efforts, it is expected that 90 percent completeness is realistic. The completeness goal will be to obtain a sufficient amount of valid data to address the objectives stated for the investigation and to reach the necessary conclusions. The Project Quality Assurance Officer will assess completeness by calculating the percentage of valid data points compared to the total data set. A valid data point is a data point judged to be acceptable for its intended use.

4.0 SAMPLING PROCEDURES

The objectives of sampling procedures are to obtain samples that represent the environment being investigated. Trace levels of contaminants from external sources must be eliminated through the use of experienced field personnel, good sampling techniques, proper sampling equipment, and adequate documentation. Field measurements and sampling will be performed in accordance with United States Environmental Protection Agency (USEPA)-accepted procedures.

Surface water samples will be collected using a properly decontaminated long-handled sampler or the water will be collected directly into the laboratory provided glassware, when appropriate. Surface water samples will be collected in appropriate new, certified-clean, sample containers supplied by the analytical laboratory. If the sampler must stand in the water, samples will be collected upstream of the sampler's location. All Standard Operating Procedure (SOP) protocols will be followed. SOPs can be found in the GRR Sampling and Analysis Plan (SAP) (URS, 2014).

Up to eight groundwater monitoring wells are proposed to be installed based on correspondence with the Utah Department of Environmental Quality. The monitoring wells will be installed and registered in accordance with Utah Administrative Code (UAC) R655-4 and as described in the GRR SAP (URS, 2014). Wells are proposed to be installed at the edges of the dry material impoundment area and the processing area. Groundwater samples will be collected from the monitoring wells using a properly decontaminated peristaltic pump, submersible pump, or bladder pump, or the water will be collected directly into the laboratory provided glassware if artesian conditions are observed. Groundwater samples will be transferred into the appropriate, new, certified-clean, sample containers supplied by the analytical laboratory. All SOP protocols will be followed. SOPs can be found in the GRR SAP (URS, 2014).

Dry material sample locations will be determined using Microsoft Excel's Random Number Generator. Discrete sample will be collected rather than composite samples due to the potential dilution effect of the composite sampling procedure. Discrete samples will be collected using disposable equipment for each sample. At each random location, samples will be collected approximately one foot below the surface and placed into new, certified-clean, sample containers supplied by the analytical laboratory. All field notes will be recorded in a Surface and Shallow Soil Sampling Log, provided in the GRR SAP (URS, 2014).

4.1 Sample Locations

The dry material impoundment area and the five surface water sampling locations are described below and shown in **Figure 4-1.**

Location #1– North Spring

North Spring is located in the north-central region of the permit boundary. It contributes to Range Creek.

Location #2 –South Spring/Tributary Spring

South Spring/Tributary Spring is southeast of North Spring and flows to Range Creek.

Location #3 – Range Creek Flume

Range Creek Flume is directly south of South Spring/Tributary Spring and lies near the southeastern boundary of the permit area. A non-functional flume is present at this sampling location.

Location #4 – Cliff Seep

Cliff seep, located on the western edge of the permit area, contributes to an unnamed fork of Water Canyon, containing a historic mining area.

Location #5 – Stormwater Retention Pond

The Stormwater Retention Pond is located south of the Process Area.

Location #6 – Dry Material Impoundment (DMI) Area

DMI located in northwestern area of permit boundary, used to store dry material.

The eight proposed monitoring well locations are described below and shown in **Figure 4-1.**

Dry Impoundment Monitoring Wells

Up to five dry impoundment monitoring wells are proposed to be installed on the northern, eastern, and southern edges of the proposed dry material impoundment area.

Process Monitoring Wells

Up to three process monitoring wells are proposed to be installed on the eastern and western edges of the processing area.

4.2 Field Calibration

A portable water quality meter will be used in the field to measure pH, conductivity, temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP). Field instruments will be calibrated at a minimum of once per day, before field work begins. Calibration checks should be performed as determined by the field personnel, especially if the meter readings appear to be anomalous. Meter calibration will be recorded on the calibration form provided in the GRR SAP (URS, 2014). There will be no equipment calibration required when sampling dry material because field instruments will not be used.

4.3 Sample Quality Control

The general QC objective is to ensure that data are not biased by contamination or sampling error. **Table 4-1** summarizes each QC sample type and frequency analyzed.

To meet this objective, the following QC samples will be collected in the field:

- One FD will be collected in the field at a frequency of 10% (one per 10 normal samples) or one per sampling event, whichever is greater for each sample type. FDs are collected to document the precision of the sampling and analytical processes. They are samples taken from the same source, collected as close as possible to the same point in space and time as the primary sample. Field duplicates will be labeled with a separate ID and sample time than the primary sample, and will be noted in the field notebook, and relevant field forms.

- A MS/MSD will be collected at a frequency of 5% (one per 20 normal samples) or one per sampling event, whichever is greater for each sample type. The MS/MSD samples assess the accuracy and precision with respect to the site-specific sample matrix.

- Field blanks (FBs) shall be collected at 5% or once per sampling event, whichever is greater. These samples are to ensure reagent integrity and to check environmental contamination. FBs will contain distilled water, be transported to the field, transferred to sample containers, and preserved.

- An equipment blank is a sample of distilled water provided by the lab that will be passed through each piece of sample collection equipment. This sample will indicate if the equipment introduced contaminants and was not properly decontaminated. These samples will be collected once per sampling event. Equipment blanks will not be required when sampling dry material, as all sampling equipment will be new and disposable.

- Trip blanks will be transported to the site, handled like a sample, but will remain sealed until they are returned to the laboratory for the same analyses as the other samples in the batch. Trip blanks will be analyzed for volatile organic compounds (VOCs) to determine if any contamination of samples has occurred from the time samples are collected to the time they reach the laboratory. This samples is only included when samples are collected and analyzed for VOCs.

Table 4-1

Quality Assurance/Quality Control Samples

QC Sample Type	Frequency of Sample/Analysis	Details
Field Duplicate Samples	1 per 10 normal samples or 1 per sampling event (whichever is greater)	Samples collected by same method and at same time as original sample. Verifies sampling and analytical reproducibility.
Matrix Spike/Matrix Spike Duplicate	1 per 20 normal samples or 1 per sampling event (whichever is greater)	Assess accuracy and precision with respect to the site-specific sample matrix.
Field Blank	1 per 20 normal samples or 1 per sampling event (whichever is greater)	These are to ensure reagent integrity and to check environmental contamination.
Equipment Blank	1 per sampling event	Assess the adequacy of the decontamination process and helps determine error arising from carryover contamination from successive use of sampling equipment. An Equipment Blank will not be required when sampling dry material since all equipment will be new and disposable.
Trip Blanks	1 per sample cooler only when samples are analyzed for VOCs	Bottles/vials contain lab provided water and accompany samples during transit, collection, and storage. Trip blanks measure contamination from the laboratory water, sample transit, sample site, and sample storage.

Notes:
QC – Quality Control
VOC – volatile organic compounds

4.4 Field Documentation

Information pertinent to the sampling effort will be documented on preprinted field forms located in the GRR SAP (URS, 2014) or in a bound logbook. All entries will be made in indelible ink and all corrections will be made by drawing one line through the error and initialing and dating the correction.

At a minimum, field documentation entries will include the following:

- Date;
- Start time;
- Weather;
- All field personnel present and directly involved;
- All visitors to the site;
- Field activities performed;
- Samples collected;

- Reference to any field forms used;
- Any field calculations not associated with a field form;
- Any significant events;
- Initials of personnel performing documentation at bottom of each page.

Because sampling situations vary widely, no general rules can specify the extent of information that must be documented. However, documentation will contain sufficient information to reconstruct the sampling activity without relying on the sampler's memory. The field documentation will be kept under strict chain-of-custody. Relevant field forms for this excavation and sampling event can be in the GRR SAP (URS, 2014).

4.5 Decontamination Procedures

All non-dedicated sampling equipment (i.e., long-handled sampler container, water quality meter, or pump) will be decontaminated before the start of each sampling or data collection event and between sample collections at each location. Decontamination will be performed using a weak phosphate-free detergent (Liquinox) and triple distilled water rinse. The sampler will wear a new pair of disposable gloves at each sampling location, before and after decontamination, and before collection quality control samples. Where possible, dedicated or disposable equipment will be used at each sample location to avoid cross-contamination. Decontamination will not be required for dry material sampling, as all equipment will be new and disposable.

4.6 Sample Containers, Preservation, Holding Times, and Analytical Method

Applicable surface water and groundwater analytes, including the appropriate container, preservation, and hold time, to be analyzed at a Utah certified laboratory are listed in **Table 4-2. Table 4-2** includes general water quality parameters and potential proprietary solvent constituents. The proprietary solvent is a mixture of some, but not all, of the listed constituents. Dry material will be analyzed for all the analytes listed in **Table 4-3**. Preservation, hold time, and laboratory methods for dry material samples are also listed in **Table 4-3.** For the dry material samples, all potential proprietary solvent constituents will undergo a total analysis. Semi-volatile organic compounds (SVOCs), VOCs, and metals will also be analyzed using the Synthetic Precipitation Leaching Procedure (SPLP) procedure. All other analytes unable to be analyzed via SPLP will undergo a total analysis. All appropriate sample containers, preservation, holding times, and sample methods should be confirmed with a Utah certified lab before commencing sampling.

5.0 SAMPLE CUSTODY

The handling of all samples collected will be traceable from the time of collection, through analyses, until final disposition. Documentation of the sample history is referred to as chain-of-custody. The components of field chain-of-custody (chain-of-custody record and custody seals) and procedures for their use are described in the following paragraphs. A sample chain-of-custody is provided in the GRR SAP (URS, 2014)

A sample is considered to be under a person's custody if it is:

- In a person's physical possession;
- In view of the person after he/she has taken possession;
- Secured by that person so that no one can tamper with the sample; and
- In a secure area accessible only to authorized personnel.

At the time of sample collection, labels will be affixed to the sample containers. These labels will contain the following information:

- Sample Identification (ID);
- Date and time of sampling;
- Preservative;
- Requested analysis; and
- Name or initials of sampler.

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody record will be completed and accompany every sample shipment. At a minimum, chain-of-custody records should contain the following information:

- Project name;
- Sample ID;
- Date and time of sample collection;
- Type of matrix;
- Number of containers;
- Preservative;
- Analyses requested;
- Signature of sampler; and
- Date and time of each change in custody.

Each person who has custody of the samples must sign the record. The completed chain-of-custody record will be put in a waterproof plastic bag and placed inside the sample cooler. The sampler will keep a copy of each chain-of-custody record. Custody seals will be affixed to the front and back of the cooler and covered with clean tape.

The laboratory Sample Custodian will assess the integrity of the custody seals upon sample arrival. The Sample Custodian will also verify and document the following information upon sample receipt:

- Condition of shipping container;
- Condition of sample container(s);
- Condition of custody seals;
- Presence/absence of custody seals;
- Presence/absence of custody records;

- Presence/absence of sample labels;
- Agreement/non-agreement of documents;
- Cross-reference of laboratory numbers; and
- Temperature inside shipping container.

The Sample Custodian will document any problems or discrepancies with the samples or custody documents, contact the URS project manager, and document the resolution to the problems or discrepancies.

6.0 LABORATORY ANALYTICAL PROTOCOLS

All analyses will be conducted by a Utah certified laboratory, and USEPA-approved methods will be used for all analyses. Laboratory qualifications, analytical methods, target detection limits, calibration procedures and frequency, and criteria for laboratory QC samples will be outlined in the laboratory's QA/QC manual, available upon request.

Any omission in this plan of relevant requirements, tasks, and other items found in the referenced methods does not constitute a waiver of the omitted requirement, task, or item. The laboratory manager and analysts are expected to be cognizant of all relevant aspects of the referenced methods to the extent necessary to provide accurate, precise, and defensible data.

7.0 DATA ANALYSIS

7.1 Data Validation

All analytical data generated as part of the remediation project will be reviewed and validated by a consultant independent of the analytical laboratory, and an environmental professional will determine if the data is usable for its intended purpose for the project. Data quality will be assessed in terms of DQOs listed in **Section 3.0** and will be qualified based on USEPA National Functional Guidelines (EPA, 2013a, 2013b). The following data qualifiers may be assigned as a result of data validation:

U The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

J The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

7.2 Pre-Operation Data Analyses

The background groundwater data, collected at least eight times over a one-year period from the eight monitoring wells, will be used to establish site-specific background levels. The 95% upper prediction limit (UPL) will be calculated for each analyte using the USEPA software package, ProUCL 5.0. The

95% UPL will be used as the site's background concentration. Only primary sample results (not field duplicate results) will be used in statistical analysis. For non-detect results, the MDL will be used in the data evaluation.

7.3 Post-Operation Data Analyses

Once site operation begins, routine monitoring data will be compared to the established background concentration (the 95% UPL). If the post-operation analytical data exceeds the 95% UPL once within the last year, then a trend analysis will be performed to determine whether a statistically significant trend exists at the 95% confidence level. USEPA software, ProUCL 5.0, will be used for analyses. To determine if a statistically significant trend exists, a Mann-Kendall Trend analysis will be performed on the data. A minimum of four sampling events must occur before statistical analysis may be performed. For compounds demonstrating a statistically significant increasing trend, the Theil-Sen Slope will be calculated in ProUCL 5.0 to provide the rate of change in concentration. Only primary sample results (not field duplicate results) will be used in data comparison and statistical analysis. For non-detect results, the MDL will be used in the data evaluation. The dry sand tailings will be limited to 25 ppm of solvent (weight/weight).

8.0 REFERENCES

EPA, 2013a. National Functional Guidelines for Inorganic Superfund Data Review. OSWER 9200.2-133, EPA-540-R-013-011. October 2013.

EPA, 2013b. National Functional Guidelines for Superfund Organic Methods Data Review. OSWER 9200.2-134, EPA-540-R-014-002. October 2013.

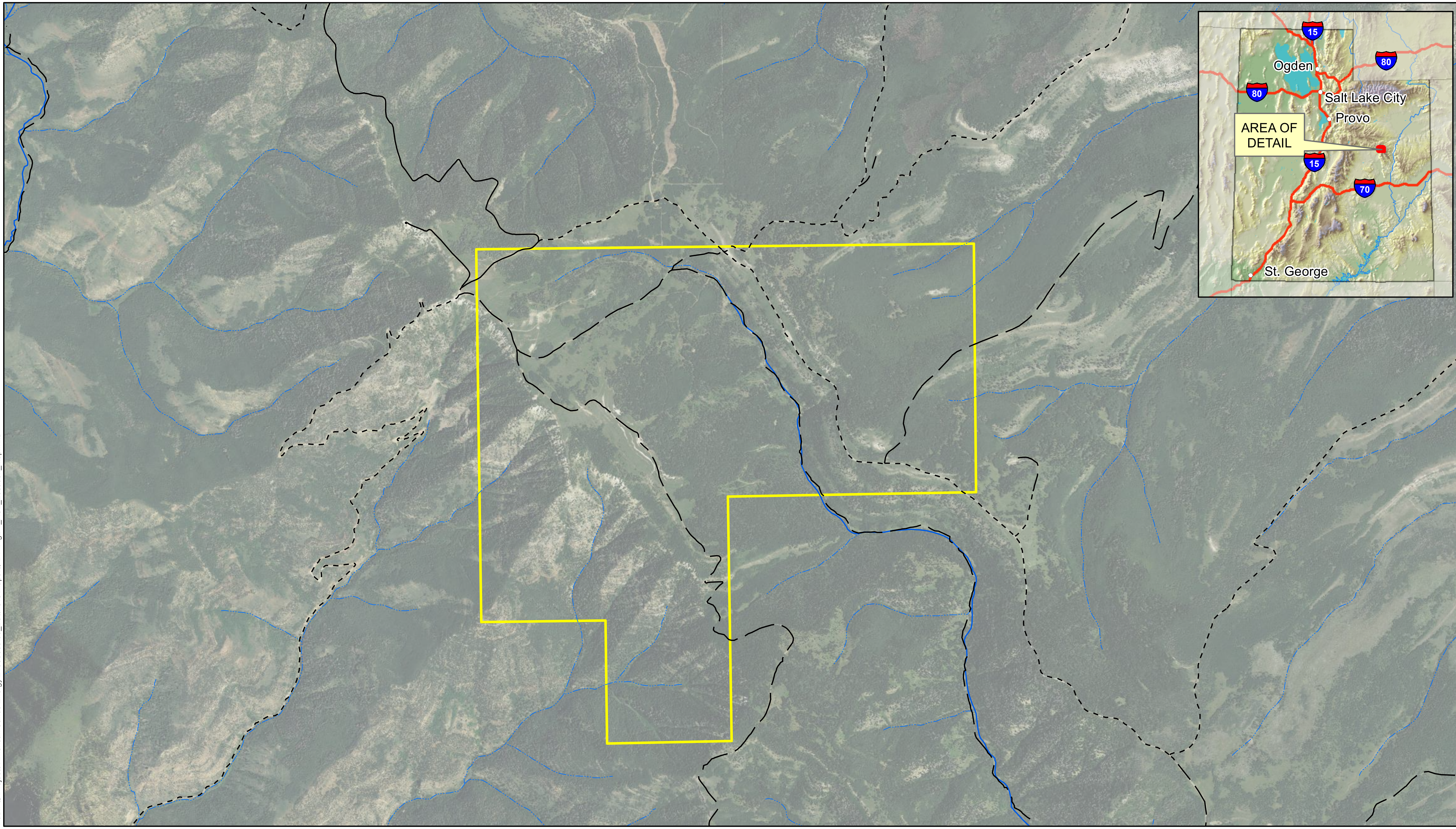
EPA, 2014. Regional Screening Levels (Formally PRGs). November 2014.

Green River Resources (GRR), 2014. Notice of Intention to Commence Large Mining Operations, Green River Resources, Inc., Bruin Point Mine. March, 2014.

URS Corporation (URS), 2014. Sampling and Analysis Plan, Green River Resources Inc. Bruin Point Mine, Carbon County, UT. August 2014

FIGURES

Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\QAPP\Fig2-1_ASE_Location_Map.mxd

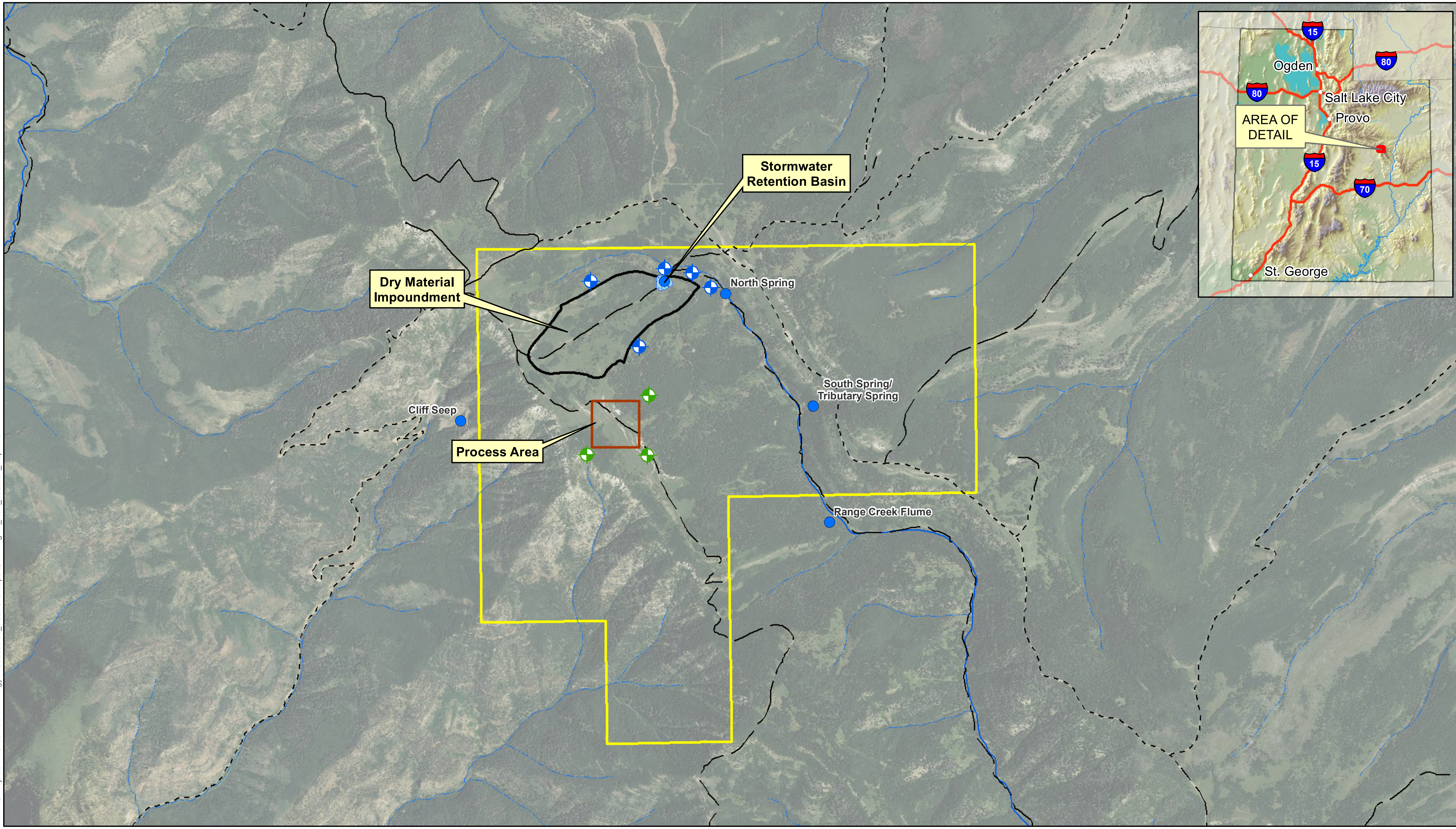


Perennial Stream
Intermittent Stream
Improved Road
Dirt Road
Road (Conditions Unknown)
Lease Boundary

N

1,000 0 1,000 2,000
Feet

Title: Site Location Map	
Bruin Point Mine Quality Assurance Project Plan	Proj No: 24585638
	Figure: 2-1
American Sands Energy Corp	Date: April 2015
	URS



Path: Q:\Projects\American Sands Energy\24585638\09_Data\GIS\Maps\QAPP\Fig4-1_ASE_Location_Map.mxd

- Perennial Stream
- Intermittent Stream
- Improved Road
- Dirt Road
- Road (Conditions Unknown)
- Lease Boundary
- Dry Material Impoundment
- Surface Water Sampling Location
- Process Area Monitoring Well
- Dry Material Impoundment Monitoring Well

N

1,000 0 1,000 2,000
Feet

Title:	Sampling Locations
Bruin Point Mine Quality Assurance Project Plan	Proj No: 24585638 Figure: 4-1 Date: April 2015
American Sands Energy Corp	URS

TABLES

Table 3-1
Drinking Water Standards and Tap Water
Risk-Based Screening Levels

Analyte	GWQS (mg/L)	Utah Drinking Water Standard MCLs (mg/L)	Tapwater RSLs (ug/L)
General Water Chemistry			
Alkalinity as $CaCO_3$	NE	NE	NE
Ammonia as N	NE	NE	NE
Bicarbonate as $CaCO_3$	NE	NE	NE
Carbonate as $CaCO_3$	NE	NE	NE
Chloride	NE	NE	NE
Sulfate	NE	1000	NE
Hardness as $CaCO_3$	NE	NE	NE
Nitrate as N	10	10	3.20E+04
Nitrate/Nitrite as N	10	10	NE
Nitrite as N	1	1	2.00E+03
Specific Conductance	NE	NE	NE
Total Dissolved Solids	NE	2000	NE
Total Suspended Solids	NE	NE	NE
Total Organic Carbon	NE	NE	NE
Benzene	0.005	0.005	4.50E-01
Toluene	1	1	1.10E+03
Xylenes, Total	10	10	1.90E+02
Naphthalene	NE	NE	1.70E-01
TPH-GRO	NE	NE	NE
TPH-DRO	NE	NE	NE
HEM, SGM-HEM	NE	NE	5.50E+00
Barium	2	2	3.80E+03
Cadmium	0.005	0.005	9.20E+00
Copper	1.3	NE	8.00E+02
Manganese	NE	NE	4.30E+02
Iron	NE	NE	1.40E+04
Nickel	NE	NE	NE
1,2,3-Trimethylbenzene	NE	NE	1.00E+01
1,2,4-Trimethylbenzene	NE	NE	1.50E+01
1,3,5-Trimethylbenzene	NE	NE	1.20E+02
2-Butanone	NE	NE	5.60E+03
Methylene chloride	NE	NE	1.10E+01
Potential Proprietary Solvent Constituents[(1)]			
Benzoic Acid	NE	NE	7.50E+04
Ethanol	NE	NE	NE
Propanol	NE	NE	NE
1,3-Dichloropropane	0.005	0.005	3.70E+02
Butane	NA	NE	NE
Ethylbenzene	0.7	0.7	1.50E+00
Hexanes	NE	NE	3.20E+02
Isopropyl alcohol	NE	NE	4.00E+04
Methyl t-butyl ether	NE	NE	1.40E+01
Pentane	NE	NE	2.10E+03
Isopentane	NE	NE	NE
n-Propylbromide	NE	NE	NE

Notes:
[(1)] – Proprietary solvent is a mixture of some, but not all, of these constituents
NE - Not Established
GWQS - Groundwater Quality Standard
RSL - Risk-Based Screening Level
mg/l - milligrams per liter
ug/L - micrograms per liter
as N - as Nitrogen
MCL - Maximum Contaminant Level
SGT - Silica Gel Treated
HEM - Hexane Extractable Material
TPH – Total Petroleum Hydrocarbons
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
Tapwater RSLs - November 2014

Table 4-2
Surface Water and Groundwater Analytes

Analyte	Container[1]	Preservation[1]	Hold Time	Laboratory Method[2]	Method Detection Limit (MDL)	Reporting Limit (RL)	Units	Comments
General Water Chemistry								
Alkalinity as $CaCO_3$	500 ml polyethylene	≤6°C	14 days	SM 2320B	1.07	5	mg/L	TAL Denver
Ammonia as N		H_2SO_4, ≤6°C	28 days	EPA 350.1	0.022	0.1	mg/L	TAL Denver
Bicarbonate as $CaCO_3$		≤6°C	14 days	SM 2320B	1.07	5	mg/L	TAL Denver
Carbonate as $CaCO_3$					1.07	5	mg/L	TAL Denver
Chloride		≤6°C	28 days	EPA 300.0	0.254	3	mg/L	TAL Denver
Sulfate					0.232	5	mg/L	TAL Denver
Hardness as $CaCO_3$		≤6°C	14 days	SM 2340C	1.3	5	mg/L	TAL Denver
Nitrate as N		≤6°C	48 hours	EPA 300.0	0.042	0.5	mg/L	TAL Denver
Nitrate/Nitrite as N		H_2SO_4, ≤6°C	14 days	EPA 353.2	0.019	0.1	mg/L	TAL Denver
Nitrite as N		≤6°C	48 hours	EPA 300.0	0.049	0.5	mg/L	TAL Denver
Specific Conductance		≤6°C	28 days	SM 2510B		2	S/m	TAL Denver
Total Dissolved Solids		≤6°C	7 days	SM 2540C	4.7	10	mg/L	TAL Denver
Total Suspended Solids		≤6°C	7 days	SM 2540D	1.1	4	mg/L	TAL Denver
Total Organic Carbon	3-40 ml glass vials with septa	<6°C, H2S04	28 days	SM5310B	0.155	1	mg/L	TAL Denver
Benzene	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.16	1	ug/L	TAL Denver
Toluene					0.17	1	ug/L	TAL Denver
Xylenes, Total					0.19	2	ug/L	TAL Denver
Naphthalene					0.22	1	ug/L	TAL Denver
TPH-GRO	3-40 ml glass vials with septa	HCL, ≤6°C	14 days	SW846 8015C	10	25	ug/L	TAL Denver
TPH-DRO	2 – 1L Amber Glass	<6°C	7 days to extraction, 40 days after extraction	SW846 8015C	0.0326	0.25	mg/l	TAL Denver
HEM, SGT-HEM	2 – 1L Amber Glass	HCL, ≤6°C	28 days	1664	2.76	5	mg/L	If 1664 method, TAL Denver
Barium	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6020A	0.00029	0.001	mg/L	TAL Denver
Cadmium	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6020A	0.000265	0.001	mg/L	TAL Denver
Copper	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6020A	0.00056	0.002	mg/L	TAL Denver
Manganese	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6020A	0.00031	0.001	mg/L	TAL Denver
Iron	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6010C	0.022	0.1	mg/L	TAL Denver
Nickel	1-250 mL HDPE	HNO_3, pH < 2; Cool < 6°C	180 days	6020A	0.0003	0.002	mg/L	TAL Denver
1,2,3-Trimethylbenzene	3-40 ml glass vials with septa	<6°C; adjust pH <2; 0.008% Na2S2O3	14 Days – Preserved	8260B	0.00027	0.002	mg/L	TAL Denver
1,2,4-Trimethylbenzene	3-40 ml glass vials with septa	<6°C; adjust pH <2; 0.008% Na2S2O3	14 Days – Preserved	8260B	0.00015	0.001	mg/L	TAL Denver
1,3,5-Trimethylbenzene	3-40 ml glass vials with septa	<6°C; adjust pH <2; 0.008% Na2S2O3	14 Days – Preserved	8260B	0.00016	0.001	mg/L	TAL Denver
2-Butanone	3-40 ml glass vials with septa	<6°C; adjust pH <2; 0.008% Na2S2O3	14 Days – Preserved	8260B	0.002	0.006	mg/L	TAL Denver
Methylene chloride	3-40 ml glass vials with septa	<6°C; adjust pH <2; 0.008% Na2S2O3	14 Days – Preserved	8260B	0.00032	0.002	mg/L	TAL Denver
Potential Proprietary Solvent Constituents[3]								
Benzoic Acid	1 – 1L Amber	<6°C	7 days to extraction, 40 days after extraction	SW846 8270D	10	25	mg/L	TAL Denver
Butane				SW846 8260B/RSK 175	0.0025	0.005	mg/L	by RSK 175, TAL Nashville
1,3-Dichloropropane	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.22	1	ug/L	TAL Denver
Ethanol	1-1L glass bottle	4°C	14 days	SW846 8015	2	10	mg/L	TAL Nashville
Ethylbenzene	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.16	1	ug/L	TAL Denver
Hexanes	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.024	0.026	mg/L	by RSK 175, TAL Nashville
Isopentane	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Isopropyl alcohol	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	2	10	mg/L	TAL Denver or by 8015 at TAL Nashville
Methyl t-butyl ether	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.25	5	ug/L	TAL Denver
n-Propylbromide	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Pentane	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8260B/RSK 175	0.016	0.026	mg/L	TAL Denver
Propanol	2-40 ml glass vials with septa	HCL, 4°C	14 days	SW846 8015B	2.3	10	mg/L	TAL Nashville

Notes:
(1) – Provided by Utah certified laboratory
(2) – Or equivalent method
(3) – Proprietary solvent is a mixture of some, but not all, of these constituents

°C – degrees Celsius
mg - milligrams
ml – milliliters
ug - micrograms

S/m - siemens per meter
HCL – Hydrochloric Acid
SM – Standard Method
EPA – Environmental Protection Agency

TPH – Total Petroleum Hydrocarbons
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
TBD - To be determined

SGT - Silica Gel Treated
HEM - Hexane Extractable Material
HDPE - High-Density Polyethylene

Table 4-3
Dry Material Analytes

Analytes	Container[(1)]	Preservation[(1)]	Hold Time	Laboratory Method[(2)]	MDL (ug/L)	RL (ug/L)	Units
Analyzed using SPLP Procedure[3]							
Metals							
Antimony	8 oz glass jar	≤6°C	6 Months	SW 846 1312/6020	0.400	2.00	ug/L
Arsenic					0.330	5.00	ug/L
Barium					0.290	1.00	ug/L
Beryllium					0.0800	1.00	ug/L
Cadmium					0.265	1.00	ug/L
Chromium					0.500	2.00	ug/L
Copper					0.560	2.00	ug/L
Lead					0.180	1.00	ug/L
Mercury			28 days	SW 846 1312/7470	0.03	2	ug/L
Major cations			6 months	SW 846 1312 /6010	--		
Aluminum					18.0	100	ug/L
Calcium					34.5	2000	ug/L
Iron					22.0	1000	ug/L
Magnesium					10.7	200	ug/L
Manganese					0.253	10.0	ug/L
Potassium					237	3000	ug/L
Sodium					91.6	10000	ug/L
Selenium			6 Months	SW 846 1312/6020	0.700	5	ug/L
Silver					0.0330	5.00	ug/L
Thallium					0.0500	1.00	ug/L
Zinc					2.00	10.0	ug/L
SVOC Organics							
Pentachlorophenol	4 oz glass jar	≤6°C	14 SPLP Extraction/7 days Water extraction/40 days to analyze	SW 846 1312/8270	20	50	ug/L
Di(2-ethylhexyl)adipate					10	10	ug/L
Benzo(a)pyrene					0.31	4	ug/L
Hexachlorocyclopentadiene					1.53	50	ug/L
Di(2-ethylhexyl)phthalate					0.56	10	ug/L
VOCs							
1,1-Dichloroethylene	4 oz glass jar	≤6°C	14 SPLP Extraction/7 days analysis	SW 846 1312/8260B	0.23	1	ug/L
1,2 Dichloropropane					0.18	1.00	ug/L
1,2,4-Trichlorobenzene					0.21	1.00	ug/L
1,2-Dichlorobenzene					0.16	1.00	ug/L
1,4-Dichlorobenzene					0.16	1.00	ug/L
Benzene					0.16	1.00	ug/L
Carbon tetrachloride					0.19	1.00	ug/L
cis-1,2 dichloroethylene					0.15	1.00	ug/L
Dichloromethane					0.32	2.00	ug/L
Ethylene Dibromide					0.18	1.00	ug/L
Heptane					0.20	5.00	ug/L
Hexachlorobenzene					0.66	10.00	ug/L
Monochlorobenzene					0.17	1.00	ug/L
Naphthalene					0.22	1.00	ug/L
Styrene					0.17	1.00	ug/L
Tetrachloroethylene					0.20	1.00	ug/L
Toluene					0.17	1.00	ug/L
trans-1,2 dichloroethylene					0.15	1.00	ug/L
Trichloroethylene					0.16	1.00	ug/L
Vinyl Chloride					0.10	1.00	ug/L
Xylenes, Total					0.19	2.00	ug/L
1,2,3-Trimethylbenzene					0.27	2.00	ug/L
1,2,4-Trimethylbenzene					0.15	1.00	ug/L
1,3,5-Trimethylbenzene					0.16	1.00	ug/L
2-Butanone					2.00	6.00	ug/L
Methylene chloride					0.32	2.00	ug/L
Potential Proprietary Solvent Constituents[(3, 4)]							
Benzoic Acid	4 oz glass jar	≤6°C	7 days to extraction, 40 days after extraction	SW 846 1312/8270D	10	25.00	ug/L
1,3-Dichloropropane	4 oz glass jar	≤6°C	14 SPLP Extraction/7 days analysis	SW 846 1312/8260	0.22	1.00	ug/L
Ethylbenzene	4 oz glass jar	≤6°C			0.16	1.00	ug/L
Methyl t-butyl ether	4 oz glass jar	≤6°C			0.25	5.00	ug/L
n-Propylbromide	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Table 4-3
Dry Material Analytes

Analytes	Container[1]	Preservation[1]	Hold Time	Laboratory Method[2]	MDL (ug/L)	RL (ug/L)	Units
Analyzed using Total Analysis Procedure[3]							
Non-Halogenated Organics							
TPH-DRO	4 oz glass jar	≤6°C	14 days Extraction/ 40 days after extraction	8015C	0.678	4	mg/kg
TPH-GRO	4 oz glass jar	≤6°C	14 days	8015C	0.325	1.2	mg/kg
HEM, SGT-HEM	4 oz glass jar	≤6°C	14 days	9071B	84.8	500	mg/kg
Others							
Ammonia as N	4 oz glass jar	≤6°C	28 days	350.1	0.022	0.10	mg/L
Chloride	4 oz glass jar	≤6°C	28 days	9056A	2.0	30.0	mg/kg
Sulfate	4 oz glass jar	≤6°C	28 days	9056A	1.7	50.0	mg/kg
Nitrate as N	4 oz glass jar	≤6°C	48 hours	9056A	0.314	5.00	mg/kg
Nitrite as N	4 oz glass jar	≤6°C	48 hours	9056A	0.336	5.00	mg/kg
Total Organic Carbon	4 oz glass jar	≤6°C	28 days	9060A	1.7	4.00	g/Kg
Total Nitrate/Nitrite as N	4 oz glass jar	H_2SO_4, ≤6°C	14 days	9056A	0.314	5.00	ug/kg
Potential Proprietary Solvent Constituents[3, 4]							
Ethanol	4 oz glass jar	≤6°C	7 days	8015B	2	10	mg/kg
Hexanes	4 oz glass jar	≤6°C	7 days	8260B	31	250	ug/kg
Isopentane	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Isopropyl alcohol	4 oz glass jar	≤6°C	7 days	8015B	2	10.00	mg/kg
Propanol	4 oz glass jar	≤6°C	7 days	8015B	2	10	mg/kg
Pentane	650 ml glass jar with septum	≤6°C	7 days	Modified ASTM 1945	1	1.00	mg/L
Butane	650 ml glass jar with septum	≤6°C	7 days	Modified ASTM 1945	1	1.00	mg/L
1,3-Dichloropropane	4 oz glass jar	≤6°C	7 days	8260B	0.51	5.00	ug/kg
Benzoic Acid	4 oz glass jar	≤6°C	7 days	8270D	330	1600	ug/kg
Ethylbenzene	4 oz glass jar	≤6°C	7 days	8260B	0.67	5.00	ug/kg
Methyl t-butyl ether	4 oz glass jar	≤6°C	7 days	8260B	20	0.34	ug/kg
n-Propylbromide	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Notes:

(1) – Provided by Utah certified laboratory

(2) – Or equivalent method

(3) – Only SVOCs, VOCs, and metals can be analyzed using the SPLP procedure. All other analytes shall undergo a total analysis.

(4) – Proprietary solvent is a mixture of some, but not all, of these constituents

oz. - ounce
ASTM - American Society for Testing and Materials
RL - Reporting Limit
MDL - Method Detection Limit
SW – Solid Waste
SOP – Standard Operating Procedure
SPLP– Synthetic Precipitation Leaching Procedure
SGT - Silica Gel Treated
HEM - Hexane Extractable Material
HCL- Hydrochloric Acid
ml - milliliter
kg- kilogram
ug- microgram
L - Liter
mg - milligram

APPENDIX I

WATER QUALITY ANALYTICAL RESULTS

Analytical Results
Green River Resources, Inc.
American Sands Energy Corporation

January 2012 Analytical Results

In January 2012, Green River Resources, Inc. (GRR) batch collected three samples of processed ore. The samples were processed using American Sands Energy Corp. (ASEC's) proprietary solvent in a manner designed to emulate, as accurately as possible, the process that the company plans to use on a production scale at the mine site. The processed samples replicate, to the extent possible, the sand tailings that will be generated by the production facility when the site is in operation.

For each of the samples, three sample containers were filled and sent to American West Analytical Laboratories (AWAL) in Salt Lake City, Utah for analysis. The three processed ore samples are identified as: 1A+BC, 2A+BC, and 3A+BC, where "A," "B," and "C" represent the three sample containers.

Each sample was analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) using U.S. Environmental Protection Agency (EPA) Method 1312, the Synthetic Precipitation Leaching Procedure (SPLP), which simulates rainfall and snowmelt that might infiltrate a stockpile of the sample material and the resulting leachate that might seep out of the stockpile. The purpose of this SPLP procedure is to estimate the maximum level of contaminants with the potential to leach from the stockpile into soil, and potentially groundwater, underneath. The SPLP extract was also analyzed for general water quality parameters, including nitrate/nitrate as nitrogen (N), chloride, total dissolved solids (TDS), and total organic carbon (TOC), as well as oil and grease (O&G) and total recoverable petroleum hydrocarbons (TRPH). O&G and TRPH are of interest since they are the nearest proxies for bitumen (the compound for which the ore is processed).

The results of the SPLP analyses are shown in **Table 1**. The general water quality parameters, O&G, and TRPH analyses are also included in **Table 1**. Samples with compound concentrations in excess of Utah Groundwater Quality Standards (GWQS) are bolded. The GWQS, as codified in Utah Administrative Code (UAC) R317-6-2.1 (UDEQ, 2014), are listed in **Table 2. Table 3** demonstrates the Utah Initial Screening Levels for groundwater, which constitute the action levels for excavating leaking underground storage tanks (UDEQ, 2005). Though the initial screening levels are not applicable to tailings or stockpiles, they are included to provide a standard for comparison, particularly for TPH-DRO and TPH-GRO.

Laboratory analytical results indicate the pH of the leaching solution under the SPLP analysis ranges from 9.35-9.42. These values are above the Utah GWQS pH limits of 6.5-8.5. The benzene concentration in Sample 3A+BC, 0.00516 milligrams per liter (mg/L), was the only other compound above Utah GWQS. The majority of compounds were non-detect. The full laboratory analytical reports from AWAL are attached.

The full laboratory analytical reports from AWAL are included with this report.

September 2012 Analytical Results

In September 2012, GRR batch collected three samples of processed ore and one sample of raw tar sands from the Sunnyside, Utah ore body. The samples were processed similarly to the January 2012 samples. The processed samples replicate, to the extent possible, the sand tailings that will be generated by the production facility when the site is in operation.

For each of the samples, two sample containers were filled and sent to AWAL in Salt Lake City, Utah for analysis. The three processed ore samples are identified as: U-001A/B, U-002A/B, and U-003A/B and the raw tar sands sample as: U-004A/B, where "A" and "B" designate the two sample containers.

Each sample was analyzed for VOC and SVOC using U.S. EPA Method 1312 (SPLP). The SPLP extract was also analyzed for general water quality parameters, including chloride, total dissolved solids (TDS), and total organic carbon (TOC). In addition, the raw tar sands sample (U-004B) was analyzed for O&G and TRPH.

The results of the SPLP analyses are shown in **Table 4**. The general water quality parameters, O&G, and TRPH analyses are also shown in **Table 4**. Samples with compound concentrations in excess of Utah Groundwater Quality Standards (GWQS) are bolded.

Laboratory analytical results indicate the pH of the leaching solution from the SPLP analysis ranges from 3.6-6.27. These values are below the Utah GWQS pH limits of 6.5-8.5. A leaching solution of pH 4.2 is used under SPLP analysis to simulate the pH of acid rain. The SPLP procedure instructs that for mine waste, an acidic extraction fluid (of pH 4.2) should be used. There were no other analytes in violation of the Utah GWQS.

Sample U-004B, the raw tar sands sample, contained 34,900 mg/kg O&G and 13,400 mg/kg TRPH. However, in the SPLP analyses, O&G and TRPH were below the detection limit (3 mg/L). The results indicate the low mobility of these components in the environment.

The full laboratory analytical reports from AWAL are included with this report.

The laboratory analytical results from January 2012 and September 2012 help demonstrate that the stockpiles of raw tar sand and processed ore produced by the ASEC process pose a *de minimis* risk to the general environment, specifically groundwater, from seepage of precipitation through the stockpile.

References

Utah Department of Environmental Quality (UDEQ), 2005. Initial Screening Levels. Utah Administrative Code R311-205. November 2005. <http://www.deq.utah.gov/ProgramsServices/programs/tanks/lust/docs/2006/08Aug/cleanupLevels.pdf>

Utah Department of Environmental Quality (UDEQ), 2014. Utah Ground Water Protection Program. Ground Water Quality Standards – Table 1 of R317-6-2.1. June 2014.

Tables:
Table 1 – January 2012 Analytical Data
Table 2 – Utah Groundwater Quality Standards
Table 3 – Utah Initial Screening Levels
Table 4 – September 2012 Analytical Data

TABLES

Table 1
January 2012 Analytical Data

Analytical Result SPLP Metals Method 1312				
Compound	**Units**	**Sample ID**		
		1A,B+C	**2A,B+C**	**3A,B+C**
Antimony	mg/L	< 0.00100	< 0.00100	< 0.00100
Arsenic	mg/L	0.00106	0.00146	0.00135
Barium	mg/L	0.012	0.0124	0.0142
Beryllium	mg/L	< 0.000600	< 0.000600	< 0.000600
Boron	mg/L	< 0.500	< 0.500	< 0.500
Cadmium	mg/L	< 0.000180	< 0.000180	< 0.000180
Calcium	mg/L	1.27	1.31	1.86
Chromium	mg/L	< 0.0100	< 0.0100	< 0.0100
Copper	mg/L	0.00161	0.0013	0.00134
Iron	mg/L	0.782	1.2	1.1
Lead	mg/L	0.00071	0.000846	0.000676
Lithium	mg/L	< 0.100 ~	< 0.100 ~	< 0.100 ~
Magnesium	mg/L	< 1.00	< 1.00	< 1.00
Manganese	mg/L	0.216	0.243	0.366
Mercury	mg/L	< 0.0100 *	< 0.0100 *	< 0.0100 *
Molybdenum	mg/L	< 0.0200	< 0.0200	< 0.0200
Nickel	mg/L	0.00336	0.00364	0.00449
Pottassium	mg/L	< 1.00	< 1.00	< 1.00
Selenium	mg/L	< 0.000800	0.00105	< 0.000800
Silver	mg/L	< 0.000400	< 0.000400	< 0.000400
Sodium	mg/L	1.07	< 1.00	< 1.00
Strontium	mg/L	< 0.0500	< 0.0500	< 0.0500
Thallium	mg/L	< 0.000400	0.000692	< 0.000400
Tin	mg/L	< 0.500	< 0.500	< 0.500
Vanadium	mg/L	< 0.0500	< 0.0500	< 0.0500
Zinc	mg/L	0.0245	0.021	0.0156
Alkalinity (as $CaCO_3$)	mg/L	14.6	13.7	10.9
Chloride	mg/L	< 0.100	< 0.100	< 0.100
Fluoride	mg/L	< 0.100	< 0.100	< 0.100
Nitrate/Nitrite (as N)	mg/L	0.0419	0.0407	0.0422
Oil & Grease	mg/L	3.07	4.39	3.69
pH	s.u.	**9.42**	**9.42**	**9.35**
Sulfate	mg/L	2.63	2.68	3.13
Total Dissolved Solids	mg/L	< 20.0	< 20.0	< 20.0
Total Organic Carbon	mg/L	3.96	4.58	4.51

Notes:

Bold indicates an exceedance of DWQ water quality standards.

< - Value is less than reporting limit.

* - The reporting limits were raised due to sample matrix interferences.

~ - Result was not performed in accordance with National Environmental Laboratory Accreditation Program (NELAP) requirements.

µmhos/cm - micromhos per centimeter

mg/L - milligram per liter

N - Nitrogen

SPLP - Synthetic Precipitation Leaching Procedure

s.u. - standard unit

$CaCO_3$ - Calcium Carbonate

Table 1
January 2012 Analytical Data

Analytical Result GC/MS Method 8270D/3510C*				
Compound	**Units**	**Sample ID**		
		1A,B+C	**2A,B+C**	**3A,B+C**
1,1 '-Biphenyl	mg/L	< 0.0100	< 0.0100	< 0.0100
1,2,4,5-Tetrachl oro benzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,2,4-Trichlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,2-Dichlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,3,5-Trinitrobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,4-Naphthoquinone	mg/L	< 0.0100	< 0.0100	< 0.0100
1,3-Dichlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,3-Dinitrobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,4-Dichlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
1,4-Phenylenediamine	mg/L	< 0.0100	< 0.0100	< 0.0100
1-Chloronaphthalene	mg/L	< 0.0100	< 0.0100	< 0.0100
1-Methylnaphthalene	mg/L	< 0.0100	< 0.0100	< 0.0100
1-Naphthylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
2,3,4,6-Tetrachlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4,5-Trichlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4,6-Trichlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4-Dichlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4-Dimethylphenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4-Dinitropbenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,4-Dinitrotoluene	mg/L	< 0.0100	< 0.0100	< 0.0100
2,6-Dichlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2,6-Dinitrotoluene	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Acetylaminofluorene	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Cbloronaphthalene	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Chlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Methylnaphthalene	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Methylphenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Naphthylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Nitroaniline	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Nitrophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
2-Picoline	mg/L	< 0.0100	< 0.0100	< 0.0100
3&4-Methylphenol	mg/L	< 0.0100	< 0.0100	< 0.0100
3,3 '-Dichlorobenzidine	mg/L	< 0.0100	< 0.0100	< 0.0100
3,3'-Dimethylbenzidine	mg/L	< 0.0100	< 0.0100	< 0.0100
3-Methylcholanthrene	mg/L	< 0.0100	< 0.0100	< 0.0100
3-Nitroaniline	mg/L	< 0.0100	< 0.0100	< 0.0100
4,6-Dinitro-2-methylphenol	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Arninobiphenyl	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Bromophenyl phenyl ether	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Chloro-3-methylphenol	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Chloroaniline	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Chlorophenyl phenyl ether	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Nitroaniline	mg/L	< 0.0100	< 0.0100	< 0.0100
4-Nitrophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
5-Nitro-o-toluidine	mg/L	< 0.0100	< 0.0100	< 0.0100
7,12-Dimethylbenz(a)anthracene	mg/L	< 0.0100	< 0.0100	< 0.0100
a,a-Dimethylphenethylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
Acenaphthene	mg/L	< 0.0100	< 0.0100	< 0.0100
Acenaphthylene	mg/L	< 0.0100	< 0.0100	< 0.0100
Acetophenone	mg/L	< 0.0100	< 0.0100	< 0.0100
alpha-Terpineol	mg/L	< 0.0100	< 0.0100	< 0.0100
Aniline	mg/L	< 0.0100	< 0.0100	< 0.0100
Anthracene	mg/L	< 0.0100	< 0.0100	< 0.0100
Aramite	mg/L	< 0.0100	< 0.0100	< 0.0100
Azobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benz(a)anthracene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzidine	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzo(a)pyrene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzo(b)fluoranthene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzo(g,h,i)perylene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzo(k)fluoranthene	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzoic acid	mg/L	< 0.0100	< 0.0100	< 0.0100
Benzyl alcohol	mg/L	< 0.0100	< 0.0100	< 0.0100
Bis(2-chloroethoxy)methane	mg/L	< 0.0100	< 0.0100	< 0.0100
Bis(2-chloroethyl) ether	mg/L	< 0.0100	< 0.0100	< 0.0100
Bis(2-chloroisopropyl) ether	mg/L	< 0.0100	< 0.0100	< 0.0100
Bis(2-ethylhexyl) phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
bis(2-ethylhexyl)adipate	mg/L	< 0.0100	< 0.0100	< 0.0100
Butyl benzyl phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
Carbazole	mg/L	< 0.0100	< 0.0100	< 0.0100
Chlorobenzilate	mg/L	< 0.0100	< 0.0100	< 0.0100
Chrysene	mg/L	< 0.0100	< 0.0100	< 0.0100

Table 1
January 2012 Analytical Data

Analytical Result GC/MS Method 8270D/3510C*				
Compound	**Units**	**Sample ID**		
		1A,B+C	**2A,B+C**	**3A,B+C**
Di-n-butyl phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
Di-n-octyl phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
Diallate (cis or trans)	mg/L	< 0.0100	< 0.0100	< 0.0100
Dibenz(a,h)anthracene	mg/L	< 0.0100	< 0.0100	< 0.0100
Dibenzofuran	mg/L	< 0.0100	< 0.0100	< 0.0100
Diethyl phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
Dimethoate	mg/L	< 0.0100	< 0.0100	< 0.0100
Dimethyl phthalate	mg/L	< 0.0100	< 0.0100	< 0.0100
Dimethylaminoazobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Dinoseb	mg/L	< 0.0100	< 0.0100	< 0.0100
Diphenylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
Disulfoton	mg/L	< 0.0100	< 0.0100	< 0.0100
Ethyl methanesulfonate	mg/L	< 0.0100	< 0.0100	< 0.0100
Famphur	mg/L	< 0.0100	< 0.0100	< 0.0100
Fluoranthene	mg/L	< 0.0100	< 0.0100	< 0.0100
Fluorene	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachlorobutadiene	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachlorocyclopentadiene	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachloroethane	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachlorophene	mg/L	< 0.0100	< 0.0100	< 0.0100
Hexachloropropene	mg/L	< 0.0100	< 0.0100	< 0.0100
lndene	mg/L	< 0.0100	< 0.0100	< 0.0100
Indeno(1,2,3-cd)pyrene	mg/L	< 0.0100	< 0.0100	< 0.0100
Isodrin	mg/L	< 0.0100	< 0.0100	< 0.0100
lsophorone	mg/L	< 0.0100	< 0.0100	< 0.0100
lsosafrole	mg/L	< 0.0100	< 0.0100	< 0.0100
Kepone	mg/L	< 0.0100	< 0.0100	< 0.0100
Methapyrilene	mg/L	< 0.0100	< 0.0100	< 0.0100
Methyl methanesulfonate	mg/L	< 0.0100	< 0.0100	< 0.0100
n-Decane	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosodi-n-butylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosodiethylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosodimethylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosodiphenylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosodi-n-propylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosomethylethylamine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosomorpholine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosopiperidine	mg/L	< 0.0100	< 0.0100	< 0.0100
N-Nitrosopyrrolidine	mg/L	< 0.0100	< 0.0100	< 0.0100
n-Octadecane	mg/L	< 0.0100	< 0.0100	< 0.0100
Naphthalene	mg/L	< 0.0100	< 0.0100	< 0.0100
Nitrobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Nitroquinoline-1-oxide	mg/L	< 0.0100	< 0.0100	< 0.0100
O,O,O-Triethyl phosphorothioate	mg/L	< 0.0100	< 0.0100	< 0.0100
a-Toluidine	mg/L	< 0.0100	< 0.0100	< 0.0100
Parathion	mg/L	< 0.0100	< 0.0100	< 0.0100
Methyl parathion	mg/L	< 0.0100	< 0.0100	< 0.0100
Pentachlorobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Pentachloronitrobenzene	mg/L	< 0.0100	< 0.0100	< 0.0100
Pentachlorophenol	mg/L	< 0.0100	< 0.0100	< 0.0100
Phenacetin	mg/L	< 0.0100	< 0.0100	< 0.0100
Phenanthrene	mg/L	< 0.0100	< 0.0100	< 0.0100
Phenol	mg/L	< 0.0100	< 0.0100	< 0.0100
Phorate	mg/L	< 0.0100	< 0.0100	< 0.0100
Pronamide	mg/L	< 0.0100	< 0.0100	< 0.0100
Pyrene	mg/L	< 0.0100	< 0.0100	< 0.0100
Pyridine	mg/L	< 0.0100	< 0.0100	< 0.0100
Quinoline	mg/L	< 0.0100	< 0.0100	< 0.0100
Safrole	mg/L	< 0.0100	< 0.0100	< 0.0100
Tetraethyl dithiopyrophosphate	mg/L	< 0.0100	< 0.0100	< 0.0100
Thionazin	mg/L	< 0.0100	< 0.0100	< 0.0100

Notes:

< - Value is less than reporting limit.

* SVOA SPLP 1312 List by GC/MS Method 8270D/3510C

GC/MS - gas chromatography/mass spectrometry

mg/L - milligrams per Liter

SPLP - Synthetic Precipitation Leaching Procedure

Table 1
January 2012 Analytical Data

Analytical Result GC/MS Method 8260C/5030C*				
Compound	**Units**	**Sample ID**		
		1A,B+C	**2A,B+C**	**3A,B+C**
1,1,1,2-Tetrachloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1,1-Trichloroethane	mg/L	< 0.00200	< 0.00200	0.00364
1,1,2,2-Tetrachloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1,2-Trichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trimethylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2,4-Trichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2,4-Trimethylbenzene	mg/L	< 0.00200	< 0.00200	0.00460
1,2-Dibromo-3-chloropropane	mg/L	< 0.00500	< 0.00500	< 0.00500
1,2-Dibromoethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2-Dichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,2-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,3,5-Trimethylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,3-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,3-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200
1,4-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
1,4-Dioxane	mg/L	< 0.0500	< 0.0500	< 0.0500
2,2-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200
2-Butanone	mg/L	0.0722	0.0648	0.0426
2-Chloroethyl vinyl ether	mg/L	< 0.00500	< 0.00500	< 0.00500
2-Chlorotoluene	mg/L	< 0.00200	< 0.00200	< 0.00200
2-Hexanone	mg/L	< 0.00500	< 0.00500	< 0.00500
2-Nitropropane	mg/L	< 0.00500	< 0.00500	< 0.00500
4-Chlorotoluene	mg/L	< 0.00200	< 0.00200	< 0.00200
4-Isopropyltoluene	mg/L	< 0.00200	< 0.00200	< 0.00200
4-Methyl-2-pentanone	mg/L	< 0.00500	< 0.00500	< 0.00500
Acetone	mg/L	< 0.0100	< 0.0100	0.01040
Acetonitrile	mg/L	< 0.00500	< 0.00500	< 0.00500
Acrolein	mg/L	< 0.00500	< 0.00500	< 0.00500
Acrylonitrile	mg/L	< 0.0100	< 0.0100	< 0.0100
Allyl chloride	mg/L	< 0.00500	< 0.00500	< 0.00500
Benzene	mg/L	< 0.00100	< 0.00100	**0.00516**
Benzyl chloride	mg/L	< 0.00500	< 0.00500	< 0.00500
Bis(2-chloroisopropyl) ether	mg/L	< 0.00500	< 0.00500	< 0.00500
Bromobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
Bromochloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Bromodichloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Bromoform	mg/L	< 0.00200	< 0.00200	< 0.00200
Bromomethane	mg/L	< 0.00500	< 0.00500	< 0.00500
Butyl acetate	mg/L	< 0.00500	< 0.00500	< 0.00500
Carbon disulfide	mg/L	< 0.00200	< 0.00200	< 0.00200
Carbon tetrachloride	mg/L	< 0.00200	< 0.00200	< 0.00200
Chlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
Chloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Chloroform	mg/L	< 0.00200	< 0.00200	< 0.00200
Chloromethane	mg/L	< 0.00300	< 0.00300	< 0.00300
Chloroprene	mg/L	< 0.00200	< 0.00200	< 0.00200
cis-1,2-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200
cis-1,3-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200
Cyclohexane	mg/L	< 0.00200	< 0.00200	< 0.00200
Cyclohexanone	mg/L	< 0.0500	< 0.0500	< 0.0500
Dibromochloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Dibromomethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Dichlorodifluoromethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Ethyl acetate	mg/L	< 0.0100	< 0.0100	< 0.0100
Ethyl ether	mg/L	< 0.0100	< 0.0100	< 0.0100
Ethyl methacrylate	mg/L	< 0.00200	< 0.00200	< 0.00200
Ethylbenzene	mg/L	< 0.00200	< 0.00200	0.00761
Hexachlorobutadiene	mg/L	< 0.00200	< 0.00200	< 0.00200
Iodomethane	mg/L	< 0.00500	< 0.00500	< 0.00500
Isobutyl alcohol	mg/L	< 0.100	< 0.100	< 0.100
Isopropyl acetate	mg/L	< 0.0200	< 0.0200	< 0.0200
Isopropyl alcohol	mg/L	< 0.0250	< 0.0250	< 0.0250
Isopropylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
m,p-Xylene	mg/L	< 0.00200	0.00501	0.0383

Table 1
January 2012 Analytical Data

Analytical Result GC/MS Method 8260C/5030C*				
Compound	**Units**	**Sample ID**		
		1A,B+C	**2A,B+C**	**3A,B+C**
Methacrylonitrile	mg/L	< 0.00500	< 0.00500	< 0.00500
Methyl Acetate	mg/L	< 0.00500	< 0.00500	< 0.00500
Methyl methacrylate	mg/L	< 0.00500	< 0.00500	< 0.00500
Methyl tert-butyl ether	mg/L	< 0.00200	< 0.00200	< 0.00200
Methylcyclohexane	mg/L	< 0.00200	< 0.00200	< 0.00200
Methylene chloride	mg/L	< 0.00200	< 0.00200	< 0.00200
n-Amyl acetate	mg/L	< 0.00200	< 0.00200	< 0.00200
n-Butyl alcohol	mg/L	< 0.0500	< 0.0500	< 0.0500
n-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
n-Hexane	mg/L	< 0.00200	< 0.00200	< 0.00200
n-Octane	mg/L	< 0.00200	< 0.00200	< 0.00200
n-Propylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
Naphthalene	mg/L	< 0.00200	< 0.00200	< 0.00200
o-Xylene	mg/L	< 0.00200	< 0.00200	0.01460
Pentachloroethane	mg/L	< 0.00500	< 0.00500	< 0.00500
Propionitrile	mg/L	< 0.0250	< 0.0250	< 0.0250
Propyl	mg/L	< 0.00200	< 0.00200	< 0.00200
sec-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
Styrene	mg/L	< 0.00200	< 0.00200	< 0.00200
tert-Butyl alcohol	mg/L	< 0.0200	< 0.0200	< 0.0200
tert-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200
Tetrachloroethene	mg/L	< 0.00200	< 0.00200	0.00312
Tetrahydrofuran	mg/L	< 0.00200	< 0.00200	< 0.00200
Toluene	mg/L	< 0.00200	< 0.00200	0.05110
trans-1,2-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200
trans-1,3-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200
trans-1,4-Dichloro-2-butene	mg/L	< 0.00200	< 0.00200	< 0.00200
Trichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200
Trichlorofluoromethane	mg/L	< 0.00200	< 0.00200	< 0.00200
Vinyl acetate	mg/L	< 0.0100	< 0.0100	< 0.0100
Vinyl chloride	mg/L	< 0.00100	< 0.00100	< 0.00100
Xylenes, Total	mg/L	< 0.00200	0.00663	0.0528
TPH (DRO)	mg/L	0.0308	0.0363	0.0429
TPH (GRO)	mg/L	< 0.0200	0.0223	0.134

Notes:

Bold indicates an exceedance of DWQ water quality standards.

< - Value is less than reporting limit.

* VOCs SPLP 1312 List by GC/MS Method 8260C/5030C

GC/MS - gas chromatography/mass spectrometry

mg/L - milligrams per Liter

SPLP - Synthetic Precipitation Leaching Procedure

TPH-DRO - total petroleum hydrocarbons, diesel range organics

TPH-GRO - total petroleum hydrocarbons, gasoline range organics

VOCs -volatile organic compounds

Table 2
Utah Groundwater Quality Standards

Parameter	GWQS	Unit	Alternate Name
Physical Characteristics			
pH	6.5 - 8.5	s.u.	
Inorganic Chemicals			
Fluoride	4	mg/l	
Total Nitrate + Nitrite (both as N)	10	mg/l	
Metals			
Antimony	0.006	mg/l	
Arsenic	0.05	mg/l	
Barium	2	mg/l	
Beryllium	0.004	mg/l	
Cadmium	0.005	mg/l	
Chromium (total)	0.1	mg/l	
Copper	1.3	mg/l	
Lead	0.015	mg/l	
Mercury (inorganic)	0.002	mg/l	
Selenium	0.05	mg/l	
Silver	0.1	mg/l	
Thallium	0.002	mg/l	
Zinc	5	mg/l	
Organic Chemicals			
Dinoseb	0.007	mg/l	
Pentachlorophenol	0.001	mg/l	
Volatile Organic Chemicals			
Benzene	0.005	mg/l	
Benzo(a)pyrene (PAH)	0.0002	mg/l	
Carbon tetrachloride	0.005	mg/l	
Dichloroethane (1,2 -)	0.005	mg/l	1,2 Dichloroethane
Dichloroethylene (1,1 -)	0.007	mg/l	1,1-Dichloroethene
Dichloromethane	0.005	mg/l	methylene chloride
Di (2-ethylhexyl) adipate	0.4	mg/l	bis(2-ethylhexyl)adipate
Di (2-ethylhexyl) phthalate (PAE)	0.006	mg/l	Bis(2-ethylhexyl) phthalate
Dichlorobenzene (para -)	0.075	mg/l	1,4-Dichlorobenzene
Dichlorobenzene (o -)	0.6	mg/l	1,2-Dichlorobenzene
Dichloroethylene (cis - 1,2)	0.07	mg/l	cis-1,2-Dichloroethene
Dichloroethylene (trans - 1,2)	0.1	mg/l	trans-1,2-Dichloroethene
Dichloropropane (1,2 -)	0.005	mg/l	1,2-Dichloropropane
Ethylbenzene	0.7	mg/l	
Hexachlorobenzene	0.001	mg/l	
Hexachlorocyclopentadiene	0.05	mg/l	
Monochlorobenzene	0.1	mg/l	Chlorobenzene
Styrene	0.1	mg/l	
Tetrachloroethylene	0.005	mg/l	Tetrachloroethene
Toluene	1	mg/l	
Trichlorobenzene (1,2,4-)	0.07	mg/l	1,2,4-Trichlorobenzene
Trichloroethane (1,1,1-)	0.2	mg/l	1,1,1-Trichloroethane
Trichloroethane (1,1,2-)	0.005	mg/l	1,1,2-Trichloroethane
Trichloroethylene	0.005	mg/l	Trichloroethene
Vinyl chloride	0.002	mg/l	
Xylenes (Total)	10	mg/l	

Notes:

GWQS - Groundwater Quality Standard

mg/L - milligram per liter

s.u. - standard units

Utah Department of Environmental Quality, Division of Water Quality (DWQ), 2014. Utah Ground Water Quality Standards – Table 1 of R317-6-2.1. Last Updated June 17, 2014. http://www.waterquality.utah.gov/GroundWater/gwstandards.htm

Table 3
Utah Initial Screening Levels

Compounds	Groundwater (mg/L)
Benzene	0.005
Toluene	1
Ethylbenzene	0.7
Xylenes	10
Naphthalene	0.7
Methyl t-butyl ether (MTBE)	0.2
Total Petroleum Hydrocarbons (TPH) as gasoline	1
Total Petroleum Hydrocarbons (TPH) as diesel	1
Oil and Grease or (TRPH)	10

Notes:

mg/L - milligram per liter

TRPH - Total Recoverable Petroleum Hydrocarbons

Table 4
September 2012 Analytical Data

Analytical Result SPLP Metals Method 1312					
Compound	Units	Sample ID			
		U-001A	U-002A	U-003A	U-004A
Antimony	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Arsenic	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Barium	mg/L	0.0413	0.0401	0.0353	0.0266
Beryllium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Boron	mg/L	<0.500	<0.500	<0.500	<0.500
Cadmium	mg/L	<0.000500	<0.000500	<0.000500	0.000924
Calcium	mg/L	2.81	2.62	2.24	5.42
Chromium	mg/L	<0.0100	<0.0100	<0.0100	<0.0100
Copper	mg/L	<0.00200	0.00302	0.00252	0.0176
Iron	mg/L	1.17	1.18	1.17	0.3
Lead	mg/L	<0.0100	<0.0100	<0.0100	<0.0100
Lithium	mg/L	<0.100 ~	<0.100 ~	<0.100 ~	<0.100 ~
Magnesium	mg/L	<1.00	<1.00	<1.00	<1.00
Manganese	mg/L	0.684	0.614	0.457	0.0669
Mercury	mg/L	<0.00100	<0.00100	<0.00100	<0.00100
Molybdenum	mg/L	<0.0200	<0.0200	<0.0200	<0.0200
Nickel	mg/L	0.0277	0.0283	0.0243	0.0309
Potassium	mg/L	<1.00	<1.00	<1.00	<1.00
Selenium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Silver	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Sodium	mg/L	<1.00	1.24	1.5	1.48
Strontium	mg/L	<0.0500	<0.0500	<0.0500	<0.0500
Thallium	mg/L	<0.00200	<0.00200	<0.00200	<0.00200
Tin	mg/L	<0.500	<0.500	<0.500	<0.500
Vanadium	mg/L	<0.0500	<0.0500	<0.0500	<0.0500
Zinc	mg/L	<0.100	<0.100	<0.100	0.306
Alkalinity (as $CaCO_3$)	mg/L	<10.0	<10.0	<10.0	<10.0
Chloride	mg/L	<5.00	<5.00	<5.00	<5.00
Oil & Grease	mg/L	<3.00	<3.00	<3.00	<3.00
pH	s.u.	**6.27**	**5.89**	**4.51**	**3.6**
Sulfate	mg/L	11.2	9.03	7.95	22.1
Total Dissolved Solids	mg/L	14.0 #	14.0	20.0	46.0
Total Organic Carbon	mg/L	6.69 B	7.14 B	6.9 B	2.83 B
Total Recoverable Hydrocarbons	mg/L	<3.00	<3.00	<3.00	<3.00

Notes:

Bold indicates an exceedance of DWQ water quality standards.

< - Value is less than reporting limit.

~ - Result was not performed in accordance with National Environmental Laboratory Accreditation Program (NELAP) requirements

High relative percent difference (RPD) due to low analyte concentration. In this range high RPDs are expected.

µmhos/cm - micromhos per centimeter

B - This analyte was also detected in the SPLP method blank above the practical quantification limit (PQL) at 1.0056 mg/L. The batch method blank was below the PQL.

mg/L - milligram per liter

SPLP - Synthetic Precipitation Leaching Procedure

s.u. - standard unit

$CaCO_3$ - Calcium Carbonate

Analytical Result SPLP Metals Method 1312		
Compound	Units	Sample ID
		U-004B
Oil & Grease	mg/L	**34,900** [3]H
Total Recoverable Hydrocarbons	mg/L	**13,400** H

Notes:

Bold indicates an exceedance of DWQ water quality standards.

[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

H - Analysis requested by the client after the holding time expired.

mg/L - milligram per liter

SPLP - Synthetic Precipitation Leaching Procedure

Analytical Result					
Compound	Units	Sample ID			
		U-001B	U-002B	U-003B	U-004B
[1]Conductivity	µmhos/cm	169	179	223	332
pH	s.u.	**4.90** H	**4.74** H	**4.70** H	**4.24** H
[1]Sodium Absorption Ratio	SAR	0.0861	0.0947	0.104	0.222

Notes:

Bold indicates an exceedance of DWQ water quality standards.

[1] Analysis performed on a 1:1 DI water extract for soils.

µmhos/cm - micromhos per centimeter

H - Sample was received outside of the holding time.

SAR - Sodium Absorption Ratio

s.u. - standard unit

Table 4
September 2012 Analytical Data

Analytical Result GC/FID Method 8015D/3510C					
Compound	Units	Sample ID			
		U-001A	U-002A	U-003A	U-004A
Diesel Range Organics (DRO)	mg/L	0.676	0.755	0.832	1.4

Notes:
mg/L - milligrams per Liter
GC/FID - gas chromatography/flame ionization detector

Analytical Result GC/MS Method 8260C/5030C*					
Compound	Units	Sample ID			
		U-001A	U-002A	U-003A	U-004A
1,1,1,2-Tetrachloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1,1-Trichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1,2,2-Tetrachloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1,2-Trichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,1-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2,3-Trimethylbenzene	mg/L	< 0.00200	< 0.00200	0.00281	< 0.00200
1,2,4-Trichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2,4-Trimethylbenzene	mg/L	< 0.00200	0.0175	0.00425	< 0.00200
1,2-Dibromo-3-chloropropane	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
1,2-Dibromoethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2-Dichloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,2-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,3,5-Trimethylbenzene	mg/L	< 0.00200	0.011	0.00245	< 0.00200
1,3-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,3-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,4-Dichlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
1,4-Dioxane	mg/L	< 0.0500	< 0.0500	< 0.0500	< 0.0500
2,2-Dichloropropane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
2-Butanone	mg/L	0.0101	1.0101	0.0118	< 0.0100
2-Chloroethyl vinyl ether	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
2-Chlorotoluene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
2-Hexanone	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
2-Nitropropane	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
4-Chlorotoluene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
4-Isopropyltoluene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
4-Methyl-2-pentanone	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Acetone	mg/L	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Acetonitrile	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Acrolein	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Acrylonitrile	mg/L	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Allyl chloride	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Benzene	mg/L	< 0.00100	< 0.00100	< 0.00100	< 0.00100
Benzyl chloride	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Bis(2-chloroisopropyl) ether	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Bromobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Bromochloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Bromodichloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Bromoform	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Bromomethane	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Butyl acetate	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Carbon disulfide	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Carbon tetrachloride	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Chlorobenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Chloroethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Chloroform	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Chloromethane	mg/L	< 0.00300	< 0.00300	< 0.00300	< 0.00300
Chloroprene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
cis-1,2-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
cis-1,3-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Cyclohexane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Cyclohexanone	mg/L	< 0.0500	< 0.0500	< 0.0500	< 0.0500
Dibromochloromethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Dibromomethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Dichlorodifluoromethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Ethyl acetate	mg/L	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Ethyl ether	mg/L	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Ethyl methacrylate	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Ethylbenzene	mg/L	< 0.00200	0.00209	< 0.00200	< 0.00200
Hexachlorobutadiene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Iodomethane	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Isobutyl alcohol	mg/L	< 0.100	< 0.100	< 0.100	< 0.100
Isopropyl acetate	mg/L	< 0.0200	< 0.0200	< 0.0200	< 0.0200

Table 4
September 2012 Analytical Data

Analytical Result GC/MS Method 8260C/5030C*					
Compound	**Units**	**Sample ID**			
		U-001A	**U-002A**	**U-003A**	**U-004A**
Isopropyl alcohol	mg/L	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Isopropylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
m,p-Xylene	mg/L	< 0.00200	0.0156 B	< 0.00200	< 0.00200
Methacrylonitrile	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Methyl Acetate	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Methyl methacrylate	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Methyl tert-butyl ether	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Methylcyclohexane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Methylene chloride	mg/L	0.00329 B	0.00327 B	0.00268 B	0.00304 B
n-Amyl acetate	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
n-Butyl alcohol	mg/L	< 0.0500	< 0.0500	< 0.0500	< 0.0500
n-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
n-Hexane	mg/L	0.0129	0.015	0.0138	< 0.00200
n-Octane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
n-Propylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Naphthalene	mg/L	< 0.00200	0.0035	0.00351	< 0.00200
o-Xylene	mg/L	< 0.00200	0.00569	< 0.00200	< 0.00200
Pentachloroethane	mg/L	< 0.00500	< 0.00500	< 0.00500	< 0.00500
Propionitrile	mg/L	< 0.0250	< 0.0250	< 0.0250	< 0.0250
Propyl acetate	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
sec-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Styrene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
tert-Butyl alcohol	mg/L	< 0.0200	< 0.0200	< 0.0200	< 0.0200
tert-Butylbenzene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Tetrachloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Tetrahydrofuran	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Toluene	mg/L	< 0.00200	0.00466	< 0.00200	< 0.00200
trans-1,2-Dichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
trans-1,3-Dichloropropene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
trans-1,4-Dichloro-2-butene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Trichloroethene	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Trichlorofluoromethane	mg/L	< 0.00200	< 0.00200	< 0.00200	< 0.00200
Vinyl acetate	mg/L	< 0.0100	< 0.0100	< 0.0100	< 0.0100
Vinyl chloride	mg/L	< 0.00100	< 0.00100	< 0.00100	< 0.00100
Xylenes, Total	mg/L	< 0.00200	0.0213 B	< 0.00200	< 0.00200
TPH (DRO)	mg/L	< 0.0200	< 0.0200	< 0.0200	< 0.0200
TPH (GRO)	mg/L	0.0971	0.190	0.162	< 0.0200

Notes:

< - Value is less than reporting limit.

* VOCs SPLP 1312 List by GC/MS Method 8260C/5030C

B - This analyte was also detected in MB-SPLP-21377, which was a method blank

GC/MS - gas chromatography/mass spectrometry

mg/L - milligrams per Liter

SPLP - Synthetic Precipitation Leaching Procedure

TPH-DRO - total petroleum hydrocarbons, diesel range organics

TPH-GRO - total petroleum hydrocarbons, gasoline range organics

VOCs -volatile organic compounds

Jon Schulman
JBR Environmental Consultants, Inc.
8160 So. Highland Dr. Ste A-4
Sandy, UT 84093
TEL: (801) 943-4144

RE: American Oil Sands

Dear Jon Schulman: Lab Set ID: 1209452

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories received 8 sample(s) on 9/26/2012 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Association Conference (NELAC) Institute in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, and Missouri. In addition, AWAL is also accredited by the American Analytical Laboratory Association (A2LA) on ISO IEC 17025:2005, Department of Defense (DOD), UST for the State of Wyoming, and the National Lead Laboratory Accreditation Program (NLLAP). All analyses were performed in accordance to The NELAC Institute and/or A2LA protocols unless noted otherwise. Accreditation documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

This is an addendum to a report originally issued on 10/12/2012.

Thank You,

Approved by: ______________________________
Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-008
Client Sample ID: U-004B
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Oil & Grease	mg/kg-dry		11/1/2012 1221h	E1664AMod.	602	**34,900**	[3]H
Total Recoverable Petroleum Hydrocarbons	mg/kg-dry		11/2/2012 1515h	E1664A-SGT	602	**13,400**	H

[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.
H - Analysis requested by the client after the holding time expired.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-R46948	Oil & Grease	mg/kg	E1664AMod.	1,690	2,000	0	84.7	78-114				11/1/2012 1221h
LCS-R47002	Total Recoverable Petroleum Hydrocarbons	mg/kg	E1664A-SGT	690	1,000	0	69.0	64-132				11/2/2012 1515h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-R46948	Oil & Grease	mg/kg	E1664AMod.	< 150				-				11/1/2012 1221h
MB-R47002	Total Recoverable Petroleum Hydrocarbons	mg/kg	E1664A-SGT	< 150				-				11/2/2012 1515h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-008AMS	Oil & Grease	mg/kg-dry	E1664AMod.	50,300	8,031	34,900	192	78-114			3	11/1/2012 1221h
1209452-008AMS	Total Recoverable Petroleum Hydrocarbons	mg/kg-dry	E1664A-SGT	16,400	4,016	13,430	74.0	64-132				11/2/2012 1515h

Analysis performed on an SPLP extract by method 1312.

3 - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-008AMSD	Oil & Grease	mg/kg-dry	E1664AMod.	53,800	8,031	34,900	236	78-114	6.71	18	3	11/1/2012 1221h
1209452-008AMSD	Total Recoverable Petroleum Hydrocarbons	mg/kg-dry	E1664A-SGT	17,600	4,016	13,430	105	64-132	7.31	34		11/2/2012 1515h

Analysis performed on an SPLP extract by method 1312.

3 - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

REVISED DB 10/31/12

O&G/TRPH added to Sample #8

American West Analytical Laboratories

UL

WORK ORDER Summary

Work Order: 1209452

 10/31/2012

Client: JBR Environmental Consultants, Inc.

Client ID: JBR400 **Contact:** Jon Schulman

Project: American Oil Sands **QC Level:** LEVEL II **WO Type:** Standard

Comments: All analysis to be performed on the SPLP extract, for samples #1, #3, #5, #7. For samples #2, #4, #6, #8 run on a 1:1. Footnote report, pH received outside of hold. Email 3 people: John Schulman, Linda Matthews, and Will Gibbs. OGB & OGF added per Jon Schulman on 10-31-12 (client is aware sample is out of hold).; eh/db

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-001A	U-001A	9/25/2012 0945h	9/26/2012 1100h	11/7/2012	Leachate	1312LM-PR	☐	SPLP	1
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-002A	U-001B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-003A	U-002A	9/25/2012 1055h			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☑ RT ☑ CN ☑ TAT ☑ QC ☑ HOK____ HOK____ HOK____ COC Emailed______

WORK ORDER Summary

Client: JBR Environmental Consultants, Inc.

Work Order: **1209452**

 10/31/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-003A	U-002A	9/25/2012 1055h	9/26/2012 1100h	11/7/2012	Leachate	6010C-SPLP	☑	SPLP	1
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-004A	U-002B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-005A	U-003A	9/25/2012 1240h			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK______ HOK______ HOK______ COC Emailed__________

WORK ORDER Summary

Client: JBR Environmental Consultants, Inc.

Work Order: **1209452**

 10/31/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-005A	U-003A	9/25/2012 1240h	9/26/2012 1100h	11/7/2012	Leachate	OGB-W-1664A	☐	SPLP	1
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-006A	U-003B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-007A	U-004A	9/25/2012			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-008A	U-004B				Solid	COND-S-9050A	☐	df / wc	
						OGB-S-1664A	☐	df / wc	
						OGF-S-1664SGT	☐	df / wc	
						PH-9045D	☐	df / wc	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK_____ HOK_____ HOK_____ COC Emailed________

WORK ORDER Summary

Client: JBR Environmental Consultants, Inc.

Work Order: **1209452**

 10/31/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-008A	U-004B	9/25/2012	9/26/2012 1100h	11/7/2012	Solid	PMOIST	☐	df / wc	1
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK______ HOK______ HOK______ COC Emailed__________

Client American Oil Sands
Address
City State Zip
Phone 801-277-7888 Fax Jon
Contact Will Gibbs / Jon Schulman
E-mail wgibbs@Americansandsenergy.com
Project Name
Project Number/P.O.#
Sampler Name R.G. McGinnis 480-239-7700

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115
(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email:awal@awal-labs.com

CHAIN OF CUSTODY

Lab Sample Set # 1209452
Page ____ of ____

Turn Around Time (Circle One)
1 day 2 day 3 day 4 day 5 day Standard

	Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	See attached		O&G & TRPH (per Jon Schulman DB 10/31/12)								QC LEVEL / COMMENTS
1	U-001A	Sept 25 9:45													
2	U-001B	" 9:45													
3	U-002A	" 10:55													
4	U-002B	" 10:55													
5	U-003A	" 12:40													
6	U-003B	" 12:40													
7	U-004A	Sept 25													
8	U-004B	Sept 25					X								

QC LEVEL: 1, (2)*, 2+, 3, 3+, 4

LABORATORY USE ONLY

SAMPLES WERE:
1. (Shipped) or hand delivered. Notes: Fed X
2. Ambient or (Chilled). Notes:
3. Temperature 2.9
4. Received Broken/Leaking (Improperly Sealed) Y (N). Notes:
5. Properly Preserved (Y) N. Checked at Bench Y N. Notes:
6. Received Within Holding Times Y (N). Notes: pH rec. outside of hold.

COC Tape Was:
1. Present on Outer Package Y N (NA)
2. Unbroken on Outer Package Y N (NA)
3. Present on Sample Y N (NA)
4. Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? Y (N). Notes:

Relinquished By: Signature	Date	Received By: Signature	Date
R.G. McGinnis (signature)	Sept 25		
PRINT NAME R.G. McGinnis	Time 2:30pm	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature (signature)	Date 9-26-12
PRINT NAME	Time	PRINT NAME Elma Hayden	Time 1100

Special Instructions:
metals list from previous set: Ag, As, B, Ba, Be, Cd, Cr, Cu, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sr, Sn, Tl, V, Zn along with cations.

* per Jon Schulman. 10/5/12 mt

Client is aware sample is out of hold - DB 10/31/12

Parameters for Tailings Analyses

These are the analyses required for the tailings samples:

1) Use the Synthetic Precipitation Leachate Procedure (SPLP) extraction (EPA Method SW-846 1312)

The leachate must be analyzed for the following:

- Residual solvents used in the bitumen extraction process (the actual, proprietary solvent that you will use or the closest available proxy),
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), ✓
- Volatile organic compounds (VOCs), ✓
- ~~Hazardous air pollutants (HAPs),~~
- Oil and grease, ✓
- Total petroleum hydrocarbon-diesel range (TPH-DRO), ✓
- Total petroleum hydrocarbon-gasoline range (TPH-GRO), ✓
- Total recoverable petroleum hydrocarbon (TRPH), ✓
- Total organic carbon (TOC), ✓
- Total dissolved solids (TDS), ✓
- pH, ✓
- Metals, and – from previous set (1201439)
- Major ions (Na, Ca, K, Mg, Cl, SO_4, alkalinity).

#1

2) Use either a saturated paste extract or a 1:1 (liquid:solid) extract: the extract should be analyzed for pH, conductivity and SAR.

2

Laboratory minimum detection limits must be equal to or less than Utah ground water standards or other applicable standards to enable meaningful comparisons with the laboratory analytical results. Some of these are for groundwater permitting, others are for air quality permitting, and others are for the engineers.

3) In addition to these chemical characteristics, Mine Engineers need to have physical tests performed. Eldon has a lab he uses in Cheyenne that he uses for these, so please send a five-gallon bucket or two of tailings sample to him. Those tests include the following:

Relative Density (ASTM D253 & D4254)
Direct Shear (ASTM D3080)
Sieve Analysis (ASTM C136 & C117)
Proctored Density

American West
ANALYTICAL LABORATORIES

William Gibbs
American Sands Energy Corp.

TEL: (801) 277-7888

RE: Green River Resources

Dear William Gibbs: Lab Set ID: 1201439

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories received 3 sample(s) on 1/31/2012 for the analyses presented in the following report.

All analyses were performed in accordance to The NELAC Institute protocols unless noted otherwise. American West Analytical Laboratories is accredited by The NELAC Institute in Utah and Texas; and is state accredited in Colorado, Idaho, and Missouri. Accreditation documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

Thank You,

Kyle F. Gross
Digitally signed by Kyle F. Gross
DN: cn=Kyle F. Gross, o=AWAL, ou=AWAL, email=kyle@awal-labs.com, c=US
Date: 2012.02.16 13:26:36 -07'00'

Approved by:
Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-001
Client Sample ID: 1A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 2/1/2012 1840h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.00100	< 0.00100	
Arsenic	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000600	**0.00106**	
Barium	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000400	**0.0120**	
Beryllium	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000600	< 0.000600	
Boron	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000180	< 0.000180	
Calcium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	1.00	**1.27**	
Chromium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000800	**0.00161**	
Iron	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.100	**0.782**	
Lead	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000400	**0.000710**	
Lithium	mg/L	2/7/2012 230h	2/9/2012 1559h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	1.00	< 1.00	
Manganese	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.00120	**0.216**	
Mercury	mg/L	2/6/2012 1530h	2/7/2012 845h	SW7470A	0.0100	< 0.0100	*
Molybdenum	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000800	**0.00336**	
Potassium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	1.00	< 1.00	
Selenium	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000800	< 0.000800	
Silver	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000400	< 0.000400	
Sodium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	1.00	**1.07**	
Strontium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.000400	< 0.000400	
Tin	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	2/7/2012 230h	2/9/2012 1554h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	2/7/2012 230h	2/8/2012 1804h	SW6020A	0.00500	**0.0245**	

** - The reporting limits were raised due to sample matrix interferences.*

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-002
Client Sample ID: 2A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 2/1/2012 1840h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.00100	< 0.00100	
Arsenic	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000600	**0.00146**	
Barium	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000400	**0.0124**	
Beryllium	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000600	< 0.000600	
Boron	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000180	< 0.000180	
Calcium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	1.00	**1.31**	
Chromium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000800	**0.00130**	
Iron	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.100	**1.20**	
Lead	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000400	**0.000846**	
Lithium	mg/L	2/7/2012 230h	2/9/2012 1601h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	1.00	< 1.00	
Manganese	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.00120	**0.243**	
Mercury	mg/L	2/6/2012 1530h	2/7/2012 853h	SW7470A	0.0100	< 0.0100	*
Molybdenum	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000800	**0.00364**	
Potassium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	1.00	< 1.00	
Selenium	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000800	**0.00105**	
Silver	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000400	< 0.000400	
Sodium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	1.00	< 1.00	
Strontium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.000400	**0.000692**	
Tin	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	2/7/2012 230h	2/9/2012 1611h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	2/7/2012 230h	2/8/2012 1838h	SW6020A	0.00500	**0.0210**	

** - The reporting limits were raised due to sample matrix interferences.*
~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-003
Client Sample ID: 3A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date: 2/1/2012 1840h

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.00100	< 0.00100	
Arsenic	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000600	**0.00135**	
Barium	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000400	**0.0142**	
Beryllium	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000600	< 0.000600	
Boron	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000180	< 0.000180	
Calcium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	1.00	**1.86**	
Chromium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000800	**0.00134**	
Iron	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.100	**1.10**	
Lead	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000400	**0.000676**	
Lithium	mg/L	2/7/2012 230h	2/9/2012 1604h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	1.00	< 1.00	
Manganese	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.00120	**0.366**	
Mercury	mg/L	2/6/2012 1530h	2/7/2012 854h	SW7470A	0.0100	< 0.0100	*
Molybdenum	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000800	**0.00449**	
Potassium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	1.00	< 1.00	
Selenium	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000800	< 0.000800	
Silver	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000400	< 0.000400	
Sodium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	1.00	< 1.00	
Strontium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.000400	< 0.000400	
Tin	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	2/7/2012 230h	2/9/2012 1615h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	2/7/2012 230h	2/8/2012 1845h	SW6020A	0.00500	**0.0156**	

* - *The reporting limits were raised due to sample matrix interferences.*
~ - *The above result was not performed in accordance with NELAP requirements.*

INORGANIC ANALYTICAL REPORT

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-001
Client Sample ID: 1A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		2/3/2012 1100h	SM2320B	10.0	**14.6**	
Chloride	mg/L		2/10/2012 1143h	E300.0	0.100	< 0.100	
Fluoride	mg/L		2/10/2012 1143h	E300.0	0.100	< 0.100	
Nitrate/Nitrite (as N)	mg/L		2/2/2012 1703h	E353.2	0.0100	**0.0419**	
Oil & Grease	mg/L		2/6/2012 1425h	E1664A	3.00	**3.07**	
pH @ 25° C	pH Units		2/2/2012 1600h	SM4500-H+B	1.00	**9.42**	
Sulfate	mg/L		2/10/2012 1143h	E300.0	0.750	**2.63**	
Total Dissolved Solids	mg/L		2/3/2012 1330h	SM2540C	20.0	< 20.0	
Total Organic Carbon	mg/L		2/5/2012 2048h	SM5310B	1.00	**3.96**	

Analysis performed on an SPLP extract.

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-002
Client Sample ID: 2A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		2/3/2012 1100h	SM2320B	10.0	**13.7**	
Chloride	mg/L		2/10/2012 1207h	E300.0	0.100	< 0.100	
Fluoride	mg/L		2/10/2012 1207h	E300.0	0.100	< 0.100	
Nitrate/Nitrite (as N)	mg/L		2/2/2012 1704h	E353.2	0.0100	**0.0407**	
Oil & Grease	mg/L		2/6/2012 1425h	E1664A	3.00	**4.39**	
pH @ 25° C	pH Units		2/2/2012 1600h	SM4500-H+B	1.00	**9.42**	
Sulfate	mg/L		2/10/2012 1207h	E300.0	0.750	**2.68**	
Total Dissolved Solids	mg/L		2/3/2012 1330h	SM2540C	20.0	< 20.0	
Total Organic Carbon	mg/L		2/5/2012 2110h	SM5310B	1.00	**4.58**	

Analysis performed on an SPLP extract.

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-003
Client Sample ID: 3A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		2/3/2012 1100h	SM2320B	10.0	**10.9**	
Chloride	mg/L		2/10/2012 1229h	E300.0	0.100	< 0.100	
Fluoride	mg/L		2/10/2012 1229h	E300.0	0.100	< 0.100	
Nitrate/Nitrite (as N)	mg/L		2/2/2012 1706h	E353.2	0.0100	**0.0422**	
Oil & Grease	mg/L		2/6/2012 1425h	E1664A	3.00	**3.69**	
pH @ 25° C	pH Units		2/2/2012 1600h	SM4500-H+B	1.00	**9.35**	
Sulfate	mg/L		2/10/2012 1229h	E300.0	0.750	**3.13**	
Total Dissolved Solids	mg/L		2/3/2012 1330h	SM2540C	20.0	< 20.0	
Total Organic Carbon	mg/L		2/5/2012 2131h	SM5310B	1.00	**4.51**	

Analysis performed on an SPLP extract.

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-001B
Client Sample ID: 1A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 2/7/2012 1351h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0100	< 0.0100	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-001B
Client Sample ID: 1A,B+C

Analyzed: 2/7/2012 1351h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Nitrophenol	88-75-5	0.0100	< 0.0100	
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3´-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3´-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	< 0.0200	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	

American West ANALYTICAL LABORATORIES

Lab Sample ID: 1201439-001B
Client Sample ID: 1A,B+C

Analyzed: 2/7/2012 1351h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-001B
Client Sample ID: 1A,B+C

Analyzed: 2/7/2012 1351h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	

Lab Sample ID: 1201439-001B
Client Sample ID: 1A,B+C

Analyzed: 2/7/2012 1351h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Terphenyl-d14	1718-51-0	0.0419	0.04000	105	10-199	
Surr: Phenol-d6	13127-88-3	0.0201	0.08000	25.2	10-122	
Surr: Nitrobenzene-d5	4165-60-0	0.0218	0.04000	54.4	10-180	
Surr: 2-Fluorophenol	367-12-4	0.0273	0.08000	34.1	14-106	
Surr: 2-Fluorobiphenyl	321-60-8	0.0233	0.04000	58.2	10-124	
Surr: 2,4,6-Tribromophenol	118-79-6	0.0660	0.08000	82.6	10-159	

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-002B
Client Sample ID: 2A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 2/7/2012 1507h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0100	< 0.0100	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-002B
Client Sample ID: 2A,B+C

Analyzed: 2/7/2012 1507h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Nitrophenol	88-75-5	0.0100	< 0.0100	
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3´-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3´-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	< 0.0200	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	

American West ANALYTICAL LABORATORIES

Lab Sample ID: 1201439-002B
Client Sample ID: 2A,B+C

Analyzed: 2/7/2012 1507h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-002B
Client Sample ID: 2A,B+C

Analyzed: 2/7/2012 1507h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	

Lab Sample ID: 1201439-002B
Client Sample ID: 2A,B+C

Analyzed: 2/7/2012 1507h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Terphenyl-d14	1718-51-0	0.0368	0.04000	92.0	10-199	
Surr: Phenol-d6	13127-88-3	0.0202	0.08000	25.2	10-122	
Surr: Nitrobenzene-d5	4165-60-0	0.0150	0.04000	37.4	10-180	
Surr: 2-Fluorophenol	367-12-4	0.0262	0.08000	32.8	14-106	
Surr: 2-Fluorobiphenyl	321-60-8	0.0149	0.04000	37.3	10-124	
Surr: 2,4,6-Tribromophenol	118-79-6	0.0702	0.08000	87.8	10-159	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-003B
Client Sample ID: 3A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8270D

Analytical Results SVOA SPLP by GC/MS Method 8270D/1312/3510C

Analyzed: 2/7/2012 1533h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1´-Biphenyl	92-52-4	0.0100	< 0.0100	
1,2,4,5-Tetrachlorobenzene	95-94-3	0.0100	< 0.0100	
1,2,4-Trichlorobenzene	120-82-1	0.0100	< 0.0100	
1,2-Dichlorobenzene	95-50-1	0.0100	< 0.0100	
1,3,5-Trinitrobenzene	99-35-4	0.0100	< 0.0100	
1,4-Naphthoquinone	130-15-4	0.0100	< 0.0100	
1,3-Dichlorobenzene	541-73-1	0.0100	< 0.0100	
1,3-Dinitrobenzene	99-65-0	0.0100	< 0.0100	
1,4-Dichlorobenzene	106-46-7	0.0100	< 0.0100	
1,4-Phenylenediamine	106-50-3	0.0100	< 0.0100	
1-Chloronaphthalene	90-13-1	0.0100	< 0.0100	
1-Methylnaphthalene	90-12-0	0.0100	< 0.0100	
1-Naphthylamine	134-32-7	0.0100	< 0.0100	
2,3,4,6-Tetrachlorophenol	58-90-2	0.0100	< 0.0100	
2,4,5-Trichlorophenol	95-95-4	0.0100	< 0.0100	
2,4,6-Trichlorophenol	88-06-2	0.0100	< 0.0100	
2,4-Dichlorophenol	120-83-2	0.0100	< 0.0100	
2,4-Dimethylphenol	105-67-9	0.0100	< 0.0100	
2,4-Dinitrophenol	51-28-5	0.0100	< 0.0100	
2,4-Dinitrotoluene	121-14-2	0.0100	< 0.0100	
2,6-Dichlorophenol	87-65-0	0.0100	< 0.0100	
2,6-Dinitrotoluene	606-20-2	0.0100	< 0.0100	
2-Acetylaminofluorene	53-96-3	0.0100	< 0.0100	
2-Chloronaphthalene	91-58-7	0.0100	< 0.0100	
2-Chlorophenol	95-57-8	0.0100	< 0.0100	
2-Methylnaphthalene	91-57-6	0.0100	< 0.0100	
2-Methylphenol	95-48-7	0.0100	< 0.0100	
2-Naphthylamine	91-59-8	0.0100	< 0.0100	
2-Nitroaniline	88-74-4	0.0100	< 0.0100	

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-003B
Client Sample ID: 3A,B+C

Analyzed: 2/7/2012 1533h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
2-Nitrophenol	88-75-5	0.0100	< 0.0100	
2-Picoline	109-06-8	0.0100	< 0.0100	
3&4-Methylphenol		0.0100	< 0.0100	
3,3′-Dichlorobenzidine	91-94-1	0.0100	< 0.0100	
3,3′-Dimethylbenzidine	119-93-7	0.0100	< 0.0100	
3-Methylcholanthrene	56-49-5	0.0100	< 0.0100	
3-Nitroaniline	99-09-2	0.0100	< 0.0100	
4,6-Dinitro-2-methylphenol	534-52-1	0.0100	< 0.0100	
4-Aminobiphenyl	92-67-1	0.0100	< 0.0100	
4-Bromophenyl phenyl ether	101-55-3	0.0100	< 0.0100	
4-Chloro-3-methylphenol	59-50-7	0.0100	< 0.0100	
4-Chloroaniline	106-47-8	0.0100	< 0.0100	
4-Chlorophenyl phenyl ether	7005-72-3	0.0100	< 0.0100	
4-Nitroaniline	100-01-6	0.0100	< 0.0100	
4-Nitrophenol	100-02-7	0.0100	< 0.0100	
5-Nitro-o-toluidine	99-55-8	0.0100	< 0.0100	
7,12-Dimethylbenz(a)anthracene	57-97-6	0.0100	< 0.0100	
a,a-Dimethylphenethylamine	122-09-8	0.0100	< 0.0100	
Acenaphthene	83-32-9	0.0100	< 0.0100	
Acenaphthylene	208-96-8	0.0100	< 0.0100	
Acetophenone	98-86-2	0.0100	< 0.0100	
alpha-Terpineol	98-55-5	0.0100	< 0.0100	
Aniline	62-53-3	0.0100	< 0.0100	
Anthracene	120-12-7	0.0100	< 0.0100	
Aramite	140-57-8	0.0100	< 0.0100	
Azobenzene	103-33-3	0.0100	< 0.0100	
Benz(a)anthracene	56-55-3	0.0100	< 0.0100	
Benzidine	92-87-5	0.0100	< 0.0100	
Benzo(a)pyrene	50-32-8	0.0100	< 0.0100	
Benzo(b)fluoranthene	205-99-2	0.0100	< 0.0100	
Benzo(g,h,i)perylene	191-24-2	0.0100	< 0.0100	
Benzo(k)fluoranthene	207-08-9	0.0100	< 0.0100	
Benzoic acid	65-85-0	0.0200	< 0.0200	
Benzyl alcohol	100-51-6	0.0100	< 0.0100	
Bis(2-chloroethoxy)methane	111-91-1	0.0100	< 0.0100	

Lab Sample ID: 1201439-003B
Client Sample ID: 3A,B+C

Analyzed: 2/7/2012 1533h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com
web: www.awal-labs.com
Kyle F. Gross
Laboratory Director
Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Bis(2-chloroethyl) ether	111-44-4	0.0100	< 0.0100	
Bis(2-chloroisopropyl) ether	108-60-1	0.0100	< 0.0100	
Bis(2-ethylhexyl) phthalate	117-81-7	0.0100	< 0.0100	
bis(2-ethylhexyl)adipate	103-23-1	0.0100	< 0.0100	
Butyl benzyl phthalate	85-68-7	0.0100	< 0.0100	
Carbazole	86-74-8	0.0100	< 0.0100	
Chlorobenzilate	510-15-6	0.0100	< 0.0100	
Chrysene	218-01-9	0.0100	< 0.0100	
Di-n-butyl phthalate	84-74-2	0.0100	< 0.0100	
Di-n-octyl phthalate	117-84-0	0.0100	< 0.0100	
Diallate (cis or trans)	2303-16-4	0.0100	< 0.0100	
Dibenz(a,h)anthracene	53-70-3	0.0100	< 0.0100	
Dibenzofuran	132-64-9	0.0100	< 0.0100	
Diethyl phthalate	84-66-2	0.0100	< 0.0100	
Dimethoate	60-51-5	0.0100	< 0.0100	
Dimethyl phthalate	131-11-3	0.0100	< 0.0100	
Dimethylaminoazobenzene	60-11-7	0.0100	< 0.0100	
Dinoseb	88-85-7	0.0100	< 0.0100	
Diphenylamine	122-39-4	0.0100	< 0.0100	
Disulfoton	298-04-4	0.0100	< 0.0100	
Ethyl methanesulfonate	62-50-0	0.0100	< 0.0100	
Famphur	52-85-7	0.0100	< 0.0100	
Fluoranthene	206-44-0	0.0100	< 0.0100	
Fluorene	86-73-7	0.0100	< 0.0100	
Hexachlorobenzene	118-74-1	0.0100	< 0.0100	
Hexachlorobutadiene	87-68-3	0.0100	< 0.0100	
Hexachlorocyclopentadiene	77-47-4	0.0100	< 0.0100	
Hexachloroethane	67-72-1	0.0100	< 0.0100	
Hexachlorophene	70-30-4	0.0100	< 0.0100	
Hexachloropropene	1888-71-7	0.0100	< 0.0100	
Indene	95-13-6	0.0100	< 0.0100	
Indeno(1,2,3-cd)pyrene	193-39-5	0.0100	< 0.0100	
Isodrin	465-73-6	0.0100	< 0.0100	
Isophorone	78-59-1	0.0100	< 0.0100	
Isosafrole	120-58-1	0.0100	< 0.0100	

Lab Sample ID: 1201439-003B

Client Sample ID: 3A,B+C

Analyzed: 2/7/2012 1533h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h

Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Kepone	143-50-0	0.0100	< 0.0100	
Methapyrilene	91-80-5	0.0100	< 0.0100	
Methyl methanesulfonate	66-27-3	0.0100	< 0.0100	
n-Decane	124-18-5	0.0100	< 0.0100	
N-Nitrosodi-n-butylamine	924-16-3	0.0100	< 0.0100	
N-Nitrosodiethylamine	55-18-5	0.0100	< 0.0100	
N-Nitrosodimethylamine	62-75-9	0.0100	< 0.0100	
N-Nitrosodiphenylamine	86-30-6	0.0100	< 0.0100	
N-Nitrosodi-n-propylamine	621-64-7	0.0100	< 0.0100	
N-Nitrosomethylethylamine	10595-95-6	0.0100	< 0.0100	
N-Nitrosomorpholine	59-89-2	0.0100	< 0.0100	
N-Nitrosopiperidine	100-75-4	0.0100	< 0.0100	
N-Nitrosopyrrolidine	930-55-2	0.0100	< 0.0100	
n-Octadecane	593-45-3	0.0100	< 0.0100	
Naphthalene	91-20-3	0.0100	< 0.0100	
Nitrobenzene	98-95-3	0.0100	< 0.0100	
Nitroquinoline-1-oxide	56-57-5	0.0100	< 0.0100	
O,O,O-Triethyl phosphorothioate	126-68-1	0.0100	< 0.0100	
o-Toluidine	95-53-4	0.0100	< 0.0100	
Parathion	56-38-2	0.0100	< 0.0100	
Methyl parathion	298-00-0	0.0100	< 0.0100	
Pentachlorobenzene	608-93-5	0.0100	< 0.0100	
Pentachloronitrobenzene	82-68-8	0.0100	< 0.0100	
Pentachlorophenol	87-86-5	0.0100	< 0.0100	
Phenacetin	62-44-2	0.0100	< 0.0100	
Phenanthrene	85-01-8	0.0100	< 0.0100	
Phenol	108-95-2	0.0100	< 0.0100	
Phorate	298-02-2	0.0100	< 0.0100	
Pronamide	23950-58-5	0.0100	< 0.0100	
Pyrene	129-00-0	0.0100	< 0.0100	
Pyridine	110-86-1	0.0100	< 0.0100	
Quinoline	91-22-5	0.0100	< 0.0100	
Safrole	94-59-7	0.0100	< 0.0100	
Tetraethyl dithiopyrophosphate	3689-24-5	0.0100	< 0.0100	
Thionazin	297-97-2	0.0100	< 0.0100	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-003B
Client Sample ID: 3A,B+C

Analyzed: 2/7/2012 1533h **Extracted:** 2/3/2012 1025h **SPLP Prep Date:** 2/1/2012 1840h
Units: mg/L **Dilution Factor:** 1

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Terphenyl-d14	1718-51-0	0.0389	0.04000	97.3	10-199	
Surr: Phenol-d6	13127-88-3	0.0181	0.08000	22.6	10-122	
Surr: Nitrobenzene-d5	4165-60-0	0.0138	0.04000	34.6	10-180	
Surr: 2-Fluorophenol	367-12-4	0.0238	0.08000	29.8	14-106	
Surr: 2-Fluorobiphenyl	321-60-8	0.0134	0.04000	33.6	10-124	
Surr: 2,4,6-Tribromophenol	118-79-6	0.0580	0.08000	72.5	10-159	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-001A
Client Sample ID: 1A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 2/5/2012 153h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	**0.0722**	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	

American West
ANALYTICAL LABORATORIES

Lab Sample ID: 1201439-001A
Client Sample ID: 1A,B+C

Analyzed: 2/5/2012 153h   **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L   **Dilution Factor:** 1

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-001A
Client Sample ID: 1A,B+C

Analyzed: 2/5/2012 153h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-001A
Client Sample ID: 1A,B+C

Analyzed: 2/5/2012 153h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	< 0.00200	
TPH C11-C15 (DRO)		0.0200	**0.0308**	
TPH C6-C10 (GRO)		0.0200	< 0.0200	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0509	0.05000	102	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0495	0.05000	99.0	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0511	0.05000	102	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0466	0.05000	93.2	72-151	

ORGANIC ANALYTICAL REPORT

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-002A
Client Sample ID: 2A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 2/5/2012 215h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	**0.0648**	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-002A
Client Sample ID: 2A,B+C

Analyzed: 2/5/2012 215h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-002A
Client Sample ID: 2A,B+C

Analyzed: 2/5/2012 215h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	**0.00501**	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-002A
Client Sample ID: 2A,B+C

Analyzed: 2/5/2012 215h | **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L | **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	**0.00663**	
TPH C11-C15 (DRO)		0.0200	**0.0363**	
TPH C6-C10 (GRO)		0.0200	**0.0223**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0524	0.05000	105	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0510	0.05000	102	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0524	0.05000	105	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0483	0.05000	96.6	72-151	

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: American Sands Energy Corp. **Contact:** William Gibbs
Project: Green River Resources
Lab Sample ID: 1201439-003A
Client Sample ID: 3A,B+C
Collection Date: 1/30/2012 1400h
Received Date: 1/31/2012 1010h **Method:** SW8260C

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 2/5/2012 237h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	**0.00364**	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	**0.00460**	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	**0.0426**	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-003A
Client Sample ID: 3A,B+C
Analyzed: 2/5/2012 237h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	**0.0104**	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	**0.00516**	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	**0.00761**	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1201439-003A
Client Sample ID: 3A,B+C

Analyzed: 2/5/2012 237h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	**0.0383**	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	< 0.00200	
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	**0.0146**	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	**0.00312**	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	**0.0511**	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	

Lab Sample ID: 1201439-003A
Client Sample ID: 3A,B+C

Analyzed: 2/5/2012 237h **SPLP Prep Date:** 2/1/2012 1945h
Units: mg/L **Dilution Factor:** 1

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	**0.0528**	
TPH C11-C15 (DRO)		0.0200	**0.0429**	
TPH C6-C10 (GRO)		0.0200	**0.134**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0489	0.05000	97.8	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0462	0.05000	92.5	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0495	0.05000	99.0	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0459	0.05000	91.8	72-151	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West Analytical Laboratories

D

WORK ORDER Summary

Work Order: 1201439
Page 1 of 3 2/1/2012

Client: American Sands Energy Corp.
Client ID: WALKIN **Contact:** William Gibbs
Project: Green River Resources **QC Level:** LEVEL I **WO Type:** Standard
Comments: Do not release w/o Financial Arrangements! / email to Karla Knoop @ JBR and Larry777@roadrunner.com; Run All analysis on leachate created from SPLP; pH received out of hold; Use Fluid #3 (DI Water) for SPLP;

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1201439-001A	1A,B+C	1/30/2012 1400h	1/31/2012 1010h	2/14/2012	Miscellaneous	1312ZHE-PR	☐	SPLP - voc	1
						8260-W-SPLP	☑	SPLP - voc	
1201439-001B						1312LM-PR	☐	SPLP - svoc	
						1312LO-PR	☐	SPLP - svoc	
						3005A-SPLP-PR	☐	SPLP - svoc	
						3510-SVOA-SPLP-PR	☐	SPLP - svoc	
						6010C-SPLP	☑	SPLP - svoc	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP - svoc	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8270-W-SPLP	☑	SPLP - svoc	
						HG-SPLP-7470A	☐	SPLP - svoc	
						HG-SPLP-PR	☐	SPLP - svoc	
1201439-001C						1312LM-PR	☐	SPLP - wc	
						300.0-W	☑	SPLP - wc	
	SEL Analytes: CL F SO4								
						ALK-W-2320B	☑	SPLP - wc	
	SEL Analytes: ALK								
						NO2/NO3-W-353.2	☐	SPLP - wc	
						OGB-W-1664A	☐	SPLP - wc	
						PH-4500H+B	☐	SPLP - wc	
						TDS-W-2540C	☐	SPLP - wc	
						TOC-W-5310B	☐	SPLP - wc	
1201439-002A	2A,B+C					1312ZHE-PR	☐	SPLP - voc	
						8260-W-SPLP	☑	SPLP - voc	
1201439-002B						1312LM-PR	☐	SPLP - svoc	
						1312LO-PR	☐	SPLP - svoc	
						3005A-SPLP-PR	☐	SPLP - svoc	

WORK ORDER Summary

Client: American Sands Energy Corp.

Work Order: **1201439**

 2/1/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1201439-002B	2A,B+C	1/30/2012 1400h	1/31/2012 1010h	2/14/2012	Miscellaneous	3510-SVOA-SPLP-PR	☐	SPLP - svoc	1
						6010C-SPLP	☑	SPLP - svoc	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP - svoc	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8270-W-SPLP	☑	SPLP - svoc	
						HG-SPLP-7470A	☐	SPLP - svoc	
						HG-SPLP-PR	☐	SPLP - svoc	
1201439-002C						1312LM-PR	☐	SPLP - wc	
						300.0-W	☑	SPLP - wc	
	SEL Analytes: CL F SO4								
						ALK-W-2320B	☑	SPLP - wc	
	SEL Analytes: ALK								
						NO2/NO3-W-353.2	☐	SPLP - wc	
						OGB-W-1664A	☐	SPLP - wc	
						PH-4500H+B	☐	SPLP - wc	
						TDS-W-2540C	☐	SPLP - wc	
						TOC-W-5310B	☐	SPLP - wc	
1201439-003A	3A,B+C					1312ZHE-PR	☐	SPLP - voc	
						8260-W-SPLP	☑	SPLP - voc	
1201439-003B						1312LM-PR	☐	SPLP - svoc	
						1312LO-PR	☐	SPLP - svoc	
						3005A-SPLP-PR	☐	SPLP - svoc	
						3510-SVOA-SPLP-PR	☐	SPLP - svoc	
						6010C-SPLP	☑	SPLP - svoc	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP - svoc	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8270-W-SPLP	☑	SPLP - svoc	
						HG-SPLP-7470A	☐	SPLP - svoc	
						HG-SPLP-PR	☐	SPLP - svoc	
1201439-003C						1312LM-PR	☐	SPLP - wc	
						300.0-W	☑	SPLP - wc	
	SEL Analytes: CL F SO4								

WORK ORDER Summary

Client: American Sands Energy Corp.

Work Order: 1201439

2/1/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1201439-003C	3A,B+C **SEL Analytes: ALK**	1/30/2012 1400h	1/31/2012 1010h	2/14/2012	Miscellaneous	ALK-W-2320B	☑	SPLP - wc	1
						NO2/NO3-W-353.2	☐	SPLP - wc	
						OGB-W-1664A	☐	SPLP - wc	
						PH-4500H+B	☐	SPLP - wc	
						TDS-W-2540C	☐	SPLP - wc	
						TOC-W-5310B	☐	SPLP - wc	

Fill out completely; Client is whoever will used to set up acct.

GO-BY

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115

CHAIN OF CUSTODY

(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email: awal@awal-labs.com

Lab Sample Set # 120439
Page 1 of 2

Turn Around Time (Circle One)
1 day 2 day 3 day 4 day 5 day **Standard** (circled)

Client: American Sands Energy Corp.
Address:
City / State / Zip: 39166
Phone: 801 277 7888 Cell (801) 699
Contact: William Gibbs
E-mail: wgibbs@greenriverresources.net
Project Name: Green River Resources
Project Number/P.O.#:
Sampler Name:

Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	SPLP, with leachate as per attachment	COMMENTS
	1/30/12 14:00				
Processed Sands, Run 1 1A, B+C	mm/dd/yy hh:mm	S	3	X	Use SPLP
Processed Sands, Run 2 2A, B+C	mm/dd/yy hh:mm	S	3	X	fluid #3
Processed Sands, Run 3 3A, B+C	mm/dd/yy hh:mm	S	3	X	(DI water)
	*per Larry Shultz 1/31/12		↑		1-31-12
Above-listed are example IDs only;		S for solids	1 large + 1 small		
Use whatever descriptive ID you					
choose.					

QC LEVEL: **1** (circled) 2 2+ 3 3+ 4

Relinquished By: Signature	Date	Received By: Signature	Date
[signature] PRINT NAME: LARRY Shultz (1)	1/30/12 Time 3PM	PRINT NAME (2)	Time
Relinquished By: Signature PRINT NAME (3)	Date / Time	Received By: Signature PRINT NAME	Date / Time
Relinquished By: Signature PRINT NAME	Date / Time	Received By: Signature PRINT NAME	Date / Time
Relinquished By: Signature PRINT NAME	Date / Time	Received By: Signature [signature] PRINT NAME Elona Hayward	Date 1/31/12 Time 10:10

Special Instructions:
Leachate from SPLP should be analzed for the general chemistry, organics, and metals listed on the attached list.

Send analytical report to above Client and to Karla Knoop, JBR Environmental at kknoop@jbrenv.com. If questions, call Karla Knoop @ 801-438-2245. Cell (435) 650-1238
SEND COPY TO LARRY777@ROADRUNNER.COM

LABORATORY USE ONLY

SAMPLES WERE:
1. Shipped or hand delivered — Notes: FedX
2. Ambient or Chilled — Notes: on ice
3. Temperature 2.7
4. Received Broken/Leaking (Improperly Sealed) Y N — Notes:
5. Properly Preserved Y N; Checked at Bench Y N — Notes:
6. Received Within Holding Times Y N — Notes: PH out of Hold

COC Tape Was:
1. Present on Outer Package Y N NA
2. Unbroken on Outer Package Y N NA
3. Present on Sample Y N NA
4. Unbroken on Sample Y N NA

Discrepancies Between Sample Labels and COC Record? Y N — Notes:

Actual sampler should complete first block. If a different person is responsible for shipping, that person would complete blocks 2 + 3.

SAMPLES 1A, 1B, 1C
2A, 2B, 2C
3A, 3B, 3C

American Sands Energy Corp.
Processed Tar Sands analysis
Additional Information attached to Chain-of-Custody
Date: 1/30/12

Three sample sets composed of ~~1~~ Three 3 containers each should be subjected to SPLP, EPA Method 1312. Note that nitrate+nitrite is included in list below; do not use nitric acid in the leaching fluid for this component of the analysis.

Use SPLP. fluid #3 (DI water) as previously discussed with John Wallace + Bob Bayer [signature] 1-31-12

Analyze leachate for the following:

General:

- pH
- total dissolved solids
- major ions (including Ca, Cl, K, Mg, Na, SO^4, alkalinity)

Organics:

- Total organic carbon
- Oil and grease
- VOCs using complete list
- SVOCs using complete list

Metals:

Ag,	Pb,
As,	Mn,
B,	Mo,
Ba	Ni,
Be,	Sb,
Cd,	Se,
Cr,	Sn
Cu,	Tl
Fe,	V
Hg,	Zn
Li,	

Other:

- Nitrate+nitrite
- Fluoride
- Strontium

(end)

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Jon Schulman
JBR Environmental Consultants, Inc.
8160 So. Highland Dr. Ste A-4
Sandy, UT 84093
TEL: (801) 943-4144

RE: American Oil Sands

Dear Jon Schulman: Lab Set ID: 1209452

American West Analytical Laboratories received 8 sample(s) on 9/26/2012 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Association Conference (NELAC) Institute in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, and Missouri. In addition, AWAL is also accredited by the American Analytical Laboratory Association (A2LA) on ISO IEC 17025:2005, Department of Defense (DOD), UST for the State of Wyoming, and the National Lead Laboratory Accreditation Program (NLLAP). All analyses were performed in accordance to The NELAC Institute and/or A2LA protocols unless noted otherwise. Accreditation documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

Thank You,

Approved by: ______________________________
Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-001
Client Sample ID: U-001A
Collection Date: 9/25/2012 945h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date:

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Arsenic	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Barium	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.0100	**0.0413**	
Beryllium	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Boron	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.000500	< 0.000500	
Calcium	mg/L	10/11/2012 920h	10/11/2012 1405h	SW6010C	1.00	**2.81**	
Chromium	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Iron	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.100	**1.17**	
Lead	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.0100	< 0.0100	
Lithium	mg/L	10/9/2012 1050h	10/10/2012 1448h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	**0.684**	
Mercury	mg/L	10/1/2012 1455h	10/2/2012 1110h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	**0.0277**	
Potassium	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Silver	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Sodium	mg/L	10/11/2012 920h	10/11/2012 1405h	SW6010C	1.00	< 1.00	
Strontium	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.00200	< 0.00200	
Tin	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/9/2012 1050h	10/10/2012 1442h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	10/2/2012 1125h	10/4/2012 1803h	SW6020A	0.100	< 0.100	

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-003
Client Sample ID: U-002A
Collection Date: 9/25/2012 1055h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date:

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Arsenic	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Barium	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.0100	**0.0401**	
Beryllium	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Boron	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.000500	< 0.000500	
Calcium	mg/L	10/11/2012 920h	10/11/2012 1421h	SW6010C	1.00	**2.62**	
Chromium	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	**0.00302**	
Iron	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.100	**1.18**	
Lead	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.0100	< 0.0100	
Lithium	mg/L	10/9/2012 1050h	10/10/2012 1451h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	**0.614**	
Mercury	mg/L	10/1/2012 1455h	10/2/2012 1117h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	**0.0283**	
Potassium	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Silver	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Sodium	mg/L	10/11/2012 920h	10/11/2012 1421h	SW6010C	1.00	**1.24**	
Strontium	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.00200	< 0.00200	
Tin	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/9/2012 1050h	10/10/2012 1450h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	10/2/2012 1125h	10/4/2012 1849h	SW6020A	0.100	< 0.100	

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-005
Client Sample ID: U-003A
Collection Date: 9/25/2012 1240h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results SPLP METALS Method 1312

SPLP Prep Date:

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Arsenic	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Barium	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.0100	**0.0353**	
Beryllium	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Boron	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.000500	< 0.000500	
Calcium	mg/L	10/11/2012 920h	10/11/2012 1425h	SW6010C	1.00	**2.24**	
Chromium	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	**0.00252**	
Iron	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.100	**1.17**	
Lead	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.0100	< 0.0100	
Lithium	mg/L	10/9/2012 1050h	10/10/2012 1453h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	**0.457**	
Mercury	mg/L	10/1/2012 1455h	10/2/2012 1123h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	**0.0243**	
Potassium	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Silver	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Sodium	mg/L	10/11/2012 920h	10/11/2012 1425h	SW6010C	1.00	**1.50**	
Strontium	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.00200	< 0.00200	
Tin	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/9/2012 1050h	10/10/2012 1519h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	10/2/2012 1125h	10/4/2012 1925h	SW6020A	0.100	< 0.100	

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

American West ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-007
Client Sample ID: U-004A
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

Analytical Results SPLP METALS Method 1312

SPLP Prep Date:

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Antimony	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Arsenic	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Barium	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.0100	**0.0266**	
Beryllium	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Boron	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.500	< 0.500	
Cadmium	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.000500	**0.000924**	
Calcium	mg/L	10/11/2012 920h	10/11/2012 1443h	SW6010C	1.00	**5.42**	
Chromium	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.0100	< 0.0100	
Copper	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	**0.0176**	
Iron	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.100	**0.300**	
Lead	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.0100	< 0.0100	
Lithium	mg/L	10/9/2012 1050h	10/10/2012 1456h	SW6010C	0.100	< 0.100	~
Magnesium	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	1.00	< 1.00	
Manganese	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	**0.0669**	
Mercury	mg/L	10/1/2012 1455h	10/2/2012 1124h	SW7470A	0.00100	< 0.00100	
Molybdenum	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.0200	< 0.0200	
Nickel	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	**0.0309**	
Potassium	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	1.00	< 1.00	
Selenium	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Silver	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Sodium	mg/L	10/11/2012 920h	10/11/2012 1443h	SW6010C	1.00	**1.48**	
Strontium	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.0500	< 0.0500	
Thallium	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.00200	< 0.00200	
Tin	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.500	< 0.500	
Vanadium	mg/L	10/9/2012 1050h	10/10/2012 1604h	SW6010C	0.0500	< 0.0500	
Zinc	mg/L	10/2/2012 1125h	10/4/2012 1935h	SW6020A	0.100	**0.306**	

~ - The above result was not performed in accordance with NELAP requirements.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-001
Client Sample ID: U-001A
Collection Date: 9/25/2012 945h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/2/2012 952h	SM2320B	10.0	< 10.0	
Chloride	mg/L		10/1/2012 1824h	SM4500-Cl-E	5.00	< 5.00	
Oil & Grease	mg/L		10/2/2012 1351h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/1/2012 1630h	SW9040C	1.00	**6.27**	
Sulfate	mg/L		10/2/2012 600h	SM4500-SO4-E	5.00	**11.2**	
Total Dissolved Solids	mg/L		10/2/2012 1215h	SM2540C	10.0	**14.0**	#
Total Organic Carbon	mg/L		10/3/2012 1558h	SM5310B	1.00	**6.69**	B
Total Recoverable Petroleum Hydrocarbons	mg/L		10/3/2012 1501h	E1664A-SGT	3.00	< 3.00	

Analysis performed on an SPLP extract by method 1312.
B - This analyte was also detected in the SPLP method blank above the PQL at 1.0056 mg/L. The batch method blank was below the PQL.
 # - High RPD due to low analyte concentration. In this range, high RPDs are expected.

INORGANIC ANALYTICAL REPORT

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-002
Client Sample ID: U-001B
Collection Date: 9/25/2012 945h
Received Date: 9/26/2012 1100h

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Conductivity	µmhos/cm		10/1/2012 610h	SW9050A	10.0	**169**	&
pH @ 25° C	pH Units		9/28/2012 1720h	SW9045D	1.00	**4.90**	H
Sodium Adsorption Ratio			10/10/2012	Calc.	0.0100	**0.0861**	&

H - Sample was received outside of the holding time.
& - Analysis is performed on a 1:1 DI water extract for soils.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-003
Client Sample ID: U-002A
Collection Date: 9/25/2012 1055h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/2/2012 952h	SM2320B	10.0	< 10.0	
Chloride	mg/L		10/1/2012 1825h	SM4500-Cl-E	5.00	< 5.00	
Oil & Grease	mg/L		10/2/2012 1351h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/1/2012 1630h	SW9040C	1.00	**5.89**	
Sulfate	mg/L		10/2/2012 600h	SM4500-SO4-E	5.00	**9.03**	
Total Dissolved Solids	mg/L		10/2/2012 1215h	SM2540C	10.0	**14.0**	
Total Organic Carbon	mg/L		10/3/2012 1708h	SM5310B	1.00	**7.14**	B
Total Recoverable Petroleum Hydrocarbons	mg/L		10/3/2012 1501h	E1664A-SGT	3.00	< 3.00	

Analysis performed on an SPLP extract by method 1312.
B - This analyte was also detected in the SPLP method blank above the PQL at 1.0056 mg/L. The batch method blank was below the PQL.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-004
Client Sample ID: U-002B
Collection Date: 9/25/2012 1055h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Conductivity	µmhos/cm		10/1/2012 610h	SW9050A	10.0	**179**	&
pH @ 25° C	pH Units		9/28/2012 1720h	SW9045D	1.00	**4.74**	H
Sodium Adsorption Ratio			10/10/2012	Calc.	0.0100	**0.0947**	&

H - Sample was received outside of the holding time.
& - Analysis is performed on a 1:1 DI water extract for soils.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-005
Client Sample ID: U-003A
Collection Date: 9/25/2012 1240h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/2/2012 952h	SM2320B	10.0	< 10.0	
Chloride	mg/L		10/1/2012 1826h	SM4500-Cl-E	5.00	< 5.00	
Oil & Grease	mg/L		10/2/2012 1351h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/1/2012 1630h	SW9040C	1.00	**4.51**	
Sulfate	mg/L		10/2/2012 600h	SM4500-SO4-E	5.00	**7.95**	
Total Dissolved Solids	mg/L		10/2/2012 1215h	SM2540C	10.0	**20.0**	
Total Organic Carbon	mg/L		10/3/2012 1731h	SM5310B	1.00	**6.90**	B
Total Recoverable Petroleum Hydrocarbons	mg/L		10/3/2012 1501h	E1664A-SGT	3.00	< 3.00	

Analysis performed on an SPLP extract by method 1312.

B - This analyte was also detected in the SPLP method blank above the PQL at 1.0056 mg/L. The batch method blank was below the PQL.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-006
Client Sample ID: U-003B
Collection Date: 9/25/2012 1240h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Conductivity	µmhos/cm		10/1/2012 610h	SW9050A	10.0	**223**	&
pH @ 25° C	pH Units		9/28/2012 1720h	SW9045D	1.00	**4.70**	H
Sodium Adsorption Ratio			10/10/2012	Calc.	0.0100	**0.104**	&

H - Sample was received outside of the holding time.
& - Analysis is performed on a 1:1 DI water extract for soils.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-007
Client Sample ID: U-004A
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Alkalinity (as CaCO3)	mg/L		10/2/2012 952h	SM2320B	10.0	< 10.0	
Chloride	mg/L		10/1/2012 1828h	SM4500-Cl-E	5.00	< 5.00	
Oil & Grease	mg/L		10/2/2012 1351h	E1664A	3.00	< 3.00	
pH @ 25° C	pH Units		10/1/2012 1630h	SW9040C	1.00	**3.60**	
Sulfate	mg/L		10/2/2012 600h	SM4500-SO4-E	5.00	**22.1**	
Total Dissolved Solids	mg/L		10/2/2012 1215h	SM2540C	10.0	**46.0**	
Total Organic Carbon	mg/L		10/3/2012 1753h	SM5310B	1.00	**2.83**	B
Total Recoverable Petroleum Hydrocarbons	mg/L		10/3/2012 1501h	E1664A-SGT	3.00	< 3.00	

Analysis performed on an SPLP extract by method 1312.
B - This analyte was also detected in the SPLP method blank above the PQL at 1.0056 mg/L. The batch method blank was below the PQL.

INORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-008
Client Sample ID: U-004B
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Conductivity	µmhos/cm		10/2/2012 710h	SW9050A	10.0	**332**	&
pH @ 25° C	pH Units		10/1/2012 1625h	SW9045D	1.00	**4.24**	H
Sodium Adsorption Ratio			10/10/2012	Calc.	0.0100	**0.222**	&

H - Sample was received outside of the holding time.
& - Analysis is performed on a 1:1 DI water extract for soils.

ORGANIC ANALYTICAL REPORT

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-001A
Client Sample ID: U-001A
Collection Date: 9/25/2012 945h
Received Date: 9/26/2012 1100h

Analytical Results TPH-DRO (C10-C28) by GC/FID Method 8015D/3510C

Analyzed: 10/2/2012 1428h **Extracted:** 10/2/2012 939h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8015D

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Diesel Range Organics (DRO) (C10-C28)	68476-34-6	0.500	**0.676**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: 4-Bromofluorobenzene	460-00-4	0.118	0.4000	29.4	10-190	

Analysis performed on an SPLP extract by method 1312.

ORGANIC ANALYTICAL REPORT

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-003A
Client Sample ID: U-002A
Collection Date: 9/25/2012 1055h
Received Date: 9/26/2012 1100h

Analytical Results TPH-DRO (C10-C28) by GC/FID Method 8015D/3510C

Analyzed: 10/2/2012 1526h **Extracted:** 10/2/2012 939h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8015D

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Diesel Range Organics (DRO) (C10-C28)	68476-34-6	0.500	**0.755**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: 4-Bromofluorobenzene	460-00-4	0.138	0.4000	34.4	10-190	

Analysis performed on an SPLP extract by method 1312.

ORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-005A
Client Sample ID: U-003A
Collection Date: 9/25/2012 1240h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results TPH-DRO (C10-C28) by GC/FID Method 8015D/3510C

Analyzed: 10/2/2012 1546h **Extracted:** 10/2/2012 939h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8015D

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Diesel Range Organics (DRO) (C10-C28)	68476-34-6	0.500	**0.832**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: 4-Bromofluorobenzene	460-00-4	0.136	0.4000	33.9	10-190	

Analysis performed on an SPLP extract by method 1312.

ORGANIC ANALYTICAL REPORT

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-007A
Client Sample ID: U-004A
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

Analytical Results TPH-DRO (C10-C28) by GC/FID Method 8015D/3510C

Analyzed: 10/2/2012 1605h **Extracted:** 10/2/2012 939h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8015D

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Diesel Range Organics (DRO) (C10-C28)	68476-34-6	0.500	**1.40**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: 4-Bromofluorobenzene	460-00-4	0.134	0.4000	33.4	10-190	

Analysis performed on an SPLP extract by method 1312.

ORGANIC ANALYTICAL REPORT

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-001A
Client Sample ID: U-001A
Collection Date: 9/25/2012 945h
Received Date: 9/26/2012 1100h

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 10/2/2012 1110h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	**0.0101**	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com
web: www.awal-labs.com
Kyle F. Gross
Laboratory Director
Jose Rocha
QA Officer

Lab Sample ID: 1209452-001A
Client Sample ID: U-001A

Analyzed: 10/2/2012 1110h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-001A
Client Sample ID: U-001A

Analyzed: 10/2/2012 1110h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	**0.00329**	B
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	**0.0129**	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	< 0.00200	
TPH C11-C15 (DRO)		0.0200	< 0.0200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-001A
Client Sample ID: U-001A

Analyzed: 10/2/2012 1110h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
TPH C6-C10 (GRO)		0.0200	**0.0971**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0491	0.05000	98.3	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0572	0.05000	114	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0537	0.05000	107	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0627	0.05000	125	72-151	

B - This analyte was also detected in MB-SPLP-21377.

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

ORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-003A
Client Sample ID: U-002A
Collection Date: 9/25/2012 1055h
Received Date: 9/26/2012 1100h

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 10/2/2012 1129h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	**0.0175**	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	**0.0110**	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-003A
Client Sample ID: U-002A

Analyzed: 10/2/2012 1129h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	**0.00209**	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	

Lab Sample ID: 1209452-003A
Client Sample ID: U-002A

Analyzed: 10/2/2012 1129h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	**0.0156**	B
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	**0.00327**	B
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	**0.0150**	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	**0.00350**	
o-Xylene	95-47-6	0.00200	**0.00569**	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	**0.00466**	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	**0.0213**	B
TPH C11-C15 (DRO)		0.0200	< 0.0200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-003A
Client Sample ID: U-002A

Analyzed: 10/2/2012 1129h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
TPH C6-C10 (GRO)		0.0200	**0.190**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Dibromofluoromethane	1868-53-7	0.0581	0.05000	116	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0507	0.05000	101	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0628	0.05000	126	72-151	
Surr: Toluene-d8	2037-26-5	0.0502	0.05000	100	77-129	

B - This analyte was also detected in MB-SPLP-21377.

ORGANIC ANALYTICAL REPORT

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-005A
Client Sample ID: U-003A
Collection Date: 9/25/2012 1240h
Received Date: 9/26/2012 1100h

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 10/2/2012 1149h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	**0.00281**	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	**0.00425**	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	**0.00245**	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	**0.0118**	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-005A
Client Sample ID: U-003A

Analyzed: 10/2/2012 1149h   **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L   **Dilution Factor:** 1   **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	

American West
ANALYTICAL LABORATORIES

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-005A
Client Sample ID: U-003A

Analyzed: 10/2/2012 1149h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	**0.00268**	B
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	**0.0138**	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	**0.00351**	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	< 0.00200	
TPH C11-C15 (DRO)		0.0200	< 0.0200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-005A
Client Sample ID: U-003A

Analyzed: 10/2/2012 1149h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
TPH C6-C10 (GRO)		0.0200	**0.162**	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0491	0.05000	98.2	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0560	0.05000	112	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0502	0.05000	100	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0608	0.05000	122	72-151	

B - This analyte was also detected in MB-SPLP-21377.

ORGANIC ANALYTICAL REPORT

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Client: JBR Environmental Consultants, Inc. **Contact:** Jon Schulman
Project: American Oil Sands
Lab Sample ID: 1209452-007A
Client Sample ID: U-004A
Collection Date: 9/25/2012
Received Date: 9/26/2012 1100h

Analytical Results VOAs SPLP 1312 List by GC/MS Method 8260C/5030C

Analyzed: 10/2/2012 1208h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
1,1,1,2-Tetrachloroethane	630-20-6	0.00200	< 0.00200	
1,1,1-Trichloroethane	71-55-6	0.00200	< 0.00200	
1,1,2,2-Tetrachloroethane	79-34-5	0.00200	< 0.00200	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.00200	< 0.00200	
1,1,2-Trichloroethane	79-00-5	0.00200	< 0.00200	
1,1-Dichloropropene	563-58-6	0.00200	< 0.00200	
1,1-Dichloroethane	75-34-3	0.00200	< 0.00200	
1,1-Dichloroethene	75-35-4	0.00200	< 0.00200	
1,2,3-Trichlorobenzene	87-61-6	0.00200	< 0.00200	
1,2,3-Trichloropropane	96-18-4	0.00200	< 0.00200	
1,2,3-Trimethylbenzene	526-73-8	0.00200	< 0.00200	
1,2,4-Trichlorobenzene	120-82-1	0.00200	< 0.00200	
1,2,4-Trimethylbenzene	95-63-6	0.00200	< 0.00200	
1,2-Dibromo-3-chloropropane	96-12-8	0.00500	< 0.00500	
1,2-Dibromoethane	106-93-4	0.00200	< 0.00200	
1,2-Dichlorobenzene	95-50-1	0.00200	< 0.00200	
1,2-Dichloroethane	107-06-2	0.00200	< 0.00200	
1,2-Dichloropropane	78-87-5	0.00200	< 0.00200	
1,3,5-Trimethylbenzene	108-67-8	0.00200	< 0.00200	
1,3-Dichlorobenzene	541-73-1	0.00200	< 0.00200	
1,3-Dichloropropane	142-28-9	0.00200	< 0.00200	
1,4-Dichlorobenzene	106-46-7	0.00200	< 0.00200	
1,4-Dioxane	123-91-1	0.0500	< 0.0500	
2,2-Dichloropropane	594-20-7	0.00200	< 0.00200	
2-Butanone	78-93-3	0.0100	< 0.0100	
2-Chloroethyl vinyl ether	110-75-8	0.00500	< 0.00500	
2-Chlorotoluene	95-49-8	0.00200	< 0.00200	
2-Hexanone	591-78-6	0.00500	< 0.00500	
2-Nitropropane	79-46-9	0.00500	< 0.00500	
4-Chlorotoluene	106-43-4	0.00200	< 0.00200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-007A
Client Sample ID: U-004A

Analyzed: 10/2/2012 1208h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
4-Isopropyltoluene	99-87-6	0.00200	< 0.00200	
4-Methyl-2-pentanone	108-10-1	0.00500	< 0.00500	
Acetone	67-64-1	0.0100	< 0.0100	
Acetonitrile	75-05-8	0.00500	< 0.00500	
Acrolein	107-02-8	0.00500	< 0.00500	
Acrylonitrile	107-13-1	0.0100	< 0.0100	
Allyl chloride	107-05-1	0.00500	< 0.00500	
Benzene	71-43-2	0.00100	< 0.00100	
Benzyl chloride	100-44-7	0.00500	< 0.00500	
Bis(2-chloroisopropyl) ether	108-60-1	0.00500	< 0.00500	
Bromobenzene	108-86-1	0.00200	< 0.00200	
Bromochloromethane	74-97-5	0.00200	< 0.00200	
Bromodichloromethane	75-27-4	0.00200	< 0.00200	
Bromoform	75-25-2	0.00200	< 0.00200	
Bromomethane	74-83-9	0.00500	< 0.00500	
Butyl acetate	123-86-4	0.00500	< 0.00500	
Carbon disulfide	75-15-0	0.00200	< 0.00200	
Carbon tetrachloride	56-23-5	0.00200	< 0.00200	
Chlorobenzene	108-90-7	0.00200	< 0.00200	
Chloroethane	75-00-3	0.00200	< 0.00200	
Chloroform	67-66-3	0.00200	< 0.00200	
Chloromethane	74-87-3	0.00300	< 0.00300	
Chloroprene	126-99-8	0.00200	< 0.00200	
cis-1,2-Dichloroethene	156-59-2	0.00200	< 0.00200	
cis-1,3-Dichloropropene	10061-01-5	0.00200	< 0.00200	
Cyclohexane	110-82-7	0.00200	< 0.00200	
Cyclohexanone	108-94-1	0.0500	< 0.0500	
Dibromochloromethane	124-48-1	0.00200	< 0.00200	
Dibromomethane	74-95-3	0.00200	< 0.00200	
Dichlorodifluoromethane	75-71-8	0.00200	< 0.00200	
Ethyl acetate	141-78-6	0.0100	< 0.0100	
Ethyl ether	60-29-7	0.0100	< 0.0100	
Ethyl methacrylate	97-63-2	0.00200	< 0.00200	
Ethylbenzene	100-41-4	0.00200	< 0.00200	
Hexachlorobutadiene	87-68-3	0.00200	< 0.00200	
Iodomethane	74-88-4	0.00500	< 0.00500	
Isobutyl alcohol	78-83-1	0.100	< 0.100	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-007A
Client Sample ID: U-004A

Analyzed: 10/2/2012 1208h **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L **Dilution Factor:** 1 **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
Isopropyl acetate	108-21-4	0.0200	< 0.0200	
Isopropyl alcohol	67-63-0	0.0250	< 0.0250	
Isopropylbenzene	98-82-8	0.00200	< 0.00200	
m,p-Xylene	179601-23-1	0.00200	< 0.00200	
Methacrylonitrile	126-98-7	0.00500	< 0.00500	
Methyl Acetate	79-20-9	0.00500	< 0.00500	
Methyl methacrylate	80-62-6	0.00500	< 0.00500	
Methyl tert-butyl ether	1634-04-4	0.00200	< 0.00200	
Methylcyclohexane	108-87-2	0.00200	< 0.00200	
Methylene chloride	75-09-2	0.00200	**0.00304**	B
n-Amyl acetate	628-63-7	0.00200	< 0.00200	
n-Butyl alcohol	71-36-3	0.0500	< 0.0500	
n-Butylbenzene	104-51-8	0.00200	< 0.00200	
n-Hexane	110-54-3	0.00200	< 0.00200	
n-Octane	111-65-9	0.00200	< 0.00200	
n-Propylbenzene	103-65-1	0.00200	< 0.00200	
Naphthalene	91-20-3	0.00200	< 0.00200	
o-Xylene	95-47-6	0.00200	< 0.00200	
Pentachloroethane	76-01-7	0.00500	< 0.00500	
Propionitrile	107-12-0	0.0250	< 0.0250	
Propyl acetate	109-60-4	0.00200	< 0.00200	
sec-Butylbenzene	135-98-8	0.00200	< 0.00200	
Styrene	100-42-5	0.00200	< 0.00200	
tert-Butyl alcohol	76-65-0	0.0200	< 0.0200	
tert-Butylbenzene	98-06-6	0.00200	< 0.00200	
Tetrachloroethene	127-18-4	0.00200	< 0.00200	
Tetrahydrofuran	109-99-9	0.00200	< 0.00200	
Toluene	108-88-3	0.00200	< 0.00200	
trans-1,2-Dichloroethene	156-60-5	0.00200	< 0.00200	
trans-1,3-Dichloropropene	10061-02-6	0.00200	< 0.00200	
trans-1,4-Dichloro-2-butene	110-57-6	0.00200	< 0.00200	
Trichloroethene	79-01-6	0.00200	< 0.00200	
Trichlorofluoromethane	75-69-4	0.00200	< 0.00200	
Vinyl acetate	108-05-4	0.0100	< 0.0100	
Vinyl chloride	75-01-4	0.00100	< 0.00100	
Xylenes, Total	1330-20-7	0.00200	< 0.00200	
TPH C11-C15 (DRO)		0.0200	< 0.0200	

463 West 3600 South
Salt Lake City, UT 84115

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Lab Sample ID: 1209452-007A
Client Sample ID: U-004A

Analyzed: 10/2/2012 1208h | **SPLP Prep Date:** 9/30/2012 1645h
Units: mg/L | **Dilution Factor:** 1 | **Method:** SW8260C

Compound	CAS Number	Reporting Limit	Analytical Result	Qual
TPH C6-C10 (GRO)		0.0200	< 0.0200	

Surrogate	CAS	Result	Amount Spiked	% REC	Limits	Qual
Surr: Toluene-d8	2037-26-5	0.0505	0.05000	101	77-129	
Surr: Dibromofluoromethane	1868-53-7	0.0571	0.05000	114	80-124	
Surr: 4-Bromofluorobenzene	460-00-4	0.0559	0.05000	112	80-128	
Surr: 1,2-Dichloroethane-d4	17060-07-0	0.0610	0.05000	122	72-151	

B - This analyte was also detected in MB-SPLP-21377.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

American West ANALYTICAL LABORATORIES

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-21529	Boron	mg/L	SW6010C	2.28	2.000	0	114	80-120				10/10/2012 1018h
LCS-21529	Chromium	mg/L	SW6010C	0.438	0.4000	0	109	80-120				10/10/2012 1018h
LCS-21529	Iron	mg/L	SW6010C	2.18	2.000	0	109	80-120				10/10/2012 1018h
LCS-21529	Magnesium	mg/L	SW6010C	21.4	20.00	0	107	80-120				10/10/2012 1018h
LCS-21529	Molybdenum	mg/L	SW6010C	0.422	0.4000	0	105	80-120				10/10/2012 1018h
LCS-21529	Potassium	mg/L	SW6010C	22.2	20.00	0	111	80-120				10/10/2012 1018h
LCS-21529	Strontium	mg/L	SW6010C	0.434	0.4000	0	109	80-120				10/10/2012 1018h
LCS-21529	Tin	mg/L	SW6010C	2.10	2.000	0	105	80-120				10/10/2012 1018h
LCS-21529	Vanadium	mg/L	SW6010C	0.428	0.4000	0	107	80-120				10/10/2012 1018h
LCS-21585	Calcium	mg/L	SW6010C	19.2	20.00	0	96.1	80-120				10/11/2012 1356h
LCS-21585	Sodium	mg/L	SW6010C	20.1	20.00	0	101	80-120				10/11/2012 1356h
LCS-21399	Antimony	mg/L	SW6020A	0.222	0.2000	0	111	85-115				10/4/2012 1753h
LCS-21399	Arsenic	mg/L	SW6020A	0.223	0.2000	0	112	85-115				10/4/2012 1753h
LCS-21399	Barium	mg/L	SW6020A	0.208	0.2000	0	104	85-115				10/4/2012 1753h
LCS-21399	Beryllium	mg/L	SW6020A	0.190	0.2000	0	95.2	85-115				10/4/2012 1753h
LCS-21399	Cadmium	mg/L	SW6020A	0.207	0.2000	0	104	85-115				10/4/2012 1753h
LCS-21399	Copper	mg/L	SW6020A	0.222	0.2000	0	111	85-115				10/4/2012 1753h
LCS-21399	Lead	mg/L	SW6020A	0.209	0.2000	0	104	85-115				10/4/2012 1753h
LCS-21399	Manganese	mg/L	SW6020A	0.217	0.2000	0	109	85-115				10/4/2012 1753h
LCS-21399	Nickel	mg/L	SW6020A	0.209	0.2000	0	105	85-115				10/4/2012 1753h
LCS-21399	Selenium	mg/L	SW6020A	0.214	0.2000	0	107	85-115				10/4/2012 1753h
LCS-21399	Silver	mg/L	SW6020A	0.208	0.2000	0	104	85-115				10/4/2012 1753h
LCS-21399	Thallium	mg/L	SW6020A	0.196	0.2000	0	97.9	85-115				10/4/2012 1753h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-21399	Zinc	mg/L	SW6020A	1.04	1.000	0	104	85-115				10/4/2012 1753h
LCS-21387	Mercury	mg/L	SW7470A	0.00309	0.003330	0	92.8	80-120				10/2/2012 1106h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-21529	Boron	mg/L	SW6010C	< 0.500				-				10/10/2012 1014h
MB-21529	Chromium	mg/L	SW6010C	< 0.0100				-				10/10/2012 1014h
MB-21529	Iron	mg/L	SW6010C	< 0.100				-				10/10/2012 1014h
MB-21529	Lithium	mg/L	SW6010C	< 0.100				-				10/10/2012 1443h
MB-21529	Magnesium	mg/L	SW6010C	< 1.00				-				10/10/2012 1014h
MB-21529	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/10/2012 1014h
MB-21529	Potassium	mg/L	SW6010C	< 1.00				-				10/10/2012 1014h
MB-21529	Strontium	mg/L	SW6010C	< 0.0500				-				10/10/2012 1014h
MB-21529	Tin	mg/L	SW6010C	< 0.500				-				10/10/2012 1014h
MB-21529	Vanadium	mg/L	SW6010C	< 0.0500				-				10/10/2012 1014h
MB-21585	Calcium	mg/L	SW6010C	< 1.00				-				10/11/2012 1352h
MB-21585	Sodium	mg/L	SW6010C	< 1.00				-				10/11/2012 1352h
MB-SPLP-21369	Boron	mg/L	SW6010C	< 0.500				-				10/10/2012 1022h
MB-SPLP-21369	Chromium	mg/L	SW6010C	< 0.0100				-				10/10/2012 1022h
MB-SPLP-21369	Iron	mg/L	SW6010C	< 0.100				-				10/10/2012 1022h
MB-SPLP-21369	Lithium	mg/L	SW6010C	< 0.100				-				10/10/2012 1445h
MB-SPLP-21369	Magnesium	mg/L	SW6010C	< 1.00				-				10/10/2012 1022h
MB-SPLP-21369	Molybdenum	mg/L	SW6010C	< 0.0200				-				10/10/2012 1022h
MB-SPLP-21369	Potassium	mg/L	SW6010C	< 1.00				-				10/10/2012 1022h
MB-SPLP-21369	Strontium	mg/L	SW6010C	< 0.0500				-				10/10/2012 1022h
MB-SPLP-21369	Tin	mg/L	SW6010C	< 0.500				-				10/10/2012 1022h
MB-SPLP-21369	Vanadium	mg/L	SW6010C	< 0.0500				-				10/10/2012 1022h
MB-SPLP-21575	Calcium	mg/L	SW6010C	< 1.00				-				10/11/2012 1348h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21575	Sodium	mg/L	SW6010C	< 1.00				-				10/11/2012 1348h
MB-21399	Antimony	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Arsenic	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Barium	mg/L	SW6020A	< 0.0100				-				10/4/2012 1735h
MB-21399	Beryllium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Cadmium	mg/L	SW6020A	< 0.000500				-				10/4/2012 1735h
MB-21399	Copper	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Lead	mg/L	SW6020A	< 0.0100				-				10/4/2012 1735h
MB-21399	Manganese	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Nickel	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Selenium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Silver	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Thallium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1735h
MB-21399	Zinc	mg/L	SW6020A	< 0.100				-				10/4/2012 1735h
MB-SPLP-21369	Antimony	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Arsenic	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Barium	mg/L	SW6020A	< 0.0100				-				10/4/2012 1744h
MB-SPLP-21369	Beryllium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Cadmium	mg/L	SW6020A	< 0.000500				-				10/4/2012 1744h
MB-SPLP-21369	Copper	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Lead	mg/L	SW6020A	< 0.0100				-				10/4/2012 1744h
MB-SPLP-21369	Manganese	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Nickel	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21369	Selenium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Silver	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Thallium	mg/L	SW6020A	< 0.00200				-				10/4/2012 1744h
MB-SPLP-21369	Zinc	mg/L	SW6020A	< 0.100				-				10/4/2012 1744h
MB-21387	Mercury	mg/L	SW7470A	< 0.00100				-				10/2/2012 1104h
MB-SPLP-21369	Mercury	mg/L	SW7470A	< 0.00100				-				10/2/2012 1126h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

American West Analytical Laboratories

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMS	Calcium	mg/L	SW6010C	21.7	20.00	2.814	94.4	75-125				10/11/2012 1413h
1209452-001AMS	Sodium	mg/L	SW6010C	20.3	20.00	0.3574	99.9	75-125				10/11/2012 1413h
1209452-003AMS	Boron	mg/L	SW6010C	2.09	2.000	0	104	75-125				10/10/2012 1459h
1209452-003AMS	Chromium	mg/L	SW6010C	0.396	0.4000	0	99.0	75-125				10/10/2012 1459h
1209452-003AMS	Iron	mg/L	SW6010C	3.09	2.000	1.178	95.7	75-125				10/10/2012 1459h
1209452-003AMS	Magnesium	mg/L	SW6010C	20.3	20.00	0.1813	101	75-125				10/10/2012 1459h
1209452-003AMS	Molybdenum	mg/L	SW6010C	0.409	0.4000	0	102	75-125				10/10/2012 1459h
1209452-003AMS	Potassium	mg/L	SW6010C	20.8	20.00	0	104	75-125				10/10/2012 1459h
1209452-003AMS	Strontium	mg/L	SW6010C	0.406	0.4000	0.005999	100	75-125				10/10/2012 1459h
1209452-003AMS	Tin	mg/L	SW6010C	2.01	2.000	0	100	75-125				10/10/2012 1459h
1209452-003AMS	Vanadium	mg/L	SW6010C	0.400	0.4000	0	99.9	75-125				10/10/2012 1459h
1209452-001AMS	Antimony	mg/L	SW6020A	0.221	0.2000	0.0001890	110	75-125				10/4/2012 1830h
1209452-001AMS	Arsenic	mg/L	SW6020A	0.223	0.2000	0.0002160	112	75-125				10/4/2012 1830h
1209452-001AMS	Barium	mg/L	SW6020A	0.245	0.2000	0.04131	102	75-125				10/4/2012 1830h
1209452-001AMS	Beryllium	mg/L	SW6020A	0.188	0.2000	0	93.8	75-125				10/4/2012 1830h
1209452-001AMS	Cadmium	mg/L	SW6020A	0.207	0.2000	0.0001210	104	75-125				10/4/2012 1830h
1209452-001AMS	Copper	mg/L	SW6020A	0.218	0.2000	0.001466	108	75-125				10/4/2012 1830h
1209452-001AMS	Lead	mg/L	SW6020A	0.207	0.2000	0.0003300	103	75-125				10/4/2012 1830h
1209452-001AMS	Manganese	mg/L	SW6020A	0.868	0.2000	0.6838	92.3	75-125				10/4/2012 1830h
1209452-001AMS	Nickel	mg/L	SW6020A	0.233	0.2000	0.02773	102	75-125				10/4/2012 1830h
1209452-001AMS	Selenium	mg/L	SW6020A	0.204	0.2000	0.0009600	101	75-125				10/4/2012 1830h
1209452-001AMS	Silver	mg/L	SW6020A	0.205	0.2000	0	102	75-125				10/4/2012 1830h
1209452-001AMS	Thallium	mg/L	SW6020A	0.191	0.2000	0.00005500	95.3	75-125				10/4/2012 1830h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMS	Zinc	mg/L	SW6020A	1.09	1.000	0.07212	101	75-125				10/4/2012 1830h
1209452-001AMS	Mercury	mg/L	SW7470A	0.00309	0.003330	0	92.8	80-120				10/2/2012 1113h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMSD	Calcium	mg/L	SW6010C	21.2	20.00	2.814	92.2	75-125	2.06	20		10/11/2012 1417h
1209452-001AMSD	Sodium	mg/L	SW6010C	19.9	20.00	0.3574	97.9	75-125	1.94	20		10/11/2012 1417h
1209452-003AMSD	Boron	mg/L	SW6010C	2.07	2.000	0	104	75-125	0.587	20		10/10/2012 1503h
1209452-003AMSD	Chromium	mg/L	SW6010C	0.401	0.4000	0	100	75-125	1.27	20		10/10/2012 1503h
1209452-003AMSD	Iron	mg/L	SW6010C	3.10	2.000	1.178	96.1	75-125	0.299	20		10/10/2012 1503h
1209452-003AMSD	Magnesium	mg/L	SW6010C	20.2	20.00	0.1813	100	75-125	0.683	20		10/10/2012 1503h
1209452-003AMSD	Molybdenum	mg/L	SW6010C	0.398	0.4000	0	99.5	75-125	2.59	20		10/10/2012 1503h
1209452-003AMSD	Potassium	mg/L	SW6010C	20.7	20.00	0	103	75-125	0.448	20		10/10/2012 1503h
1209452-003AMSD	Strontium	mg/L	SW6010C	0.404	0.4000	0.005999	99.5	75-125	0.546	20		10/10/2012 1503h
1209452-003AMSD	Tin	mg/L	SW6010C	1.98	2.000	0	99.2	75-125	1.28	20		10/10/2012 1503h
1209452-003AMSD	Vanadium	mg/L	SW6010C	0.395	0.4000	0	98.8	75-125	1.15	20		10/10/2012 1503h
1209452-001AMSD	Antimony	mg/L	SW6020A	0.221	0.2000	0.0001890	111	75-125	0.275	20		10/4/2012 1839h
1209452-001AMSD	Arsenic	mg/L	SW6020A	0.223	0.2000	0.0002160	111	75-125	0.133	20		10/4/2012 1839h
1209452-001AMSD	Barium	mg/L	SW6020A	0.247	0.2000	0.04131	103	75-125	1.06	20		10/4/2012 1839h
1209452-001AMSD	Beryllium	mg/L	SW6020A	0.191	0.2000	0	95.6	75-125	1.88	20		10/4/2012 1839h
1209452-001AMSD	Cadmium	mg/L	SW6020A	0.208	0.2000	0.0001210	104	75-125	0.119	20		10/4/2012 1839h
1209452-001AMSD	Copper	mg/L	SW6020A	0.217	0.2000	0.001466	108	75-125	0.393	20		10/4/2012 1839h
1209452-001AMSD	Lead	mg/L	SW6020A	0.202	0.2000	0.0003300	101	75-125	2.45	20		10/4/2012 1839h
1209452-001AMSD	Manganese	mg/L	SW6020A	0.897	0.2000	0.6838	107	75-125	3.23	20		10/4/2012 1839h
1209452-001AMSD	Nickel	mg/L	SW6020A	0.235	0.2000	0.02773	104	75-125	0.991	20		10/4/2012 1839h
1209452-001AMSD	Selenium	mg/L	SW6020A	0.209	0.2000	0.0009600	104	75-125	2.57	20		10/4/2012 1839h
1209452-001AMSD	Silver	mg/L	SW6020A	0.207	0.2000	0	103	75-125	1.09	20		10/4/2012 1839h
1209452-001AMSD	Thallium	mg/L	SW6020A	0.194	0.2000	0.00005500	97.1	75-125	1.82	20		10/4/2012 1839h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: ME
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMSD	Zinc	mg/L	SW6020A	1.09	1.000	0.07212	102	75-125	0.621	20		10/4/2012 1839h
1209452-001AMSD	Mercury	mg/L	SW7470A	0.00312	0.003330	0	93.7	80-120	0.966	20		10/2/2012 1115h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: DUP

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-002ADUP	Conductivity	µmhos/cm	SW9050A	169		169.0		-	0	10	&	10/1/2012 610h
1209452-008ADUP	Conductivity	µmhos/cm	SW9050A	330		332.0		-	0.604	10	&	10/2/2012 710h
1209452-001ADUP	pH @ 25° C	pH Units	SW9040C	6.24		6.270		-	0.48	10		10/1/2012 1630h
1209452-003ADUP	pH @ 25° C	pH Units	SW9040C	5.89		5.890		-	0	10		10/1/2012 1630h
1209452-005ADUP	pH @ 25° C	pH Units	SW9040C	4.51		4.510		-	0	10		10/1/2012 1630h
1209452-007ADUP	pH @ 25° C	pH Units	SW9040C	3.61		3.600		-	0.277	10		10/1/2012 1630h
1209452-002ADUP	pH @ 25° C	pH Units	SW9045D	4.88		4.900		-	0.409	10	H	9/28/2012 1720h
1209452-008ADUP	pH @ 25° C	pH Units	SW9045D	4.25		4.240		-	0.236	10	H	10/1/2012 1625h
1209452-001ADUP	Total Dissolved Solids	mg/L	SM2540C	16.0		14.00		-	13.3	5	#	10/2/2012 1215h

 # - High RPD due to low analyte concentration. In this range, high RPDs are expected.
H - Sample was received outside of the holding time.
& - Analysis is performed on a 1:1 DI water extract for soils.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-R45676	Alkalinity (as CaCO3)	mg/L	SM2320B	51,900	50,000	0	104	90-110				10/2/2012 952h
LCS-R45697	Chloride	mg/L	SM4500-Cl-E	25.3	25.00	0	101	90-110				10/1/2012 1822h
LCS-R45625	Conductivity	µmhos/cm	SW9050A	992	1,000	0	99.2	98-102				10/1/2012 610h
LCS-R45666	Conductivity	µmhos/cm	SW9050A	1,010	1,000	0	101	98-102				10/2/2012 710h
LCS-R45731	Oil & Grease	mg/L	E1664A	38.9	40.00	0	97.3	78-114				10/2/2012 1351h
LCS-R45766	Total Recoverable Petroleum Hydrocarbons	mg/L	E1664A-SGT	15.5	20.00	0	77.5	64-132				10/3/2012 1501h
LCS-R45659	pH @ 25° C	pH Units	SW9040C	9.02	9.000	0	100	98-102				10/1/2012 1630h
LCS-R45605	pH @ 25° C	pH Units	SW9045D	8.96	9.000	0	99.6	98-102				9/28/2012 1720h
LCS-R45658	pH @ 25° C	pH Units	SW9045D	8.98	9.000	0	99.8	98-102				10/1/2012 1625h
LCS-R45667	Sulfate	mg/L	SM4500-SO4-E	996	1,000	0	99.6	90-110				10/2/2012 600h
LCS-R45719	Total Dissolved Solids	mg/L	SM2540C	198	205.0	0	96.6	80-120				10/2/2012 1215h
LCS-R45767	Total Organic Carbon	mg/L	SM5310B	10.1	10.00	0	101	90-110				10/3/2012 1535h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-R45676	Alkalinity (as CaCO3)	mg/L	SM2320B	< 10.0				-				10/2/2012 952h
MB-SPLP-21369	Alkalinity (as CaCO3)	mg/L	SM2320B	< 10.0				-				10/2/2012 952h
MB-R45697	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				10/1/2012 1821h
MB-SPLP-21369	Chloride	mg/L	SM4500-Cl-E	< 5.00				-				10/1/2012 1823h
MB-R45625	Conductivity	µmhos/cm	SW9050A	< 10.0				-				10/1/2012 610h
MB-R45666	Conductivity	µmhos/cm	SW9050A	< 10.0				-				10/2/2012 710h
MB-R45731	Oil & Grease	mg/L	E1664A	< 3.00				-				10/2/2012 1351h
MB-SPLP-21369	Oil & Grease	mg/L	E1664A	< 3.00				-				10/2/2012 1351h
MB-R45766	Total Recoverable Petroleum Hydrocarbons	mg/L	E1664A-SGT	< 3.00				-				10/3/2012 1501h
MB-SPLP-21369	Total Recoverable Petroleum Hydrocarbons	mg/L	E1664A-SGT	< 3.00				-				10/3/2012 1501h
MB-R45667	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/2/2012 600h
MB-SPLP-21369	Sulfate	mg/L	SM4500-SO4-E	< 5.00				-				10/2/2012 600h
MB-R45719	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/2/2012 1215h
MB-SPLP-21369	Total Dissolved Solids	mg/L	SM2540C	< 10.0				-				10/2/2012 1215h
MB-R45767	Total Organic Carbon	mg/L	SM5310B	< 1.00				-				10/3/2012 1512h
MB-SPLP-21369	Total Organic Carbon	mg/L	SM5310B	1.01				-				10/3/2012 1815h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-007AMS	Alkalinity (as CaCO3)	mg/L	SM2320B	49.2	50.00	0	98.4	80-120				10/2/2012 952h
1209452-001AMS	Sulfate	mg/L	SM4500-SO4-E	29.7	20.00	11.21	92.5	80-120				10/2/2012 600h
1209452-001AMS	Total Organic Carbon	mg/L	SM5310B	11.3	5.000	6.687	92.7	80-120				10/3/2012 1621h

Analysis performed on an SPLP extract by method 1312.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-007AMSD	Alkalinity (as CaCO3)	mg/L	SM2320B	51.0	50.00	0	102	80-120	3.59	10		10/2/2012 952h
1209452-001AMSD	Sulfate	mg/L	SM4500-SO4-E	28.6	20.00	11.21	87.1	80-120	3.74	10		10/2/2012 600h
1209452-001AMSD	Total Organic Carbon	mg/L	SM5310B	11.3	5.000	6.687	92.5	80-120	0.0998	20		10/3/2012 1644h

Analysis performed on an SPLP extract by method 1312.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: QCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCS-R45731	Oil & Grease	mg/L	E1664A	44.1	40.00	1.900	106	78-114				10/2/2012 1351h
QCS-R45766	Total Recoverable Petroleum Hydrocarbons	mg/L	E1664A-SGT	15.9	20.00	0	79.5	64-132				10/3/2012 1501h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: WC
QC Type: QCSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
QCSD-R45731	Oil & Grease	mg/L	E1664A	44.3	40.00	1.900	106	78-114	0.452	18		10/2/2012 1351h
QCSD-R45766	Total Recoverable Petroleum Hydrocarbons	mg/L	E1664A-SGT	18.8	20.00	0	94.0	64-132	16.7	34		10/3/2012 1501h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: GC
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS-21396	Diesel Range Organics (DRO) (C10-C28)	mg/L	SW8015D	1.51	2.000	0	75.5	48-118				10/2/2012 1409h
LCS-21396	Surr: 4-Bromofluorobenzene	%REC	SW8015D	0.158	0.4000		39.5	18-95				10/2/2012 1409h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: GC
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-21396	Diesel Range Organics (DRO) (C10-C28)	mg/L	SW8015D	< 0.500				-				10/2/2012 1350h
MB-21396	Surr: 4-Bromofluorobenzene	%REC	SW8015D	0.126	0.4000		31.4	18-95				10/2/2012 1350h
MB-SPLP-21369	Diesel Range Organics (DRO) (C10-C28)	mg/L	SW8015D	< 0.500				-				10/2/2012 1624h
MB-SPLP-21369	Surr: 4-Bromofluorobenzene	%REC	SW8015D	0.151	0.4000		37.7	18-95				10/2/2012 1624h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: GC
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMS	Diesel Range Organics (DRO) (C10-C28)	mg/L	SW8015D	2.21	2.000	0.6755	76.6	60-161				10/2/2012 1448h
1209452-001AMS	Surr: 4-Bromofluorobenzene	%REC	SW8015D	0.180	0.4000		45.0	10-190				10/2/2012 1448h

Analysis performed on an SPLP extract by method 1312.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: GC
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209452-001AMSD	Diesel Range Organics (DRO) (C10-C28)	mg/L	SW8015D	2.10	2.000	0.6755	71.1	60-161	5.12	25		10/2/2012 1507h
1209452-001AMSD	Surr: 4-Bromofluorobenzene	%REC	SW8015D	0.164	0.4000		40.9	10-190				10/2/2012 1507h

Analysis performed on an SPLP extract by method 1312.

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: LCS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
LCS VOC 100212A	1,1,1-Trichloroethane	mg/L	SW8260C	0.0271	0.02000	0	136	49.9-140				10/2/2012 703h
LCS VOC 100212A	1,1-Dichloroethene	mg/L	SW8260C	0.0266	0.02000	0	133	46-171				10/2/2012 703h
LCS VOC 100212A	1,2-Dichlorobenzene	mg/L	SW8260C	0.0205	0.02000	0	103	67-135				10/2/2012 703h
LCS VOC 100212A	1,2-Dichloroethane	mg/L	SW8260C	0.0250	0.02000	0	125	60-137				10/2/2012 703h
LCS VOC 100212A	1,2-Dichloropropane	mg/L	SW8260C	0.0198	0.02000	0	99.0	59-135				10/2/2012 703h
LCS VOC 100212A	Benzene	mg/L	SW8260C	0.0214	0.02000	0	107	62-127				10/2/2012 703h
LCS VOC 100212A	Chlorobenzene	mg/L	SW8260C	0.0208	0.02000	0	104	63-140				10/2/2012 703h
LCS VOC 100212A	Chloroform	mg/L	SW8260C	0.0241	0.02000	0	120	67-132				10/2/2012 703h
LCS VOC 100212A	Ethylbenzene	mg/L	SW8260C	0.0218	0.02000	0	109	55-133				10/2/2012 703h
LCS VOC 100212A	Isopropylbenzene	mg/L	SW8260C	0.0207	0.02000	0	104	60-147				10/2/2012 703h
LCS VOC 100212A	Methyl tert-butyl ether	mg/L	SW8260C	0.0282	0.02000	0	141	37-189				10/2/2012 703h
LCS VOC 100212A	Methylene chloride	mg/L	SW8260C	0.0248	0.02000	0	124	32-185				10/2/2012 703h
LCS VOC 100212A	Naphthalene	mg/L	SW8260C	0.0125	0.02000	0	62.4	28-136				10/2/2012 703h
LCS VOC 100212A	Tetrahydrofuran	mg/L	SW8260C	0.0146	0.02000	0	73.0	43-146				10/2/2012 703h
LCS VOC 100212A	Toluene	mg/L	SW8260C	0.0209	0.02000	0	105	64-128				10/2/2012 703h
LCS VOC 100212A	Trichloroethene	mg/L	SW8260C	0.0226	0.02000	0	113	54-152				10/2/2012 703h
LCS VOC 100212A	Xylenes, Total	mg/L	SW8260C	0.0656	0.06000	0	109	52-134				10/2/2012 703h
LCS VOC 100212A	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0619	0.05000		124	76-138				10/2/2012 703h
LCS VOC 100212A	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0489	0.05000		97.8	77-121				10/2/2012 703h
LCS VOC 100212A	Surr: Dibromofluoromethane	%REC	SW8260C	0.0569	0.05000		114	67-128				10/2/2012 703h
LCS VOC 100212A	Surr: Toluene-d8	%REC	SW8260C	0.0475	0.05000		95.0	81-135				10/2/2012 703h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 100212A	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 100212A	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				10/2/2012 741h
MB VOC 100212A	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	2-Butanone	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	2-Hexanone	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Acetone	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Acetonitrile	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Acrolein	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Allyl chloride	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Benzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Bromobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Bromoform	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Bromomethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 100212A	Butyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Chloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Chloroform	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Chloromethane	mg/L	SW8260C	< 0.00300				-				10/2/2012 741h
MB VOC 100212A	Chloroprene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Cyclohexane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				10/2/2012 741h
MB VOC 100212A	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Dibromomethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Ethyl ether	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Iodomethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				10/2/2012 741h
MB VOC 100212A	Isopropyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 100212A	Isopropyl alcohol	mg/L	SW8260C	< 0.0400				-				10/2/2012 741h
MB VOC 100212A	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	m,p-Xylene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Methylcyclohexane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Methylene chloride	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	n-Amyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Naphthalene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	n-Butyl alcohol	mg/L	SW8260C	< 0.100				-				10/2/2012 741h
MB VOC 100212A	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	n-Hexane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	n-Octane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	o-Xylene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 741h
MB VOC 100212A	Propionitrile	mg/L	SW8260C	< 0.0250				-				10/2/2012 741h
MB VOC 100212A	Propyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Styrene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				10/2/2012 741h

American West Analytical Laboratories

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB VOC 100212A	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Toluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	TPH C11-C15 (DRO)	mg/L	SW8260C	< 0.0200				-				10/2/2012 741h
MB VOC 100212A	TPH C6-C10 (GRO)	mg/L	SW8260C	< 0.0200				-				10/2/2012 741h
MB VOC 100212A	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Trichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 741h
MB VOC 100212A	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				10/2/2012 741h
MB VOC 100212A	Xylenes, Total	mg/L	SW8260C	< 0.00200				-				10/2/2012 741h
MB VOC 100212A	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0620	0.05000		124	76-138				10/2/2012 741h
MB VOC 100212A	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0557	0.05000		111	77-121				10/2/2012 741h
MB VOC 100212A	Surr: Dibromofluoromethane	%REC	SW8260C	0.0559	0.05000		112	67-128				10/2/2012 741h
MB VOC 100212A	Surr: Toluene-d8	%REC	SW8260C	0.0496	0.05000		99.2	81-135				10/2/2012 741h
MB-SPLP-21377	1,1,1,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1,1-Trichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1,2,2-Tetrachloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1,2-Trichloro-1,2,2-trifluoroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21377	1,1,2-Trichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1-Dichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,1-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2,3-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2,3-Trichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2,3-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2,4-Trichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2,4-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2-Dibromo-3-chloropropane	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	1,2-Dibromoethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2-Dichloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,3,5-Trimethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,3-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,3-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,4-Dichlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	1,4-Dioxane	mg/L	SW8260C	< 0.0500				-				10/2/2012 1051h
MB-SPLP-21377	2,2-Dichloropropane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	2-Butanone	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	2-Chloroethyl vinyl ether	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	2-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h

American West Analytical Laboratories
463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21377	2-Hexanone	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	2-Nitropropane	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	4-Chlorotoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	4-Isopropyltoluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	4-Methyl-2-pentanone	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Acetone	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Acetonitrile	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Acrolein	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Acrylonitrile	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Allyl chloride	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Benzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Benzyl chloride	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Bis(2-chloroisopropyl) ether	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Bromobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Bromochloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Bromodichloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Bromoform	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Bromomethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Butyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Carbon disulfide	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Carbon tetrachloride	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Chlorobenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Chloroethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21377	Chloroform	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Chloromethane	mg/L	SW8260C	< 0.00300				-				10/2/2012 1051h
MB-SPLP-21377	Chloroprene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	cis-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	cis-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Cyclohexane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Cyclohexanone	mg/L	SW8260C	< 0.0500				-				10/2/2012 1051h
MB-SPLP-21377	Dibromochloromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Dibromomethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Dichlorodifluoromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Ethyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Ethyl ether	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Ethyl methacrylate	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Ethylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Hexachlorobutadiene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Iodomethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Isobutyl alcohol	mg/L	SW8260C	< 0.100				-				10/2/2012 1051h
MB-SPLP-21377	Isopropyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Isopropyl alcohol	mg/L	SW8260C	< 0.0400				-				10/2/2012 1051h
MB-SPLP-21377	Isopropylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	m,p-Xylene	mg/L	SW8260C	0.00781				-				10/2/2012 1051h
MB-SPLP-21377	Methacrylonitrile	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Methyl Acetate	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21377	Methyl methacrylate	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Methyl tert-butyl ether	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Methylcyclohexane	mg/L	SW8260C	0.00434				-				10/2/2012 1051h
MB-SPLP-21377	Methylene chloride	mg/L	SW8260C	0.00365				-				10/2/2012 1051h
MB-SPLP-21377	n-Amyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Naphthalene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	n-Butyl alcohol	mg/L	SW8260C	< 0.100				-				10/2/2012 1051h
MB-SPLP-21377	n-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	n-Hexane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	n-Octane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	n-Propylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	o-Xylene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Pentachloroethane	mg/L	SW8260C	< 0.00500				-				10/2/2012 1051h
MB-SPLP-21377	Propionitrile	mg/L	SW8260C	< 0.0250				-				10/2/2012 1051h
MB-SPLP-21377	Propyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	sec-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Styrene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	tert-Butyl alcohol	mg/L	SW8260C	< 0.0200				-				10/2/2012 1051h
MB-SPLP-21377	tert-Butylbenzene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Tetrachloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Tetrahydrofuran	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Toluene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	TPH C11-C15 (DRO)	mg/L	SW8260C	< 0.0200				-				10/2/2012 1051h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MBLK

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
MB-SPLP-21377	TPH C6-C10 (GRO)	mg/L	SW8260C	< 0.0200				-				10/2/2012 1051h
MB-SPLP-21377	trans-1,2-Dichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	trans-1,3-Dichloropropene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	trans-1,4-Dichloro-2-butene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Trichloroethene	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Trichlorofluoromethane	mg/L	SW8260C	< 0.00200				-				10/2/2012 1051h
MB-SPLP-21377	Vinyl acetate	mg/L	SW8260C	< 0.0100				-				10/2/2012 1051h
MB-SPLP-21377	Vinyl chloride	mg/L	SW8260C	< 0.00100				-				10/2/2012 1051h
MB-SPLP-21377	Xylenes, Total	mg/L	SW8260C	0.00915				-				10/2/2012 1051h
MB-SPLP-21377	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	0.0636	0.05000		127	76-138				10/2/2012 1051h
MB-SPLP-21377	Surr: 4-Bromofluorobenzene	%REC	SW8260C	0.0561	0.05000		112	77-121				10/2/2012 1051h
MB-SPLP-21377	Surr: Dibromofluoromethane	%REC	SW8260C	0.0577	0.05000		115	67-128				10/2/2012 1051h
MB-SPLP-21377	Surr: Toluene-d8	%REC	SW8260C	0.0504	0.05000		101	81-135				10/2/2012 1051h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MS

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209495-035AMS	1,1,1-Trichloroethane	mg/L	SW8260C	4.90	4.000	0	122	67-147				10/2/2012 819h
1209495-035AMS	1,1-Dichloroethene	mg/L	SW8260C	4.63	4.000	0	116	51-152				10/2/2012 819h
1209495-035AMS	1,2-Dichlorobenzene	mg/L	SW8260C	3.86	4.000	0	96.4	70-130				10/2/2012 819h
1209495-035AMS	1,2-Dichloroethane	mg/L	SW8260C	4.77	4.000	0	119	39-162				10/2/2012 819h
1209495-035AMS	1,2-Dichloropropane	mg/L	SW8260C	3.67	4.000	0	91.8	59-135				10/2/2012 819h
1209495-035AMS	Benzene	mg/L	SW8260C	3.89	4.000	0	97.4	66-145				10/2/2012 819h
1209495-035AMS	Chlorobenzene	mg/L	SW8260C	3.84	4.000	0	96.0	63-140				10/2/2012 819h
1209495-035AMS	Chloroform	mg/L	SW8260C	4.52	4.000	0	113	50-146				10/2/2012 819h
1209495-035AMS	Ethylbenzene	mg/L	SW8260C	6.74	4.000	2.744	99.9	69-133				10/2/2012 819h
1209495-035AMS	Isopropylbenzene	mg/L	SW8260C	3.80	4.000	0	95.1	60-147				10/2/2012 819h
1209495-035AMS	Methyl tert-butyl ether	mg/L	SW8260C	5.51	4.000	0	138	37-189				10/2/2012 819h
1209495-035AMS	Methylene chloride	mg/L	SW8260C	4.66	4.000	0	116	30-192				10/2/2012 819h
1209495-035AMS	Naphthalene	mg/L	SW8260C	2.67	4.000	0	66.8	41-131				10/2/2012 819h
1209495-035AMS	Tetrahydrofuran	mg/L	SW8260C	3.34	4.000	0	83.4	43-146				10/2/2012 819h
1209495-035AMS	Toluene	mg/L	SW8260C	3.90	4.000	0	97.6	18-192				10/2/2012 819h
1209495-035AMS	Trichloroethene	mg/L	SW8260C	4.14	4.000	0	103	61-153				10/2/2012 819h
1209495-035AMS	Xylenes, Total	mg/L	SW8260C	21.4	12.00	8.988	103	42-167				10/2/2012 819h
1209495-035AMS	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	12.2	10.00		122	72-151				10/2/2012 819h
1209495-035AMS	Surr: 4-Bromofluorobenzene	%REC	SW8260C	9.70	10.00		97.0	80-128				10/2/2012 819h
1209495-035AMS	Surr: Dibromofluoromethane	%REC	SW8260C	11.1	10.00		111	80-124				10/2/2012 819h
1209495-035AMS	Surr: Toluene-d8	%REC	SW8260C	9.26	10.00		92.6	77-129				10/2/2012 819h

463 West 3600 South
Salt Lake City, UT 84115
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: JBR Environmental Consultants, Inc.
Lab Set ID: 1209452
Project: American Oil Sands

Contact: Jon Schulman
Dept: MSVOA
QC Type: MSD

Sample ID	Analyte	Units	Method	Result	Amount Spiked	Original Amount	%REC	Limits	%RPD	RPD Limit	Qual	Date Analyzed
1209495-035AMSD	1,1,1-Trichloroethane	mg/L	SW8260C	5.22	4.000	0	130	67-147	6.37	25		10/2/2012 838h
1209495-035AMSD	1,1-Dichloroethene	mg/L	SW8260C	4.94	4.000	0	123	51-152	6.44	25		10/2/2012 838h
1209495-035AMSD	1,2-Dichlorobenzene	mg/L	SW8260C	3.99	4.000	0	99.6	70-130	3.26	25		10/2/2012 838h
1209495-035AMSD	1,2-Dichloroethane	mg/L	SW8260C	4.89	4.000	0	122	39-162	2.44	25		10/2/2012 838h
1209495-035AMSD	1,2-Dichloropropane	mg/L	SW8260C	3.79	4.000	0	94.8	59-135	3.32	25		10/2/2012 838h
1209495-035AMSD	Benzene	mg/L	SW8260C	4.06	4.000	0	102	66-145	4.27	25		10/2/2012 838h
1209495-035AMSD	Chlorobenzene	mg/L	SW8260C	4.04	4.000	0	101	63-140	4.97	25		10/2/2012 838h
1209495-035AMSD	Chloroform	mg/L	SW8260C	4.63	4.000	0	116	50-146	2.27	25		10/2/2012 838h
1209495-035AMSD	Ethylbenzene	mg/L	SW8260C	7.30	4.000	2.744	114	69-133	8.03	25		10/2/2012 838h
1209495-035AMSD	Isopropylbenzene	mg/L	SW8260C	4.18	4.000	0	105	60-147	9.47	25		10/2/2012 838h
1209495-035AMSD	Methyl tert-butyl ether	mg/L	SW8260C	5.66	4.000	0	141	37-189	2.61	25		10/2/2012 838h
1209495-035AMSD	Methylene chloride	mg/L	SW8260C	4.84	4.000	0	121	30-192	3.87	25		10/2/2012 838h
1209495-035AMSD	Naphthalene	mg/L	SW8260C	2.90	4.000	0	72.5	41-131	8.18	25		10/2/2012 838h
1209495-035AMSD	Tetrahydrofuran	mg/L	SW8260C	3.63	4.000	0	90.7	43-146	8.33	25		10/2/2012 838h
1209495-035AMSD	Toluene	mg/L	SW8260C	4.22	4.000	0	106	18-192	7.93	25		10/2/2012 838h
1209495-035AMSD	Trichloroethene	mg/L	SW8260C	4.34	4.000	0	108	61-153	4.67	25		10/2/2012 838h
1209495-035AMSD	Xylenes, Total	mg/L	SW8260C	22.9	12.00	8.988	116	42-167	6.76	25		10/2/2012 838h
1209495-035AMSD	Surr: 1,2-Dichloroethane-d4	%REC	SW8260C	12.3	10.00		123	72-151				10/2/2012 838h
1209495-035AMSD	Surr: 4-Bromofluorobenzene	%REC	SW8260C	9.97	10.00		99.7	80-128				10/2/2012 838h
1209495-035AMSD	Surr: Dibromofluoromethane	%REC	SW8260C	11.2	10.00		112	80-124				10/2/2012 838h
1209495-035AMSD	Surr: Toluene-d8	%REC	SW8260C	9.67	10.00		96.7	77-129				10/2/2012 838h

American West Analytical Laboratories

REVISED 10/5/12 MH
updated to QC 2.

UL

WORK ORDER Summary

Work Order: 1209452

10/12/2012

Client: JBR Environmental Consultants, Inc.
Client ID: JBR400
Contact: Jon Schulman
Project: American Oil Sands
QC Level: LEVEL II
WO Type: Standard
Comments: All analysis to be performed on the SPLP extract, for samples #1, #3, #5, #7. For samples #2, #4, #6, #8 run on a 1:1. Footnote report, pH received outside of hold. Email 3 people: John Schulman, Linda Matthews, and Will Gibbs.;

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-001A	U-001A	9/25/2012 0945h	9/26/2012 1100h	10/12/2012	Leachate	1312LM-PR	☐	SPLP	1
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-002A	U-001B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-003A	U-002A	9/25/2012 1055h			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☑ RT ☑ CN ☑ TAT ☑ QC ☑ HOK CC HOK DB HOK MH HOK___

WORK ORDER Summary

Client: JBR Environmental Consultants, Inc.

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-003A	U-002A	9/25/2012 1055h	9/26/2012 1100h	10/12/2012	Leachate	6010C-SPLP	☑	SPLP	1
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-004A	U-002B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-005A	U-003A	9/25/2012 1240h			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK_ _ _ HOK_ _ _ HOK_ _ _ HOK_ _ _

WORK ORDER Summary

Client: JBR Environmental Consultants, Inc.

Work Order: **1209452**

 10/12/2012

Sample ID	Client Sample ID	Collected Date	Received Date	Date Due	Matrix	Test Code	Sel	Storage	
1209452-005A	U-003A	9/25/2012 1240h	9/26/2012 1100h	10/12/2012	Leachate	OGB-W-1664A	☐	SPLP	1
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-006A	U-003B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	
1209452-007A	U-004A	9/25/2012			Leachate	1312LM-PR	☐	SPLP	
						1312ZHE-PR	☐	SPLP	
						3005A-SPLP-PR	☐	SPLP	
						3510-TPH-PR	☐	SPLP	
						6010C-SPLP	☑	SPLP	
	SEL Analytes: B CA CR FE LI MG MO K NA SR SN V								
						6020-SPLP	☑	SPLP	
	SEL Analytes: SB AS BA BE CD CU PB MN NI SE AG TL ZN								
						8015-W-TPH(1L)	☑	SPLP	
						8260-W-SPLP	☑	SPLP	
						ALK-W-2320B	☑	SPLP	
	SEL Analytes: ALK								
						CL-W-4500CLE	☐	SPLP	
						HG-SPLP-7470A	☐	SPLP	
						HG-SPLP-PR	☐	SPLP	
						OGB-W-1664A	☐	SPLP	
						OGF-W-1664SGT	☐	SPLP	
						PH-9040C	☐	SPLP	
						SO4-W-4500SO4E	☐	SPLP	
						TDS-W-2540C	☐	SPLP	
						TOC-W-5310B	☐	SPLP	
1209452-008A	U-004B				Solid	COND-S-9050A	☐	df / wc	
						PH-9045D	☐	df / wc	
						SAR-S	☐	df / wc	
						SOIL-PR	☐	df / wc	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK___ HOK___ HOK___ HOK___

JBR

1201439

Client: American Oil Sands

Address:

City / State / Zip

Phone: 801-277-7888 Fax: Jon

Contact: Will Gibbs / ~~John~~ Schulman

E-mail: wgibbs@Americansandsenergy.com

Project Name:

Project Number/P.O.#:

Sampler Name: R.G. McGinnis 480-239-7700

AMERICAN WEST ANALYTICAL LABORATORIES
463 West 3600 South
Salt Lake City, Utah 84115

CHAIN OF CUSTODY

(801) 263-8686
(888) 263-8686
Fax (801) 263-8687
Email:awal@awal-labs.com

Lab Sample Set #: 1209452

Page ____ of ____

Turn Around Time (Circle One)
1 day 2 day 3 day 4 day 5 day Standard

	Sample ID	Date/Time Collected	Matrix	Number of Containers (Total)	TESTS REQUIRED: See attached									QC LEVEL / COMMENTS
#1	U-001A	Sept 25 9:45												
2	U-001B	" 9:45												
3	U-002A	" 10:55												
4	U-002B	" 10:55												
5	U-003A	" 12:40												
6	U-003B	" 12:40												
7	U-004A	Sept 25												
8	U-004B	Sept 25												

QC LEVEL: 1, (2)*, 2+, 3, 3+, 4

LABORATORY USE ONLY

SAMPLES WERE:
1. (Shipped) or hand delivered. Notes: Fed X
2. Ambient or (Chilled). Notes:
3. Temperature 2.9
4. Received Broken/Leaking (Improperly Sealed) Y (N) Notes:
5. Properly Preserved (Y) N. Checked at Bench Y N. Notes:
6. Received Within Holding Times Y (N) Notes: pH rec. outside of hold.

COC Tape Was:
1. Present on Outer Package Y N (NA)
2. Unbroken on Outer Package Y N (NA)
3. Present on Sample Y N (NA)
4. Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? Y (N) Notes:

Relinquished By: Signature	Date	Received By: Signature	Date
R McGinnis	Sept 25		
PRINT NAME: R.G. McGinnis	Time: 2:30pm	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature	Date
PRINT NAME	Time	PRINT NAME	Time
Relinquished By: Signature	Date	Received By: Signature: Elma Hay	Date: 9-26-12
PRINT NAME	Time	PRINT NAME: Elma Hayden	Time: 1100

Special Instructions:
metals list from previous set: Ag, As, B, Ba, Be, Cd, Cr, Cu, Fe, Hg, Li, Pb, Mn, Mo, Ni, Sb, Se, Sr, Sn, Tl, V, Zn along with cations.

* per Jon Schulman. 10/5/12 MA

Parameters for Tailings Analyses

These are the analyses required for the tailings samples:

1) Use the Synthetic Precipitation Leachate Procedure (SPLP) extraction (EPA Method SW-846 1312)

The leachate must be analyzed for the following:

- Residual solvents used in the bitumen extraction process (the actual, proprietary solvent that you will use or the closest available proxy),
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN),
- Volatile organic compounds (VOCs),
- ~~Hazardous air pollutants (HAPs),~~
- Oil and grease,
- Total petroleum hydrocarbon-diesel range (TPH-DRO),
- Total petroleum hydrocarbon-gasoline range (TPH-GRO),
- Total recoverable petroleum hydrocarbon (TRPH),
- Total organic carbon (TOC),
- Total dissolved solids (TDS),
- pH,
- Metals, and – from previous set (1201439)
- Major ions (Na, Ca, K, Mg, Cl, SO_4, alkalinity).

#1

2) Use either a saturated paste extract or a 1:1 (liquid:solid) extract: the extract should be analyzed for pH, conductivity and SAR.

2

Laboratory minimum detection limits must be equal to or less than Utah ground water standards or other applicable standards to enable meaningful comparisons with the laboratory analytical results. Some of these are for groundwater permitting, others are for air quality permitting, and others are for the engineers.

3) In addition to these chemical characteristics, Mine Engineers need to have physical tests performed. Eldon has a lab he uses in Cheyenne that he uses for these, so please send a five-gallon bucket or two of tailings sample to him. Those tests include the following:

Relative Density (ASTM D253 & D4254)
Direct Shear (ASTM D3080)
Sieve Analysis (ASTM C136 & C117)
Proctored Density