SW 387

R.N. INDUSTRIES

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Division of
Solid and Hazardous Waste

MAY 3 1 2013

2013-003732

May 31 2013

Mr. Scott T. Anderson, Director
Permit Manager
Division of Solid and Hazardous Waste
Utah Department of Environmental Quality
PO Box 144880
Salt Lake City, Utah 84114-4880

Re: **Oil and Gas Exploration and Production Landfill Permit Application**
Wonsit Disposal Facility – Landfill Cell #1
374 East Chapita Grove Road, Uintah County, Utah 84078

Dear Mr. Anderson:

Please find attached a permit application for an oil and gas Exploration and Production (E&P) Landfill to be constructed at RN Industries' (RNI's) Wonsit Disposal Facility near Ouray, Utah. All UDSHW requirements have been indexed to a checklist provided in Appendix L of the application.

We appreciated the opportunity to discuss this proposed Landfill with the UDSHW during the preapplication meeting and also the timely responses from Ralph Bohn and Doug Taylor throughout the development of this application. If you have any questions or require additional information, please do not hesitate to contact me at the e-mail or phone number shown below or Boyd Breeding of MWH at 801-617-3241.

Sincerely,

Gary H. Richins
Environmental Manager
(435) 503-5069
grichins@rnindustries.com

cc:	R. Chapman	RNI	C. Chapman	RNI
	B. Breeding	MWH	Kerry Spiroff	MWH

Prepared for:

RN INDUSTRIES

WONSIT FACILITY

LANDFILL PERMIT APPLICATION
UTAH DIVISION OF SOLID AND HAZARDOUS WASTE

May 2013

Prepared by:

MWH

2890 East Cottonwood Parkway Suite 300

Salt Lake City, Utah 84121

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1.0 GENERAL INFORMATION

1.1 NAME AND ADRESS OF APPLICANT – PROPERTY OWNER – OPERATOR

RN Industries (RNI) is the permit applicant, property owner, and will operate the Wonsit Disposal Facility. Their corporate office is located at the following address:

RN Industries
244 West Highway 40 P.O. Box 98
Roosevelt, Utah
84066

1.2 OVERALL FACILITY OPERATIONS SUMMARY

The RNI Wonsit Disposal facility (Facility) is located in in the N½ of the NE¼ and SE¼ of Section 35 and the SE¼ of the SE¼ of Section 26, Township 8 South, Range 21 East of the Salt Lake Base and Meridian (Figures 1 and 2).

The coordinates of the front gate are:

Latitude	40° 4’ 59.5” N
Longitude	109° 31’ 15.3” W

The Facility receives and treats oil and gas Exploration and Production (E&P) RCRA exempt wastes including produced water, natural gas liquids (NGL), condensate, crude oil, other E&P solid wastes such as frac sands and drill cuttings. The Facility currently includes one oil-water separator (OWS), one skim pond, one landfarm cell, two above ground storage tanks, and nine evaporation ponds. This permit application request authorization from the Utah Division of Solid and Hazardous Waste (UDSHW) to construct and operate a landfill to receive E&P solid wastes.

Under the terms of this UDSHW Landfill Permit Application, RN Industries plans to convert Evaporation Pond 9 into a landfill cell for E&P wastes including but limited to, drill cuttings, drilling muds, petroleum impacted soils, and discarded E&P impoundment liners. The landfill cell is to be constructed in two phases and this application seeks authorization for Phase I construction and operations. Expansion of Landfill Cell #1 is anticipated to be required in calendar year 2019.

1.3 GENERAL FACILITY INFORMATION

The Facility is operated by RNI, a subsidiary to Dalbo Holdings Inc., a Delaware corporation, and is located approximately seven miles west of Ouray, Utah. The address to the Facility is:

374 East Chapita Grove Road
Uintah County, Utah
84078

The current permitted area of the Facility is approximately 161 acres with a total evaporation pond surface area of 53.6 acres, a total landfarm surface area of approximately 5 acres, and proposed landfill foot print of 7.2 acres. As previously described, this permit application requests authorization from the UDSHW to convert existing evaporation Pond 9 into a landfill cell.

1.4 LEGAL DESCRIPTION OF PROPERTY - PROOF OF OWNERSHIP - LAND STATUS

A legal description and proof of ownership of the property encompassed by the Wonsit Disposal Facility are provided in the Warrantee Deed in Appendix A.

The landfill will formally be named Wonsit Disposal Facility Landfill Cell #1 and have the final footprint shown on Figure 2. Land use surrounding the Wonsit Facility is dominated by oil and gas operations and open range lands. The town of Ouray is located approximately seven miles to the west.

The Ute Tribe has provided a written verification of land status indicating that the property represents "Trust Lands within the exterior boundaries of the Uncompahgre Reservation". The UTE Tribe's written verification of land status letter is also included in Appendix A.

1.5 QUALIFICATION AS A NONCOMMERCIAL FACILITY

RNI has been notified by Ralph Bohn of the UDSHW that landfill disposal facilities accepting only 1) E&P (RCRA Subtitle C Exempt) wastes from oil and gas operations, and 2) solid wastes generated by the company seeking the permit qualifies as noncommercial landfill. RNI will accept only E&P wastes and thus qualifies as a noncommercial facility.

1.6 TYPES OF WASTE AND ESTIMATED DAILY VOLUME TO BE ACCEPTED

Landfill Cell #1 will accept only: 1) oil and gas exploration and production (E&P) wastes that pass the paint filter test (Method 9095B). The areas to be served by the facility are primarily oil and gas operations in Utah, Colorado, and Wyoming. It is estimated that, on average, 14 loads (15 cubic yards (cy) per load) of waste will be accepted into the landfill each week. Some of this waste will require solidification with native soil or other materials preapproved by the UDSHW. To roughly estimate the life of the facility, it is assumed that 75% of the waste will be mixed with clean native soil at a 1:1 ratio during the stabilization process. The remaining 25% has been assumed to be suitable for direct placement into the landfill without solidification. Based on these assumptions, the estimated total net annual fill volume for the landfill is 19,110 cy and the life spans for Phase I and II are approximately six years each (total of twelve years of landfilling operations).

1.7 INTENDED SCHEDULE OF CONSTRUCTION

The landfill is to be constructed and operated in two phases referred to throughout the remainder of this permit application as Phase I and Phase II. Construction during Phase I will involve:

- An inspection of the existing 60 mil HDPE liner will be performed under the direction of a third party HDPE technician having more than ten years of recent welding and liner construction experience. The inspection will involve electronic leak detection of the liner floor and then air pressure testing of seams. Repair of any punctures, rips, leaking welds, folds, or other questionable areas will be made by this third party team and then vacuum testing of the repairs completed.

- Placement of a synthetic geocomposite drainage layer on top of the existing 60 mil HDPE liner. To protect the geocomposite from UV degradation, RNI will place it in three or four rectangular sections starting on the southern end.

- Once the first section is placed, 18-inches of wastes and / or silt will be loaded on top to hold the geocomposite in place and protect from UV degradation. The initial 18-inches of cover over the geocomposite will have unconfined compressive strength similar to a ML (silt) and be devoid of gravel or other sharp edged particles that could later puncture the geocomposite and underlying HDPE liner. On the side slopes of the landfill cell, approximately 4-inches of clay or other native soils will be spread to protect the geocomposite from UV degradation.

- Because Evaporation Pond 9 already contains a 60 mil HDPE primary liner, underlying leak detection system, and compacted clay secondary liner, it is anticipated that construction activities relating to Phase I of the Wonsit Landfill Cell #1 will take approximately one to two months.
- A leachate collection system will be installed in the Northeast corner of landfill Cell #1 as shown in Appendix G.

Phase II of the landfill cell design and construction will involve:

- Evaluation of the maximum allowable slope for placement of waste during Phase II operations. Analyses of wastes will be performed during the Phase I operations and include evaluation of the geotechnical properties of solidified waste, the solidification processes being used, and earthquake loads for the Wonsit Disposal Facility location;
- Design of a new stormwater management system prior to filling the Phase I stormwater diversion swales located to the west, and south of the Phase I Landfill Cell footprint;
- Design of an underlying protective layer and HDPE liner extending the landfill cell to the west and south of the Phase I berms;
- Design of the maximum allowable waste slope angles (Appendix G3) and the final cover requirements;
- Update of the Closure and Post Closure Plans as well as the Financial Assurance Plan to reflect the Phase II design;
- Submitting an application to UDSHW for the Phase II Landfill expansion approximately 12 months prior to RNI's need to begin Phase II operations. RNI will continue Phase I operations in parallel with the Phase II permitting and construction. The construction activities associated with Phase II are roughly expected to take three months.

1.8 DOCUMENTATION OF HISTORICAL SURVEY

Mr. Chris Jensen, a Utah licensed Archeologist with Canyon Environmental has reviewed the proposed landfill construction project, prepared a letter indicating that there would be no adverse effect on historical resources. Mr. Jensen's letter is included in Appendix D and an electronic copy was sent to Doug Taylor of the UDSHW on April 2, 2013 to facilitate timely communications with State Historical Preservation Officer (SHPO).

1.9 PUBLIC PARTICIPATION

The Ute Tribe is the only property owner within 1000 feet of the Facility. Appendix C contains a copy of a Notice of Intent (NOI) sent to and a registered mail receipt received from the Ute Tribe's Department of Natural Resources. The NOI informs the tribe of RNI's plans to permit and construct an E&P landfill at the Wonsit Facility under the oversight of the UDSHW.

1.10 UINTAH COUNTY ZONING AND SPECIAL USE PERMIT

RNI's Wonsit Disposal Facility is currently zoned MG-1 (mining and grazing) and operates under a Special Use Permit granted by Uintah County and a permit approved by the Utah Division of Oil Gas and Mining (DOGM). Uintah County regulations restrict the construction of a landfill in areas zoned MG-1 and therefore an application to rezone the property to Heavy Industrial (I-2) has been prepared and submitted to the Uintah County Planning and Zoning Commission. The rezoning application as well as a signed resolution by the Uinta County Commission approving the change is included as Appendix B.

1.11 LOCAL GOVERNMENT WITH JURISDICTION

Local governments with jurisdiction include the Ute Tribe and Uinta County. The mailing addresses are provided below.

Karen Cambridge
Ute Tribe Department of Natural Resources
PO Box 190
FT. Duchesne, Utah 84026

Mathew Cazier (Director – Uinta County)
152 E 100 N
Vernal, Utah 84078

2.0 LOCATION STANDARDS

2.1 GEOLOGY

Uplift of the Uinta Mountains began in the latest Cretaceous, about 66 million years ago (Ma) and ended near the end of the Eocene, about 37 Ma (Hintze, 1988). During this period of uplift, basins formed on the north and south flanks of the Uintas and subsided as they were filled with erosional debris shed from the uplifted mountains. As much as 15,000 feet of such basin fill occupies the deeper portions of the Uinta Basin (Hintze, 1988).

During the Eocene, a number of subtropical freshwater lakes (the Green River Lake system) occupied the basins north and south of the uplift, and were connected around the east end of the Uinta Mountains. The large lake that occupied the Uinta Basin is referred to as Lake Uinta (Stokes, 1986). The mudstone exposed at the Wonsit facility was deposited near the top of the Lake Uinta basin fill sequence, toward the end of the Uinta Mountain uplift. It is given the name Member C of the Uinta Formation, consists of both fluvial (stream-deposited) and lacustrine (lake-deposited) sediments, and has a thickness of 60 to 250 meters (200 to 800 feet; Sprinkel, 2007). In the area of the Wonsit facility, younger (late Eocene to Oligocene) formations (e.g., the Duchesne River Fm. and the Bishop Conglomerate) that were deposited above of the Tuc (Ruble and Philip, 1998) have been completely eroded from the top of the Tuc and carried out of the area by river systems. During the Holocene (the past 10,000 years) streams continued to incise the landscape, cutting channels and valleys through the upper Tuc. The resulting topographic lows (the present-day valley floors) are filled with eolian, alluvial, and fluvial deposits from glacial outwash and other recent Quaternary deposition (Neuendorf et al., 2005).

2.2 HYDROGEOLOGY

Two aquifers recognized in the Wonsit Valley region of the Southern Uinta Basin include:

- Shallow Quaternary alluvial aquifers within valley floors above relatively flat lying Uinta Formation deposits. These shallow aquifers seasonally contain groundwater in relatively fine grained, unconsolidated sands, silts, and clays and are underlain by low permeability Unita Formation bedrock deposits (Tuc). The underlying bedrock typically forms an aquitard which may deflect groundwater horizontally and hydraulically down gradient, toward the confluence with the White River or other drainage.

- Uinta Formation Member A, B and C deposits beneath the Wonsit facility are approximately 2000 feet thick and are not known to contain regionally significant water bearing units.

- The upper and lower Birds Nest Aquifers are found just beneath the contact of the Uinta and underlying Green River Formations. Near the Wonsit Disposal facility, these aquifers have been mapped at approximately 80 and 140 feet in thickness, respectively, and are separated by about 80 feet of less permeable bedrock. Near the Wonsit Disposal facility, the Birds Nest Aquifers generally contain saline groundwater with total dissolved solids (TDS) concentrations greater than 10,000 mg/L. Well logs depicting the depth to the Upper and Lower Birds Nest Aquifers in the vicinity of the Wonsit facility are provided in Appendix F2.

2.3 STRUCTURAL AND ENGINEERING GEOLOGY

The Wonsit Disposal facility is located approximately 27 miles south of the east west trending synclinal axis of the Uinta Basin syncline. In the vicinity of the disposal facility, bedrock dips northward at approximately 2° toward the axis of the basin. The Interim Geologic Map of the Vernal 30' x 60' Quadrangle provided in Appendix B does not show any mapped faults within the vicinity of the Wonsit Valley Disposal facility.

An analysis of slope stability for the berms surrounding Phase I of Landfill Cell #1 has been completed and the results provided in Section 3.3 of this permit application. Additional slope stability analyses will be performed during Phase I operations under the direction of a Utah Registered Geotechnical Engineer. These analyses will be used to establish the allowable waste slope angles for Phase II operations as well as to configuration the final cover implemented during the Closure period. The Phase II design and permit modification for landfill expansion will be submitted for UDSHW review and approval approximately one year prior to reaching the landfill capacity of Phase I. Preliminary estimates are that RNI will reach the capacity of Landfill Cell # 1 Phase I in six years.

2.4 SUBSURFACE INVESTIGATION

To comply with the UDSHW requirements outlined under the E&P Landfill Application Checklist Section 1d (Geohydrologic Assessment), RNI drilled two borings (Landfill B1, and Landfill B2) and installed three monitoring wells (MW4, MW5, and MW8). Boring/well logs along with a site map showing these locations is provided in Appendix B. Soils from the borings were logged using the unified soil classification system (USCS) and then back pressure permeability tests run on two bedrock and two Quaternary alluvial samples. The results of the geotechnical testing and estimates of potential groundwater seepage velocities are summarized below. The geotechnical lab reports are provided in Appendix F1.

Summary of Geotechnical Results

Boring No.	Sample Depth (feet)	USCS Soil Classification	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Permeability (cm/s)
					Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index	
B-1	**17.5**		**10.0**	**129.5**						**1.71E-07**
B-3	**20.0**		**15.3**	**116.3**						**1.88E-05**
MW-4	**5.0**	**SM**	**3.6**	**102.4**	**9.7**	**57.2**	**33.1**	**NP**	**NP**	**3.83E-04**
MW-5	**10.0**	**SM**	**4.1**		**1.8**	**55.7**	**42.5**	**NP**	**NP**	
MW-8	**10.0**	**SM**	**3.5**	**103.6**	**5.1**	**76.4**	**18.5**	**NP**	**NP**	**5.86E-04**

Seepage Velocity Estimates

Sample Id	Hydraulic Conductivity		Estimated porosity	Assumed Gradient	Groundwater Seepage Velocity	
Bedrock	**cm/sec**	**ft/day**		**ft/ft**	**ft/day**	**ft/yr**
B-1 @ 17.5 ft bgs	1.71E-07	4.85E-04				
B-3 @ 20 ft bgs	1.88E-05	5.33E-02				
Average	9.49E-06	2.69E-02	0.20			
				0.001	0.0001	0.05
				0.01	0.001	0.5
				0.1	0.01	5
				1	0.13	50
Soil						
MW-4 @ 5 ft bgs	3.83E-04	1.09E+00				
MW-8 @10 ft bgs	5.86E-04	1.66E+00				
Average	4.85E-04	1.37E+00	0.25			
				0.001	0.0055	2.0
				0.01	0.055	20
				0.1	0.55	200

These data suggest that horizontal seepage velocities for groundwater through the Quaternary Alluvium would typically range from 2 to 200 feet per year while the bedrock samples suggests that the vertical seepage of groundwater through the bedrock beneath the proposed landfill might be as high as 50 feet per year but more likely to fall in the range of 1 to 5 feet per year.

Monitoring well locations MW4, MW5, MW6, MW7, and MW8 (see Appendix B – Figure B3) were selected to determine whether a seasonal aquifer was present within the Quaternary alluvium sitting on top of the Uinta Formation. The first three wells (MW4, MW5, and MW8) were installed to the bedrock interface but were found to be dry. Therefore, the two remaining wells (MW6 and MW7) were eliminated from the subsurface investigation program. Wells MW4, MW5, and MW8 will be monitored each Spring for the presence of groundwater and if present, the UDSHW will be notified and sampling will be performed as required by the agency. Further details relating to the surface water and groundwater monitoring programs are described in Section 2.6 below.

2.5 SURFACE WATER

An ephemeral stream has been identified running north south in the vicinity of Landfill Cell #1 (Figure 3). No landfill construction or operational activities will be allowed to restrict this intermittent stream or significantly impact its quality as it flows toward the White River. Monitoring of the stream will occur as described in Section 2.6 below and the results compared to background concentration ranges, ambient water quality criteria, and other potentially applicable regulatory standards.

The magnitudes of the 24 hour 25 and 100 year storm events are 1.67 and 2.15 inches, respectively and the average annual rainfall for the period between 1941 and 2013 is 6.79 inches (NOAA Atlas 14 – Ouray 4 NE Station).

2.6 GROUNDWATER AND SURFACE WATER MONITORING PLAN

During drilling and well installation on April 23 and 24 of 2013, groundwater was not observed in monitoring wells MW4, MW5, or MW8. Based on the absence of an aquifer in the alluvial deposits during the spring of 2013, RNI proposes to sample only surface water from the ephemeral drainage adjacent to each of wells MW4, MW5, and MW8. These three surface water samples will be collected each Spring and analyzed for:

- Benzene, toluene, ethylbenzene, xylene (Method SW-846 8260C);
- Gasoline Range Organics (Method SW-846 8260C);
- Antimony, arsenic, barium, beryllium, cadmium, total chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc, sodium (Methods 3005A/6010C/6020A);
- Total mercury (Method EPA 243.1 or SW-846 7470A/7471A)
- Chloride (Methods SM4500(Cl)E or EPA 300.0);
- Selenium (Method 6010B); and
- Gross alpha (Method 900.1).

Concentrations of radium 226 (Method 903.1), radium 228 (Method 904.0), and total uranium (Method 6020A) will also be evaluated and reported for the initial round of sampling conducted prior to receipt of waste into the landfarm.

During the annual surface water sampling events, all site monitoring wells will be checked for the presence of groundwater. Should it be found in three or more wells, a potentiometric surface would be prepared and the direction and rate of groundwater flow estimated. While in the field, RNI personnel would notify UDSHW that groundwater was detected and request further clarification on whether collection and analyses of groundwater samples is required. If groundwater sampling is deemed necessary by the UDSHW at some point in the future, samples would be collected and evaluated for the same set of analytes as surface water.

To evaluate the typical range of constituents dissolved in surface water upstream of the landfill operations, RNI will use eight rounds of sampling results from the ephemeral stream near well MW5. RNI will then calculate the 95% upper confidence interval for each constituent in the data set. Background or upgradient data will typically be assumed to be log-normally distributed when calculating the 95% upper confidence interval. Concentrations detected above the 95% confidence interval in downstream sample locations will be considered as outliers and will be evaluated further. These outliers may simply represent natural fluctuations in constituent concentrations but could also be an indicator that leachate or produced water from the disposal facility has affected the stream quality. An interpretation of the data along with the response to outliers will be provided in the appropriate annual monitoring reports. Outliers will also be compared to ambient water quality criteria and other appropriate regulatory standards to establish the appropriate response.

2.7 WATER WELL SURVEY

RNI searched the Utah Division of Water Rights Point of Diversion on-line database system to identify all registered water rights within a one mile radius of the Wonsit Disposal facility and found only one (water right 49-1659). This water right is registered to Price Water and Plumbing and allows for the extraction of 10 acre-feet of water over a five year period from the White and Green Rivers for use by the oil and gas industry. There were no registered groundwater extraction wells within the one mile search radius (Appendix F3).

2.8 FLOODPLAIN

The Federal Emergency Management Agency (FEMA) has prepared a Flood Insurance Rate Map (FIRM) for the area that includes the Wonsit Facility. As shown in Appendix B, the southeastern corner of the Facility falls within the area designated as the 100 year floodplain. The FEMA FIRM map labels a portion of the Wonsit Facility as "Zone A" meaning that, the 100 year flood elevation has been established but that the flood zone has been determined based on review of historical photos and / or other evidence of flooding. The footprint for Landfill Cell #1 is well outside this designated floodplain.

During surveying of the site, the approximate elevation of the 100 year flood contour closest to Landfill Cell #1 was 4702.7 feet NGVD 88. The elevations of the top of the protective berm and the bottom of Cell #1 are approximately 4728.2 and 4712.2 feet, respectively, thus the landfill is positioned well above the maximum anticipated flood elevation.

2.9 WETLANDS

Landfill cell #1 is positioned topographically above and more than 200 feet west of the ephemeral stream discussed in Section 2.3. The footprint of the proposed landfill cell is outside of any area that could reasonably be assumed to represent jurisdictional wetlands.

2.10 DEPTH TO GROUNDWATER

As shown in the groundwater elevation calculations provided in Appendix F4, groundwater was greater than 20 feet below the lowest point of the primary HDPE liner on April 23, 2013. Note that the elevations shown on the design drawings in Appendix G3 are approximately 62.7 feet below those of the North American Vertical Datum of 1988 (NAVD88). The calculations in Appendix F4, however, are based on a very recent (May 2013) topographic survey which is referenced to NAVD88. Caution should be taken when referencing elevations between the design drawings in Appendix G3 and the elevations calculated in Appendix F4. RNI is in the process of updating their aerial survey data to NAVD88 but the revisions were not available for this permit application.

2.11 LAND USE COMPATABILITY

The area surrounding the Wonsit disposal facility represents open range land used primarily for oil and gas production and cattle grazing. As shown on the Zoning Map in Appendix B there are no residences, parks, monuments, recreation areas, or wilderness areas within 1000 feet of the site. Certifications that there are no ecologically or scientifically significant areas or endangered species present in the site area are provided in Appendix D.

3.0 ENGINEERING REPORT

As previously described in this application, Wonsit Landfill Cell #1 will be designed and constructed in two phases. The first phase involves the conversion and then filling of former Evaporation Pond 9. The design and all regulatory requirements required for Phase I are included within this application.

Permitting and design of Phase II will begin one year prior to reaching the Phase I capacity and will involve lining the steep slope to the west and south of the Phase I landfill berms. While formal design drawings and specifications are provided for all Phase I construction activities, only conceptual drawings have been prepared to represent Phase II. Conceptual drawings depicting the final waste slope angles and final cover for Phase II have been included in order to estimate Closure / Post Closure costs and thus secure the financial assurance required for this permit application.

Final design of the allowable slope angles and the final Phase II cover will require:

- Testing of the landfilled waste for shear strength and cohesion during Phase I operations,
- Screening of landfill biogas for percent LEL concentrations.

An application containing the Phase II design will be submitted to UDSHW for review and approval approximately one year prior to the end of Phase I operations.

3.1 STORMWATER MANAGEMENT

The stormwater management design for Phase I operations is provided in Appendix H. This plan must be revised for Phase II operations because a geocomposite liner system will cover the Phase I stormwater drainage swales and then the swales will be filled with waste during Phase II operations.

The Phase I stormwater management plan details how water is diverted away from the landfill cell and into a drainage swale on the west and south side of Landfill Cell #1. This water is directed through two culverts into a stormwater retention basin located adjacent to the North West side of Landfill Cell #1. The plan details how water that falls inside the landfill footprint will be managed.

3.2 LINERS AND LEACHATE COLLECTION SYSTEMS

The following sections describe both the preexisting liner and future leachate collection systems for Phase I of Wonsit Landfill Cell #1.

3.2.1 Pre-existing Liner and Leak Detection System

Phase I of Landfill Cell #1 is to be constructed within the existing footprint of Evaporation Pond 9. This pond was permitted, constructed, and operated under the jurisdiction of the Utah DOGM to receive and evaporate E&P produced water. CIVCO Engineering provided the design and construction support required by RNI to complete this facility.

The following describes the existing engineered systems starting with the first layer placed above the native bedrock surface:

- One foot of compacted clay was placed on top of native Uinta Formation Member C mudstone and cemented sandstone deposits.
- Shallow trenches were cut into this one foot thick compacted clay layer, filled with drainage sand, and then slotted pipe was placed in accordance with the permitting and design documents provided in Appendix G2. This leak detection system drains by gravity to an external sump where fluids can be detected and transferred to any on-site evaporation pond.
- Approximately six-inches of silt and/or sand was placed above the compacted clay to protect the overlying synthetic liner.
- A 60 mil HDPE synthetic liner was then placed and field welded.

For further details regarding the existing liner and leak detection system, see Appendix G2.

3.2.2 Visual Inspection and Repair of Existing Liner

An inspection of the existing 60 mil HDPE liner will be performed under the direction of a third party HDPE technician having more than ten years of recent welding and liner construction experience. The inspection will involve electronic leak detection of the liner floor and then air pressure testing of seams and visual inspections of the folds and other portions of the sidewalls of the future landfill cell. Repair of any punctures, rips, leaking welds, folds, or other questionable areas will be made by this third party team and then vacuum testing of the repairs completed.

Note that industry standards and modeling of water balance assumes some imperfections will remain in the primary 60 mil HDPE liner system. Two defects per acre have been assumed within the Hydrologic Evaluation of Landfill Performance (HELP) model used for this project. This defect ratio equates to an installation quality referred to as “Good”. A rating of “Good” implies that the subgrade soil beneath the liner was a well prepared consisting of a smooth surface absent angular rock fragments and that welding and testing was performed in accordance with recognized industry standards.

3.2.3 New Leachate Collection System for Phase I

A leachate collection system will be constructed above the existing 60 mil HDPE liner as shown on the drawings in Appendix G3. The existing liner in the floor of Evaporation Pond 9 slopes at approximately 1^{o} toward the northeast corner. Therefore the leachate collection sump will be constructed in this corner and designed such that vacuum trucks or a class I Division I Group D electronic sump pump can be used to remove and dispose of leachate.

The landfill is designed such that leachate will flow toward the sump through a composite geosynthetic consisting of two layers of 8 ounce geofabric separated by a geonet drainage material. Details and specifications for the geocomposite materials along with other the geologic materials to be used in the sump are provided in Appendices G3 and G4. Leachate produced by the landfill will be transferred to Wonsit Disposal Facility Pond 1 and then distributed along with produced water to other Wonsit evaporation ponds. The evaporation ponds are permitted and regulated by the Utah Division of Oil Gas and Mining.

3.3 SLOPE STABILITY FOR PHASE I OPERATIONS

An analysis of slope stability for Wonsit Landfill Cell #1 Phase I operations is provided in Appendix G5. Final allowable slope angles for waste placed during Phase II operations will be designed and specified in a future permit submittal.

3.4 DAILY COVER

No daily cover is required by the UDSHW for the Wonsit Landfill. Requirements for daily cover may be negotiated with US EPA Region 8 as a part of the site's air permit. Although liter control is not expected to be a significant issue since Landfill Cell #1 will accept only E&P wastes, RNI site personnel will diligently attend to any waste that can be carried by wind from their disposal operations.

3.5 CONCEPTUAL DESIGN FOR PHASE II FINAL COVER

In order to estimate the financial assurance requirements for this permit application, it was necessary to conceptualize final waste slope angles during Phase II. Estimating the final landfill surface area and Final Cover (Appendix G3) has allowed RNI to reasonably project the closure and post closure costs and thus provide the basis for the financial assurance calculations in Appendix K.

It is important to understand that there are significant slope stability design requirements for the Phase II expansion which cannot be resolved without first testing the shear strength and other geotechnical properties of the waste to be landfilled. This testing will be a part of the Phase I operations and be performed under the direction of a Utah Registered Geotechnical Engineer. Appropriate earthquake loads and geotechnical properties of the solidified waste and soil berms will be considered when establishing the allowable slopes for landfilled waste. The projected final slopes for wastes shown in Conceptual Phase II Drawings (Appendix G3) are to be used for financial assurance purposes only.

Based on the assumptions provided above and in accordance with sections R315-304-5(2)(b) and 315-305-5(5)(b) of the Utah Administrative Code, RNI will perform the following activities at closure:

- Level the waste to the extent practicable;
- Cover the waste with a minimum of two feet of soil including six inches of top soil;
- Contour the slope of the final cover as specified in Subsection R315-303-3(4)(a)(i)(B) to be not less than 2 and not more than 33%. Cross sectional views conceptually depicting the projected slope of the landfill final cover are shown in Appendix G3.
- Seed the top soil in accordance with the recommendations provided below by Mr. Steve Strong of the U.S. Bureau of Land Management (BLM).

BLM Recommended Mix and Seeding Procedures

Squirreltail	Elymus clymoides	2 lbs/acre
Western wheatgrass	Pascopyrum smithii	2 lbs/acre
Siberian wheatgrass	Agropyron fragile	1 lb/acre
Scarlet Globemallow	Sphaeralcea coccinea	0.5 lb/acre
Rocky Mountain Bee Plant	Cleome serrulata	0.5 lb/acre
Shadscale	Atriplex confertifolia	3 lbs/acre
Fourwing saltbush	Atriplex canescens	2 lbs/acre

Per Steve Strong (BLM):

> *"Seed will be drilled with a rangeland drill device. Seed will be applied between August 15 and December 15. If slopes or rocky conditions preclude the use of the drill, then the seed shall be broadcasted and covered immediately after application. All seed rates are in terms of Pure Live Seed. Operator shall notify the Authorized Officer when seeding has commenced, and shall retain all seed tags."*

3.6 GROUNDWATER CONCENTRATIONS BENEATH THE FACILITY

In accordance with R315-303-2, groundwater beneath any permitted landfill facility shall not be impacted above the concentrations established in R315-308-4. If at some point in the future, groundwater is detected in monitoring wells MW4, MW5, and MW8, the UDSHW will be notified and sampling would be performed as required by the Agency. Should impacts to the groundwater be detected above levels of regulatory concern, RNI would prepare plans doe UDSHW review and approval. These plans would describe RNI's proposed site assessment and corrective action programs.

3.7 CONTROL OF LANDFILL GASES

RNI will operate the landfill and design the final cover to meet the Standards of Performance described in Utah Administrative Code rule R315-303-2 (2). These standards are:

- Explosive gas concentrations within facility structures shall be maintained below 25 percent of the lower explosive limit (LEL) for methane,
- Explosive gas concentrations at the property boundary shall not exceed the LEL,
- RNI shall not cause a violation of any ambient air quality standard at the property boundary or exceed emission threshold limits negotiated in the facilities air permit.

3.8 EXEMPTION FROM UTAH NPDES PERMIT REQUIREMENTS

Based on an SIC code of 1389 (Oil and Gas Services) RNI's Wonsit Landfill cell is exempt for regulation under the Utah NPDES permit program. Other methods and systems are described within this permit application, however, to monitor surface water quality and to control runoff. If a release were to occur during operation of the landfill that effected surface water quality, RNI will notify UDSHW and implement corrective actions as describe in the Landfill Plan of Operations (Appendix I).

4.0 REQUIRED PLANS

Four separate appendices have been prepared to demonstrate compliance UDSHW E&P Landfill application requirements:

- Stormwater Management Plan – Appendix H
- Operations Management Plan – Appendix I
- Closure and Post Closure Plans – Appendix J
- Financial Assurance will be secured in the form of Letter of Credit with an effective date of September 15, 2013. Refer to Appendix K for a preliminary Letter of Credit from RNI's selected bank, required financial calculations, and the estimated time period over which the Closure and Post Closure funds will be expended.

5.0 APPLICATION FORM AND CHECKLIST

Appendix L contains a Landfill Application Form and Checklist detailing the page number where each regulatory requirement has been met.

6.0 REFERENCES

Hintze, Lehi F., 1988, Geologic History of Utah, Brigham Young University Geology Studies Special Publication 7, Bart Kowallis, ed., 202 p.

Neuendorf, Klaus K.E, Mehl, James P., Jr. and Jackson, Julia A., 2005, Glossary of Geology, 5th edition, American Geological Institute, Alexandria, Virginia.

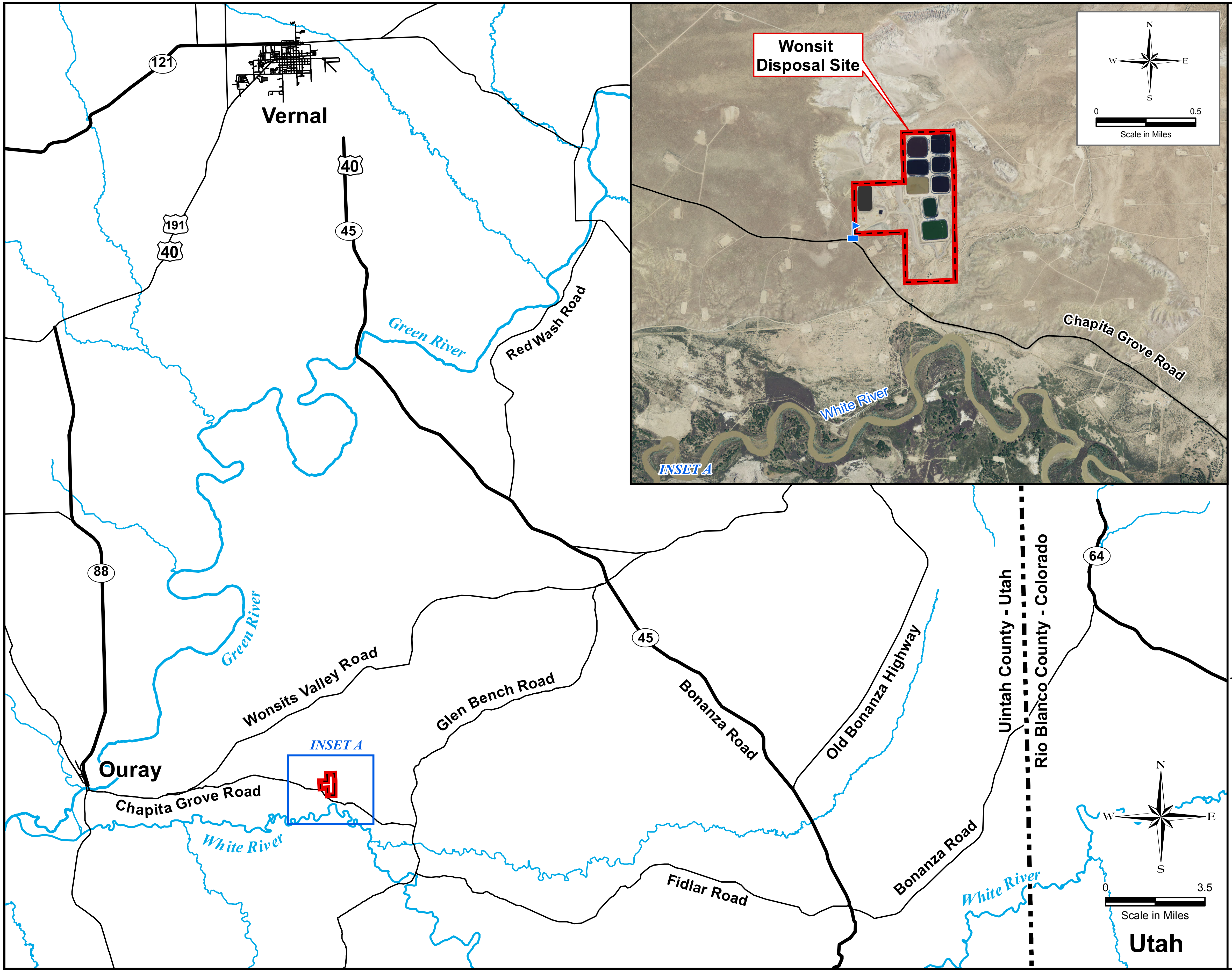
NOAA Atlas 14 Online Database, 2013, National Oceanic and Atmospheric Administration.

Price, Don, Louise Miller, 1975 Hydrologic Reconnaissance of the Southern Uinta Basin, Utah and Colorado, Technical Publication No. 49 State of Utah Department of Natural Resources.

Sprinkel, Douglas A. 2007, Interim geologic map of the Vernal 30' x 60' quadrangle, Uintah and Duchesne counties, Utah, and Moffat and Rio Blanco counties, Colorado, Utah Geological Survey Open-File Report 506DM, 1:100,000-scale, 2 plates.

Stokes, William Lee, 1986, Geology of Utah, Utah Museum of Natural History, Occasional Paper Number 6, Salt Lake City, Utah, 280 p.

U.S. Natural Resources Conservation Service, 2005, Soil Survey of the Uintah Area, Utah—Parts of Daggett, Grand, and Uintah counties: U.S. Department of Agriculture, Washington, D.C.



LEGEND

🟥 Site Boundary
▪ ▪ ▪ County/State Boundary
— River

Road Types

— US Highway
— State Highway
— Local

PHYSICAL ADDRESS:

374 East Chapita Grove Road
Uintah County, UT 84078

GPS @ Road Entrance:
NAD 83 UTM Zone 12 N
Latitude 40 ° 4' 59.5" N
Longitude 109° 31' 15.3" W

Aerial Photography Reference: NAIP 2011

FIGURE 1

RNI WONSIT DISPOSAL LOCATION MAP

MWH

File: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Fig 1_Wonsit_Loc.mxd *Date: 5/13/2013*

File: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Fig 2_Wonsit_Site.mxd *Date: 5/13/2013*

FIGURE 2
RNI WONSIT DISPOSAL SITE (EXISTING)

Aerial Photography Reference: Olympus Aerial Surveys Inc., August 2009 (Modified)

MWH

LEGEND

- 🟥 Site Boundary *(161 Acres)*
- 1 Existing Pond with Pond Number

-Total Existing Pond Surface Area (53.6 Acres)

Figure 2

File: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Fig 3_Stream.mxd

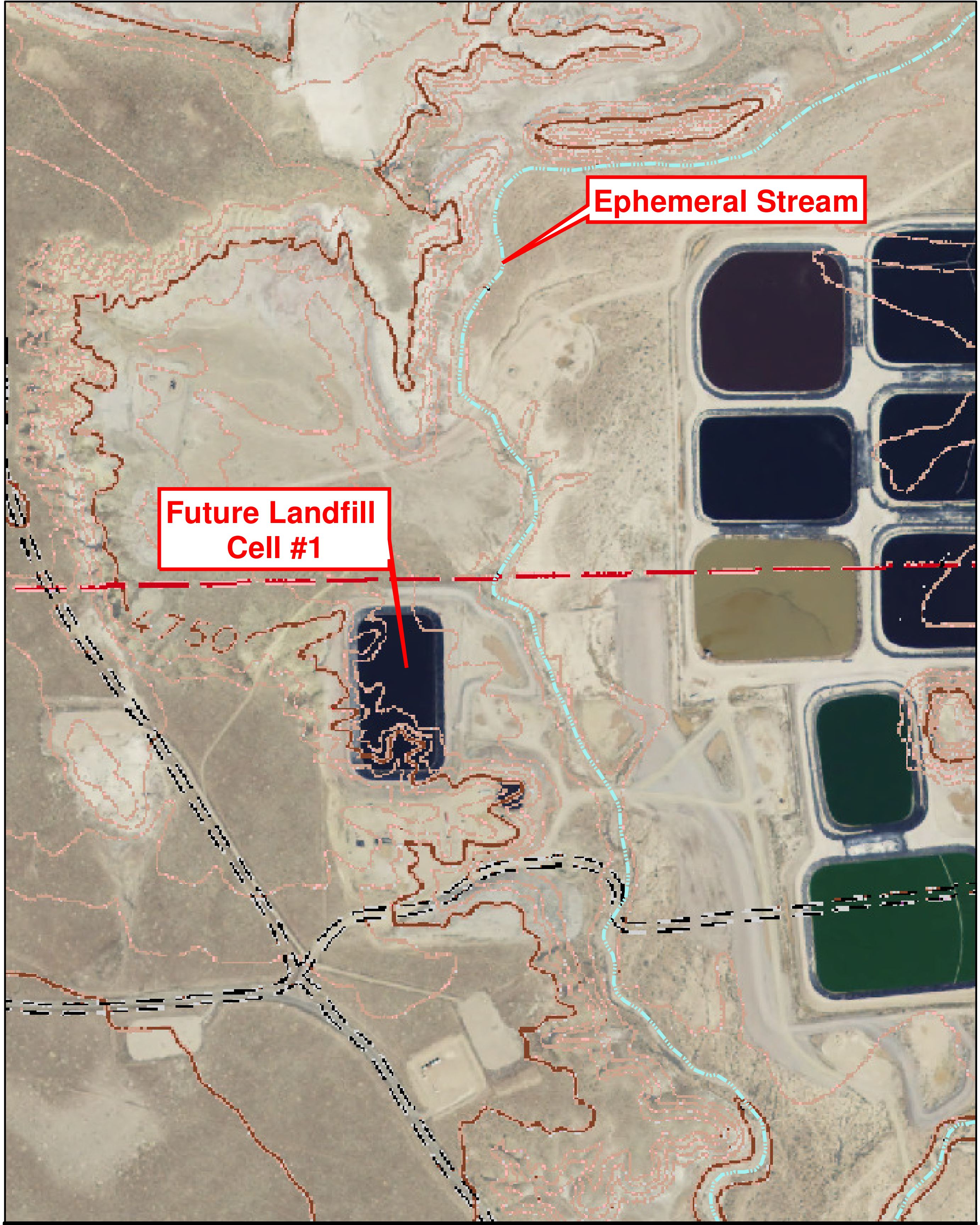


FIGURE 3

EPHEMERAL STREAM

MWH

LEGEND

- · · -	Ephemeral Stream
—	Contour Lines

Appendix A

Legal Description of Property

Proof of Ownership

Written Verification of Land Status

Farm and Home Title
File # ACCOMMODATION ONLY
Tax ID #09-021-0001- 09-019-0001

Mail Tax Notice to Grantee at:
P.O. Box 98
Roosevelt Utah 84066

Entry 2006009746
Book 996 Page 654 $10.00
03-OCT-06 08:17
RANDY SIMMONS
RECORDER, UINTAH COUNTY UTAH
FARM & HOME TITLE INSURANCE AGENCY
721 E 200 N (115-14) ROOSEVELT, UT 84066
Rec By CONNIE SIMPER , DEPUTY

3A

Entry 2006009746
~~Book 586 Page 654~~

WARRANTY DEED

RED MOUNTAIN CORPORATION, A Utah Corporation grantor

of ROOSEVELT , County of DUCHESNE, State of UTAH , hereby

CONVEYS and WARRANTS to

RN INDUSTRIES, a Utah Corporation grantee

of ROOSEVELT County of DUCHESNE State of UTAH,

For the sum of----------------TEN and other good and valuable consideration---------DOLLARS, the following described tract of land in UINTAH County, State of Utah

The North Half of the Northeast Quarter and the Southeast Quarter of the Northeast Quarter of Section 35, Township 8 South, Range 21 East, Salt Lake Base and Meridian

Also: The Southeast Quarter of the Southeast Quarter of Section 26, Township 8 South, Range 21 East, Salt lake Base and Meridian

TOGETHER with all improvements and appurtenances thereto belonging

SUBJECT to all existing easements and rights-of-way

EXCEPTING therefrom all oil, gas, and mineral rights

WITNESS, the hand of said grantor, this 2 Day of October , A D. 2006

Signed in the Presence of

Red Mountain Corporation
By Nile Chapman President

STATE OF UTAH)
ss.
County of DUCHESNE)

On the 2 Day of October , A.D 2006, Personally appeared before me, **Red Mountain Corporation by Nile Chapman President,** the signer of the within instrument, who duly acknowledged to me that he executed the same

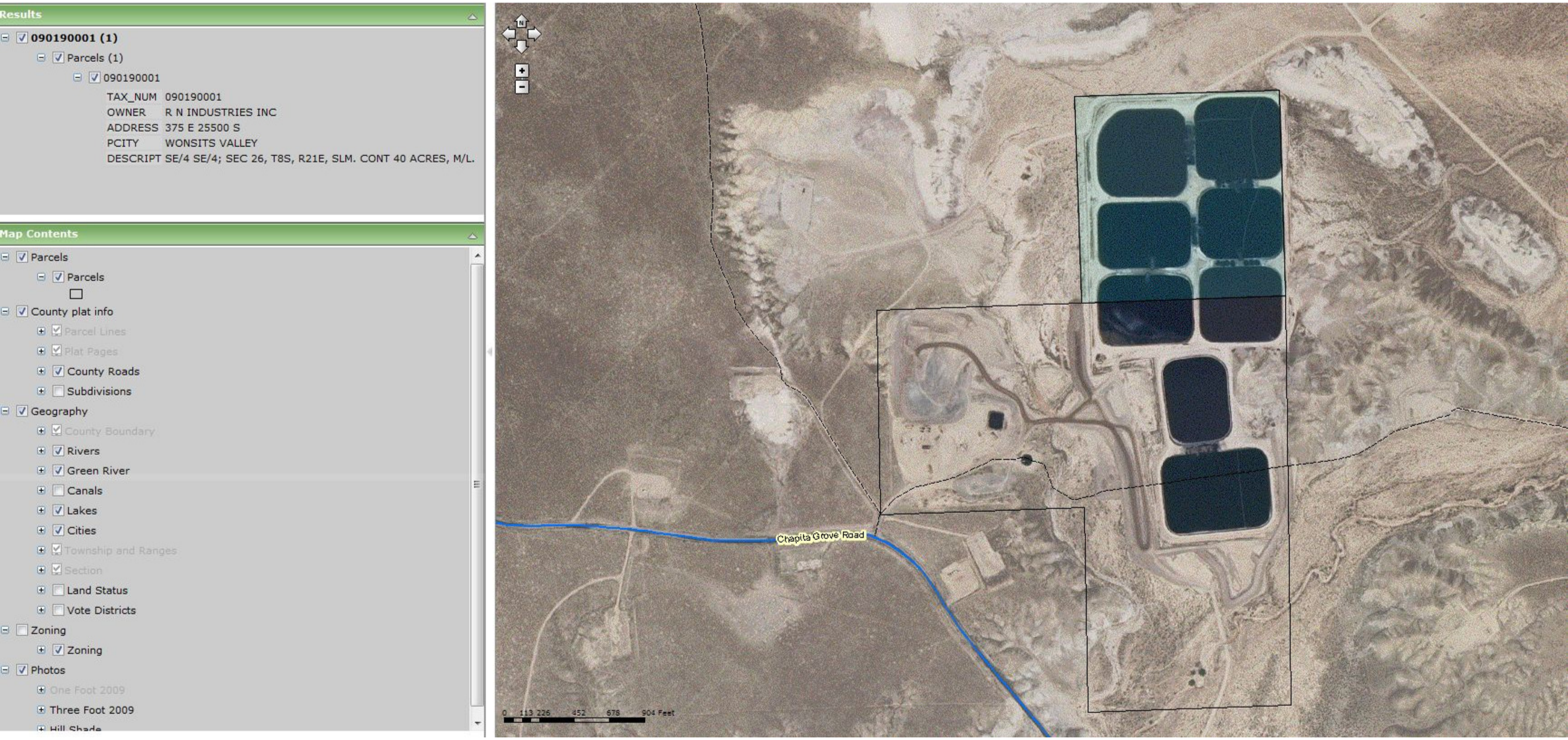
Notary Public
JAYNE RICHENS
721 East 200 North (115-14)
Roosevelt, Utah 84066
My Commission Expires
August 8, 2009
State of Utah

Jayne Richens
Notary Public

My commission expires 8-8-09

Residing in Vernal Ut 84078

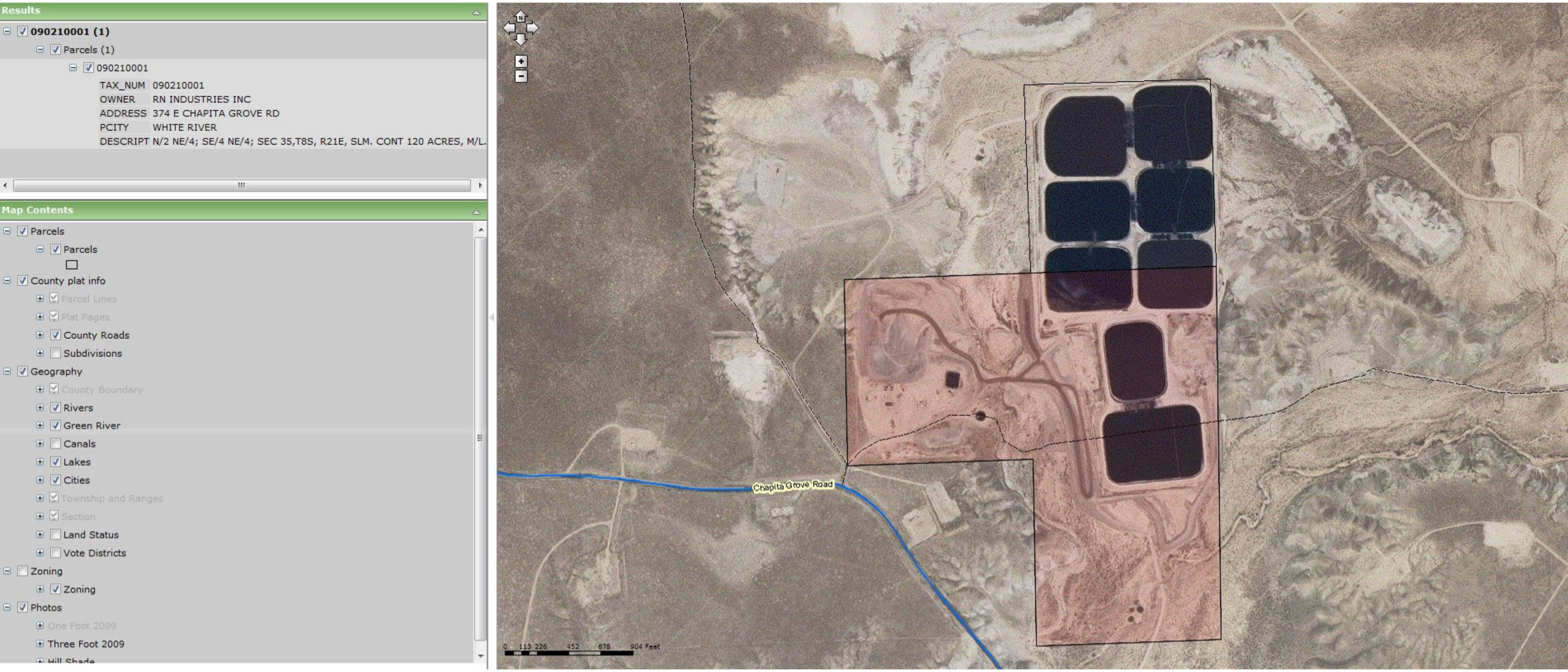
MSJ-EXHIBIT 1



⊟ ☑ **090190001 (1)**
  ⊟ ☑ Parcels (1)
    ⊟ ☑ 090190001

TAX_NUM 090190001
OWNER R N INDUSTRIES INC
ADDRESS 375 E 25500 S
PCITY WONSITS VALLEY
DESCRIPT SE/4 SE/4; SEC 26, T8S, R21E, SLM. CONT 40 ACRES, M/L.

- ⊟ ☑ Parcels
  - ⊟ ☑ Parcels
    - ☐
- ⊟ ☑ County plat info
  - ⊞ ☑ Parcel Lines
  - ⊞ ☑ Plat Pages
  - ⊞ ☑ County Roads
  - ⊞ ☐ Subdivisions
- ⊟ ☑ Geography
  - ⊞ ☑ County Boundary
  - ⊞ ☑ Rivers
  - ⊞ ☑ Green River
  - ⊞ ☐ Canals
  - ⊞ ☑ Lakes
  - ⊞ ☑ Cities
  - ⊞ ☑ Township and Ranges
  - ⊞ ☑ Section
  - ⊞ ☐ Land Status
  - ⊞ ☐ Vote Districts
- ⊟ ☐ Zoning
  - ⊞ ☑ Zoning
- ⊟ ☑ Photos
  - ⊞ One Foot 2009
  - ⊞ Three Foot 2009
  - ⊞ Hill Shade



TAX_NUM	090210001
OWNER	RN INDUSTRIES INC
ADDRESS	374 E CHAPITA GROVE RD
PCITY	WHITE RIVER
DESCRIPT	N/2 NE/4; SE/4 NE/4; SEC 35,T8S, R21E, SLM. CONT 120 ACRES, M/L.

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
UINTAH & OURAY AGENCY
P.O. Box 130 or 988 S. 7500 E.
Fort Duchesne, Utah 84026

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
Real Estate Services MS-420

DEC 18 2012

Roger Chapman, President
RN Industries
P.O. Box 98
Roosevelt, Utah 84066

RE: Verification for Written Verification of Land Status

Dear Mr. Chapman:

A request was made for written verification of land status N/2 NE/4, SE/4 NE/4 of Section 35 and the SE/4 SE/4 of Section 26, Township 8 South, Range 21 East, Salt Lake Base and Meridian.

Under our approach, the Ute Tribe and the Federal Government retain jurisdiction over all trust lands, the National Forest Lands, the Uncompahgre Reservation, and the three categories of non-trust lands that remain within the boundaries of the Uintah Valley Reservation. The status referred to is that of "INDIAN COUNTRY" as defined in 18 U.S.C. § 1151, and also land ownership.

The above location is where written verification of land status was requested and is described as:

LEGAL DESCRIPTION: A parcel of land described as follows, to wit:
N/2 NE/4, SE/4 NE/4 of Section 35 & SE/4 SE/4 of Section 26
Township 8 South, Range 21 East
Uintah County, Salt Lake Meridian, State of Utah.

LAND STATUS: These are Trust Lands within the exterior boundaries of the Uncompahgre Reservation and IS WITHIN THE AREA DESIGNATED AS INDIAN COUNTRY.

If you have any questions regarding the above information you may contact Mr. David Murray, Realty Officer by phone at 435/722-4321, by email david.murray@bia.gov or by facsimile at 435/722-2323.

Sincerely,

Johnna Blackhair
Superintendent

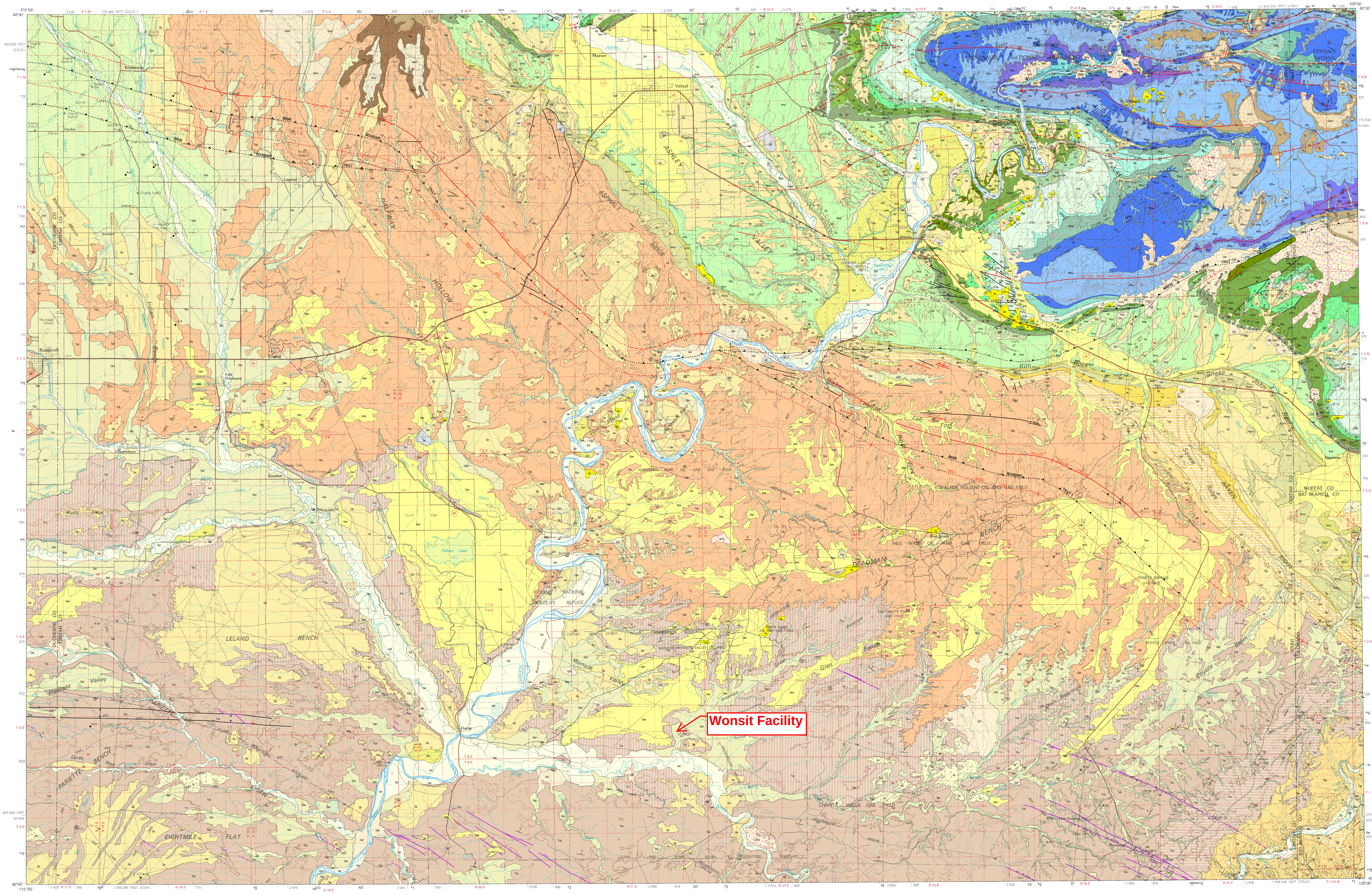
Cc: Agency chrono file

Appendix B

Maps and Additional Figures

Utah Geological Survey
a division of
Utah Department of Natural Resources

Plate 1
Utah Geological Survey Open-File-Report 506DM
Interim Geologic Map of the Vernal 30' x 60' Quadrangle, Uintah and
Duchesne Counties, Utah, and Moffat and Rio Blanco Counties, Colorado



Base from U.S. Geological Survey, Vernal 30' x 60' quadrangle, 1980
Geologic data and base map in NAD 1927

14½°
TRUE NORTH
MAGNETIC NORTH
APROXIMATE MEAN DECLINATION, 1980

SCALE 1:100 000
CONTOUR INTERVAL 50 METERS
5 0 5 10 15 Kilometers
5 0 5 Miles

UTAH
QUADRANGLE LOCATION

GIS Data Preparation: Basia Matyjasik, Douglas A. Sprinkel,
Lori J. Douglas, and Kent D. Brown

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award numbers 02HQAG0055, 03HQAG0096, 04HQAG0040 and 06HQAG0037. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

This map is a plot of Geographic Information System (GIS) files created to visually represent the content of the GIS data files. It is not a published map and it contains many features that do not meet UGS cartographic standards, such as automatically generated labels that may overlap other labels and lines.

INTERIM GEOLOGIC MAP OF THE VERNAL 30' x 60' QUADRANGLE, UINTAH AND DUCHESNE COUNTIES, UTAH, AND MOFFAT AND RIO BLANCO COUNTIES, COLORADO

by

Douglas A. Sprinkel

2007

Utah Geological Survey
a division of
Utah Department of Natural Resources

Plate 2
Utah Geological Survey Open-File Report 506DM
Interim Geologic Map of the Vernal 30' x 60' Quadrangle, Uintah and
Duchesne Counties, Utah, and Moffat and Rio Blanco Counties, Colorado

Description of Map Units

Qf DISTURBED GROUND (HISTORICAL) - Gravel pit operations mostly along the flood plain of the Green River; material excavated is from unconsolidated deposits of Qal and Qaf; includes sewage lagoon along Ashley Creek and larger earthen dams for reservoirs.

Qmf DEBRIS-FLOW DEPOSITS (HISTORICAL) - Unconsolidated and poorly sorted heterogenous mixture of boulders, gravel, sand, silt, and mud; matrix supported; less than 2 m thick.

Qal FLOOD-PLAIN AND CHANNEL ALLUVIUM (HOLOCENE) - Unconsolidated silt, sand, and gravel in flood plains of Green River, Ashley and Brush Creeks, and Pleasant Valley Wash; locally grade into Qac; 1-30 m thick.

Qat TERRACE DEPOSITS (HOLOCENE) - Unconsolidated to locally cemented silt, sand, gravel, cobbles, and boulders; remnants of alluvial terraces along the Green River and Ashley and Brush Creeks; less than a few tens of meters thick.

Qaf ALLUVIAL-FAN DEPOSITS (HOLOCENE AND PLEISTOCENE) - Unconsolidated, poorly sorted boulder, gravel, sand, and silt; locally grade into Qac; less than 30 m thick.

Qac MIXED ALLUVIUM AND COLLUVIUM (HOLOCENE) - Unconsolidated mud, silt, sand, and gravel in intermittent stream drainages and in areas of low topographic relief. On the Mancos Shale or other soft formations, this unit is mostly reworked mud; locally grade into Qae, Qaf, and Qal; less than 10 m thick.

Qae MIXED ALLUVIUM AND EOLIAN DEPOSITS (HOLOCENE) - Unconsolidated alluvial mud, silt, and sand mixed with windblown sand and silt; many of these deposits are in tributary stream channels of the Green River, along smaller streams, and in other intermittent stream drainages and locally grade into Qac; less than 10 m thick.

Qe EOLIAN DEPOSITS (HOLOCENE) - Unconsolidated, well-sorted, fine-grained, windblown sand and silt; less than 10 m thick.

Qc COLLUVIUM (HOLOCENE) - Heterogeneous mixture of boulders, gravel, cobbles, sand, and silt that may grade into talus, landslide, and alluvial deposits; thin to a few tens of meters thick.

Qmt TALUS DEPOSITS (HOLOCENE AND PLEISTOCENE?) - Unconsolidated and unstratified angular rock fragments that accumulate at the base of cliffs. Colluvium is a locally significant part of this deposit; less than 5 m thick.

Qms SLIDES, SLUMPS AND FLOWS (HOLOCENE AND PLEISTOCENE) - Earth flow and rotational slumps and slides in formations prone to slope failure; some Qms units may include mass movements of slightly different age or may share a common boundary with an adjoining mass movement.

Qa PIEDMONT AND BASIN ALLUVIUM, UNDIVIDED (HOLOCENE AND PLEISTOCENE[?]) - Variably consolidated, poorly to moderately sorted sand, gravel, cobbles, and boulders deposited on near-planar bedrock surfaces; more than one level recognized but not subdivided so deposits of different ages can share a common boundary; poorly to well-developed soil profile developed in all levels with the best-developed profile in the topographically highest deposit; less than 2 m thick.

Qas1 YOUNGEST SOUTH FLANK PIEDMONT ALLUVIUM (HOLOCENE AND UPPER PLEISTOCENE) - Unconsolidated to poorly consolidated, poorly sorted sand, gravel, cobbles, and boulders; poorly developed soil profile and stage I pedogenic carbonate (caliche) coatings on undersides of clasts; mapped in the northern part of the quadrangle where traceable from Dutch John 30' x 60' quadrangle (Sprinkel, 2006); less than 2 m thick.

Qas2 YOUNGER SOUTH FLANK PIEDMONT ALLUVIUM (UPPER PLEISTOCENE) - Unconsolidated to moderately consolidated, poorly sorted sand, gravel, cobbles, and boulders; poorly to well-developed soil profile and stage II-III pedogenic carbonate (caliche) coatings of clasts in upper 1 m of deposit; mapped in the northern part of the quadrangle where traceable from Dutch John 30' x 60' quadrangle (Sprinkel, 2006) and topographically higher than Qas1; less than 3 m thick.

Qga GLACIAL ALLUVIAL OUTWASH, UNDIVIDED (PLEISTOCENE) - Unconsolidated, well-rounded, mostly red quartzose sandstone and quartzite (Uinta Mountain Group) boulders to pebbles and sand deposits in the Whiterocks Canyon drainage in the northwest part of the quadrangle (see Sprinkel, 2006) derived from the high-energy meltwaters of glaciers of undetermined age; thickness not determined but probably less than 10 m.

Qas3 OLDER SOUTH FLANK PIEDMONT ALLUVIUM (MIDDLE PLEISTOCENE) - Variably consolidated, poorly sorted, silt, sand, gravel, and cobble to boulder deposit; subangular to subrounded clasts dominated by quartz sandstone and quartzite of Uinta Mountain Group; mostly matrix-supported with clast-supported channel deposits; well-developed soil profile with stage III-IV carbonate (caliche) cementation; some clasts coated with iron-manganese deposits; boulders are scattered on surface as lag deposit; deposit typically “rests” on Bishop Conglomerate but does “rest” on pre-Bishop units in places; forms the highest and oldest gravel deposit that caps the Yampa Plateau in this quadrangle; also mapped in the Dutch John 30' x 60' quadrangle (Sprinkel, 2006); less than 10 m thick in quadrangle.

Tb BISHOP CONGLOMERATE (OLIGOCENE) - Light-gray to pinkish-gray, friable sandstone with tuffaceous interbeds, and poorly sorted, loosely cemented, boulder to pebble conglomerate mapped on the Yampa Plateau; an ash bed near the base of the Bishop on the Yampa Plateau yielded ^{40}Ar/^{39}Ar weighted mean age on sanidine of about 34 Ma (Kowallis and others, 2005); a stratigraphically higher ash bed on the Diamond Plateau in the adjoining Dutch John 30' x 60' quadrangle yielded an ^{40}Ar/^{39}Ar age on sanidine of 30.5 Ma (Kowallis and others, 2005), which is similar to K-Ar ages of 28.5 Ma (hornblende) and 29.5 Ma (biotite) reported by Hansen (1986); less than 50 m thick.

Tds STARR FLAT MEMBER OF DUCHESNE RIVER FORMATION (OLIGOCENE) - Reddish-brown, reddish-purple, yellowish-gray, and greenish-gray, fine- to coarse-grained sandstone, siltstone, mudstone, and conglomerate; sandstone and fine-grained beds dominate the member and coarsen upward; resistant and thick-bedded; Bryant and others (1989) obtained fission-track ages in zircon of 30.0 to 36.7 Ma from the member in the adjoining Duchesne and Kings Peak 30' x 60' quadrangles; Anderson and Picard (1972) defined the Starr Flat as the uppermost member of the Duchesne River Formation, but it is likely correlative with the Bishop Conglomerate because of similar stratigraphic relations and age (see Hansen, 1986; Bryant and others, 1989, Kowallis and others, 2005); 40-230 m thick.

Tdl LAPOINT MEMBER OF DUCHESNE RIVER FORMATION (OLIGOCENE AND EOCENE) - Light-reddish-brown and yellowish-gray, fine-grained sandstone, siltstone, and mudstone; contains abundant light-greenish-gray bentonite beds; mostly nonresistant and thin- to very thin bedded; late Eocene (Duchesnean) in age based on vertebrate fossil assemblage and K-Ar age (mineral not reported) of 39.3 Ma from an ashy siltstone bed at the Lapoint-Dry Gulch Creek contact (Anderson and Picard, 1972); three K-Ar ages on biotite of 35.7 to 40.3 were obtained from near the base of the Lapoint Member (McDowell and others, 1973; Mauger, 1977); exposed thickness 120 m, but as much as 300 m thick in subsurface of Uinta Basin.

Tdd DRY GULCH CREEK MEMBER OF DUCHESNE RIVER FORMATION (EOCENE) - Medium-reddish-brown and purplish-gray, fine-grained sandstone, siltstone, mudstone, and conglomerate; dominated by slope-forming siltstone and mudstone with ledge-forming thin-bedded sandstone; contains some vertebrate fossils (Anderson and Picard, 1972); less than 150 m thick.

Tdb BRENNAN BASIN MEMBER OF DUCHESNE RIVER FORMATION (EOCENE) - Light- to medium-red, light-reddish-brown, and yellowish-gray, fine- to medium-grained lithic sandstone and siltstone with minor amounts of mudstone and conglomerate; contains well-developed paleosols; the exposed basal part of the Brennan Basin Member intertongues with the underlying Uinta Formation and is as much as 60 m thick; the contact is placed at the base of a resistant reddish-brown sandstone bed that lies on the uppermost variegated mudstone bed of the Uinta Formation; the Brennan Basin Member, however, lies unconformably on beds of the Green River Formation near Squaw Ridge and Mesaverde Group along Asphalt Ridge; contains a diverse assemblage of vertebrate fossils of Late Eocene age; see Anderson and Picard (1972) for a summary of the fossils and age of the Brennan Basin Member; exposed thickness 220-600 m, but as much as 1040 m thick in subsurface of Uinta Basin.

Tu UINTA FORMATION (EOCENE) - Consists of three members but combined where members are too thin to show separately at map scale or where member identification uncertain; see below for unit description and thickness; combined exposed thickness of map unit is 335-745 m.

Tuc MEMBER C OF UINTA FORMATION (EOCENE) - Soft, light-gray, greenish-gray, white, grayish-purple, red, and pale-yellow shale, mudstone, claystone, and minor sandstone with local tuffaceous interbeds; consists mostly of Horizon C of Osborn (1929), Peterson and Kay (1931), and Kay (1934); informally referred to as the Myton member by some authors; the base of member C is placed near the Amynodon sandstone of Riggs (1912); forms the badlands topography characteristic of Fantasy Canyon (section 12, T. 9 S., R. 22 E., Uintah County); contains some gilsonite deposits; exposed thickness 60-250 m, but as much as 570 m thick in subsurface of Uinta Basin.

Tub MEMBER B OF UINTA FORMATION (EOCENE) - Light-gray, light-greenish-gray, light-brown, and light-purple, mudstone and claystone with interbeds of greenish-gray, yellow, and brown fine-grained sandstone; contains minor conglomerate and tuffaceous beds; forms nonresistant slopes and thin resistant ledges; consists mostly of Horizon B of Osborn (1929), Peterson and Kay (1931), and Kay (1934); these beds are included in the informal Wagonhound member of some authors; contains significant gilsonite deposits in southern part of quadrangle, particulary around Bonanza, Utah; exposed thickness about 275 m, but 108-508 m thick in subsurface of Uinta Basin.

Tua MEMBER A OF UINTA FORMATION (EOCENE) - Yellowish-gray and yellowish-brown, fine- to very fine grained sandstone and siltstone; contains minor conglomerate, shale, and tuffaceous interbeds; forms resistant beds; consists of Horizon A of Osborn (1929), Peterson and Kay (1931), and Kay (1934); these beds are included in the informal Wagonhound member of some authors; intertongues with the underlying Parachute Creek Member of the Green River Formation; the lower contact is irregular and bedding is contorted because of soft-sediment deformation; generally thins northward; 0-220 m thick.

Tgp PARACHUTE CREEK MEMBER OF GREEN RIVER FORMATION (EOCENE) - Moderately resistant, light- to medium-gray, light- to medium-brown, yellow, organic-rich marlstone, siltstone, sandstone, and oolitic limestone; contains pods of nahcolite, some of which have been leached leaving cavities; includes the Mahogany oil-shale zone; upper part intertongues with overlying Uinta Formation near the White River drainage in the southeast part of the quadrangle but pinches out and is unconformably overlain by the Duchesne Formation near The Rim Rock to the north; exposed thickness 0-270 m, but 335-1230 m thick in subsurface of Uinta Basin.

Tgd DOUGLAS CREEK MEMBER OF GREEN RIVER FORMATION (EOCENE) - Soft to moderately resistant, light- to medium-gray, light- to medium-brown, yellow, and light-gray siltstone, sandstone, shale, and cherty and oolitic limestone; base is light-brown ostracodal limestone of Long Point Bed (Johnson, 1984); unconformably overlain by the Duchesne Formation near Spring Hollow along the Green River; exposed thickness 0-150 m, but 284-425 m thick in subsurface of Uinta Basin.

Tgr-Tw GREEN RIVER-WASATCH FORMATIONS TRANSITION ZONE (EOCENE) - Intertonguing beds of Green River (lithotypes similar to Douglas Creek Member) and Wasatch Formations identified only in wells; represents interval between the base of Long Point Bed and the main body of the Wasatch Formation; shown on cross sections only; 75-265 m thick.

Tw WASATCH FORMATION (EOCENE AND PALEOCENE[?]) - Red, yellow, and light-gray friable sandstone, siltstone, claystone, and conglomerate; conglomerate clasts consist mostly of gray limestone (Paleozoic), sandstone (Mesozoic), and some red quartzose sandstone and quartzite (Uinta Mountain Group); upper part intertongues with overlying Douglas Creek Member of Green River Formation where the transition zone is not identified; lower part intertongues with underlying Flagstaff Member of Green River Formation where identified; 300-920 m thick where undivided, but is 245-620 m thick for main body of Wasatch Formation.

Tgf FLAGSTAFF MEMBER OF GREEN RIVER FORMATION (EOCENE) - Mostly medium- to dark-gray carbonate, light-gray sandstone, light-gray to green-gray claystone; only identified in subsurface from lithologic and geophysical well logs; intertongues with Wasatch Formation; shown on cross section only; 70-800+ m thick.

Kmvu UPPER UNIT OF MESAVERDE GROUP (UPPER CRETACEOUS) - Moderately resistant, light-gray to pale-grayish-orange, fine-grained, lenticular cross-bedded sandstone with carbonaceous shale and thick coal beds; may include beds of the Tuscher, Farrer, and Neslen Formations; exposed thickness 450-550 m, but as much as 695 m thick in subsurface of Uinta Basin.

Kmvl LOWER UNIT OF MESAVERDE GROUP (UPPER CRETACEOUS) - Resistant, light-gray, tan, and light-yellow, cross-bedded sandstone with subordinate gray carbonaceous shale and minor coal; likely includes beds of the Sego Sandstone, Buck Tongue of the Mancos Shale, and Castlegate Sandstone; locally defined by Walton (1944) as the Rim Rock Formation; exposed thickness 200-250 m, but 120-340 m thick in subsurface of Uinta Basin.

Kms MANCOS SHALE (UPPER CRETACEOUS) - Dark-gray, soft, slope-forming, calcareous shale containing beds of siltstone and bentonitic clay; 1360-1700 m thick.

Kfd FRONTIER SANDSTONE, MOWRY SHALE, AND DAKOTA SANDSTONE, UNDIVIDED - These formations are shown as one unit along part of the south flank of the Yampa Plateau; see below for descriptions and thickness; combined thickness of map unit is 75-235 m.

Kf FRONTIER SANDSTONE (UPPER CRETACEOUS) - Upper part resistant, light-brown to light-gray and yellow, fine-grained and ripple-marked sandstone with local petrified wood and fossils; lower part soft, light- to dark-gray calcareous shale; may include minor limestone and coal beds in the lower part; exposed thickness 50-85 m, but as much as 100 m thick in subsurface of Uinta Basin.

Kmd MOWRY SHALE AND DAKOTA SANDSTONE, UNDIVIDED - These formations are locally shown as one unit along Snake John Reef because they are too thin to show separately at map scale. See below for descriptions and thickness; combined thickness of map unit is 25-150 m.

Kmr MOWRY SHALE (UPPER AND LOWER CRETACEOUS) - Dark-gray, siliceous shale that weathers silver gray; contains abundant fossil fish scales; age based on Obradovich and Cobban (1975), Cobban and Kennedy (1989), Molenaar and Cobban (1991), and unpublished palynological data; 10-70 m thick.

Kd DAKOTA SANDSTONE (LOWER CRETACEOUS) - Upper and lower resistant, yellow and light-gray, medium- to coarse-grained sandstone beds separated by a carbonaceous shale; contains coal beds in exposures along the flank of Split Mountain (Doelling and Graham, 1972); 15-80 m thick.

KJcm CEDAR MOUNTAIN FORMATION AND MORRISON FORMATION - Cedar Mountain is mapped with the underlying Morrision Formation because it is generally thin and the contact with the underlying Morrison is difficult to determine despite being a major unconformity representing about 25 Ma; combined thickness of map unit is 245-350 m.

Cedar Mountain Formation (Lower Cretaceous) - Purple, gray, and greenish-gray mudstone, siltstone, and minor sandstone and limestone; contains calcrete beds that weather out as carbonate nodules; 0-60 m thick.

Morrison Formation (Upper Jurassic) - Upper Brushy Basin Member consists of soft, banded, variegated (light-gray, olive-gray, red, and light-purple) shale, claystone, siltstone, and minor cross-bedded sandstone, conglomerate, and bentonite. Lower Salt Wash Member consists of resistant, light-gray to white, cross-bedded sandstone; dinosaur remains are preserved in the Salt Wash Member at Dinosaur National Monument; exposed thickness 245-290 m thick, but as thin as 160 m in subsurface.

Jsc STUMP FORMATION, ENTRADA SANDSTONE, AND CARMEL FORMATION, UNDIVIDED - These formations are mapped as one unit where too thin to show separately at map scale; see below for unit description and individual formation thickness; combined thickness of map unit is 140-295 m.

Js STUMP FORMATION (UPPER JURASSIC) - Upper Redwater Member is greenish-gray and light-green, slope-forming shale with glauconitic, fossiliferous (belemnites) sandstone and limestone. Lower Curtis Member is resistant, light-gray to greenish-gray, cross-bedded, fossiliferous, glauconitic sandstone, oolitic limestone, and fissile shale; palynomorph assemblage from base of Curtis indicates Oxfordian age (Wilcox and Currie, 2006; Brian Currie, Miami University (Ohio), verbal communication, March 15, 2006); J-3 unconformity of Pipiringos and O’Sullivan (1978) is at base of Curtis Member; total thickness is 40-80 m.

Je ENTRADA SANDSTONE (MIDDLE JURASSIC) - Upper reddish-brown siltstone and fine-grained sandstone and a lower light-gray, pink, and light-brown sandstone; lower sandstone is resistant to erosion and forms cliffs and ridges; 15-75 m thick.

Jc CARMEL FORMATION (MIDDLE JURASSIC) - Medium- to dark-red, green, and gray sandy shale, sandstone, siltstone, limestone, and gypsum; upper part is mostly slope-forming red shale, siltstone, and sandstone underlain by a middle gypsiferous unit; lower part is mostly red siltstone and thin, ledge-forming limestone, which is commonly oolitic and fossiliferous; 85-140 m thick.

JTRn NUGGET SANDSTONE (LOWER JURASSIC AND UPPER TRIASSIC) - Pink, light-gray, and light-brown, resistant, massive-weathering, large-scale cross-bedded sandstone; locally contains carbonate lenses (playa) and fluvial lenses (wadi) near top; forms cliffs and ridges; mapped as Navajo Sandstone prior to 1964 by several workers, however, the nomenclature was changed to Glen Canyon Sandstone by Poole and Stewart (1964) and adopted by several workers; I have abandoned the use of Glen Canyon Sandstone and adopted Nugget Sandstone, which is present in the western Uinta Mountains. I have restricted the Nugget Sandstone to the upper eolian beds and included the lower flat-lying sandstone and carbonate beds in the underlying Chinle Formation; vertebrate tracks of Jurassic age preserved in a fluvial lens near the top of Nugget Sandstone near Red Fleet Resevoir (Hamblin and others, 2000) in Dutch John 30' x 60' quadrangle; casts of vertebrate tracks of Late Triassic age are preserved on underside beds near or at the base of typical Nugget Sandstone in this quadrangle near Dinosaur National Monument and at McConkie Ranch in Dutch John 30' x 60' quadrangle (Lockley and others, 1992); 155-275 m thick.

TRcd CHINLE, MOENKOPI, AND DINWOODY FORMATIONS, UNDIVIDED - Combined where formations are too thin to show at map scale; see below for descriptions and thickness; combined thickness of map unit is 255-550 m.

TRc CHINLE FORMATION (UPPER TRIASSIC) - Purplish-red, purple, light-gray, greenish-gray, light-green, ripple-marked siltstone, sandstone, claystone, shale, and conglomerate that locally contains abundant petrified wood; generally forms slopes; upper 26-36 m is light-reddish-brown planar laminated sandstone, cross-bedded sandstone, siltstone, and variegated mudstone that is correlated with Bell Springs Member of Nugget Sandstone by Jensen and Kowallis (2005); impressions of the vertebrate tracks of Late Triassic age (the mates of overlying casts found in overlying Nugget) may be preserved; base is resistant conglomerate unit named the Gartra Member; 85-125 m thick.

TRmd MOENKOPI AND DINWOODY FORMATIONS, UNDIVIDED - Combined as one map unit where formations are too thin to show separately at map scale; see below for descriptions and thickness; combined thickness of map unit is 170-425 m.

TRm MOENKOPI FORMATION (LOWER TRIASSIC) - Medium- to dark-red, reddish-brown, green, and gray, ripple-marked siltstone, fine-grained sandstone, and shale with gypsum and limestone beds; mostly “soft,” slope-forming unit; 170-260 m thick.

TRd DINWOODY FORMATION (LOWER TRIASSIC) - Light-gray, greenish-gray, light-brown, and brown, thin-bedded, ripple-marked shale, siltstone, and sandstone with minor amounts of limestone. "Soft," slope-forming unit along the flanks of the Yampa Plateau; 0-165 m thick.

Pp PARK CITY AND PHOSPHORIA FORMATIONS (LOWER PERMIAN) - Combined thickness of Park City and Phosphoria Formations is 20-125 m.

Franson Member of Park City Formation - Gray, thick- to thin-bedded, cherty limestone and dolomite interbedded with brownish-gray sandstone and red to ochre shale; generally resistant and forms ledges and cliffs.

Meade Peak Phosphatic Shale Member of the Phosphoria Formation - Slope-forming, dark-gray, phosphatic shale with interbeds of sandstone and limestone.

Grandeur Member of Park City Formation - Light-gray to light-brownish-gray sandstone, dolomite, and limestone; generally resistant and forms ledges and cliffs.

PIPw WEBER SANDSTONE (LOWER PERMIAN TO MIDDLE PENNSYLVANIAN) - Light-gray to yellowish-gray, very thick bedded sandstone with interbeds of limestone in the lower part; highly cross-bedded sandstone in the upper part; forms steep cliffs and ridges; 230-475 m thick.

IPm MORGAN FORMATION (MIDDLE PENNSYLVANIAN) - Light- to medium-red, yellow, and gray shale and siltstone, light- to medium-gray fossiliferous and red cherty limestone, and light-red-gray, fine-grained, locally cross-bedded sandstone; 10-290 m thick.

IPrv ROUND VALLEY LIMESTONE (LOWER PENNSYLVANIAN) - Light-gray to light-blue-gray, thin- to very thick bedded limestone interbedded with soft, red shale; limestone is fossiliferous and cherty; chert is blue gray and yellowish gray, but red to pink jasperoid chert is common in the region; forms ledges and cliffs; only exposed in Split Mountain; 65-130 m thick.

Mdh DOUGHNUT SHALE AND HUMBUG FORMATION (UPPER MISSISSIPPIAN) - Combined thickness of map units is 160-185 m; only exposed in Split Mountain.

Doughnut Shale - Dark-gray shale, with some red shale near base, with beds of coarse sandstone, limestone, and “coal;” shale is slope forming and clayey; only exposed in Split Mountain; 85-95 m thick.

Humbug Formation - Light-gray to red, fine-grained to very fine grained, "soft" to resistant sandstone interbedded with light-gray limestone and red to black shale; sandstone is locally cross-bedded and hematitic near top of formation; 75-90 m thick.

Mm MADISON LIMESTONE (UPPER AND LOWER MISSISSIPPIAN) - Mostly dark-gray, medium to coarse crystalline, cherty limestone; chert is typically light gray; regionally contains numerous caves and sinkholes; only exposed in Split Mountain; base not exposed, regionally 130-300 m thick.

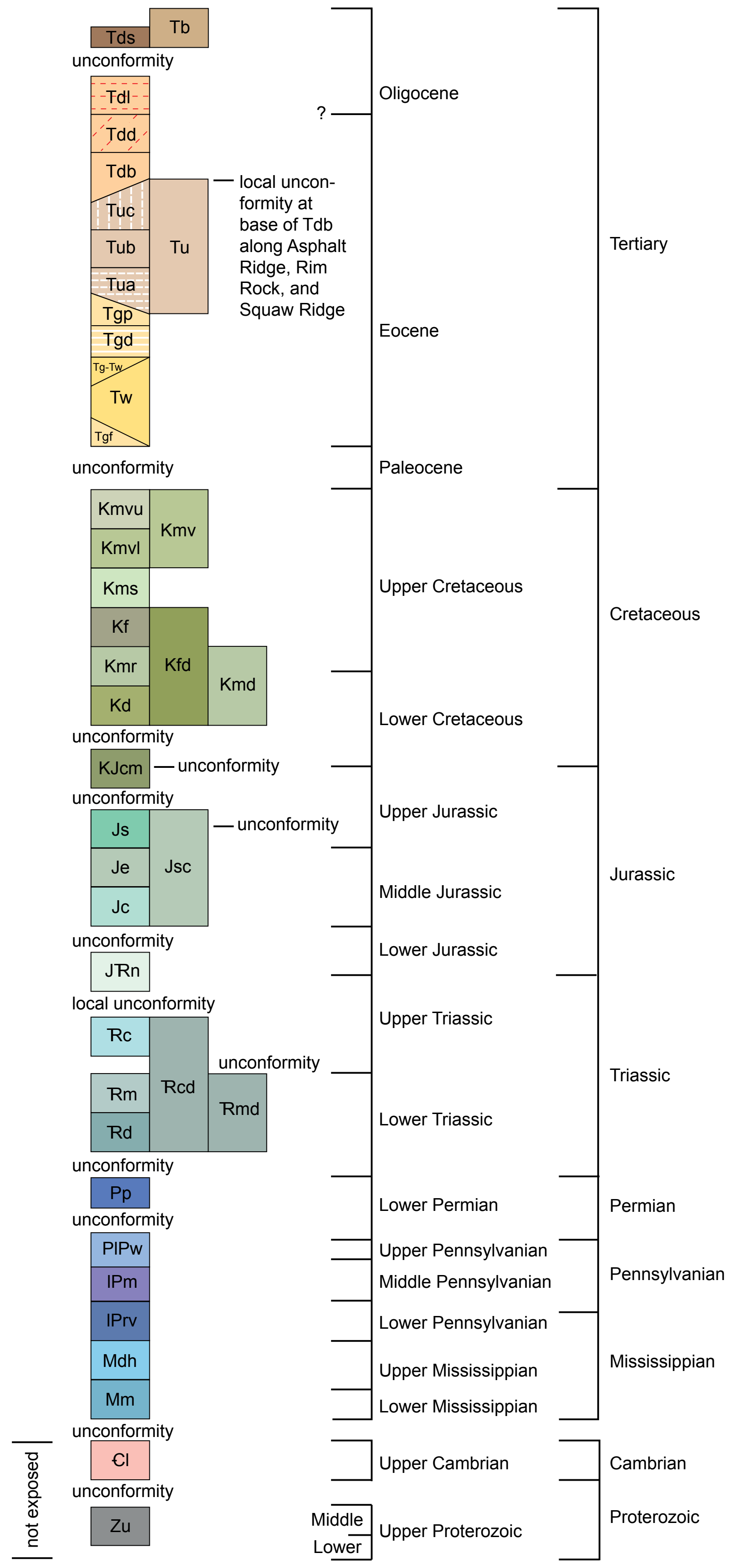
NOT EXPOSED IN VERNAL 30' X 60' QUADRANGLE

The formations below are exposed in the adjoining Dutch John 30’ x 60’ quadrangle and are likely present in subsurface of this quadrangle (see cross sections). In addition, some of these formations are the primary source of clasts for Quaternary and Tertiary units in the Vernal 30’ x 60’ quadrangle.

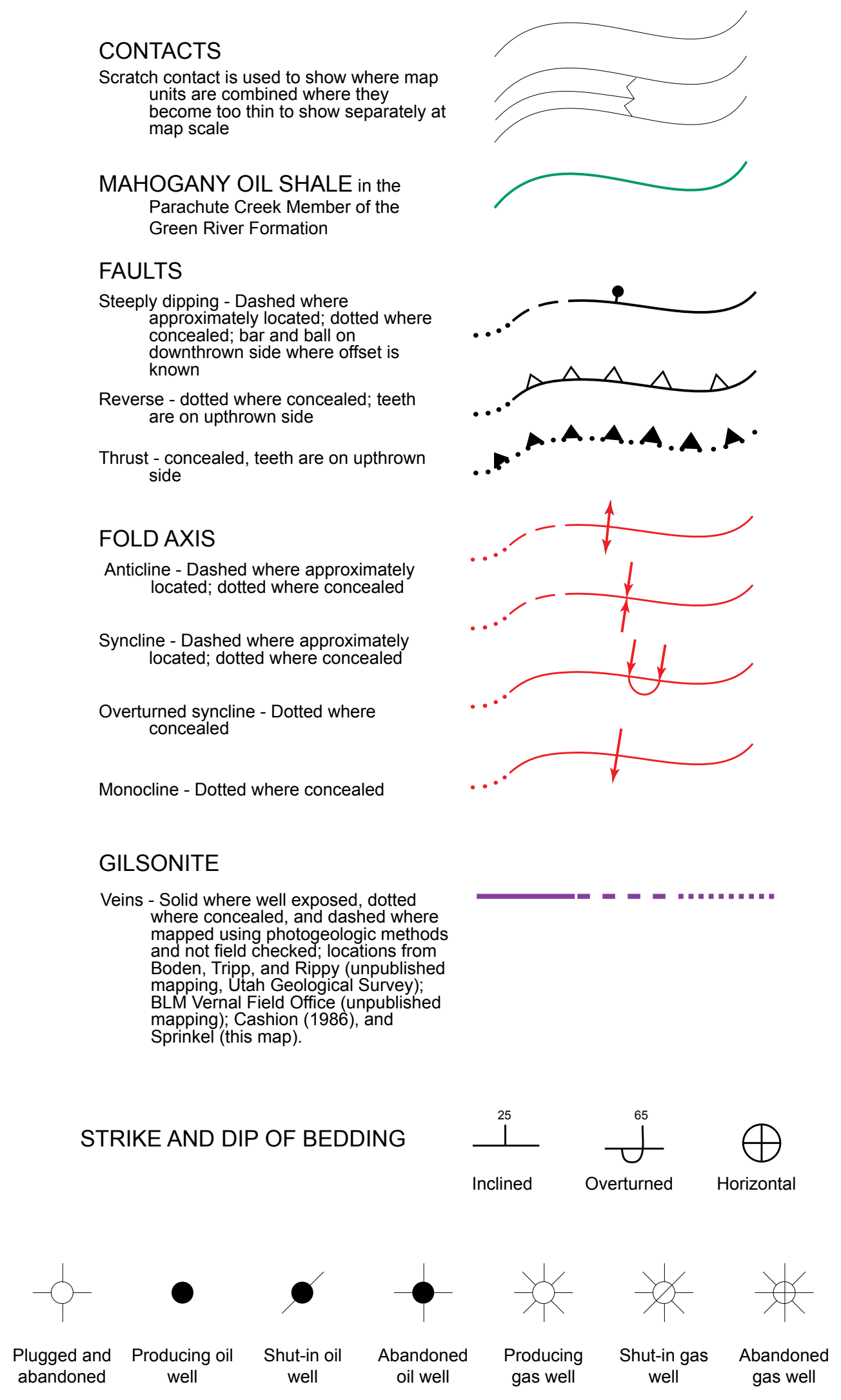
Ꞓl LODORE FORMATION (UPPER CAMBRIAN) - Light-brown to greenish-gray sandstone underlain by pink to tan to pale-greenish-gray glauconitic shale interbedded with tan to pale-green sandstone; base is variegated (pink, gray, and pale-green) coarse- to medium-grained cross-bedded sandstone; locally pebbly; Lodore pinches out to the west; 0-180 m thick.

Zu UINTA MOUNTAIN GROUP (NEOPROTEROZOIC [MIDDLE AND LOWER?]) - Dark- to light-red, fine- to coarse-grained, quartzose and lithic sandstone and quartzite; sandstone is thick to medium bedded with planar, contorted and cross-bedding; some beds contain tool and groove marks, ripples, and mudcracks; contains considerable red, green, and dark-gray micaceous shale interbeds and some conglomerate; age is based on palynomorphs recovered from near middle of formation in the Dutch John 30' x 60' quadrangle (Sprinkel and Waanders, 2005; Sprinkel, 2006) and detrital zircon grains (770 Ma) from lower part of the unit (Fanning and Dehler, 2005); as much as 3500 m thick, but thins southward; not likely present south of Asphalt Ridge and Snake John Reef.

Correlation of Bedrock Units



Map Symbols



CONTACTS
Scratch contact is used to show where map units are combined where they become too thin to show separately at map scale

MAHOGANY OIL SHALE in the Parachute Creek Member of the Green River Formation

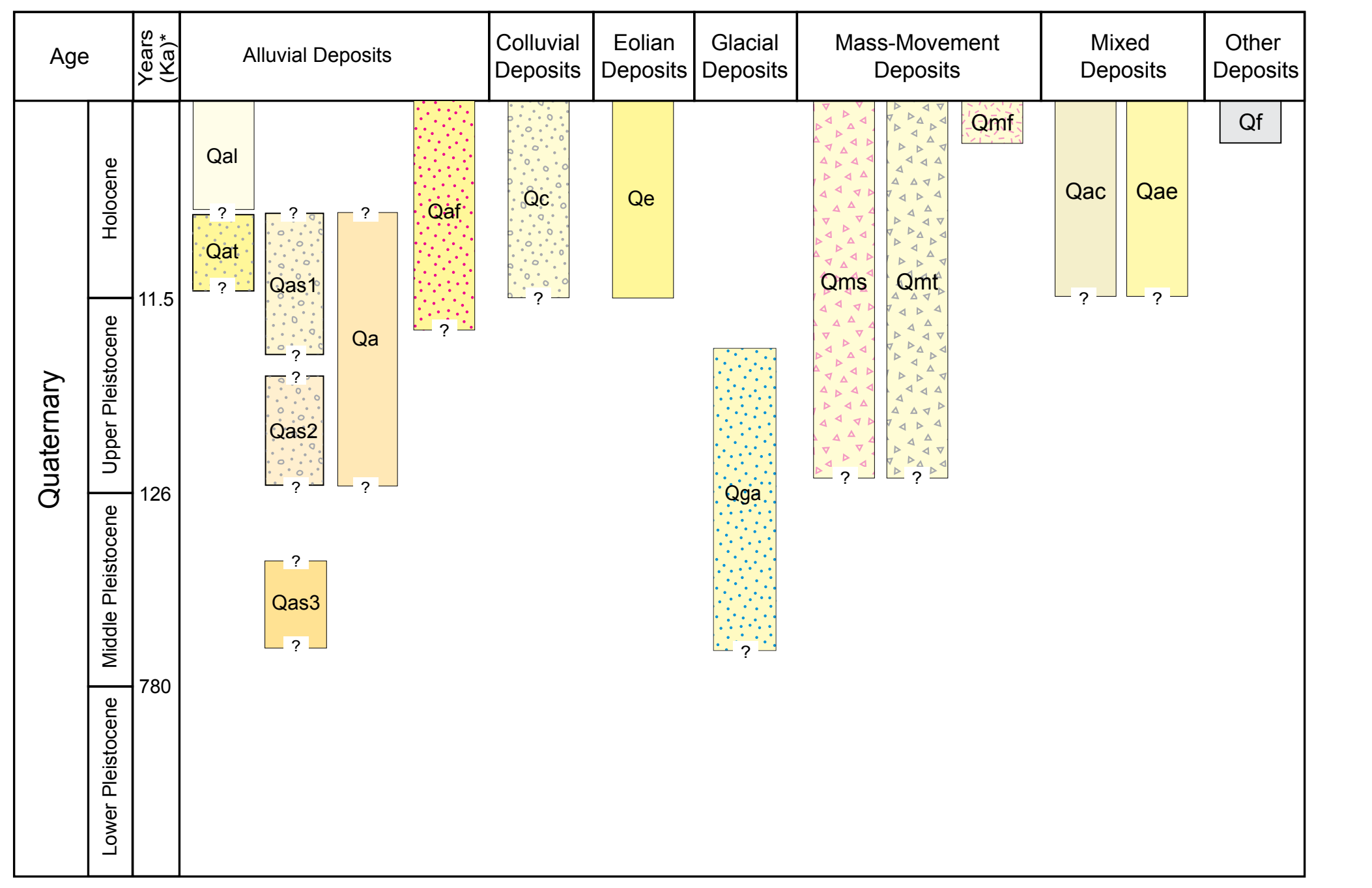
FAULTS
Steeply dipping - Dashed where approximately located; dotted where concealed; bar and ball on downthrown side where offset is known
Reverse - dotted where concealed; teeth are on upthrown side
Thrust - concealed, teeth are on upthrown side

FOLD AXIS
Anticline - Dashed where approximately located; dotted where concealed
Syncline - Dashed where approximately located; dotted where concealed
Overturned syncline - Dotted where concealed
Monocline - Dotted where concealed

GILSONITE
Veins - Solid where well exposed, dotted where concealed, and dashed where mapped using photogeologic methods and not field checked; locations from Boden, Tripp, and Rippy (unpublished mapping, Utah Geological Survey); BLM Vernal Field Office (unpublished mapping); Cashion (1986), and Sprinkel (this map).

STRIKE AND DIP OF BEDDING

Correlation of Quaternary Units



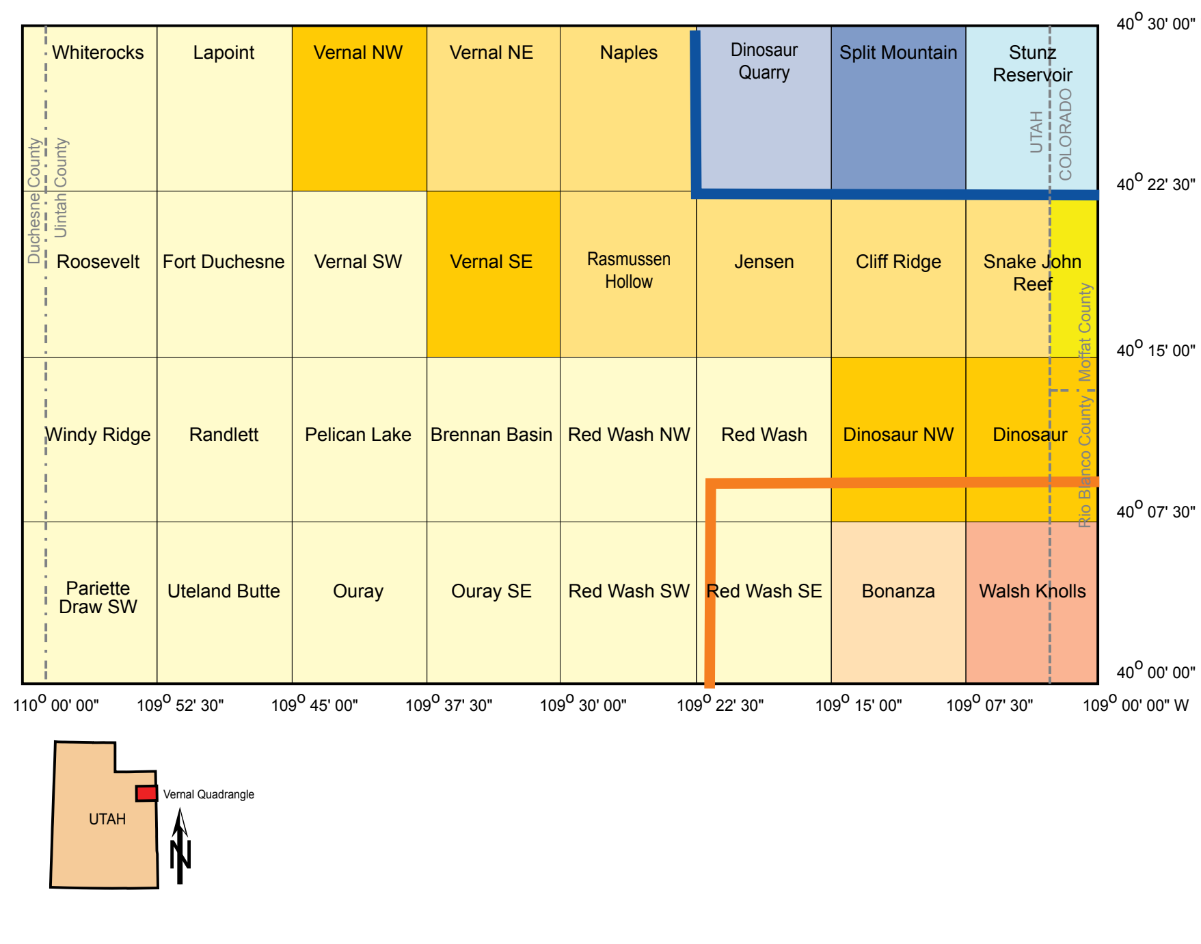
Stratigraphic Column

SYSTEM	SERIES	SYMBOL		FORMATIONS	Thickness* (meters) (not to scale)	LITHOLOGY	NOTES
Quaternary	Holocene	Q**		Unconsolidated deposits	less than 50		Alpine glaciers in Uinta Mountains. Capture of Green River by Colorado River
	Pleistocene	Qas3		South Flank peidmont alluvium	less than 10		Crustal relaxation; Uinta Mountains down- dropped along Uinta fault zone and drainage patterns change in eastern Uintas
Tertiary		Tb		Bishop Conglomerate	less than 50		
	Oligocene	Tds		Starr Flat Member of Duchesne River Formation	40-230		Crustal stability; Gilbert Peak erosion surface forms and Bishop Conglomerate is deposited; Uinta Mountain Group is well exposed
	Eocene	Tdl		Lapoint Member of Duchesne River Formation	120		
		Tdd		Dry Gulch Creek Member of Duchesne River Formation	less than 150		
		Tdb		Brennan Basin Member of Duchesne River Formation	220-600		Local uplift near the northern margin of the Uinta Basin; the Duchesne River Fm unconformably overlies the Green River Fm through the Mesaverde Group from near Squaw Ridge to Asphalt Ridge; the Duchesne River Formation is interbedded with Uinta Formation in the Uinta Basin
		Tu	Tuc	Member C of Uinta Formation	60-250		
			Tub	Member B of Uinta Formation	about 275		Contains gilsonite deposits
			Tua	Member A of Uinta Formation	0-220		
		Tgp		Parachute Creek Member of Green River Formation	0-270		Mahogany oil shale zone
		Tgd		Douglas Creek Member of Green River Formation	0-150		Uinta Mountains continue to uplift and erode; creation of Lake Uinta as the Uinta Basin continues to subside; contains oil shale and oil reserves
		Tg-Tw		Green River-Wasatch Formations transition zone	75-265		
		Tw		Wasatch Formation	300-920		Uinta Mountains continue to uplift and erode locally exposing the Uinta Mountain Group; subsidence of Uinta Basin; gas reservoir in Uinta Basin
		Tgd		Flagstaff Member of Green River Formation	70-800+		Unconformity, about 6 m.y.; TK boundary and the extinction of dinosaurs Uplift of Uinta Mountains begins near end of Cretaceous
Cretaceous	Upper	Kmvu		Upper unit of Mesaverde Group	450-550		Mesaverde Group is gas reservoir in Uinta Basin
		Kmvl		Lower unit of Mesaverde Group	200-250		contains minor coal
		Kms		Mancos Shale	1360-1700		End of Western Interior Seaway Gas reservoir in Uinta Basin
		Kfd	Kf	Frontier Sandstone	50-85		Unconformity, about 5 m.y.
	Lower		Kmr	Mowry Shale	10-70		Fossil fish scales in Mowry Gas reservoir in Uinta Basin
			Kd	Dakota Sandstone	15-80		K-1 unconformity, about 2 m.y.
		KJcm		Cedar Mountain Formation	0-60		K-0 unconformity, about 25 m.y.
Jurassic	Upper			Morrison Formation	245-290		Abundant dinosaur remains J-5 unconformity, about 2 m.y.
		Jsc	Js	Stump Formation	40-80		*Belemnites* fossils
	Middle		Je	Entrada Sandstone	15-75		J-3 unconformity, about 1 m.y.
			Jc	Carmel Formation	85-140		*Isocrinus* fossils J-2 unconformity, about 14 m.y.; top of Nugget Sandstone may include Page Sandstone
	Lower	JTRn		Nugget Sandstone	155-275		
Triassic	Upper	TRcd	TRc	Chinle Formation	85-125		Ankareh and Steinaker Formation of some workers Gartra Member
	Lower		TRm	Moenkopi Formation	170-260		TR-3 unconformity, about 15 m.y.
			TRd	Dinwoody Formation	0-165		TR-1 unconformity, about 6 m.y.
Permian	Lower	Pp		Park City and Phosphoria Formations	20-125		Contains phosphate deposits Unconformity, about 3 m.y.
Pennsylvanian	Upper	PIPw		Weber Sandstone	230-475		Forms cliffs and important oil reservoir in the Rocky Mountains
	Middle	IPm		Morgan Formation	10-290		
	Lower	IPrv		Round Valley Limestone	65-130		
Mississippian	Upper	Mdh		Doughnut Shale	85-95		
				Humbug Formation	75-90		
	Lower	Mm		Madison Limestone	130-300		Forms cliffs, contains marine fossils
Cambrian	Upper	Ꞓl		Lodore Formation	0-180		Unconformity, about 220-350 m.y. Base of Madison Limestone and underlying formations are not exposed in the quadrangle
Neoproterozoic	Middle Lower?	Zu		Uinta Mountain Group	0-3500		Unconformity, about 200 m.y. Uinta Mountain group forms the core of Uinta Mountains; not likely preserved south of Asphalt Ridge and Snake John Reef

*Exposed thickness; does not include subsurface thickness

**See Correlation of Quaternary Units for symbols

USGS 7.5' Quadrangles and Geologic Maps Compiled in the Vernal 30' x 60' Quadrangle, Utah-Colorado



Source of Map Data

- Cashion, W.B., 1978, Geologic map of the Walsh Knolls quadrangle, Uintah County, Utah, and Rio Blanco County, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1013, scale 1:24,000.
- Cashion, W.B., 1986, Geologic map of the Bonanza quadrangle, Uintah County, Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1865, scale 1:24,000.
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- Doelling, H.H, and Graham, R.L., 1972, Coal and geology map, Cliff Ridge, Jensen, Naples, Rasmussen Hollow, Snake John Reef, Steinaker Reservoir-Vernal NE, and Vernal NE-Vernal SE quadrangles, in Doelling, H.H., and Graham, R.L., Eastern and northern Utah coal fields: Utah Geological and Mineral Survey Monograph Series 2, scale 1:42,240; and Sprinkel, D.A, unpublished geologic mapping, scale 1:24,000.
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- Rowley, P.D., Kinney, D.M., and Hansen, W.R., 1979, Geologic map of the Dinosaur Quarry quadrangle, Uintah County, Utah: U.S. Geological Survey Geologic Quadrangle Series Map GQ-1513, scale 1:24,000.
- Sprinkel, D.A., 2003, unpublished geologic mapping of the eastern part of the Snake John Reef quadrangle, Moffat County, Colorado, scale 1:24,000.
- Sprinkel, D.A., 2004, unpublished geologic mapping of the Dinosaur quadrangle, Uintah County, Utah, and Moffat and Rio Blanco Counties, Colorado, and Dinosaur NW, Vernal SE, and Vernal NW quadrangles, Uintah County, Utah, scale 1:24,000.
- Sprinkel, D.A., 2005, unpublished geologic mapping of the Brennan Basin, Fort Duchesne, Lapoint, Ouray, Ouray SE, Pelican Lake, Randlett, Red Wash, Red Wash NW, Red Wash SE, Red Wash SW, Uteland Butte, and Vernal SW quadrangles, Uintah County, Utah, and Pariette Draw SW, Roosevelt, Whiterocks, and Windy Ridge quadrangles, Duchesne and Uintah Counties, Utah, scale 1:24,000.

This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award numbers 02HQAG0055, 03HQAG0096, 04HQAG0040, and 06HQAG0037. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 12. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from multiple sources. This information was compiled from the U.S. Geological Survey, 1989, Utah Automated Geographic Reference Center (AGRC), 1985 and 2003, National Geodetic Survey, 2005, United States Department of Agricultural and Farm Service Agency Aerial Photography Field Office, 2006.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

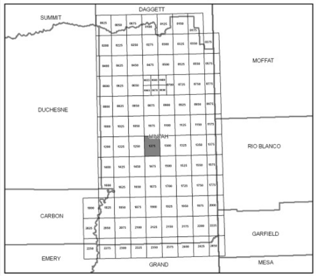
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

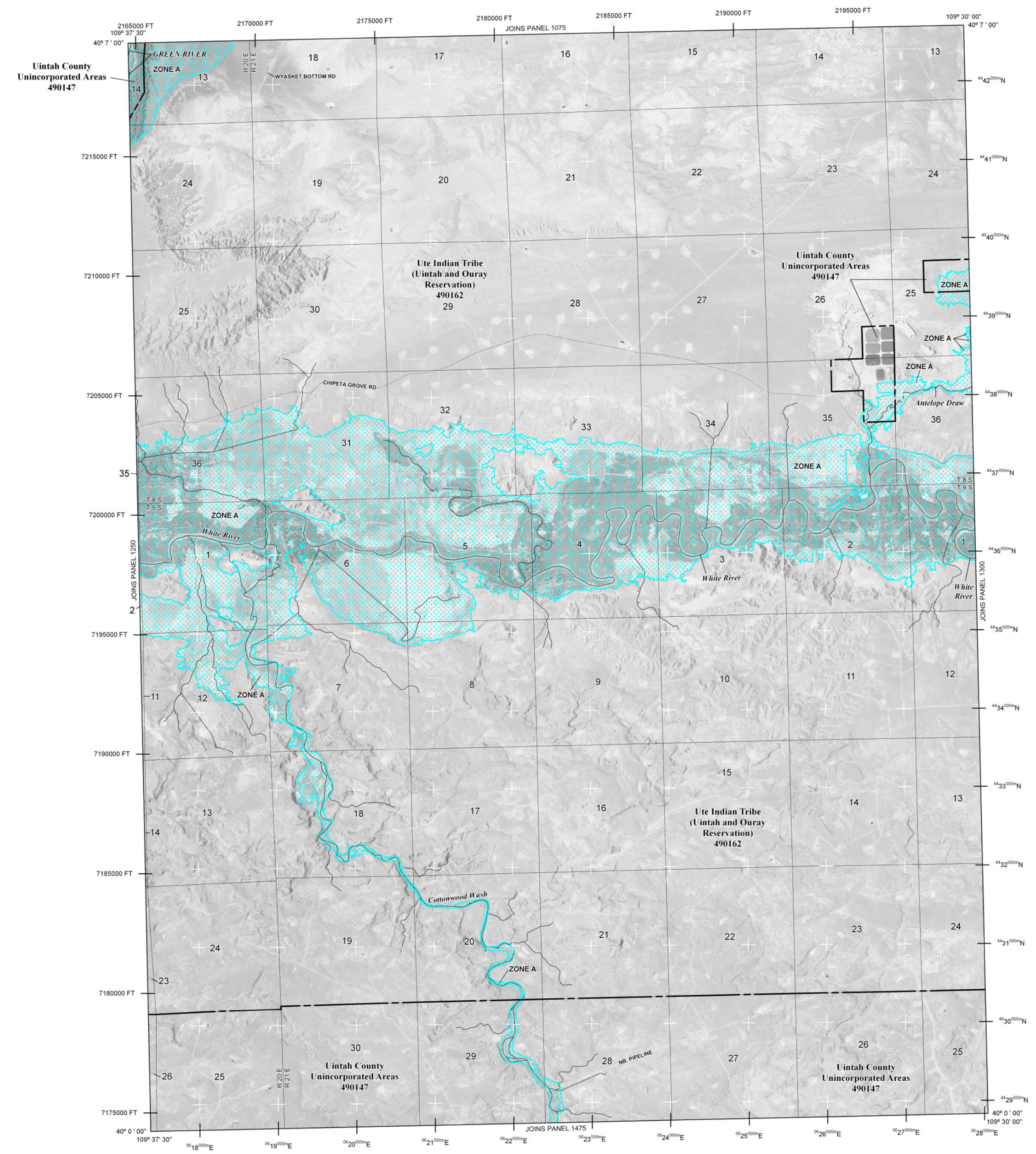
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and their website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

STATE OF UTAH FIRM PANEL LOCATOR DIAGRAM





LEGEND

▨ SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

▨ OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

☐ OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

▨ COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

▨ OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

———	1% annual chance floodplain boundary
———	0.2% annual chance floodplain boundary
— — —	Floodway boundary
— — —	Zone D boundary
• • • • • • • •	CBRS and OPA boundary
▨	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{24}76^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 12
600000 FT	5000-foot grid ticks: Utah State Plane coordinate system, Central zone (FIPSZONE 4302), Transverse Mercator Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP PANEL

OCTOBER 6, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1275D

FIRM
FLOOD INSURANCE RATE MAP

UINTAH COUNTY,
UTAH
AND INCORPORATED AREAS

PANEL 1275 OF 2450

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
UINTAH COUNTY	490147	1275	D
UTE INDIAN TRIBE (UINTAH AND OURAY RESERVATION)	490162	1275	D

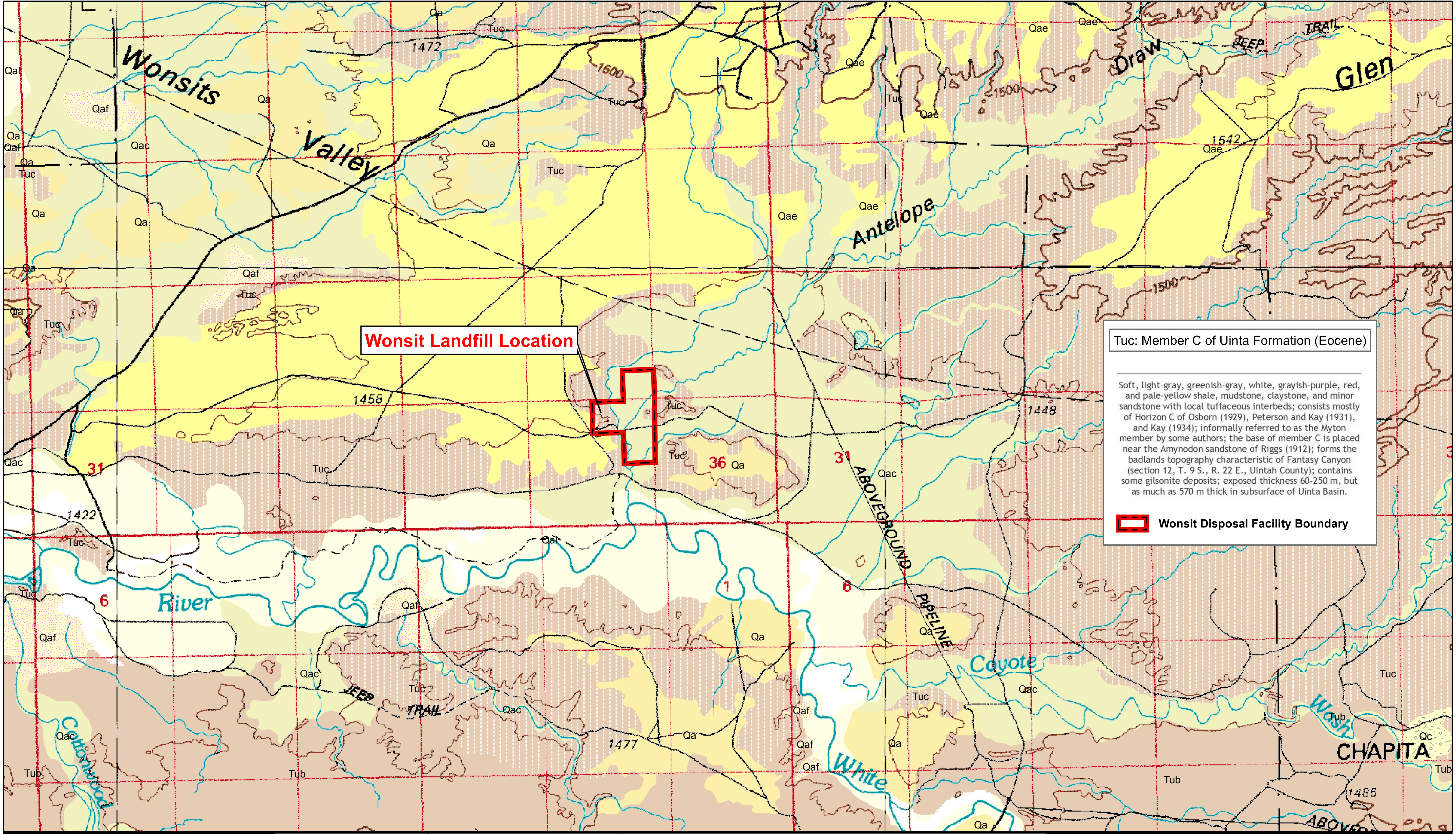
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
49047C1275D

EFFECTIVE DATE
OCTOBER 6, 2010

Federal Emergency Management Agency

Document Path: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Apdx_B1_Geo.mxd



Tuc: Member C of Uinta Formation (Eocene)

Soft, light-gray, greenish-gray, white, grayish-purple, red, and pale-yellow shale, mudstone, claystone, and minor sandstone with local tuffaceous interbeds; consists mostly of Horizon C of Osborn (1929), Peterson and Kay (1931), and Kay (1934); informally referred to as the Myton member by some authors; the base of member C is placed near the Amynodon sandstone of Riggs (1912); forms the badlands topography characteristic of Fantasy Canyon (section 12, T. 9 S., R. 22 E., Uintah County); contains some gilsonite deposits; exposed thickness 60-250 m, but as much as 570 m thick in subsurface of Uinta Basin.

🟥 Wonsit Disposal Facility Boundary

ISSUE / REV	DESCRIPTION	TECH	ENG	DATE
A	ISSUED FOR CLIENT REVIEW AND COMMENT	JCK	LBB	05/13

DRAWING REFERENCE(S):

7.5 USGS Topographic Quadrangle Map

Utah Geological Survey Map

N

SCALE:

0 0.375 0.75

Miles

Wonsit RNI R.N. INDUSTRIES Utah

PROJECT LOCATION
WONSIT DISPOSAL FACILITY

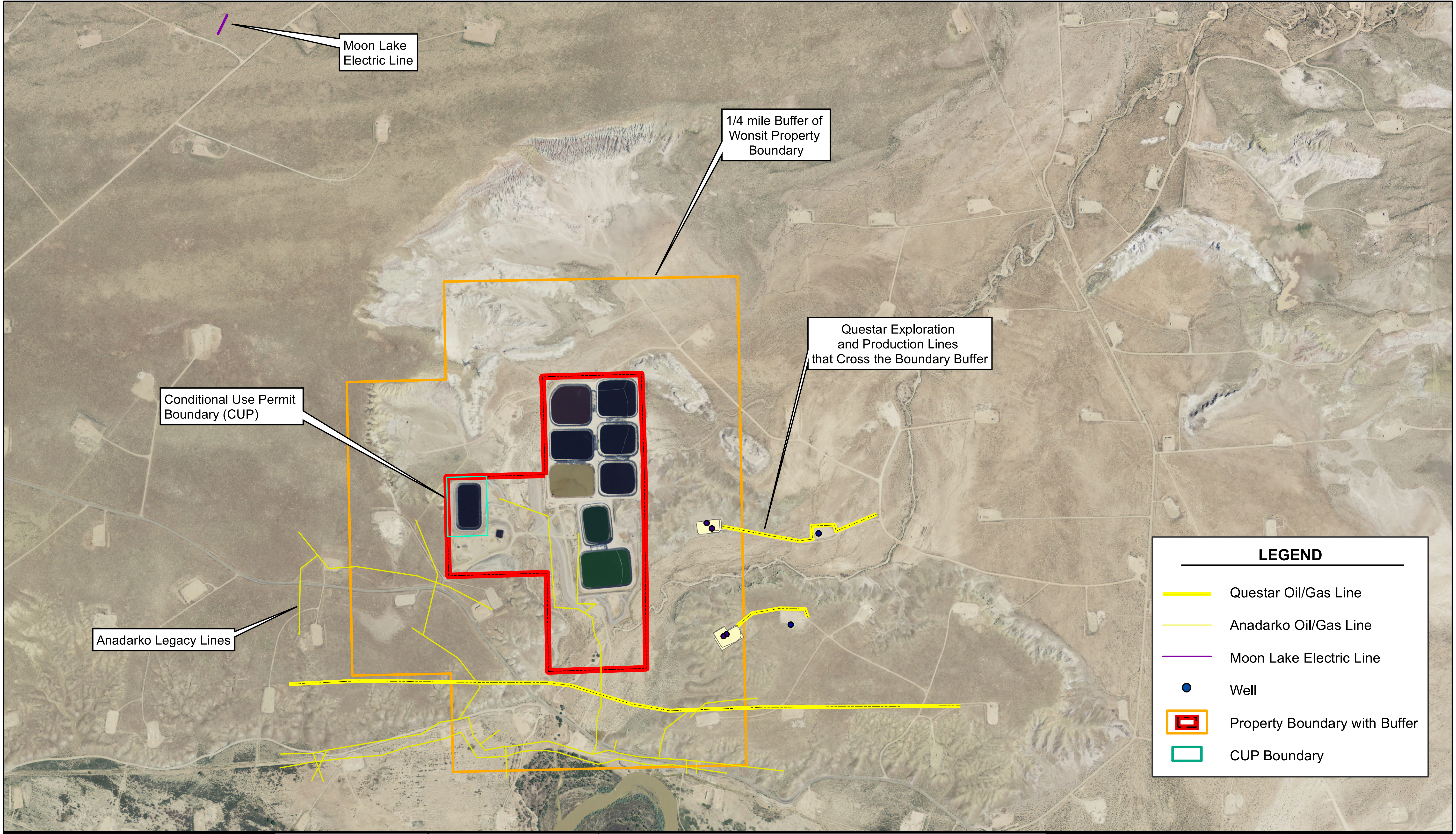
PROJECT
WONSIT LANDFILL

TITLE
SITE SPECIFIC GEOLOGY

MWH

FIGURE No.
B1

Document Path: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Apdx_B2_Utilities.mxd



A	ISSUED FOR CLIENT REVIEW AND COMMENT	JCK	LBB	05/13
ISSUE REV	DESCRIPTION	TECH	ENG	DATE

DRAWING REFERENCE(S):

NAIP2011_UnitahCounty Image

N

SCALE:

0 1,250

Feet

PROJECT LOCATION

WONSIT DISPOSAL FACILITY

PROJECT

WONSIT LANDFILL

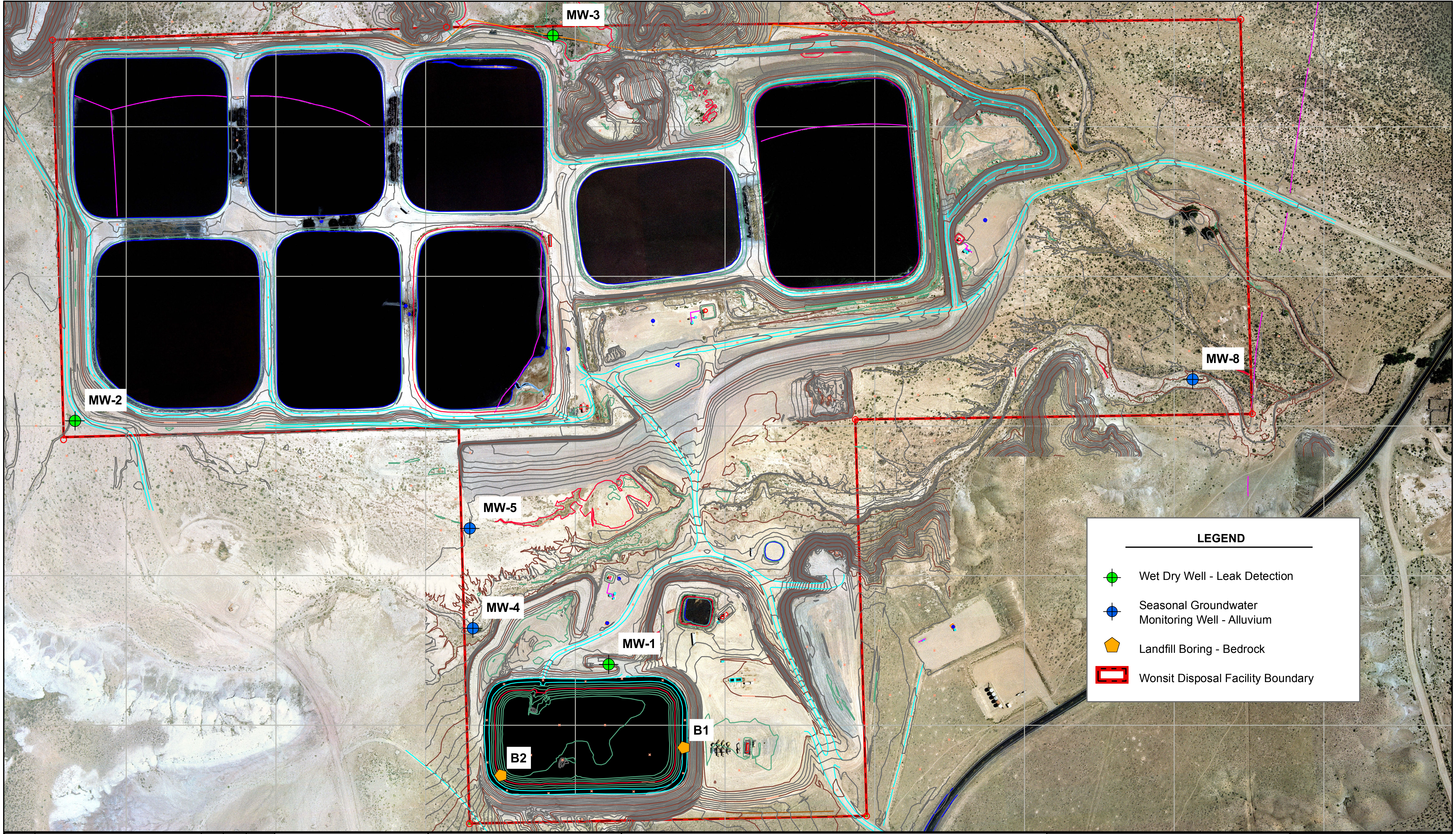
TITLE

UTILITIES MAP

FIGURE No.

B2

Document Path: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Apdx_B3_Hydro.mxd



A	ISSUED FOR CLIENT REVIEW AND COMMENT	JCK	LBB	05/13
ISSUE REV	DESCRIPTION	TECH	ENG	DATE

DRAWING REFERENCE(S):

Olympus Aerials 2010

N

SCALE:

0 155 310

Feet

PROJECT LOCATION

WONSIT DISPOSAL FACILITY

PROJECT

WONSIT LANDFILL

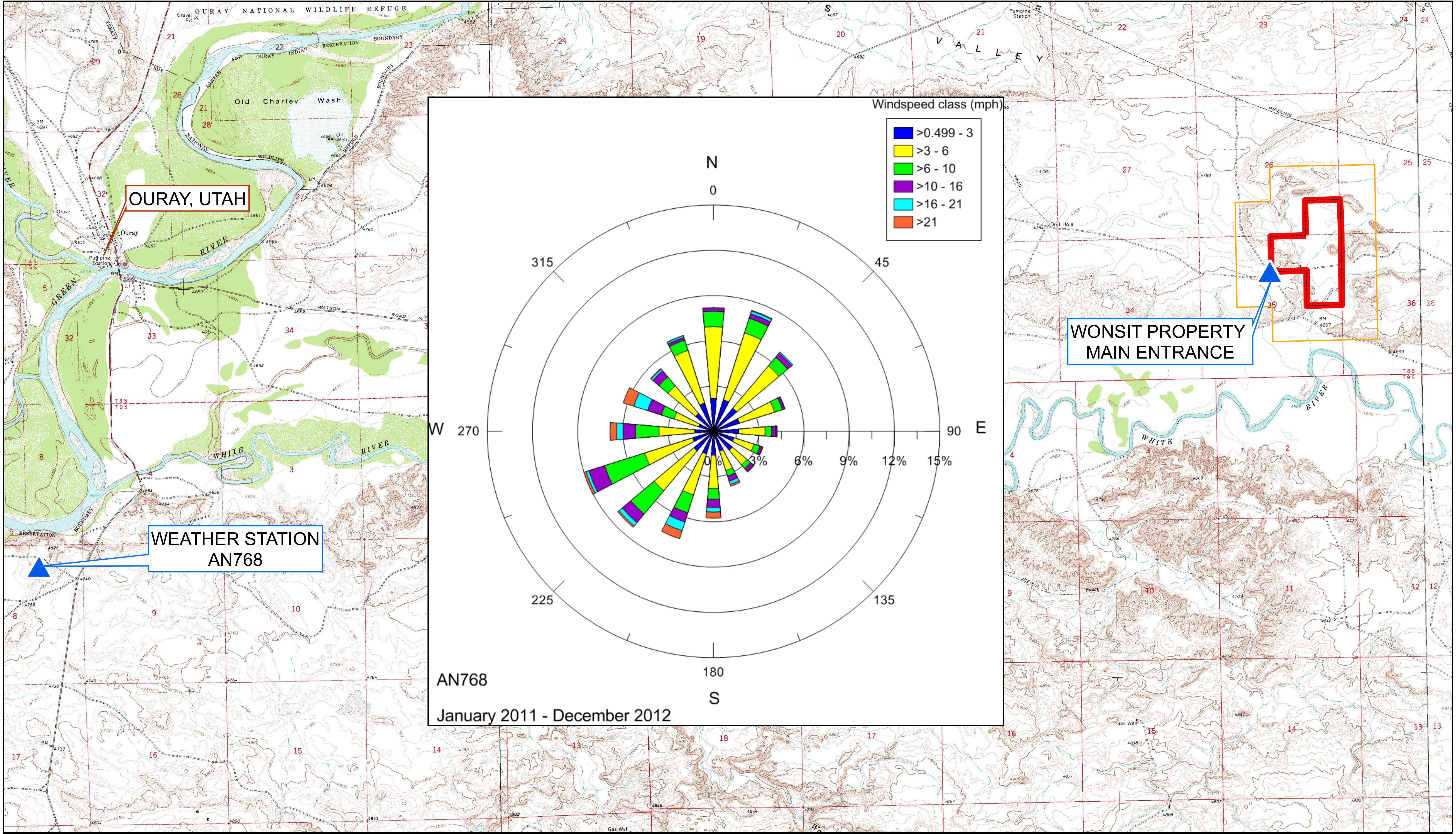
TITLE

HYDROGEOLOGIC EVALUATION

FIGURE No.

B3

Document Path: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Apdx_B4_Wind.mxd



A	ISSUED FOR CLIENT REVIEW AND COMMENT	JCK	LBB	05/13
ISSUE REV	DESCRIPTION	TECH	ENG	DATE

DRAWING REFERENCE(S):

7.5 USGS Topographic Quadrangle Map

N

SCALE:

0 0.5 1

Miles

Wonsit RNI R.N. INDUSTRIES Utah

PROJECT LOCATION

WONSIT DISPOSAL FACILITY

PROJECT

WONSIT LANDFILL

TITLE

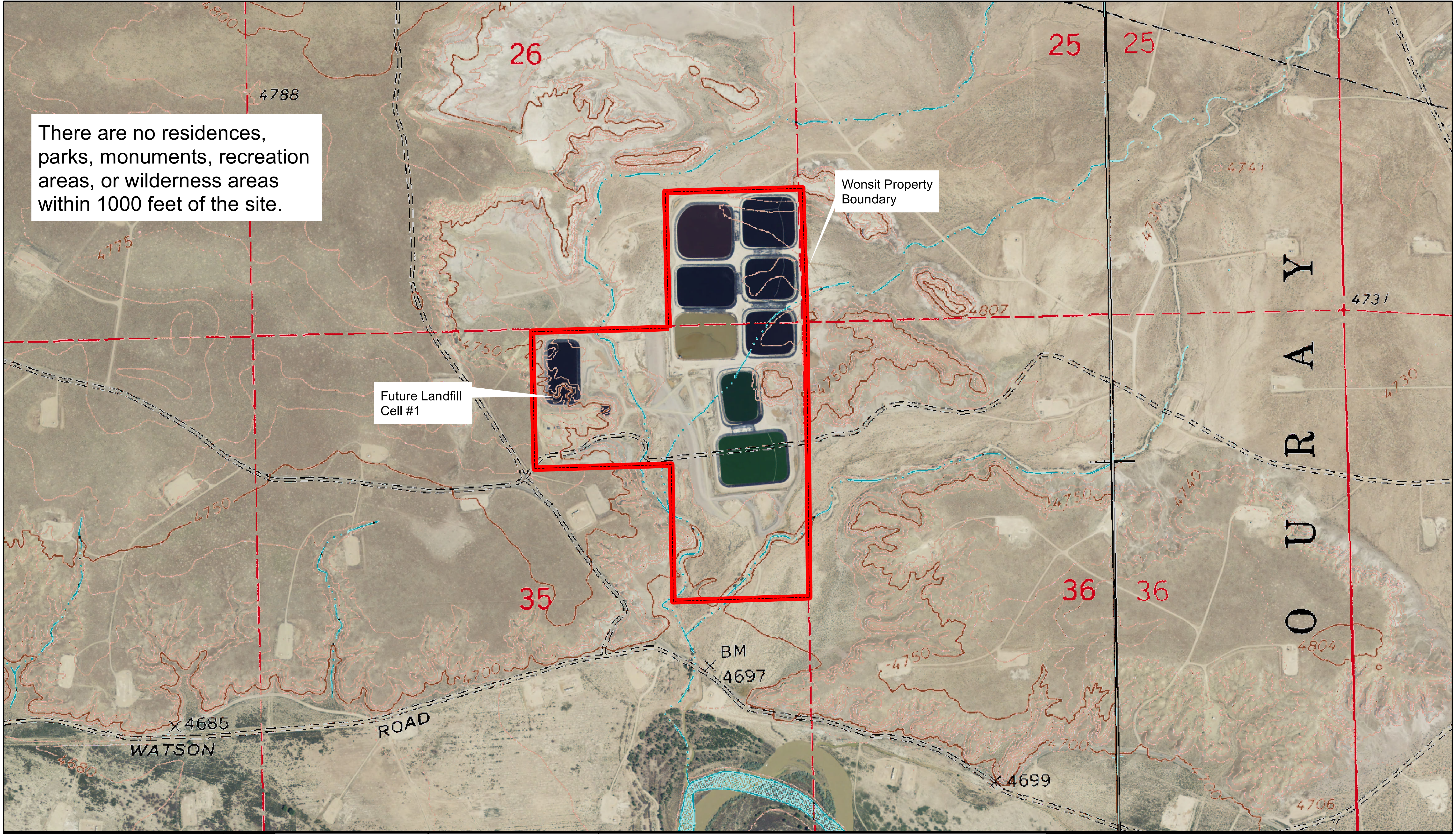
WIND DIRECTION MAP

MWH

FIGURE No.

B4

Document Path: I:\RNI\Utah\Wonsit\Landfill_Permit_2\Apdx_B5_Landuse.mxd



There are no residences, parks, monuments, recreation areas, or wilderness areas within 1000 feet of the site.

Wonsit Property Boundary

Future Landfill Cell #1

A	ISSUED FOR CLIENT REVIEW AND COMMENT	JCK	LBB	05/13
ISSUE REV	DESCRIPTION	TECH	ENG	DATE

DRAWING REFERENCE(S):

7.5 USGS Topographic Quadrangle Map

NAIP2011_Uintah

N

SCALE:

0 450 900

Feet

PROJECT LOCATION

WONSIT DISPOSAL FACILITY

PROJECT

WONSIT LANDFILL

TITLE

LANDUSE COMPATIBILITY

FIGURE No.

B5

UINTAH COUNTY

Zoning

Legend

- ▨ Cities

Roads

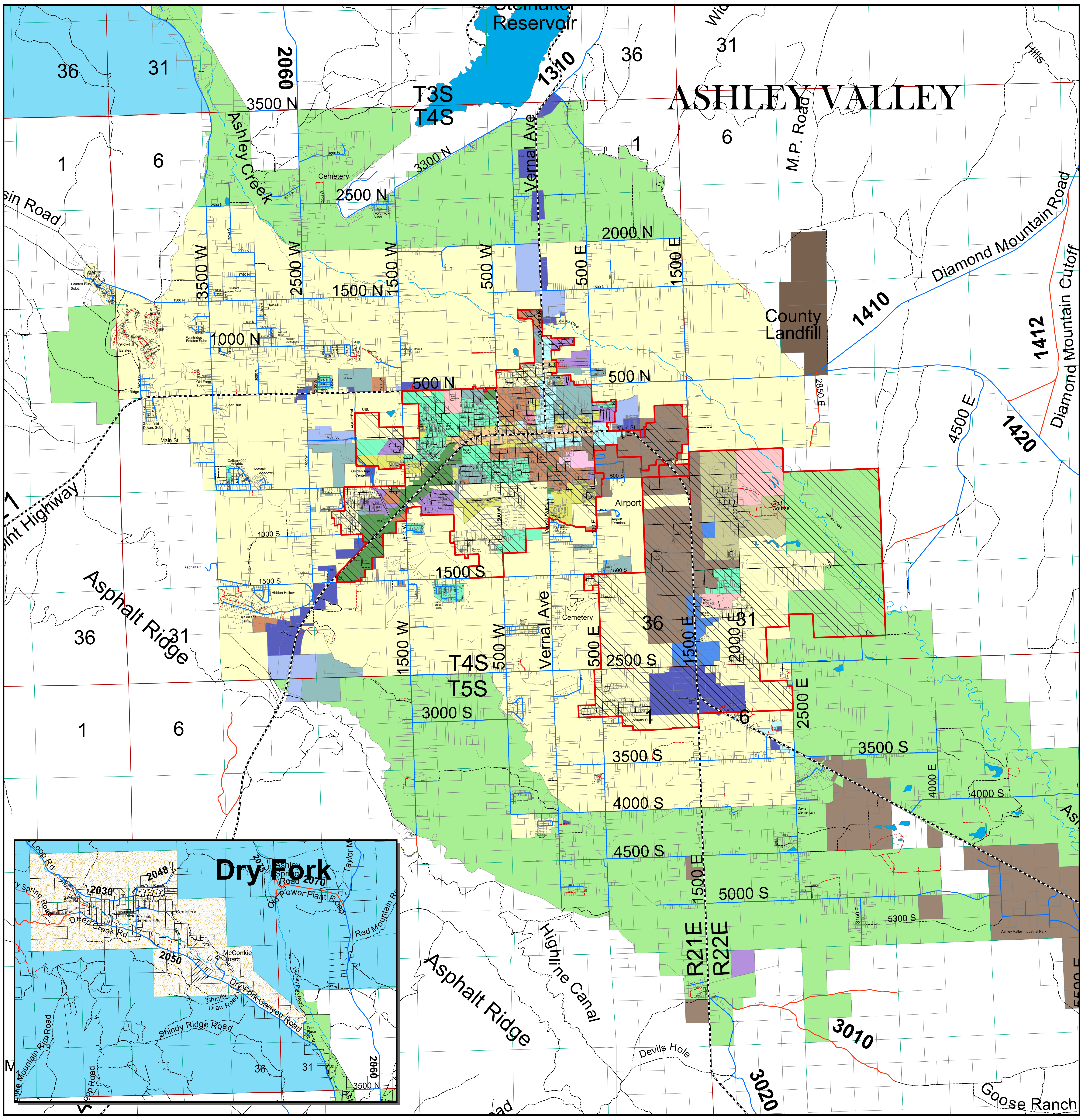
Road Catagory

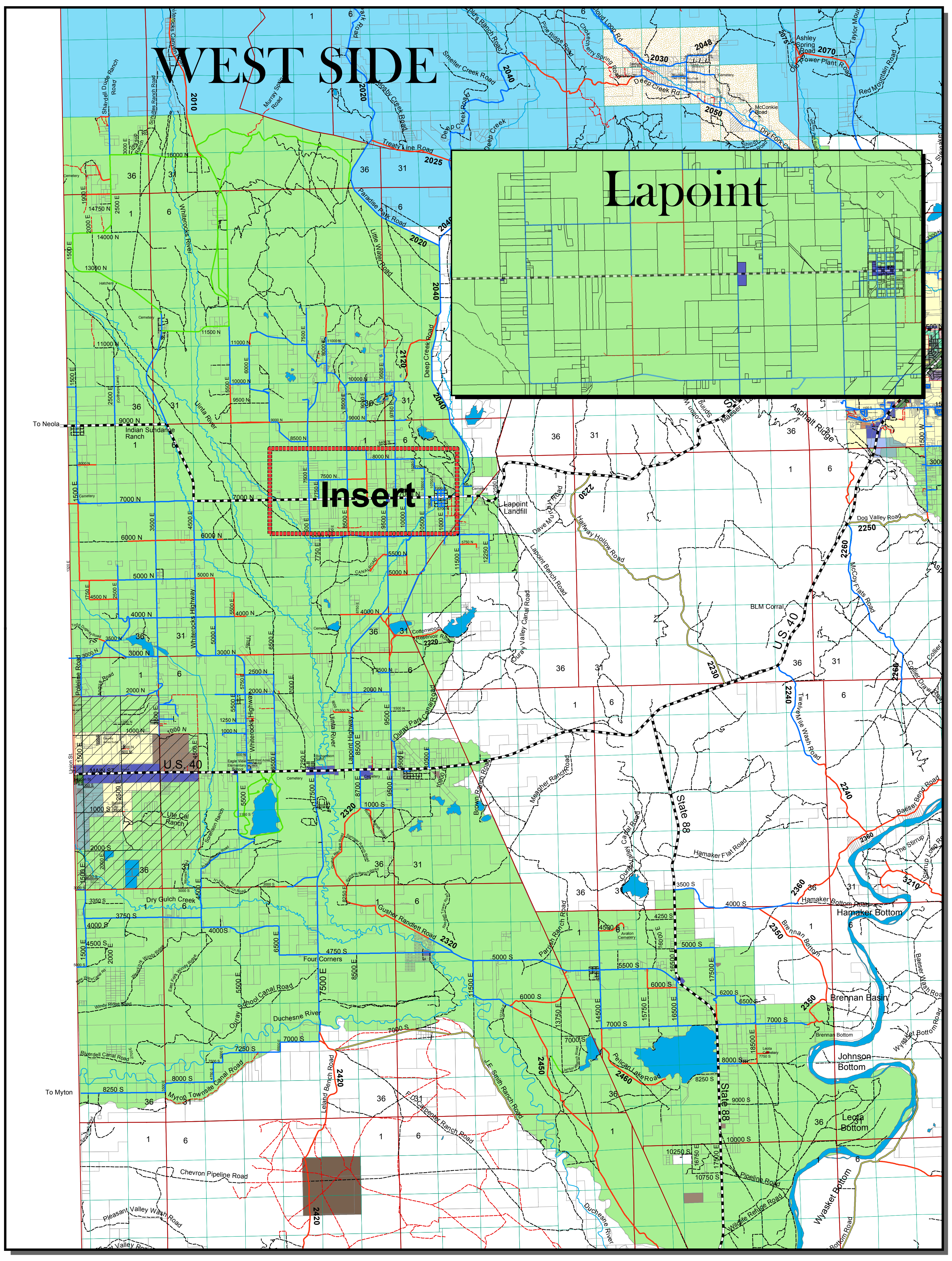
- Class 1-B Paved
- Class 1-B Gravel
- Class 1-B Native
- Class C City
- Class D
- Private
- US Forest Service
- Ute Tribe
- Rail Road
- Federal or State
- Unclassified

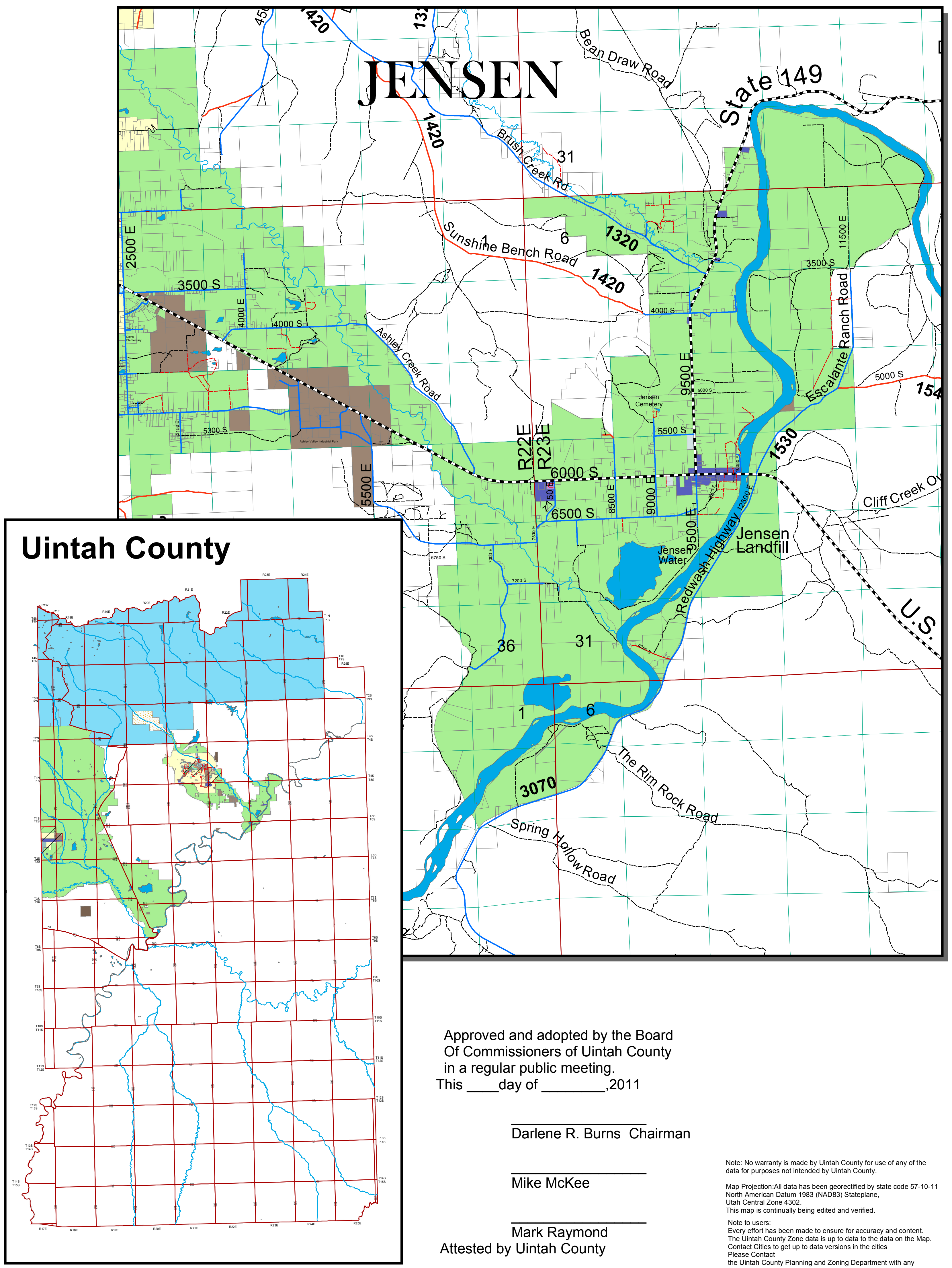
Zoning

ZONE

- A1 - Agricultural
- A1D - Agricultural Dryfork Overlay
- C - Commercial City
- C1 - Commercial
- C2 - Heavy Commercial
- CC1 - Central Commercial
- CP1 - Planned Commercial
- CP2 - City Planned Commercial
- F1 - Fairground
- HC1 - Health Care
- I1 - Light Industrial
- I2 - Heavy Industrial
- MG1 - Mining & Grazing
- MH - Residential Mobile Home
- P1 - Park
- R1 - Residential-5
- R2 - Residential-8
- R3 - Residential-12+
- R4 - City Residential
- RA1 - Residential Agricultural
- RA2 - Residential Agricultural Single Family
- RFM - Recreation, Forestry & Mining
- TTR - Travel, Tourism & Recreation







Approved and adopted by the Board
Of Commissioners of Uintah County
in a regular public meeting.
This ____day of ________,2011

____
Darlene R. Burns Chairman

____
Mike McKee

____
Mark Raymond
Attested by Uintah County

Clerk ______________
Michael W. Wilkins

Prepared by Uintah County GIS Department

I:gis/maps/arcmap small_zone **Updated June 2012**

Map Projection:All data has been georectified by state code 57-10-11
North American Datum 1983 (NAD83) Stateplane,
Utah Central Zone 4302.
This map is continually being edited and verified.

Note to users:
Every effort has been made to ensure for accuracy and content.
The Uintah County Zone data is up to data to the data on the Map.
Contact Cities to get up to data versions in the cities
Please Contact
the Uintah County Planning and Zoning Department with any questions or comments.

Appendix C

Notice of Intent

MWH®
BUILDING A BETTER WORLD

January 31, 2013

Karen Cambridge
Ute Tribe Department of Natural Resources
PO Box 190
FT. Duchesne, UT
84026

Subject: Notice of Intent
Class IIIb Solid Waste Landfill

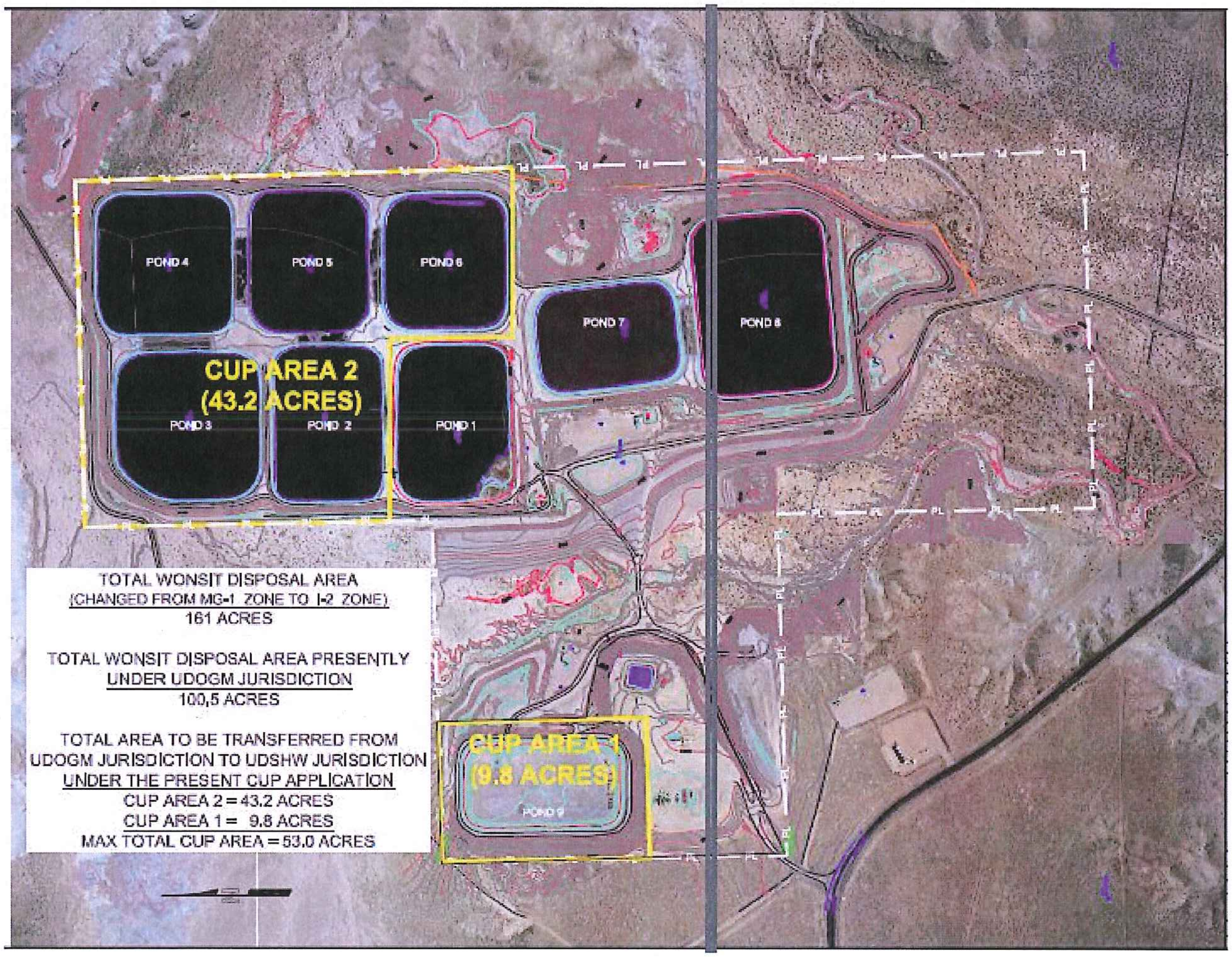
Dear Karen,

This letter has been prepared in compliance with Utah Department of Environmental Quality (UDEQ) regulations, to inform you of RN Industries' intent to permit, construct, and operate Class IIIb landfill cells at their Wonsit Disposal Facility located approximately 30 miles south of Vernal, Utah. The lead agency responsible for permitting and regulating these landfill cells is the UDEQ – Division of Solid and Hazardous Waste (UDSHW) – Solid Waste Section.

RN Industries (RNI) has permitted and currently operates a privately owned disposal facility at 374 East Chapita Grove Road. The facility occupies the N½ of the NE¼ and SE¼ of the NE¼ of Section 35 and the SE¼ of the SE ¼ of Section 26, Township 8 South, Range 21 East of the Salt Lake Base and Meridian, Duchesne County Utah. In accordance with Utah regulation R315-310-3(2)(a), you are being notified today because Tribal land surrounds the disposal facility.

Under a new I-2 Zone designation, RNI is proposing to develop a solid waste landfill for the permanent disposal of oil and gas field solids meeting the definition of RCRA-Exempt, Exploration and Production (E &P) Wastes. The landfill cells would be designed and operated in compliance with a Class IIIb Landfill Permit issued by the UDSHW. Access to the landfill cells would follow existing roads within the exterior boundary of the RNI Wonsit Disposal. No new access roads would be required. The proposed landfill would operate from 7:00 am to 6:00 pm, daily. This is the same schedule as the other parts of the RNI Wonsit Disposal.

RNI's Wonsit Facility is currently permitted by the Utah Division of Oil Gas and Mining (UDOGM) to manage produced water and other (E&P) Special Wastes. Existing treatment units at the facility include oil/water skimming, evaporation ponds, landfarms, and condensate/crude oil decanting systems. RNI is seeking a permit to convert Evaporation Ponds 2, 3, 4, 5, 6, and 9 (see Figure below) into a series of individual Class IIIb landfill cells regulated by the UDSHW.



Construction of these cells will allow operational changes to be made at the RNI Wonsit Disposal that will have the following beneficial effects that RNI believes are in the best interest of the Tribe, Uintah County and the general public:

- Provide permanent, permitted, commercial, UDSHW-regulated Class IIIb Landfill disposal cells for certain RCRA-Exempt E & P Solid Wastes not allowed for disposal under UDOGM regulations. These wastes would likely otherwise be buried at individual drilling pads throughout the Uintah and Piceance Basins.
- Provide a UDSHW Class IIIb Landfill for disposal of other solid wastes allowed under this designation.
- Provide a UDSHW Class IIIb Landfill near points of solid waste generation in the Uintah Basin and thus reducing truck traffic and the associated emissions to the atmosphere.
- Reduce Volatile Organic Compound (VOC) and ozone precursor emissions.
    - Reduction of existing evaporation pond surface area, decreasing the opportunity for emissions.
    - Regular covering of the working face, also decreasing the opportunity for emissions.

Permitting of the proposed Class IIIb landfill also requires that the Uintah County Board of Commissioners rezone parcel numbers 09-019-0001 and 09-021-0001from MG-1to I-2. Uintah County has indicated it would allow such conversion and operation under a Conditional Use Permit (CUP) in Zone I-2. The present use of portions of the Parcels as a RCRA-Exempt E&P Waste Disposal regulated by UDOGM would not change under the new I-2 Zone. The existing CUP allowing these uses would not be altered under the proposed Zoning change from MG-1 to I-2. These two parcels are owned by RN Industries and represent the land upon which the current disposal facility is built.

In February 2013, the Uintah County Planning Commission will prepare a public notification describing RN Industries rezoning initiative. As a part of the rezoning process, you will have an opportunity to speak at both the Uintah County Planning Commission and County Commissioners meetings if you so desire. The date and time for these two meetings will be provided in the Uintah County public notification.

In March of 2013, RN Industries will be submitting a Class IIIb landfill permit application to the UDEQ/ DSHW – Solid Waste Section. The Executive Secretary of the DSHW will then send you a letter indicating that you can request to be placed on a list to receive further public information concerning the proposed disposal facility. After RN Industries submits the Class IIIb permit application and a Draft version of the permit is prepared by the DSHW, there will be a 30 day public comment period which you may also participate in.

Sincerely,

L. Boyd B

Boyd Breeding P.E., P.Hg.
MWH Americas, Inc.
Supervising Engineer and Hydrogeologist

GH Richins

Gary H. Richins
RN Industries
Environmental Manager

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Karen Cambridge
Ute Tribe Dept. of Natural
Resources
PO Box 190
FT. Duchesne, UT
84026

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☒ Agent
☐ Addressee

B. Received by (*Printed Name*)
Bill Cuch

C. Date of Delivery
2·4·13

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☒ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7011 3500 0003 6838 6014

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

Appendix D

Historical Survey

and

Certification Relative to Scientific or Ecologically Significant Areas

Historical Survey

COVER PAGE
Must Accompany All Project Reports Submitted to Utah SHPO

Project Name: Cultural Resources Evaluation of the Existing Wonsit Disposal Site

State Proj. No.: U-13-YN-0155p

Report Date: June 21, 2010 **County(ies):** Unitah

Principal Investigator: Chris Jensen

Field Supervisor(s): Chris Jensen

Records search completed at what office(s)? Utah Division of State History

Record search date(s): March 2013

Area Surveyed – Intensive *(≤15 m intervals)*: **160** **Recon/Intuitive** *(>15 m intervals)*: **acres:**
7.5' Series USGS Map Reference(s): Ouray SE, UT

SITES REPORTED	COUNT / SMITHSONIAN SITE NUMBERS	
Archaeological Sites	**0**	**N/A**
Revisits (no inventory form update)	0	N/A
Updates (updated IMACS site inventory form attached)	0	N/A
New recordings (IMACS site inventory form attached)	0	**N/A**
Total Count of Archaeological Sites	0	N/A
Historic Structures (USHS 106 site info form attached)	0	N/A
Total National Register Eligible Sites	0	**N/A**

Checklist of Required Items, attached

1. X Copy of the final report
2. X Copy of 7.5' Series USGS map with surveyed/excavated area clearly identified
3. __ Completed IMACS site inventory forms
    - __ Parts A and B or C
    - __ IMACS Encoding Form
    - __ Site Sketch Map
    - __ Photographs
    - __ Copy of the appropriate 7.5' Series USGS map with site location marked and Smithsonian site number clearly labeled
4. X Completed "Cover Page" accompanying final report and survey materials

For UDSH office use only

Canyon Environmental, LLC

Canyon Environmental
2562 N 320 E
Provo, UT 84604
Phone: 801.602.6883 Fax: 801.341.0005
www.canyonenvironmental.com

March 11, 2013

Gary Richens
RN Industries
Roosevelt, UT

Subject: **Cultural Resources Evaluation of the existing Wonsit Disposal Site**

Dear Mr. Richens:

Canyon Environmental has conducted a Class I File Search and associated Cultural Resources Evaluation for the above mentioned site on behalf of Gary Richens of RNI Trucking. The Evaluation was conducted in order to comply with requirements set forth by State and Federal Regulations. This letter report represents the findings of the evaluation.

Utah State Antiquities Permit Number: 177

Utah State Antiquities Project Number: U-13-YN-0155p

The Bluebell Disposal site was developed on private land in the Bluebell area and consists of 9 disposal pits and associated pumps and tanks. The site comprises approximately 160 acres and is irregular in shape. The project site has been completely developed for use and the landscape has been significantly disturbed through grading and excavation processes.

Location: The legal description can be described as a portion of Sections 26 and Section 35, Township 4 South, Range 4 East in Uintah County, Utah (Appendix A).

Setting: The proposed project is located within the Unita Basin, east of Ouray and to the north of the White River in an area dominated by sage scrubland. Underlying geology is sedimentary in nature and vegetation on the site is sparse and isolated to invasive weeds. Vegetation of the surrounding area is comprised of limited juniper trees, sagebrush and other drought tolerant plants including; various forbs, native and non-native grasses, and invasive weeds species. The site has been significantly altered from any natural state through construction activities and development of the disposal ponds.

Previous Research: The file search was conducted in March 2013 at the Utah State Historic Preservation Office in Salt Lake City, Utah. The file search identified 13 previously conducted inventories and two cultural resource sites within a 1/2-mile radius of the project area. According to the information obtained from SHPO, the proposed project area is located on private land and had not been surveyed for cultural resources. The file search results are described in the Table 1.1.

Table 1.1 Previous Cultural Resource Inventories Conducted in the Vicinity of the Project Area and Applicable Findings

Project No.	Company Name	Project Name	Findings*
99-MQ-0409	Montgomery	CRI of 14 well locations and access roads in the Ouray Field	N/A
99-MQ-0378	Montgomery	CRI of the Ouray Field Ankerpoint 31-85 and Federal 33-92, 33—93, and Ouray 35-94 well locations	N/A
99-MQ-0182	Montgomery	CRI of the Ouray Field Watson road trunk pipeline extension	N/A
96-AF-0557	AERC	CRE of 9 proposed well locations in White River	N/A
95-AF-0250	AERC	CRE of 4 proposed well locations in White River	N/A
95-AF-0251	AERC	CRE of proposed Ouray gas gathering system in White River	N/A
78-WK-0335	Western Wyoming College	Four proposed Conoco Wells	N/A
05-MQ-0175	Montgomery	CRI of EOG Resources proposed North Duck Creek 272-26	N/A
04-AY-1037	AIA	EOG Resources North Duck Creek 272-26	N/A
03-MQ-0996	Montgomery	CRI of Questar Gas Management pipeline replacement along Watson Road	N/A
03-MQ-0818	Montgomery	CRI of Questar Pipeline T8S, R21E and T8S, R22E	N/A
02-AY-0086	AIA	EOG Natural cotton 14-7	N/A
01-AF-0022	AERC	CRE of 7 proposed wells in Ouray, Whiter River locality	N/A

Two previously identified cultural resource sites were identified within a 1/2-mile radius of the proposed project area:

42UN2626 – Archaic campsite
42UN6657 – Fremont petroglyph site

The previously identified sites have been determined "eligible" for inclusion on the National Register of Historic Places. However, these sites are not located within the project area, or in any area directly adjacent to the existing disposal pond site. These sites are not expected to be affected by the continued existence of the disposal pond operation.

Field Inventory: The proposed project area was evaluated by visual means and pedestrian surveys across the site to identify and record any items of historic and/or cultural significance. The entire site has been previously disturbed by construction activities and property development. No cultural resources were identified within the project area.

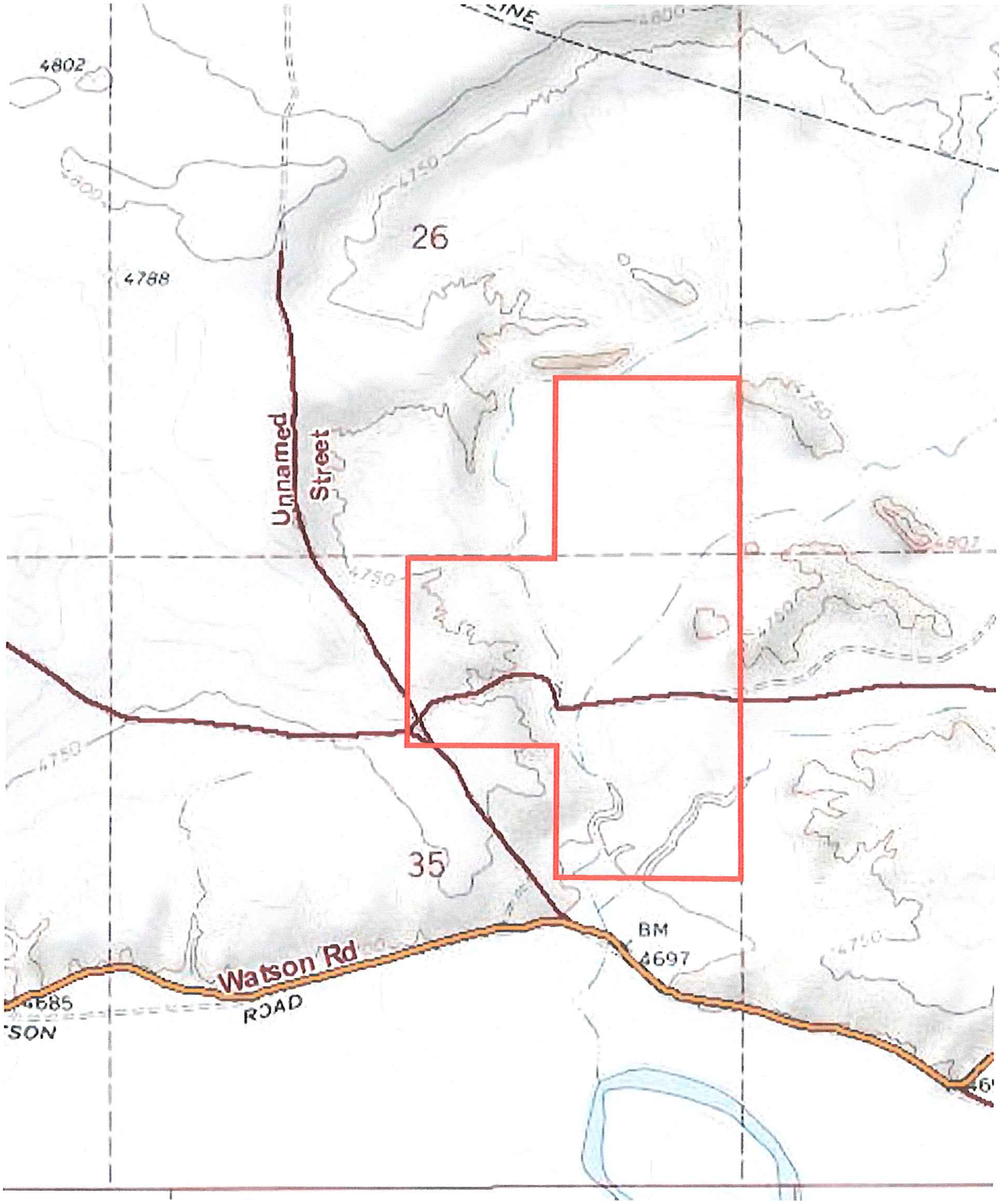
Conclusions and Recommendations: No cultural resources were identified on or within close proximity to the proposed project area. As such, is it recommended that the proposed project proceed accordingly.

This cultural resources evaluation was conducted with readily accepted methods that are considered by State and Federal Statute to adequately identify cultural surface features and artifacts. However, care should be taken to ensure the proper reporting of any cultural resources that may be discovered during earth-moving activities and/or construction by notifying the State Historic Preservation Office in Salt Lake City, Utah.

Sincerely,

Chris Jensen
Archaeologist
Canyon Environmental

APPENDIX A



LOCATION MAP

Wonsit Disposal Site

Canyon Environmental, LLC

Figure 1

▭ Site Ouray SE, UT 7.5 Min Quad

SITE MAP

Wonsit Evaporative Pond, Uintah County, UT

Canyon Environmental, LLC

Figure 2

🟥 Site

Certification Relative to Scientific or Ecologically Significant Areas

R.N. INDUSTRIES
RNI
R.N. INDUSTRIES

16 April 2013

Mr. Scott Andersen, Director
Utah Division of Solid and Hazardous Waste
P.O. Box 144880
Salt Lake City, UT 84114-4880

Re: Endangered Species/Scientifically Significant Areas Certification for the Proposed RN Industries (RNI) RCRA Exempt E & P Solid Waste Landfill Cell at the RNI Wonsit Disposal in Uintah County, UT

Dear Mr. Anderson:

Recently issued Utah Division of Solid and Hazardous Waste (UDSHW) "Requirements for E&P Landfills" necessitate "…certifications that no ecologically or scientifically significant areas or endangered species are present in the site area". Ecologically significant areas would generally include the presence of, or suitable habitat for, plant or animal species protected under the Endangered Species Act (ESA). Scientifically significant areas could also include the presence of significant Paleontological Resources or significant Cultural Resources.

In the Uinta Basin, the principal species of interest under the protection of the ESA include the Uinta Basin Hookless Cactus (*Sclerocactus wetlandicus*) which is listed as "Threatened" and the Greater Sage-grouse (*Centrocercus urophasianus*) which is listed as a "Candidate Species for Listing" under the ESA. The location of the proposed landfill cell is wholly within the footprint of an existing HDPE-lined pond at the RNI Wonsit Disposal. The entire area surrounding the proposed landfill cell has been inexorably altered by the development and operation of the existing disposal facility and does not contain suitable habitat for either of these species.

Based on my survey of the area surrounding the proposed landfill cell and the greater area within the boundaries of the RNI Wonsit Disposal, neither of these species are present and it is unlikely that suitable habitat for either of these species is extant. Additionally, no Paleontological Resources were identified during the excavation and development of any of the existing evaporation ponds on site, including the pond (#9) that is slated for conversion to the proposed landfill cell.

A reasonable certification can therefore be made that neither does the proposed landfill site area contain any ecologically or scientifically significant area, nor does it contain any endangered species or their habitats.

Cultural Resources are outside my area of expertise, but these have been addressed in a separate report to you from Chris Jensen of Canyon Environmental.

Sincerely,

GHRichins

Gary H. Richins
Environmental Manager
Certified Wildlife Biologist
(435) 503-5069
grichins@rnindustries.com

CC: RNI
MWH

Appendix E

Uintah County Rezoning Approval and Application

09:019:0001, 09:021:0001 #221 02/25/2013

A Decision of the Uintah County Commission Approving the Rezone (#221) of Property for RN Industries located at 374 E Chapita Grove Road, Uintah County, UT

Be it concluded by the County Commission of the County of Uintah, State of Utah:

Section 1 The Uintah County Commission finds that:

1.1 An application for the rezone of property from MG-1 to I-2 has been submitted.

1.2 Said application was found to be complete upon review by the Community Development Office.

1.3 The Uintah County Planning Commission reviewed the application at a public hearing on February 20, 2013 and recommended approval to the Uintah County Commission.

1.4 Said application was considered by the Uintah County Commission during a public meeting on February 25, 2013.

1.5 Proper notice was given in accordance with section 17.04.090 of the Uintah County Code and 17.27a.205 of the Utah State Code.

1.6 Said application conforms to the applicable requirements of Title 17 of the Uintah County Code.

1.7 There was a letter received from a nearby property owner opposing the rezone.

Section 2 This conclusion constitutes the written report, findings and decision of the Uintah County Commission.

Section 3 On the basis of the above, the Uintah County Commission approves the application.

This application approved this 25 February 2013, by a vote of 3 to 0.

Mark D. Raymond

Chairman, Uintah County Commission

Michael W. Wilkins

Attest, Uintah County Clerk-Auditor

Uintah County
Building, Planning and Zoning
Amend Zoning Map Application

OFFICE USE ONLY

Application Fee $300.00 Date Received____________________

Receipt #______________ Date______________ Rec'd by__________________

Application Due by: _______________ ***Meeting Date:***____________________

Property information and location
(All lines applicable to this site must be filled in)

Section 26 Township T8S Range R21E

Parcel #(s) 09-019-0001 and 09-021-0001

Property Address 374 East Chapita Grove Road

Currently Zoned MG-1 **Requested Zone Change** I-2

Purpose of Request See attached Narrative

You MUST include a parcel map obtained from the Uintah County Recorder's Office with this Application!

Property owner(s) information

Name(s): RN Industries

Mailing Address: P.O. Box 98

City/County Roosevelt/Duchesne State: UT Zip: 84066

Office/home phone: (435) 722-2800 Fax phone:__________________

Mobile phone:__________________ Message phone:__________________

A copy of the deed, offer or tax notice MUST be included to demonstrate ownership

Signature of Petitioner (s)	***Date***	***Address***
	29 January 2013	P.O. Box 98, Roosevelt UT 84066
	Jan 29, 2013	P.O Box 98 Roosevelt UT 84066

APPLICANTS MUST ANSWER THE FOLLOWING QUESTIONS
(Attach Additional Sheets If Necessary)

1. ***How will this proposal be in the best interest of the general public?***

   See attached Narrative

2. ***How will this proposal be consistent with the Uintah County General Plan?***

   Matt Cazier advised that both a zone change (from MG-1 to I-2) and a new CUP (under the1-2 zone)would be required for Uintah Co. to authorize conversion of some of the evaporation ponds to Class IIIb landfill cells under UDSHW jurisdiction.

17-27-403. Amendments and rezoning.

(1) (a) The legislative body may amend:

(i) the number, shape, boundaries, or area of any zoning district;

(ii) any regulation of or within the zoning district; or

(iii) any other provision of the zoning ordinance.

(b) The legislative body may not make any amendment authorized by this subsection unless the amendment was proposed by the planning commission or is first submitted to the planning commission for its approval, disapproval, or recommendations.

(2) The legislative body shall comply with the procedure specified in Section 17-27-402 in preparing and adopting an amendment to the zoning ordinance or the zoning map.

17-27-402. Preparation and adoption.

(1) The Planning Commission shall prepare and recommend to the legislative body a proposed zoning ordinance, including both the full text of the zoning ordinance and maps that represents the commission's recommendations for zoning all or any part of the area within the County.

(2) (a) The legislative body shall hold a public hearing on the proposed zoning ordinance recommended to it by the Planning Commission.

(b) The legislative body shall provide reasonable notice of the public hearing at least 14 days before the date of the hearing.

(3) After the public hearing, the legislative body may:

(a) adopt the zoning ordinance as proposed;

(b) amend the zoning ordinance and adopt or reject the zoning ordinance as amended; or

(c) reject the ordinance.

Application for Amendment to Uintah County Zoning Map for RNI Wonsit Disposal Facility

374 East Chapita Grove Road

Narrative

RN Industries (RNI) operates the subject RCRA-Exempt, Exploration and Production (E &P) Waste disposal facility (Facility). It receives and treats oil and gas field E&P wastes and is permitted to operate under Utah Division of Oil, Gas, and Mining (UDOGM) regulations and a Conditional Use Permit (CUP) from Uintah County. The Facility occupies two parcels (# 09-019-0001 and #09-021-0001) currently zoned MG-1.

Under UDOGM guidelines, certain RCRA-Exempt E&P wastes (e.g., used drilling mud, used reserve pit liners, etc.) may not be accepted in UDOGM-regulated disposals. However, the oil and gas industry needs permitted waste disposals which can accept those materials excluded from UDOGM regulated facilities. To be economically feasible, the permitted waste disposals must be located near the point of waste generation. UDOGM has indicated that these wastes should be disposed in landfills regulated by Utah Division of Solid and Hazardous Waste (UDSHW).

In its discussions with UDOGM and UDSHW, RNI has determined that several of its Wonsit evaporation ponds can be converted to Class IIIb Landfill cells (Conversions) regulated by UDSHW. UDSHW has agreed to work with RNI and its engineer, MWH, to design the Conversions and develop operational guidelines in accordance with UDSHW regulations.

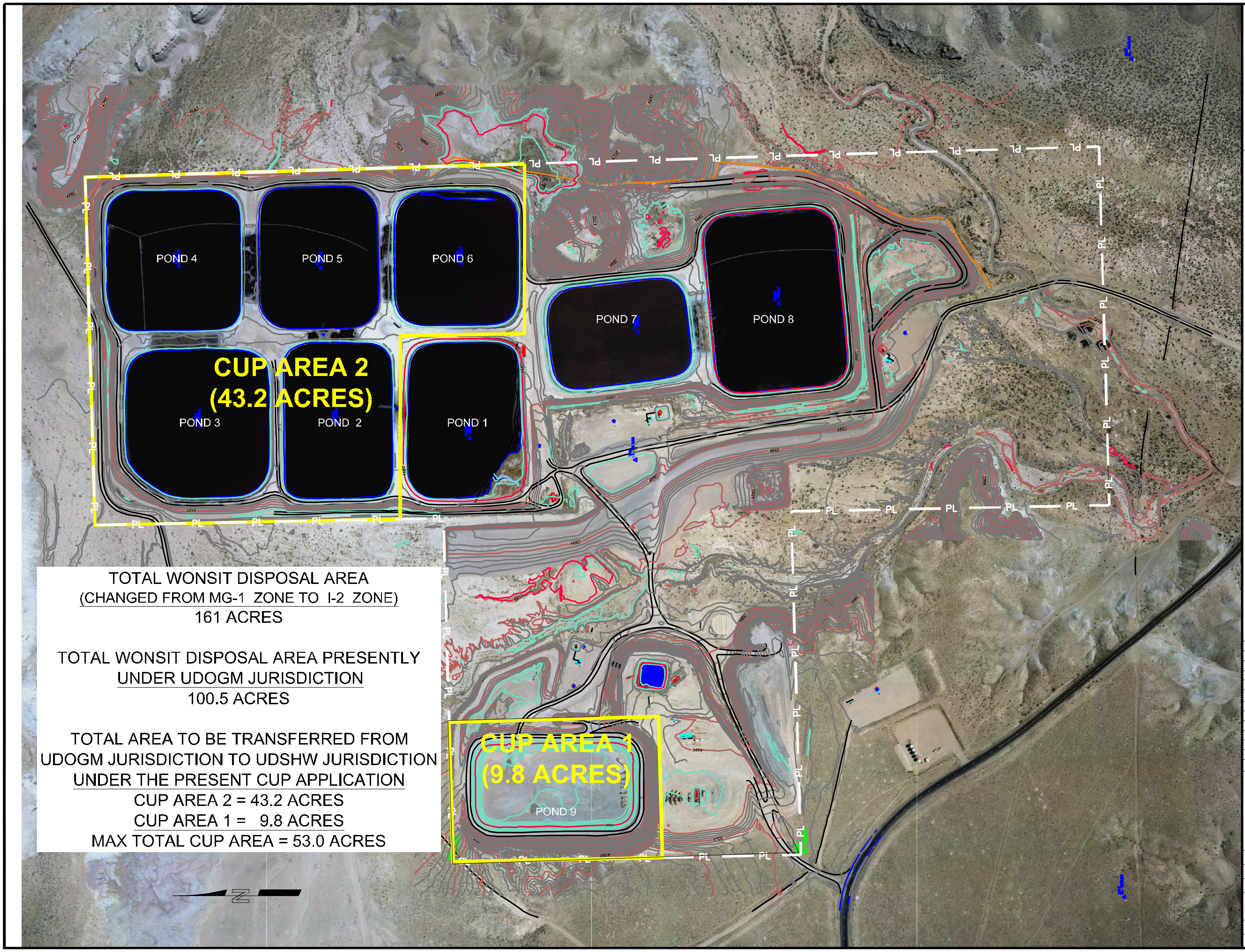
Certain Uintah County Commissioners and Matt Cazier (Uintah County Community Development) have indicated that the proposed Conversions would require the following actions by Uintah County after reviewing the following petitions from RNI:

- Petition to re-zone the RNI Wonsit Disposal (parcels # 09-019-0001 and #09-021-0001, hereinafter referred to as Parcels) from MG-1 to I-2. Such re-zoning would allow some of the evaporation ponds to be converted to, and operated as Class IIIb Landfill cells. Uintah County has indicated it would allow such conversion and operation under a Conditional Use Permit (CUP) in Zone I-2. The present use of portions of the Parcels as a RCRA-Exempt E&P Waste Disposal regulated by UDOGM would not change under the new I-2 Zone. The existing CUP allowing these uses would not be altered under the proposed Zoning change from MG-1 to I-2.

- Petition to add a new CUP for a designated portion of the Parcels. The new CUP would allow conversion of several of the ponds from evaporation ponds under UDOGM regulatory authority to Class IIIb Landfill cells under UDSHW regulatory authority. The new CUP would be dependent upon successful completion of the proposed zone change application described above. (See attached, Uintah County CUP Application)

It is important to note that the proposed zoning change for the Parcels would allow operational changes to be made at the RNI Wonsit Disposal that would have the following beneficial effects that RNI believes are in the best interest of Uintah County and the general public:

- Provide permanent, permitted, commercial, UDSHW-regulated Class IIIb Landfill disposal cells for certain RCRA-Exempt E & P Solid Wastes not allowed for disposal under UDOGM regulations.
- Provide a UDSHW Class IIIb Landfill for disposal of other solid wastes allowed under this designation.
- Provide a UDSHW Class IIIb Landfill near points of solid waste generation in the Uintah Basin.
- Reduce Volatile Organic Compound (VOC) and ozone precursor emissions. Over time, the proposed zone change and its accompanying CUP will result in:
    - Reduction of existing evaporation pond surface area, decreasing the opportunity for *emissions*.
    - Regular covering of the working face, also decreasing the opportunity for emissions.



TOTAL WONSIT DISPOSAL AREA
(CHANGED FROM MG-1 ZONE TO I-2 ZONE)
161 ACRES

TOTAL WONSIT DISPOSAL AREA PRESENTLY
UNDER UDOGM JURISDICTION
100.5 ACRES

TOTAL AREA TO BE TRANSFERRED FROM
UDOGM JURISDICTION TO UDSHW JURISDICTION
UNDER THE PRESENT CUP APPLICATION
CUP AREA 2 = 43.2 ACRES
CUP AREA 1 = 9.8 ACRES
MAX TOTAL CUP AREA = 53.0 ACRES

MWH

MONTGOMERY WATSON HARZA
2890 EAST COTTONWOOD PARKWAY
SALT LAKE CITY, UT
(801) 617-3200

Wonsit
RNI
R.N. INDUSTRIES
Utah

1	FOR CONSTRUCTION	JK	KJS	2010.08.12
0	RNI REVIEW	JK	KJS	2010.07.26
REV	DESCRIPTION	BY	APPD	DATE

3	DOGM SUBMITTAL	JK	KJS	2010.09.22
2	FOR CONSTRUCTION	JK	KJS	2010.08.12
1	RNI REVIEW	JK	KJS	2010.07.26
ISSUE	DESCRIPTION	BY	APPD	DATE

No. 273867-2203
KERRY JORDAN
SPIROFF

Project Location UNITAH COUNTY
Project RNI DISPOSAL FACILITIES
Title RNI WONSIT DISPOSAL FACILITY

RNI RCRA EXEMPT E&P SOLID WASTE
LANDFILL CUP APPLICATION FOOTPRINT

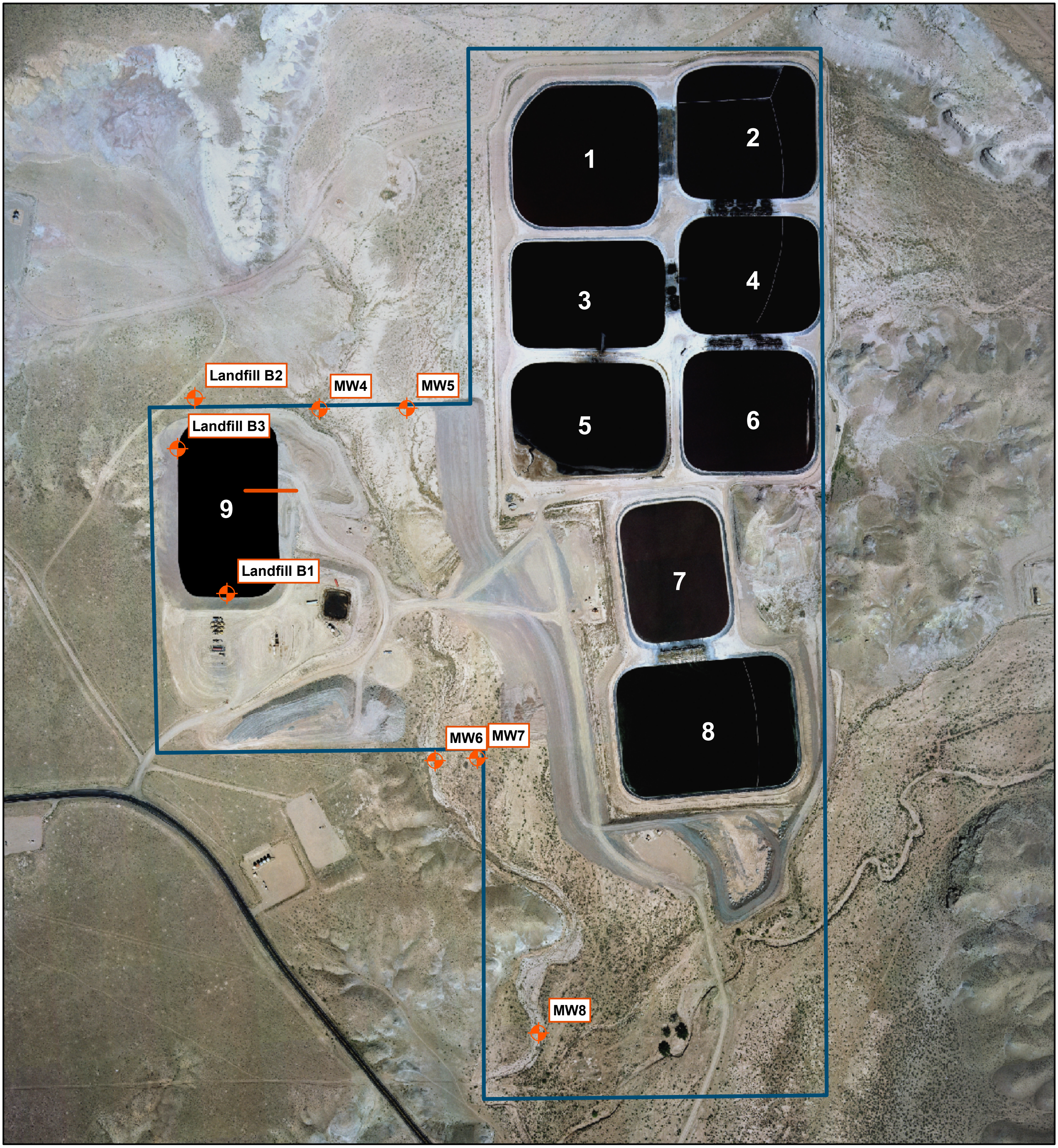
Drawing No. USHW-W6272
Sheet Sh. 1 of 1
File 1006272

Appendix F

Subsurface Investigation

Appendix F1

Well Logs and Lab Reports



BASE MAP:
August 2009 Olympus Aerial Orthophotography Obtained
from MWH

0 100 200 400 600 800
Feet

1:6,000

N

GeoStrata
Engineering & Geosciences
Copyright GeoStrata, 2013

Legend

⌖ Boring Location

— Slope Stability Profile

▭ Site Boundary

R.N. Industries
Wonsit Landfill Cell #1 Phase 1
Wonsit, UT
Project Number: 524-042

Exploration Location Map

Plate
1

DATE
STARTED: 4/22/13
COMPLETED: 4/22/13
BACKFILLED: 4/22/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:
Landfill B-1
Sheet 1 of 1

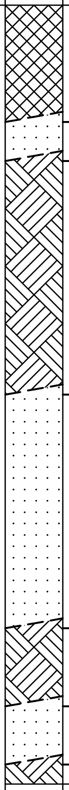
DEPTH: METERS | FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION

LOCATION
STATION OFFSET ELEVATION

Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

SPT BLOW COUNT
10 20 30 40 50 60 70 80 90



MATERIAL DESCRIPTION	N	N*
Silt, Sand, Gravel up to 1" diameter, brown, maroon, very washed out		
Bedrock; Sandtone - grey		
Bedrock; Mudstone - reddish brown to maroon		
Bedrock; Sandstone - grey		
Bedrock; Mudstone - reddish brown to maroon, 1" sandstone layers throughout		
Bedrock; Sandstone - grey		
Bedrock; Mudstone - reddish brown to maroon		

Bottom of Boring @ 20 Feet

N - OBSERVED UNCORRECTED BLOW COUNT
N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

SAMPLE TYPE
☒ - 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
■ - 3" O.D./2.48" I.D. SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
2

DATE	
STARTED:	4/22/13
COMPLETED:	4/22/13
BACKFILLED:	4/22/13

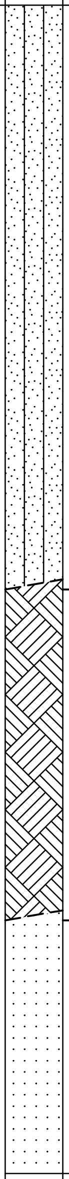
R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:
Landfill B-2
Sheet 1 of 1

LOCATION
STATION OFFSET ELEVATION

DEPTH: METERS / FEET; SAMPLES; WATER LEVEL; GRAPHICAL LOG; UNIFIED SOIL CLASSIFICATION



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
SM	Silty SAND - medium brown, moist, gravel up to 1/2" diameter, orgamics in top 1 ft									
	Bedrock; Mudstone - reddish brown to maroon									
	Bedrock; Sandstone - grey									
	Bottom of Boring @ 30 Feet									

N - OBSERVED UNCORRECTED BLOW COUNT

N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
☒ - 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
☒ - 3" O.D./2.48" I.D. SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
3

DATE		
STARTED:	4/23/13	
COMPLETED:	4/23/13	
BACKFILLED:	4/23/13	

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:

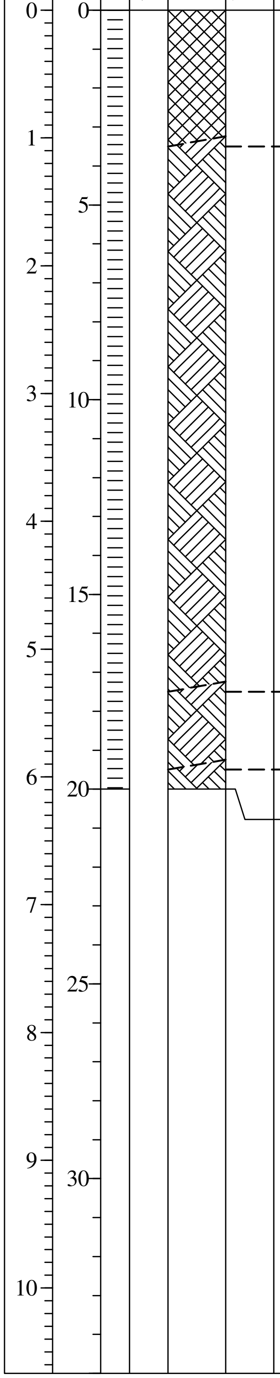
Landfill B-3

Sheet 1 of 1

DEPTH — METERS — FEET — SAMPLES — WATER LEVEL — GRAPHICAL LOG — UNIFIED SOIL CLASSIFICATION

LOCATION
STATION OFFSET ELEVATION

MATERIAL DESCRIPTION — N — N* — SPT BLOW COUNT 10 20 30 40 50 60 70 80 90 — Dry Density(pcf) — Moisture Content % — Percent minus 200 — Liquid Limit — Plasticity Index — Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90



Silt, Sand, Clay, with gravel up to 1.5" diameter, brown

Bedrock; Mudstone - maroon to reddish brown

Bedrock; Mudstone - dark green

Bedrock; Mudstone - maroon to reddish brown

Bottom of Boring @ 20 Feet

N - OBSERVED UNCORRECTED BLOW COUNT

N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.48" I.D. SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◩- Modified California Sampler

NOTES:

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate

4

DATE	
STARTED:	2/1/13
COMPLETED:	2/1/13
BACKFILLED:	2/1/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

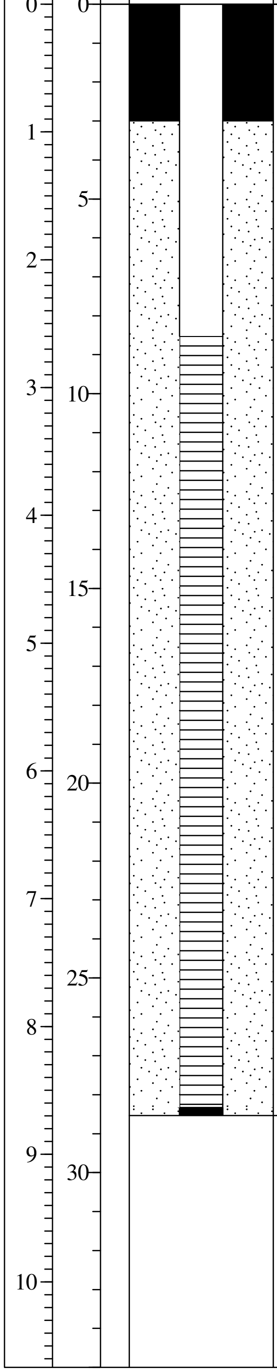
GeoStrata Rep:MV/JP
Rig Type: John Henry

BORING NO:
MW-1
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

WELL DESCRIPTION



SOIL; Alluvium, Silty SAND, brown, dense.

BEDROCK - Lighter Brown to tan Mudstone

BEDROCK - Darker Brown to Reddish Mudstone

Bottom of Boring @ 28.5 Feet

GeoStrata

SAMPLE TYPE
- ☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- ☒- 3.25" O.D./2.42" I.D. U SAMPLER
- ◪- 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯- GRAB SAMPLE
- ◪- Modified California Sampler

NOTES:

Cuttings	Bentonite	10-20 Silica Sand	20 Slot Screen	Pipe Cap
▨	▮	▯	▤	▮

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate

5

DATE	
STARTED:	2/1/13
COMPLETED:	2/1/13
BACKFILLED:	2/1/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep:MV/JP
Rig Type: John Henry

BORING NO:
MW-2
Sheet 1 of 1

LOCATION

NORTHING	EASTING	ELEVATION

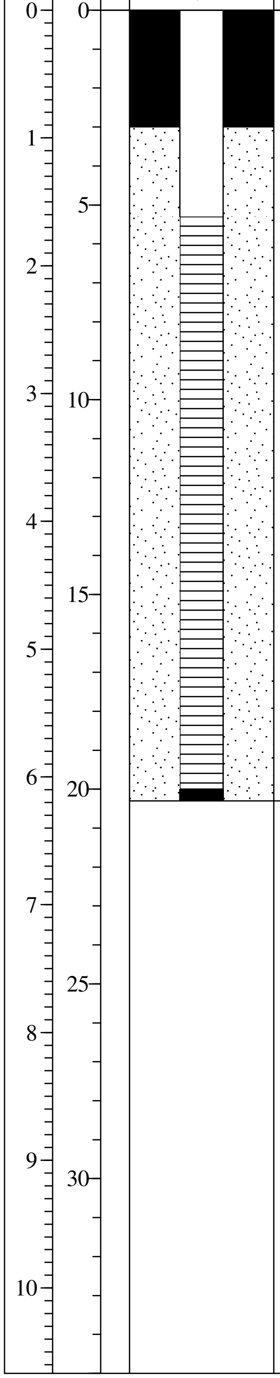
Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

DEPTH: METERS / FEET — SAMPLES — GRAPHICAL WELL LOG

WELL DESCRIPTION



Depth (feet)	Well Description
0	SOIL; Alluvium, Silty SAND, brown, dense.
5.5	BEDROCK - Lighter Brown to tan Mudstone
10	BEDROCK - Darker Brown to Reddish Mudstone
20.3	Bottom of Boring @ 20.3 Feet

WELL_PLATE BORING LOGS.GPJ IGES.GDT 5/29/13

GeoStrata

SAMPLE TYPE
- ☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- ■- 3.25" O.D./2.42" I.D. U SAMPLER
- ▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯- GRAB SAMPLE
- ◩- Modified California Sampler

NOTES:

Cuttings	Bentonite	10-20 Silica Sand	20 Slot Screen	Pipe Cap
▨	■	▤	▦	▮

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
6

DATE	
STARTED:	2/1/13
COMPLETED:	2/1/13
BACKFILLED:	2/1/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

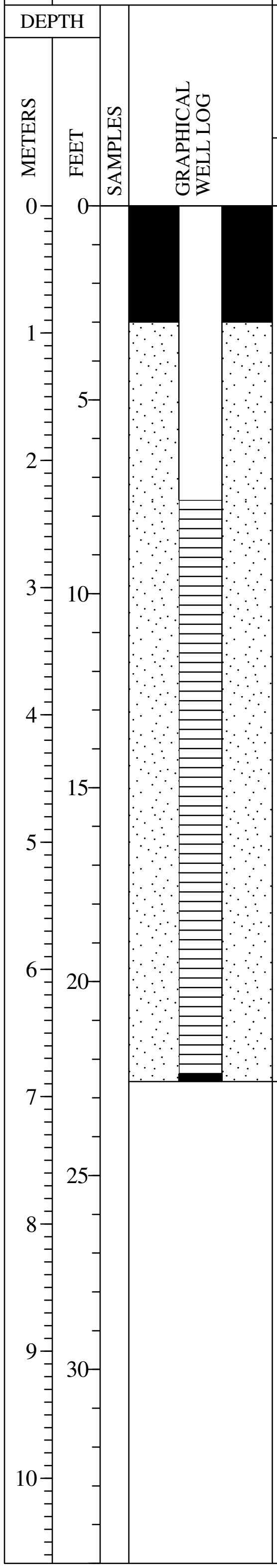
GeoStrata Rep:MV/JP
Rig Type: John Henry

BORING NO:
MW-3
Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

WELL DESCRIPTION



SOIL; Alluvium, Silty SAND, brown, dense.

BEDROCK - Dark Brown to Purple Mudstone

BEDROCK - Lighter Brown to Tan Mudstone

Bottom of Boring @ 22.6 Feet

Moisture Content
and
Atterberg Limits

Plastic Limit · Moisture Content · Liquid Limit

10 20 30 40 50 60 70 80 90

GeoStrata

SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
☒- 3.25" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◩- Modified California Sampler

NOTES:

Cuttings	Bentonite	10-20 Silica Sand	20 Slot Screen	Pipe Cap
▨	■	⁘	▤	▮

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
7

DATE	
STARTED:	4/22/13
COMPLETED:	4/22/13
BACKFILLED:	4/22/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

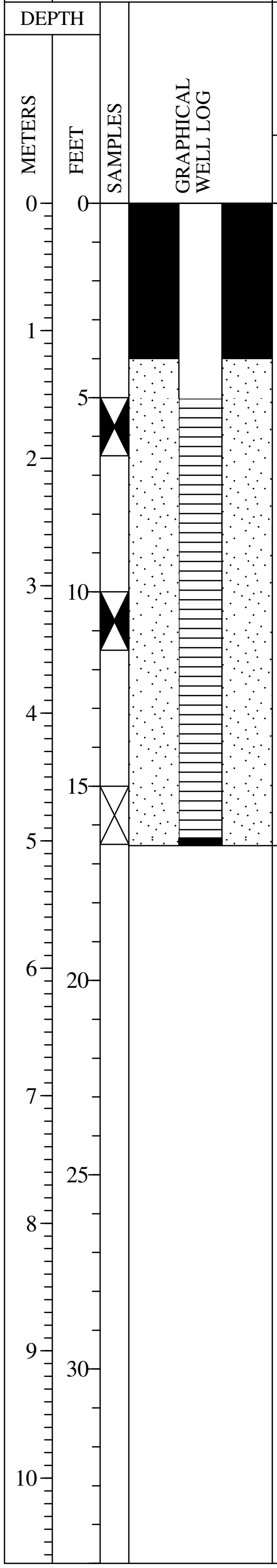
GeoStrata Rep:J. Mattson
Rig Type: CME 75

BORING NO:
MW-4
Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

WELL DESCRIPTION

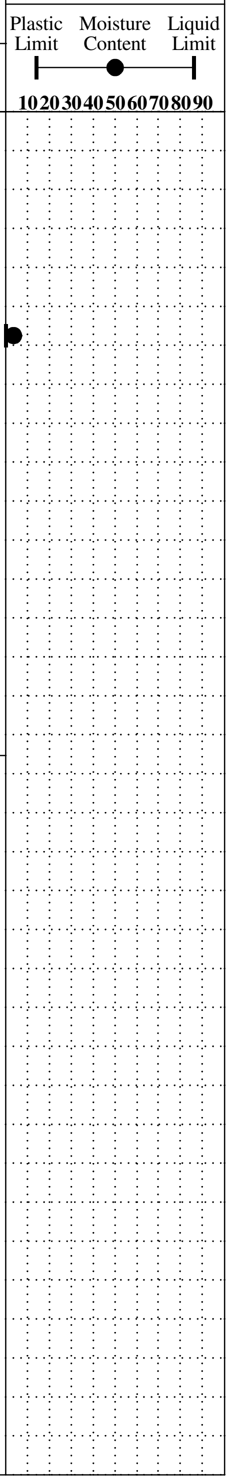


Silty SAND - medium brown, slightly moist, medium dense, some gravel up tp 1/4"

Bedrock; Sandstone/Mudstone

Bottom of Boring @ 16.5 Feet

Moisture Content
and
Atterberg Limits



SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
☒- 3.25" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◪- Modified California Sampler

NOTES:

Cuttings	Bentonite	10-20 Silica Sand	20 Slot Screen	Pipe Cap
▨	▮	▯	▤	▮

WATER LEVEL
▼ - MEASURED ▽- ESTIMATED

Plate

8

DATE	
STARTED:	4/22/13
COMPLETED:	4/22/13
BACKFILLED:	4/22/13

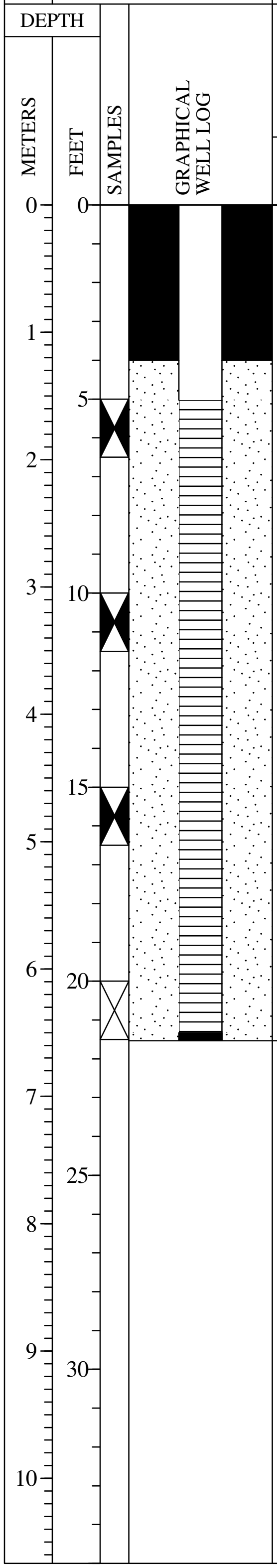
R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep:J. Mattson
Rig Type: CME 75

BORING NO:
MW-5
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

WELL DESCRIPTION



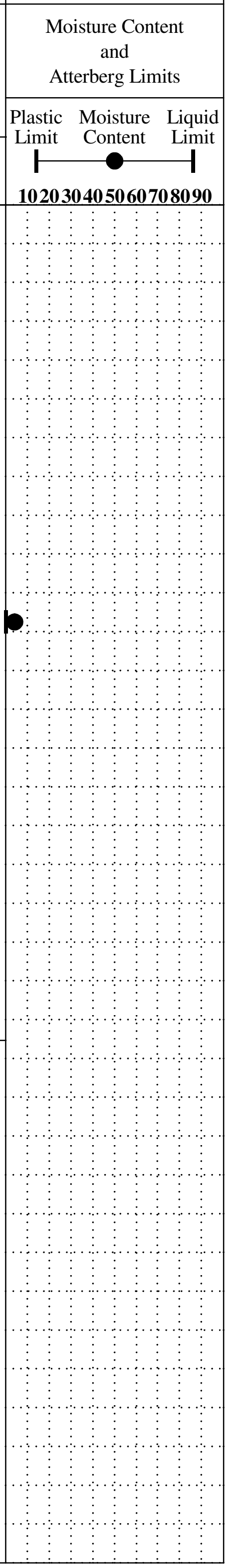
Sandy SILT - medium brown, slightly moist, very stiff

- minor organics in sample

Silty SAND - medium brown, slightly moist, medium dense to dense

Bedrock; Sandtone - cemented, medium brown

Bottom of Boring @ 21.5 Feet



GeoStrata

SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
☒- 3.25" O.D./2.42" I.D. U SAMPLER
◪- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◩- Modified California Sampler

NOTES:

Cuttings	Bentonite	10-20 Silica Sand	20 Slot Screen	Pipe Cap
▨	■	▯	▤	▮

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
9

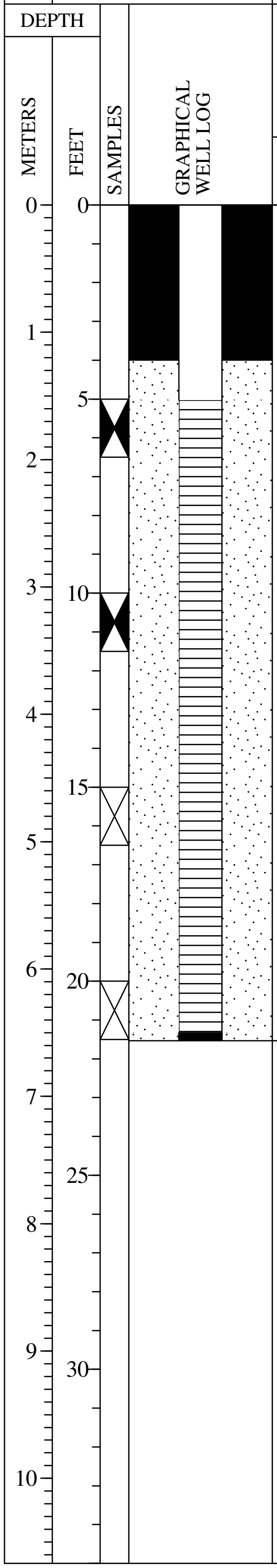
DATE	
STARTED:	4/22/13
COMPLETED:	4/22/13
BACKFILLED:	4/22/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep:J. Mattson
Rig Type: CME 75

BORING NO:
MW-8
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION



WELL DESCRIPTION

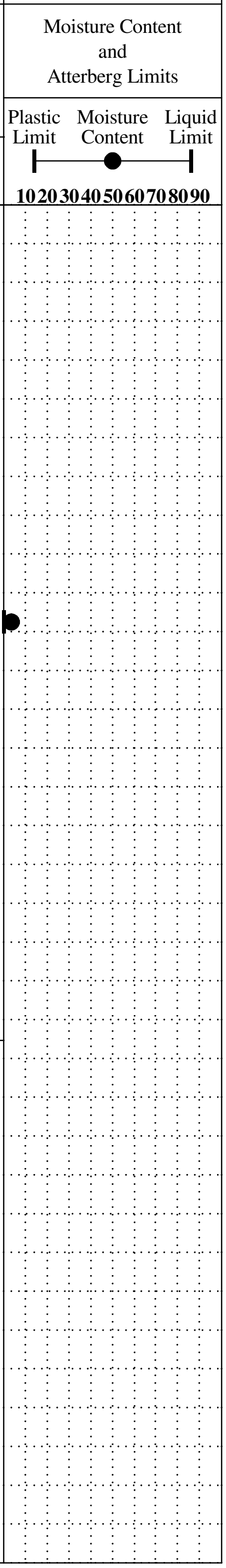
Sandy SILT - medium brown, slightly moist, medium stiff

- minor organics in sample

Silty SAND - brown, moist, medium dense

Bedrock; Sandstone - cemented, medium brown

Bottom of Boring @ 21.5 Feet



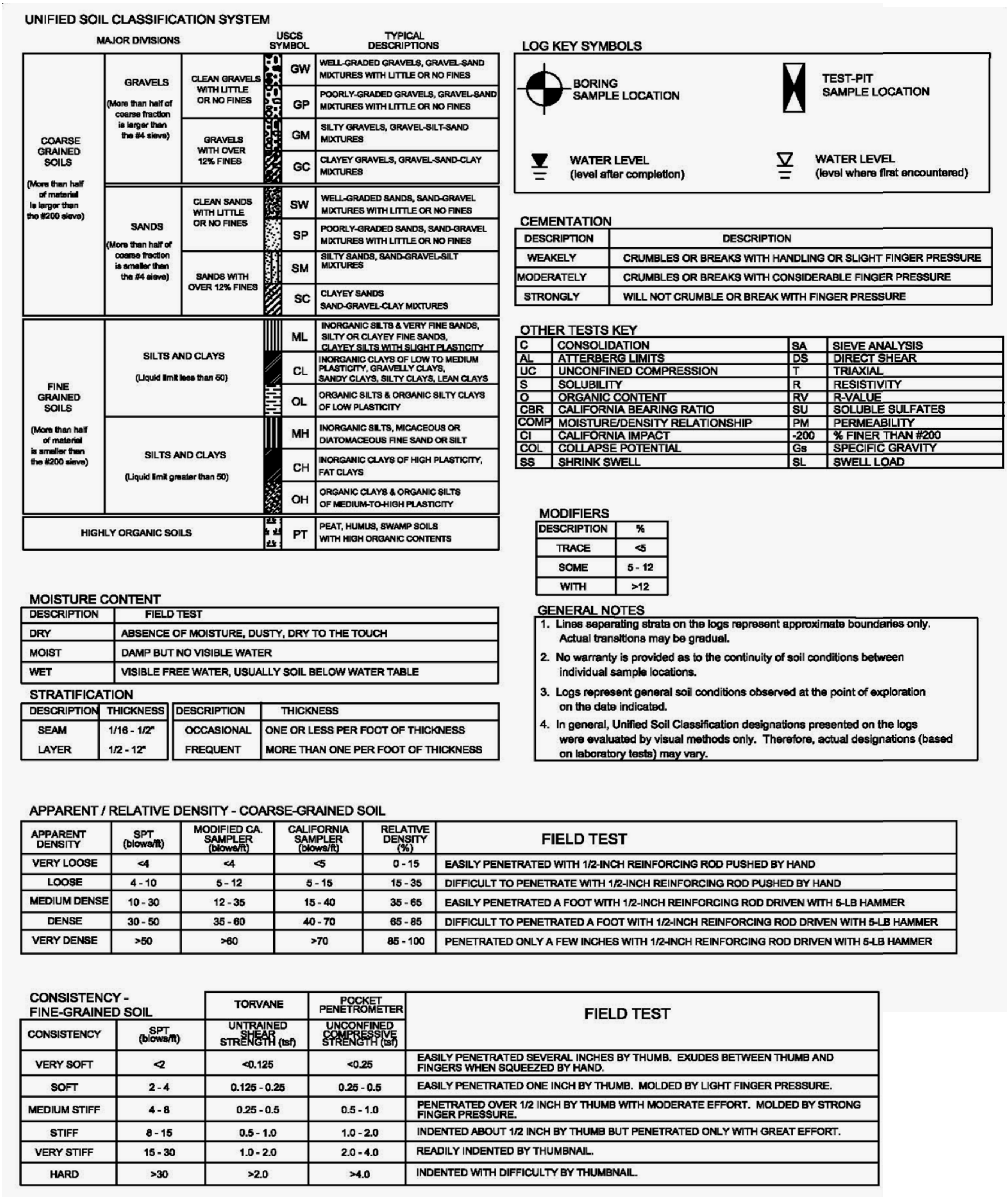
SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
⧗- 3.25" O.D./2.42" I.D. U SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◩- Modified California Sampler

NOTES:
Cuttings ▨
Bentonite ▮
10-20 Silica Sand ▯
20 Slot Screen ▤
Pipe Cap ▮

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

GeoStrata

Plate
10



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

		TORVANE	POCKET PENETROMETER	FIELD TEST
CONSISTENCY	SPT (blows/ft)	UNTRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

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Soil Symbols Description Key

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, Utah
Project Number: 524-042

Plate
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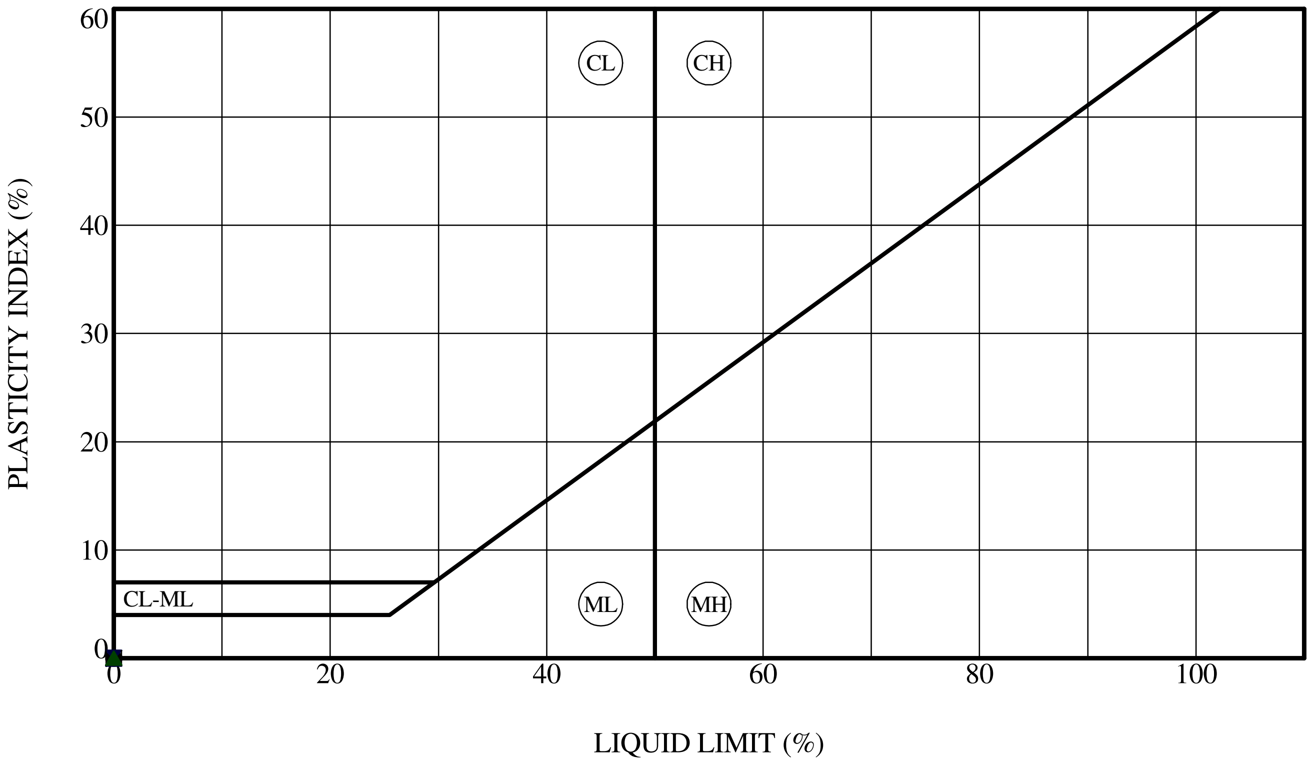
Boring No.	Sample Depth (feet)	USCS Soil Classification	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Permeability (cm/s)	Consolidated Undrained Triax			
					Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index		Effective Cohesion (psf)	Efective Internal Friction Angle (°)	Total Cohesion (psf)	Total Internal Friction Angle (°)
B-1	**17.5**		**10.0**	**129.5**						**1.71E-07**				
B-3	**20.0**		**15.3**	**116.3**						**1.88E-05**				
MW-4	**5.0**	**SM**	**3.6**	**102.4**	**9.7**	**57.2**	**33.1**	**NP**	**NP**	**3.83E-04**				
MW-5	**10.0**	**SM**	**4.1**		**1.8**	**55.7**	**42.5**	**NP**	**NP**					
MW-8	**10.0**	**SM**	**3.5**	**103.6**	**5.1**	**76.4**	**18.5**	**NP**	**NP**	**5.86E-04**				
Pond 9	**Embankment**		**9.6**	**110.2**							**90**	**35**	**340**	**26**

Lab Summary Report

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate 12



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**MW-4**	**5.0**	**NP**	**NP**	**NP**		**Silty SAND**
⧗	**MW-5**	**10.0**	**NP**	**NP**	**NP**		**Silty SAND**
▲	**MW-8**	**10.0**	**NP**	**NP**	**NP**		**Silty SAND**

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ATTERBERG LIMITS' RESULTS - ASTM D 4318

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate

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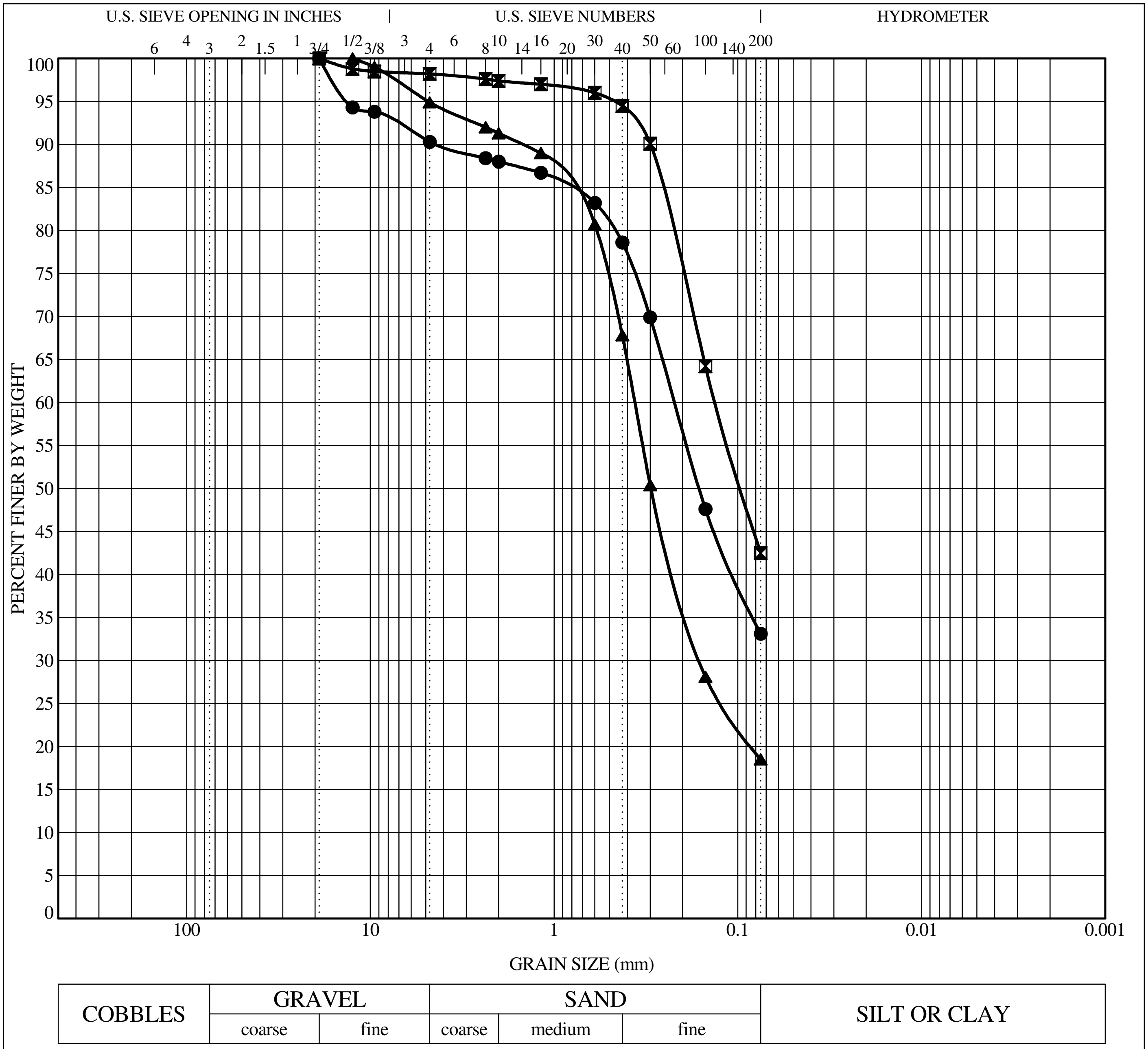
PLATE_ATTERBERG BORING LOGS.GPJ IGES.GDT 5/29/13



	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**MW-4**	**5.0**	**Silty SAND**	**NP**	**NP**	**NP**		
☒	**MW-5**	**10.0**	**Silty SAND**	**NP**	**NP**	**NP**		
▲	**MW-8**	**10.0**	**Silty SAND**	**NP**	**NP**	**NP**		

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MW-4**	**5.0**	**19**	**0.221**			**9.7**	**57.2**	**33.1**	
☒	**MW-5**	**10.0**	**19**	**0.131**			**1.8**	**55.7**	**42.5**	
▲	**MW-8**	**10.0**	**12.5**	**0.364**	**0.159**		**5.1**	**76.4**	**18.5**	

GeoStrata

GRAIN SIZE DISTRIBUTION - ASTM D422

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

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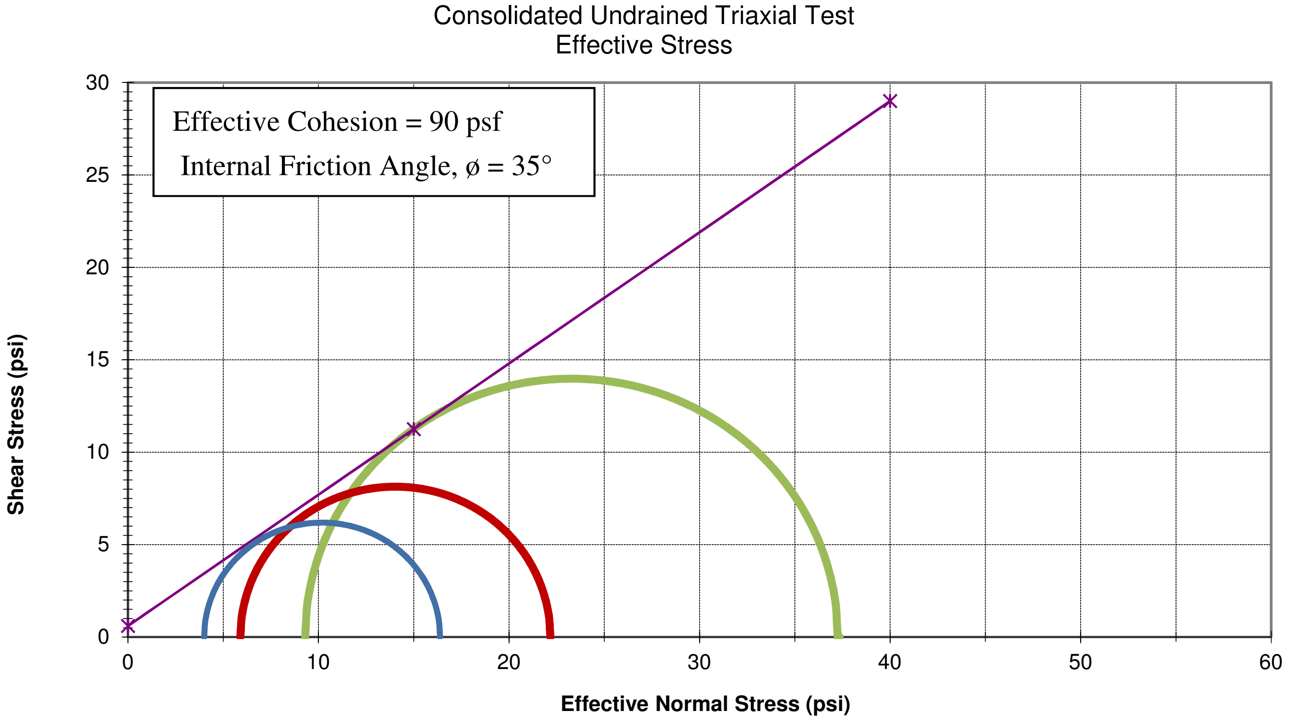

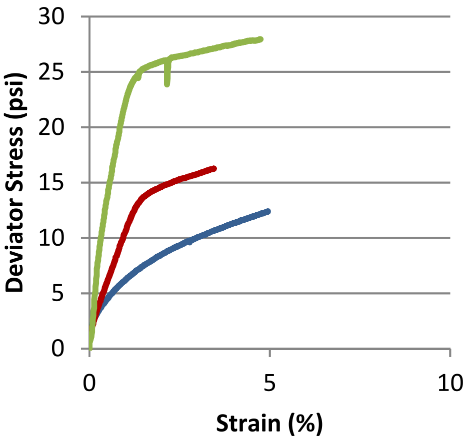

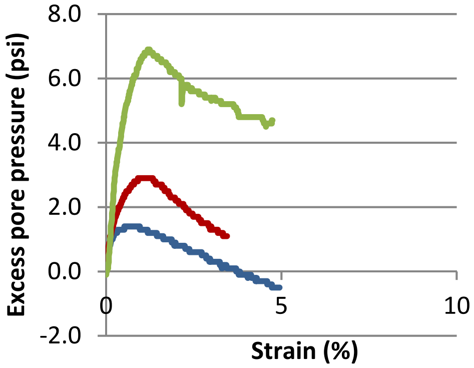

Sample Location	Pond 9 Embankment		
Sample Type	Remolded		
Test Type	Consolidated Undrained		
Length (in)	5.40	NA	NA
Diameter (in)	2.87	NA	NA
Dry Density (pcf)	121.7	NA	NA
Moisture (%)	12.9	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
Total Axial Stress σ_1 (psi)	15.9	23.3	42.0
Deviator Stress σ_1-σ_3 (psi)	12.4	16.3	28.0
Effective Confining Stress σ_3' (psi)	4.0	5.9	9.3
Effective Axial Stress σ_1' (psi)	16.4	22.2	37.3
Pore Pressure μ (psi)	-0.5	1.1	4.7
Strain (%)	5.0	5.0	5.0

Project No.: 542-042

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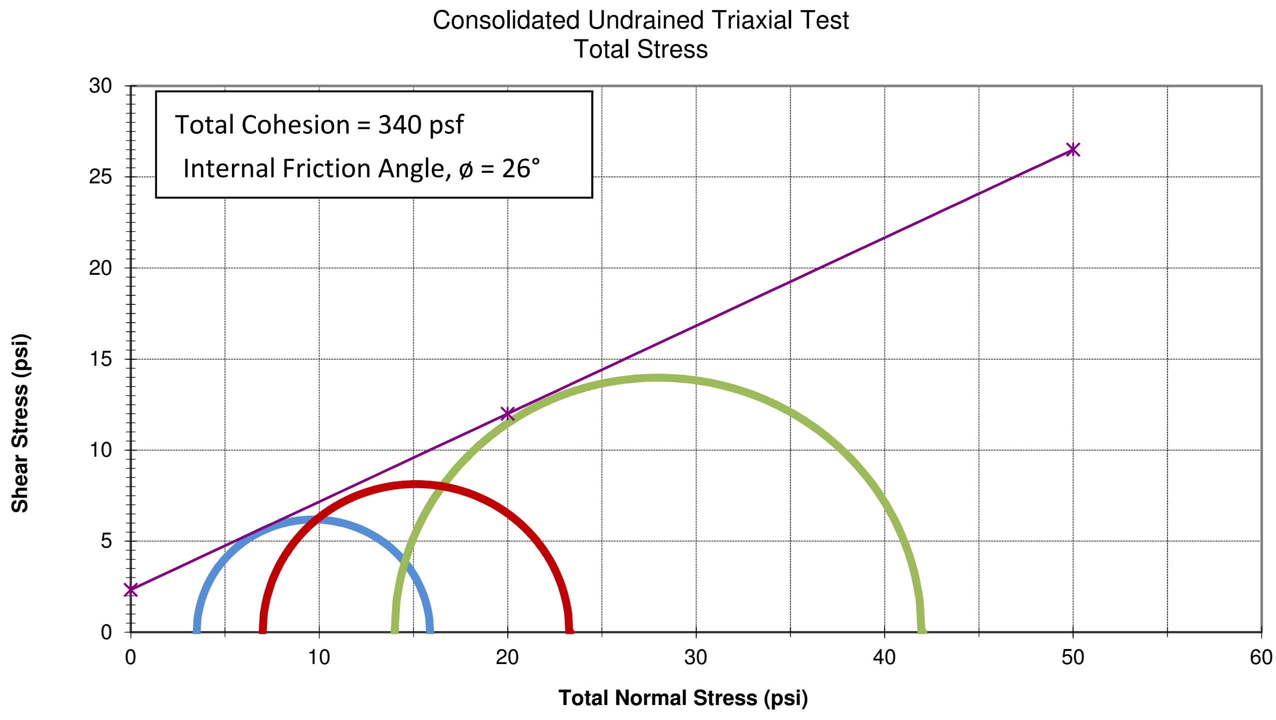
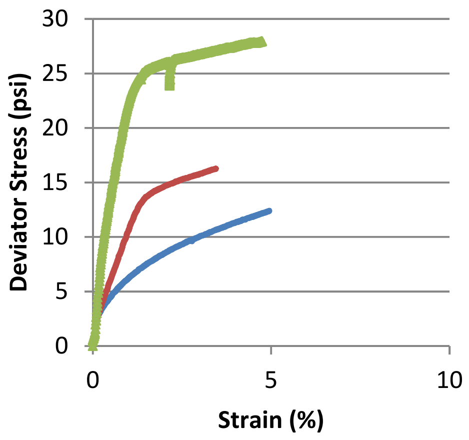
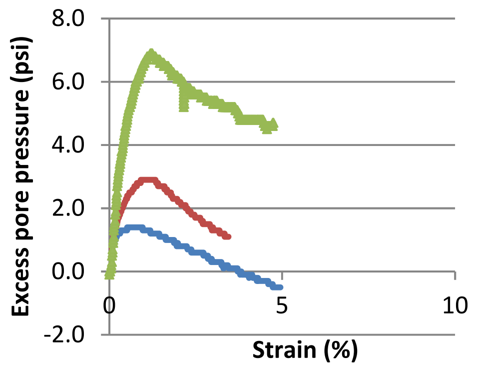






Sample Location	Pond 9 Embankment		
Sample Type	Remolded		
Test Type	Consolidated Undrained		
Length (in)	5.40	NA	NA
Diameter (in)	2.87	NA	NA
Dry Density (pcf)	121.7	NA	NA
Moisture (%)	12.9	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
Total Axial Stress σ_1 (psi)	15.9	23.3	42.0
Deviator Stress σ_1-σ_3 (psi)	12.4	16.3	28.0
Effective Confining Stress σ_3' (psi)	4.0	5.9	9.3
Effective Axial Stress σ_1' (psi)	16.4	22.2	37.3
Pore Pressure μ (psi)	-0.5	1.1	4.7
Strain (%)	5.0	5.0	5.0

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

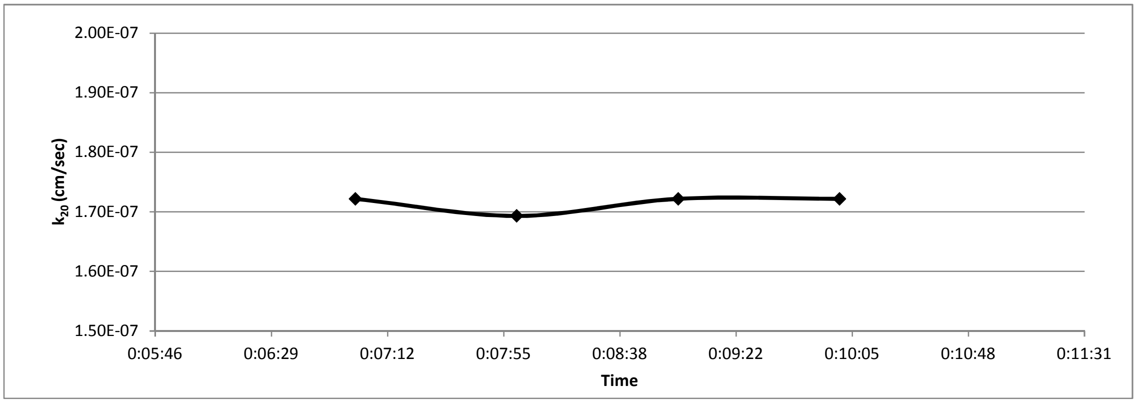
Project: Wonsit Landfill Cell #1 Phase I
Project Number: 524-042
Soil Classification: Sandstone
Boring: B-1
Depth: 17.5
Sample Type: Undisturbed
Test Date: 5/6/2013

Permeant Liquid: Deaired Water
Total Backpressure (psi): 60
Effective Consolidation Stress (psi): 5

	Initial	Final
G_s:	2.77	2.77
Mass (g):	469.1	472.3
Height (in.):	2.708	2.720
Diameter (in.):	2.428	2.389
Area (cm^2):	29.88	28.91
Volume (cm^3):	205.5	199.7
Water Content (%):	9.99	10.74
Dry Unit Weight, γ_d (pcf):	129.5	133.3
Saturation (%):	83	100

Recorded Time	Elapsed Time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	Δh (cm)	K (cm/sec)	Temp (°C)	Viscocity Ratio, Rf	k_{20} (cm/sec)
0:07:00	59	3.02	9.16	415.2	1.88E-07	23.7	0.916	1.72E-07
0:08:00	60	3.04	9.14	415.2	1.85E-07	23.7	0.916	1.69E-07
0:09:00	59	3.06	9.12	415.2	1.88E-07	23.7	0.916	1.72E-07
0:10:00	59	3.08	9.10	415.2	1.88E-07	23.7	0.916	1.72E-07

Average k_{20} 1.71E-07 (cm/sec)



PROJECT NO.: 524-042

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

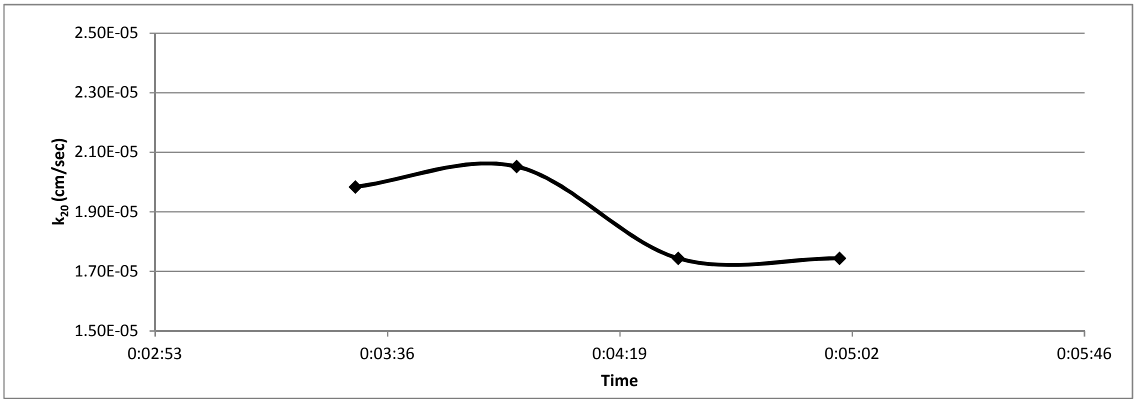
Project:	Wonsit Landfill Cell #1 Phase I
Project Number:	524-042
Soil Classification:	Mudstone
Boring:	B-3
Depth:	20
Sample Type:	Undisturbed
Test Date:	5/6/2013

Permeant Liquid:	Deaired Water
Total Backpressure (psi):	70
Effective Consolidation Stress (psi):	3

	Initial	**Final**
G_s:	2.81	2.81
Mass (g):	395.4	394.5
Height (in.):	2.436	2.354
Diameter (in.):	2.422	2.394
Area (cm^2):	29.73	29.03
Volume (cm^3):	184.0	173.6
Water Content (%):	15.34	15.08
Dry Unit Weight, γ_d (pcf):	116.3	123.3
Saturation (%):	85	100

Recorded Time	**Elapsed Time (sec)**	**Bottom Burette (cm^3)**	**Top Burette (cm^3)**	**Δh (cm)**	**K (cm/sec)**	**Temp (°C)**	**Viscosity Ratio, Rf**	**k_{20} (cm/sec)**
0:03:30	30	2.04	7.20	61.9	2.24E-05	25.2	0.885	1.98E-05
0:04:00	29	2.24	7.00	61.9	2.32E-05	25.2	0.885	2.05E-05
0:04:30	29	2.41	6.83	61.9	1.97E-05	25.2	0.885	1.74E-05
0:05:00	29	2.58	6.66	61.9	1.97E-05	25.2	0.885	1.74E-05

Average k_{20} 1.88E-05 (cm/sec)



PROJECT NO.: 524-042

Plate 18

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

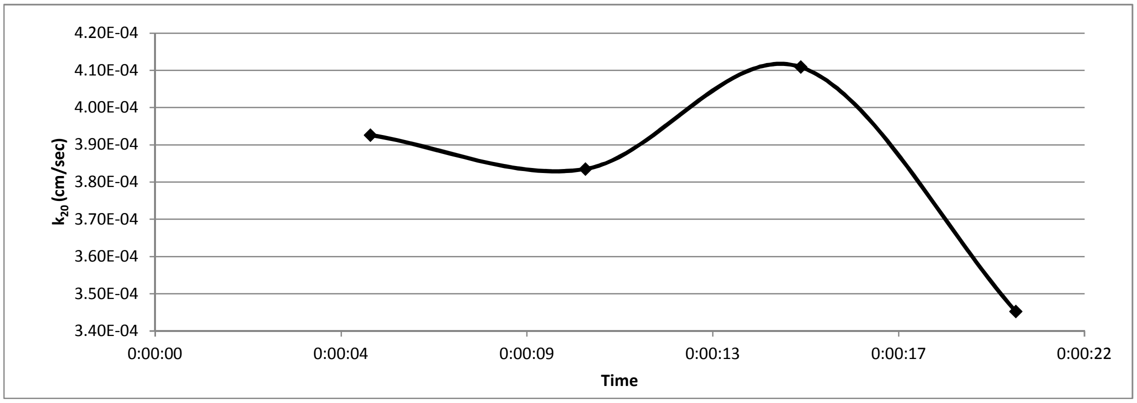
Project: Wonsit Landfill Cell #1 Phase I
Project Number: 524-042
Soil Classification: Sand
Boring: MW-4
Depth: 5 ft
Sample Type: Remolded
Test Date: 5/7/2013

Permeant Liquid: Deaired Water
Total Backpressure (psi): 100
Effective Consolidation Stress (psi): 3

	Initial	Final
G_s:	2.38	2.38
Mass (g):	480.1	544.7
Height (in.):	2.800	2.800
Diameter (in.):	2.800	2.800
Area (cm^2):	39.73	39.73
Volume (cm^3):	282.5	282.5
Water Content (%):	6.22	20.51
Dry Unit Weight, γ_d (pcf):	99.9	99.9
Saturation (%):	30	100

Recorded Time	Elapsed Time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	Δh (cm)	K (cm/sec)	Temp (°C)	Viscosity Ratio, Rf	k_{20} (cm/sec)
0:00:05	5	1.46	8.32	70.4	4.38E-04	24.6	0.897	3.93E-04
0:00:10	5	2.34	7.52	70.4	4.27E-04	24.6	0.897	3.84E-04
0:00:15	4	3.06	6.80	70.4	4.58E-04	24.6	0.897	4.11E-04
0:00:20	4	3.62	6.15	70.4	3.85E-04	24.6	0.897	3.45E-04

Average k_{20} 3.83E-04 (cm/sec)



PROJECT NO.: 524-042

GeoStrata

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

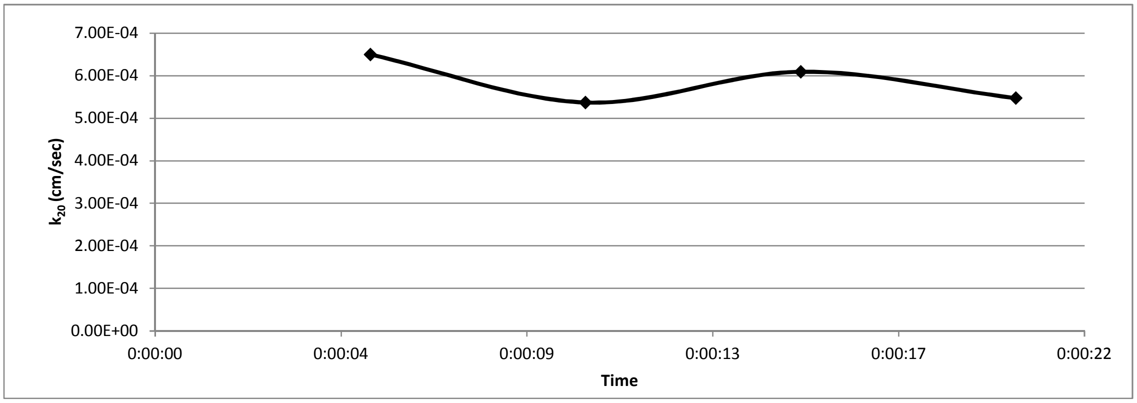
Project:	Wonsit
Project Number:	524-042
Soil Classification:	Sand
Boring:	MW-8
Depth:	10 ft
Sample Type:	Remolded
Test Date:	5/7/2013

	Initial	Final
G_s:	2.40	2.40
Mass (g):	485.3	547.9
Height (in.):	2.800	2.800
Diameter (in.):	2.800	2.800
Area (cm^2):	39.73	39.73
Volume (cm^3):	282.5	282.5
Water Content (%):	6.59	20.34
Dry Unit Weight, γ_d (pcf):	100.6	100.6
Saturation (%):	32	100

Permeant Liquid:	Deaired Water
Total Backpressure (psi):	100
Effective Consolidation Stress (psi):	3

Recorded Time	Elapsed Time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	Δh (cm)	K (cm/sec)	Temp (°C)	Viscocity Ratio, Rf	k_{20} (cm/sec)
0:00:05	5	2.34	7.36	35.2	7.33E-04	25.1	0.887	6.50E-04
0:00:10	5	2.93	6.76	35.2	6.05E-04	25.1	0.887	5.37E-04
0:00:15	5	3.47	6.22	35.2	6.87E-04	25.1	0.887	6.09E-04
0:00:20	5	3.96	5.74	35.2	6.17E-04	25.1	0.887	5.47E-04

Average k_{20} 5.86E-04 (cm/sec)



PROJECT NO.: 524-042	GeoStrata Copyright GeoStrata , 2013	**Plate** **20**

Appendix F2

Historical Geophysical Logs showing the Birds Nest Aquifer

Stratigraphic Characterization of the Birds Nest Aquifer in the Uinta Basin, Utah: Implications for Saline Water Disposal from Natural Gas Production

Michael D. Vanden Berg, Stephanie M. Carney, Craig D. Morgan, and Michael D. Laine
Utah Geological Survey, Salt Lake City, Utah

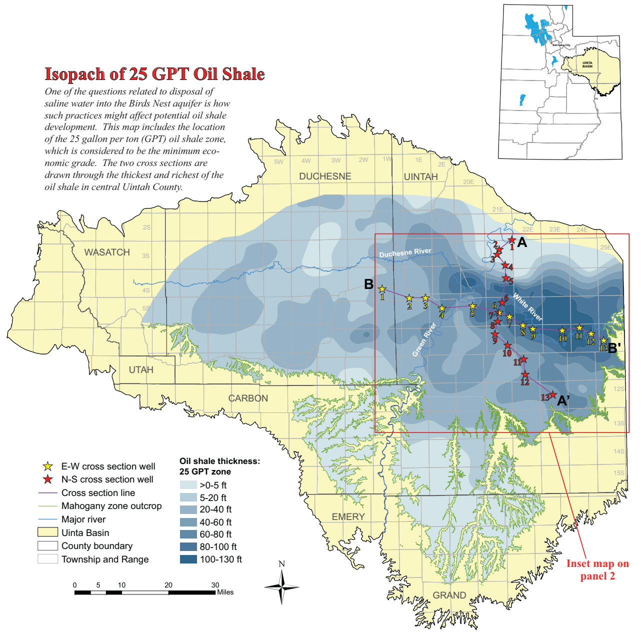
Project funded by: U.S. Department of Energy - National Energy Technology Laboratory and Utah Geological Survey

Project Web site: http://geology.utah.gov/emp/UBwater_study

ABSTRACT

During deposition of the upper Green River Formation in the late Eocene, Utah's Lake Uinta transitioned from a balanced-filled basin dominated by organic-rich, laminated marlstone, to an underfilled restricted basin. During this time, the saline mineral nahcolite formed within the deep-lake sediments (depocenter in central Uintah County) as isolated crystals, nodules ranging up to one foot in diameter, and beds ranging from less than an inch to 2 feet thick. Post-deposition, the saline mineral shortite formed in fracture zones several feet thick. More recently, the Birds Nest aquifer developed from the dissolution of these saline minerals. This aquifer, ranging in thickness from <100 feet on the basin margins to >300 feet in the basin's depocenter, is targeted by natural gas operators as a potential saline water disposal zone. Understanding the aquifer's areal extent, thickness, water chemistry, and zones of differential dissolution will help determine possible saline water disposal volumes and safe disposal practices, both of which could directly impact the success of increased petroleum production in the region.

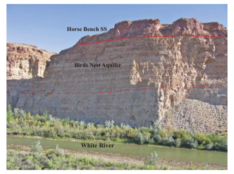
Preliminary research shows the Birds Nest's water chemistry in the north (averaging >10,000 ppm TDS and as high as 100,000 ppm TDS) is distinct from that in the south (averaging <10,000 ppm TDS and down to near 1000 ppm TDS). This abrupt change in water chemistry is most likely due to the differing amounts of saline mineral dissolution in the two areas; the southern area may have been flushed clean, whereas saline minerals in the northern area are still actively dissolving. The presence of intact nahcolite in the Utah State 1 core (section 26, T. 9 S., R. 21 E.) – displayed with this poster –demonstrates that there are still zones of no dissolution north of the 10,000 ppm TDS line. Just to the south of this well, the saline minerals in the Birds Nest show significant dissolution, as seen in the Utah State 13X-2 core (section 2, T. 10 S., R. 21 E.) – also displayed. Separating these two areas is a prominent gilsonite vein that cross-cuts the Birds Nest aquifer. Northwest-trending gilsonite veins seem to influence ground-water flow patterns in the Birds Nest by creating "channels" of dissolution and impermeable barriers to flow. In addition, research shows the Birds Nest aquifer in this area is divided into two or three stratigraphic zones of dissolution each roughly 40 feet thick; it is currently unclear if these zones are hydraulically connected or if the Birds Nest as a whole is vertically connected to other water-bearing zones both above and below. New insights into the structure of the Birds Nest aquifer will play an important role in future disposal practices, including how best to protect freshwater resources in the area.

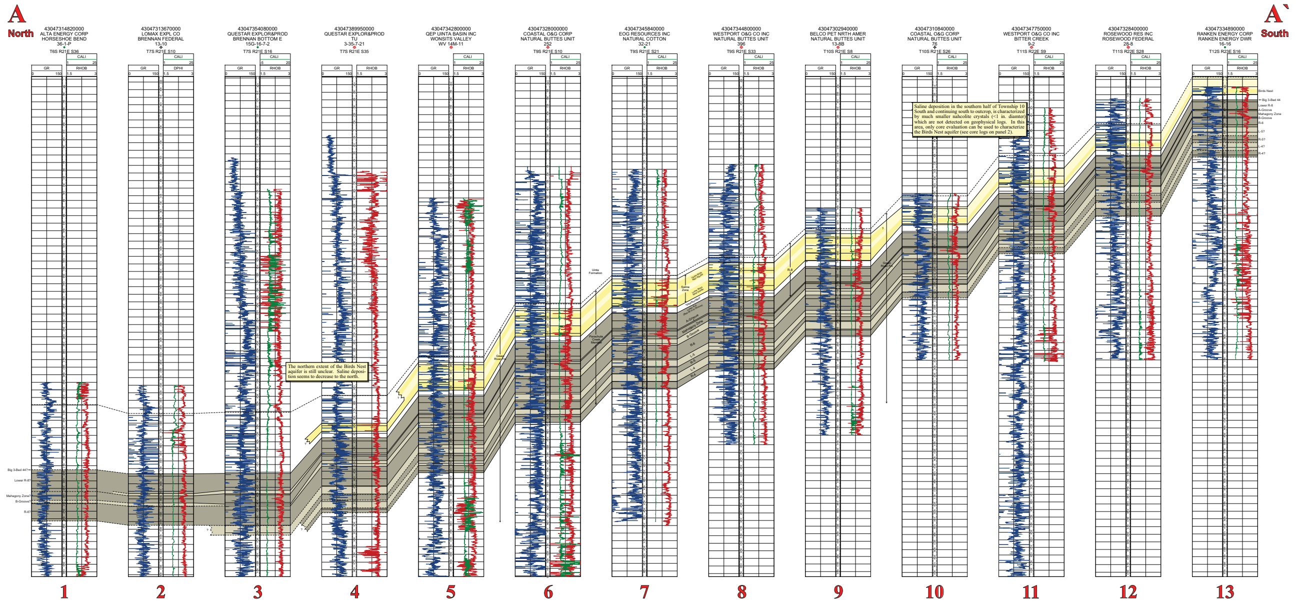


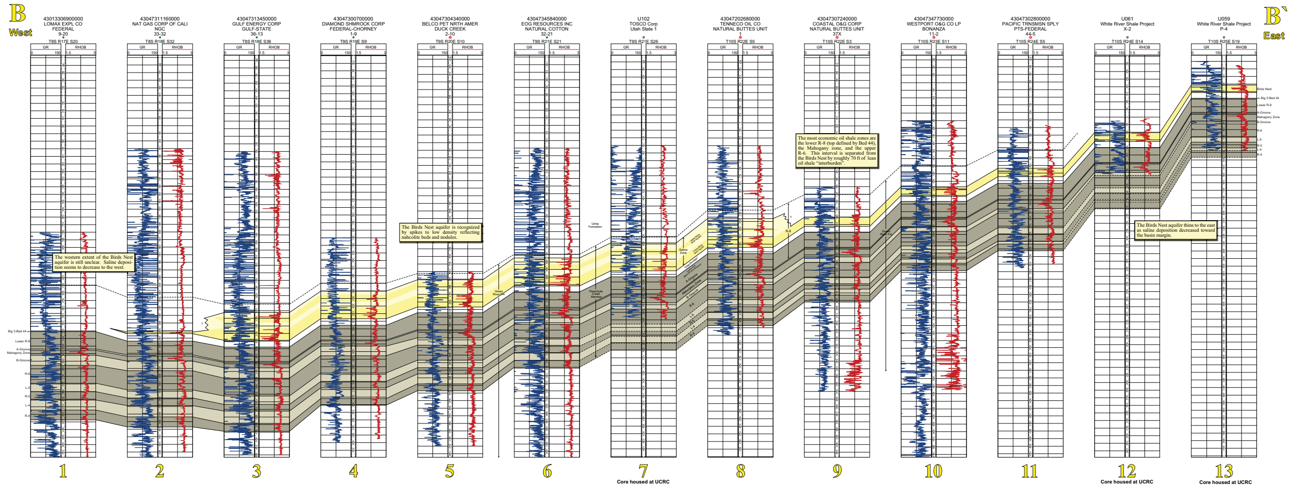
Isopach of 25 GPT Oil Shale

One of the questions related to disposal of saline water into the Birds Nest aquifer is how such practices might affect potential oil shale development. This map includes the location of the 25 gallon per ton (GPT) oil shale zone, which is considered to be the minimum economic grade. The two cross sections are drawn through the thickest and richest of the oil shale in central Uintah County.

Birds Nest aquifer in outcrop along Evacuation Creek, eastern Uinta Basin. The large cavities resulted from the dissolution of nahcolite nodules, creating the aquifer's porosity and permeability.







PROBLEM

The Birds Nest aquifer is poorly understood and needs further study to determine potential impacts of saline water disposal.

- What is its areal and stratigraphic extent?
- How is it related to Utah's oil shale deposits?
- What causes the differing zones of dissolution and salinity?

Eastern Uinta Basin natural gas producers have identified the Birds Nest aquifer, located in the Parachute Creek Member of the Green River Formation, as the most promising reservoir suitable for large-volume saline water disposal. This aquifer, ranging in thickness from less than 100 feet on the basin margins to greater than 300 feet in the basin's depocenter, formed from the dissolution of saline minerals which left behind large open cavities and fractured rock. Understanding the aquifer's areal extent, thickness, water chemistry, and zones of differential dissolution will help determine possible saline water disposal volumes and safe disposal practices, both of which could directly impact the success of increased hydrocarbon production in the region.

The Birds Nest aquifer is typically several hundred feet above the richest oil shale interval called the Mahogany zone. A significant concern is that saline water disposal into the Birds Nest by conventional gas producers could hinder oil shale development by creating unforeseen water disposal problems.

RESEARCH / DELIVERABLES

- Conduct comprehensive literature review and historic data collection.
- Evaluate the Birds Nest aquifer in core:
  - 20 wells have been identified as having all or part of the Birds Nest captured in core.
  - 10 cores have been examined to date (see map on panel 2).
- Evaluate the Birds Nest aquifer on outcrop:
  - Good outcrop exposures can be found on the eastern side of the basin.
- Evaluate the Birds Nest aquifer on geophysical log.
- Determine how disposal into the Birds Nest aquifer could affect future oil shale development.
- Evaluate the oil shale resource within the Birds Nest interval.
- Determine how gilsonite veins might influence water flow and saline mineral dissolution.
- Create a GIS database and maps showing:
  - Outcrop,
  - Thickness,
  - Lateral extent,
  - Water quality, and
  - Interburden between Birds Nest and "economic" oil shale zones.

PRELIMINARY CONCLUSIONS

- The southern portion of the Birds Nest aquifer contains much smaller saline mineral crystals (<1 inch) as compared to the large (up to 1 foot) nodules found near the basin's depocenter.
  - This transition occurs at about Township 10 South.
- Gilsonite veins seem to influence ground-water flow in the Birds Nest aquifer, in some cases creating barriers to flow.
  - A gilsonite vein runs between the two nearby cores displayed with this poster.
  - The core to the south (Utah State 13X-2) shows significant saline mineral dissolution, whereas the core to the north (Utah State 1) shows no saline mineral dissolution.
- Gilsonite took advantage of a pre-existing northwest-trending joint/fracture system; some joints/fractures may not be filled with gilsonite and could provide pathways for vertical water movement.
- There is potential for vertical water movement along the gilsonite rock interface.
  - Often the gilsonite nearest the host rock displays highly pencilated fractures.
- Saline water disposal into the Birds Nest aquifer should be accompanied by down-dip water monitoring in aquifers both above and below the disposal unit.
- The northern and western extent of the Birds Nest aquifer is poorly understood due to lack of core from those areas.

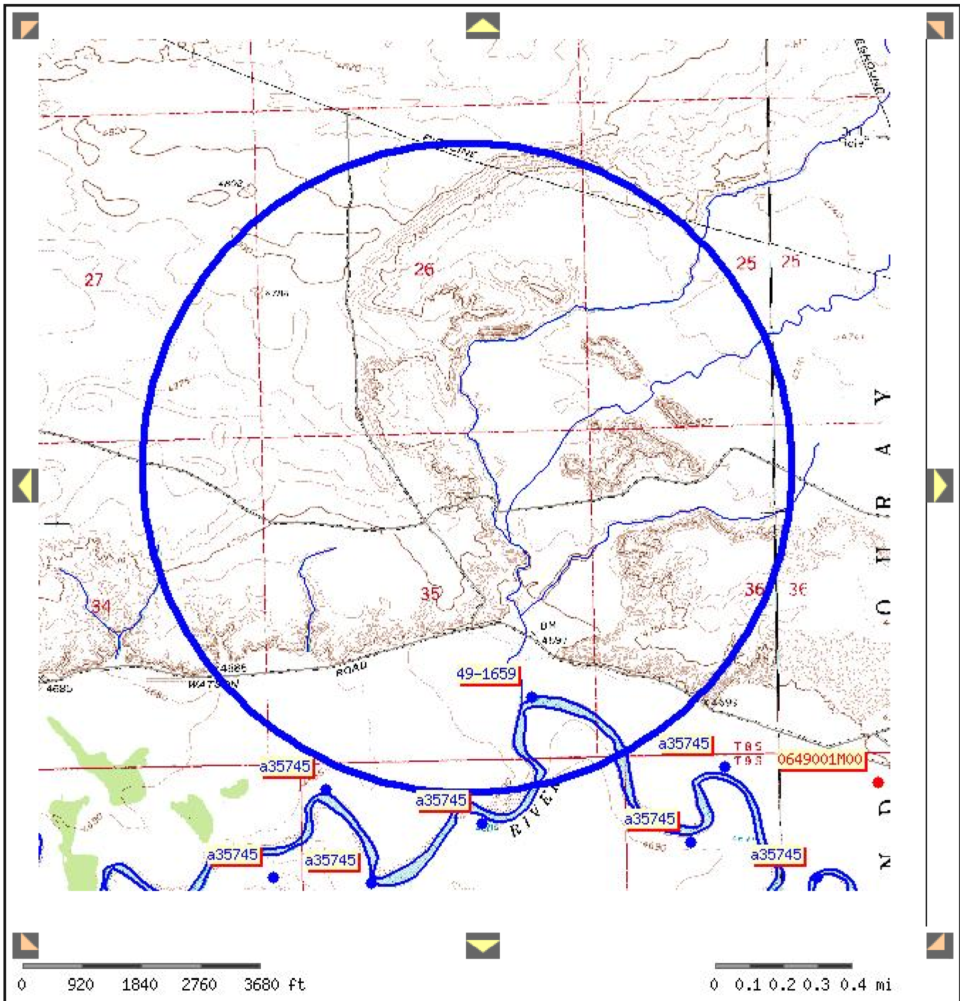
Appendix F3

Utah Division of Water Rights - Water Well Survey

1 Mile Search Radius Surrounding Wonsit Disposal Area

utah gov | Online Services | Agency List | Business | Search

Utah Division of Water Rights



Zoom In Mode Map Tools

Display	Layer Name
☑	Points of Diversion
☑	POD Labels
☐	Digitized Place of Use
☐	National Historic Sites
☐	National Historic Sites Labels
☐	Counties
☐	Public Land Survey System
☑	Rivers and Streams
☑	Roads
☐	Water Right Areas
☐	Adjudication Books
☐	County Parcels (As Available)
☐	County Parcel Labels
☐	Duty

Topographic Maps **Base Map**

Legend

- ● UNDERGROUND
- ● SURFACE
- ● SPRING
- ● POINT TO POINT
- ● REDIVERSION
- Search Area
- Primary Route
- Secondary
- Rural Roads
- Minor Roads
- Stream
- Ditch or Canal
- Wash or Ephemeral Drain
- Intermittent Stream
- Aqueduct

utah gov | Online Services | Agency List | Business

Search

Utah Division of Water Rights

Search Radius: 5280 ft.

From the NE corner South 600 West 2000 section 35 township 8S range 21E SLbm

WR Number	Diversion Type	Well Log	Location	Status	Priority	Uses	CFS	ACFT	Address	Owner Name
49-1659	Surface		N1000 W1100 SE 35 8S 21E SL	A	20020515	O	0.000	10.000	DERK PRICE (OWNER)	PRICE WATER PUMPING INC.

Utah Division of Water Rights | 1594 West North Temple Suite 220, P.O. Box 146300, Salt Lake City, Utah 84114-6300 | 801-538-7240
Natural Resources | Contact | Disclaimer | Privacy Policy | Accessibility Policy | Emergency Evacuation Plan

utah gov | Online Services | Agency List | Business

Search

Utah Division of Water Rights

Select Related Information

```
      (WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 02/21/2013
WATER RIGHT: 49-1659      APPLICATION/CLAIM NO.: F73703      CERT. NO.:
CHANGES: a35745     Approved
==================================================================================================================================
OWNERSHIP************************************************************************************************************************
==================================================================================================================================

NAME: Price Water Pumping Inc.
ADDR: Derk Price (Owner)
      P.O. Box 1763
      Vernal UT 84078
==================================================================================================================================
DATES, ETC.**********************************************************************************************************************
==================================================================================================================================
LAND OWNED BY APPLICANT? No                        COUNTY TAX ID#:
FILED:     05/15/2002|PRIORITY:  05/15/2002|PUB BEGAN: 05/29/2002|PUB ENDED: 06/05/2002|NEWSPAPER:  Vernal Express
ProtestEnd:06/25/2002|PROTESTED: [No      ]|HEARNG HLD:          |SE ACTION: [Approved]|ActionDate:12/27/2002|PROOF DUE:  12/31/2014
EXTENSION:           |ELEC/PROOF:[        ]|ELEC/PROOF:          |CERT/WUC:             |LAP, ETC:  12/31/2014|LAPS LETTER:
RUSH LETTR:          |RENOVATE:            |RECON REQ:           |TYPE: [              ]
PD BOOK: [  49-     ]|MAP:  [              ]|PUB DATE:
*TYPE -- DOCUMENT -- STATUS-------------------------------------------------------------------------------------------------------*
Type of Right: Fixed-Time Application         Source of Info: Application to Appropriate    Status: Approved
==================================================================================================================================
LOCATION OF WATER RIGHT***(Points of Diversion: Click on Location to access PLAT Program.)*********MAP VIEWER***GOOGLE VIEW*
==================================================================================================================================
FLOW: 10.0 acre-feet                                 SOURCE: Green River and White River
COUNTY: Uintah       COMMON DESCRIPTION: Near Ouray

POINTS OF DIVERSION -- SURFACE:
(1)  N  750 ft W 1000 ft from S4 cor, Sec 27, T  8S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  Green River
(2)  N 1200 ft W 1000 ft from SE cor, Sec 32, T  8S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  Green River
(3)  N 2000 ft W 1200 ft from E4 cor, Sec 33, T  8S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  Green River
(4)  S  100 ft W 2300 ft from N4 cor, Sec 34, T  8S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  Green River
(5)  N 1000 ft W 1100 ft from SE cor, Sec 35, T  8S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(6)  N  800 ft E 1200 ft from W4 cor, Sec 01, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(7)  N  900 ft W 1700 ft from E4 cor, Sec 01, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(8)  N  800 ft W 2000 ft from E4 cor, Sec 02, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(9)  N  900 ft E 1100 ft from W4 cor, Sec 02, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(10) N  900 ft E 1000 ft from W4 cor, Sec 03, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(11) S 2000 ft E  200 ft from N4 cor, Sec 03, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(12) S 1000 ft E   50 ft from NW cor, Sec 04, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  Green River
(13) S 1800 ft E  900 ft from N4 cor, Sec 04, T  9S, R 20E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(14) N 1300 ft E 1000 ft from W4 cor, Sec 01, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(15) S  200 ft W 1000 ft from N4 cor, Sec 01, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(16) S 2000 ft E  500 ft from N4 cor, Sec 01, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White RIver
(17) N  700 ft E 1100 ft from W4 cor, Sec 02, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(18) S  400 ft E  400 ft from NW cor, Sec 02, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(19) S 1000 ft E  300 ft from N4 cor, Sec 02, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(20) N  800 ft W  500 ft from E4 cor, Sec 03, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(21) S 1200 ft E  500 ft from NW cor, Sec 03, T  9S, R 21E, SLBM
      Diverting Works:  Pump in River                                      Source:  White River
(22) N  400 ft W 2300 ft from E4 cor, Sec 04, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(23) S  400 ft E 2000 ft from W4 cor, Sec 04, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(24) S  800 ft W  700 ft from NE cor, Sec 04, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(25) S  900 ft E  300 ft from W4 cor, Sec 04, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(26) N  200 ft E 2000 ft from W4 cor, Sec 05, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(27) N  900 ft E 1000 ft from W4 cor, Sec 05, T  9S, R 21E, SLBM
      Diverting Works:  Pump in River                                      Source:  White River
(28) S  100 ft W 1300 ft from E4 cor, Sec 05, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
(29) N  300 ft W 1400 ft from E4 cor, Sec 06, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                      Source:  White River
```

```
(30) S  600 ft E  900 ft from NW cor, Sec 06, T  9S, R 21E, SLBM
      Diverting Works:  Pump in river                                     Source:  White River
(31) S  800 ft E  800 ft from W4 cor, Sec 06, T  9S, R 22E, SLBM
      Diverting Works:  Pump in river                                     Source:  White River

Stream Alt Required?: No
===================================================================================================================================
USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
===================================================================================================================================
SUPPLEMENTAL GROUP NO.: 226252.

...................................................................................................................................
  OIL EXPLORATION:    Water will be used in the drilling process of gas wells.                    PERIOD OF USE: 01/01 TO 12/31
                Acre Feet Contributed by this Right for this Use: 10.0
Fixed Time = 5 years
...................................................................................................................................
  ###PLACE OF USE:       *-------NORTH WEST QUARTER------*-------NORTH EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST
                         *  NW   |  NE   |  SW   |  SE   *  NW   |  NE   |  SW   |  SE   *  NW   |  NE   |  SW   |  SE   *  NW   |  NE   |
 Sec 33 T  8S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 34 T  8S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 35 T  8S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 36 T  8S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 31 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 32 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 33 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 34 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 35 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 36 T  8S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 01 T  9S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 02 T  9S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 03 T  9S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 04 T  9S R 20E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 01 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 02 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 03 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 04 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 05 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 06 T  9S R 21E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
 Sec 06 T  9S R 22E SLBM *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X      |X      *X      |X      |X
                                                                                                                                         GROUP
===================================================================================================================================
OTHER COMMENTS*********************************************************************************************************************
===================================================================================================================================
     Each point of diversion will be used during the drilling of near by gas wells.
     Upon completion of the driling process, pumps and hoses will be moved to
     another point of diversion.
===================================================================================================================================
APPLICATIONS FOR EXTENSIONS OF TIME WITHIN WHICH TO SUBMIT PROOF*******************************************************************
===================================================================================================================================
FILED:     10/11/2007|PUB BEGAN:           |PUB ENDED:           |NEWSPAPER: No Adv Required
ProtestEnd:          |PROTESTED: [No      ]|HEARNG HLD:          |SE ACTION: [Approved]|ActionDate:03/24/2008|PROOF DUE:  12/31/2014
===================================================================================================================================
***********************************************************************************************************************************
*******************************************************E N D   O F   D A T A*******************************************************
***********************************************************************************************************************************
```

Appendix F4

Groundwater Elevation and Seepage Velocity Calculations

Estimated Seepage Velocity Calculations for Soil and Bedrock

Sample Id	Hydraulic Conductivity		Estimated porosity	Assumed Gradient	Groundwater Seepage Velocity	
Bedrock	**cm/sec**	**ft/day**		**ft/ft**	**ft/day**	**ft/yr**
B-1 @ 17.5 ft bgs	1.71E-07	4.85E-04				
B-3 @ 20 ft bgs	1.88E-05	5.33E-02				
Average	9.49E-06	2.69E-02	0.20			
				0.001	0.0001	0.05
				0.01	0.001	0.5
				0.1	0.01	5
				1	0.13	50
Soil						
MW-4 @ 5 ft bgs	3.83E-04	1.09E+00				
MW-8 @10 ft bgs	5.86E-04	1.66E+00				
Average	4.85E-04	1.37E+00	0.25			
				0.001	0.0055	2.0
				0.01	0.055	20
				0.1	0.55	200

Groundwater Elevation Calculations

Well ID	Top of Casing Elevation ft NVGD 88	Ground Surface Elevation ft NVGD 88	Total Well Depth BGS [1] ft	Water Elevation ft NVGD 88	Notes
MW1	4722.15	4720.55	28.5	<4692.05	
MW2	Casing is broken	4715.75	20.3	<4695.45	Casing is broken
MW3	Area Flooded	Area Flooded	22.6	NA	Area flooded during spring 2013 surveying. Could not survey TOC or GS.
MW4	4711.39	4708.44	16.5	<4691.94	
MW5	4715.45	4712.66	21.5	<4691.16	
MW8	4702.7	4704.46	21.5	<4682.96	
100 year flood elevation [2]		4702.7			
Top of Pond 9 Berm NE corner		4728.24			
Estimated lowest elevation of waste		4712.24			

Depth to groundwater beneath the waste is projected to be greater than 20 feet for April 22, 2013. Estimate based on well data from MW4.

Notes:

1. BGS = Below ground surface

2. 100 year flood elevation located nearest to Landfill Cell #1 per FEMA FIRM Map.

Appendix G

Landfill Design

Appendix G1

Water Balance Modeling

Phase I Water Balance Modeling

Water Balance for Phase I

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              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\WONSIT4.D4
TEMPERATURE DATA FILE:      C:\HELP3\WONSIT7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\WONSIT13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\WONSIT11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\PHASEI.D10
OUTPUT DATA FILE:           C:\HELP3\WonsitO.OUT



TIME:  17:56     DATE:   4/10/2013



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

     TITLE:  Wonsit Landfill

******************************************************************************
```

```
NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
         COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  11
      THICKNESS                   =    120.00   INCHES
      POROSITY                    =      0.4640 VOL/VOL
      FIELD CAPACITY              =      0.3100 VOL/VOL
      WILTING POINT               =      0.1870 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.3111 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 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   3
      THICKNESS                   =     18.00   INCHES
      POROSITY                    =      0.4570 VOL/VOL
      FIELD CAPACITY              =      0.0830 VOL/VOL
      WILTING POINT               =      0.0330 VOL/VOL
      INITIAL SOIL WATER CONTENT  =      0.0903 VOL/VOL
      EFFECTIVE SAT. HYD. COND.   =  0.310000009000E-02 CM/SEC
```

```
                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.19   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   10.0000000000     CM/SEC
SLOPE                       =      1.00   PERCENT
DRAINAGE LENGTH             =    500.0    FEET


                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

```
                        LAYER  5
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   4
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.1050 VOL/VOL
WILTING POINT                =      0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1050 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.170000002000E-02 CM/SEC
SLOPE                        =      1.00   PERCENT
DRAINAGE LENGTH              =    500.0    FEET



                        LAYER  6
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  29
THICKNESS                    =    600.00   INCHES
POROSITY                     =      0.4510 VOL/VOL
FIELD CAPACITY               =      0.4190 VOL/VOL
WILTING POINT                =      0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.680000028000E-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 BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  1.% AND
          A SLOPE LENGTH OF  500. FEET.

SCS RUNOFF CURVE NUMBER             =     94.30
FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      5.700  ACRES
EVAPORATIVE ZONE DEPTH              =      4.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      0.942  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      1.856  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.748  INCHES
INITIAL SNOW WATER                  =      0.103  INCHES
INITIAL WATER IN LAYER MATERIALS    =    310.185  INCHES
TOTAL INITIAL WATER                 =    310.287  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SALT LAKE CITY        UTAH

     STATION LATITUDE                        =  40.76 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   1.00
     START OF GROWING SEASON (JULIAN DATE)   =    117
     END OF GROWING SEASON (JULIAN DATE)     =    289
     EVAPORATIVE ZONE DEPTH                  =   4.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   8.80 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  48.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  39.00 %
```

```
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  65.00 %


         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    SALT LAKE CITY      UTAH

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
       0.52        0.14        0.37        0.71        0.55        0.70
       0.53        0.54        0.69        1.00        0.26        0.86


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    SALT LAKE CITY      UTAH

             NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      13.70       24.80       40.10       50.30       60.20       69.60
      77.70       73.00       62.90       50.10       36.70       18.20


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    SALT LAKE CITY      UTAH
                    AND STATION LATITUDE  =  40.76 DEGREES



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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.17    0.07    0.33    0.32    0.27    0.30
                                 0.36    0.95    0.60    1.76    0.21    0.88

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.273   0.121   0.174   0.396   0.391   0.319
                                 0.368   1.023   0.527   1.045   0.604   0.646

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0128  0.0315  0.0282  0.0237
  FROM LAYER  3                  0.0224  0.0197  0.0178  0.0163  0.0116  0.0003

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0001  0.0002  0.0002  0.0001
  LAYER  4                       0.0001  0.0001  0.0001  0.0001  0.0001  0.0000

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  5                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0001  0.0002  0.0002  0.0001
  LAYER  6                       0.0001  0.0001  0.0001  0.0001  0.0001  0.0000


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.001   0.001   0.001
  TOP OF LAYER  4                0.001   0.001   0.001   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
```

```
  HEAD ON TOP OF LAYER  4        0.000   0.000   0.000   0.000   0.000   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  6                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  6        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            6.22         128698.023    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       5.885        121760.680     94.61

  DRAINAGE COLLECTED FROM LAYER  3         0.1842         3811.318      2.96

  PERC./LEAKAGE THROUGH LAYER  4           0.001089         22.541      0.02

  AVG. HEAD ON TOP OF LAYER  4             0.0004

  DRAINAGE COLLECTED FROM LAYER  5         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  6           0.001089         22.541      0.02

  AVG. HEAD ON TOP OF LAYER  6             0.0000

  CHANGE IN WATER STORAGE                  0.150          3103.523      2.41
```

```
  SOIL WATER AT START OF YEAR            310.815       6431063.500

  SOIL WATER AT END OF YEAR              310.965       6434167.000

  SNOW WATER AT START OF YEAR              0.103          2123.357      1.65

  SNOW WATER AT END OF YEAR                0.103          2123.357      1.65

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.047      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    2
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.18    0.20    0.44    0.41    0.73    0.69
                                 0.29    1.68    0.61    0.78    0.18    0.70

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.213   0.270   0.382   0.326   0.567   1.091
                                 0.302   1.562   0.360   0.338   0.362   0.580

LATERAL DRAINAGE COLLECTED       0.0000  0.0230  0.0637  0.0482  0.0397  0.0179
  FROM LAYER  3                  0.0410  0.0337  0.0060  0.0333  0.0398  0.0145

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0001  0.0003  0.0002  0.0002  0.0001
```

```
  LAYER  4                      0.0002  0.0002  0.0000  0.0002  0.0002  0.0001

LATERAL DRAINAGE COLLECTED      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  5                 0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH     0.0000  0.0001  0.0003  0.0002  0.0002  0.0001
  LAYER  6                      0.0002  0.0002  0.0000  0.0002  0.0002  0.0001


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON           0.000   0.001   0.002   0.001   0.001   0.001
  TOP OF LAYER  4               0.001   0.001   0.000   0.001   0.001   0.000

STD. DEVIATION OF DAILY         0.000   0.001   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  4       0.000   0.000   0.000   0.001   0.000   0.000

AVERAGE DAILY HEAD ON           0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  6               0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY         0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  6       0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                        INCHES         CU. FEET     PERCENT
                                       --------       ----------    -------
  PRECIPITATION                           6.89        142561.016    100.00
```

```
  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       6.354        131465.922     92.22

  DRAINAGE COLLECTED FROM LAYER  3         0.3607         7462.531      5.23

  PERC./LEAKAGE THROUGH LAYER  4           0.001827         37.798      0.03

  AVG. HEAD ON TOP OF LAYER  4             0.0009

  DRAINAGE COLLECTED FROM LAYER  5         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  6           0.001827         37.798      0.03

  AVG. HEAD ON TOP OF LAYER  6             0.0000

  CHANGE IN WATER STORAGE                  0.174          3594.665      2.52

  SOIL WATER AT START OF YEAR            310.965       6434167.000

  SOIL WATER AT END OF YEAR              311.204       6439119.500

  SNOW WATER AT START OF YEAR              0.103          2123.357      1.49

  SNOW WATER AT END OF YEAR                0.037           765.644      0.54

  ANNUAL WATER BUDGET BALANCE              0.0000            0.093      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    3
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.11    0.08    0.38    0.32    0.16    1.50
                                 0.33    0.67    0.13    0.47    0.05    0.88

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.147   0.074   0.248   0.258   0.345   1.339
                                 0.374   0.397   0.403   0.141   0.248   0.293

LATERAL DRAINAGE COLLECTED       0.0000  0.0490  0.0743  0.0475  0.0500  0.0401
  FROM LAYER  3                  0.0307  0.0010  0.0000  0.0169  0.1444  0.0933

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0002  0.0003  0.0002  0.0002  0.0002
  LAYER  4                       0.0002  0.0000  0.0000  0.0001  0.0005  0.0004

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  5                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0002  0.0003  0.0002  0.0002  0.0002
  LAYER  6                       0.0002  0.0000  0.0000  0.0001  0.0005  0.0004


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.000   0.002   0.002   0.001   0.001   0.001
  TOP OF LAYER  4                0.001   0.000   0.000   0.000   0.004   0.003
```

```
STD. DEVIATION OF DAILY          0.000   0.001   0.000   0.001   0.000   0.000
  HEAD ON TOP OF LAYER  4        0.000   0.000   0.000   0.001   0.001   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  6                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  6        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    3
-------------------------------------------------------------------------------
                                         INCHES         CU. FEET     PERCENT
                                        --------       ----------    -------
  PRECIPITATION                            5.08        105110.273    100.00

  RUNOFF                                   0.000            0.000      0.00

  EVAPOTRANSPIRATION                       4.267         88292.734     84.00

  DRAINAGE COLLECTED FROM LAYER  3         0.5473        11325.145     10.77

  PERC./LEAKAGE THROUGH LAYER  4           0.002409         49.840      0.05

  AVG. HEAD ON TOP OF LAYER  4             0.0013

  DRAINAGE COLLECTED FROM LAYER  5         0.0000           0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  6           0.002409         49.840      0.05

  AVG. HEAD ON TOP OF LAYER  6             0.0000

  CHANGE IN WATER STORAGE                  0.263          5442.221      5.18
```

```
  SOIL WATER AT START OF YEAR            311.204       6439119.500

  SOIL WATER AT END OF YEAR              310.917       6433178.000

  SNOW WATER AT START OF YEAR              0.037           765.644      0.73

  SNOW WATER AT END OF YEAR                0.587         12149.077     11.56

  ANNUAL WATER BUDGET BALANCE              0.0000            0.328      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    4
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                     0.89    0.24    0.41    0.89    0.85    0.35
                                  0.47    0.78    0.50    0.92    0.19    0.98

RUNOFF                            0.000   0.000   0.000   0.000   0.000   0.000
                                  0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION                0.518   0.564   0.823   0.405   1.003   0.301
                                  0.539   0.619   0.661   0.718   0.190   0.497

LATERAL DRAINAGE COLLECTED        0.0667  0.0485  0.0422  0.0337  0.0245  0.0151
  FROM LAYER  3                   0.0000  0.0000  0.0113  0.1426  0.1454  0.0371
```

```
PERCOLATION/LEAKAGE THROUGH      0.0003  0.0002  0.0002  0.0002  0.0001  0.0001
  LAYER  4                       0.0000  0.0000  0.0001  0.0005  0.0005  0.0002

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  5                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0003  0.0002  0.0002  0.0002  0.0001  0.0001
  LAYER  6                       0.0000  0.0000  0.0001  0.0005  0.0005  0.0002


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.002   0.001   0.001   0.001   0.001   0.000
  TOP OF LAYER  4                0.000   0.000   0.000   0.004   0.004   0.001

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  4        0.000   0.000   0.000   0.003   0.001   0.001

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  6                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  6        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            7.47         154561.766    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       6.838        141494.406     91.55

  DRAINAGE COLLECTED FROM LAYER  3         0.5671        11733.776      7.59

  PERC./LEAKAGE THROUGH LAYER  4           0.002474         51.198      0.03

  AVG. HEAD ON TOP OF LAYER  4             0.0014

  DRAINAGE COLLECTED FROM LAYER  5         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  6           0.002474         51.198      0.03

  AVG. HEAD ON TOP OF LAYER  6             0.0000

  CHANGE IN WATER STORAGE                  0.062          1282.587      0.83

  SOIL WATER AT START OF YEAR            310.917       6433178.000

  SOIL WATER AT END OF YEAR              311.083       6436609.500

  SNOW WATER AT START OF YEAR              0.587         12149.077      7.86

  SNOW WATER AT END OF YEAR                0.483         10000.424      6.47

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.204      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR     5
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.37    0.14    0.47    0.41    0.78    0.68
                                 0.37    0.00    0.88    0.53    0.15    0.49

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.542   0.204   0.340   0.419   0.394   0.742
                                 0.596   0.000   0.829   0.243   0.403   0.292

LATERAL DRAINAGE COLLECTED       0.1591  0.0994  0.0757  0.0495  0.0469  0.0331
  FROM LAYER  3                  0.0056  0.0000  0.0333  0.1096  0.1280  0.0863

PERCOLATION/LEAKAGE THROUGH      0.0006  0.0004  0.0003  0.0002  0.0002  0.0002
  LAYER  4                       0.0000  0.0000  0.0001  0.0004  0.0005  0.0004

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  5                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0006  0.0004  0.0003  0.0002  0.0002  0.0002
  LAYER  6                       0.0000  0.0000  0.0001  0.0004  0.0005  0.0004
```

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-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.005   0.003   0.002   0.001   0.001   0.001
  TOP OF LAYER  4                0.000   0.000   0.001   0.003   0.004   0.002

STD. DEVIATION OF DAILY          0.001   0.000   0.000   0.001   0.000   0.000
  HEAD ON TOP OF LAYER  4        0.000   0.000   0.001   0.002   0.001   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  6                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  6        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    5
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            5.27         109041.555    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       5.005        103548.180     94.96

  DRAINAGE COLLECTED FROM LAYER  3         0.8266        17103.246     15.69

  PERC./LEAKAGE THROUGH LAYER  4           0.003432         71.004      0.07

  AVG. HEAD ON TOP OF LAYER  4             0.0020
```

```
  DRAINAGE COLLECTED FROM LAYER  5          0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  6            0.003432         71.004      0.07

  AVG. HEAD ON TOP OF LAYER  6              0.0000

  CHANGE IN WATER STORAGE                  -0.565        -11680.934    -10.71

  SOIL WATER AT START OF YEAR             311.083       6436609.500

  SOIL WATER AT END OF YEAR               310.866       6432134.000

  SNOW WATER AT START OF YEAR               0.483         10000.424      9.17

  SNOW WATER AT END OF YEAR                 0.135          2795.131      2.56

  ANNUAL WATER BUDGET BALANCE               0.0000            0.058      0.00

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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.34     0.15     0.41     0.47     0.56     0.70
                           0.36     0.82     0.54     0.89     0.16     0.79
```

```
  STD. DEVIATIONS        0.32     0.07     0.05     0.24     0.32     0.48
                         0.07     0.60     0.27     0.52     0.06     0.19

RUNOFF
------
  TOTALS                 0.000    0.000    0.000    0.000    0.000    0.000
                         0.000    0.000    0.000    0.000    0.000    0.000

  STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                         0.000    0.000    0.000    0.000    0.000    0.000

EVAPOTRANSPIRATION
------------------
  TOTALS                 0.339    0.247    0.393    0.361    0.540    0.758
                         0.436    0.720    0.556    0.497    0.361    0.462

  STD. DEVIATIONS        0.181    0.193    0.253    0.068    0.272    0.461
                         0.125    0.599    0.192    0.376    0.160    0.163

LATERAL DRAINAGE COLLECTED FROM LAYER  3
----------------------------------------
  TOTALS                 0.0452   0.0440   0.0537   0.0421   0.0379   0.0260
                         0.0199   0.0109   0.0137   0.0637   0.0938   0.0463

  STD. DEVIATIONS        0.0699   0.0371   0.0265   0.0087   0.0112   0.0105
                         0.0171   0.0153   0.0128   0.0585   0.0634   0.0419

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
  TOTALS                 0.0002   0.0002   0.0002   0.0002   0.0002   0.0001
                         0.0001   0.0001   0.0001   0.0003   0.0004   0.0002

  STD. DEVIATIONS        0.0003   0.0002   0.0001   0.0000   0.0000   0.0001
                         0.0001   0.0001   0.0001   0.0002   0.0002   0.0002

LATERAL DRAINAGE COLLECTED FROM LAYER  5
----------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```

```
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  ------------------------------------
    TOTALS                 0.0002   0.0002   0.0002   0.0002   0.0002   0.0001
                           0.0001   0.0001   0.0001   0.0003   0.0004   0.0002

    STD. DEVIATIONS        0.0003   0.0002   0.0001   0.0000   0.0000   0.0001
                           0.0001   0.0001   0.0001   0.0002   0.0002   0.0002


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
    AVERAGES               0.0013   0.0014   0.0015   0.0012   0.0011   0.0008
                           0.0006   0.0003   0.0004   0.0018   0.0028   0.0013

    STD. DEVIATIONS        0.0020   0.0012   0.0008   0.0003   0.0003   0.0003
                           0.0005   0.0004   0.0004   0.0017   0.0019   0.0012

  DAILY AVERAGE HEAD ON TOP OF LAYER  6
  -------------------------------------
    AVERAGES               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS   1 THROUGH    5
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                   6.19    (   1.026)     127994.5     100.00

 RUNOFF                          0.000   (  0.0000)          0.00      0.000

 EVAPOTRANSPIRATION              5.670   (  1.0356)     117312.38     91.654

 LATERAL DRAINAGE COLLECTED      0.49718 (  0.24110)     10287.203    8.03722
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.00225 (  0.00087)        46.476     0.03631
   LAYER  4

 AVERAGE HEAD ON TOP             0.001 (    0.001)
   OF LAYER  4

 LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)         0.000    0.00000
   FROM LAYER  5

 PERCOLATION/LEAKAGE THROUGH     0.00225 (  0.00087)        46.476     0.03631
   LAYER  6

 AVERAGE HEAD ON TOP             0.000 (    0.000)
   OF LAYER  6

 CHANGE IN WATER STORAGE         0.017   (  0.3328)        348.41      0.272

*******************************************************************************
```

```
******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH    5
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                              0.69         14276.789

      RUNOFF                                     0.000            0.0000

      DRAINAGE COLLECTED FROM LAYER  3           0.00915        189.38101

      PERCOLATION/LEAKAGE THROUGH LAYER  4       0.000030         0.61438

      AVERAGE HEAD ON TOP OF LAYER  4            0.008

      MAXIMUM HEAD ON TOP OF LAYER  4            0.016

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)               19.0 FEET

      DRAINAGE COLLECTED FROM LAYER  5           0.00000          0.00000

      PERCOLATION/LEAKAGE THROUGH LAYER  6       0.000030         0.61438

      AVERAGE HEAD ON TOP OF LAYER  6            0.000

      MAXIMUM HEAD ON TOP OF LAYER  6            0.018

      LOCATION OF MAXIMUM HEAD IN LAYER  5
            (DISTANCE FROM DRAIN)                0.0 FEET

      SNOW WATER                                 1.01         20862.9062


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3732

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1870
```

```
       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.


******************************************************************************
```

```
******************************************************************************

                 FINAL WATER STORAGE AT END OF YEAR    5
    ----------------------------------------------------------------------
                  LAYER        (INCHES)       (VOL/VOL)
                  -----        --------       ---------
                    1           36.8041         0.3067

                    2            2.1986         0.1221

                    3            0.0036         0.0191

                    4            0.0000         0.0000

                    5            0.6300         0.1050

                    6          270.6000         0.4510

                SNOW WATER       0.135

******************************************************************************
******************************************************************************
```

Phase II Water Balance Modeling

(Conceptual Design)

Water Balance for Phase II

```
******************************************************************************
 ******************************************************************************
 **                                                                          **
 **                                                                          **
 **              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\WONSIT4.D4
 TEMPERATURE DATA FILE:      C:\HELP3\WONSIT7.D7
 SOLAR RADIATION DATA FILE:  C:\HELP3\WONSIT13.D13
 EVAPOTRANSPIRATION DATA:    C:\HELP3\WONSIT11.D11
 SOIL AND DESIGN DATA FILE:  C:\HELP3\PHASEII.D10
 OUTPUT DATA FILE:           C:\HELP3\WonsitO.OUT


 TIME:  17:46     DATE:   4/10/2013


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

      TITLE:  Wonsit Landfill

 ******************************************************************************
```

```
NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
         COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                              LAYER  1
                              --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  10
      THICKNESS                    =      6.00   INCHES
      POROSITY                     =      0.3980 VOL/VOL
      FIELD CAPACITY               =      0.2440 VOL/VOL
      WILTING POINT                =      0.1360 VOL/VOL
      INITIAL SOIL WATER CONTENT   =      0.1992 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.



                              LAYER  2
                              --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   6
      THICKNESS                    =      6.00   INCHES
      POROSITY                     =      0.4530 VOL/VOL
      FIELD CAPACITY               =      0.1900 VOL/VOL
      WILTING POINT                =      0.0850 VOL/VOL
      INITIAL SOIL WATER CONTENT   =      0.1900 VOL/VOL
      EFFECTIVE SAT. HYD. COND.    =  0.720000011000E-03 CM/SEC
      SLOPE                        =      5.00   PERCENT
      DRAINAGE LENGTH              =    700.0    FEET
```

```
                        LAYER  3
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  23
THICKNESS                   =    18.00   INCHES
POROSITY                    =     0.4610 VOL/VOL
FIELD CAPACITY              =     0.3600 VOL/VOL
WILTING POINT               =     0.2030 VOL/VOL
INITIAL SOIL WATER CONTENT  =     0.4610 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.900000032000E-05 CM/SEC



                        LAYER  4
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  11
THICKNESS                   =   360.00   INCHES
POROSITY                    =     0.4640 VOL/VOL
FIELD CAPACITY              =     0.3100 VOL/VOL
WILTING POINT               =     0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT  =     0.3120 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC



                        LAYER  5
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   3
THICKNESS                   =    18.00   INCHES
```

```
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.0830 VOL/VOL
WILTING POINT               =      0.0330 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0897 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.310000009000E-02 CM/SEC



                        LAYER  6
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  20
THICKNESS                   =      0.19   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   10.0000000000     CM/SEC
SLOPE                       =      1.00   PERCENT
DRAINAGE LENGTH             =    500.0    FEET



                        LAYER  7
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
```

```
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD



                        LAYER  8
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   4
THICKNESS                   =      6.00   INCHES
POROSITY                    =      0.4370 VOL/VOL
FIELD CAPACITY              =      0.1050 VOL/VOL
WILTING POINT               =      0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.1050 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.170000002000E-02 CM/SEC
SLOPE                       =      1.00   PERCENT
DRAINAGE LENGTH             =    500.0    FEET



                        LAYER  9
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  29
THICKNESS                   =    600.00   INCHES
POROSITY                    =      0.4510 VOL/VOL
FIELD CAPACITY              =      0.4190 VOL/VOL
WILTING POINT               =      0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.680000028000E-06 CM/SEC
```

```
           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
          POOR STAND OF GRASS, A SURFACE SLOPE OF  5.%
          AND A SLOPE LENGTH OF  700. FEET.

SCS RUNOFF CURVE NUMBER             =     89.80
FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      7.200  ACRES
EVAPORATIVE ZONE DEPTH              =      4.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      0.707  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      1.592  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.544  INCHES
INITIAL SNOW WATER                  =      0.103  INCHES
INITIAL WATER IN LAYER MATERIALS    =    395.790  INCHES
TOTAL INITIAL WATER                 =    395.893  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR



            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          SALT LAKE CITY        UTAH

     STATION LATITUDE                       =  40.76 DEGREES
     MAXIMUM LEAF AREA INDEX                =   1.00
     START OF GROWING SEASON (JULIAN DATE)  =    117
     END OF GROWING SEASON (JULIAN DATE)    =    289
     EVAPORATIVE ZONE DEPTH                 =   4.0  INCHES
     AVERAGE ANNUAL WIND SPEED              =   8.80 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  48.00 %
```

```
        AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  39.00 %
        AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  65.00 %


    NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    SALT LAKE CITY      UTAH

             NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
  0.52        0.14        0.37        0.71        0.55        0.70
  0.53        0.54        0.69        1.00        0.26        0.86


    NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    SALT LAKE CITY      UTAH

        NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
 13.70       24.80       40.10       50.30       60.20       69.60
 77.70       73.00       62.90       50.10       36.70       18.20


    NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
             COEFFICIENTS FOR    SALT LAKE CITY      UTAH
               AND STATION LATITUDE  =  40.76 DEGREES
```

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

                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                     0.17    0.07    0.33    0.32    0.27    0.30
                                  0.36    0.95    0.60    1.76    0.21    0.88

RUNOFF                            0.000   0.000   0.000   0.000   0.000   0.000
                                  0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION                0.273   0.114   0.182   0.430   0.425   0.222
                                  0.359   0.990   0.539   0.973   0.533   0.639

LATERAL DRAINAGE COLLECTED        0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  2                   0.0000  0.0000  0.0000  0.0001  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH       0.0000  0.0000  0.0000  0.0000  0.0000  0.0001
  LAYER  3                        0.0000  0.0402  0.0000  0.4462  0.0547  0.0000

LATERAL DRAINAGE COLLECTED        0.0000  0.0000  0.0000  0.0000  0.0117  0.0921
  FROM LAYER  6                   0.0681  0.0473  0.0393  0.0410  0.0341  0.0180

PERCOLATION/LEAKAGE THROUGH       0.0000  0.0000  0.0000  0.0000  0.0000  0.0004
  LAYER  7                        0.0003  0.0002  0.0002  0.0002  0.0002  0.0001

LATERAL DRAINAGE COLLECTED        0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  8                   0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH       0.0000  0.0000  0.0000  0.0000  0.0000  0.0004
  LAYER  9                        0.0003  0.0002  0.0002  0.0002  0.0002  0.0001


------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
```

```
-------------------------------------------------------------------------------

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  3                0.000   0.001   0.000   0.015   0.001   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  3        0.000   0.002   0.000   0.051   0.002   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.003
  TOP OF LAYER  7                0.002   0.001   0.001   0.001   0.001   0.001

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.001   0.000
  HEAD ON TOP OF LAYER  7        0.000   0.000   0.001   0.000   0.000   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  9                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  9        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    1
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            6.22         162565.922    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       5.679        148423.875     91.30

  DRAINAGE COLLECTED FROM LAYER  2         0.0001            3.084      0.00
```

```
  PERC./LEAKAGE THROUGH LAYER  3           0.541343      14148.533      8.70

  AVG. HEAD ON TOP OF LAYER  3             0.0013

  DRAINAGE COLLECTED FROM LAYER  6         0.3517         9190.921      5.65

  PERC./LEAKAGE THROUGH LAYER  7           0.001666         43.538      0.03

  AVG. HEAD ON TOP OF LAYER  7             0.0008

  DRAINAGE COLLECTED FROM LAYER  8         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  9           0.001666         43.538      0.03

  AVG. HEAD ON TOP OF LAYER  9             0.0000

  CHANGE IN WATER STORAGE                  0.188          4905.286      3.02

  SOIL WATER AT START OF YEAR            396.420      10360844.000

  SOIL WATER AT END OF YEAR              396.608      10365749.000

  SNOW WATER AT START OF YEAR              0.103          2682.136      1.65

  SNOW WATER AT END OF YEAR                0.103          2682.136      1.65

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.775      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    2
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.18    0.20    0.44    0.41    0.73    0.69
                                 0.29    1.68    0.61    0.78    0.18    0.70

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.213   0.270   0.410   0.379   0.427   1.105
                                 0.296   1.514   0.371   0.335   0.388   0.584

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  2                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0000  0.0630  0.0423
  LAYER  3                       0.0000  0.1662  0.0001  0.2632  0.0515  0.0000

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0024  0.1456  0.1089  0.0701
  FROM LAYER  6                  0.0316  0.0760  0.0400  0.0024  0.0811  0.0536

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0005  0.0004  0.0003
  LAYER  7                       0.0002  0.0003  0.0002  0.0000  0.0003  0.0003

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  8                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0000  0.0005  0.0004  0.0003
  LAYER  9                       0.0002  0.0003  0.0002  0.0000  0.0003  0.0003


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------
```

```
AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.001   0.001
  TOP OF LAYER  3                0.000   0.003   0.000   0.005   0.001   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.002   0.001
  HEAD ON TOP OF LAYER  3        0.000   0.015   0.000   0.016   0.002   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.004   0.003   0.002
  TOP OF LAYER  7                0.001   0.002   0.001   0.000   0.002   0.002

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.002   0.001   0.001
  HEAD ON TOP OF LAYER  7        0.001   0.000   0.001   0.000   0.001   0.001

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  9                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  9        0.000   0.000   0.000   0.000   0.000   0.000

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                          ANNUAL TOTALS FOR YEAR    2
-------------------------------------------------------------------------------
                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                             6.89         180077.062    100.00

  RUNOFF                                    0.000             0.000      0.00

  EVAPOTRANSPIRATION                        6.291        164432.031     91.31

  DRAINAGE COLLECTED FROM LAYER  2          0.0001            1.366      0.00

  PERC./LEAKAGE THROUGH LAYER  3            0.586379      15325.612      8.51
```

```
  AVG. HEAD ON TOP OF LAYER  3            0.0008

  DRAINAGE COLLECTED FROM LAYER  6        0.6115        15981.826      8.87

  PERC./LEAKAGE THROUGH LAYER  7          0.002604         68.059      0.04

  AVG. HEAD ON TOP OF LAYER  7            0.0015

  DRAINAGE COLLECTED FROM LAYER  8        0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  9          0.002604         68.059      0.04

  AVG. HEAD ON TOP OF LAYER  9            0.0000

  CHANGE IN WATER STORAGE                -0.016          -406.930     -0.23

  SOIL WATER AT START OF YEAR           396.608      10365749.000

  SOIL WATER AT END OF YEAR             396.658      10367057.000

  SNOW WATER AT START OF YEAR             0.103          2682.136      1.49

  SNOW WATER AT END OF YEAR               0.037           967.130      0.54

  ANNUAL WATER BUDGET BALANCE             0.0000            0.723      0.00

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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    3
------------------------------------------------------------------------------
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                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.11    0.08    0.38    0.32    0.16    1.50
                                 0.33    0.67    0.13    0.47    0.05    0.88

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.147   0.074   0.262   0.282   0.367   1.542
                                 0.350   0.416   0.384   0.143   0.274   0.293

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  2                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0032  0.0018  0.0012  0.1272
  LAYER  3                       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

LATERAL DRAINAGE COLLECTED       0.0006  0.0062  0.1489  0.0971  0.0714  0.0507
  FROM LAYER  6                  0.0198  0.0379  0.0576  0.0472  0.0376  0.0329

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0006  0.0004  0.0003  0.0002
  LAYER  7                       0.0001  0.0002  0.0003  0.0002  0.0002  0.0002

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  8                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0006  0.0004  0.0003  0.0002
  LAYER  9                       0.0001  0.0002  0.0003  0.0002  0.0002  0.0002


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.002
```

```
  TOP OF LAYER  3                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.005
  HEAD ON TOP OF LAYER  3        0.000   0.000   0.000   0.000   0.000   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.004   0.003   0.002   0.001
  TOP OF LAYER  7                0.001   0.001   0.002   0.001   0.001   0.001

STD. DEVIATION OF DAILY          0.000   0.000   0.001   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  7        0.001   0.001   0.000   0.000   0.000   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  9                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  9        0.000   0.000   0.000   0.000   0.000   0.000

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



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

                          ANNUAL TOTALS FOR YEAR    3
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            5.08         132770.875    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       4.533        118472.109     89.23

  DRAINAGE COLLECTED FROM LAYER  2         0.0000            0.104      0.00

  PERC./LEAKAGE THROUGH LAYER  3           0.133301       3483.945      2.62

  AVG. HEAD ON TOP OF LAYER  3             0.0002
```

```
  DRAINAGE COLLECTED FROM LAYER  6          0.6078        15885.548     11.96

  PERC./LEAKAGE THROUGH LAYER  7            0.002731         71.383      0.05

  AVG. HEAD ON TOP OF LAYER  7              0.0015

  DRAINAGE COLLECTED FROM LAYER  8          0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  9            0.002731         71.383      0.05

  AVG. HEAD ON TOP OF LAYER  9              0.0000

  CHANGE IN WATER STORAGE                  -0.063         -1658.419     -1.25

  SOIL WATER AT START OF YEAR             396.658      10367057.000

  SOIL WATER AT END OF YEAR               396.045      10351019.000

  SNOW WATER AT START OF YEAR               0.037           967.130      0.73

  SNOW WATER AT END OF YEAR                 0.587         15346.203     11.56

  ANNUAL WATER BUDGET BALANCE               0.0000            0.154      0.00

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




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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    4
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
```

```
                                ------- ------- ------- ------- ------- -------

PRECIPITATION                    0.89    0.24    0.41    0.89    0.85    0.35
                                 0.47    0.78    0.50    0.92    0.19    0.98

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.518   0.564   0.280   0.777   0.745   0.456
                                 0.539   0.634   0.646   0.658   0.190   0.497

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0002  0.0001  0.0000  0.0000
  FROM LAYER  2                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.5194  0.3909  0.0011  0.0000
  LAYER  3                       0.0000  0.0000  0.0000  0.2623  0.0000  0.0000

LATERAL DRAINAGE COLLECTED       0.0284  0.0235  0.0217  0.0194  0.0176  0.0046
  FROM LAYER  6                  0.0000  0.0000  0.0000  0.0259  0.1794  0.0773

PERCOLATION/LEAKAGE THROUGH      0.0002  0.0001  0.0001  0.0001  0.0001  0.0000
  LAYER  7                       0.0000  0.0000  0.0000  0.0001  0.0006  0.0003

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  8                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0002  0.0001  0.0001  0.0001  0.0001  0.0000
  LAYER  9                       0.0000  0.0000  0.0000  0.0001  0.0006  0.0003


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.000   0.000   0.021   0.012   0.000   0.000
  TOP OF LAYER  3                0.000   0.000   0.000   0.004   0.000   0.000
```

```
STD. DEVIATION OF DAILY          0.000   0.000   0.069   0.053   0.000   0.000
  HEAD ON TOP OF LAYER  3        0.000   0.000   0.000   0.013   0.000   0.000

AVERAGE DAILY HEAD ON            0.001   0.001   0.001   0.001   0.001   0.000
  TOP OF LAYER  7                0.000   0.000   0.000   0.001   0.005   0.002

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  7        0.000   0.000   0.000   0.001   0.001   0.001

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  9                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  9        0.000   0.000   0.000   0.000   0.000   0.000

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



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

                          ANNUAL TOTALS FOR YEAR    4
-------------------------------------------------------------------------------
                                         INCHES         CU. FEET     PERCENT
                                        --------       ----------    -------
  PRECIPITATION                           7.47         195235.906    100.00

  RUNOFF                                  0.000             0.000      0.00

  EVAPOTRANSPIRATION                      6.504        169985.141     87.07

  DRAINAGE COLLECTED FROM LAYER  2        0.0003            7.043      0.00

  PERC./LEAKAGE THROUGH LAYER  3          1.173775      30677.781     15.71

  AVG. HEAD ON TOP OF LAYER  3            0.0030

  DRAINAGE COLLECTED FROM LAYER  6        0.3977        10395.256      5.32
```

```
  PERC./LEAKAGE THROUGH LAYER  7           0.001795         46.925      0.02

  AVG. HEAD ON TOP OF LAYER  7             0.0010

  DRAINAGE COLLECTED FROM LAYER  8         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  9           0.001795         46.925      0.02

  AVG. HEAD ON TOP OF LAYER  9             0.0000

  CHANGE IN WATER STORAGE                  0.566         14802.168      7.58

  SOIL WATER AT START OF YEAR            396.045      10351019.000

  SOIL WATER AT END OF YEAR              396.715      10368536.000

  SNOW WATER AT START OF YEAR              0.587         15346.203      7.86

  SNOW WATER AT END OF YEAR                0.483         12632.115      6.47

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.624      0.00

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




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

                  MONTHLY TOTALS (IN INCHES) FOR YEAR    5
-------------------------------------------------------------------------------

                                JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                ------- ------- ------- ------- ------- -------
```

```
PRECIPITATION                    0.37    0.14    0.47    0.41    0.78    0.68
                                 0.37    0.00    0.88    0.53    0.15    0.49

RUNOFF                           0.000   0.000   0.000   0.000   0.000   0.000
                                 0.000   0.000   0.000   0.000   0.000   0.000

EVAPOTRANSPIRATION               0.542   0.204   0.349   0.436   0.417   0.539
                                 0.737   0.001   0.818   0.266   0.380   0.293

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  2                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0000  0.0000  0.0816  0.0136  0.3830  0.0000
  LAYER  3                       0.0001  0.0000  0.0623  0.0000  0.0000  0.0000

LATERAL DRAINAGE COLLECTED       0.0639  0.0697  0.2036  0.1241  0.0913  0.0967
  FROM LAYER  6                  0.0216  0.0067  0.0636  0.1433  0.1365  0.0898

PERCOLATION/LEAKAGE THROUGH      0.0003  0.0003  0.0007  0.0005  0.0004  0.0004
  LAYER  7                       0.0001  0.0000  0.0003  0.0005  0.0005  0.0004

LATERAL DRAINAGE COLLECTED       0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
  FROM LAYER  8                  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000

PERCOLATION/LEAKAGE THROUGH      0.0003  0.0003  0.0007  0.0005  0.0004  0.0004
  LAYER  9                       0.0001  0.0000  0.0003  0.0005  0.0005  0.0004


-------------------------------------------------------------------------------
                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


AVERAGE DAILY HEAD ON            0.000   0.000   0.001   0.000   0.005   0.000
  TOP OF LAYER  3                0.000   0.000   0.001   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.002   0.000   0.014   0.000
  HEAD ON TOP OF LAYER  3        0.000   0.000   0.002   0.000   0.000   0.000
```

```
AVERAGE DAILY HEAD ON            0.002   0.002   0.006   0.004   0.003   0.003
  TOP OF LAYER  7                0.001   0.000   0.002   0.004   0.004   0.003

STD. DEVIATION OF DAILY          0.000   0.001   0.002   0.001   0.002   0.000
  HEAD ON TOP OF LAYER  7        0.001   0.000   0.002   0.002   0.001   0.000

AVERAGE DAILY HEAD ON            0.000   0.000   0.000   0.000   0.000   0.000
  TOP OF LAYER  9                0.000   0.000   0.000   0.000   0.000   0.000

STD. DEVIATION OF DAILY          0.000   0.000   0.000   0.000   0.000   0.000
  HEAD ON TOP OF LAYER  9        0.000   0.000   0.000   0.000   0.000   0.000

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



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

                          ANNUAL TOTALS FOR YEAR    5
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            5.27         137736.703    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       4.982        130217.062     94.54

  DRAINAGE COLLECTED FROM LAYER  2         0.0000            0.675      0.00

  PERC./LEAKAGE THROUGH LAYER  3           0.540643      14130.246     10.26

  AVG. HEAD ON TOP OF LAYER  3             0.0007

  DRAINAGE COLLECTED FROM LAYER  6         1.1109        29034.016     21.08

  PERC./LEAKAGE THROUGH LAYER  7           0.004413        115.330      0.08
```

```
  AVG. HEAD ON TOP OF LAYER  7             0.0027

  DRAINAGE COLLECTED FROM LAYER  8         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  9           0.004413        115.330      0.08

  AVG. HEAD ON TOP OF LAYER  9             0.0000

  CHANGE IN WATER STORAGE                -0.828        -21630.240    -15.70

  SOIL WATER AT START OF YEAR           396.715      10368536.000

  SOIL WATER AT END OF YEAR             396.235      10356007.000

  SNOW WATER AT START OF YEAR             0.483         12632.115      9.17

  SNOW WATER AT END OF YEAR               0.135          3530.691      2.56

  ANNUAL WATER BUDGET BALANCE             0.0000            -0.137      0.00
********************************************************************************




********************************************************************************
         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH    5
--------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.34     0.15     0.41     0.47     0.56     0.70
```

```
                        0.36     0.82     0.54     0.89     0.16     0.79

  STD. DEVIATIONS       0.32     0.07     0.05     0.24     0.32     0.48
                        0.07     0.60     0.27     0.52     0.06     0.19

RUNOFF
------
  TOTALS                0.000    0.000    0.000    0.000    0.000    0.000
                        0.000    0.000    0.000    0.000    0.000    0.000

  STD. DEVIATIONS       0.000    0.000    0.000    0.000    0.000    0.000
                        0.000    0.000    0.000    0.000    0.000    0.000

EVAPOTRANSPIRATION
------------------
  TOTALS                0.339    0.245    0.296    0.461    0.476    0.773
                        0.456    0.711    0.551    0.475    0.353    0.461

  STD. DEVIATIONS       0.181    0.194    0.087    0.187    0.152    0.538
                        0.182    0.574    0.188    0.337    0.130    0.162

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS       0.0000   0.0000   0.0001   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS                0.0000   0.0000   0.1208   0.0812   0.0897   0.0339
                        0.0000   0.0413   0.0125   0.1944   0.0213   0.0000

  STD. DEVIATIONS       0.0000   0.0000   0.2255   0.1732   0.1662   0.0552
                        0.0000   0.0720   0.0279   0.1926   0.0291   0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER  6
```

```
  ----------------------------------------
    TOTALS                 0.0186   0.0199   0.0753   0.0773   0.0602   0.0628
                           0.0282   0.0336   0.0401   0.0519   0.0937   0.0543

    STD. DEVIATIONS        0.0281   0.0295   0.0945   0.0644   0.0437   0.0374
                           0.0251   0.0310   0.0248   0.0539   0.0633   0.0299

  PERCOLATION/LEAKAGE THROUGH LAYER  7
  ------------------------------------
    TOTALS                 0.0001   0.0001   0.0003   0.0003   0.0003   0.0003
                           0.0001   0.0002   0.0002   0.0002   0.0004   0.0003

    STD. DEVIATIONS        0.0001   0.0001   0.0003   0.0002   0.0002   0.0002
                           0.0001   0.0001   0.0001   0.0002   0.0002   0.0001

  LATERAL DRAINAGE COLLECTED FROM LAYER  8
  ----------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  9
  ------------------------------------
    TOTALS                 0.0001   0.0001   0.0003   0.0003   0.0003   0.0003
                           0.0001   0.0002   0.0002   0.0002   0.0004   0.0003

    STD. DEVIATIONS        0.0001   0.0001   0.0003   0.0002   0.0002   0.0002
                           0.0001   0.0001   0.0001   0.0002   0.0002   0.0001


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  3
```

```
  -------------------------------------
    AVERAGES               0.0000   0.0000   0.0044   0.0025   0.0013   0.0005
                           0.0000   0.0008   0.0002   0.0046   0.0003   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0090   0.0054   0.0024   0.0009
                           0.0000   0.0014   0.0004   0.0060   0.0004   0.0000

  DAILY AVERAGE HEAD ON TOP OF LAYER  7
  -------------------------------------
    AVERAGES               0.0005   0.0006   0.0021   0.0023   0.0017   0.0018
                           0.0008   0.0010   0.0012   0.0015   0.0028   0.0015

    STD. DEVIATIONS        0.0008   0.0009   0.0027   0.0019   0.0012   0.0011
                           0.0007   0.0009   0.0007   0.0015   0.0019   0.0008

  DAILY AVERAGE HEAD ON TOP OF LAYER  9
  -------------------------------------
    AVERAGES               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

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



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

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                   6.19    (   1.026)     161677.3     100.00

 RUNOFF                          0.000   (  0.0000)          0.00      0.000

 EVAPOTRANSPIRATION              5.598   (  0.8399)     146306.05     90.493
```

```
 LATERAL DRAINAGE COLLECTED      0.00009 (  0.00011)         2.454    0.00152
   FROM LAYER  2

 PERCOLATION/LEAKAGE THROUGH     0.59509 (  0.37217)     15553.223     9.61992
   LAYER  3

 AVERAGE HEAD ON TOP             0.001 (    0.001)
   OF LAYER  3

 LATERAL DRAINAGE COLLECTED      0.61591 (  0.30104)     16097.512    9.95657
   FROM LAYER  6

 PERCOLATION/LEAKAGE THROUGH     0.00264 (  0.00110)        69.047     0.04271
   LAYER  7

 AVERAGE HEAD ON TOP             0.001 (    0.001)
   OF LAYER  7

 LATERAL DRAINAGE COLLECTED      0.00000 (  0.00000)         0.000    0.00000
   FROM LAYER  8

 PERCOLATION/LEAKAGE THROUGH     0.00264 (  0.00110)        69.047     0.04271
   LAYER  9

 AVERAGE HEAD ON TOP             0.000 (    0.000)
   OF LAYER  9

 CHANGE IN WATER STORAGE        -0.031   (  0.5100)       -797.63     -0.493

*******************************************************************************
```

```
******************************************************************************

             PEAK DAILY VALUES FOR YEARS    1 THROUGH    5
    ------------------------------------------------------------------------
                                              (INCHES)      (CU. FT.)
                                             ----------   -------------
      PRECIPITATION                             0.69        18033.840

      RUNOFF                                    0.000           0.0000

      DRAINAGE COLLECTED FROM LAYER  2          0.00008         2.20336

      PERCOLATION/LEAKAGE THROUGH LAYER  3      0.243466     6363.22021

      AVERAGE HEAD ON TOP OF LAYER  3           0.302

      MAXIMUM HEAD ON TOP OF LAYER  3           0.573

      LOCATION OF MAXIMUM HEAD IN LAYER  2
            (DISTANCE FROM DRAIN)               6.3 FEET

      DRAINAGE COLLECTED FROM LAYER  6          0.00973       254.35350

      PERCOLATION/LEAKAGE THROUGH LAYER  7      0.000031        0.81311

      AVERAGE HEAD ON TOP OF LAYER  7           0.009

      MAXIMUM HEAD ON TOP OF LAYER  7           0.018

      LOCATION OF MAXIMUM HEAD IN LAYER  6
            (DISTANCE FROM DRAIN)               0.0 FEET

      DRAINAGE COLLECTED FROM LAYER  8          0.00000         0.00000

      PERCOLATION/LEAKAGE THROUGH LAYER  9      0.000031        0.81311

      AVERAGE HEAD ON TOP OF LAYER  9           0.000
```

```
          MAXIMUM HEAD ON TOP OF LAYER  9            0.019

          LOCATION OF MAXIMUM HEAD IN LAYER  8
                (DISTANCE FROM DRAIN)                0.0 FEET

          SNOW WATER                                 1.01         26353.1445


          MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3159

          MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1360

           ***  Maximum heads are computed using McEnroe's equations.  ***

                Reference:  Maximum Saturated Depth over Landfill Liner
                            by Bruce M. McEnroe, University of Kansas
                            ASCE Journal of Environmental Engineering
                            Vol. 119, No. 2, March 1993, pp. 262-270.

    ******************************************************************************
```

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

                   FINAL WATER STORAGE AT END OF YEAR    5
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1           1.1272         0.1879

                      2           1.1400         0.1900

                      3           8.2980         0.4610

                      4         111.6000         0.3100

                      5           2.2064         0.1226

                      6           0.0037         0.0194

                      7           0.0000         0.0000

                      8           0.6300         0.1050

                      9         270.6000         0.4510

                  SNOW WATER      0.135

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******************************************************************************
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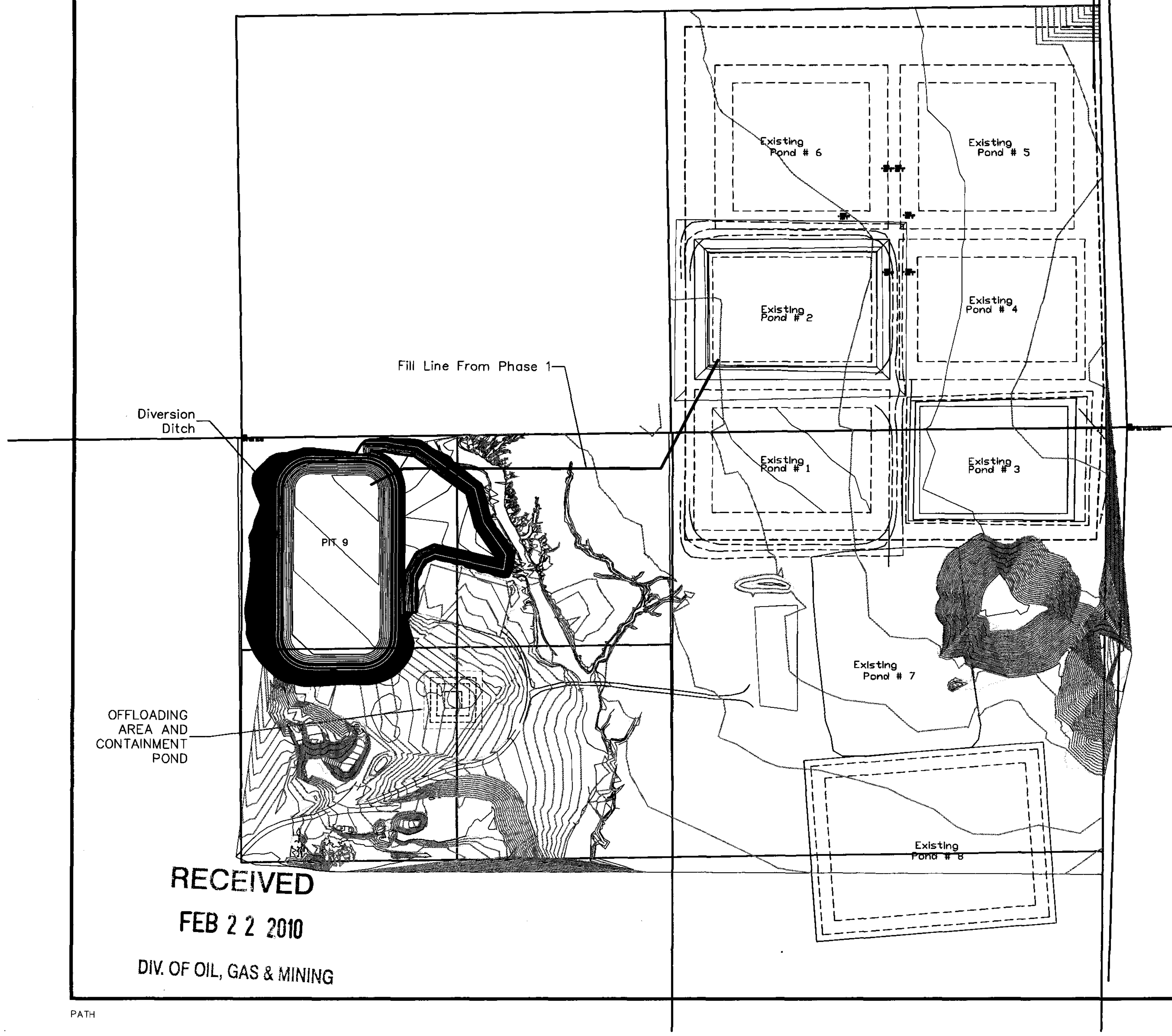
Appendix G2

Historical Design of Existing Systems

R.N.INDUSTRIES
WONSIT FACILITY

Located in the
S1/2SE1/4SE1/4 of Section
26, T8S, R21E, S.L.B. & M.
and in the
N1/2NE1/4 and the
SE1/4N1/4 Section 35,
T8S, R21E, S.L.B. & M.



0 100 200 300 400 500 600 700 800 900 1000

TROY D. OSTLER
167895

CIVCO Engineering Inc.
P.O. Box 1758, Vernal, Utah 84078
Telephone: (435) 789-5448 Fax: (801) 789-4485

APPROVAL RECOMM. 1/09 DATE TROY E. OSTLER, P.E. PROJECT DESIGN ENGINEER
APPROVED 1/09 DATE GARY KENDALL PLANS AND ESTIMATES ENGINEER

DESIGN 1/09 GLK CHECK TDO 1/09
DRAWN 1/09 GLK CHECK TDO 1/09
QUANT. 1/09 GLK CHECK TDO 1/09
REVIEW
DATE
BY

NO.	DATE	DESIGN REV. BY	MAPS CORR. BY	PARCELS AFFECTED	REQUEST BY	REMARKS

DATE ORIGINAL SUBMISSION FOR AUTHORIZATION

REVISIONS

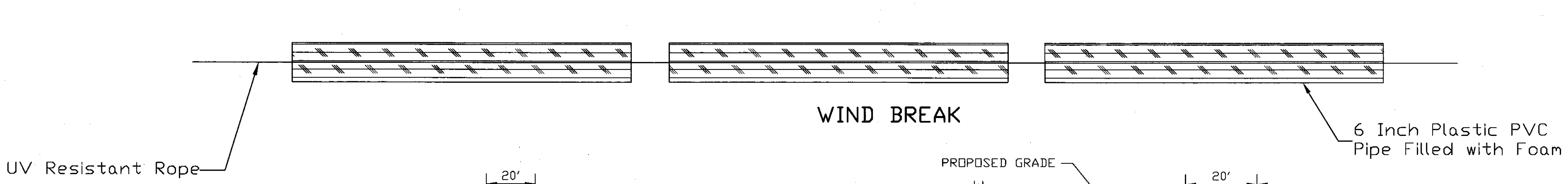
R N INDUSTRIES
WONSIT FACILITY
NEW DRAINAGE LAYOUT

PROJECT NUMBER

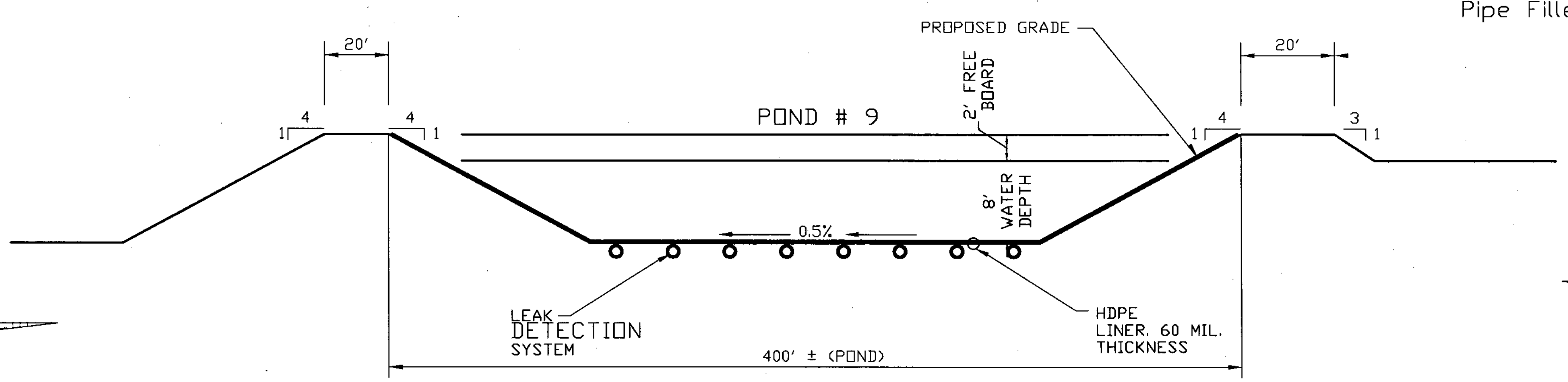
UINTAH
COUNTY

SHEET NO. 2A

PATH



WIND BREAK



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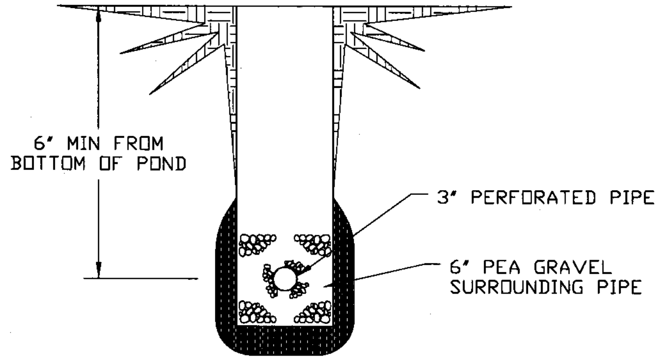
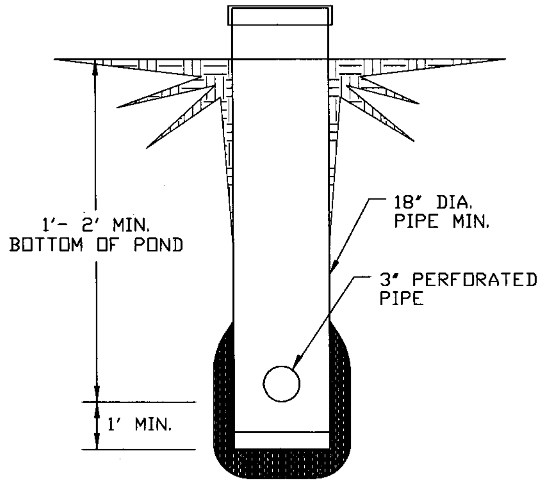
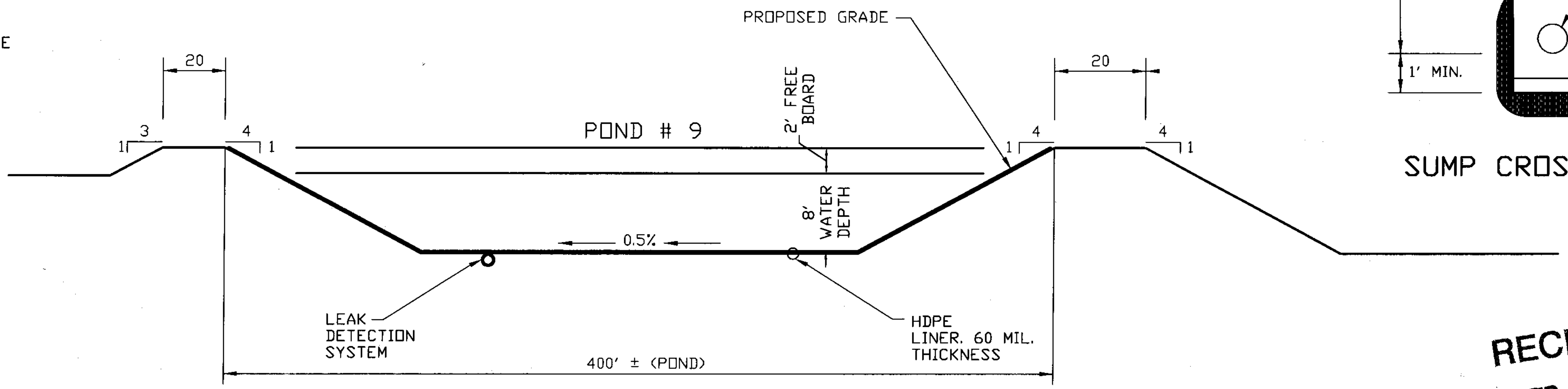


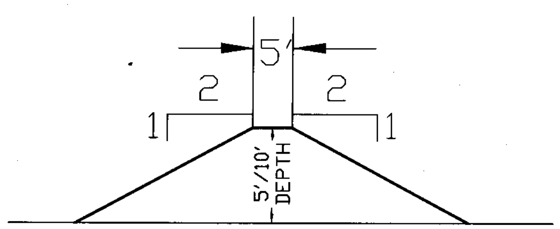
TRENCH CROSS SECTION



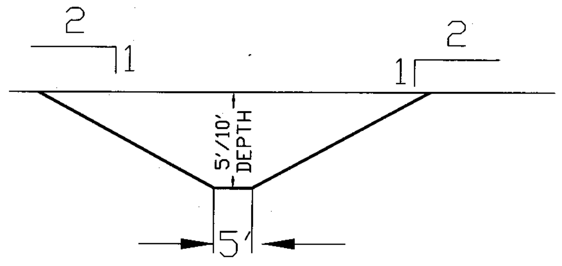
SUMP CROSS SECTION



SECTION "B-B"

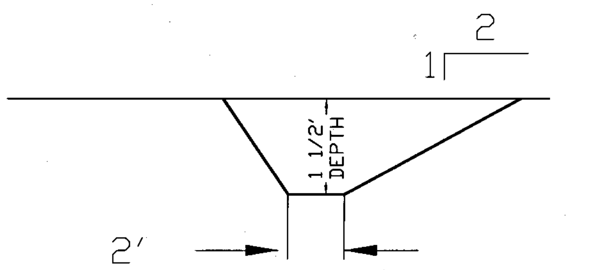


SECONDARY CONTAINMENT BERM



SECONDARY CONTAINMENT DITCH
MAJOR DRAINAGE DIVERSION DITCH

POND #9



SURFACE DRAINAGE DIVERSION DITCH

RECEIVED
FEB 2 2 2010
DIV. OF OIL, GAS & MINING

164830
JOHN SHANE WOOD
2-17-2010

EXACT NUMBER AND LOCATION OF LEAK DETECTION LINES TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

CIVCO Engineering Inc.
P.O. Box 1758, Vernal, Utah 84078
Telephone: (435) 789-5448 Fax: (801) 789-4485

APPROVAL RECOMM. 12/09
TROY D. OSTLER, P.E.
PROJECT DESIGN ENGINEER
DESIGN GLK 12/09
CHECK TDO 12/09
APPROVED 12/09
GARY L. KENDALL
DRAWN GLK 12/09
CHECK GLK 12/09

No.	DATE	BY	REMARKS

R. N. INDUSTRIES
WONSIT FACILITY
TYPICAL SECTION
POND #9
PROJECT NUMBER
UINTAH
COUNTY
SHEET No. 3

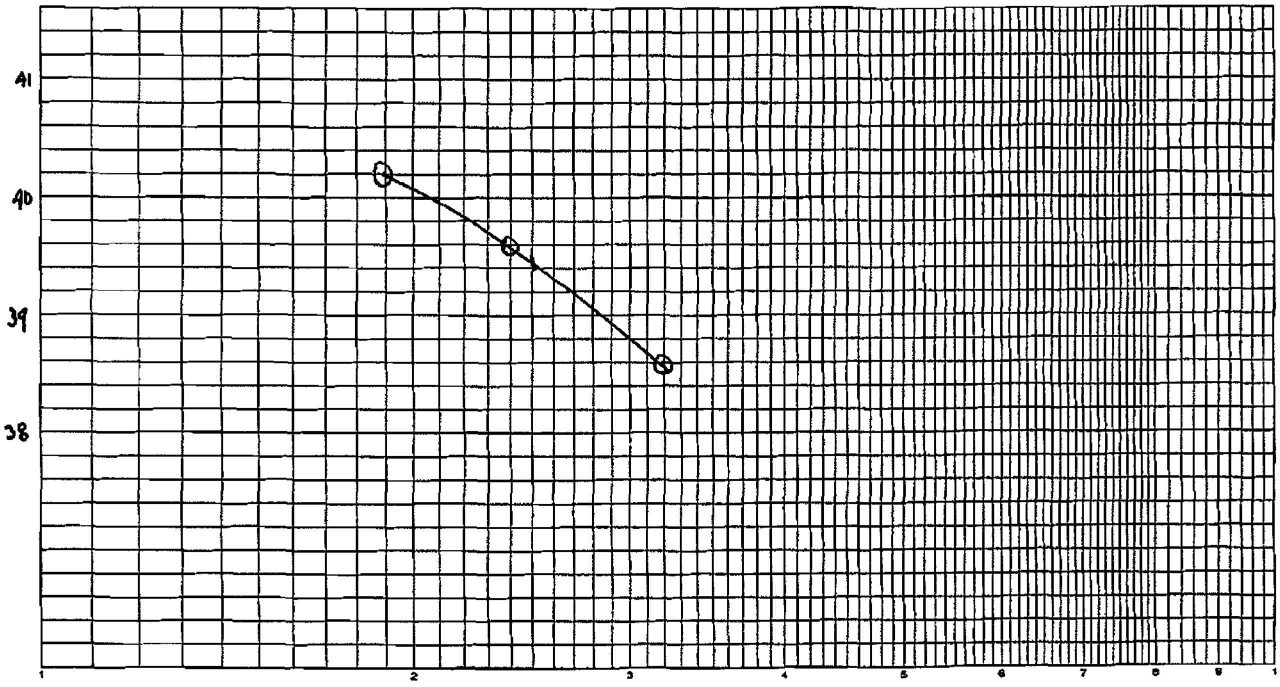
Q. C. TESTING

Liquid Limit-Plastic Limit-Field Moisture

PROJECT	Wonsit Valley	SAMPLED BY	QC Testing Mike
JOB NO.	Pond #9 clay liner	SAMPLE NO	#1 west bottom
DATE SAMPLED	9-4-09	TESTED BY	Karl Lund

	LIQUID LIMIT					PLASTIC LIMIT	
Trial No.	1	2	3	4	5	1	2
Can No.	1	2	3			4	
No. of Blows	32	24	19				
1 Wt. Can+Wet Soil	32.00	32.66	32.59			24.91	
2 Wt. Can+Dry Soil	28.86	29.47	29.37			24.20	
3 Wt. of Water(1-2)	3.14	3.19	3.22			0.71	
4 Wt. of Can	20.72	21.42	21.36			21.34	
5 Wt. Dry Soil(2-4)	8.14	8.05	8.01			2.76	
6 % Moisture(3/5x100)	38.6	39.6	40.2			24.8	

FLOW CURVE



NUMBER OF BLOWS

Liquid Limit (L)	40	Plastic Limit (P)	25	Plasticity Index (I)	15

RECEIVED
OCT 27 2009
DIV. OF OIL, GAS & MINING

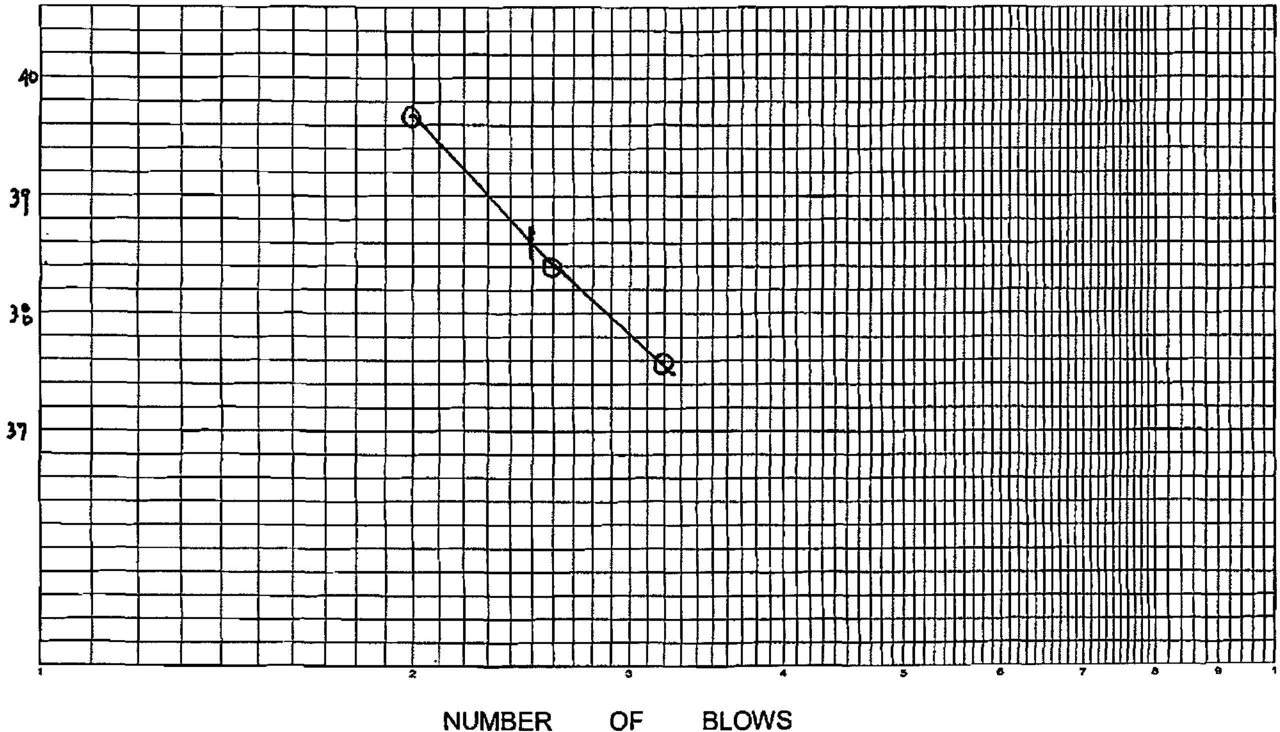
Q. C. TESTING

Liquid Limit-Plastic Limit-Field Moisture

PROJECT Wonsit Valley
SAMPLED BY QC Testing Mike
JOB NO. Pond #9 clay liner
SAMPLE NO #2 south bottom
DATE SAMPLED 9-4-09
TESTED BY Karl Lund

	LIQUID LIMIT					PLASTIC LIMIT	
Trial No.	1	2	3	4	5	1	2
Can No.	5	6	7			8	
No. of Blows	32	26	20				
1 Wt. Can+Wet Soil	33.93	34.24	34.13			24.83	
2 Wt. Can+Dry Soil	30.48	30.69	30.42			24.15	
3 Wt. of Water(1-2)	3.45	3.55	3.71			0.68	
4 Wt. of Can	21.30	21.44	21.08			21.47	
5 Wt. Dry Soil(2-4)	9.18	9.25	9.34			2.68	
6 % Moisture(3/5x100)	37.6	38.4	39.7			25.4	

FLOW CURVE



Liquid Limit (L)	39	Plastic Limit (P)	25	Plasticity Index (I)	14

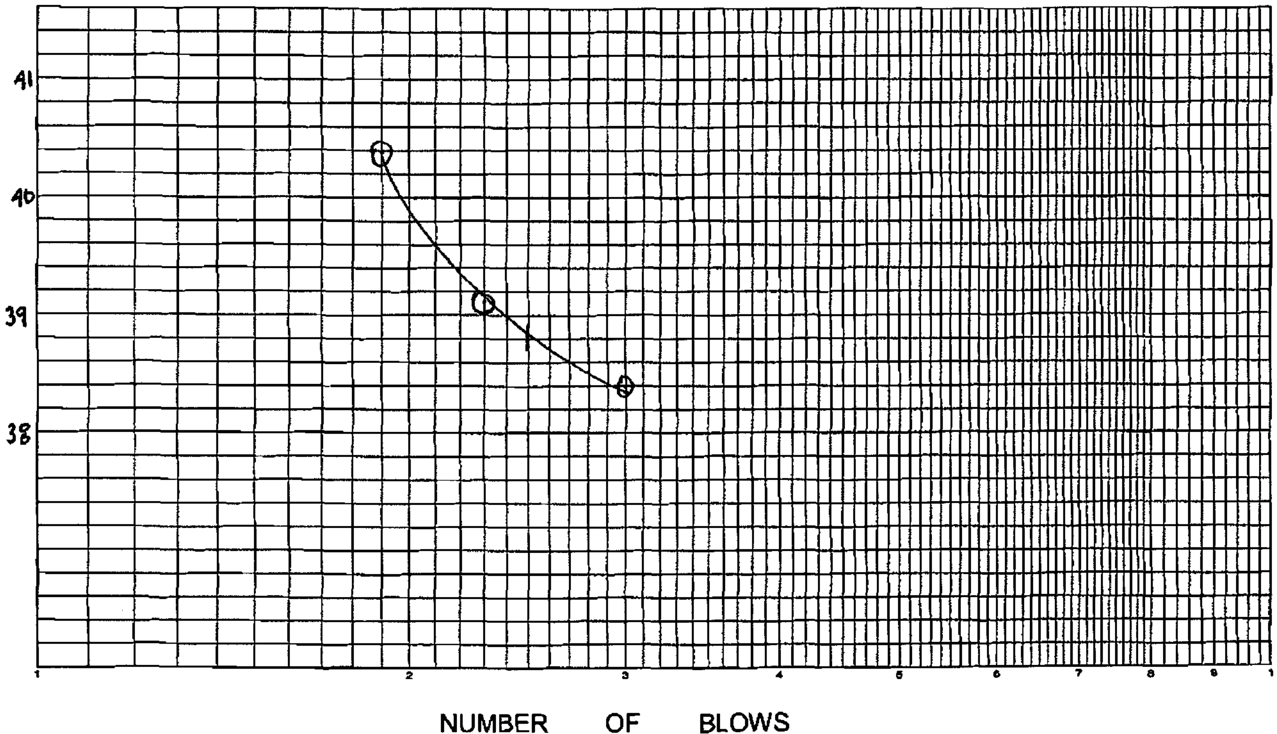
Q. C. TESTING

Liquid Limit-Plastic Limit-Field Moisture

PROJECT	Wonsit Valley	SAMPLED BY	QC Testing Mike
JOB NO.	Pond #9 clay liner	SAMPLE NO	#3 north bottom
DATE SAMPLED	9-4-09	TESTED BY	Karl Lund

	LIQUID LIMIT					PLASTIC LIMIT	
Trial No.	1	2	3	4	5	1	2
Can No.	9	10	11			12	
No. of Blows	30	24	19				
1 Wt. Can+Wet Soil	31.69	31.78	32.28			25.03	
2 Wt. Can+Dry Soil	28.83	28.81	29.18			24.29	
3 Wt. of Water(1-2)	2.86	2.97	3.10			0.74	
4 Wt. of Can	21.38	21.21	21.50			21.42	
5 Wt. Dry Soil(2-4)	7.45	7.60	7.68			2.87	
6 % Moisture(3/5x100)	38.4	39.1	40.4			25.8	

FLOW CURVE



Liquid Limit (L)	39	Plastic Limit (P)	26	Plasticity Index (I)	13

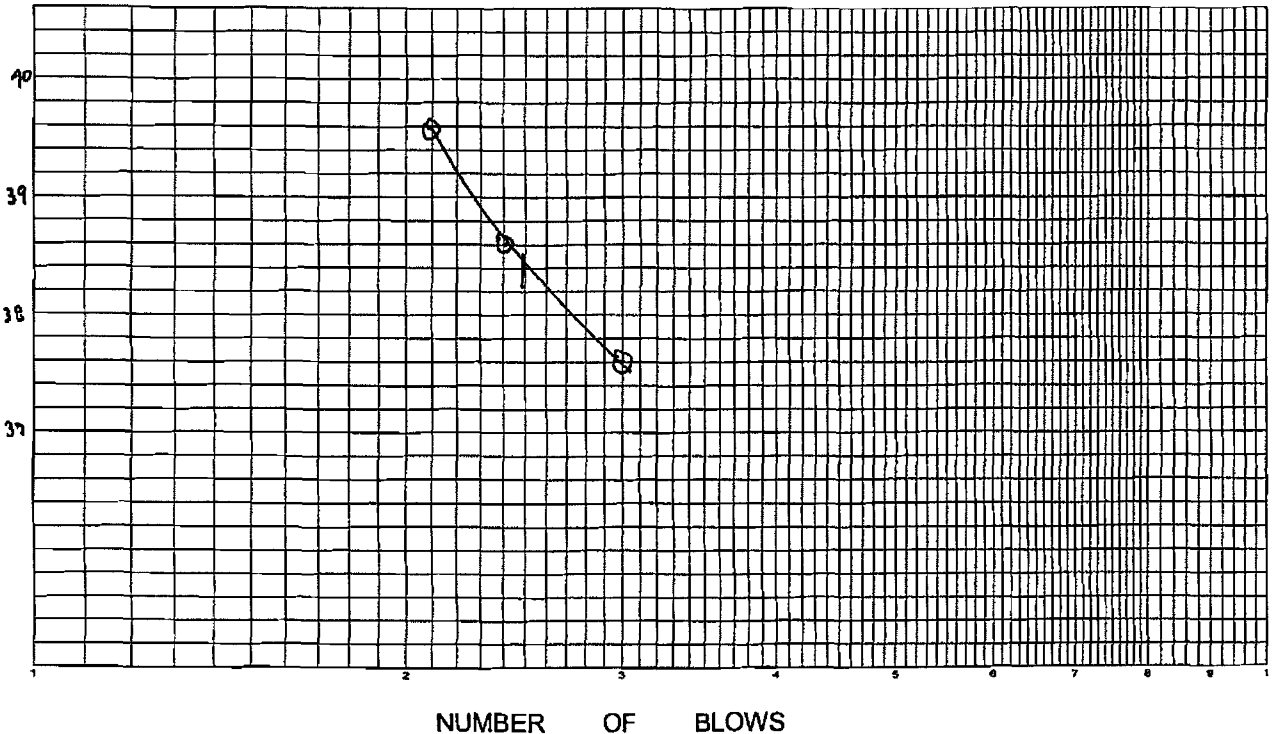
Q. C. TESTING

Liquid Limit-Plastic Limit-Field Moisture

PROJECT Wonsit Valley
SAMPLED BY QC Testing Mike
JOB NO. Pond #9 clay liner
SAMPLE NO #4 east bottom
DATE SAMPLED 9-4-09
TESTED BY Karl Lund

	LIQUID LIMIT					PLASTIC LIMIT	
Trial No.	1	2	3	4	5	1	2
Can No.	1	2	3			4	
No. of Blows	30	24	21				
1 Wt. Can+Wet Soil	35.69	36.22	36.10			25.75	
2 Wt. Can+Dry Soil	31.60	32.10	31.92			24.88	
3 Wt. of Water(1-2)	4.09	4.12	4.18			0.87	
4 Wt. of Can	20.72	21.42	21.36			21.34	
5 Wt. Dry Soil(2-4)	10.88	10.68	10.56			3.54	
6 % Moisture(3/5x100)	37.6	38.6	39.6			24.6	

FLOW CURVE



Liquid Limit (L)	38	Plastic Limit (P)	25	Plasticity Index (I)	13

Q.C. Testing, Inc.
2550 W 500 N #2A
Vernal, UT 84078
(435) 789-0220

AASHTO T-238
AASHTO T-239
NUCLEAR MOISTURE - DENSITY DETERMINATION

Client: Civco Engineering

Project Name Wonsit Valley Disposal Ponds

Date 9/8/2009

Project Number Pond 9

Charge ID Pond 9

Instrument Used and Number TROXLER 3411-B

Material Type clay liner

DENSITY

Back Scatter ☐ 2" D.T. ☐ 4" D.T. ☐ 6" D.T. ☐ 8" D.T. ☐

1		1	
2		2	
3		3	
Total		Total	
Average		Average	

MOISTURE

1		1	
2		2	
3		3	
Total		Total	
Average		Average	

Day Average Standard Counts

Day Average Standard Counts

Test No.	Station Ft. Rt. or Lt. Of Line		Standard Counts	Direct Contact Reading	Count Ratio	Wet Density Lbs. Ft.^{3}	Dry Density	Marshall or Proctor	T-99	% Comp.
27	SE corner	Density	1824	1640		123.0	111.1	111.7		99.5
		Moisture	507	104		11.8	10.7	14.7		
28	E side center	Density		1611		123.7	110.0	111.7		98.5
		Moisture		111		13.7	12.4	14.7		
29	NE corner	Density		1675		122.1	110.6	111.7		99.0
		Moisture		101		11.5	10.4	14.7		
30	N side center	Density		1854		117.7	108.9	111.7		97.5
		Moisture		97		8.8	8.1	14.7		
31	Center of pond	Density		1506		126.7	111	111.7		99.4
		Moisture		99		15.7	14.2	14.7		
32	S side center	Density		1688		121.8	110	111.7		98.5
		Moisture		84		11.8	10.7	14.7		
33	SW corner	Density		1798		119.1	108.6	111.7		97.2
		Moisture		83		10.5	9.7	14.7		
34	W side center	Density		1803		119	108.9	111.7		97.5
		Moisture		88		10	9.2	14.7		
35	NW corner	Density		1625		123.4	110.3	111.7		98.5
		Moisture		96		13.1	11.9	14.7		
		Density								
		Moisture								

D.T = Direct Transmission

For Moisture: $\frac{\text{Contact Counts}}{\text{Standard Counts}}$ = Count Ratio

For Density Back Scatter or Depth Probe: $\frac{\text{Direct Contact Reading}}{\text{Standard Count Read}}$ = Count Ratio

Remarks BOTTOM OF POND 9 CLAY LINER

Tested By Mike Morgan

Project Engineer

CIVCO Engineering, Inc.

Civil Engineering Consultants
P.O. Box 1758
1256 West 400 South, Suite W-1
Vernal, Utah 84078

October 26, 2009

Lisha Cordova
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84180

Re: Chapman Disposal Ponds at The Wonsit Facility, Pond 9,

Dear Lisha:

The pond, the leak detection system and the liner is constructed in the same manner and using the same standards as the ponds that have been constructed and permitted in the master plan for the Wonsit Disposal facility. I am sending this notice as per Roger's request to inform the UDOG that the liner for pond 9 is installed. The leak detection system has been installed and inspected by Richard Powell of the DOGM.

CIVCO Engineering Inc. has provided the preliminary testing of the materials to be placed in the lining of the detection system and pond bottoms. These materials are a clayey material with an average PI of 13.75. This material will seal the existing ground from any leaks and force any leakage to the detection system. We are including the test results for this material for your inspection and information. We will also provide on site inspections by a certified materials technician and a Registered Professional Engineer. By providing these services, we will be able to certify to your office, the construction is in accordance with the permit issued by the Division of Oil, Gas and Mining. From previous correlation testing we have determined that a clayey material with a minimum PI of 13 have a permeability of $1x10^{-7}$ or slower.

If you should have any questions or need additional information concerning this matter, please feel free to contact myself at CIVCO Engineering Inc. (435-789-5448).

Sincerely,

Troy D. Ostler

Troy D. Ostler
CIVCO Engineering Inc.

cc: Nile Chapman
Project File

Phone (435)789-5448 ✱ Fax (435)789-4485
Email: garykendall@civcoengineering.com

Lisha Cordova - RNI - Wonsit Facility - Pit 9

From: Lisha Cordova
To: Gary Kendall (CIVCO)
Date: 10/14/2009 4:42 PM
Subject: RNI - Wonsit Facility - Pit 9
Attachments: 20090323 Amended Const Aprvl.pdf

Hi Gary,

I need eng. certification from Troy Ostler, P.E. for the above referenced pit. I did not receive eng. certification for the secondary clay liner prior to installation of the LD system; please submit info ASAP.

Thanks,
Lisha

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
MICHAEL R. STYLER
Executive Director
Division of Oil, Gas and Mining
JOHN R. BAZA
Division Director

March 23, 2009

Mr. Roger Chapman
RN Industries, Inc.
P.O. Box 98
Roosevelt, Utah 84066

Subject: Wonsit Facility (Sec. 26 & 35) – Amended Approval to Construct Produced Water Evaporative Pit 9, Section 35, Township 8 South, Range 21 East, Uintah County, Utah

Dear Mr. Chapman,

Approval to construct the above referenced pit ("the Pit") was granted by the Division of Oil, Gas and Mining ("the Division") on February 18, 2009. On February 25 - March 19, 2009, the Division received your application/maps to amend the Pit by expanding it from 400' X 400' to 677' X 380'. The application/maps were reviewed by Division staff and meets the requirements for a produced water disposal pit in accordance with Utah Administrative Code R649-9 et al., of the Oil and Gas General Rules.

Therefore approval to amend and commence construction of the Pit is hereby granted in accordance with the following stipulations:

1. The Pit shall be constructed under the supervision of a registered professional engineer and shall meet all the conditions and requirements of the amended application/maps.

2. The Division requires that our staff be informed of all phases of construction and be allowed the opportunity for inspection during the construction and installation activities including but not limited to, secondary liner installation, leak detection system emplacement, primary liner installation, and dike construction. Call Dan Jarvis at (801) 538-5338 or Richard Powell (435) 790-6145 at least 2 days prior to construction activity.

3. A secondary liner consisting of native and/or imported clay material, 1' thick throughout the entire pit floor, with an acceptable PI (Plastic Index) and permeability rate (as determined by a registered professional engineer) shall be emplaced below the leak detection system; engineer certification is required prior to installation of the leak detection system.

4. The leak detection system shall be emplaced as specified in the amended engineering plans, and the lines shall be exposed at time of inspection.

5. The 60-mil HDPE primary liner shall be emplaced over the leak detection system as specified in the amended engineering plans. The seams shall be tested prior to inspection, and the liner shall be keyed into trench at time of inspection.

6. The pit/site shall be fenced to deter wildlife and unauthorized personnel.

7. Secondary containment is required at the Facility to prevent pit waters from leaving the site in the event of catastrophic pit failure; secondary containment at Pit 9 shall be constructed as specified in the amended engineering plans.

8. Additional bonding in the amount of $171,837.50 is required prior to pits' use (see updated facility bonding spreadsheet attached).

Final approval to operate the Pit will be issued upon completion of the construction phase, and compliance with all the stipulations.

This approval does not exempt the operator from complying with all other federal, state and local rules and ordinances.

If you have any questions concerning this approval, please contact Lisha Cordova at (801) 538-5296 or Brad Hill at (801) 538-5315.

Sincerely,

Gil Hunt

Gil Hunt
Associate Director

GLH/LC/er
Enclosure (1): Facility Bonding Spreadsheet
cc: Brad Hill, Permitting Manager
Dan Jarvis, Operations Manager
Richard Powell, Roosevelt Office
Mike George, DEQ/Water Quality (SL)
Robert Leake, Water Rights/Dam Safety (Vernal)
Dave Marble, Water Rights/Dam Safety (SL)
Ben Williams, Wildlife Resources
Troy Ostler, P.E., CIVCO Engineering, Inc.
Matthew Cazier, Uintah County Planning Office
Bond File
Facility File

N:\O&G Permits\Disposal Facilities (Pits, LF, etc)\RN Industries (Wonsit)\Pit 9

DIVISION OF OIL, GAS AND MINING

STATEMENT OF BASIS
WONSIT FACILITY / AMENDED PIT 9

Applicant: R N Industries Inc. **Pit Type:** Commercial/Evaporative

Location: Wonsit Facility - Sec. 26 (Pits 2,4,5, & 6) & Sec. 35 (Unloading Pit & Pits 1,3,7, 8 & 9)
T8S, R21E, Uintah County, Ut **Cause No.** WD-01-2005

Ownership and Local Setting:

The Wonsit Facility ("the facility") is located in the southeastern edge of Wonsit Valley north of Watson Road, approx. 3 miles NW of RNIs' Glen Bench Facility on Fee land owned by RNI, surrounded by Native American lands. The facility is approx. 24 miles south of Vernal, approx. ¾ mile north of the White River, and approx. 6 miles SE of the Green River. An application to construct the facility was received on 2/23/05 that involved one unloading pit and six evaporative pits. Approval to operate Pit 1 was granted on 4/26/05, followed by approval to operate the Unloading Pit on 7/19/05, Pit 2 on 7/28/05, Pit 3 on 11/28/05, Pit 4 on 1/4/06, Pit 5 on 2/16/06, and Pit 6 on 5/5/06. An application to expand the facility (3 additional evap. pits proposed) was received on 4/25/06. Approval to operate Pit 7 was granted 5/25/06. An application to construct Pit 8 was received on 6/1/06; approval to operate was granted on 9/21/06. An application to construct Pit 9 was received on 12/29/08; approval to construct was granted 2/18/09. An application/maps to amend Pit 9 was received 2/25/09; pit review is in progress. The pits/facility (including drainage diversion & secondary containment) was designed by a registered professional engineer (Troy Ostler, P.E./CIVCO) and construction operations "have been and are being" performed under his direct supervision. This analysis is specifically for amended Evaporative Pit 9.

Pit Design Specifications / Pit 9:

Containment for disposal of produced water derived from Oil & Gas operations.
Constructed in +80% cut, with compacted fill dikes constructed in lifts.
678' X 380' X 10' deep (including 2' of freeboard). *From 400'X400'
4:1 interior slopes, 3:1/4:1 exterior slopes.
Total storage capacity of 350,550 bbls or 45.18 acre-feet (not including 2' of freeboard).
Secondary liner (native/imported clay material, 1' thick throughout entire pit floor).
7-8 lateral leak detection system (3" diameter perforated/solid pipe surrounded by 6" of pea gravel), 50' centers, and external 18" capped monitoring sump inspected weekly.
Primary liner (flexible 60 mil HDPE liner keyed into trench).
Secondary containment (compacted berms, 5-10' high X 5' wide, 70,704 bbl capacity).
Drainage diversion(s).

Site Characteristics:

Pit 9 will be located NW of the Unloading Pit. Test boring soil sampling was conducted 2/9/09 (QC Testing) to define subsurface conditions, to assure that the liner will be placed on a firm stable base, and to determine the appropriate leak detection system (results on file).

The surface formation is the Uinta Formation comprised of interbedded sandstones, siltstones and shales overlain/interbedded with Quaternary alluvium derived from the Uinta Formation. Surface soils are a weathered sedimentary material comprised of fine-grained material, light tan-brown in color, with small-medium sized sandstone/siltstone rocks & fragments. There is little natural erosion at the site. The Uinta Formation sandstones are lenticular and discontinuous and do not generally make good aquifers.

Local flora (sparse) consists of native grasses, sagebrush, greasewood, prickly pear, salt brush, shadscale, etc; local fauna consists of reptiles, rodents, birds, coyotes, deer, etc.

There are numerous PGW's and several wells in drilling within a one-mile radius of the pit/facility. Kerr-McGees' Ouray 35-94 well (43-047-33053) is located SE/adjacent to Pit 9; the access road should not be impacted. RNI plans to construct a separate access road to Pit 9. Access road(s) to Kerr-McGees' Ouray 35-174 well (43-047-33248) located south of Pit 1 & west of Pit 7, and the Fed 35-52 St well (43-047-32697) located south of Pit 8 are minimally impacted by facility operations; the road(s) are being restored by RNI when deemed necessary as previously agreed to. See ArcView map dated 2/10/09.

Surface and Ground Water Protection:

A minor drainage bisects the NE quarter of the proposed pit; drainage will be diverted around the pit & secondary containment areas (see eng. maps). In addition, there is a major drainage (two forks that merge into one) 2-4' deep that runs in a southeasterly direction between Pit 9 & Unloading Pit and Pits 1-8, it is a seasonal intermittent drainage that flows to the White River located approx. ¾ miles south of the facility. The pit will be constructed in 80% cut, and will be located 100' (minimum) from the drainage; a stream alteration permit is being submitted by CIVCO/RNI to the US Army Corp of Engineers to relocate the drainage further away from the Pit. The facility is not in a floodplain or wetland area.

Secondary containment is required at the facility to prevent pit water from leaving the site in the event of catastrophic pit failure or other breach; secondary containment will be constructed at Pit 9 (see eng. map) & currently exists in the Pit 1-8 area; both containments shall be inspected on a regular basis to ensure integrity. In addition, a "wind break" will be installed at Pit 9 when deemed necessary to prevent pit water from lapping over pit dikes during occasional high wind episodes.

Produced water is trucked & unloaded (4 hoses) into the Unloading Pit for separation; it is fenced & netted to deter wildlife/waterfowl. Following separation, the produced water is piped (below ground) from the Unloading Pit to Pit 1, then it is piped (above ground) to Pits 2-8 (& Pit 9 upon completion); all piping is compatible with the material or fluids it transports that meets the Spill Prevention, Control and Countermeasures Plan (SPCC) requirements.

Two feet of freeboard (or > if deemed necessary) will be maintained in Pit 9, and will be monitored for hydrocarbons; any accumulation will be skimmed off immediately and placed in a tank to be sold. The leak detection monitoring system will be inspected weekly and reported to the Division quarterly, any leaks will be reported to the Division immediately and corrective measures will be taken. Spray systems to enhance evaporation will be monitored to ensure that overspray does not occur.

A search of the Division of Water Rights database reveals that there are no underground water wells within 10,000 feet of the facility. Within a one-mile radius there is one active surface water permit south of the facility (No. 49-1659) issued to Price Water Pumping Inc. (source water is from the Green & White River's) for drilling gas wells.

The elevation at Pit 9 is 4745-4705'; the base of moderately saline ground water is +/-4640-4500' (Tech Pub 92/Plate 1), +/-105-205' below surface. The average annual precipitation is 6.83" (Western Regional Climate Center 8/17/55-12/31/05/Ouray 4 NE); and the average evaporation rate is 56 inches. Meteoric waters are expected to evaporate and/or will be diverted around the pit/facility and secondary containment(s).

Site Security:

Pit 9 will be fenced to deter wildlife and unauthorized entry. A facility sign is posted. Field staff is on-site during regular business hours, and the gate is locked after hours. In addition, DOGM staff conducts periodic facility inspections.

Bonding:

Bonding for the Wonsit Facility has been determined using the following formula from R649-9-9, Bonding of Disposal Facilities, of the Oil & Gas Conservation General Rules:

$14,000 per acre of pit, partial acres will be calculated at the rate of $14,000 per acre; plus
$1.00 per barrel of produced water for one-quarter of the total storage capacity of the facility.

RNI has submitted facility bonding, Letter of Credit No. L5LS-275190 ($1,461,497.00), issued by JPMorgan Chase Bank that currently covers the Unloading Pit, and Pit's 1-8. Additional bonding for Pit 9 (& 2 tanks/400 bbl capacity ea) in the amount of $171,837.50 is required following completion of the construction phase, prior to pits' use. See updated facility bonding spreadsheet.

Actions Taken and Further Approvals Needed:

Properly designed, constructed, and maintained pits/facilities, including secondary containment(s) & drainage diversion(s), and compliance with the operating, monitoring, reporting, and recordkeeping requirements set forth under R649-9 et al, should pose no threat to fresh or useable surface and groundwater supplies.

A Notice of Agency Action, Cause No. WD-01-2005, was published in the Salt Lake Tribune on March 4, 2005, and in the Uintah Basin Standard on March 8, 2005 (15-day comment period). No comments or objections were received. Additional noticing is not required at this time.

An onsite review of Pit 9 was conducted on 2/4/09, in attendance; Ryan Chapman & field staff members (RNI), Gary Kendall (CIVCO), Contractors (QC Testing), and Lisha & Richard (DOGM). Ben Williams (DWR) was not invited (fee lands); the pit will be fenced to deter wildlife. *No onsite required for amended Pit 9.

Misc info:

1. RNI plans to file a stream alteration permit with the US Army Corp of Engineers.
2. Berm compaction method “wheel-rolled method, 95% compaction”.

Other approvals needed:

1. DEQ/Water Quality; Storm Water Pollution Prevention Plan “SWPPP”.
   *RNI/Gary Kendall (CIVCO) referred to Mike George (801) 538-6146 or Scott Hacking.

2. Water Rights/Dam Safety; Small Dam (<20 acre ft) or Other (=/>20 acre ft).
   RNI/Gary Kendall (CIVCO) referred to Dave Marble (801) 538-7376 or Robert Leake.

3. Uintah County; Conditional Use Permit (expansion ops).
   RNI/Gary Kendall (CIVCO) referred to Matthew Cazier (435) 781-5335.

4. Compliance with all other federal, state and local rules and ordinances.

Reviewer(s): Lisha Cordova, Petroleum Specialist Date: March 23, 2009

R649-9-3. Permitting of Disposal Pits
Analysis3 Document For Permit Review
R N Industries Inc. / Wonsit Facility / Amended Pit 9
Sec. 26 (Pit's 2, 4, 5 & 6) & Sec. 35 (Unloading Pit & Pit's 1, 3, 7, 8 & 9)
Township 8 South, Range 21 East, Uintah County, Utah

R649-9-3. Permitting of Disposal Pits

1. All commercial disposal pits and disposal pits located off of an existing mineral lease shall be bonded in accordance with R649-9-9, Bonding of Disposal Facilities to assure proper operation, maintenance, and closure of the pits.	1. RNI has submitted facility bonding, Letter of Credit #L5LS-275190 ($1,461,497), issued by JPMorgan Chase that covers the Unl. Pit & Evap. Pits 1-8. **Add'l bonding in the amount of $171,837.50 for Pit 9 & Tanks 1-2 is required prior to pits' use. See updated facility bonding spreadsheet.**
2. Application shall be made to the Division for approval of any disposal pit.	2. Ok. Orig. application rec'd 2/23/05. Pit 9 eng. maps rec'd 12/29/08; amended application/maps rec'd 2/25/09 (CIVCO, Troy Ostler, P.E.)
2.1. The pit shall be designed appropriately for the intended purpose.	2.1. Ok.
2.2. Commercial disposal pits shall be designed and constructed under the supervision of a registered professional engineer.	2.2. Ok. See 2.
2.3. The application and site shall meet the following requirements:	2.3. Ok. See below.
2.3.1. The pit shall be located on level, stable ground, and an acceptable distance away from any established or intermittent drainage.	2.3.1. Ok. The ground is not level, slopes gently toward the NE; the pit will be constructed in 80% cut on stable ground (see 3.5), and will be 100' min. from a major drainage; a stream alteration permit is being submitted to the US Army Corp of Engineers to relocate the drainage further away from the pit.
2.3.2. The pit shall not be located in a geologically and hydrologically unsuitable area, such as aquifer recharge areas, flood plains, drainage bottoms, and areas near faults.	2.3.2. Ok.
2.3.3. The pit shall have adequate storage capacity to safely contain all produced water even during those periods when evaporation rates are at a minimum.	2.3.3. Ok. Max. pit capacity is 350,550 bbls (-2' FB). A 2' FB (or > if deemed necessary) shall be maintained in the pit at all times.
2.3.4. The pit shall be designed and constructed so as to prevent the entrance of surface water.	2.3.4. Ok. In addition, a drainage diversion ditch (5' wide X 5-10' deep) shall be constructed to divert storm water/sheet flow away from the pit area.
2.3.5. The pit shall be designed, maintained and operated to prevent unauthorized surface or subsurface discharge of water.	2.3.5. Ok. In addition, secondary containment (berms 5-10' high X 5' wide, wheel-rolled compaction method, 70,704 bbl capacity), and pit wind breaks as deemed necessary. 3/18/09 Same per GK/CIVCO. fc
2.3.6. The pit shall be fenced and maintained to prevent access by livestock, wildlife and unauthorized personnel and if required, equipped with flagging or netting to deter entry by birds and waterfowl.	2.3.6. Ok. The pit will be fenced, and netted if deemed necessary.
2.3.7. The pit levees for produced water pits receiving volumes in excess of five barrels per day, shall be constructed so that the inside grade of the levee is no steeper than 3:1 and the outside grade no steeper than 2:1. The top of the levee shall be level and of sufficient width to allow for adequate compaction.	2.3.7. Ok. 4:1 interior slopes & 3:1-4:1 exterior slopes. Level levee tops, 20' wide, wheel-rolled compaction method.
2.3.8. All approved produced water pits not located at a well site shall be identified with a suitable sign.	2.3.8. Ok. A facility has been posted.
2.3.9. The artificial materials used in lining pits shall be impervious and resistant to weather, sunlight, hydrocarbons, aqueous acids, alkalies, salt, fungi, or other substances which might be contained in the produced water.	2.3.9. Ok. 60-mil HDPE primary liner (specs previously submitted).
3. If rigid materials are used, leak proof expansion joints shall be provided, or the material shall be of sufficient thickness and strength to withstand, without cracking, expansion, contraction and settling movements in the underlying earth.	3. N/A.
3.1. If flexible materials are used, they shall be of sufficient thickness and strength to be resistant to tears and punctures.	3.1. Ok. 60-mil HDPE primary liner (specs previously submitted).
3.2. Commercial disposal pits shall be lined with a minimum liner thickness of 40 mils or as approved by the Division.	3.2. Ok. 60-mil HDPE primary liner.
3.3. Lined pits constructed in relatively impermeable soils shall have an underlaying gravel filled sump and lateral system or suitable leak detection system.	3.3. N/A.
3.4. Lined pits constructed in relatively permeable soils shall have a secondary liner underlaying the leak detection system, that is graded so as to direct leakages to the observation sump.	3.4. Ok. A secondary liner of native and/or imported clay material, 1' thick, with an acceptable PI shall underlie the LD system; eng. "certification" is required prior to LD install (see also 5.9).
3.5. Test borings shall be taken in sufficient quantity and to an adequate depth to satisfactorily define subsurface conditions and assure that the liner will be placed on a firm stable base and to determine the appropriate leak detection system.	3.5. Ok. Soils sampling conducted 2/9/09 (QC Testing); see testing results & eng. certification from Troy Ostler, P.E./CIVCO rec'd 2/10/09.
4. Requirements for Unlined Disposal Pits. 4.1 An application for disposal of produced water into an unlined pit will be considered if such disposal does not demonstrate significant pollution potential to surface or ground water and	4 et al. N/A.

meets at least one of the following criteria:

4.2. The water to be disposed of does not have a higher total dissolved solids "TDS" content than ground water that could be affected and provided that the water does not contain objectionable levels of constituents and characteristics including chlorides, sulfates, pH, oil, grease, heavy metals and aromatic hydrocarbons.

4.3. That all, or a substantial part of the produced water is being used for beneficial purposes such as irrigation and livestock or wildlife watering and a water analysis indicates that the water is acceptable for the intended use.

4.4. The volume of water to be disposed of does not exceed five barrels per day on a monthly basis.

5. Application Requirements for Produced Water Pits.

5.1. Applications for disposal of produced water into lined pits shall include the following information:

5.2. A topographic map and drawing of the site on a suitable scale that indicate the pit dimensions, cross section, side slopes, leak detection system and location relative to other site facilities. The drawings shall be of professional quality.

5.3. The maximum daily quantity of water to be disposed of and a representative water analysis of such water that includes the concentrations of chlorides and sulfates, pH, total dissolved solids "TDS", and information regarding any other significant constituents if requested.

5.4. Climatological data indicating the average annual evaporation and precipitation for the area.

5.5. The method and schedule for disposal of precipitated solids.

5.6. Drawings of unloading facilities and explanation of the method for controlling and disposing of any liquid hydrocarbon accumulation so that the evaporation process is not hampered

5.7. The engineering data and design criteria used to determine the pit size which includes a 2-foot free-board.

5.8. The type, thickness, strength, and life span of material to be used for lining the pit and the method of installation.

5.9. A description of the leak detection method to be utilized.

5.9.1. The proposed inspection frequency of the detection system.

5.9.2. The proposed procedures for repair of the liner should leakage occur.

6. Applications for disposal of produced water into Unlined Pits shall include the following information:

6.1. A topographic map and drawing of the site on a suitable scale that indicate the pit dimensions, cross section, side slopes, size and location relative to other site facilities.

6.2 The daily quantity of water to be disposed of and a representative water analysis of such water that includes the total dissolved solids "TDS", pH, oil and grease content, the concentrations of chlorides and sulfates, and information regarding any other significant constituents if required.

6.3. Climatological data indicating the average annual evaporation and precipitation for the area.

6.4. The estimated percolation rate based on soil characteristics under and adjacent to the pit.

6.5. Estimated depth and areal extent of any USDW in the area and an indication of any effect or interaction of the produced water with any such water resources present at or near the surface.

6.6. If beneficial use is the basis for the application, written confirmation from the user should be submitted.

6.7. If the application is made on the basis that surface and subsurface waters will not be adversely affected by disposal in an unlined pit, the following additional information is required:

6.7.1. A map showing the location of surface waters, water wells, and existing water disposal facilities within a one mile radius of the proposed disposal facility.

6.7.2. The weighted average concentration of total dissolved solids "TDS" of all surface and subsurface waters within a one mile radius that might be affected by the proposed disposal.

6.7.3. Any reasonable geological and hydrological evidence showing that the proposed disposal method will not adversely affect existing water quality or major uses of such waters.

4 et al. N/A

5. See below.

5.1. See below.

5.2. Ok. See R649-9-3.2.

5.3. Ok. Max. daily quantity of water to Pit 9 will be the amount siphoned from the pits in Phase 1 and/or Phase 2. A representative water analysis previously submitted (American West Analytical Laboratories, 3/30/05).

5.4. Ok. Average annual evap. rate is 47.59" (NOAA's National Weather Service), & average annual precip. is 6.83" (Western Regional Climate Center/Ouray 8/17/55-12/31/05).

5.5. Ok. No precipitated solids anticipated (info rec'd 3/30/05); will revisit at time of pit closure.

5.6. Ok. Existing netted unloading/skim pit (above ground hoses) and associated tanks (separator/oil); any hydrocarbon accumulation in Pit 9 will be removed via pump truck & be placed in oil tank to be sold.

5.7. Ok. See 5.2 & R649-9-3.2.

5.8. Ok. 60-mil HDPE primary liner (specs previously submitted, +20 yr lifespan); installed per manufactures specifications.

5.9. Ok. 7-8 lateral LD system (50' centers) & 18" diameter <u>capped</u> monitoring sump (see maps for eng. details).

5.9.1. Ok. Weekly inspections (DOGM requirement).

5.9.2. Ok. Pit will be drained & leak(s) will be repaired with heat seal patch(s).

6 et al. N/A.

7. Within 30 days of the submission of an application for disposal of produced water into a commercial disposal pit, the division shall review the application as to its completeness and adequacy for the intended purpose and shall require such changes that are found necessary to assure compliance with the applicable rules. If the application is in order, the Division shall provide for a public notice to be published in a newspaper of general circulation in the county where the pit is to be located.	7. Ok. Application rec'd 12/29/08, initial review completed 1/28/09. Amended application/maps rec'd 2/25/09, review completed 3/16/09. A Notice of Agency Action, Cause No. WD-01-2005 was issued 2/24/05 and was published in the SL Tribune on 3/4/05, and the Uintah Basin Standard on 3/8/05. No comments and/or objections were rec'd. Approval to begin construction of the Facility was granted 4/8/05, followed by approval to operate on 4/28/05. Add'l noticing is not required for Pit 9.
R649-9-4. Permitting of Other Disposal Facilities. 1. Facilities used for the treatment and disposal of E and P wastes other than evaporation pits shall be permitted by the Division. This would include such activities as landfarming, composting, solidifying, bioremediation, and others. 2. All commercial treatment and disposal facilities must be bonded in accordance with R649-9-9, Bonding of Disposal Facilities, to assure proper operation, maintenance, and closure of the facility. 3. Application Requirements for Treatment and Disposal Facilities. The application shall contain the following: 3.1. A complete description of the proposed facility. 3.2. Processes involved including a complete list of all wastes to be accepted at the facility and products generated. 3.3. Maps and drawings of suitable scale showing all facilities and equipment. 3.4. Materials or products to be applied to the land surface or subsurface shall meet the Division's cleanup levels for contaminated soil and other wastes. 3.5. If leachability and/or toxicity is of concern due to the type or source(s) of wastes, tests will be required and may utilize the Toxicity Characteristic Leaching Procedure (TCLP). 3.6. The submission of an application to the Division of Water Quality, Department of Environmental Quality, for a discharge permit may be required if it is determined that the facility and associated activity will not have a de minimus actual or potential effect on ground water quality. 3.7. If the Division determines there is potential for discharge, or if the proposal involves a commercial disposal operation it will be forwarded to the Division of Water Quality for their review.	R649-9-4 et al. N/A
R649-9-5. Construction and Inspection Requirements for Disposal Facilities.	R649-9-5. See below.
1. Division personnel shall be afforded a reasonable opportunity for inspection of any proposed disposal facility during the construction and operation of the facility.	1. Operator shall comply.
2. The division shall be notified at least two working days prior to the installation of a pit liner so that an inspection of the leak detection system can be conducted.	2. Operator shall comply.
3. In any case, the division shall be notified after completion of facility construction, at least two working days prior to its use, so that an inspection can be conducted to verify that the facility has been constructed in accordance with the approved application.	3. Operator shall comply.
4. Disposal facilities shall be operated in accordance with an approved application and in a manner which does not cause pollution or safety and health hazards.	4. Operator shall comply.
5. Failure to meet the requirements and standards for construction and operation of a disposal facility shall be considered as noncompliance and will result in the imposition of corrective actions and compliance schedules or a cessation of operations order.	5. Operator/Division shall comply.
R649-9-6. Reporting and Recordkeeping Requirements for Disposal Facilities.	R649-9-6. See below.
1.All unauthorized discharges or spills from disposal facilities including water observed in a leak detection system shall be promptly reported to the division.	1. Operator shall comply.
2.Each producer who utilizes any approved produced water disposal facility shall comply with the reporting requirements of R649-8-10.	2. Operator shall comply.

3. Each operator of a disposal facility, excluding disposal wells, shall report to the Division on a quarterly basis. This report shall include the volume and type of wastes received at the facility during the quarter and results of the leak detection system inspections.	3. Operator shall comply.
4. The occurrence of water in a leak detection system during operation of a pit constitutes liner failure and requires immediate action.	4. Operator shall comply.
4.1. The Division has the option of allowing the operator a short period of time to take corrective action.	4.1. Operator/Division shall comply.
4.2. Further utilization of the pit will be allowed only after liner repairs and an inspection by the Division.	4.2. Operator/Division shall comply.
5. Each owner/operator of a commercial disposal facility shall keep records showing at a minimum the following: date and time waste was received, origin, volume, type, transporter, and generator of the waste. These records shall be available for inspection by the Division for at least six years.	5. Operator shall comply.
R649-9-7. Final Closure and Cleanup of Disposal Facilities.	R649-9-7. See below.
1. A plan for final closure of a disposal facility shall be submitted to the Division for approval. The closure plan shall include the following:	1. Operator shall comply.
1.1. Provisions for removal of all equipment at the site.	1.1. Operator shall comply.
1.2. Proposed plans and procedures for sampling and testing soils and ground water at the site.	1.2. Operator shall comply.
1.3. Soils will need to meet the Division's Cleanup Levels for Contaminated Soils or background levels whichever is less stringent.	1.3. Operator shall comply.
1.4. Provisions for a monitoring plan if required by the Division, and	1.4. Operator shall comply.
1.5. A consideration of post disposal land use and landowner requests when the closure plan is developed.	1.5. Operator shall comply.
2. A bond for a disposal facility will be released when the requirements of a closure plan approved by the Division has been met as determined by the Division.	2. Operator/Division shall comply.
R649-9-8. Variances from Requirements and Standards. Requests for approval of a variance from any of the requirements or standards of these rules shall be submitted to the director in writing and provide information as to the circumstances which warrant approval of the requested variance and the proposed alternative means by which the requirements or standards will be satisfied. Variances may be approved only after proper notice and public hearing before the board.	R649-9-8. Operator/Division shall comply; no variances requested at this time.
R649-9-9. Bonding of Disposal Facilities.	R649-9-9. See below.
1. Disposal facilities, other than injection wells, shall be bonded according to this rule in order to protect the State and oil and gas producers from unnecessary liabilities and cleanup costs in the future. The objectives are to provide the State with adequate security to allow rehabilitation of a site to the point of preventing further or future pollution, and health and safety hazards should a facility owner default.	1. Operator shall comply.
1.1. The parameters used to calculate the proper bond amount are: pit area, storage capacity, and volume of waste stored.	1.1. Operator/Division shall comply.
1.2. Bonds accepted shall be of the same type as those accepted for wells i.e. surety, collateral, or a combination of the two as described in the R649-3-1.	1.2. Operator shall comply.
1.2.1. In order to assist facility owners of facilities operating prior to 1997 to establish bonding, the total bond amount provided may consist of an initial amount as determined by the division and an additional amount collected at a price per barrel and/or price per cubic yard of waste collected until the total bond amount is reached.	1.2.1. N/A.
1.2.2. The total bond will be held by the division or financial institution until the facility has been closed and inspected by the division in accordance with a division approved closure plan.	1.2.2. Operator/Division shall comply.
1.3. Total bond amount is calculated using values for pit area, pit storage capacity, and volume of stock piled waste material.	1.3. Operator/Division shall comply.

1.3.1. No salvage value of equipment or removal cost is used.	1.3.1. Operator/Division shall comply.
1.3.2. This bond will only be used by the State to treat or remove waste from the site and secure the facility to prevent any future contamination should the facility owner default on cleanup responsibilities.	1.3.2. Division shall comply.
1.3.3. Bond amounts will be calculated as follows, and the per volume or per acre figures may be adjusted periodically to compensate for change in cost to perform the necessary cleanup work: $14,000 per acre of pit, partial acres will be calculated at the rate of $14,000 per acre; plus $1.00 per barrel of produced water for one-quarter of the total storage capacity of the facility; plus $30 per cubic yard of solid or semi-solid waste material stockpiled at the facility. $10,000 Minimum bond amount.	1.3.3. Operator/Division shall comply.
1.4. All commercial disposal facilities (except injection wells covered by R649-3-1) will be covered by an adequate and acceptable bond before being permitted to accept any exploration and production waste. The initial and minimum bond payment will be at least $10,000. The total bond amount will be calculated as described in R649-9-9-1.3. If requested by the disposal facility owner, the bond beyond the initial amount may be posted at a rate of two cents per barrel of liquid or sixty cents per cubic yard of solid/semi-solid waste material accepted for disposal at the facility.	1.4. Operator/Division shall comply. See R649-9-3.1 (facility bonding information) & R649-9-9.1.3.2 (tank waste). *Portions of this rule does not apply to pits/facilities permitted & operated after 1996, see R649-9-9.1.2.1.

Comments:

12/29/08 Rec'd eng. maps for Pit 9 from Roger Chapman/RNI (prepared by Troy Ostler, P.E./CIVCO).

01/29/09 Initial permit review completed. A copy of the analysis document & an updated **preliminary** facility bonding spreadsheet was emailed to Roger Chapman/RNI at roger@rnindustries.com; add'l info requested (core sampling/results, etc).

02/04/09 Onsite review conducted, in attendance; Ryan Chapman & field staff members (RNI), Gary Kendall (CIVCO), Consultants (QC Testing), Lisha & Richard (DOGM). Ben Williams (DWR) was not invited (fee lands); the pit will be fenced to deter wildlife.

02/05/09 Amended eng. maps rec'd (Troy Ostler, P.E./CIVCO); w/o add'l information.

02/10/09 Additional information received (soils testing results/QC Testing, and info. requested on 1/29/09 (Troy Ostler, P.E./CIVCO).

02/18/09 Permit review completed; approval to construct granted.

02/25/09 Rec'd amended application/maps for Pit 9 (Troy Ostler, P.E./CIVCO).

03/16/09 Amended permit review completed. A copy of the analysis3 document & an updated facility bonding spreadsheet was emailed to Gary Kendall/CIVCO at garykendall@civcoengineering.com.

1. LD monitoring sump - 18" dia. pipe should be extended a minimum of 1' below inlet pipe, bottom seal or catchment required, and sump should be capped at all times except during weekly inspection.
2. Secondary Containment – new capacity? *Pit 9 from 400'X400' to 677'X380'.

Reviewer(s): Lisha Cordova, Petroleum Specialist

Date: March 16, 2009 (Analysis3 – Amended Pit 9)

CIVCO Engineering, Inc.
Civil Engineering Consultants
P.O. Box 1758
365 West 50 North, Suite W-1
Vernal, Utah 84078

February 25, 2009

Lisha Cordova
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84180

Re: Chapman Disposal Ponds at Wonsit Facility (Amended) Pond #9,

Dear Lisha:

I am sending the information needed on The Wonsit Disposal Ponds New Facility, amended pond no. 9 and I hope this gives you the information you need to permit the new pond.

The pond and the leak detection system will be constructed in the same manner and using the same standards as the ponds that are proposed and permitted in the master plan for the Wonsit Disposal facility. The Secondary Containment Area as depicted on Sheet 5 will contain the water loss amount from pond 9. I am sending this notice of application as per Roger's request for the approval to construct the amended pond #9.

If you should have any questions or need additional information concerning this matter, please feel free to contact myself at CIVCO Engineering Inc. (435-789-5448).

RECEIVED
FEB 25 2009
DIV. OF OIL, GAS & MINING

Sincerely,

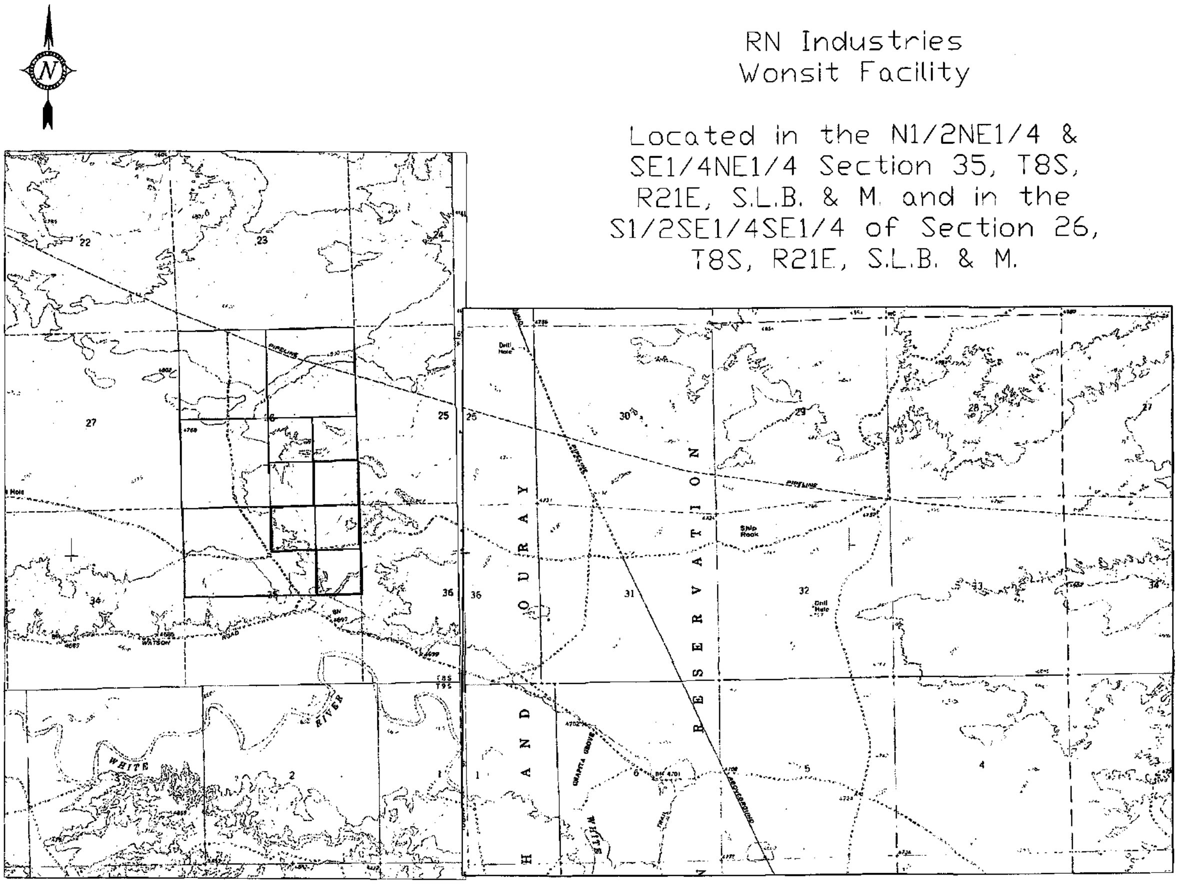
Troy D. Ostler

Troy D. Ostler, P.E.
CIVCO Engineering Inc.

cc: Nile Chapman
Project File

RN Industries
Wonsit Facility

Located in the N1/2NE1/4 &
SE1/4NE1/4 Section 35, T8S,
R21E, S.L.B. & M. and in the
S1/2SE1/4SE1/4 of Section 26,
T8S, R21E, S.L.B. & M.



Troy D. Oaller
7895
2-25-09

R.N. INDUSTRIES
Wonsit Facility
Title Sheet
PROJECT NUMBER Pond 9 Amended

UINTAH
COUNTY
SHEET NO. 1

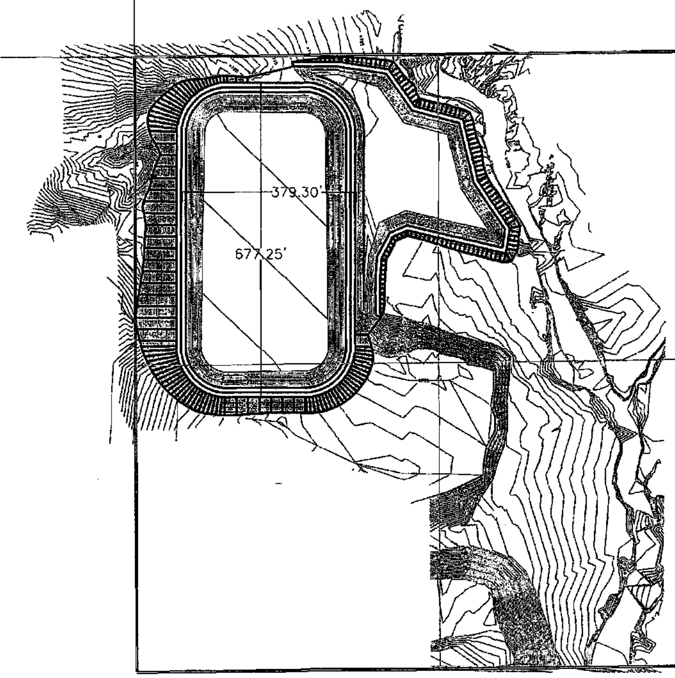
CIVCO Engineering Inc.
P.O. Box 1758, Vernal, Utah 84078
Telephone: (435) 789-5448 Fax: (435) 789-4485

APPROVAL RECOMM. 2/09 Gary Kendall	DESIGN GLK 2/09	CHECK TDO 2/09	REVIEW
	DRAWN GLK 2/09	CHECK TDO 2/08	DATE
APPROVED 2/09 Troy D. Oaller, P. E.	QUANT. GLK 2/09	CHECK TDO 2/09	BY

NO.	DATE	DESIGN REV. BY	MAPS CORR. BY	PARCELS AFFECTED	REQUEST BY	REMARKS
		ORIGINAL SUBMISSION FOR AUTHORIZATION				

DATE
REVISIONS

RECEIVED
FEB 25 2009
DIV. OF OIL, GAS & MINING



R.N.INDUSTRIES
WONSIT FACILITY

Located in the
S1/2SE1/4SE1/4 of Section
26, T8S, R21E, S.L.B. & M.
and in the
N1/2NE1/4 and the
SE1/4N1/4 Section 35,
T8S, R21E, S.L.B. & M.

NEW PIT 9

0 100 200 300 400 500 600 700 800 900 1000

167895
2-25-09

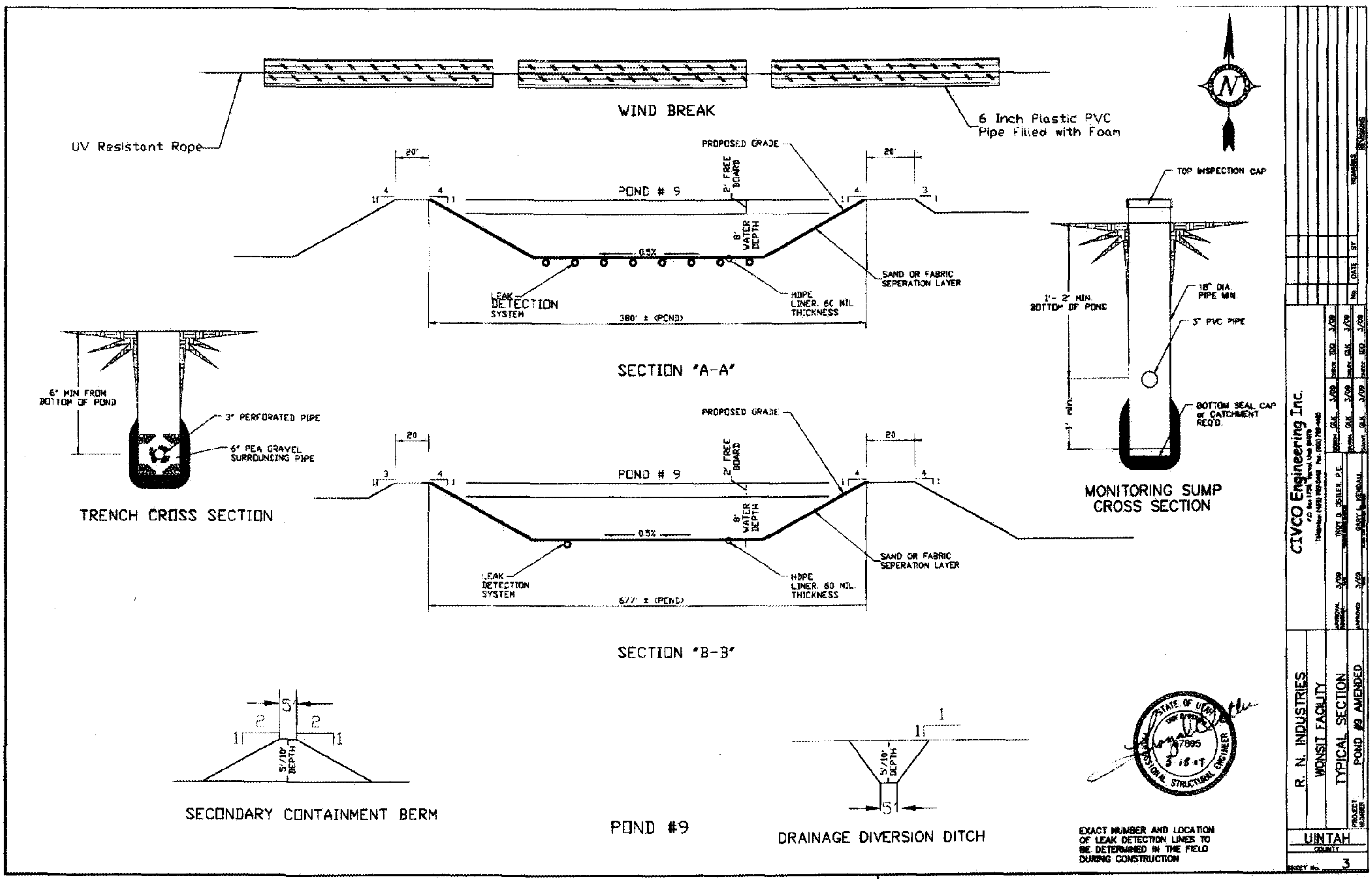
NO	DATE	DESIGN REV. BY	MAPS TO BE REVISED	PARCELS AFFECTED	REQUEST BY	REMARKS
		ORIGINAL SUBMISSION FOR AUTHORIZATION				
DATE	REVISIONS					

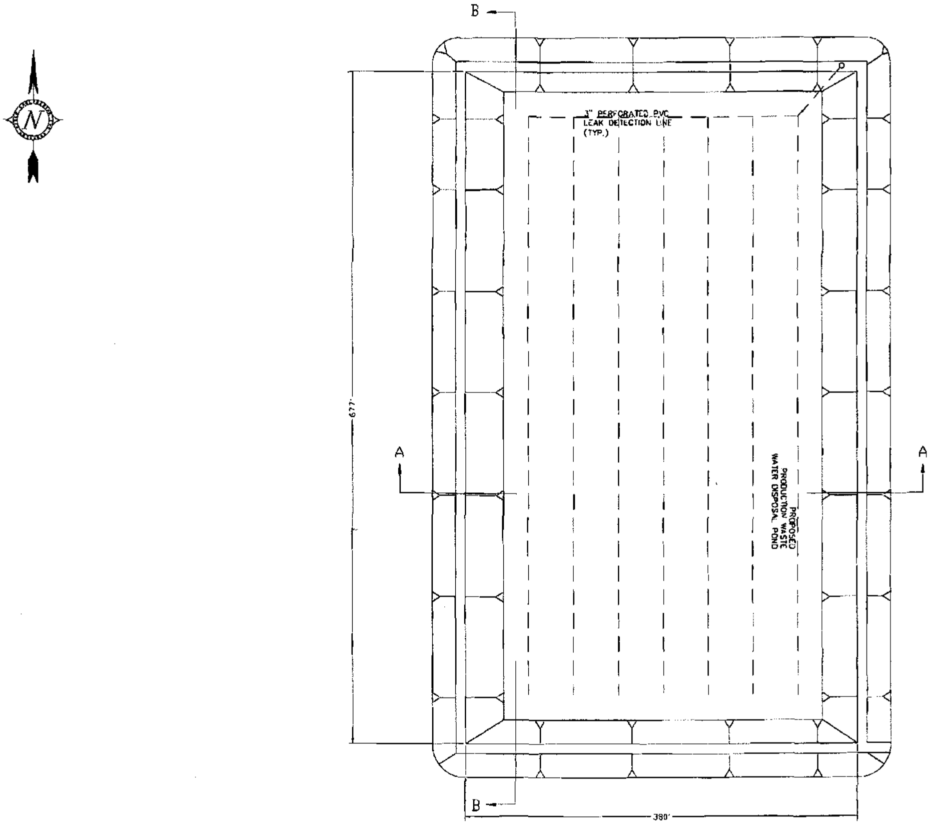
CIVCO Engineering Inc.
P.O. Box 1758, Vernal, Utah 84078
Telephone (435) 789-5448 Fax (801) 789-4485

APPROVAL RECOMM. 2/09 TROY E. OSTLER, P.E.
APPROVED 2/09 GARY KENDALL
DESIGN 2/09 GLK CHECK TDO 2/09
DRAWN 2/09 GLK CHECK TDO 2/09
QUANT 2/09 GLK CHECK TDO 2/09
REVIEW
DATE
BY

R N INDUSTRIES
WONSIT FACILITY
POND # 9 AMENDED
PROJECT NUMBER

UINTAH
COUNTY
SHEET NO. 2


WIND BREAK
UV Resistant Rope
6 Inch Plastic PVC Pipe Filled with Foam
PROPOSED GRADE
20'
POND # 9
2' FREE BOARD
8' WATER DEPTH
0.5%
SAND OR FABRIC SEPERATION LAYER
LEAK DETECTION SYSTEM
HDPE LINER, 60 MIL THICKNESS
380' ± (POND)
SECTION 'A-A'
677' ± (POND)
SECTION 'B-B'
6" MIN FROM BOTTOM OF POND
3" PERFORATED PIPE
6" PEA GRAVEL SURROUNDING PIPE
TRENCH CROSS SECTION
TOP INSPECTION CAP
18" DIA. PIPE MIN
1'- 2' MIN. BOTTOM OF POND
3" PVC PIPE
BOTTOM SEAL CAP or CATCHMENT REQ'D.
MONITORING SUMP CROSS SECTION
SECONDARY CONTAINMENT BERM
5'/10' DEPTH
POND #9
DRAINAGE DIVERSION DITCH
EXACT NUMBER AND LOCATION OF LEAK DETECTION LINES TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION
CIVCO Engineering Inc.
TROY D. ZSLER, P.E.
GARY L. KENDALL
R. N. INDUSTRIES
WONSIT FACILITY
TYPICAL SECTION
POND #9 AMENDED
UINTAH
COUNTY
SHEET No. 3



NOTES:
PIT CAPACITY = 350,550 BARRELS (ASSUMING 42 GAL. PER BARREL & MINUS 2' FREE BOARD.)
OR 14,723,041 GALLONS

POND # 9

TROY D. OSTLER
2-25-09

R. N. INDUSTRIES
WONSIT FACILITY
TYPICAL SECTION
PROJECT NUMBER POND # 9 AMENDED

CIVCO Engineering Inc.
P.O. Box 1758, Vernal, Utah 84078
Telephone (435) 789-5448 Fax (801) 789-4485

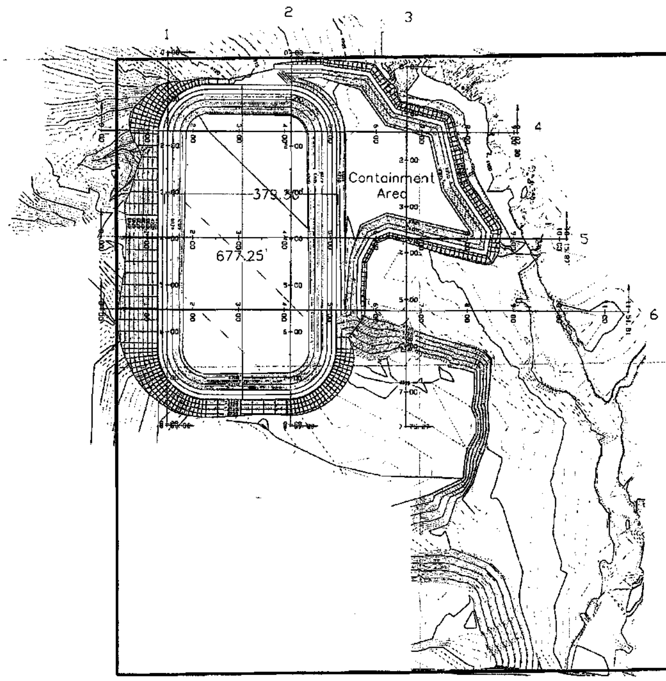
APPROVAL 2/09 CARY L. KENDALL
APPROVED 2/09 TROY D. OSTLER, P.E.
DESIGN CLK 2/09 CHECK TDO 2/09
DRAWN CLK 2/09 CHECK CLK 2/09
QUANT CLK 2/09 CHECK TDO 2/09

No	DATE	BY	REMARKS

REVISIONS

UINTAH
COUNTY

SHEET No. 4



R.N. INDUSTRIES
WONSIT FACILITY

Located in the
S1/2SE1/4SE1/4 of Section
26, T8S, R21E, S.L.B. & M.
and in the
N1/2NE1/4 and the
SE1/4N1/4 Section 35,
T8S, R21E, S.L.B. & M.

NEW PIT 9

0 100 200 300 400 500 600 700 800 900 1000

2-25-09

R N INDUSTRIES
WONSIT FACILITY
POND # 9 AMENDED
PROJECT NUMBER

UINTAH
COUNTY

SHEET NO 5

CIVCO Engineering Inc.
P.O. Box 1758, Vernal Utah 84078
Telephone (435) 789-5448 Fax (801) 789-4485

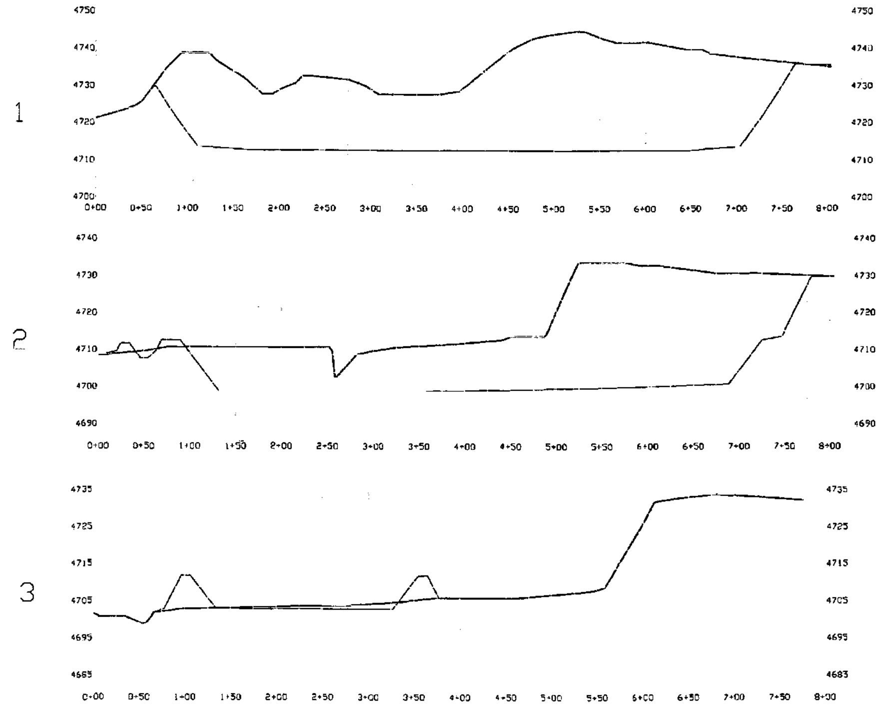
APPROVAL RECOMM. 2/09 TROY E. OSTLER, P.E.
APPROVED 2/09 GARY KENDALL

DESIGN 2/09	GLK	CHECK TDO	2/09
DRAWN 2/09	GLK	CHECK TDO	2/09
QUANT 2/09	GLK	CHECK TDO	2/09

REVIEW
DATE
BY

NO. DATE | DESIGN REV. BY | MAPS CORR. BY | PARCELS AFFECTED | REQUEST BY | REMARKS
DATE | ORIGINAL SUBMISSION FOR AUTHORIZATION
REVISIONS

RECEIVED
FEB 25 2009
DIV. OF OIL, GAS & MINING



R N INDUSTRIES

WONSIT FACILITY

POND # 9 AMENDED

CIVCO Engineering Inc.

APPROVAL 2/09 TROY E. OSTLER, P.E.

APPROVED 2/09 GARY KENDALL

DESIGN 2/09 GLK CHECK TDO 2/09

DRAWN 2/09 GLK CHECK TDO 2/09

QUANT 2/09 GLK CHECK TDO 2/09

REVIEW

ORIGINAL SUBMISSION FOR AUTHORIZATION

R E V I S I O N S

NO DATE REMARKS

PROJECT NUMBER

UINTAH

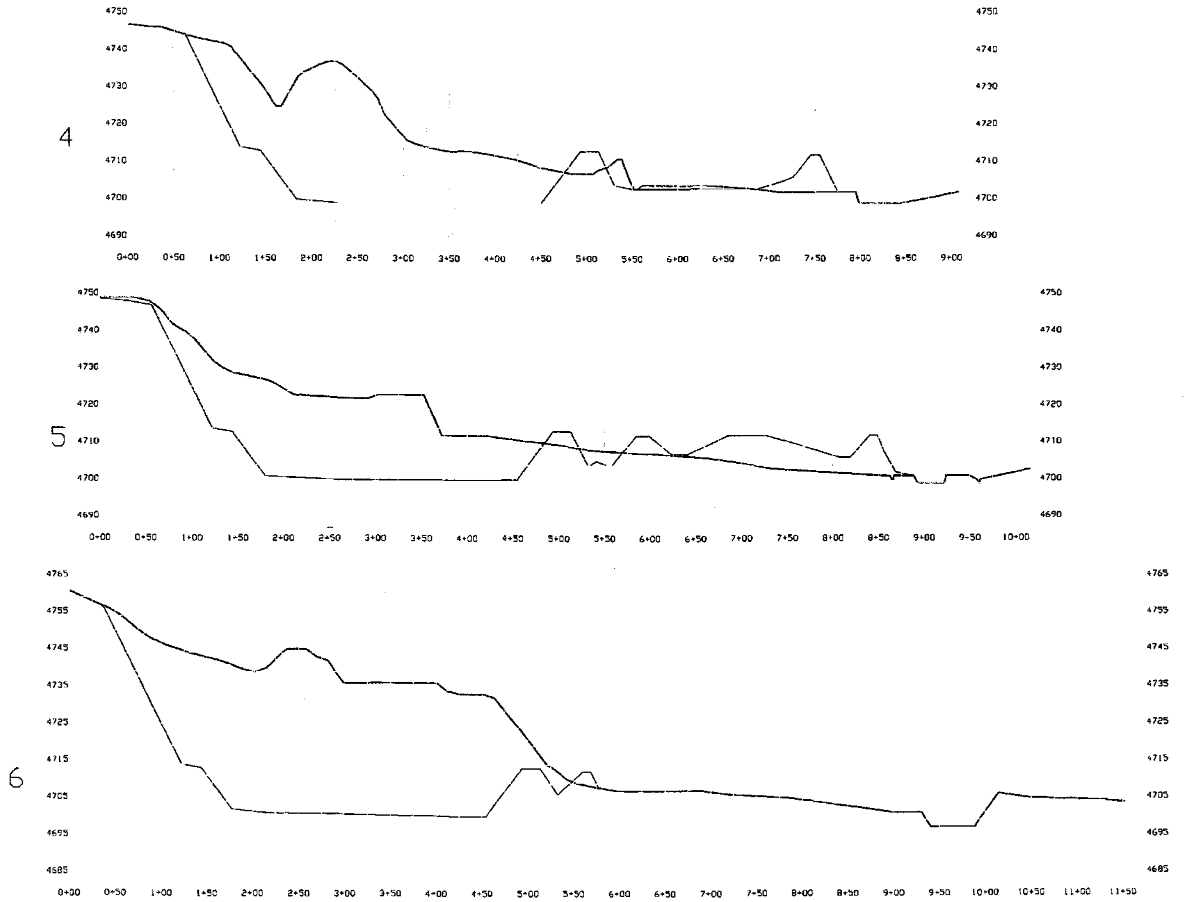
COUNTY

SHEET NO. 6

RECEIVED

FEB 25 2009

DIV. OF OIL, GAS & MINING



R N INDUSTRIES
WONSIT FACILITY
POND # 9 AMENDED
PROJECT NUMBER

UINTAH
COUNTY
SHEET NO. 7

CIVCO Engineering Inc.
P.O. Box 1758 Vernal, Utah 84078
Telephone: (435) 789-5448 Fax: (801) 789-4409

APPROVAL RECOMM. 2/09 TROY E. OSTLER, P.E.
APPROVED 2/09 GARY KENDALL
DESIGN 2/09 GLK CHECK TDO 2/09
DRAWN 2/09 GLK CHECK TDO 2/09
QUANT 2/09 GLK CHECK TDO 2/09
REVIEW
DATE
BY

NO	DATE	DESIGN REV. BY	MAPS	PARCELS AFFECTED	REQUEST BY	REMARKS
						ORIGINAL SUBMISSION FOR AUTHORIZATION

DATE
REVISIONS

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Oil, Gas and Mining

JOHN R. BAZA
Division Director

February 18, 2009

Mr. Roger Chapman
RN Industries, Inc.
P.O. Box 98
Roosevelt, Utah 84066

Subject: Wonsit Facility (Sec. 26 & 35) - Approval to Construct Produced Water Evaporative Pit 9, Section 35, Township 8 South, Range 21 East, Uintah County, Utah

Dear Mr. Chapman,

Your application/maps to construct the above referenced pit ("the Pit") was received on December 29, 2008 – February 10, 2009. The application was reviewed by Division staff and meets the requirements for a produced water disposal pit in accordance with Utah Administrative Code R649-9 et al., of the Oil and Gas General Rules.

Therefore approval to commence construction of the Pit is hereby granted in accordance with the following stipulations:

1. The Pit shall be constructed under the supervision of a registered professional engineer and shall meet all the conditions and requirements of the submitted application/maps.

2. The Division requires that our staff be informed of all phases of construction and be allowed the opportunity for inspection during the construction and installation activities including but not limited to, secondary liner installation, leak detection system emplacement, primary liner installation, and dike construction. Call Dan Jarvis at (801) 538-5338 or Richard Powell (435) 790-6145 at least 2 days prior to construction activity.

3. A secondary liner consisting of native and/or imported clay material, 1' thick throughout the entire pit floor, with an acceptable PI (Plastic Index) and permeability rate (as determined by a registered professional engineer) shall be emplaced below the leak detection system; engineer certification is required prior to installation of the leak detection system.

4. The leak detection system shall be emplaced as specified in the engineering plans, and the lines shall be exposed at time of inspection.

5. The 60-mil HDPE primary liner shall be emplaced over the leak detection system as specified in the engineering plans. The seams shall be tested prior to inspection, and the liner shall be keyed into trench at time of inspection.

6. The pit/site shall be fenced to deter wildlife and unauthorized personnel.

7. Secondary containment is required at the Facility to prevent pit waters from leaving the site in the event of catastrophic pit failure; secondary containment at Pit 9 shall be constructed as specified in the engineering plans.

8. Additional bonding in the amount of $113,397.00 is required prior to pits' use (see updated facility bonding spreadsheet attached).

Final approval to operate the Pit will be issued upon completion of the construction phase, and compliance with all the stipulations.

This approval does not exempt the operator from complying with all other federal, state and local rules and ordinances.

If you have any questions concerning this approval, please contact Lisha Cordova at (801) 538-5296 or Brad Hill at (801) 538-5315.

Sincerely,

Gil Hunt

Gil Hunt
Associate Director

GLH/LC/js
Enclosure (1): Facility Bonding Spreadsheet
cc: Brad Hill, Permitting Manager
Dan Jarvis, Operations Manager
Richard Powell, Roosevelt Office
Mike George, DEQ/Water Quality (SL)
Robert Leake, Water Rights/Dam Safety (Vernal)
Dave Marble, Water Rights/Dam Safety (SL)
Ben Williams, Wildlife Resources
Troy Ostler, P.E., CIVCO Engineering, Inc.
Matthew Cazier, Uintah County Planning Office
Bond File
Facility File

N:\O&G Permits\Disposal Facilities (Pits, LF, etc)\RN Industries (Wonsit)\Pit 9

DIVISION OF OIL, GAS AND MINING

STATEMENT OF BASIS
WONSIT FACILITY / PIT 9

Applicant: R N Industries Inc. **Pit Type:** Commercial/Evaporative

Location: Wonsit Facility - Sec. 26 (Pits 2,4,5, & 6) & Sec. 35 (Unloading Pit & Pits 1,3,7, 8 & 9)
T8S, R21E, Uintah County, Ut **Cause No.** WD-01-2005

Ownership and Local Setting:

The Wonsit Facility ("the facility") is located in the southeastern edge of Wonsit Valley north of Watson Road, approx. 3 miles NW of RNIs' Glen Bench Facility on Fee land owned by RNI, surrounded by Native American lands. The facility is approx. 24 miles south of Vernal, approx. ¾ mile north of the White River, and approx. 6 miles SE of the Green River. An application to construct the facility was received on 2/23/05 that involved one unloading pit and six evaporative pits. Approval to operate Pit 1 was granted on 4/26/05, followed by approval to operate the Unloading Pit on 7/19/05, Pit 2 on 7/28/05, Pit 3 on 11/28/05, Pit 4 on 1/4/06, Pit 5 on 2/16/06, and Pit 6 on 5/5/06. An application to expand the facility (3 additional evap. pits proposed) was received on 4/25/06. Approval to operate Pit 7 was granted 5/25/06. An application to construct Pit 8 was received on 6/1/06; approval to operate was granted on 9/21/06. An application to construct Pit 9 was received on 12/29/08; pit review is in progress. The pits/facility (including drainage diversion & secondary containment) was designed by a registered professional engineer (Troy Ostler, P.E./CIVCO) and construction operations "have been and are being" performed under his direct supervision. This analysis is specifically for Evaporative Pit 9.

Pit Design Specifications / Pit 9:

Containment for disposal of produced water derived from Oil & Gas operations.
Constructed in +80% cut, with compacted fill dikes constructed in lifts.
400' X 400' X 10' deep (including 2' of freeboard).
4:1 interior slopes, 3:1/4:1 exterior slopes.
Total storage capacity of 228,788 bbls or 29.49 acre-feet (not including 2' of freeboard).
Secondary liner (native/imported clay material, 1' thick throughout entire pit floor).
7-8 lateral leak detection system (3" diameter perforated/solid pipe surrounded by 6" of pea gravel), 50' centers, and external 18" capped monitoring sump inspected weekly.
Primary liner (flexible 60 mil HDPE liner keyed into trench).
Secondary containment (compacted berms, 5-10' high X 5' wide, 70,704 bbl capacity).
Drainage diversion(s).

Site Characteristics:

Pit 9 will be located NW of the Unloading Pit. Test boring soil sampling was conducted 2/9/09 (QC Testing) to define subsurface conditions, to assure that the liner will be placed on a firm stable base, and to determine the appropriate leak detection system (results on file).

The surface formation is the Uinta Formation comprised of interbedded sandstones, siltstones and shales overlain/interbedded with Quaternary alluvium derived from the Uinta Formation. Surface soils are a weathered sedimentary material comprised of fine-grained material, light tan-brown in color, with small-medium sized sandstone/siltstone rocks & fragments. There is little natural erosion at the site. The Uinta Formation sandstones are lenticular and discontinuous and do not generally make good aquifers.

Local flora (sparse) consists of native grasses, sagebrush, greasewood, prickly pear, salt brush, shadscale, etc; local fauna consists of reptiles, rodents, birds, coyotes, deer, etc.

There are numerous PGW's and several wells in drilling within a one-mile radius of the pit/facility. Kerr-McGees' Ouray 35-94 well (43-047-33053) is located SE/adjacent to Pit 9; the access road should not be impacted. RNI plans to construct a separate access road to Pit 9. Access road(s) to Kerr-McGees' Ouray 35-174 well (43-047-33248) located south of Pit 1 & west of Pit 7, and the Fed 35-52 St well (43-047-32697) located south of Pit 8 are minimally impacted by facility operations; the road(s) are being restored by RNI when deemed necessary as previously agreed to. See ArcView map dated 2/10/09.

Surface and Ground Water Protection:

A minor drainage bisects the NE quarter of the proposed pit; drainage will be diverted around the pit & secondary containment areas (see eng. maps). In addition, there is a major drainage (two forks that merge into one) 2-4' deep that runs in a southeasterly direction between Pit 9 & Unloading Pit and Pits 1-8, it is a seasonal intermittent drainage that flows to the White River located approx. ¾ miles south of the facility. The pit will be constructed in 80% cut, and will be located 100' (minimum) from the drainage; a stream alteration permit is being submitted by CIVCO/RNI to the US Army Corp of Engineers to relocate the drainage further away from the pit . The facility is not in a floodplain or wetland area.

Secondary containment is required at the facility to prevent pit water from leaving the site in the event of catastrophic pit failure or other breach; secondary containment will be constructed at Pit 9 (see eng. map) & currently exists in the Pit 1-8 area; both containments shall be inspected on a regular basis to ensure integrity. In addition, a "wind break" will be installed at Pit 9 when deemed necessary to prevent pit water from lapping over pit dikes during occasional high wind episodes.

Produced water is trucked & unloaded (4 hoses) into the Unloading Pit for separation; it is fenced & netted to deter wildlife/waterfowl. Following separation, the produced water is piped (below ground) from the Unloading Pit to Pit 1, then it is piped (above ground) to Pits 2-8 (& Pit 9 upon completion); all piping is compatible with the material or fluids it transports that meets the Spill Prevention, Control and Countermeasures Plan (SPCC) requirements.

Two feet of freeboard (or > if deemed necessary) will be maintained in Pit 9, and will be monitored for hydrocarbons; any accumulation will be skimmed off immediately and placed in a tank to be sold. The leak detection monitoring system will be inspected weekly and reported to the Division quarterly, any leaks will be reported to the Division immediately and corrective measures will be taken. Spray systems to enhance evaporation will be monitored to ensure that overspray does not occur.

A search of the Division of Water Rights database reveals that there are no underground water wells within 10,000 feet of the facility. Within a one-mile radius there is one active surface water permit south of the facility (No. 49-1659) issued to Price Water Pumping Inc. (source water is from the Green & White River's) for drilling gas wells.

The elevation at Pit 9 is 4745-4705'; the base of moderately saline ground water is +/- 4640-4500' (Tech Pub 92/Plate 1), +/-105-205' below surface. The average annual precipitation is 6.83" (Western Regional Climate Center 8/17/55-12/31/05/Ouray 4 NE); and the average evaporation rate is 56 inches. Meteoric waters are expected to evaporate and/or will be diverted around the pit/facility and secondary containment(s).

Site Security:

Pit 9 will be fenced to deter wildlife and unauthorized entry. A facility sign is posted. Field staff is on-site during regular business hours, and the gate is locked after hours. In addition, DOGM staff conducts periodic facility inspections.

Bonding:

Bonding for the Wonsit Facility has been determined using the following formula from R649-9-9, Bonding of Disposal Facilities, of the Oil & Gas Conservation General Rules:

$14,000 per acre of pit, partial acres will be calculated at the rate of $14,000 per acre; plus
$1.00 per barrel of produced water for one-quarter of the total storage capacity of the facility.

RNI has submitted facility bonding, Letter of Credit No. L5LS-275190 ($1,461,497.00), issued by JPMorgan Chase Bank that currently covers the Unloading Pit, and Pit's 1-8. Additional bonding for Pit 9 (& 2 tanks/400 bbl capacity ea) in the amount of $113,397.00 is required following completion of the construction phase, prior to pits' use. See updated facility bonding spreadsheet.

Actions Taken and Further Approvals Needed:

Properly designed, constructed, and maintained pits/facilities, including secondary containment(s) & drainage diversion(s), and compliance with the operating, monitoring, reporting, and recordkeeping requirements set forth under R649-9 et al, should pose no threat to fresh or useable surface and groundwater supplies.

A Notice of Agency Action, Cause No. WD-01-2005, was published in the Salt Lake Tribune on March 4, 2005, and in the Uintah Basin Standard on March 8, 2005 (15-day comment period). No comments or objections were received. Additional noticing is not required at this time.

An onsite review of Pit 9 was conducted on 2/4/09, in attendance; Ryan Chapman & field staff members (RNI), Gary Kendall (CIVCO), Contractors (QC Testing), and Lisha & Richard (DOGM). Ben Williams (DWR) was not invited (fee lands); the pit will be fenced to deter wildlife.

Misc info/other topics discussed:

1. No dirt work commenced prior to onsite.
2. Core sampling scheduled for 2/4/09 (QC Testing).
3. Landowner "RNI"; cultural resource clearance & paleo survey not required.
4. Existing "agreement" between RNI & mineral owners (Kerr-McGee, EOG, etc).
5. RNI plans to file a stream alteration permit with the US Army Corp of Engineers.
6. Berm compaction method "wheel-rolled method, 95% compaction".
7. Amended eng. maps (& analysis info requested 1/29/09 forthcoming).

Other approvals needed:

1. DEQ/Water Quality; Storm Water Pollution Prevention Plan "SWPPP".
   *RNI/Gary Kendall (CIVCO) referred to Mike George (801) 538-6146 or Scott Hacking.

2. Water Rights/Dam Safety; Small Dam (<20 acre ft) or Other (=/>20 acre ft).
   RNI/Gary Kendall (CIVCO) referred to Dave Marble (801) 538-7376 or Robert Leake.

3. Uintah County; Conditional Use Permit (expansion ops).
   RNI/Gary Kendall (CIVCO) referred to Matthew Cazier (435) 781-5335.

4. Compliance with all other federal, state and local rules and ordinances.

Reviewer(s): Lisha Cordova, Petroleum Specialist Date: Feb. 18, 2009

R649-9-3. Permitting of Disposal Pits
Analysis2 Document For Permit Review
R N Industries Inc. / Wonsit Facility / Pit 9
Sec. 26 (Pit's 2, 4, 5 & 6) & Sec. 35 (Unloading Pit & Pit's 1, 3, 7, 8 & 9)
Township 8 South, Range 21 East, Uintah County, Utah

R649-9-3. Permitting of Disposal Pits	
1. All commercial disposal pits and disposal pits located off of an existing mineral lease shall be bonded in accordance with R649-9-9, Bonding of Disposal Facilities to assure proper operation, maintenance, and closure of the pits.	1. RNI has submitted facility bonding, Letter of Credit #L5LS-275190 ($1,461,497), issued by JPMorgan Chase that covers the Unl. Pit & Evap. Pits 1-8. Add'l bonding in the amount of $113,397 for Pit 9 & Tanks 1-2 is required prior to pits' use. See updated facility bonding spreadsheet.
2. Application shall be made to the Division for approval of any disposal pit.	2. Ok. Orig. application rec'd 2/23/05. Pit 9 eng. maps rec'd 12/29/08 (CIVCO, Troy Ostler, P.E.).
2.1. The pit shall be designed appropriately for the intended purpose.	2.1. Ok.
2.2. Commercial disposal pits shall be designed and constructed under the supervision of a registered professional engineer.	2.2. Ok. See 2.
2.3. The application and site shall meet the following requirements:	2.3. Ok. See below.
2.3.1. The pit shall be located on level, stable ground, and an acceptable distance away from any established or intermittent drainage.	2.3.1. Ok. The ground is not level, slopes gently toward the NE; the pit will be constructed in 80% cut on stable ground (see 3.5), and will be 100' min. from a major drainage; a stream alteration permit is being submitted to the US Army Corp of Engineers to relocate the drainage further away from the pit.
2.3.2. The pit shall not be located in a geologically and hydrologically unsuitable area, such as aquifer recharge areas, flood plains, drainage bottoms, and areas near faults.	2.3.2. Ok.
2.3.3. The pit shall have adequate storage capacity to safely contain all produced water even during those periods when evaporation rates are at a minimum.	2.3.3. Ok. Max. pit capacity is 228,788 bbls (-2' FB). A 2' FB (or > if deemed necessary) shall be maintained in the pit at all times.
2.3.4. The pit shall be designed and constructed so as to prevent the entrance of surface water.	2.3.4. Ok. In addition, a drainage diversion ditch (5' wide X 5-10' deep) shall be constructed to divert storm water/sheet flow away from the pit area.
2.3.5. The pit shall be designed, maintained and operated to prevent unauthorized surface or subsurface discharge of water.	2.3.5. Ok. In addition, secondary containment (berms 5-10' high X 5' wide, wheel-rolled compaction method, 70,704 bbl capacity), and pit wind breaks as deemed necessary.
2.3.6. The pit shall be fenced and maintained to prevent access by livestock, wildlife and unauthorized personnel and if required, equipped with flagging or netting to deter entry by birds and waterfowl.	2.3.6. Ok. The pit will be fenced, and netted if deemed necessary.
2.3.7. The pit levees for produced water pits receiving volumes in excess of five barrels per day, shall be constructed so that the inside grade of the levee is no steeper than 3:1 and the outside grade no steeper than 2:1. The top of the levee shall be level and of sufficient width to allow for adequate compaction.	2.3.7. Ok. 4:1 interior slopes & 3:1-4:1 exterior slopes. Level levee tops, 20' wide, wheel-rolled compaction method.
2.3.8. All approved produced water pits not located at a well site shall be identified with a suitable sign.	2.3.8. Ok. A facility has been posted.
2.3.9. The artificial materials used in lining pits shall be impervious and resistant to weather, sunlight, hydrocarbons, aqueous acids, alkalies, salt, fungi, or other substances which might be contained in the produced water.	2.3.9. Ok. 60-mil HDPE primary liner (specs previously submitted).
3. If rigid materials are used, leak proof expansion joints shall be provided, or the material shall be of sufficient thickness and strength to withstand, without cracking, expansion, contraction and settling movements in the underlying earth.	3. N/A.
3.1. If flexible materials are used, they shall be of sufficient thickness and strength to be resistant to tears and punctures.	3.1. Ok. 60-mil HDPE primary liner (specs previously submitted).
3.2. Commercial disposal pits shall be lined with a minimum liner thickness of 40 mils or as approved by the Division.	3.2. Ok. 60-mil HDPE primary liner.
3.3. Lined pits constructed in relatively impermeable soils shall have an underlaying gravel filled sump and lateral system or suitable leak detection system.	3.3. N/A.
3.4. Lined pits constructed in relatively permeable soils shall have a secondary liner underlaying the leak detection system, that is graded so as to direct leakages to the observation sump.	3.4. Ok. A secondary liner of native and/or imported clay material, 1' thick, with an acceptable PI shall underlie the LD system; eng. "certification" is required prior to LD install (see also 5.9).
3.5. Test borings shall be taken in sufficient quantity and to an adequate depth to satisfactorily define subsurface conditions and assure that the liner will be placed on a firm stable base and to determine the appropriate leak detection system.	3.5. Ok. Soils sampling conducted 2/9/09 (QC Testing); see testing results & eng. certification from Troy Ostler, P.E./CIVCO rec'd 2/10/09.
4. Requirements for Unlined Disposal Pits.	
4.1 An application for disposal of produced water into an unlined pit will be considered if such disposal does not demonstrate significant pollution potential to surface or ground water and	4 et al. N/A.

meets at least one of the following criteria:	
4.2. The water to be disposed of does not have a higher total dissolved solids "TDS" content than ground water that could be affected and provided that the water does not contain objectionable levels of constituents and characteristics including chlorides, sulfates, pH, oil, grease, heavy metals and aromatic hydrocarbons.	4 et al. N/A
4.3. That all, or a substantial part of the produced water is being used for beneficial purposes such as irrigation and livestock or wildlife watering and a water analysis indicates that the water is acceptable for the intended use.	
4.4. The volume of water to be disposed of does not exceed five barrels per day on a monthly basis.	
5. Application Requirements for Produced Water Pits.	5. See below.
5.1. Applications for disposal of produced water into lined pits shall include the following information:	5.1. See below.
5.2. A topographic map and drawing of the site on a suitable scale that indicate the pit dimensions, cross section, side slopes, leak detection system and location relative to other site facilities. The drawings shall be of professional quality.	5.2. Ok. See R649-9-3.2.
5.3. The maximum daily quantity of water to be disposed of and a representative water analysis of such water that includes the concentrations of chlorides and sulfates, pH, total dissolved solids "TDS", and information regarding any other significant constituents if requested.	5.3. Ok. Max. daily quantity of water to Pit 9 will be the amount siphoned from the pits in Phase 1 and/or Phase 2. A representative water analysis previously submitted (American West Analytical Laboratories, 3/30/05).
5.4. Climatological data indicating the average annual evaporation and precipitation for the area.	5.4. Ok. Average annual evap. rate is 47.59" (NOAA's National Weather Service), & average annual precip. is 6.83" (Western Regional Climate Center/Ouray 8/17/55-12/31/05).
5.5. The method and schedule for disposal of precipitated solids.	5.5. Ok. No precipitated solids anticipated (info rec'd 3/30/05); will revisit at time of pit closure.
5.6. Drawings of unloading facilities and explanation of the method for controlling and disposing of any liquid hydrocarbon accumulation so that the evaporation process is not hampered	5.6. Ok. Existing netted unloading/skim pit (above ground hoses) and associated tanks (separator/oil); any hydrocarbon accumulation in Pit 9 will be removed via pump truck & be placed in oil tank to be sold.
5.7. The engineering data and design criteria used to determine the pit size which includes a 2-foot free-board.	5.7. Ok. See 5.2 & R649-9-3.2.
5.8. The type, thickness, strength, and life span of material to be used for lining the pit and the method of installation.	5.8. Ok. 60-mil HDPE primary liner (specs previously submitted, +20 yr lifespan); installed per manufactures specifications.
5.9. A description of the leak detection method to be utilized.	5.9. Ok. 7-8 lateral LD system (50' centers) & 15" diameter capped monitoring sump (see maps for eng. details).
5.9.1. The proposed inspection frequency of the detection system.	5.9.1. Ok. Weekly inspections (DOGM requirement).
5.9.2. The proposed procedures for repair of the liner should leakage occur.	5.9.2. Ok. Pit will be drained & leak(s) will be repaired with heat seal patch.
6. Applications for disposal of produced water into Unlined Pits shall include the following information:	
6.1. A topographic map and drawing of the site on a suitable scale that indicate the pit dimensions, cross section, side slopes, size and location relative to other site facilities.	
6.2 The daily quantity of water to be disposed of and a representative water analysis of such water that includes the total dissolved solids "TDS", pH, oil and grease content, the concentrations of chlorides and sulfates, and information regarding any other significant constituents if required.	
6.3. Climatological data indicating the average annual evaporation and precipitation for the area.	
6.4. The estimated percolation rate based on soil characteristics under and adjacent to the pit.	
6.5. Estimated depth and areal extent of any USDW in the area and an indication of any effect or interaction of the produced water with any such water resources present at or near the surface.	6 et al. N/A.
6.6. If beneficial use is the basis for the application, written confirmation from the user should be submitted.	
6.7. If the application is made on the basis that surface and subsurface waters will not be adversely affected by disposal in an unlined pit, the following additional information is required:	
6.7.1. A map showing the location of surface waters, water wells, and existing water disposal facilities within a one mile radius of the proposed disposal facility.	
6.7.2. The weighted average concentration of total dissolved solids "TDS" of all surface and subsurface waters within a one mile radius that might be affected by the proposed disposal.	
6.7.3. Any reasonable geological and hydrological evidence showing that the proposed disposal method will not adversely affect existing water quality or major uses of such waters.	

7. Within 30 days of the submission of an application for disposal of produced water into a commercial disposal pit, the division shall review the application as to its completeness and adequacy for the intended purpose and shall require such changes that are found necessary to assure compliance with the applicable rules. If the application is in order, the Division shall provide for a public notice to be published in a newspaper of general circulation in the county where the pit is to be located.	7. Ok. Application rec'd 12/29/08, initial review completed 1/28/09. A Notice of Agency Action, Cause No. WD-01-2005, was issued 2/24/05 and was published *in the SL Tribune on* 3/4/05, *and the* Uintah Basin Standard on 3/8/05. No comments and/or objections were rec'd. Approval to begin construction was granted 4/8/05, followed by approval to operate on 4/28/05. Add'l noticing is not required for Pit 9.
R649-9-4. Permitting of Other Disposal Facilities. 1. Facilities used for the treatment and disposal of E and P wastes other than evaporation pits shall be permitted by the Division. This would include such activities as landfarming, composting, solidifying, bioremediation, and others. 2. All commercial treatment and disposal facilities must be bonded in accordance with R649-9-9, Bonding of Disposal Facilities, to assure proper operation, maintenance, and closure of the facility. 3. Application Requirements for Treatment and Disposal Facilities. The application shall contain the following: 3.1. A complete description of the proposed facility. 3.2. Processes involved including a complete list of all wastes to be accepted at the facility and products generated. 3.3. Maps and drawings of suitable scale showing all facilities and equipment. 3.4. Materials or products to be applied to the land surface or subsurface shall meet the Division's cleanup levels for contaminated soil and other wastes. 3.5. If leachability and/or toxicity is of concern due to the type or source(s) of wastes, tests will be required and may utilize the Toxicity Characteristic Leaching Procedure (TCLP). 3.6. The submission of an application to the Division of Water Quality, Department of Environmental Quality, for a discharge permit may be required if it is determined that the facility and associated activity will not have a de minimus actual or potential effect on ground water quality. 3.7. If the Division determines there is potential for discharge, or if the proposal involves a commercial disposal operation it will be forwarded to the Division of Water Quality for their review.	R649-9-4 et al. N/A
R649-9-5. Construction and Inspection Requirements for Disposal Facilities.	R649-9-5. See below.
1. Division personnel shall be afforded a reasonable opportunity for inspection of any proposed disposal facility during the construction and operation of the facility.	1. Operator shall comply.
2. The division shall be notified at least two working days prior to the installation of a pit liner so that an inspection of the leak detection system can be conducted.	2. Operator shall comply.
3. In any case, the division shall be notified after completion of facility construction, at least two working days prior to its use, so that an inspection can be conducted to verify that the facility has been constructed in accordance with the approved application.	3. Operator shall comply.
4. Disposal facilities shall be operated in accordance with an approved application and in a manner which does not cause pollution or safety and health hazards.	4. Operator shall comply.
5. Failure to meet the requirements and standards for construction and operation of a disposal facility shall be considered as noncompliance and will result in the imposition of corrective actions and compliance schedules or a cessation of operations order.	5. Operator/Division shall comply.
R649-9-6. Reporting and Recordkeeping Requirements for Disposal Facilities.	R649-9-6. See below.
1.All unauthorized discharges or spills from disposal facilities including water observed in a leak detection system shall be promptly reported to the division.	1. Operator shall comply.
2.Each producer who utilizes any approved produced water disposal facility shall comply with the reporting requirements of R649-8-10.	2. Operator shall comply.

3. Each operator of a disposal facility, excluding disposal wells, shall report to the Division on a quarterly basis. This report shall include the volume and type of wastes received at the facility during the quarter and results of the leak detection system inspections.	3. Operator shall comply.
4. The occurrence of water in a leak detection system during operation of a pit constitutes liner failure and requires immediate action.	4. Operator shall comply.
4.1. The Division has the option of allowing the operator a short period of time to take corrective action.	4.1. Operator/Division shall comply.
4.2. Further utilization of the pit will be allowed only after liner repairs and an inspection by the Division.	4.2. Operator/Division shall comply.
5. Each owner/operator of a commercial disposal facility shall keep records showing at a minimum the following: date and time waste was received, origin, volume, type, transporter, and generator of the waste. These records shall be available for inspection by the Division for at least six years.	5. Operator shall comply.
R649-9-7. Final Closure and Cleanup of Disposal Facilities.	R649-9-7. See below.
1. A plan for final closure of a disposal facility shall be submitted to the Division for approval. The closure plan shall include the following:	1. Operator shall comply.
1.1. Provisions for removal of all equipment at the site.	1.1. Operator shall comply.
1.2. Proposed plans and procedures for sampling and testing soils and ground water at the site.	1.2. Operator shall comply.
1.3. Soils will need to meet the Division's Cleanup Levels for Contaminated Soils or background levels whichever is less stringent.	1.3. Operator shall comply.
1.4. Provisions for a monitoring plan if required by the Division, and	1.4. Operator shall comply.
1.5. A consideration of post disposal land use and landowner requests when the closure plan is developed.	1.5. Operator shall comply.
2. A bond for a disposal facility will be released when the requirements of a closure plan approved by the Division has been met as determined by the Division.	2. Operator/Division shall comply.
R649-9-8. Variances from Requirements and Standards. Requests for approval of a variance from any of the requirements or standards of these rules shall be submitted to the director in writing and provide information as to the circumstances which warrant approval of the requested variance and the proposed alternative means by which the requirements or standards will be satisfied. Variances may be approved only after proper notice and public hearing before the board.	R649-9-8. Operator/Division shall comply; no variances requested at this time.
R649-9-9. Bonding of Disposal Facilities.	R649-9-9. See below.
1. Disposal facilities, other than injection wells, shall be bonded according to this rule in order to protect the State and oil and gas producers from unnecessary liabilities and cleanup costs in the future. The objectives are to provide the State with adequate security to allow rehabilitation of a site to the point of preventing further or future pollution, and health and safety hazards should a facility owner default.	1. Operator shall comply.
1.1. The parameters used to calculate the proper bond amount are: pit area, storage capacity, and volume of waste stored.	1.1. Operator/Division shall comply.
1.2. Bonds accepted shall be of the same type as those accepted for wells i.e. surety, collateral, or a combination of the two as described in the R649-3-1.	1.2. Operator shall comply.
1.2.1. In order to assist facility owners of facilities operating prior to 1997 to establish bonding, the total bond amount provided may consist of an initial amount as determined by the division and an additional amount collected at a price per barrel and/or price per cubic yard of waste collected until the total bond amount is reached.	1.2.1. N/A.
1.2.2. The total bond will be held by the division or financial institution until the facility has been closed and inspected by the division in accordance with a division approved closure plan.	1.2.2. Operator/Division shall comply.
1.3. Total bond amount is calculated using values for pit area, pit storage capacity, and volume of stock piled waste material.	1.3. Operator/Division shall comply.

1.3.1. No salvage value of equipment or removal cost is used.	1.3.1. Operator/Division shall comply.
1.3.2. This bond will only be used by the State to treat or remove waste from the site and secure the facility to prevent any future contamination should the facility owner default on cleanup responsibilities.	1.3.2. Division shall comply.
1.3.3. Bond amounts will be calculated as follows, and the per volume or per acre figures may be adjusted periodically to compensate for change in cost to perform the necessary cleanup work: $14,000 per acre of pit, partial acres will be calculated at the rate of $14,000 per acre; plus $1.00 per barrel of produced water for one-quarter of the total storage capacity of the facility; plus $30 per cubic yard of solid or semi-solid waste material stockpiled at the facility. $10,000 Minimum bond amount.	1.3.3. Operator/Division shall comply.
1.4. All commercial disposal facilities (except injection wells covered by R649-3-1) will be covered by an adequate and acceptable bond before being permitted to accept any exploration and production waste. The initial and minimum bond payment will be at least $10,000. The total bond amount will be calculated as described in R649-9-9-1.3. If requested by the disposal facility owner, the bond beyond the initial amount may be posted at a rate of two cents per barrel of liquid or sixty cents per cubic yard of solid/semi-solid waste material accepted for disposal at the facility.	1.4. Operator/Division shall comply. See R649-9-3.1 (facility bonding information) & R649-9-9.1.3.2 (tank waste). *Portions of this rule does not apply to pits/facilities permitted & operated after 1996, see R649-9-9.1.2.1.

Comments:

12/29/08 Rec'd eng. maps for Pit 9 from Roger Chapman/RNI (prepared by Troy Ostler, P.E./CIVCO).

01/29/09 Initial permit review completed. A copy of the analysis document & an updated **preliminary** facility bonding spreadsheet was emailed to Roger Chapman/RNI at roger@rnindustries.com; add'l info requested (core sampling/results, etc).

02/04/09 Onsite review conducted, in attendance; Ryan Chapman & field staff members (RNI), Gary Kendall (CIVCO), Consultants (QC Testing), Lisha & Richard (DOGM). Ben Williams (DWR) was not invited (fee lands); the pit will be fenced to deter wildlife.

02/05/09 Amended eng. maps rec'd (Troy Ostler, P.E./CIVCO); w/o add'l information.

02/10/09 Additional information received (soils testing results/QC Testing, and info. requested on 1/29/09 (Troy Ostler, P.E./CIVCO).

2/18/09 Permit review completed; approval to construct in progress.

Reviewer(s): Lisha Cordova, Petroleum Specialist

Date: February 18, 2009 (Analysis2)

CIVCO Engineering, Inc.
Civil Engineering Consultants
P.O. Box 1758
365 West 50 North, Suite W-1
Vernal, Utah 84078

January 29, 2009

Lisha Cordova
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84180

RECEIVED
FEB 10 2009
DIV. OF OIL, GAS & MINING

Re: Chapman Disposal Ponds at Wonsit Facility Pond #9,

Wonsit Facility Pit 9 Analysis Answers

2.3.1 Ground not level- The pit is constructed 80% in cut, the pit will be built on stable ground. The pond will be 100 ft min. from a major drainage. A stream alteration permit is being submitted to the Army Corps of Engineers to relocate the drainage further away from the pit.

2.3.2 The pit is not located in a drainage bottom, flood plain, aquifer recharge area, geological and hydrologically unsuitable or fault area.

2.3.5 The compaction method for the secondary containment berm is the wheel rolled method.

2.3.6 The pit will be fenced to keep wildlife out.

2.3.7 The compaction method of the levee will be the wheel rolled method.

3.5 The test boring information is submitted with this report.

5.3 The max. daily quantity of water to pit 9 will be the amount siphoned from the pits in phase 1 and/or phase 2.

If you should have any questions or need additional information concerning this matter, please feel free to contact myself at CIVCO Engineering Inc. (435-789-5448).

Sincerely,

Troy D. Ostler

Troy D. Ostler, P.E.
CIVCO Engineering Inc.

cc: Nile Chapman
Project File

Phone (435)789-5448 ✱ Fax (435)789-4485
Email: garykendall@civcoengineering.com

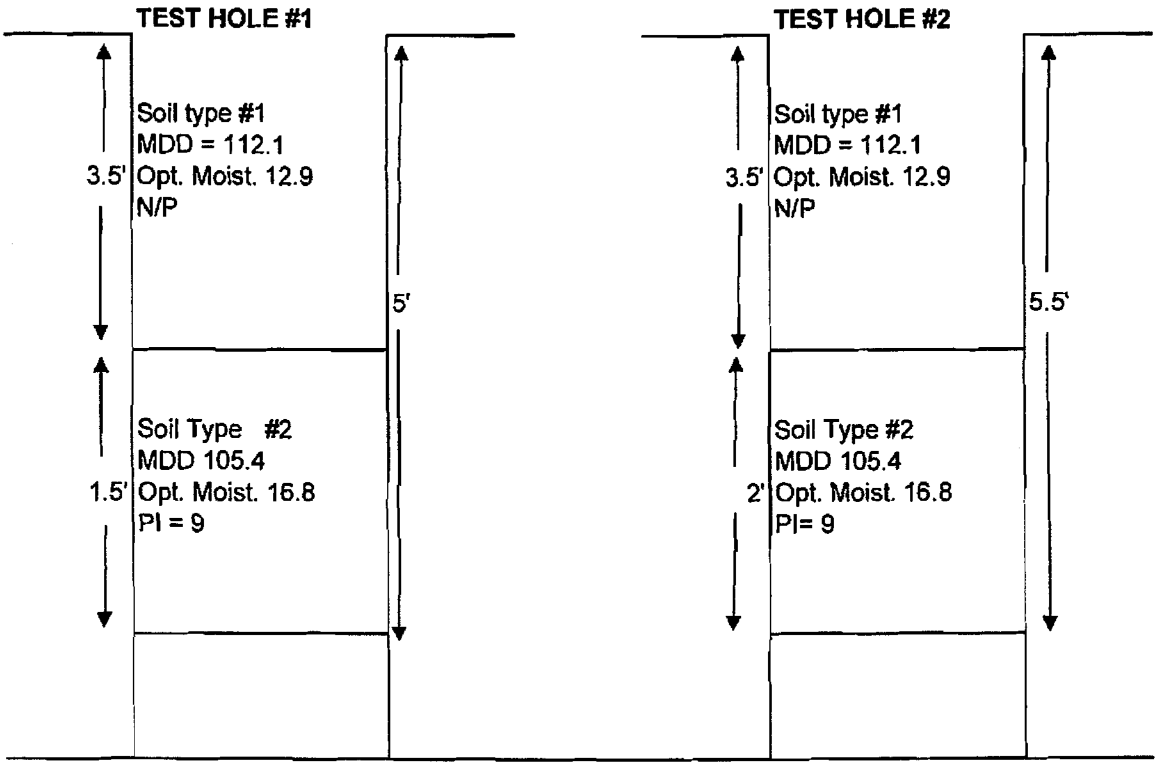
Q. C. TESTING

TESTING LOG

CLIENT: CIVCO Engineering
PROJECT: Wonsit Valley Pond #9
DATE: 2/9/2009

TESTS RUN: Soil classification

REMARKS:



Q. C. TESTING

TESTING LOG

CLIENT: CIVCO Engineering

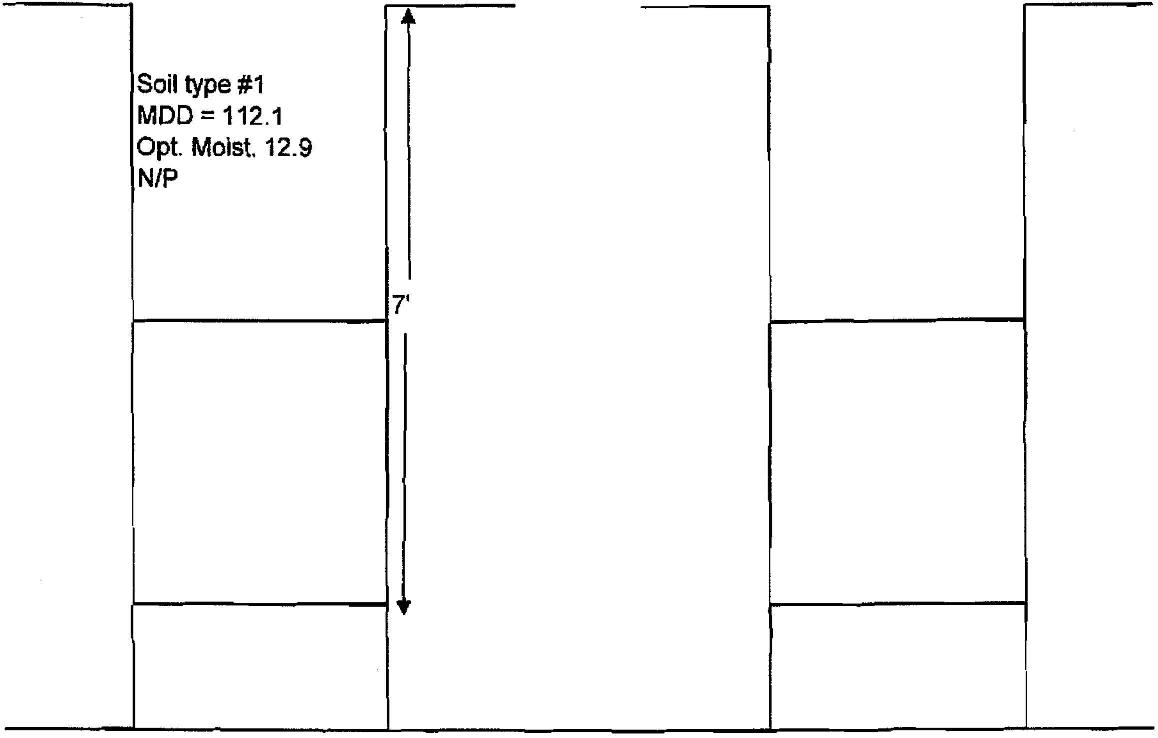
PROJECT: Wonsit Valley Pond #9

DATE: 2/9/2009

TESTS RUN: Soil classification

REMARKS:

TEST HOLE #3



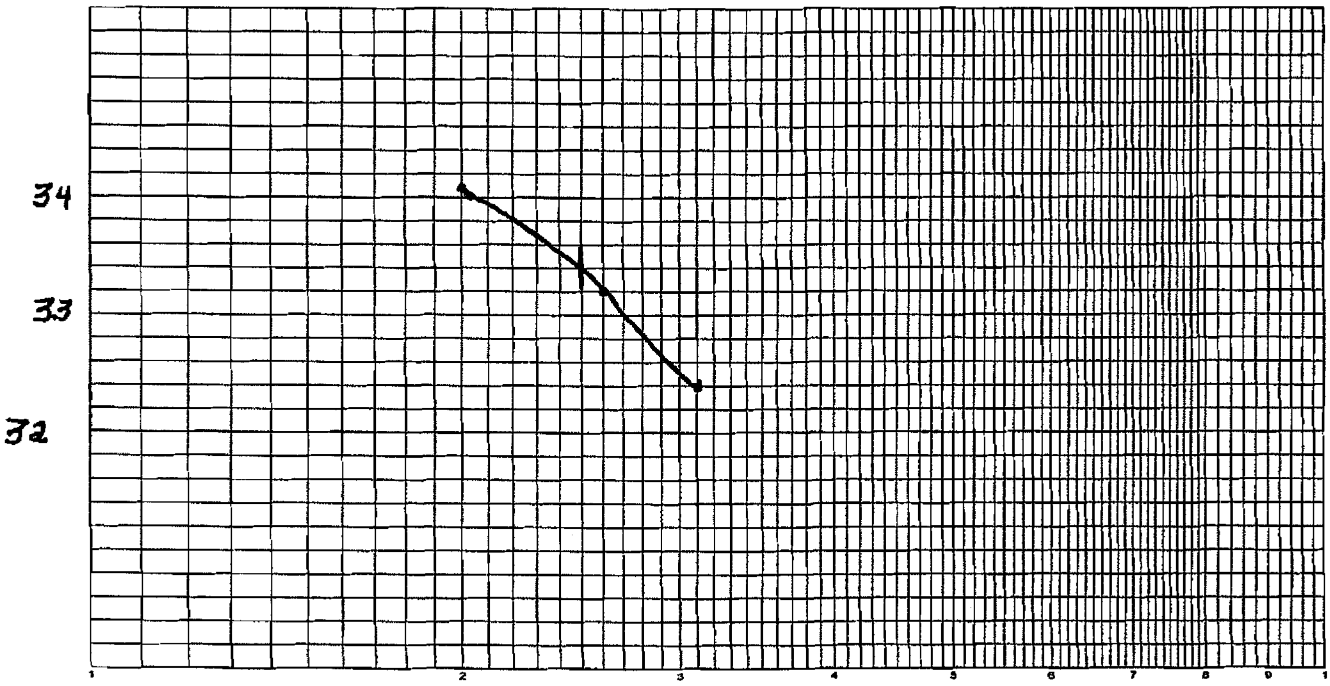
Q. C. TESTING

Liquid Limit-Plastic Limit-Field Moisture

PROJECT Wonsit Valley Disposal
SAMPLED BY Karl Lund
JOB NO. Pond #9
SAMPLE NO Soil Type 2
DATE SAMPLED 2-6-09
TESTED BY Karl Lund

	LIQUID LIMIT					PLASTIC LIMIT	
Trial No.	1	2	3	4	5	1	2
Can No.	9	10	11			12	
No. of Blows	31	26	20				
1 Wt. Can+Wet Soil	26.64	25.76	27.44			18.37	
2 Wt. Can+Dry Soil	23.50	22.79	24.02			17.48	
3 Wt. of Water(1-2)	3.14	2.97	3.42			0.89	
4 Wt. of Can	13.82	13.84	14.00			13.71	
5 Wt. Dry Soil(2-4)	9.68	8.95	10.02			3.77	
6 % Moisture(3/5x100)	32.4	33.2	34.1			23.6	

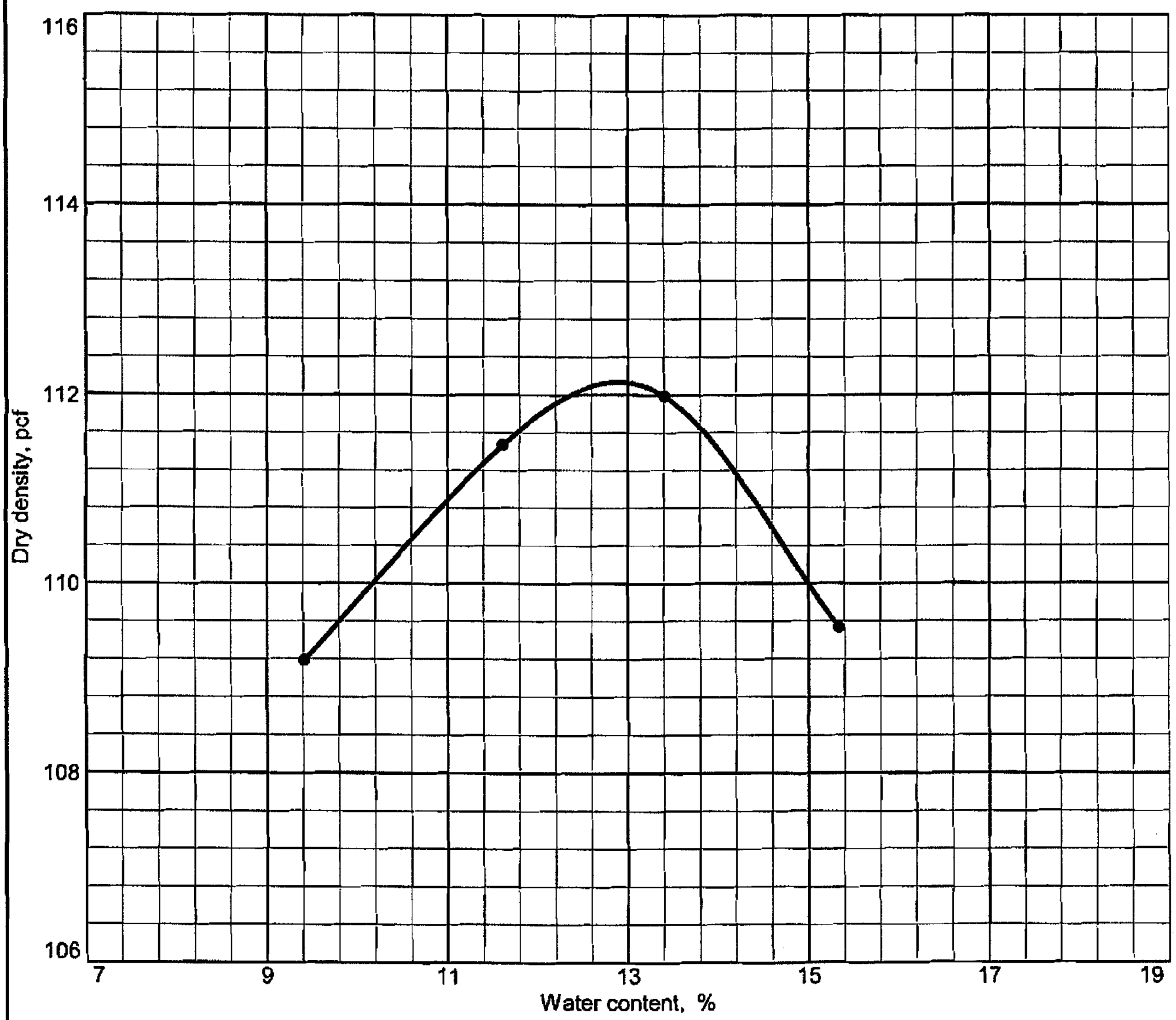
FLOW CURVE



NUMBER OF BLOWS

Liquid Limit (L)	33	Plastic Limit (P)	24	Plasticity Index (I)	9

COMPACTION TEST REPORT



Test specification: AASHTO T 99 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
		T-99-D						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.1 pcf Optimum moisture = 12.9 %	soil type I silty sands yellow

Project No. **Client:** CIVCO Engineering
Project: Wonsit Valley Disposal Ponds
Date: 2-6-09
● **Location:** Pond #9

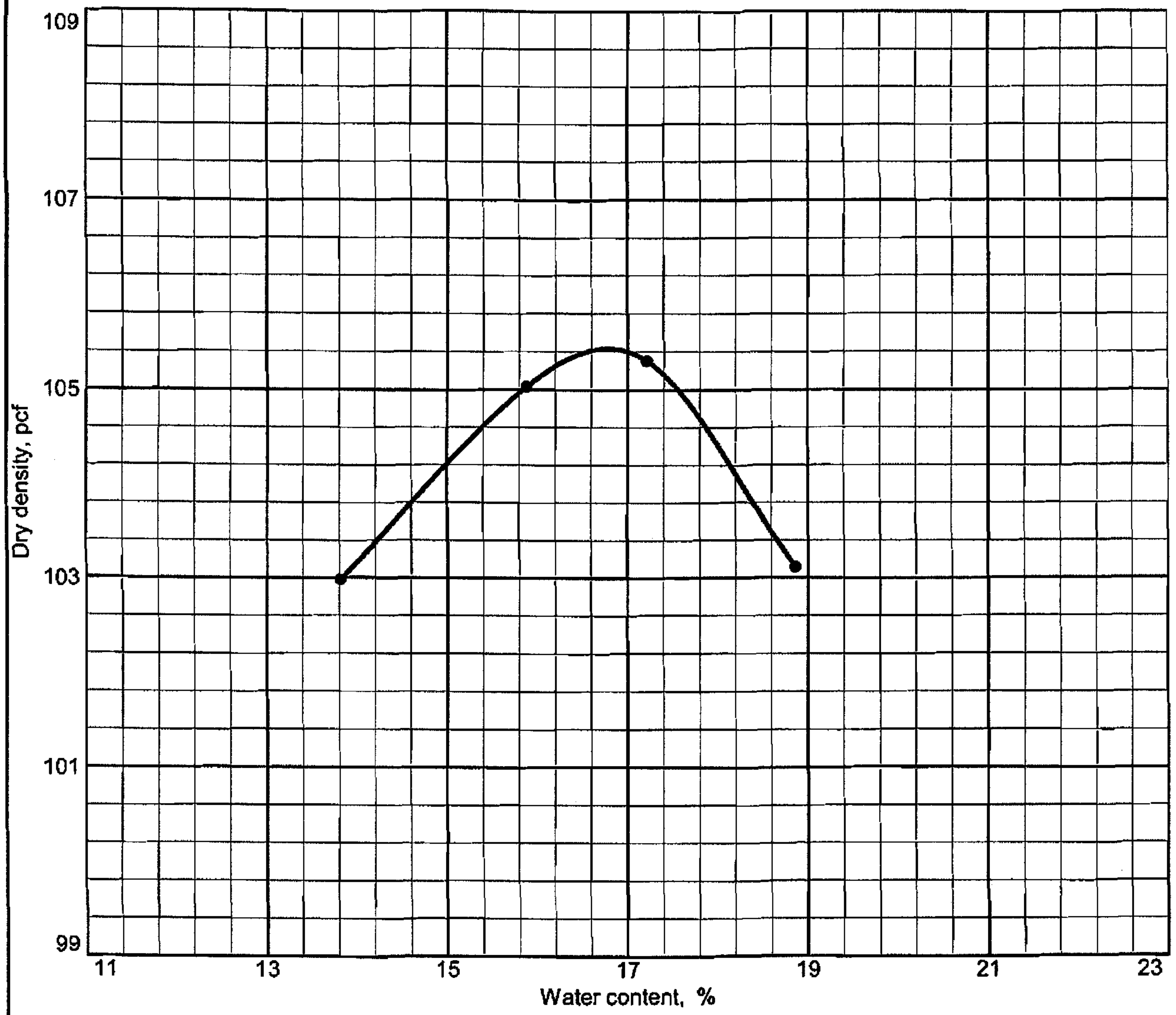
Remarks:

COMPACTION TEST REPORT

QC TESTING, INC.

Figure

COMPACTION TEST REPORT



Test specification: AASHTO T 99 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
		T-99-D						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 105.4 pcf Optimum moisture = 16.8 %	soil type 2 purple shale

Project No. **Client:** CIVCO Engineering

Project: Wonsit Valley Disposal Ponds

Date: 2-6-09

● **Location:** Pond #1 log hole

Remarks:

COMPACTION TEST REPORT

QC TESTING, INC.

Figure

Q. C. Testing. Inc

2550 W 500 N #2A
VERNAL, UTAH 84078
Phone (435) 789-0220
Fax (435) 781-1876

SIEVE ANALYSIS AND ATTERBERG LIMITS

Project Client: CIVCO Engineering
Project Name No. Wonsit Valley
Material Type: soil type #1
Stations: Pond #9
Distance from CL:
Depth:
Date Sampled: 2/4/2009
Date Tested: 2/5/2009

AASHTO T-27		Coarse Gradation				
Sieve Size	Weight Ret.	% Ret.		% Total Passing	Sieve Size	Target Specs
					3"	
2"					2"	
1.5"					1.5"	
1" (25mm)					1"	
3/4" (19mm)					3/4"	
1/2" (12.5mm)					1/2"	
3/8" (9.5mm)					3/8"	
#4 (4.75mm)					#4	
-#4 (4.75mm) WET WT.						
-#4 (4.75mm) DRY WT.						
Total						

MF=

Tested By Karl Lund/Mike Morgan

Atterberg Limit	
Liquid Limit	18
Plastic Limit	NP
Plastic index	NP
Classification	A-2-4

silty sands

-#4 Moisture Data	
Wet Wt.	645.2
Dry Wt.	617.8
H2O Wt.	27.4
H2O %	4.4
Washed Dry Wt.	

Fine Gradation						
Sieve Size	Weight Ret.	% Ret.	% Pass			
#4 (4.75mm)						
#8 (2.36mm)			100			
#10 (2.0mm)	5.8	0.4	99.6			
#16 (1.18mm)						
#20 (850μm)	22.0	3.6	96.0			
#30 (600μm)						
#40 (425μm)	105.0	17.0	79.0			
#50 (300μm)						
#60 (250μm)						
#80 (180μm)						
#100 (150μm)						
#200 (75μm)	368.0	60.0	19.0			
-#200 (75μm)	117.0	19.0				
Total	617.8	100				

Pan 35

Remarks

Q. C. Testing. Inc

2550 W 500 N #2A
VERNAL, UTAH 84078
Phone (435) 789-0220
Fax (435) 781-1876

SIEVE ANALYSIS AND ATTERBERG LIMITS

Project Client: CIVCO Engineering
Project Name No. Wonsit Valley Disposal Ponds (Chapman)
Material Type: Soil Type 2 Stations: Pond 9
Distance from CL: Depth: Date Sampled: 2/4/2009 Date Tested: 2/5/2009

AASHTO T-27		Coarse Gradation				
Sieve Size	Weight Ret.	% Ret.		% Total Passing	Sieve Size	Target Specs
					3"	
2"					2"	
1.5"				100.0	1.5"	
1" (25mm)	106.1	2.5		97.5	1"	
3/4" (19mm)	60.3	1.4		86.1	3/4"	
1/2" (12.5mm)	187.3	4.4		91.7	1/2"	
3/8" (9.5mm)	224.0	5.3		86.4	3/8"	
#4 (4.75mm)	637.0	15.2		71.2	#4	
-#4 (4.75mm) WET WT.	3022.0	71.2				
-#4 (4.75mm) DRY WT.	4243.0	100				
Total						

MF= Tested By Karl Lund/Mike Morgan

L-8

Fine Gradation						
Sieve Size	Weight Ret.	% Ret.	% Pass			
#4 (4.75mm)						
#8 (2.36mm)			100			
#10 (2.0mm)	20.4	3.4	96.6	68.8		
#16 (1.18mm)						
#20 (850μm)	79.0	13.2	83.4	59.4		
#30 (600μm)						
#40 (425μm)	81.4	13.4	70.0	49.8		
#50 (300μm)						
#60 (250μm)						
#80 (180μm)						
#100 (150μm)						
#200 (75μm)	189.0	32.0	38.0	27.1		
-#200 (75μm)	226.4	38.0				
Total	596.2	100.0				

Pan

Atterberg Limit	
Liquid Limit	33
Plastic Limit	24
Plastic index	9
Classification	A-2-4

clayey shale purple

-#4 Moisture Data	
Wet Wt.	4453
Dry Wt.	4243
H2O Wt.	210
H2O %	5.0
Washed Dry Wt.	

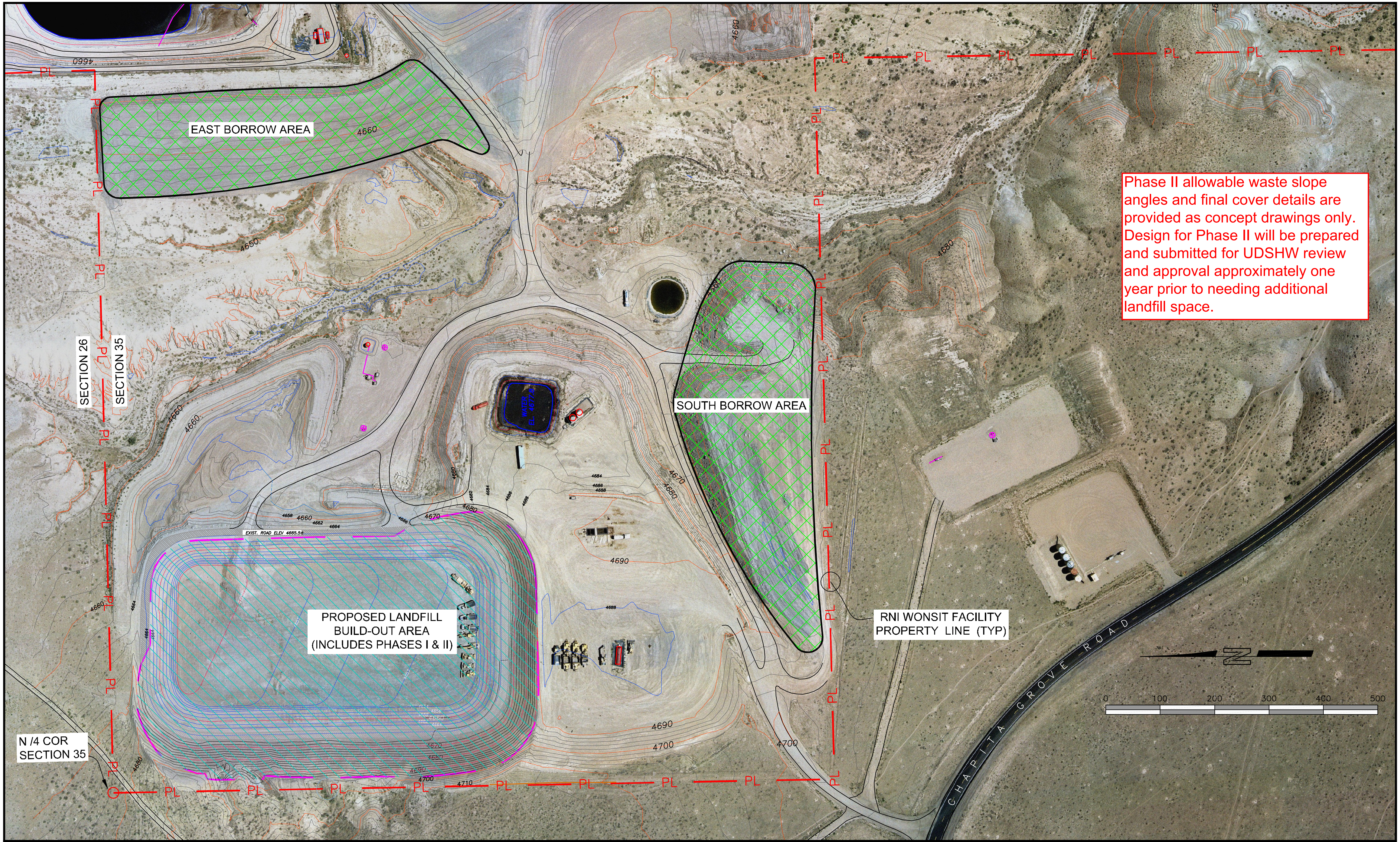
LL Pan A12

Remarks SPLIT GRADATION

Appendix G3

Phase I Design Drawings and Phase II Conceptual Drawings

Note: Vertical elevations shown on Drawings 1 through 9 are approximately 62.7 feet below the North American Vertical Datum of 1988.



Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.

ISSUE / REV	DESCRIPTION	TECH	ENG	DATE
0	RNI REVIEW	JK	KJS	13.02.13

DISCLAIMER:

SCALE:
SCALE: 1" = 80 FT

Wonsit
RNI
R.N. INDUSTRIES
Utah

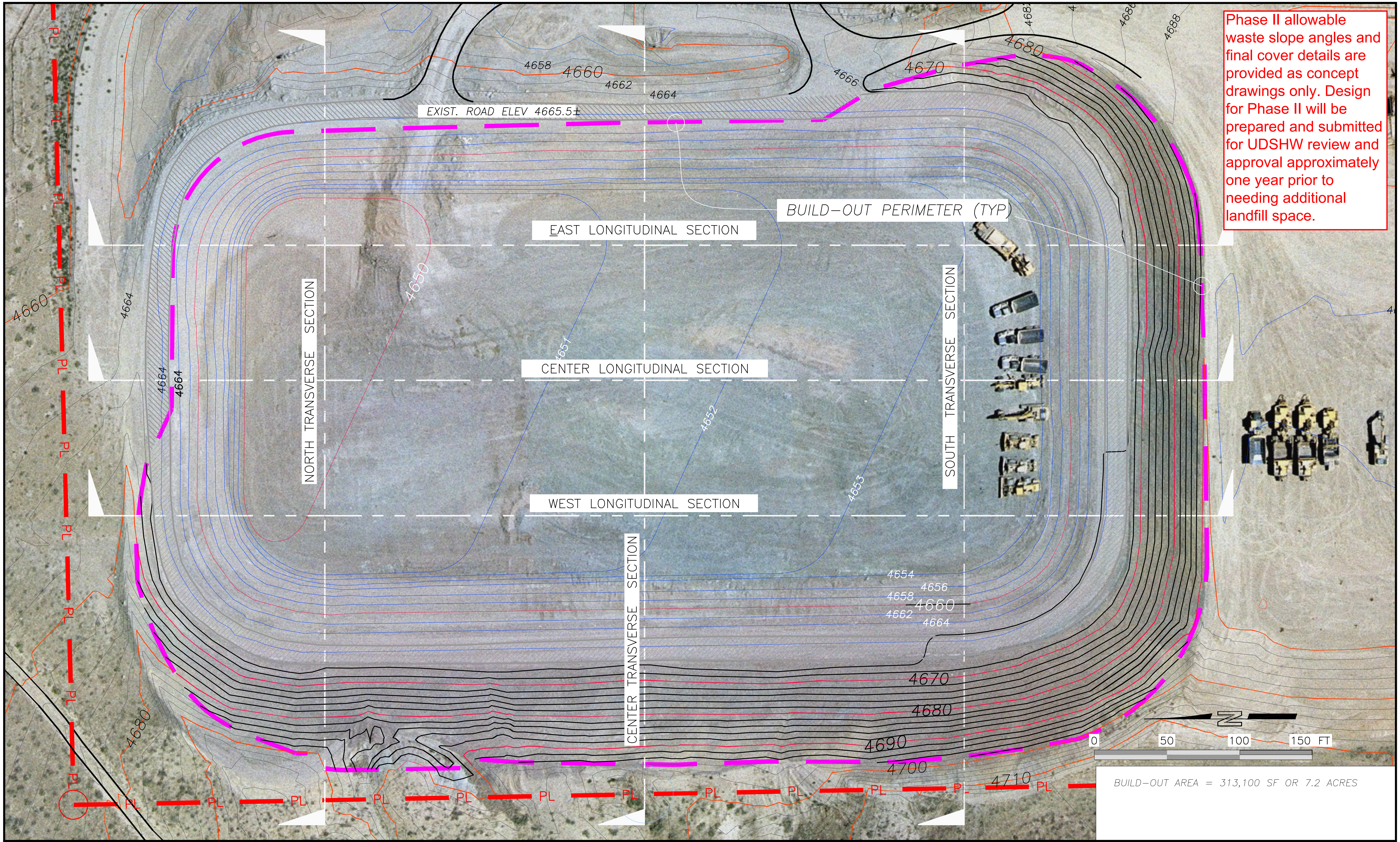
PROJECT LOCATION
UINTAH COUNTY, UT

PROJECT
WONSIT DISPOSAL LANDFILL

TITLE
LANDFILL CELL #1
SITE MAP

MWH

WL-9100 SH 1 OF 9



Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.

BUILD–OUT AREA = 313,100 SF OR 7.2 ACRES

ISSUE REV	DESCRIPTION	TECH	ENG	DATE
0	RNI REVIEW	JK	KJS	13.02.13

DISCLAIMER:

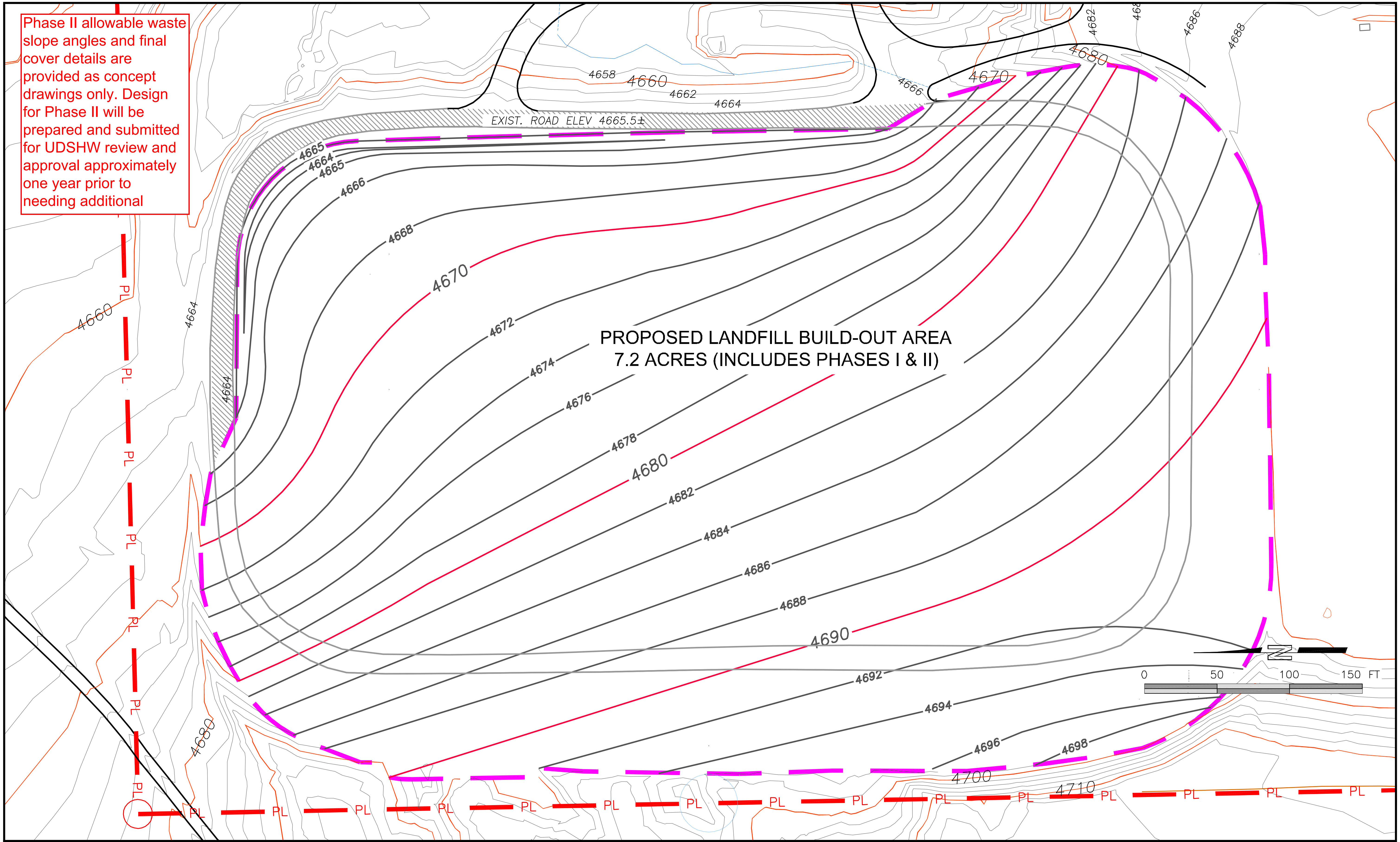
SCALE:
SCALE: 1" = 30 FT

PROJECT LOCATION
UINTAH COUNTY, UT

PROJECT
WONSIT DISPOSAL LANDFILL

TITLE
LANDFILL CELL #1
EXISTING SITE

WL-9100
SH 2 OF 9



Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional

ISSUE/REV	DESCRIPTION	TECH	ENG	DATE
0	RNI REVIEW	JK	KJS	13.02.13

DISCLAIMER:

SCALE:
SCALE: 1" = 30 FT

Wonsit RNI R.N. INDUSTRIES Utah

PROJECT LOCATION
UINTAH COUNTY, UT

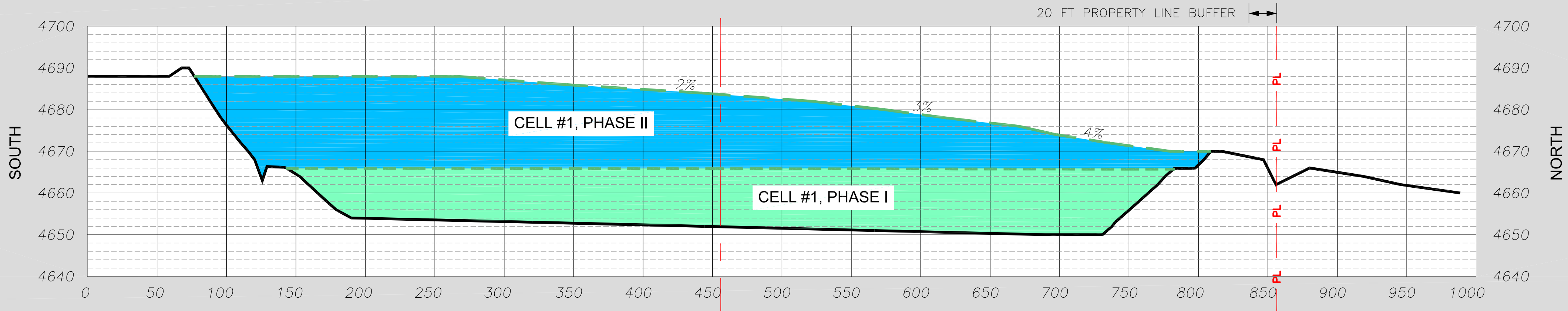
PROJECT
WONSIT DISPOSAL LANDFILL

TITLE
LANDFILL CELL #1
FINAL CAP

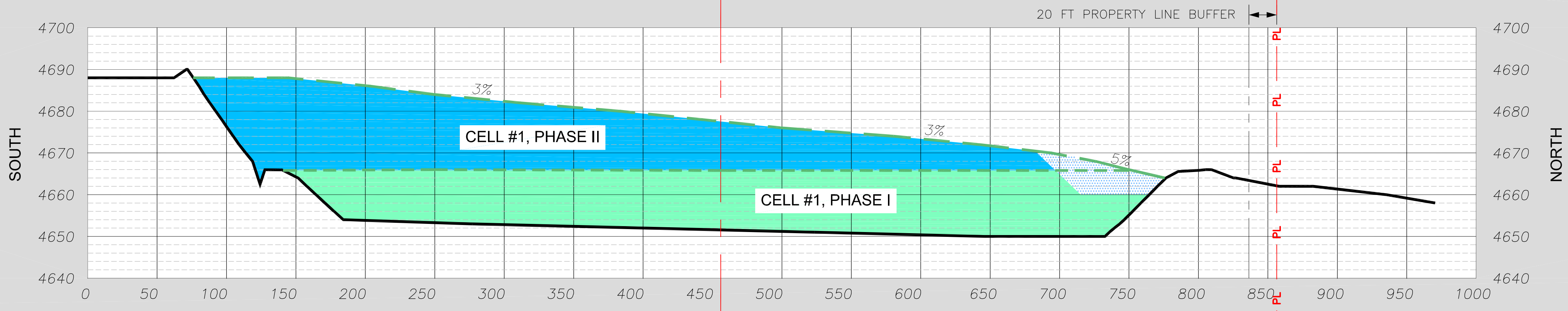
MWH

WL-9100

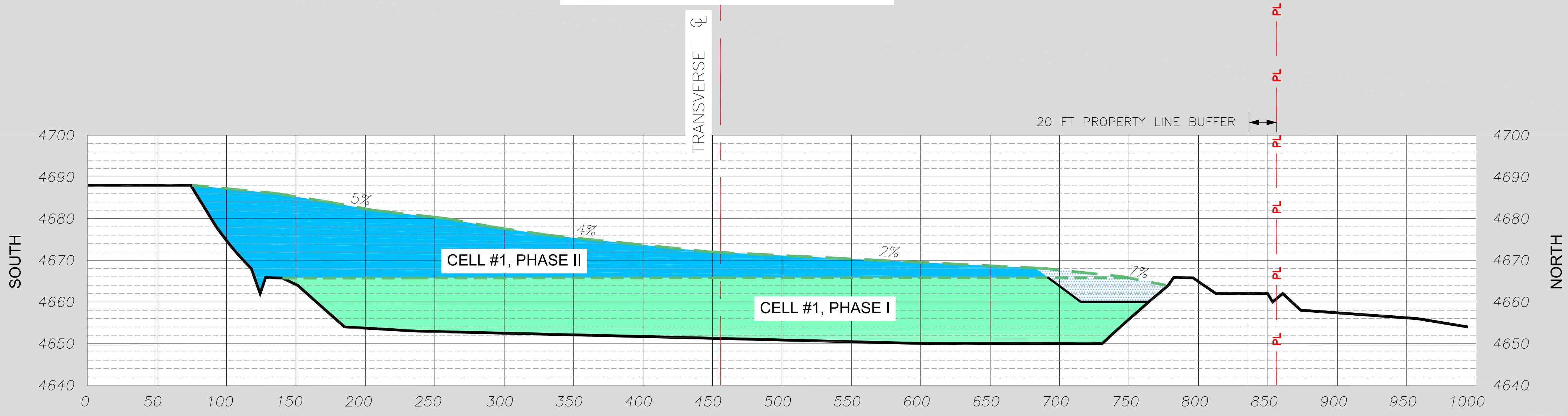
Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.



WEST LONGITUDINAL SECTION



CENTER LONGITUDINAL SECTION



EAST LONGITUDINAL SECTION

BUILD–OUT CAP AREA = 7.2 ACRES
PHASE I VOLUME = 108,687 CY
PHASE II VOLUME = 97,068 CY
BUILD–OUT VOLUME = 205,755 CY

ISSUE/REV	DESCRIPTION	TECH	ENG	DATE
0	RNI REVIEW	JK	KJS	13.02.13

DISCLAIMER:

SCALE:
SCALE: 1" = 50 FT (H)
SCALE: 1" = 15 FT (V)

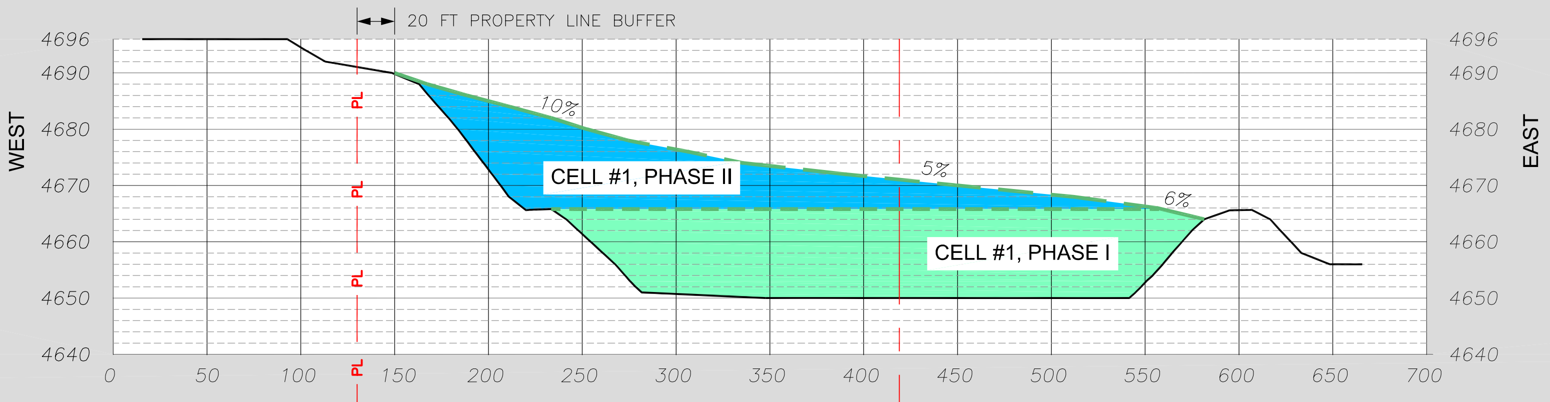
PROJECT LOCATION
UINTAH COUNTY, UT

PROJECT
WONSIT DISPOSAL LANDFILL

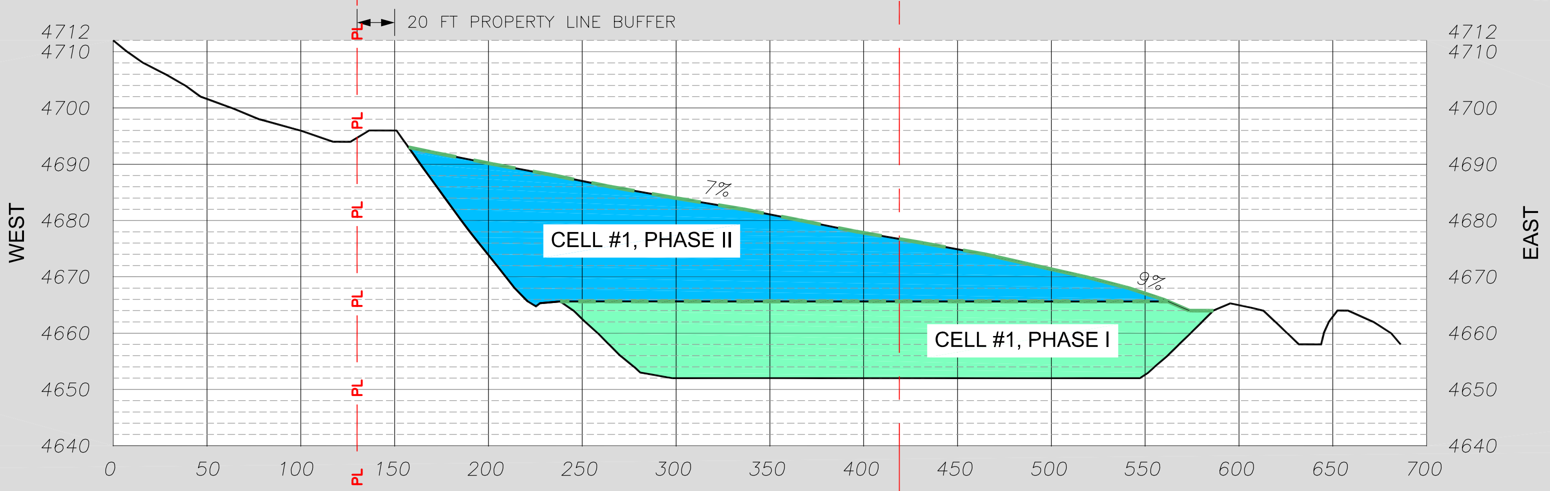
TITLE
LANDFILL CELL #1
LONGITUDINAL SECTIONS

WL-9100 SH 4 OF 9

Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.



NORTH TRANSVERSE SECTION



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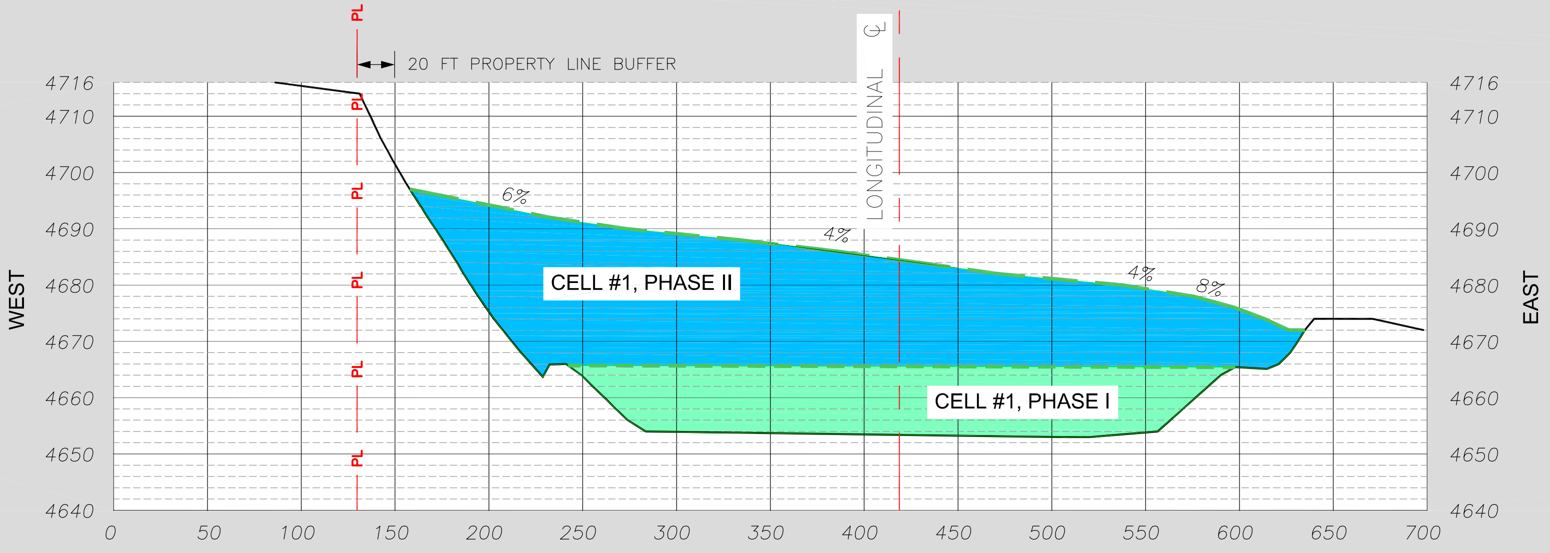


SOUTH TRANSVERSE SECTION

BUILD–OUT CAP AREA = 7.2 ACRES
PHASE I VOLUME = 108,687 CY
PHASE II VOLUME = 97,068 CY
BUILD–OUT VOLUME = 205,755 CY

ISSUE REV	DESCRIPTION	TECH	ENG	DATE
0	RNI REVIEW	JK	KJS	13.02.13

DISCLAIMER:

SCALE:
SCALE: 1" = 50 FT (H)
SCALE: 1" = 15 FT (V)

PROJECT LOCATION
UINTAH COUNTY, UT

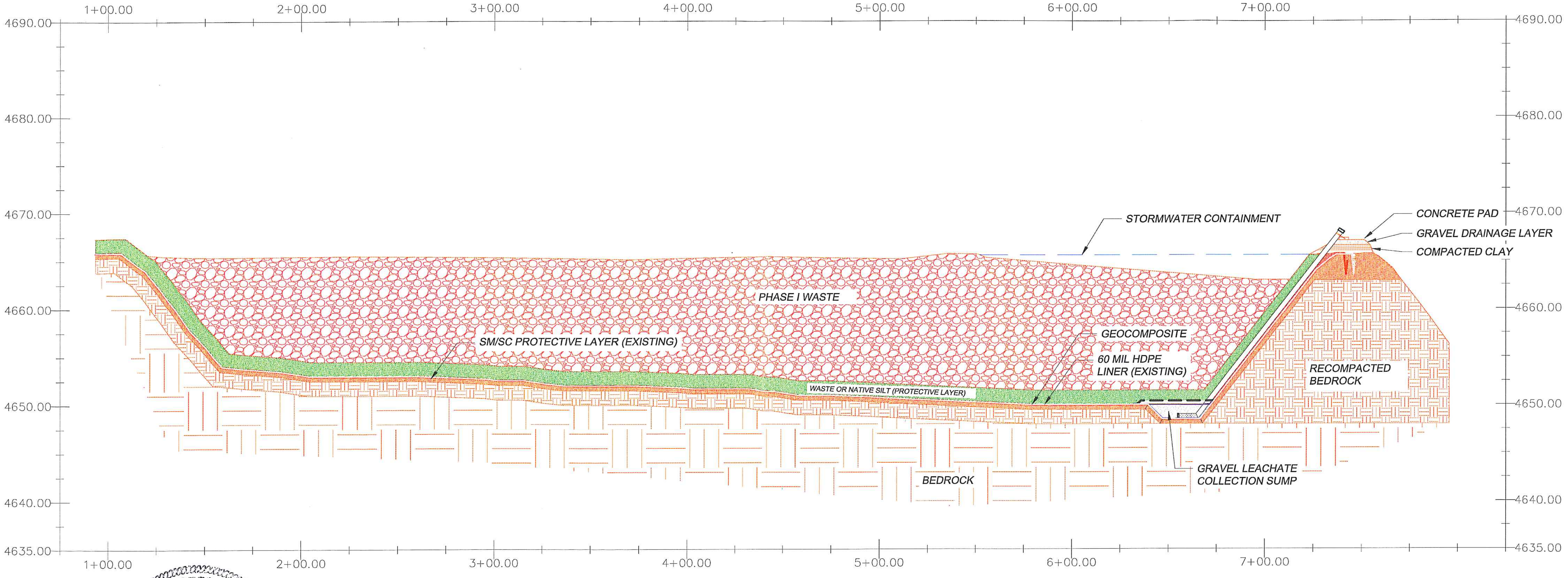
PROJECT
WONSIT DISPOSAL LANDFILL

TITLE
LANDFILL CELL #1
TRANSVERSE SECTIONS

MWH

WL-9100

SH 5 OF 9



5/30/13

No. 5302376-2202

LYNN BOYD BREEDING

Boyd Breeding

ISSUE REV	DESCRIPTION	TECH	ENG	DATE
	LANDFILL PERMIT APPLICATION	JD	BB	05/13/13

DISCLAIMER:

SCALE:
NOT TO SCALE

PROJECT LOCATION UINTAH COUNTY, UT

PROJECT WONSIT DISPOSAL LANDFILL

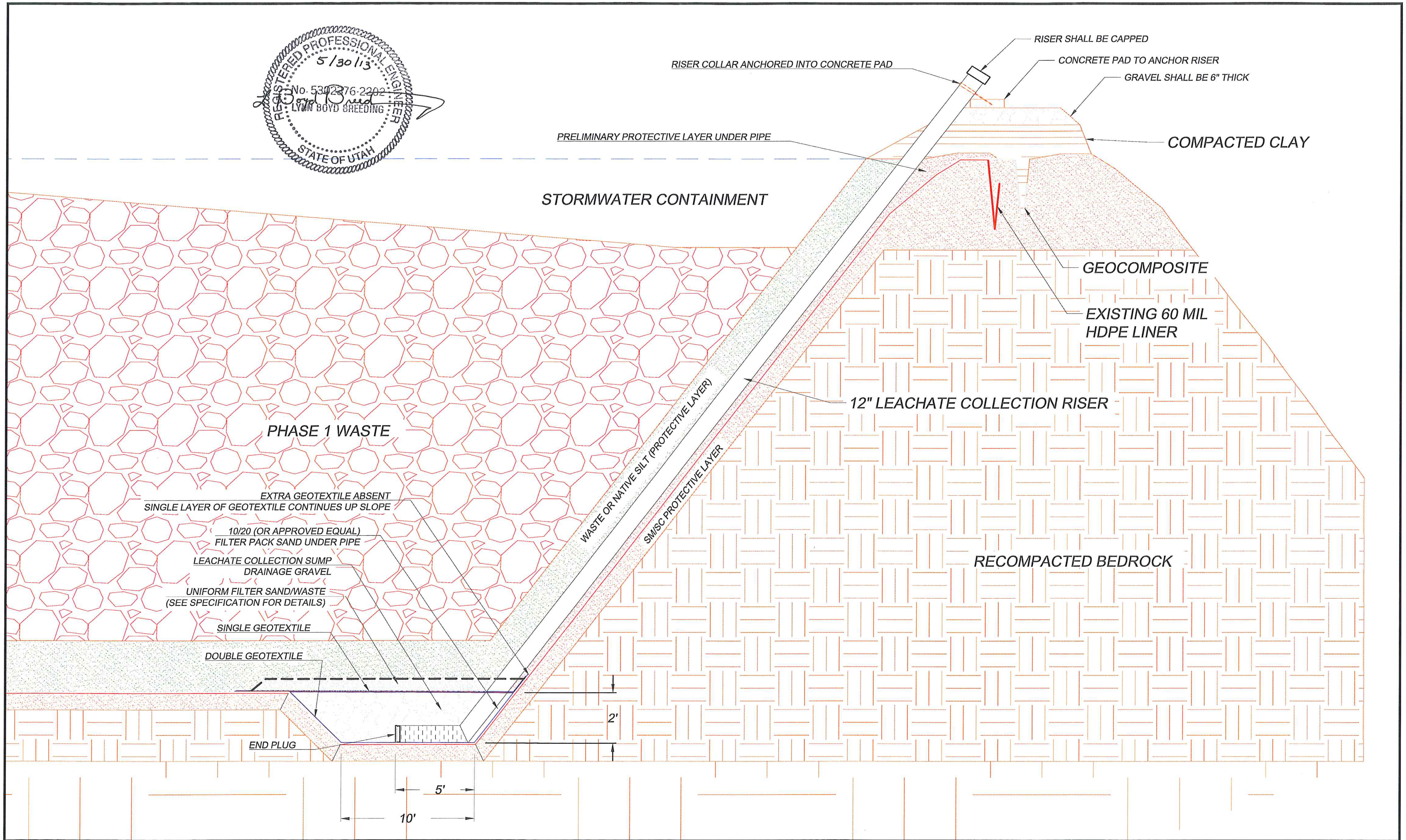
TITLE LANDFILL PHASE I SECTION

SHEET 6 OF 9

REVISION

FILE NAME

5/30/13
No. 5302276-2202
LYNN BOYD BREEDING



ISSUE/REV	DESCRIPTION	TECH	ENG	DATE
	LANDFILL PERMIT APPLICATION	JD	BB	05/13/13

DISCLAIMER:

SCALE:
NOT TO SCALE

PROJECT LOCATION: UINTAH COUNTY, UT

PROJECT: WONSIT DISPOSAL LANDFILL

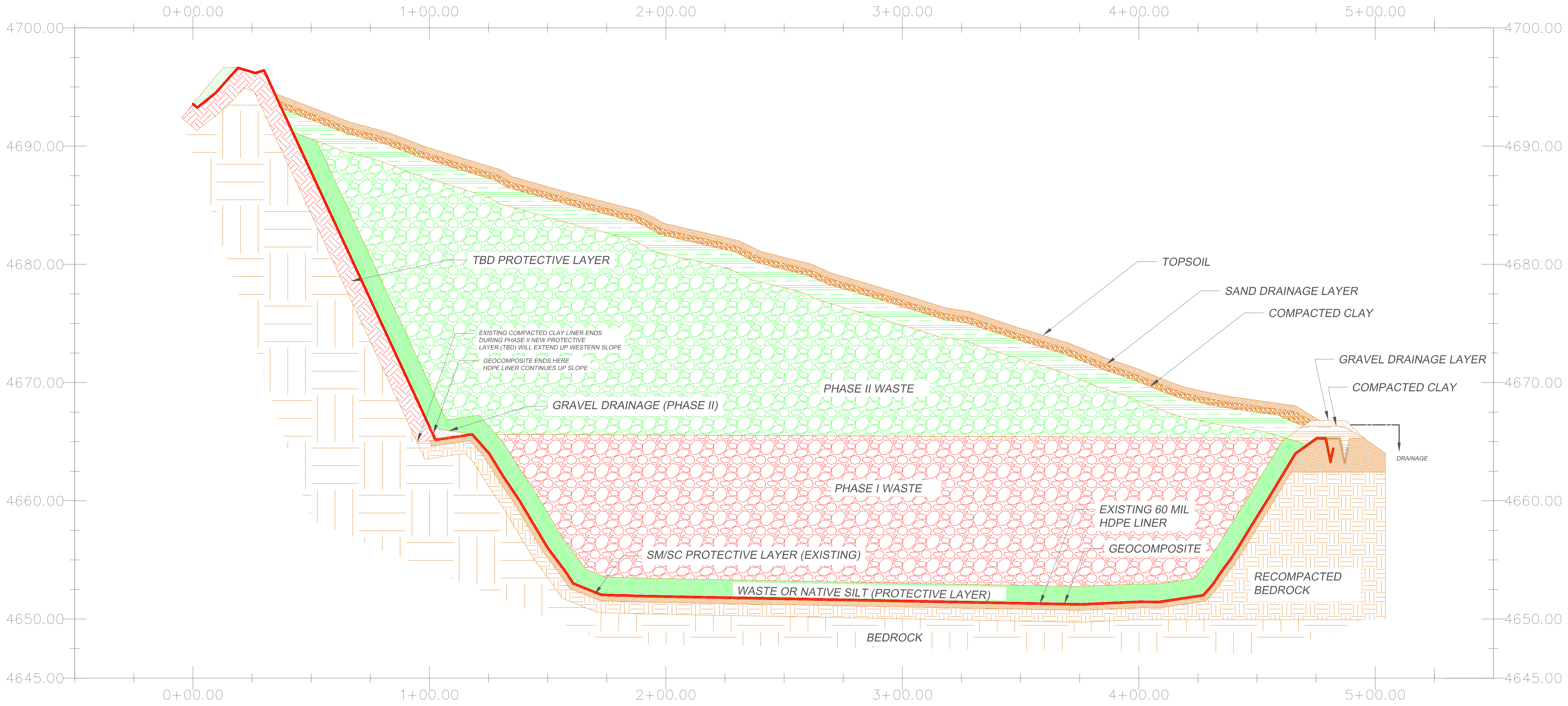
TITLE: LANDFILL PHASE I LEACHATE COLLECTION DETAIL

SHEET 7 OF 9

REVISION

FILE NAME

Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.



ISSUE / REV	DESCRIPTION	TECH	ENG	DATE
	LANDFILL PERMIT APPLICATION	JD	BB	05/13/13

DISCLAIMER:

SCALE:
NOT TO SCALE

PROJECT LOCATION UINTAH COUNTY, UT

PROJECT
WONSIT DISPOSAL LANDFILL

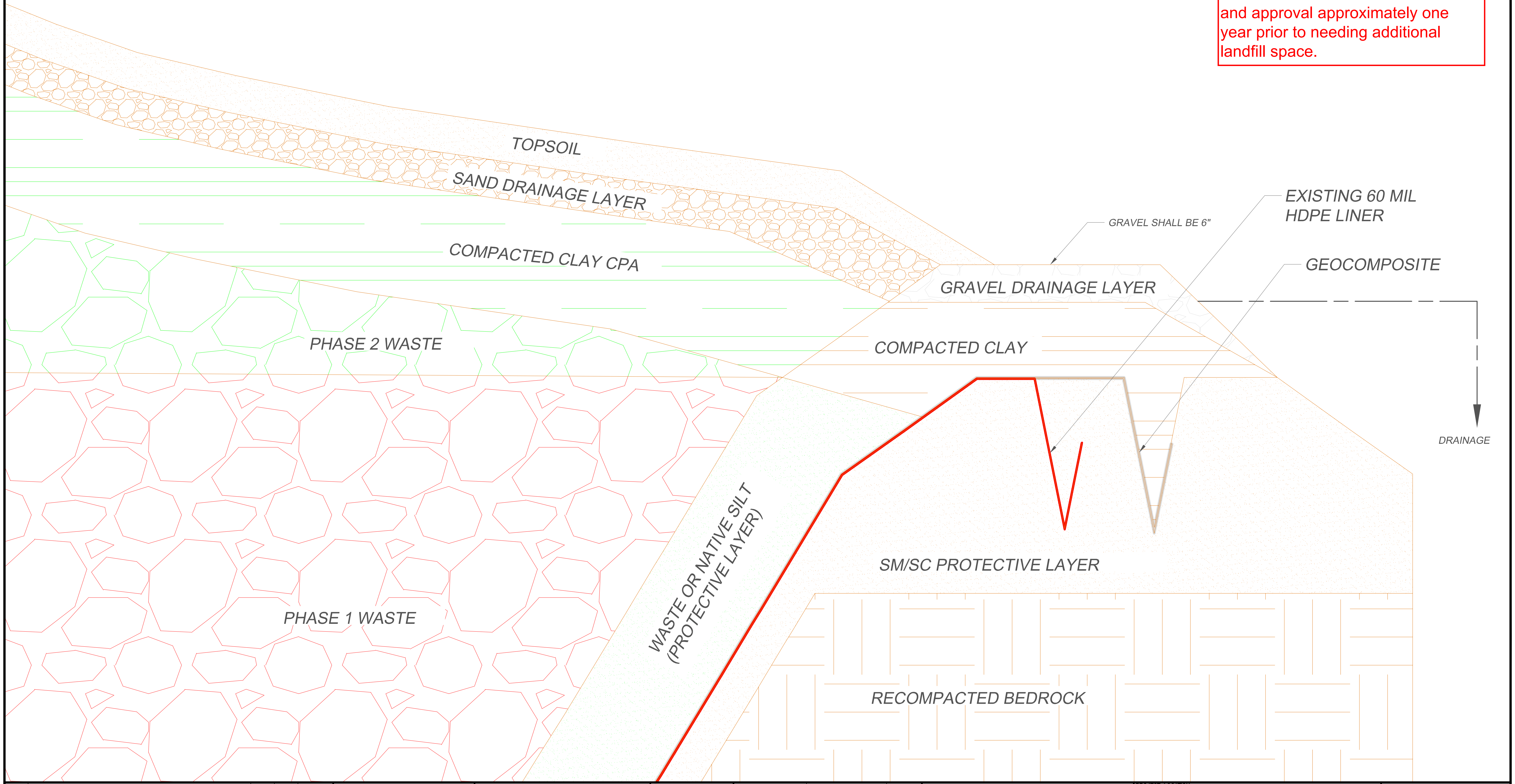
TITLE
LANDFILL PHASE II
CONCEPTUAL SECTION

SHEET 8 OF 9

REVISION

FILE NAME

Phase II allowable waste slope angles and final cover details are provided as concept drawings only. Design for Phase II will be prepared and submitted for UDSHW review and approval approximately one year prior to needing additional landfill space.



ISSUE/REV	DESCRIPTION	TECH	ENG	DATE
	LANDFILL PERMIT APPLICATION	JD	BB	05/13/13

DISCLAIMER:

SCALE: NOT TO SCALE

PROJECT LOCATION: UINTAH COUNTY, UT

PROJECT: WONSIT DISPOSAL LANDFILL

TITLE: LANDFILL PHASE II CONCEPTUAL LAYERING DETAIL

SHEET 9 OF 9

REVISION

FILE NAME

Appendix G4

Material Cut Sheets and Specifications

Attachment G4

Preliminary Material Specifications and Vehicle Load Limitations immediately Above Geosynthetic Liners

Summary of Geologic Materials To be Used for Wonsit Landfill Cell #1

Geomaterial	**Properties**	**Purpose and/or Other Notes**
Top Soil	Use top one foot of native silt, clay, sand from the Quaternary Alluvium in the Wonsit Facility Valley floor. These soils are to be mined from areas at least 300 feet from any water of the US and the mined areas shall be restored to prevent runoff of suspended sediments during rainfall and snow melt events .	Top soil used to sustain vegetative cover which will help prevent erosion of the final cover and enhance evapotranspiration.
Drainage Layer above Final Cover	Use native Quaternary Alluvium SM or imported well graded sand or silty sand.	Permeability used in water balance model was 7.2 x 10-4 cm/sec. Materials used should be similar to this permeability. USCS = SM
Compacted Clay Final Cover	Use weathered Uinta Member C mudstone stockpiled on-site.	R315-303-4 (4) calls for a 10-5 cm/sec permeability. This represents the typical cover. Alternatives are allowed but must be justified by the water balance modeling.
Waste or Native Silt Protective Layer above 60 Mil HDPE liner.	Use native silt, clay, sand from the Quaternary Alluvium in the Wonsit Facility Valley floor. These soils are to be mined from areas at least 300 feet from any water of the US and the mined areas shall be restored to prevent runoff of suspended sediments during rainfall and snow melt events . Equivalent solidified waste may also be used.	The purpose of this layer is to provide protection to the 60 mil HDPE cover as well as the geocomposite fabric sitting on top of the cover. It waste is used in lieu of native soil, the permeability should be comparable to the native silt (see geotechnical laboratory results).
Gravel Layer (Drainage Layer on Top of Berm)	Use native gravel from the top of on-site knolls or use imported road base.	Gravel shall have permeability greater than drainage layer installed above Final Cover and will be used to cover the compacted clay of the final cover (weathered Uinta Member C mudstone).
Drain Rock for Leachate Collection Sump	Use 3/8-inch minus well graded pit run (rounded) gravel/sand.	Imported permeable, rounded gravel with sand (GW).
10/20 gradation sand for Leachate Collection Sump	Use 10-20 gradation filter pack sand between the leachate collection pipe and the geocomposite material.	Use this permeable sand to cover the geotextile beneath the leachate collection pipe within the sump only. Above the sump, use weather mudstone to cover the geotextile beneath the extraction pipe.
Uniform Filter Sand above the Leachate Collection Sump.	Place 0.5' of 20-40 gradation filter pack sand above the leachate collection sump geofabric layer and below the waste/native silt (protective layer).	Place this layer of relatively fine, uniform sand above the geotextile which covers the leachate collection sump.

OGLEBAY NORTON INDUSTRIAL SANDS

Colorado Silica Sand™

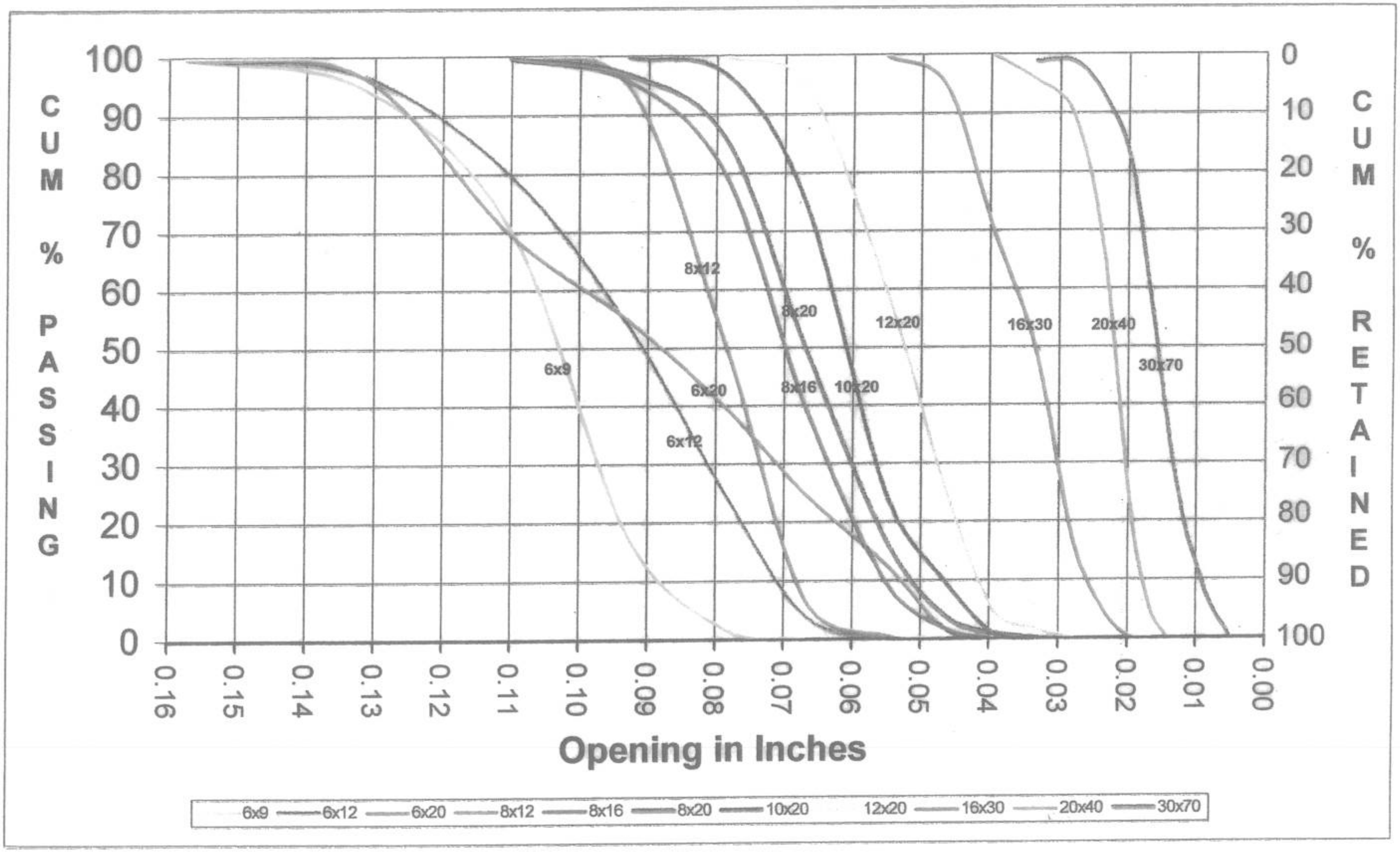
Well-Pack Sands

Product Range (Cumulative Percent Passing)

US Sieves	Opening (inches)	6 x 9	6 x 12	6 x 20	8 x 12	8 x 16	8 x 20	10 x 20	12 x 20	16 x 30	20 x 40	30 x 70
6	0.1319	90 - 100	95 - 100	95 - 100								
8	0.0929	4 - 35	25 - 90	52 - 92	90 - 100	90 - 100	90 - 100					
10	0.0787	0 - 10	5 - 55	35 - 86	23 - 68	65 - 95	60 - 91	90 - 100				
12	0.0669		0 - 10	20 - 75	0 - 10	15 - 65	35 - 60	70 - 92	90 - 100			
14	0.0551			10 - 50	0 - 2	2 - 20	15 - 35	15 - 65	40 - 90			
16	0.0465			5 - 30		0 - 5	2 - 15	10 - 25	10 - 45	90 - 100		
18	0.0394			0 - 25			0 - 8	0 - 20	1 - 20	63 - 85		
20	0.0335			0 - 5			0 - 5	0 - 10	0 - 10	23 - 66	90 - 100	98 - 100
25	0.0280								0 - 1	9 - 25	80 - 97	98 - 100
30	0.0236									0 - 10	54 - 75	85 - 100
35	0.0197									0 - 2	18 - 32	85 - 95
40	0.0167										0 - 10	45 - 75
45	0.0140											17 - 40
50	0.0118											10 - 40
60	0.0098											5 - 25
70	0.0083											0 - 10
80	0.0071											0 - 5

Grain size distributions presented herein are merely a representation of the grain size analyses of the various product sizes at the time of production. This information is subject to change without notice and does not represent a commitment on the part of Oglebay Norton Industrial Sands, or it's representatives. Over time and within the same shipments, product gradations may vary due to natural variations in the raw product. It is recommended that the user request a current gradation analysis before making any design decisions.

Oglebay Norton Industrial Sands - Colorado Silica Sand™
Well-Pack Sands



TENCATE
Mirafi®

Drainage Separation

Mirafi® 180N

Mirafi® 180N is a needlepunched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 180N geotextile is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D 4632	N (lbs)	912 (205)	912 (205)
Grab Tensile Elongation	ASTM D 4632	%	50	50
Trapezoid Tear Strength	ASTM D 4533	N (lbs)	356 (80)	356 (80)
CBR Puncture Strength	ASTM D 6241	N (lbs)	2225 (500)	
Apparent Opening Size (AOS) [1]	ASTM D 4751	mm (U.S. Sieve)	0.18 (80)	
Permittivity	ASTM D 4491	sec^{-1}	1.1	
Flow Rate	ASTM D 4491	$l/min/m^2$ ($gal/min/ft^2$)	3870 (95)	
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70	

[1] ASTM D 4751: AOS is a Maximum Opening Diameter Value

Physical Properties	Test Method	Unit	Typical Value	
Weight	ASTM D 5261	g/m^2 (oz/yd^2)	271 (8.0)	
Thickness	ASTM D 5199	mm (mils)	1.8 (72)	
Roll Dimensions (width x length)	--	m (ft)	3.8 x 110 (12.5 x 360)	4.5 x 91 (15 x 300)
Roll Area	--	m^2 (yd^2)	418 (500)	
Estimated Roll Weight	--	kg (lb)	120 (265)	

Made in USA

TENCATE™
materials that make a difference

FGS000351
ETQR30

2-Sided Geocomposite
200mil Geonet

Geonet Component(4)

Property	Test Method	Minimum Average Roll Value(5)	
		6-200-6	8-200-8
Thickness, (mm)	ASTM D5199	200	200
*The thickness values may be changed due to project specifications (i.e., absolute minimum thickness)			
Peak Tensile Strength, lbs./in. (MD)	ASTM D5035	45	45
Melt Flow Index, g/10 minutes (max.)	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0
Density, g/cm^3	ASTM D792, Method B	0.94	0.94
Carbon Black Content	ASTM D4218	2 - 3	2 - 3
Transmissivity(1), m^2/sec.	ASTM D4716	2×10^{-3}	2×10^{-3}

Geotextile Component (Prior to Lamination)

Property	Test Method	Minimum Average Roll Value(5)	
Mass per Unit Area, oz./sq. yd.	ASTM D5261	6.0	8.0
Grab Tensile Strength, lbs.	ASTM D4632	170	225
Grab Elongation, %	ASTM D4632	50	50
Trapezoidal Tear, lbs.	ASTM D4533	70	90
Puncture, lbs.	ASTM D4833	95	140
Mullen Burst, psi	ASTM D3786	325	400
Permittivity(2), sec.$^{-1}$	ASTM D4491	1.60	1.26
Water Flow(2), gpm./ft.^{2}	ASTM D4491	125	90
Apparent Opening Size, U.S. Stnd Sieve Size (max.)	ASTM D4751	70	80
UV Resistance after 500 hours, % Strength Retained	ASTM D4355	70	70

Geocomposite(4)

Property	Test Method	Minimum Average Roll Value(5)	
Laminated Strength (Ply Adhesion), lbs./in.	ASTM D7005	1	1
Transmissivity(3), m^2/sec.	ASTM D4716	1×10^{-4}	1×10^{-4}

Notes:
- **(1) Geonet Transmissivity at a temp. of 21°C, gradient of 0.1 and a load of 10,000psf: seating time 15 min. between steel plates.**
- **(2) At time of manufacture. Handling may change these properties.**
- **(3) Geocomposite Transmissivity at a temp. of 21°C, gradient of 0.1 and a load of 10,000psf: seating time 15 min. between steel plates.**
- **(4) Component Properties are prior to Lamination**
- **(5) For Geonet, Melt Flow Index is a maximum value, and for Geotextile, AOS is a maximum average roll value.**
- **(6) All roll lengths and widths have a tolerance of ±1%**

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email: salesmkg@agruamerica.com www.agruamerica.com

2.3 Type of Overburden Stress

The overburden stress on a geomembrane comes primarily from two sources: construction equipment and overlying media such as waste, water or soil. The total stress on the geomembrane is the summation of stress from various sources at any given time.

2.3.1 Stress from Construction Equipment

The stress on a geomembrane from construction equipment depends upon the type of vehicle, load on the vehicle, type of wheels and depth of soil cover over the geomembrane. Typically two types of vehicles are used for the placement of soil or aggregate over a liner: a track type dozer for spreading the stone and a rubber tired vehicle (truck or LTV) for transporting the stone. Calculation of pressure on a liner for each of these cases is explained below.

2.3.1.1 Tracked Vehicles

Assuming a 2:1 pressure distribution as indicated in Figure 2.4, stress over the geomembrane can be calculated as follows:

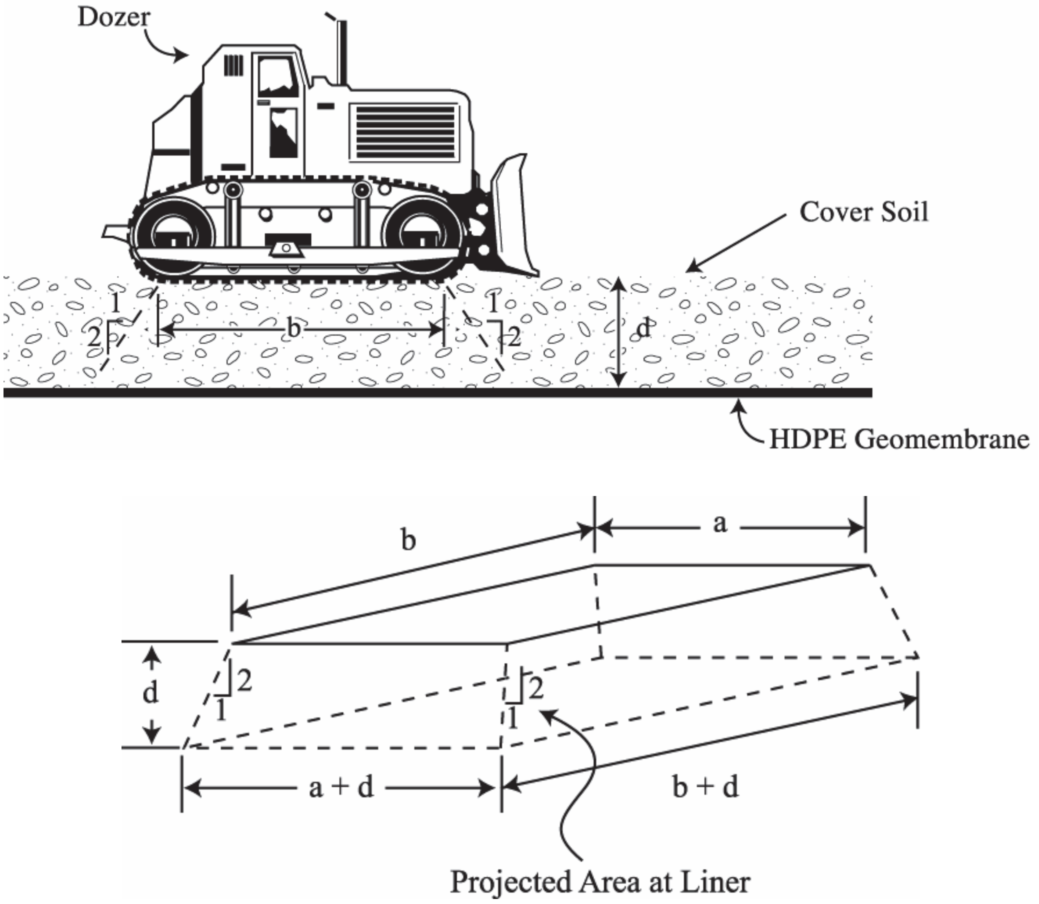


Figure 2.4 Calculation of Stress on Geomembrane for Track Type Vehicles.

$$\sigma_{Geomembrane} = \frac{W}{2 \times A_g} + \gamma_{soil} \times d \qquad (2.1)$$

Where,
W = Operating weight of dozer (kg or lbs) from Table 2.1,
A_g = Area of track (m^2 or $inch^2$) at geomembrane surface,
d = Depth of soil layer over the liner (m or inches), and
γ_{soil} = Unit weight of soil overlying the liner (kN/m^3 or $lbs/inch^3$).

Projected area over the geomembrane can be calculated as follows:

$$A_g = (a+d) \times (b+d) \qquad (2.2)$$

Where,
a = width of track (m or inches), and
b = length of track (m or inches).

For Caterpillar dozers in Table 2.1, length of track (b) can be calculated as:

$$b = \frac{Contact\ \ Area\ \ from\ Table\ 2.1}{Shoe\ Width\ in\ Table\ 2.1} \qquad (2.3)$$

2.3.1.2 Rubber Tire Vehicles

Pressure over the geomembrane from rubber tired vehicle can be calculated as follows (see also Figure 2.5):

$$\sigma_{Geomembrane} = \frac{m \times W \times I_{OL} \times I_{if}}{2 \times Ag} + \gamma_{soil} \times d \qquad (2.4)$$

Where
m = Load distribution factor,
W = Operating weight (kg or lbs),
A_g = Area of tire (m^2 or $inch^2$) at geomembrane surface,
d = Depth of soil layer over the geomembrane (m or inches),
γ_{soil} = Unit weight of soil overlying the geomembrane (kN/m^3 or $lbs/inch^3$),
I_{if} = Impact factor, and
I_{ol}= Overload factor.

For the values of m, I_{if} and I_{ol}, equipment manufacturer should be consulted. However, in the absence of other guidelines, a value of 0.67 for m and 1.3 for each of I_{ol} and I_{if} may be assumed.

Table 2.1 Operating Ground Contact Pressure for Track-Type Tractors (Caterpillar Performance Handbook, Edition 31).

Model	**Shoe Width (mm)**	**Contact Area (m^2)**	**Operating Weight**		**Ground Contact Pressure**	
			Kg	**lb**	**kPa**	**psi**
D6R	560	2.92	18,200	40,000	61	8.9
	610	3.18			56	8.1
D7R	510	2.94	25,077	55,300	82	11.9
	560	3.24			75	10.8
	610	3.53			69	10.0
	660	3.82			64	9.3
D8R	560	3.59	37,580	82,850	101.1	14.7
	610	3.91			92.8	13.5
	660	4.23			85.9	12.5
	710	4.55			79.7	11.6
D9R	560	3.86	48,840	107,670	121.1	17.5
	610	4.24			110.8	16.1
	685	4.74			98.7	14.3
	760	5.26			88.8	12.9
D10R	610	4.74	65,400	144,200	135.7	19.7
	710	5.52			116.2	16.9
	800	6.22			103.1	15.0
D11R	710	6.31	104,600	230,100	162.4	23.6
	810	7.20			142.4	20.7
	915	8.13			126	18.3

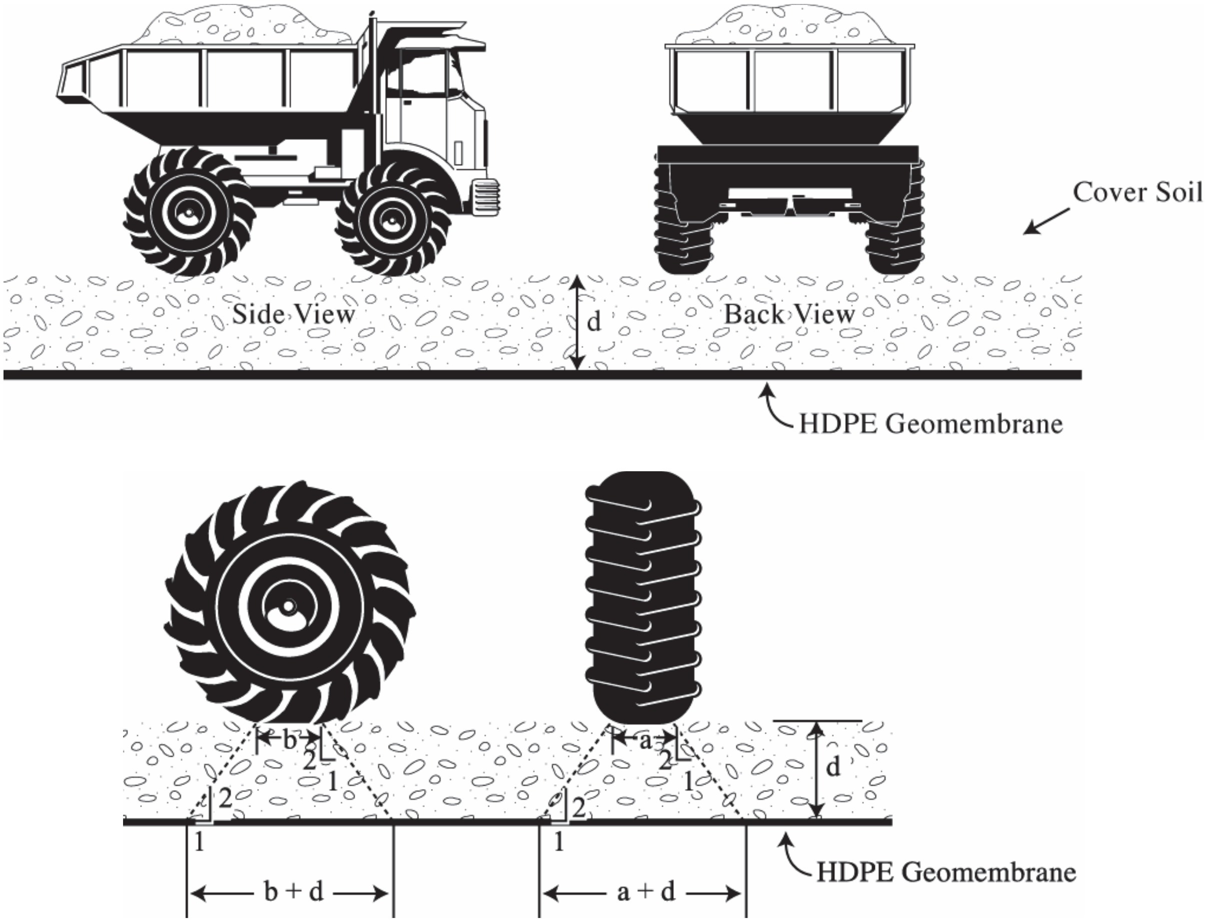


Figure 2.5 Stress Over Liner from Rubber Tire Vehicles.

2.3.2 Stress from Infinite Media

Stress from infinite media, such as soil, waste or water, can be calculated as:

$$P = \gamma \times h \tag{2.5}$$

Where

P = Stress (kPa or psi)

γ = Unit weight (kN/m^3 or lbs/inch^3), and

h = Depth of the material overlying the geomembrane (m or inches)

Chapter 3

DESIGN METHOD

3.1 Protecting Geomembranes from Puncture During Installation

Puncture of geomembranes during installation can occur from both subgrade conditions and overlying soil. Each of these two concerns is discussed in the following sections.

3.1.1 Geomembrane Puncture from Subgrade

Geomembranes should be placed on subgrades free of coarse particles, earth clods, uneven areas, ruts, roots, debris and wood pieces. The following steps should be followed to ensure that a geomembrane is not damaged from underlying surface during installation:

a) Any survey stakes, if used, should be pulled out of the soil surface. Breaking off of the survey stakes at the ground surface is not recommended.
b) Insitu soil or compacted clay liner must be smooth drum rolled to achieve the necessary compaction and to ensure that particles coarser than 1 cm (3/8 inches) do not protrude from the surface.
c) Alternately, where the preparation of the surface, as recommended above, is not feasible, a cushioning material should be placed between the geomembrane and the subgrade to protect the geomembrane from puncture.
d) A qualified and certified Construction Quality Assurance (CQA) inspector and the geomembrane installer must inspect and approve the surface prior to the placement of the geomembrane.
e) No vehicular traffic should be allowed on top of an installed geomembrane. However the use of light equipment, such as ATVs, approved by the project engineer, CQA inspector and installer, may be allowed.
f) Workers with sharp shoe soles, or shoes with treading that can trap stones, should not be allowed to traverse directly on top of the geomembrane.

3.1.2 Geomembrane Puncture from Overlying Soil

A soil cover or aggregate drainage layer is almost always placed over the geomembrane. For example, an aggregate drainage layer is typically placed over the primary geomembrane in a landfill liner system (see Koerner, 1998, pp. 551 for details). The placement of these overlying materials is typically performed using construction equipment such as trucks and bulldozers. For this reason puncture of geomembrane is of greater concern during the placement of overlying soil than the installation of the geomembrane itself. The following recommendations should be followed to ensure that the geomembrane is well protected during the placement of overlying soil:

a) Soil particles coarser than 1 cm (3/8 inch) should never be placed directly on a geomembrane without first placing a suitable nonwoven needlepunched geotextile as a protection layer.
b) Sudden breaking and turning of vehicles over the geomembrane should be avoided.
c) A minimum soil cover of thickness proposed in Table 3.1 should be maintained at all times between the tires or treads of the equipment and the geomembrane.

Table 3.1 Recommended Minimum Soil Cover Thickness Over Geomembranes for the Operation of Construction Equipment.

Equipment Ground Pressure		Recommended Minimum Lift Thickness, m (in.)	
kPa	psi	meter	inches
< 70	< 10	0.30	~~12~~
70 - 140	10-20	0.60	24
> 140	> 20	0.90	36

Wonsit landfill Cell Design requires a minimum of 18-inches of lift thickness for all loads <10 psi. For loads greater than 10 psi, follow the guidance in Table 3.1.

A number of researchers have evaluated geomembrane protection requirements during the construction process by building test pads. The methodology followed for such an evaluation can be summarized as follows:

a) A subgrade is prepared to the site-specific compaction and moisture content requirements.
b) A sample of the desired geomembrane is placed over the subgrade.
c) A nonwoven needlepunched protection geotextile is placed over the geomembrane.
d) A controlled thickness of overlying material is placed on top of the geomembrane.
e) Construction equipment, such as a truck or a dozer with a known weight, is moved over the soil a fixed number of times to simulate traffic during the construction project.
f) At the completion of the desired number of passes, soil overlying the geotextile is carefully removed. Coupons of geotextile and geomembrane are removed and observed visually for signs of damage and tested in a laboratory for changes in the physical or mechanical properties.

A study of the type described above was performed by Reddy et. al. (1996) to determine protection requirements for AASHTO # 8 (12 mm max diameter) stone. The conclusion of this study was to use a minimum of 270 gram/m^2 (8 oz. per square yard) nonwoven needle punched geotextile for the protection of a 1.5 mm (60 mil) thick HDPE geomembrane.

A similar study has been described by Richardson & Johnson (1998). They evaluated protection requirements for a 1.5 mm thick HDPE geomembrane under an AASHTO # 57 (max diameter 38 mm) stone. They recommend using at a minimum a 405 g/m^2 (12 oz. per square yard) nonwoven needlepunched geotextile to protect the geomembrane from damage by a # 57 stone.

A number of other researchers have performed similar testing for project-specific conditions. Generally, their recommendations have ranged from 270 grams/m^2 to 540 grams/m^2 (8 oz. to 16 oz.) geotextile depending on the type of soil and construction equipment.

Appendix G5

Slope Stability Analyses

GeoStrata Engineering & Geosciences
14425 S. Center Point Way, Bluffdale, Utah 84065 ~ T: (801) 501-0583 ~ F: (801) 501-0584

May 28, 2013

RN Industries
Attn: Mr. Chris Chapman
PO Box 98
Roosevelt, UT 84066
GeoStrata Project No. 524-042

Subject: **Slope Stability**
Wonsit Landfill Cell #1 Phase I
Uintah County, Utah

Mr. Chapman:

At your request GeoStrata has performed a slope stability assessment for the east embankment of the Pond 9 Landfill at the RNI Wonsit Facility located in Uintah County, Utah. Pond 9 is located at the west end of the Wonsit Facility. The western and southern sides of the pond are excavated into bedrock and do not incorporate an earth embankment. The eastern half of the north side of the pond and the eastern side of the pond consist of an earth embankment. The critical section of the embankment is located on east side of the pond, and is approximately 12 feet in height.

To assist our investigation, two borings were drilled along the crest of the pond perimeter, a third boring was drilled north of the pond, and both a bulk and undisturbed soil sample were collected from the east embankment. All borings were drilled using a truck-mounted CME-75 hollow stem auger drill rig. The approximate location of the borings and monitor wells are presented in Plate 1. Logs of the subsurface conditions, as encountered in the exploration, were recorded at the time of exploration by a qualified geotechnical engineer and are presented on Plates 2 through 4. A Soil Symbols Description Key used in the boring logs is included as Plate 5.

Subsurface Conditions

Based on the explorations drilled at the site, the embankment material generally consists of Silty SAND (SM) overlying sandstone and mudstone bedrock through the maximum depth explored. The stratification lines shown on the enclosed boring logs represent an approximate boundary between soil types. The actual in situ transition may be more gradual. Groundwater was not encountered in our borings and we understand that near surface groundwater has not been found in monitor wells constructed near the proposed landfill site.

Laboratory Testing

As indicated above a bulk and an undisturbed soil sample was collected from the east embankment for laboratory testing.

Samples were returned to the GeoStrata Laboratory for testing. Testing consisted of moisture- and density determinations as well as triaxial strength testing of the embankment material and permeability testing of the underlying bedrock. The results of the tests indicated embankment soils have a unit weight of 110 pcf. Triaxial testing indicates that the embankment soils have an effective shear strength consisting of an angle of internal friction of 35 degrees and a cohesion of 90 psf. Test results are presented in Plates 6 through 10.

Pond Embankment Stability

GeoStrata has evaluated the stability of the east landfill embankment using SLIDE, a computer application incorporating (among others) Bishop's Simplified Method of analysis. Calculations for stability were developed by searching for the minimum factor of safety for a circular-type failure. Stability analyses were conducted on representative cross-sections drawn through the pond in the east-west orientation through the east embankment as shown on Plate 1. The inside and outside embankment slope was modeled with the landfill empty and with the outside landfill slope was modeled with the landfill full to the top of the embankment. The stability of the embankment was assessed under static and pseudo static conditions. The pseudo static condition is used to assess stability of slopes during seismic events. A peak ground acceleration with a 2 percent chance of exceedance in 50 years was used in the pseudo static assessments.

The strength value for the embankment soils was obtained from our laboratory testing. Bedrock was assumed to have a strength of 3,000 psf. The landfill waste material was assumed to have an angle of internal friction of 20 degrees and a cohesion of 100 psf. Groundwater was not encountered in our borings and we understand that near surface groundwater has not been found in monitor wells constructed near the proposed landfill site. We further understand that the landfill will incorporate a geosynthetic liner. Groundwater was therefore not included in our stability assessment.

The results of our stability modeling indicate the following factors of safety for embankment slope failure:

Cell Embankment	Factor of Safety
Empty Down Slope	3.4
Empty Down Slope – Pseudo Static	2.6
Empty Up Slope	4.8
Empty Up Slope – Pseudo Static	3.7
Full Down Slope	3.4
Full Down Slope – Pseudo Static	2.6

Results of the slope stability modeling are presented on Plates 11 to 16 attached to this letter. Slopes with factors of safety greater than 1.5 and 1.1 for the static and pseudo static conditions respectively are typically considered stable. As indicated above the embankment has factors of safety for the static and pseudo static conditions greater than 1.5 and 1.0, respectively. It is therefore our opinion that the existing embankment is suitable for use for the planned landfill. .

Limitations

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation as well as from data obtained from previous investigations completed by others. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, GeoStrata should be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

We appreciate the opportunity to provide these services. Please contact us if you have questions regarding the information provided in this letter.

Respectfully,
GeoStrata

5/29/13

LICENSED PROFESSIONAL ENGINEER
MARK I. CHRISTENSEN
No. 188039
LICENSED
STATE OF UTAH

Mark I. Christensen, P.E.
Senior Engineer

Appendices:	Plate 1	Exploration Location Map
	Plates 2-4	Boring Logs
	Plate 5	Key to Soil Symbols and Terms
	Plate 6	Lab Summary
	Plates 7-8	Triaxial Test Results
	Plates 9-10	Back Presure Permeability Test Results
	Plates 11-16	Slope Stability Results

BASE MAP:
August 2009 Olympus Aerial Orthophotography Obtained
from MWH

1:6,000

GeoStrata
Engineering & Geosciences

Legend

⊕ Boring Location

— Slope Stability Profile

▭ Site Boundary

R.N. Industries
Wonsit Landfill Cell #1 Phase 1
Wonsit, UT
Project Number: 524-042

Exploration Location Map

Plate
1

DATE	
STARTED:	4/22/13
COMPLETED:	4/22/13
BACKFILLED:	4/22/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:

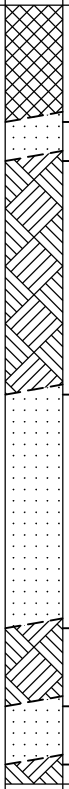
Landfill B-1

Sheet 1 of 1

DEPTH: METERS / FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION

LOCATION: STATION | OFFSET | ELEVATION

MATERIAL DESCRIPTION | N | N* | SPT BLOW COUNT 10 20 30 40 50 60 70 80 90 | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index | Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit 10 20 30 40 50 60 70 80 90



Silt, Sand, Gravel up to 1" diameter, brown, maroon, very washed out

Bedrock; Sandtone - grey

Bedrock; Mudstone - reddish brown to maroon

Bedrock; Sandstone - grey

Bedrock; Mudstone - reddish brown to maroon, 1" sandstone layers throughout

Bedrock; Sandstone - grey

Bedrock; Mudstone - reddish brown to maroon

Bottom of Boring @ 20 Feet

N - OBSERVED UNCORRECTED BLOW COUNT   N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
☒ - 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
■ - 3" O.D./2.48" I.D. SAMPLER
▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
▯ - GRAB SAMPLE
◩ - Modified California Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

2

LOG OF BORING - PLATE BORING LOGS.GPJ GEOSTRATA.GDT 5/28/13

DATE
STARTED: 4/22/13
COMPLETED: 4/22/13
BACKFILLED: 4/22/13

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

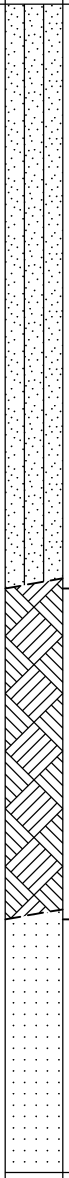
GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:
Landfill B-2
Sheet 1 of 1

DEPTH: METERS 0 1 2 3 4 5 6 7 8 9 10; FEET 0 5 10 15 20 25 30

SAMPLES | WATER LEVEL | GRAPHICAL LOG

LOCATION: STATION | OFFSET | ELEVATION



UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
SM	Silty SAND - medium brown, moist, gravel up to 1/2" diameter, orgamics in top 1 ft								
	Bedrock; Mudstone - reddish brown to maroon								
	Bedrock; Sandstone - grey								
	Bottom of Boring @ 30 Feet								

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT

N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
☒- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
■- 3" O.D./2.48" I.D. SAMPLER
▨- 3" O.D. THIN-WALLED SHELBY SAMPLER
▯- GRAB SAMPLE
◩- Modified California Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽- ESTIMATED

Plate
3

DATE
STARTED: 4/23/13
COMPLETED: 4/23/13
BACKFILLED: 4/23/13

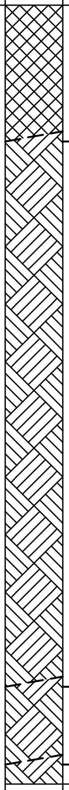
R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number 524-042

GeoStrata Rep: J. Mattson
Rig Type: CME 75
Boring Type:

BORING NO:
Landfill B-3
Sheet 1 of 1

LOCATION
STATION OFFSET ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					Silt, Sand, Clay, with gravel up to 1.5" diameter, brown									
1	5					Bedrock; Mudstone - maroon to reddish brown									
2															
3	10														
4															
5	15					Bedrock; Mudstone - dark green									
6	20					Bedrock; Mudstone - maroon to reddish brown									
						Bottom of Boring @ 20 Feet									
7															
8	25														
9	30														
10															



N - OBSERVED UNCORRECTED BLOW COUNT
N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

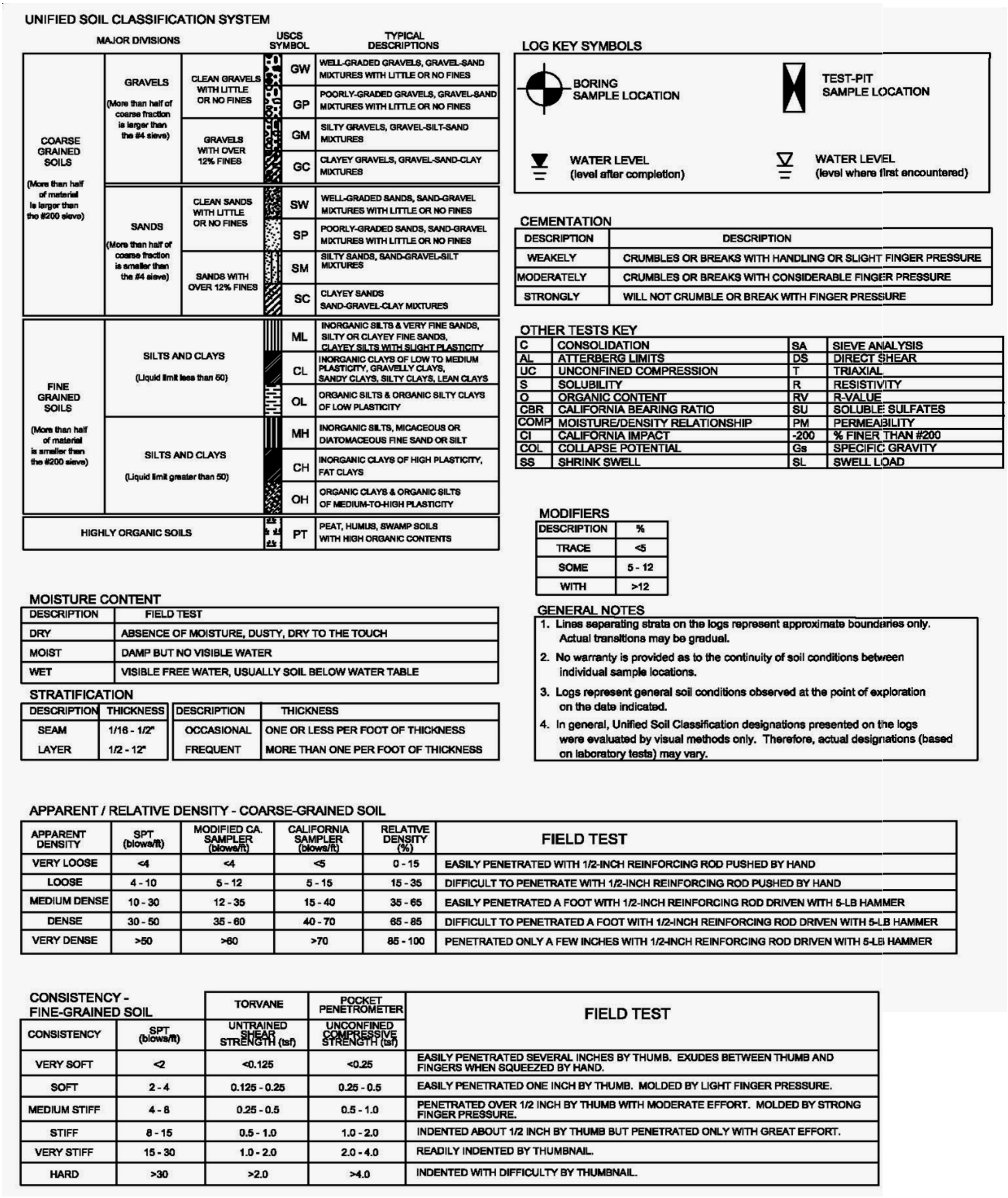
SAMPLE TYPE
- ☒ - 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- ■ - 3" O.D./2.48" I.D. SAMPLER
- ▨ - 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯ - GRAB SAMPLE
- ◩ - Modified California Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

4



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

		TORVANE	POCKET PENETROMETER	FIELD TEST
CONSISTENCY	SPT (blows/ft)	UNTRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

GeoStrata

Soil Symbols Description Key

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, Utah
Project Number: 524-042

Plate
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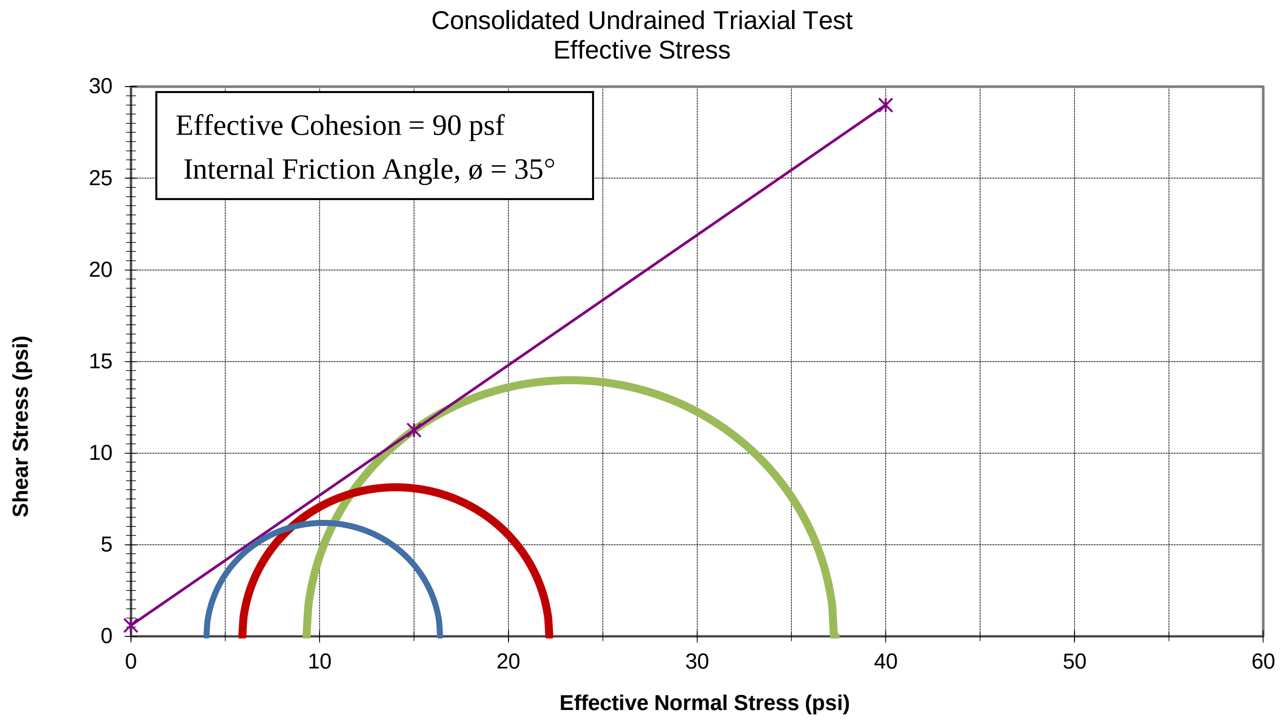
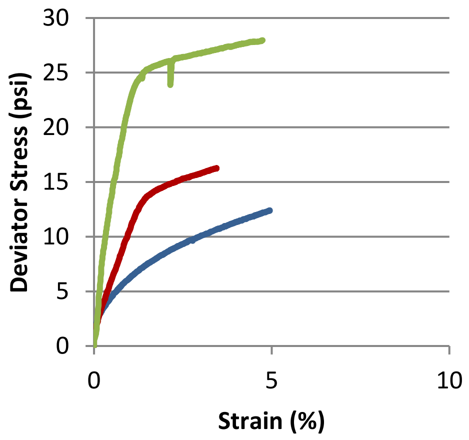
Boring No.	Sample Depth (feet)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Permeability (cm/s)	Consolidated Undrained Triax			
					Effective Cohesion (psf)	Efective Internal Friction Angle (°)	Total Cohesion (psf)	Total Internal Friction Angle (°)
B-1	17.5	10.0	129.5	1.71E-07				
B-3	20.0	15.3	116.3	1.88E-05				
Pond 9	Embankment	9.6	110.2		90	35	340	26

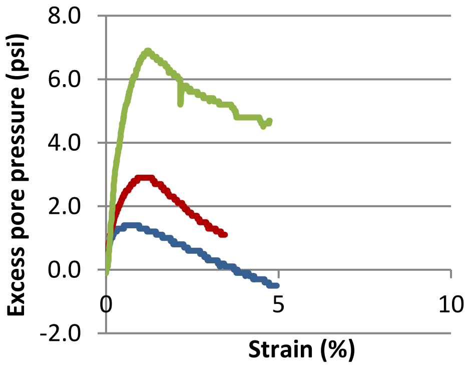
GeoStrata

Lab Summary Report

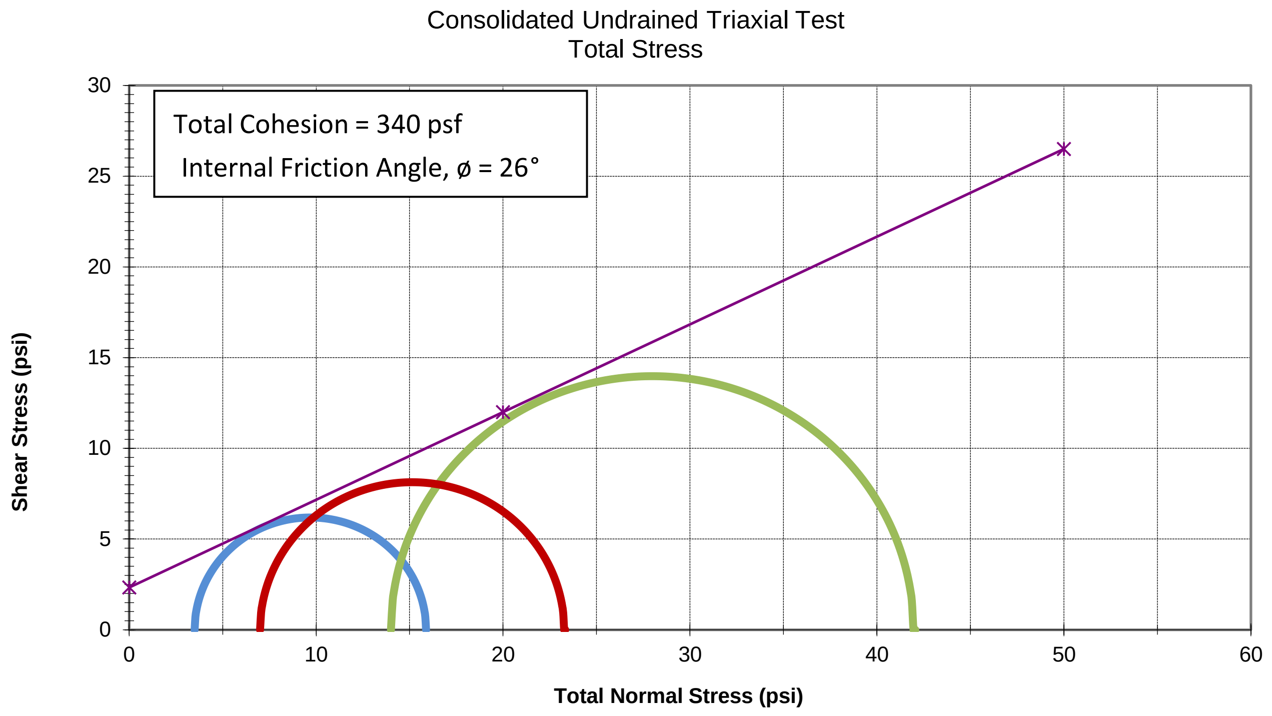
R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

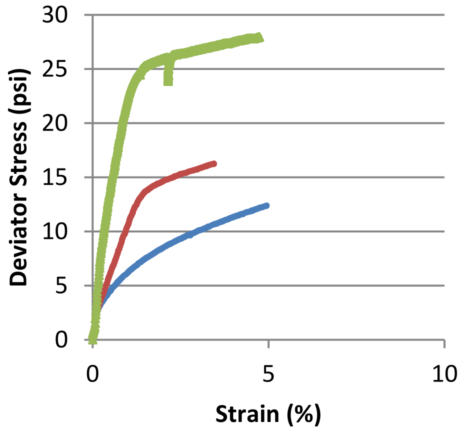


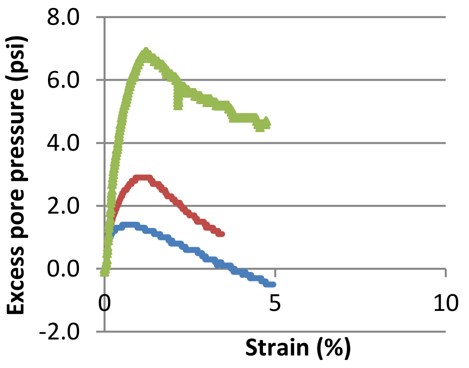




Sample Location	Pond 9 Embankment		
Sample Type	Remolded		
Test Type	Consolidated Undrained		
Length (in)	5.40	NA	NA
Diameter (in)	2.87	NA	NA
Dry Density (pcf)	121.7	NA	NA
Moisture (%)	12.9	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
Total Axial Stress σ_1 (psi)	15.9	23.3	42.0
Deviator Stress σ_1-σ_3 (psi)	12.4	16.3	28.0
Effective Confining Stress σ_3' (psi)	4.0	5.9	9.3
Effective Axial Stress σ_1' (psi)	16.4	22.2	37.3
Pore Pressure μ (psi)	-0.5	1.1	4.7
Strain (%)	5.0	5.0	5.0







Sample Location	Pond 9 Embankment		
Sample Type	Remolded		
Test Type	Consolidated Undrained		
Length (in)	5.40	NA	NA
Diameter (in)	2.87	NA	NA
Dry Density (pcf)	121.7	NA	NA
Moisture (%)	12.9	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
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Pore Pressure μ (psi)	-0.5	1.1	4.7
Strain (%)	5.0	5.0	5.0

Project No.: 524-042

GeoStrata

Plate 8

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

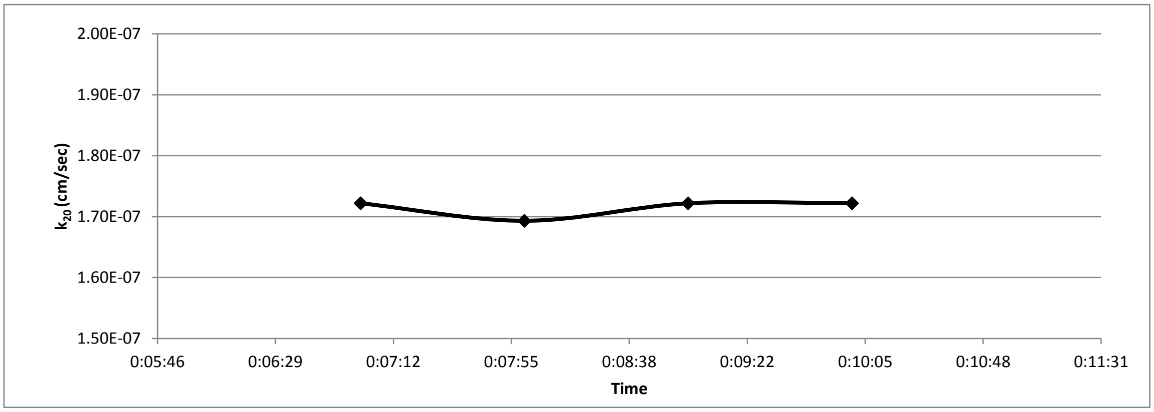
Project:	Wonsit Landfill Cell #1 Phase I
Project Number:	524-042
Soil Classification:	Sandstone
Boring:	B-1
Depth:	17.5
Sample Type:	Undisturbed
Test Date:	5/6/2013

	Initial	Final
G_s:	2.77	2.77
Mass (g):	469.1	472.3
Height (in.):	2.708	2.720
Diameter (in.):	2.428	2.389
Area (cm^2):	29.88	28.91
Volume (cm^3):	205.5	199.7
Water Content (%):	9.99	10.74
Dry Unit Weight, γ_d (pcf):	129.5	133.3
Saturation (%):	83	100

Permeant Liquid:	Deaired Water
Total Backpressure (psi):	60
Effective Consolidation Stress (psi):	5

Recorded Time	Elapsed Time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	Δh (cm)	K (cm/sec)	Temp (°C)	Viscocity Ratio, Rf	k_{20} (cm/sec)
0:07:00	59	3.02	9.16	415.2	1.88E-07	23.7	0.916	1.72E-07
0:08:00	60	3.04	9.14	415.2	1.85E-07	23.7	0.916	1.69E-07
0:09:00	59	3.06	9.12	415.2	1.88E-07	23.7	0.916	1.72E-07
0:10:00	59	3.08	9.10	415.2	1.88E-07	23.7	0.916	1.72E-07

Average k_{20} 1.71E-07 (cm/sec)



PROJECT NO.: 524-042

GeoStrata

Plate 9

Hydraulic Conductivity of Saturated Pourous Materials Using a Flexible Wall Permeameter

ASTM D5084, Method C

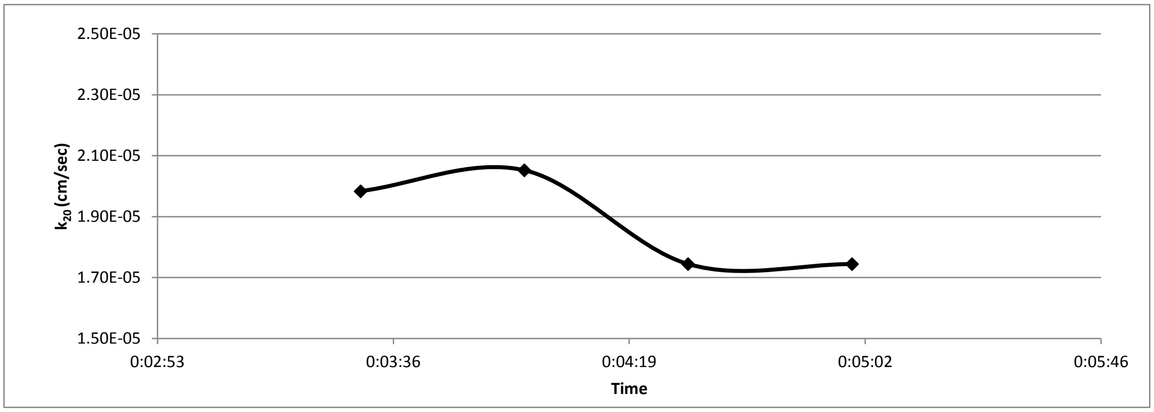
Project:	Wonsit Landfill Cell #1 Phase I
Project Number:	524-042
Soil Classification:	Mudstone
Boring:	B-3
Depth:	20
Sample Type:	Undisturbed
Test Date:	5/6/2013

Permeant Liquid:	Deaired Water
Total Backpressure (psi):	70
Effective Consolidation Stress (psi):	3

	Initial	Final
G_s:	2.81	2.81
Mass (g):	395.4	394.5
Height (in.):	2.436	2.354
Diameter (in.):	2.422	2.394
Area (cm^2):	29.73	29.03
Volume (cm^3):	184.0	173.6
Water Content (%):	15.34	15.08
Dry Unit Weight, γ_d (pcf):	116.3	123.3
Saturation (%):	85	100

Recorded Time	Elapsed Time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	Δh (cm)	K (cm/sec)	Temp (°C)	Viscocity Ratio, Rf	k_{20} (cm/sec)
0:03:30	30	2.04	7.20	61.9	2.24E-05	25.2	0.885	1.98E-05
0:04:00	29	2.24	7.00	61.9	2.32E-05	25.2	0.885	2.05E-05
0:04:30	29	2.41	6.83	61.9	1.97E-05	25.2	0.885	1.74E-05
0:05:00	29	2.58	6.66	61.9	1.97E-05	25.2	0.885	1.74E-05

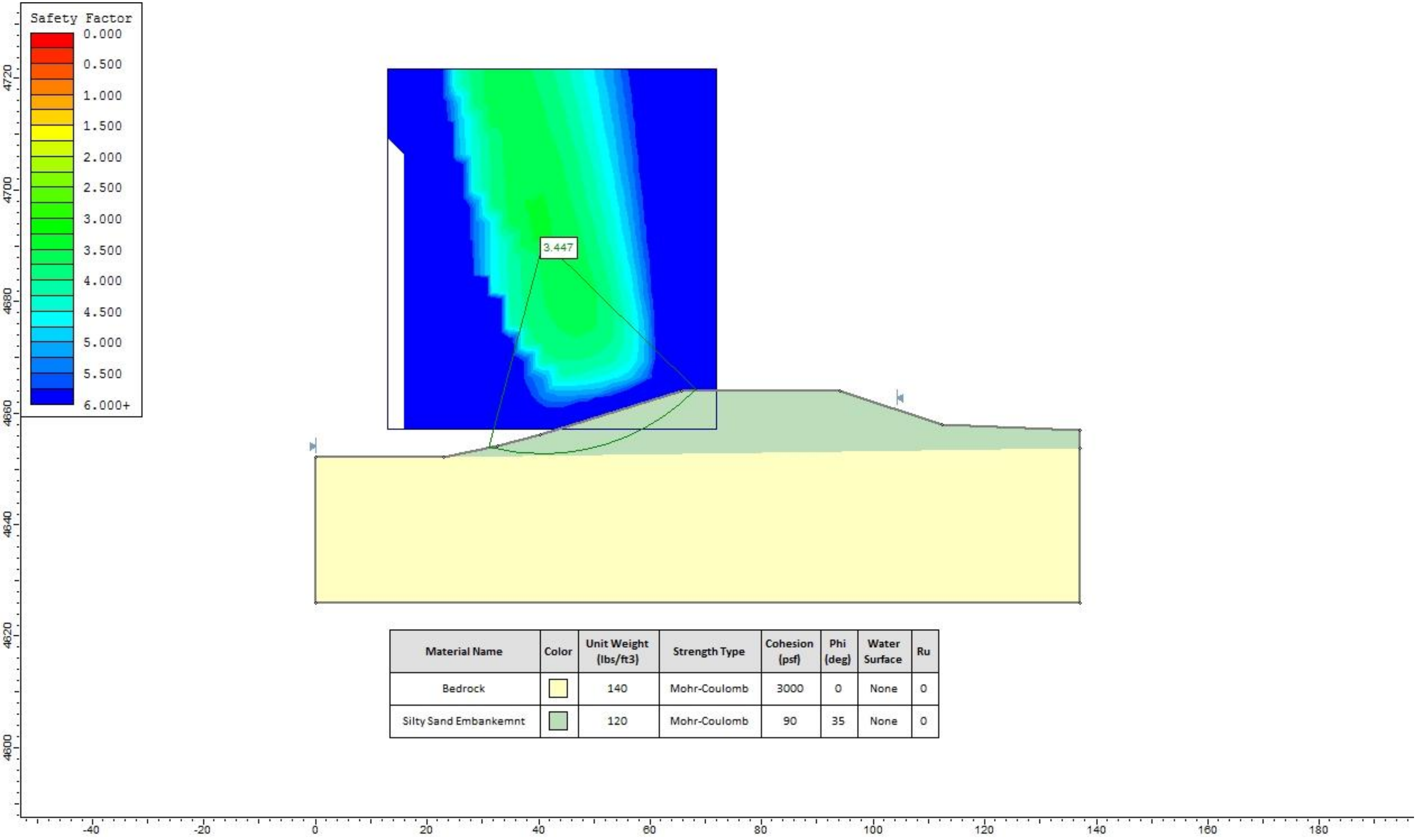
Average k_{20} 1.88E-05 (cm/sec)



PROJECT NO.: 524-042

GeoStrata

Plate 10



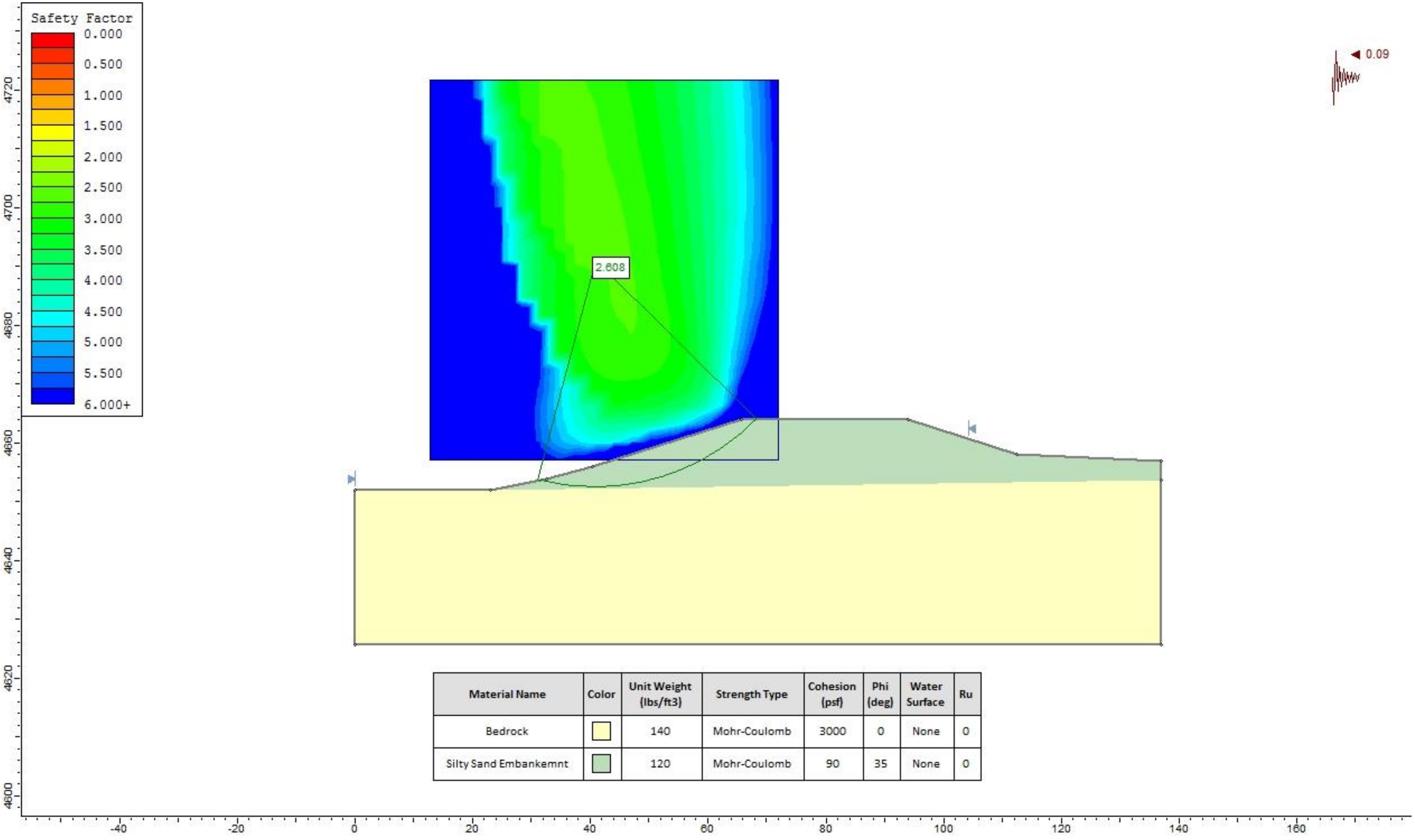
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0

GeoStrata

Landfill Cell Embankment – Empty Down Slope - Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate
11



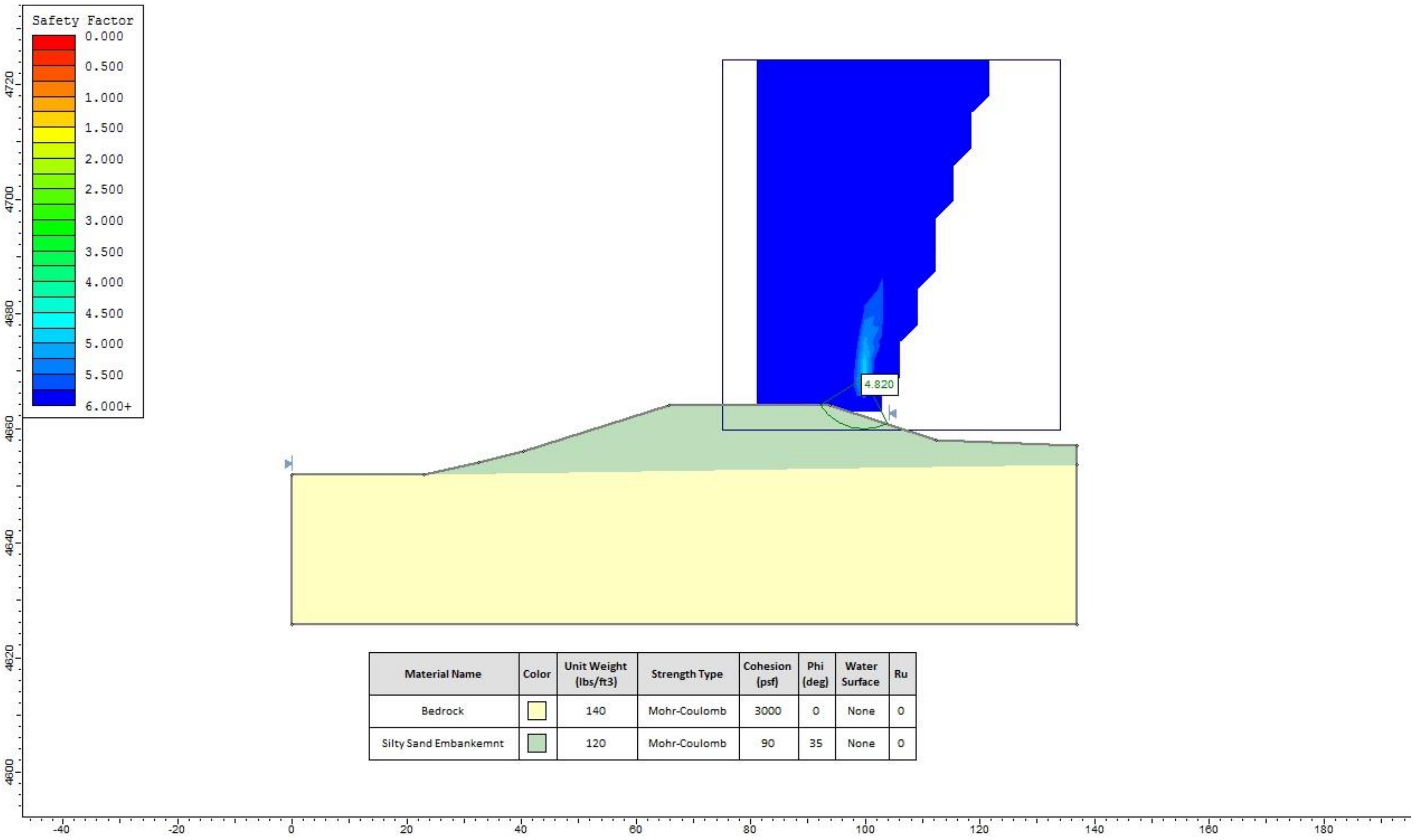
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0

GeoStrata

Landfill Cell Embankment – Empty Down Slope – Pseudo Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate
12



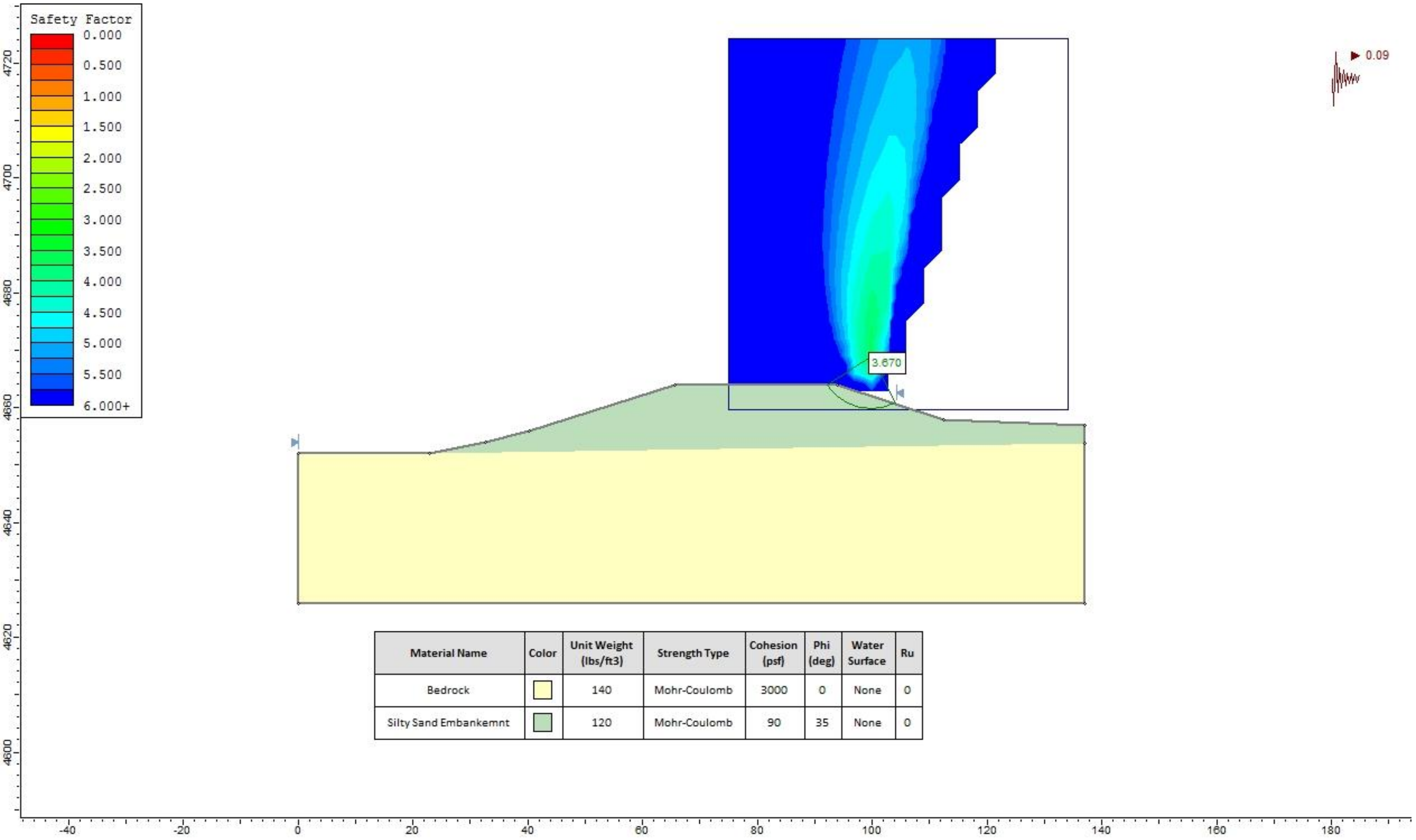
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0

GeoStrata

Landfill Cell Embankment – Empty Up Slope - Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate 13



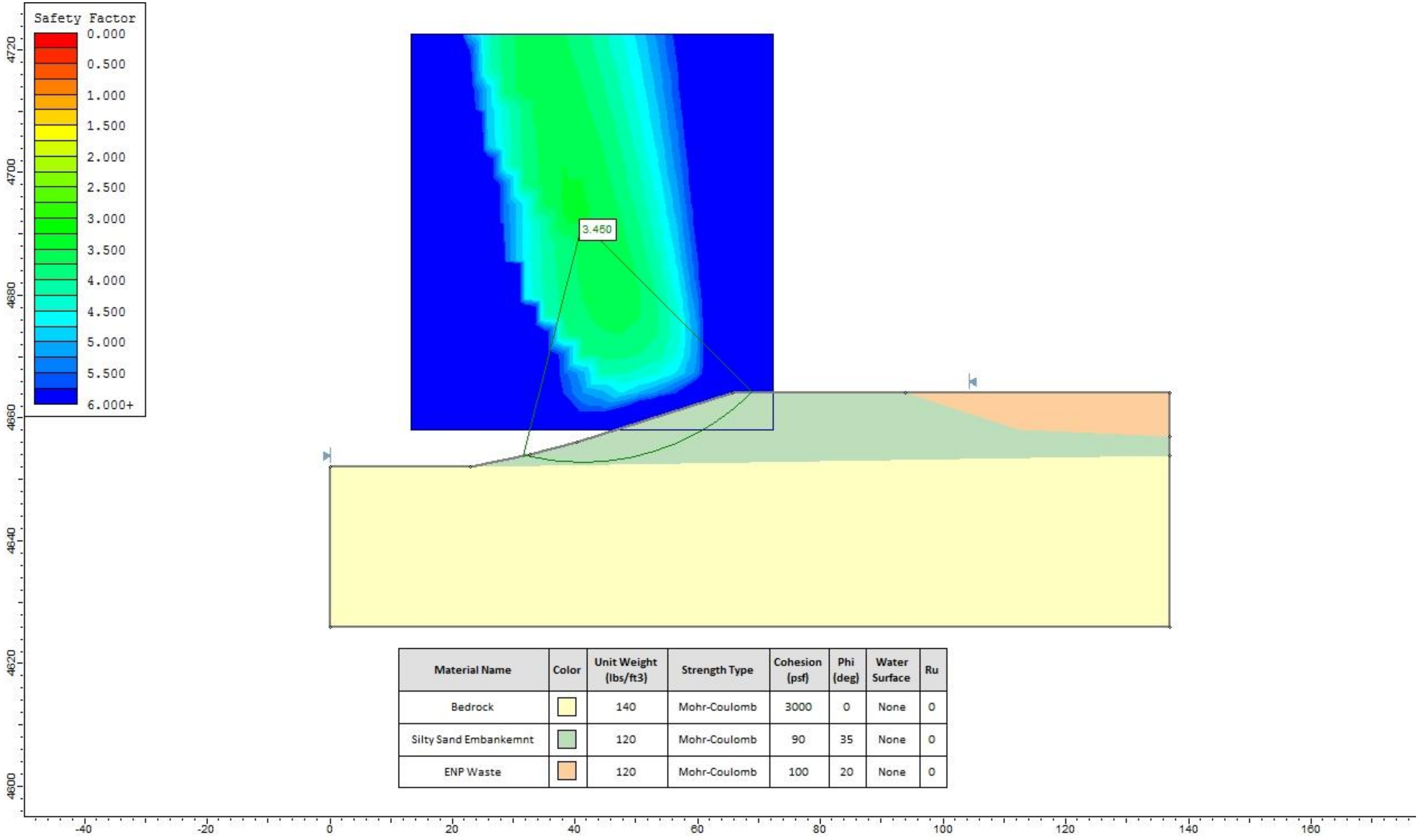
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0

GeoStrata

Landfill Cell Embankment – Empty Up Slope – Pseudo Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate 14

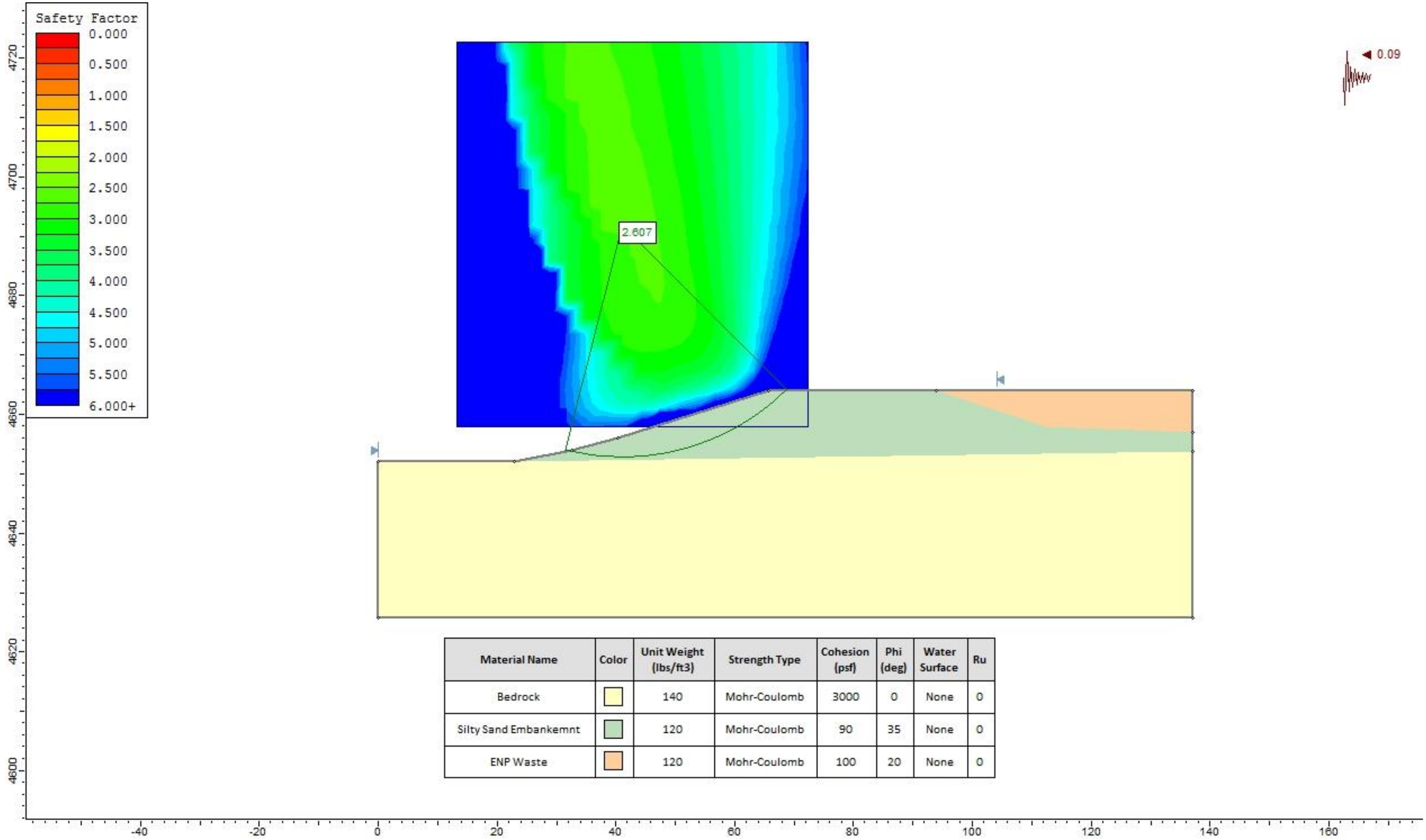


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0
ENP Waste	🟧	120	Mohr-Coulomb	100	20	None	0

Landfill Cell Embankment – Full Down Slope - Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate 15



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock	🟨	140	Mohr-Coulomb	3000	0	None	0
Silty Sand Embankemnt	🟩	120	Mohr-Coulomb	90	35	None	0
ENP Waste	🟧	120	Mohr-Coulomb	100	20	None	0

GeoStrata

Landfill Cell Embankment – Full Down Slope – Pseudo Static

R.N. Industries
Wonsit Landfill Cell #1 Phase I
Wonsit, UT
Project Number: 524-042

Plate 16

Appendix H

Stormwater Management Plan

Prepared for:

RN INDUSTRIES

WONSIT LANDFILL
STORMWATER MANAGEMENT PLAN

May 2013

Prepared by:

MWH

2890 East Cottonwood Parkway Suite 300
Salt Lake City, Utah 84121

TABLE OF CONTENTS

LIST OF TABLES

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1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

The RN Industries Inc. (RNI) Wonsit Disposal Facility is a produced water disposal operation located in the Northeast Quarter of Section 35 and the Southwest Quarter of Section 26, Township 8 South, Range 21 East, 6th Principal Meridian (Figures 1 and 2 in the Main Section of this Permit Application). The Facility is currently permitted by the Utah Division of Oil Gas and Mining (DOGM) as well as Uintah County to receive and treat produced water, natural gas liquids (NGL) and other Resource Conservation and Recovery Act (RCRA) Exempt Exploration and Production (E&P) wastes.

Through this permit application process, RN Industries of Roosevelt Utah (RNI) seeks authorization from the Utah Division of Solid and Hazardous Waste (UDSHW) to construct and operate an E&P Landfill. The proposed landfill is to be formally referred to as Wonsit Disposal Facility Landfill Cell #1 (Cell #1) and have a final surface area of approximately 7.2 acres. Drawings of the proposed landfill are provided in Appendix G3 of the permit application. The landfill will be constructed within and surrounding the footprint of former produced water evaporation referred to as Pond 9.

The landfill will be constructed in two phases with the first represented by the filling of the Pond 9 footprint. The second phase of construction involves the continued filling of the Landfill cell to the final footprint shown in drawings provided in Appendix G3.

This Appendix describes the Conceptual Stormwater Management Plan (SMP) for the initial phase of construction (Phase I). Phase I operations are expected to last for approximately nine years. Six months prior to the end of Phase I, a revised SMP will be prepared and submitted for UDSHW review and approval. A new SMP will be required for Phase II operations because the landfilling operations will encroach on the Phase I stormwater drainage swales. Included in this report are rainfall analyses and run-on/runoff estimates, and run-on estimates based on the landfill layout drawings provided in Appendix G3.

1.2 FACILITY LOCATION

The Wonsit Disposal Facility is located approximately 7 miles east of Ouray, Utah and operated by RNI, a subsidiary to Dalbo Holdings Inc. a Delaware corporation. The address to the Facility is:

374 East Chapita Grove Road
Uintah County, UT 84078

1.3 OBJECTIVE

The main objectives of the Phase I Conceptual SMP are as follows:

1. Prevent run-on during Phase I operations from reaching the landfill by providing diversion channels designed for a 25-year 24-hour storm event.

2. Manage runoff falling directly on the landfill by maintaining storage capacity within the landfill cell footprint which is able to store the runoff volume from a 25-year 24-hour storm event. Note that there will be different runoff storage volumes requiring management during Phase I and II operations. This SMP describes the requirements for Phase I operations. A separate SMP will be prepared for Phase II Operations.

1.4 LIMITATIONS

Professional judgments are presented in this report. These are based partly on evaluation of technical information gathered, partly on our experience with similar projects, and partly on our understanding of the characteristics of the project. The findings, interpretations of data, recommendations, professional opinions and conclusions that are presented in this report are within the limits prescribed by available information at the time the report was prepared, and in accordance with generally accepted professional engineering practice. In the event that there are any changes in the nature, design, or characteristics of the project, or if additional data are obtained, the conclusions and recommendations contained in the report will need to be reevaluated by MWH. Variations from results presented in the report may be expected, due to uncertainties that are inherent in these types of analyses. Therefore, decisions that are based on these results should consider these variations.

MWH's services were performed within the limits prescribed by our client, with the usual thoroughness and competence of the engineering profession. No other representation, expressed or implied, is included or intended in our proposals, contracts, or reports.

2.0 RAINFALL FREQUENCY ANALYSIS

2.1 GENERAL

Diversion channels and other hydraulic structures for the Wonsit Landfill Cell #1 will be designed for a 25-year 24-hour rainstorm event. A Rainfall Frequency Duration Analysis was performed and used in the development of the SMP.

Hydrologic design criteria used in the SMP for Landfill Cell #1 is set by the Department of Solid and Hazardous Waste (DSHW) regulations. Based on these regulations, all hydraulic structures must be designed for the 25-yr, 24-hr storm event.

2.2 METHODOLOGY

The rainfall distribution for the design storms used SCS 24-hr Type II storm. The 25-year rainfall depths were estimated for various durations ranging from 30 minutes up to 24 hours and are shown in Attachment H1. The rainfall total depths for the 25-year storms were obtained using the NOAA Atlas No. 14 (NOAA 2004).

2.3 RESULTS

The estimated rainfall at the site for the 25-year storms with storm durations ranging from 30 minutes to 24 hours, are shown in Table H2-1. Per the DSHW regulations, all hydraulic structures must be designed for the 25-yr, 24-hr rainfall event.

TABLE H2-1
RAINFALL DEPTH-DURATION VALUES: 25-YEAR STORM EVENT

Time (hours)	25-Year Rainfall depth (inches)
0.5	0.74
1	0.92
2	1.02
3	1.06
6	1.23
12	1.43
24	1.67

3.0 RUNOFF ANALYSIS

3.1 DRAINAGE BASINS

The tributary drainage basins for the landfill generally follow in an easterly direction and which eventually empty into the White River (See Figure H1). The drainage basins in this area are primarily undeveloped with vegetations consisting of sparse shrub and brush rangeland.

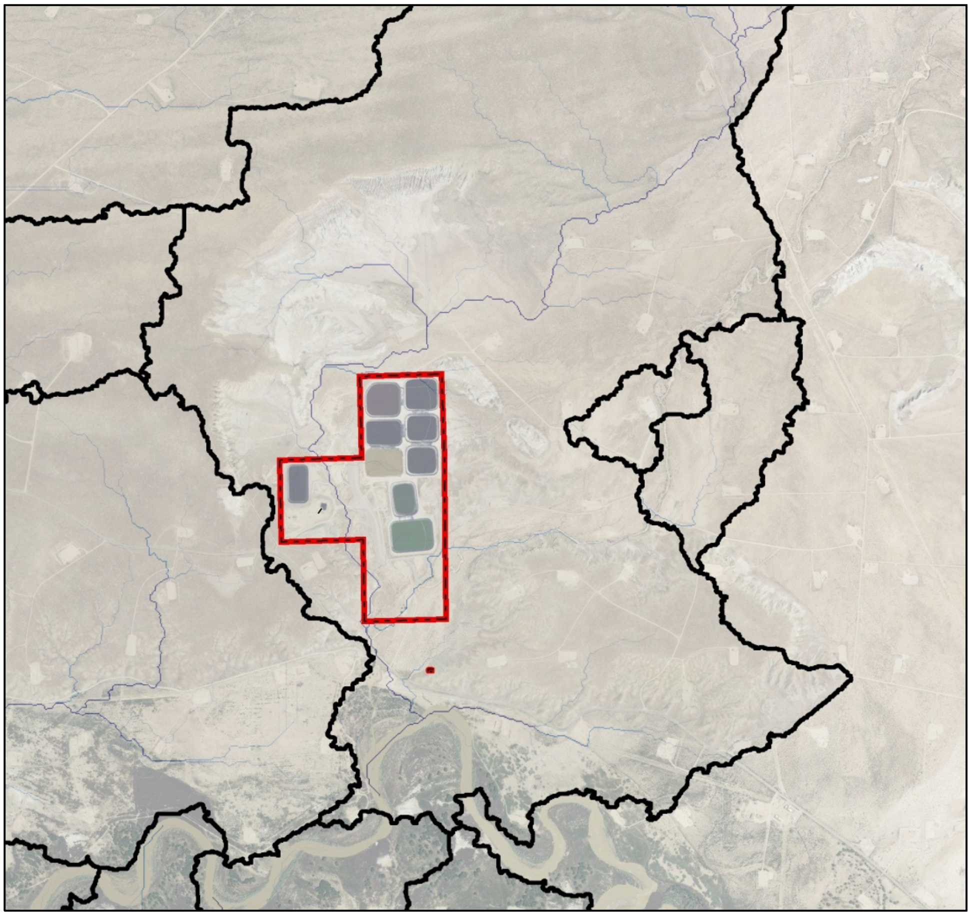

Figure H1: Project Area Catchment Streambeds

The drainage basins for the project (Figure H2) were delineated using aerial topography in conjunction with USGS DEM data for areas outside the project site. The site description data was collected using ArcGIS.

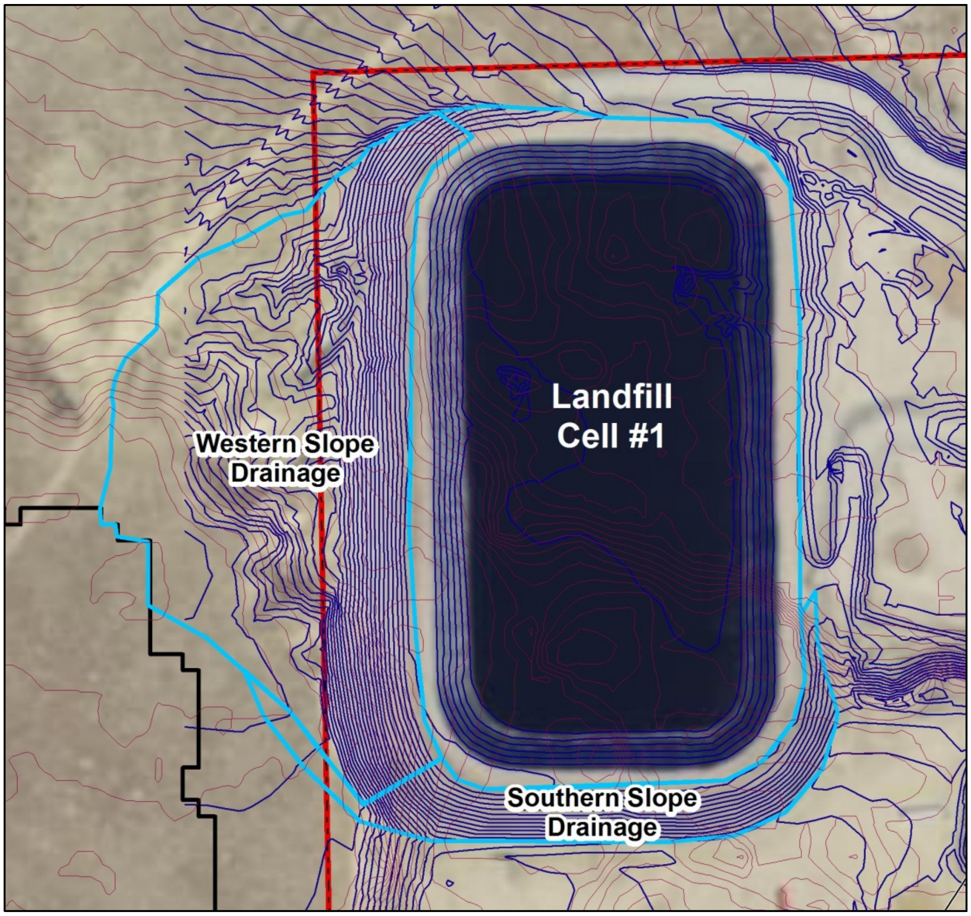

Figure H2: Landfill Drainage Basins

At this stage there is only one proposed landfill (Cell #1) at the facility. The diversion channels for Phase I operations have been placed to protect the proposed landfill and divert clean water away. The hydrologic characteristics of the watershed basins modeled are summarized in Table G3-1.

TABLE H3-1
HYDROLOGIC CHARACTERISTICS OF BASINS

Basin Name	Area ($mile^2$)	Area (acre)	CN
Western Slope Drainage	0.005	3.32	87
Southern Slope Drainage	0.001	0.78	87
Landfill	0.009	5.85	87

The watershed characteristics considered, including route length, elevation difference, average slope, and lag time, is summarized in Table H3-2.

The lag time for the watershed was estimated based on the curve number method developed by the NRCS. This method is described as follows:

$$L = \frac{l^{0.8} * (S+1)^{0.7}}{1900 * Y^{0.5}}$$

Where,

L = lag time in hours
l = hydraulic length of watershed in feet
S = (1000/CN) – 10
CN = soil group curve number
Y = average watershed land slope in percent

The infiltration loss for the drainage areas was computed based on the curve number (CN). The CN value used in this analysis was assumed at 87 based on soil and land use information from the site. Curve numbers recommended are: for the hydrologic soil group (HSG) B, 77 for HSG C, 85 and for HSG D, 88. HSG B is recommended for silt loam or loam, HSG C for sandy clay loam and HSG D for clay loam, silty clay loam, sandy clay, silty clay, or clay. A curve number of 87 was selected, since surface soils at the Facility are composed mainly of clay soils, and vegetative cover consists of shrub and brush rangeland with sparse vegetative cover.

The time of concentration is defined as the time needed for water to travel from the most remote point of the watershed to the watershed outlet. Based on the empirical relation, NRCS suggests that time lag equals 0.6 times the time of concentration. Table H3-2 summarizes the route length, elevation difference, weighted average slope, and lag time for each route.

TABLE H3-2
WATERSHED CHARACTERISTICS OF BASINS

Basin	Length (ft)	Elevation Difference (ft)	Average Slope (%)	Lag Time (min)
Western Slope Drainage	663	0.39	45.2	16.1
Southern Slope Drainage	585	3.27	46.7	14.3
Landfill	NA	NA	NA	0.0

3.2 METHODOLOGY

The HEC-HMS model developed by the Corps of Engineers was used to compute the surface runoff during the 25-year 24-hour storm. Rainfall depths for specified durations were input into the HEC-HMS model for generation of the peak flows due to the storm events. The SCS 24-hr rainfall distribution defined for a Type II storm was used used for the 25-year storm event.

3.3 RESULTS

Based on our analysis using the 25-year 24-hour storm event and the HEC-HMS model, the peak basin flows for swale and landfill containment pond sizing are presented in Table H3-3.

TABLE H3-3
BASIN RESULTS – 25-YEAR 24-HOUR STORM

	25-year 24-hour	
Basin	**Runoff Volume (ac-ft)**	**Peak Flow (cfs)**
Western Slope Drainage	0.18	1.75
Southern Slope Drainage	0.04	0.43
Landfill	0.81	11.22

4.0 DIVERSION CHANNELS AND STRUCTURES FOR PHASE I OPERATIONS

4.1 GENERAL

Based on our analysis using the 25-year 24-hour storm event and the HEC-HMS model, the peak flows used for the sizing of the diversion structures are presented in Table H4-1. The drainage structure locations are shown in Figure H3, below.

TABLE H4-1
DIVERSION CHANNEL AND STRUCTURES PEAK FLOWS
25-YEAR 24-HOUR STORM

Element	Peak Flow (cfs)	Comments
Western Pond Swale	1.71	Diversion Channel
Southern Pond Swale	1.85	Diversion Channel
Southern Swale Culvert	1.85	Diversion Culvert

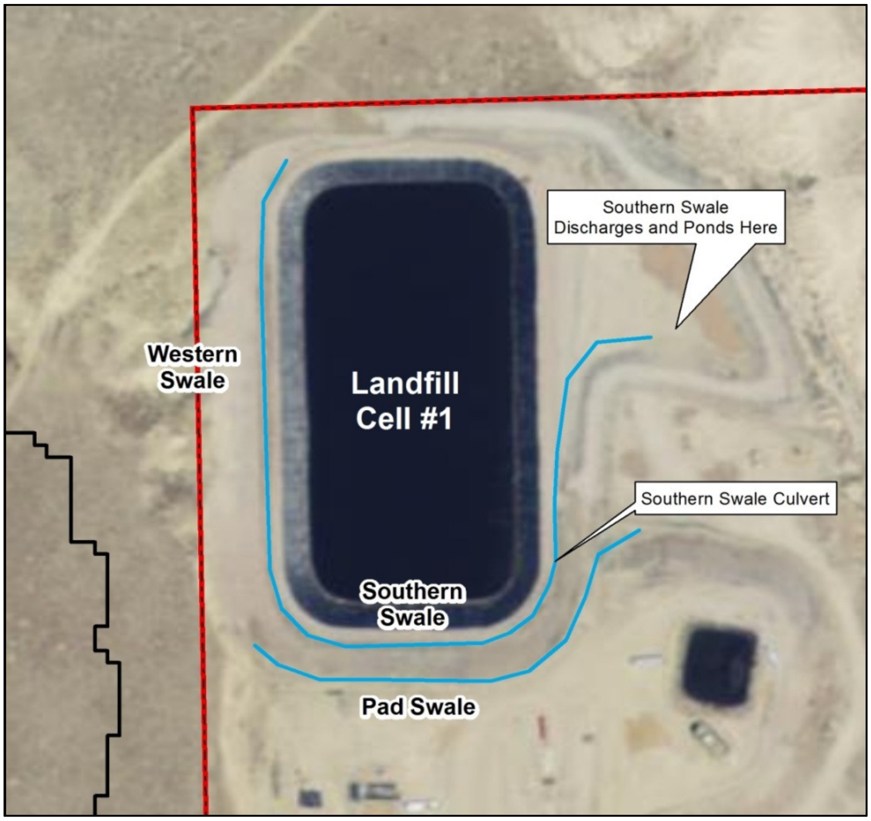

Figure H3: Drainage Structure Locations

The natural flowlines through the site are shown on Figure H3. Drainage channels are located to intercept these flowlines and have been sized as described in Section 4.2.

4.2 DIVERSION CHANNELS FOR PHASE I OPERATIONS

For the Western and Southern Slope Drainages, existing swales are located to route stormwater around the landfill to prevent stormwater from coming into contact with it. Any water not caught in the swales should drain into the landfill where it will be collected and evaporated or pumped, as needed.

A survey was performed to verify the sizing of the existing structures. However, as the sizing was very irregular, the calculations were performed using the sizing of the structures below which is based on the most critical cross section, or the section which provides the smallest cross-sectional area below the crest of the landfill. Larger cross-sectional areas will allow for greater volumes of water to be passed and will be less likely to overtop.

Manning's roughness coefficients used are shown below:

- Aged Plastic Pipe..0.012
- Riprap..0.035
- Earthen/Grass-Lined..0.030

The size of the proposed channels is summarized in the following lists.

TABLE H 4-2
WONSIT DISPOSAL FACILITY DIVERSION CHANNELS

Channel	n	Bottom Width (ft)	Left Side Slope (XH:1V)	Right Side Slope (XH:1V)	Max Depth (ft)	So (%)
Western Pond Swale	0.030	0	10	2.5	0.54	0.07
Southern Pond Swale	0.030	0	5	2.5	0.47	0.70
Southern Swale Culvert	0.012	-	-	-	0.76	1.00

4.3 CONTAINMENT POND FOR PHASE I OPERATIONS

A containment pond to hold the 25-year 24-hour storm event will be designed as part of the northeast corner of the landfill to retain and evaporate the total volume of runoff inside the landfill area. Initially, this pond will contain the 0.81 ac-ft generated by the storm with an additional 0.2 ac-ft to act as freeboard for water currently being evaporated. A gage will be placed on the side of the pond indicating when the 0.2 ac-ft has been reached and the pond should be pumped. Using this, operators will know when the pond has too much water stored and will be able to make the 25-year design storm capacity available when it is needed. The proposed shape of this pond is shown in Figure H3, but may be altered as required for the project.

During Phase 2, the landfill pond will no longer be adequate a revised SMP will submitted for UDSHW review and approval.

5.0 SUMMARY

The philosophy of the conceptual SMP presented in this report is based on stormwater solutions for Phase I Operations associated with Wonst Landfill Cell #1. The initial phase of operations for Cell #1 are expected to last for approximately six years. A revised SMP will be submitted for UDSHW review and approval approximately six months prior to initiating Phase II operations.

After performing the hydrologic and hydraulic calculations for the structures impacting Landfill Cell #1, it was established that the existing structures will be adequate to handle the 25-yr, 24-hr rainfall event. Because the containment pond will be installed as part of the landfilling process, no additional hydraulic structures will need to be installed for Phase I operations.

6.0 REFERENCES

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NOAA (2004). *"NOAA Atlas No. 14-Utah"*, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, 2012.

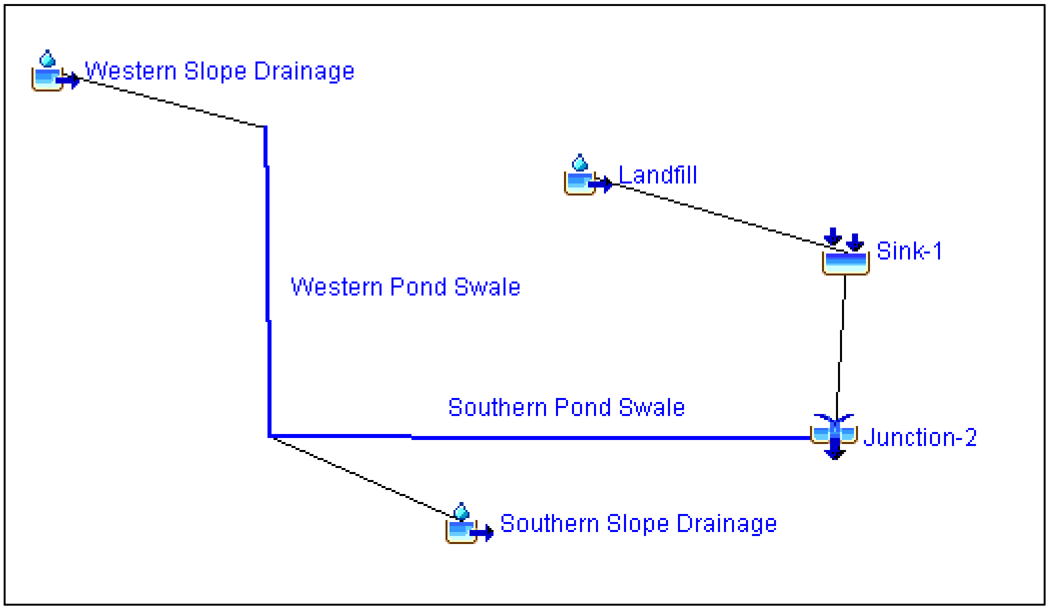
SEO (1994). "Dam *Safety & Construction Rules & Regulations Project Review Guide"*, State of Colorado, Office of the State Engineer, Division of Water Resources, September 1994.

SEO (2007). "Rules and Regulations for Dam Safety and Dam Construction". State of Colorado, Office of the State Engineer, Division of Water Resources, January 1, 2007.

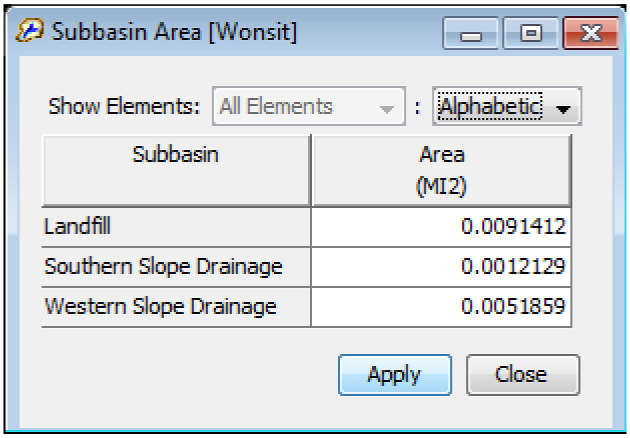
U.S. Department of Transportation, July 2006, Hydraulic Engineering Circular No. 14, Third Edition, "Hydraulic Design of Energy Dissipators for Culverts and Channels", Chapter 10.

ATTACHMENT H1

HEC-HMS INPUTS AND OUTPUTS



ATTACHMENT H1 FIGURE 1: HEC-HMS LAYOUT



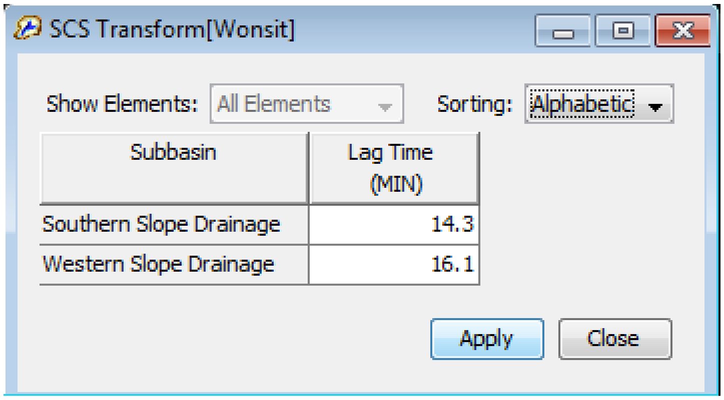
Show Elements: All Elements : Alphabetic

Subbasin	Area (MI2)
Landfill	0.0091412
Southern Slope Drainage	0.0012129
Western Slope Drainage	0.0051859

ATTACHMENT H1 FIGURE 2: INPUT SUBBASIN AREAS

ATTACHMENT H1 TABLE 1: INPUT SCS LAG CALCULATIONS

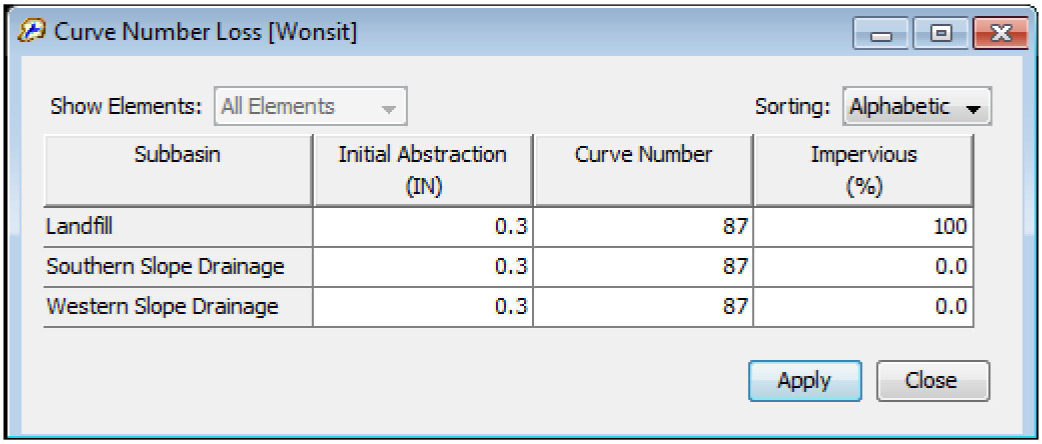
	length	**CN**	**S**	**Y**	**L**	**L**
	ft			%	hrs	mins
Western Slope Drainage	663.31	87	1.5	45.20%	0.268	16.1
Southern Slope Drainage	585.34	87	1.5	46.70%	0.239	14.3
Landfill	0	100	0.0	1.00%	0.000	0.0



Show Elements: All Elements
Sorting: Alphabetic

Subbasin	Lag Time (MIN)
Southern Slope Drainage	14.3
Western Slope Drainage	16.1

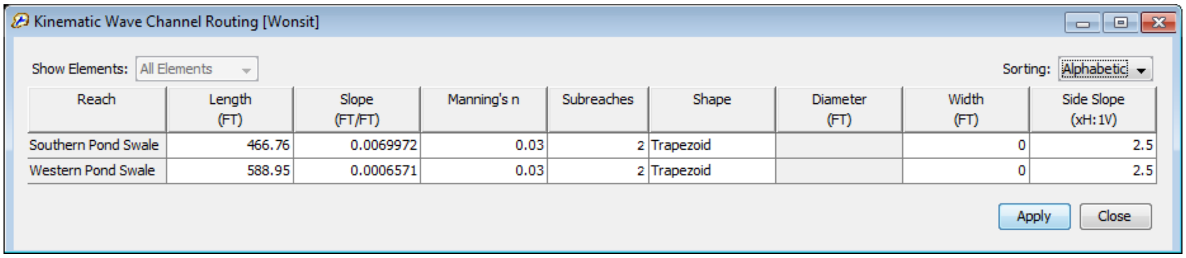
ATTACHMENT H1 FIGURE 3: INPUT SCS TRANFORMATION LAG TIMES



Show Elements: All Elements
Sorting: Alphabetic

Subbasin	Initial Abstraction (IN)	Curve Number	Impervious (%)
Landfill	0.3	87	100
Southern Slope Drainage	0.3	87	0.0
Western Slope Drainage	0.3	87	0.0

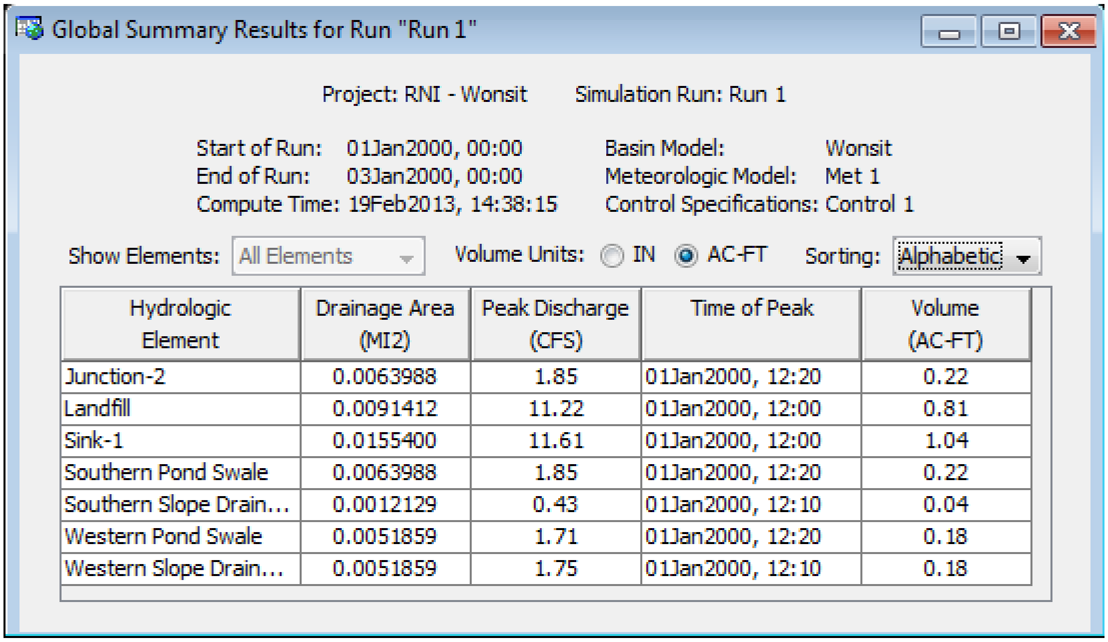
ATTACHMENT H1 FIGURE 4: INPUT CURVE NUMBER LOSSES



Show Elements: All Elements
Sorting: Alphabetic

Reach	Length (FT)	Slope (FT/FT)	Manning's n	Subreaches	Shape	Diameter (FT)	Width (FT)	Side Slope (xH:1V)
Southern Pond Swale	466.76	0.0069972	0.03	2	Trapezoid		0	2.5
Western Pond Swale	588.95	0.0006571	0.03	2	Trapezoid		0	2.5

ATTACHMENT H1 FIGURE 5: INPUT KINEMATIC WAVE ROUTING DIMENSIONS



Project: RNI - Wonsit Simulation Run: Run 1

Start of Run: 01Jan2000, 00:00 Basin Model: Wonsit
End of Run: 03Jan2000, 00:00 Meteorologic Model: Met 1
Compute Time: 19Feb2013, 14:38:15 Control Specifications: Control 1

Show Elements: All Elements Volume Units: ○ IN ● AC-FT Sorting: Alphabetic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-2	0.0063988	1.85	01Jan2000, 12:20	0.22
Landfill	0.0091412	11.22	01Jan2000, 12:00	0.81
Sink-1	0.0155400	11.61	01Jan2000, 12:00	1.04
Southern Pond Swale	0.0063988	1.85	01Jan2000, 12:20	0.22
Southern Slope Drain...	0.0012129	0.43	01Jan2000, 12:10	0.04
Western Pond Swale	0.0051859	1.71	01Jan2000, 12:20	0.18
Western Slope Drain...	0.0051859	1.75	01Jan2000, 12:10	0.18

ATTACHMENT H1 FIGURE 6: OUTPUT HEC-HMS RESULTS

ATTACHMENT H1 TABLE 2: OUTPUT MANNING DEPTH CALCULATIONS

Channel	n	b ft	XH: 1V left	XH: 1V right	y or D ft	So ft/ft	Q calc cfs	Peak Flow cfs	Average Velocity fps	Available Depth ft	Remaining Freeboard ft
Western Pond Swale	0.03	**0**	**10**	**2.5**	**0.54**	0.0006571	1.71	1.71	2.37	0.62	0.08
Southern Pond Swale	0.03	**0**	**5**	**2.5**	**0.47**	0.0069972	1.85	1.85	3.41	1.16	0.69
Pond Swale Culvert	0.012				**0.76**	0.01	1.85	1.85	4.09	NA	NA

Appendix I

Plan of Operations

Wonsit Landfill Cell #1 Phase I

Prepared for:

RN INDUSTRIES

WONSIT LANDFILL

PLAN OF OPERATIONS

May 2013

Prepared by:

MWH

2890 East Cottonwood Parkway Suite 300

Salt Lake City, Utah 84121

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1.0 PLAN OF OPERATIONS SUMMARY

This plan address operational requirements for an Exploration and Production Landfill to be constructed at RNI's Wonsit Valley Disposal Facility located at 374 East Chapita Grove Road, Uintah County, Utah 84078. The overall disposal facility occupies the North Half of the Northeast Quarter and the Southeast Quarter of the Northeast Quarter of Section 35, Township 8 South, Range 21 East, Salt Lake Base and Meridian and the Southeast Quarter of the Southeast Quarter of Section 26, Township 8 South, Range 21 East, Salt Lake Base and Meridian. The proposed landfill identified as Wonsit Landfill Cell #1 will be located in the former Evaporation Pond 9 footprint and will accept exploration and production (E&P) RCRA exempt wastes including, but not limited to, drill cuttings, drilling muds, petroleum impacted soils, and discarded E&P impoundment liners. Only E&P wastes that pass a paint filter test (Method 9095B) will be accepted in to Landfill Cell #1. Wastes such as drilling mud that do pass the paint filter test will be solidified before being placed in the landfill.

Schedule of Construction - Construction of Phase I of RNI's Wonsit Landfill Cell #1 is expected to occur in the summer of 2013 and then receipt of E&P Waste will begin in the Fall of 2013. As calculated in Appendix K of the permit application, Phase I operations for the landfill is expected to last for six years. One year prior to running out of landfill space, RNI will design Phase II of the Landfill and then file an application for expansion of Cell #1. Conceptual drawings of Phase II are provided in Appendix G3, however, the actual design for the allowable waste slope angles and final cover must wait until geotechnical testing of wastes and monitoring of landfill gasses are completed.

This Plan of Operations has been prepared in accordance with the Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste (DSHW) regulations outlined in Utah Administrative Code R315-310-3(1)(e) and R315-302-2(2).

2.0 ON-SITE WASTE HANDLING PROCEDURES

Site Security – Prior to receipt of waste into the landfill, a barbed wire fence approximately three feet high with signage every 250 feet will be used to control access to the landfill. An additional sign will be placed at the closest approach of the gravel road located to the north of the landfill. The signs will be visible within 25 feet of the fence and read as follows:

CAUTION – HAZARDOUS AREA – AUTHORIZED PERSONNEL ONLY

The main entrance into the Wonsit Disposal Facility is controlled by a gate which is kept locked in the evening or when the Facility Manager is not present. Delivery drivers have access to a key which allows them to enter the facility if the gate is locked.

All on-site personnel except delivery drivers are required to sign in at the receiving gatehouse and wear hard hat, steel tipped boots, safety glasses, and any other task specific personnel protective equipment required. No smoking is allowed on site and the emergency gathering area for the Wonsit Facility is the intersection of the main entrance road and Chapita Grove Road.

Transportation and Off-Loading - Waste will be hauled to the Wonsit Landfill by commercial or independently owned trucks. Trucks will enter the main gate and either dump the waste into a concrete mixing vault, an offloading shoot directed to a pug mill system, or deposit the waste directly onto a conveyor system moving material into the landfill.

Wastes such as drilling mud that do not pass a paint filter test (Method 9095B), will be solidified with native soil or other UDSHW preapproved material(s) by mixing in a concrete vault or pug mill system. Solidified waste as well as other E&P wastes will be placed in the landfill cell using a conveyor belt system or by landfill operators using front loaders, bulldozers, road graders, and backhoes. Written authorization from UDSHW will be obtained prior to the use of any solidification material other than native soil.

Protection of Geocomposite and 60 Mil HDPE Liner During Loading - An initial 18-inch layer of waste/native soil will be carefully placed and compacted to prevent damage to the geocomposite drainage layer and underlying 60 mil HDPE liner. Bulldozers and other earth moving equipment used inside the landfill shall be limited in contact pressure to the specification provided in Permit Application Appendices G3 (Design Drawings) and G4 (Specifications – Protection of Geocomposit). For example, construction equipment with ground pressures less than 10 psi are shown in Appendix G4 to require a minimum of 12 inches of compacted native silt or appropriately solidified waste. For this design, however, the minimum allowable thickness of protective soil or appropriate solidified waste is 18 inches. Earth moving equipment will not be permitted access to any area of the landfill where the geocomposite (double 8 oz geotextile layers with geonet) are exposed until the protective soil/waste layer is placed and compacted. The initial protective layer of soil or waste will be placed using long-stick backhoes (or similar equipment) and the conveyor system(s).

Prior to initial filling of the bottom of the landfill, approximately 1/4th to 1/3rd of the HDPE primary liner in Pond 9 (Cell #1)will be covered with geocomposite drainage materials consisting of two 8 ounce non-woven geofabric layers with an embedded geonet. A minimum of 18 inches of protective waste or soil will be placed and compacted on top of the geocomposite. Wastes will then be loaded into this section of the landfill until it is necessary to place the geocomposite and protective soil/waste layer over the next 1/4th to 1/3rd of the landfill cell. This process will begin on the southern end of the landfill and move northward until the entire bottom and sides of the landfill cell are covered with the geocomposite and protective soil/waste layer.

Constructing the geocomposite and overlying 18 inch soil/waste layer in sections allows for protection of the polypropylene fibers in the 8 ounce geofabric layers from degradation via ultraviolet light (sunlight). Geofabric materials must be covered with soil or waste within two weeks of placement in order to retain suitable strength and engineering properties. The HDPE materials in the geonet and 60 mil liner are not affected in the same way as the polypropylene in the geofabric.

Slope Stability - During Phase I operations, a professional geotechnical engineer registered in the state of Utah will provide direction to RNI on slope stability. Potential slope stability issues for the landfill include, but are not limited to, shear strength of the stabilized wastes; effects of rainfall, snow melt or other moisture on waste shear strength; slope angle of waste placement; structural stability of the existing berms surrounding the former Evaporation Pond 9; and effects of earth quake forces on slope stability. As appropriate, the RNI selected geotechnical engineer will assess the pug milling operation and test the solidified waste for shear strength, make recommendations on the mixture of waste and stabilizing materials, establish safe slopes angles for the waste placement, and perform any other assessments required based on the engineer's best judgment. The engineer's recommendations and testing results will be included in annual reports submitted to UDSHW.

3.0 LANDFILL INSPECTION, MONITORING, RECORD KEEPING AND REPORTING.

The Facility's personnel will conduct routine inspections of the landfill, perform sampling, monitor gas generation, and prepare reports. A summary of the monitoring events and frequencies are provided in Appendix I - Attachment 2. Scheduled maintenance or unscheduled repairs shall be documented in the repair log provided in Appendix I -Attachment 3.

Leachate Monitoring and Disposal – Once per week, site personnel will check the leachate collection sump, leak detection sump, and wet/dry well MW1 for the presence of fluids. Results of the well and sump monitoring will be recorded in the operators log along with the volume of water (if any) removed from either sump and transferred to Wonsit Disposal Evaporation Pond 1. Depths to groundwater in well MW1 will be record to the nearest 1/100 of a foot using an electronic water level detector.

Monitoring of Landfill Gas - RNI landfill operators will monitor for oxygen (O_2), lower explosive limit (LEL), hydrogen sulfide (H_2S), methane, and VOCs with an on-site detector. RNI's health and safety plan will be implemented and includes, but is not limited to, monitoring of volatile organic compounds (VOC) concentrations, health based exposure thresholds, % LEL thresholds, personal protective equipment (PPE) requirements, confined space entry, contingency planning, hazard communications, and employee training requirements.

Surface and Ground Water Monitoring – Each Spring, three surface water samples will be collected and analyzed as described in Section 2.6 of the Permit Application. Groundwater elevations will be monitored during the Spring of each year and if detected, a sampling program will be established with the UDSHW. To date, all monitoring wells installed have been dry. Further details regarding the groundwater monitoring program are also provided in Permit Application Section 2.6.

Record Keeping – As required by regulation R315-302-2 (3) RNI personnel will, at a minimum, collect and retain at the site or at the corporate headquarters in Roosevelt, Utah the following records:

- **Waste Shipments** - Facility personnel shall keep records of each shipment of waste being disposed at the Facility. A waste disposal ticket shall be completed for each truck entering the Facility. Record keeping of waste disposal shall include the following at a minimum:

    - Date and time
    - Receiving impoundment identification
    - Quantity (cubic yards and estimated tons based on appropriate unit weight)
    - Type of waste
    - Location waste was produced
    - Waste generator
    - Hauler and truck number,
    - Driver's name and signature.

  Waste shipment information is recorded by the truck driver electronically or on a paper Waste Disposal Ticket as shown in Appendix I - Attachment 1. Individual load receipts will be retained for at least six years.

- **Operating Record** – By the end of each day, the RNI Facility Manager will, at a minimum, record:

    - Estimated weight in tons and volume in cubic yards (cy) of E&P waste received that did not require solidification, and was directly loaded into the landfill. A description of each waste load with the tonnage estimated based on an appropriate unit weight,

    - Estimated weight in tons and volume in cy of E&P waste received that required solidification. A description of each waste load received and the raw tonnage estimated based on an appropriate unit weight,

    - Estimated weight in tons and volume in cy of each type of material used to solidify the load described in the second bullet above.

- Total weight in tons and total volume in cy of solidified waste placed in the landfill associated with bullets 2 and 3 above.

Additional entries in the Operating Log will include:

- Deviations from the UDSHW approved operations plan,
- Training records and required notification procedures. The general training plan for the Wonsit Landfill Cell #1 is presented in Chapter 10 below,
- Results of surface water, ground water, and gas monitoring / laboratory analyses,
- Completed Inspection Log (Appendix I - Attachment 2),
- Dust Suppression Activities completed in accordance with Chapter 6.0 below.
- Weekly monitoring results for the leak detection and leachate collection sumps and MW1.
- Closure and Post Closure Plans are considered by regulation to be a part of the operators record and are included with this permit application as Appendix J,
- Geotechnical Testing of solidified and other landfilled waste;
- Written guidance from the Utah Registered Professional Engineer describing the allowable waste slope angles and other slope stability related issues. Geotechnical testing of waste and adjustment of the solidification process and allowable slope angles will be performed during Phase I operations at the discretion of the Utah Registered Engineer. All geotechnical testing and written slope stability guidance shall be maintained as a part of the Operating Record.
- Required financial assurance and closure / post closure documentation as described in Permit Application Appendices J and K.

Reporting - As required by regulation R315-302-2 (4), by March 1 of each year, RNI personnel will prepare and submit to the UDSHW an Annual Report describing facility activities for the preceding calendar year. This Report will include at a minimum the following items:

- Name and address of the facility,
- Calendar year covered by the report,
- Annual quantities of waste received,
- Annual quantities of waste landfilled taking into account solidification performed at the facility prior to placing waste into the landfill,
- Annual update of the required financial assurance mechanism as described in R315 309-2(2),
- Annual results of surface water, ground water, and gas monitoring, and
- Documentation of training programs completed during the year by site personnel.

4.0 POTENTIAL CORRECTIVE ACTION

Should a release from the landfill operations occur which impacts the ephemeral stream or groundwater, RNI would expeditiously perform all immediate response actions they judged to be needed to mitigate the release. RNI personnel would inform the UDSHW of the impacts with two days of observing a release or within one week of completing statistical calculations that suggested that a regulatory significant impact to the stream or groundwater had occurred. The one week delay in notification for statistically based detections allows time to consider the validity of the laboratory data and the applicability of regulatory standards before initiating contact with the agency. Once the Agency was notified and feedback received, RNI would prepare a long term corrective action strategy (if needed) and submit it to UDSHW for review and approval.

5.0 CONTINGENCY PLAN FOR FIRE OR EXPLOSION

In the event of a fire or explosion, the designated Emergency Response Coordinator for the Facility will be contacted at the RNI Dispatch Center. He or she will contact the local emergency authorities to initiate emergency response. In the case of a spill, leak, or other non-fire or explosion emergency, the Facility's First Responders will be notified. The list of First Responders and Local, State, and Federal agency contacts and the required agency notifications are presented in Appendix I - Attachment 4. See Appendix I - Attachment 6 for details of the Personnel Training Program which includes fire prevention and control.

6.0 FUGITIVE DUST CONTROL PLAN

The intent of the Fugitive Dust Control Plan (FDCP) is to provide procedures used to minimize fugitive dust from the RNI Wonsit Landfill operations. This document has been prepared to offer flexibility yet maintain compliance with the Utah Administrative Code (UAC) Section R315-302-2(2)(g), and the requirements of the Exploration and Production Landfill Application submitted to the Utah Department of Solid and Hazardous Waste.

The primary sources of fugitive dust at the Facility will be from road and non-road vehicle travel for delivery of E&P waste materials to the landfill cell, excavation and stockpiling of borrow material for use in the pug mill, and spreading and distribution of landfill materials within the landfill cell footprint. Equipment used for these activities consist of dump trucks, graders, tractors, backhoes, trackhoes, and delivery trucks. Best management practices to reduce fugitive dust emission at the Facility include speed limit control of 5 miles per hour along with watering and general maintenance of dirt roads.

The access road, Chapita Grove Road, to the Wonsit Facility is paved. All haul roads beyond the gate for the Wonsit Facility are unpaved. RNI will perform daily inspections of the surface conditions of the unpaved roads within the Facility and document required dust suppression activities in an operator's log. Primary controls will be implemented when measurements of opacity exceeds 10% at the property boundary or 20% onsite.

Should the opacity limits described above be observed, RNI personnel will implement primary controls consisting of spraying water on the unpaved roads, borrow piles, and wastes at a frequency and volume suitable for the site conditions. Water for dust suppression activities will be trucked in from a nearby one million gallon reservoir located in Ouray and owned by Dalbo Holdings, Inc., and operated by RNI. The volume of water used, approximate length of unpaved road treated, and date and time of the treatment shall be recorded in the Facility operation's log. If necessary, magnesium chloride may also be applied to dirt roads in accordance with standard application rates recommended by the supplier to provide long term reductions of dust emissions. All potential dust control strategies will be implemented to achieve the opacity limitations outlined in Utah Administrative Code rule R307-309-5. Additional requirements for daily cover of the landfilled waste will be negotiated with EPA under the sites air permit.

7.0 PLANS FOR EXCLUDING PCBS AND NON EXPLORATION AND PRODUCTION WASTE

Off-site generators wishing to dispose of drill cuttings, frac sands or other forms of E&P exempt wastes are required to provide RNI an initial waste profile and a disposal certification letter for evaluation. Each generator shall collect representative sample(s) of their waste stream(s) and complete the Landfill Waste Characterization Form (Appendix I - Attachment 5) for initial acceptance by RNI. Analyses and Waste Characterization forms should be completed for each type of waste (frac sand, drill cuttings and other E&P wastes). Waste generators are required to notify RNI when there has been a change in their processes or waste composition.

Hazardous or PCB containing wastes will not be accepted at the Wonsit Landfill. Due to the nature of the wastes accepted at the Wonsit Landfill (i.e., E&P waste only), it is not expected that any PCB containing waste will be encountered. However, the Landfill Manager may require, at his discretion, that analysis for PCBs be performed and reported prior to acceptance to the Landfill.

8.0 PROCEDURES FOR CONTROLLING DISEASE VECTORS

Because of the type of wastes that will be accepted at the Wonsit Landfill, disease vectors are not expected to be an issue for the disposal unit. However, visual inspection for rodents, birds, insects, and other animals will be performed on a regular basis.

9.0 PLAN FOR ALTERNATIVE WASTE HANDLING

The RNI Bluebell Facility located in Roosevelt, Utah will be utilized as the primary alternative waste handling facility in the event that the Wonsit Landfill is unable to accept waste due to repairs, emergency events, or other activities that prevent waste from being accepted at the Wonsit Landfill.

10.0 GENERAL TRAINING FOR SITE OPERATIONS

Personnel involved in the onsite management and disposal of exploration and production (E&P) wastes are required to undergo an initial and continuing training program designed to ensure safe and efficient handling of E&P wastes and to maintain compliance with applicable regulations found in 6 CCR 1007-2 Section 17.2.2(H). The training consists of a program of classroom instruction, on-the-job training, general safety training, and specific training for E&P waste management operations. Employees will complete the required training within two months of the date of their employment, transfer, or new assignment at the Facility. Employees hired will not work in unsupervised positions until they have completed the training requirements covered in the following sections. The Personnel Training Plan for the Wonsit Facility is located in Attachment 6.

11.0 LITTER CONTROL AND COLLECTION PLAN

Wonsit Landfill Cell #1 will not be accepting solid waste materials and therefore is not anticipated to require a formal litter control plan addressing light-weight wind-blown materials. However, the facility staff will operate under best housekeeping practices and shall be responsible for minimizing the escape of litter from the facility.

12.0 RECYCLING PLANS PLANNED FOR THE FACILITY

There are currently no plans for recycling material disposed of in Landfill Cell #1.

13.0 OTHER SITE SPECIFIC INFORMATION REQUIRED BY THE DIRECTOR

The slope stability analysis will require ongoing testing and evaluation during Phase I operations. The plan for geotechnical testing and engineering analyses is describe in Chapter 3.0 above. Details of the plan including recommendations for waste solidification and safe slope angles will be developed by the Utah Registered Geotechnical Engineer during the operating period.

Appendix I

Attachments 1 -5

Attachment 1
Landfill Disposal Ticket RN Industries
Box 98 Roosevelt, Utah 84066
Office 435-722-2800

Disposal Site		Cubic Yards Received (cy)	Pricing per cy ($/cy)	Total $
☐ Bluebell	☐ Category 5 - E&P Landfill Waste that does **NOT** Require Solidification			
☐ Wonsit	☐ Category 6 - E&P Landfill Waste that **Requires** Solidification			
	Totals =			

Date	
Oil Company	
Location	
Truck Company	
Driver	
Truck #	
Truck Ticket #	

Route or Run # __________________

AFE #_________________________

User #________________________

Code#________________________

General Description of the Wasdte and Other Comments: ____
____
____
____
____

Customer Signature:____

Landfill Operators Final Report For This Ticket

Material used to solidify Category 6 Waste: (Example: native soil) ____

Cubic yards (cy) of material used to solidify Category 6 waste from this ticket:_____________________________________

Total cubic yards of Solidified Waste placed in the landfill for this ticket: ____

Estimated tons of Solidified Category 6 Waste placed in the landfill for this ticket: __________________________________

Estimated tons of Category 5 Waste placed in the landfill for this ticket: __________________________________

Comments: ____

____

____

ATTACHMENT 2 - SITE INSPECTION CHECKLIST

Daily
Weekly
Quarterly
Other as noted

Facility Name: **Date:**

	Frequency	Yes	No	Remarks
SITE SECURITY				
Fire extinguisher is charged, not exceeding inspection deadline?	Weekly			
Spill kits are stocked on site?	Weekly			
Emergency eyewash stations are functioning properly and well stocked?	Weekly			
Perimeter fence and security gate are in good condition?	**Daily**			
Lock functioning and in place?	**Daily**			
Signage visible and in reasonable condition?	Weekly			
Warning signage present every 250 feet of exterior fencing and at closest approch of gravel road ?	Weekly			
ROADS				
Do roads require watering? If so record in the operators log the volume of water used and describe the section of road watered.	**Daily**			
OPERATIONS				
Is there water in the leachate collection system? If so, remove and record volume transferred to Evporation Pond 1.	Weekly			
Is there water in the leak detection sump? If so, remove and record volume transferred to Evporation Pond 1. Call the landfill Supervisor to inform him of the presence of water.	Weekly			
Collect daily landfill gas monitoring levels and compare to RNI Heath and Safety Plan Action levels. Upgrade PPE if appropriate.	Daily			
Record daily volumes and weights of wastes received, solidified, and placed in the landfill cell. Also record volume and weight of solidification material used each day.	Daily			
Are slopes at which the waste is placed in accordance with the guidance provided by the Project Geotechnical Engineer? If not Contact the Waste Disposal Facility Manager.	Daily			
INSPECTION OF GEOCOMPOSITE AND HDPE LINER UNTIL FULLY COVERED				
Are geocomposite and HDPE anchors in place and in good condition?	Daily			
Is the geocomposite and/or HDPE systems free of rips, excessive weathering, or excessive tension. Monitor daily until the geocomposite layer is completely covered with waste or a protective layer of soil.	Daily			
SURFACE AND GROUNDWATER MONITORING				
Is there water flowing in the ephemial stream near monitoring well MW4 and MW8? If so call the Disposal Facilty Manager by the end of the dqy to make arrangements for annual surface water sampling.	Check Daily during March, April, May of each year.			Once sampling is completed, monitoring of stream flow can be discontinued for the year.
Is there groundwater present in wells MW4, MW5 or MW8? If so call the Disposal Facilty Manager by the end of the day to make arrangements for annual groundwater sampling.	Check depth to groundwater from top of well casing weekly during March, April,and May of each year.			Once sampling is completed, monitoring of groundwater levels can be discontinued for the year. Measure water levels from the top of well casing (north side) to the nearest 1/100th of a foot.
EMBANKMENT				
Inboard Slope				
Has the geofabric material been covered by soil or waste within two weeks of placement? If not, cover with at least 4-inches of soil by the end of the day.	Daily			
Crest				
Are there any signs of erosion gullies greater than 6 inches deep?	Weekly			
Are there any signs of settlement, cracks slides, slumps, boils, sinkholes, other?	Weekly			
Outboard slope to 10-feet past toe				
Are there any signs of erosion gullies greater than 6 inches deep?	Weekly			
Are there any signs of settlement, cracks slides, slumps, boils, sinkholes, other?	Weekly			
Are there debris or weeds that prevent inspection?	Weekly			
Are there new signs of seepage (i.e. flows of water, wet spots, or ponding)?	Weekly			
Is there evidence of burrowing animals?	Weekly			
Are the diversion channels serviceable and unobstructed?	Weekly			

OTHER NOTES: Record any other significant issues below. Fill out additional page(s) and attach if more room is needed.

If any checks appear in the "NO" column, provide a detailed of what you've observed, including: accurate location, extent of affected area, and a description of the condition.
Refer to the Operations Manual, initiate the prescribed corrective action and estimate time to completion.
Inform the appropriate RNI personnel (Supervisor, Safety and/or Environmental Manager) per the Operations Manual and document the corrective action taken (notes, photos, etc,)

Completed By:

REV: 2013.05.15

ATTACHMENT 3 - REPAIR LOG

Instructions: This repair log shall be completed for each repair performed on all facility infrastructure.
Append additional pages, photos and etc to this checklist as needed.

Item Being Repaired	Type of Repair	Descriptions and Comments

Location:
Date:
Completed By:
REV:2009.06.29

ATTACHMENT 4 - LIST OF EMERGENCY CONTACTS

First Responders

Emergency Organization Title	Job Title	Name	Emergency Contact Number	Comments
Incident Commander-Primary/First Responder	Dispatch Center Operator	Person On-Shift	(435) 725-1099	24/ 7/ 365 Operation
Incident Commander-Alternate/First Responder	Manager Day Operations	Norvil Glines	(435) 823-1399	Main Office: (435) 722-2800
First Responder	Safety Division Director	Chris Baker	(435) 823-1305	Main Office: (435) 722-2800
First Responder	Environmental Manager	Gary Richins	(435) 823-6077	Main Office: (435) 722-2800
Spill Response Contractor	Construction Division Manager	Ryan Chapman	(435) 503-4685	Main Office: (435) 722-2800

Local Emergency Contacts

Police	Fire	Hospital	Emergency Planning Committee	Spill Response Contractor
Vernal City Police Department	Vernal City Fire Department	Ashley Regional Medical Center	Chris Baker - Chair	Nile Chapman Construction
374 East Main Vernal, Utah 84078 (435) 789-5835	495 East Main Street Vernal, Utah 84078 (435) 789-4222	150 West 100 North Vernal, Utah 84078 (435) 789-3342	Norvil Glines Gary Richins Dispatch Center Supervisor	244 West Highway 40 Roosevelt, Utah 84066 (435) 722-3800

State and Federal Emergency Contacts

Criteria for Produced Water and/or Oil Release	Agencies to be Contacted	
Discharges of oil to water bodies	National Response Center (NRC)	(800) 424-8802 (24 hours)
Discharges of oil to water bodies, storm sewer, drainages, streams, creeks, etc.	Utah Department of Environmnetal Quality - Division of Water Quality	(801) 536-4300 (normal business hours)
Spill or release of 25 gallons of fluid or greater	Utah Department of Environmnetal Quality - Environmental Release and Incident Reporting Line	(801) 536-4123 (24 hours)

Attachment 5

LANDFILL WASTE CHARACTERIZATION FORM
GENERATOR INFORMATION

NAME: ________
ADDRESS: ______________________
PHONE: ______________________ FAX: __________________
BILLING ADDRESS: ________
CONTACT: ______________________ PHONE: ______________

WASTE INFORMATION

Location/Place of Origin:
Description of Waste:
Address: ____
____

REGULATORY CATEGORY

☐ RCRA Exempt E&P Activity ☐ Other Activity

ESTIMATED VOLUME & FREQUENCY

Estimated QUANTITY:________PER: _________

REGULATORY QUESTIONS

Is there contamination other than E&P exempt petroleum hydrocarbon?	☐ Yes ☐ No
Fuels mixed with solids? If so, please explain below. (i.e. Diesel fuel added as fracing ingredient.)	☐ Yes ☐ No
Is the solid waste specifically excluded from hazardous waste Regulations in 40 CFR Part 261.4(b)(5) as drilling fluids, produced water, and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy?	☐ Yes ☐ No
Does the solid waste pass a paint filter test (i.e., no free liquids)	☐ Yes ☐ No
Is the solid waste ignitable, corrosive or reactive? If so, please explain below.	☐ Yes ☐ No
Is any of the contamination from or mixed with a non-specific source listed in 40CFR Part 261.31 **(F Codes)?**	☐ Yes ☐ No
Is any of the contamination from or mixed with a non-specific source listed in 40CFR Part 261.32 **(K, P, U Codes)?**	☐ Yes ☐ No
Are there any metal additives, filings/cuttings in the solids?	☐ Yes ☐ No %________
Are there any oils/grease in the solids?	☐ Yes ☐ No %________

COMMENTS: ____
____

WASTE CONTAMINANT CHARACTERIZATION

(Required Analytical Test Methods)

List of Inorganics (Al, At, Ar, Ba, Be, Cd, Cr+3, Cr+6, Co, Cu, Fe, Pb, Mn, total Mg, Ni, Se, Ag, Tl, V, Zn) Methods (SW846 6010B, 6020, 7471A, 7196A).

Volatile Organics (EPA 8260)
Paint Filter Test (9095B)
Petroleum Hydrocarbons TVH/GRO, TEPH/DRO (8015)
Semi-Volatile Organics (full scan) (EPA 8270)
Salinity (1:1 DI extraction/SM2510B)
Gross Alpha (900.0M)
PCBa (8082)

Does the waste contain:

☐ Crude oil ☐ Petroleum Hydrocarbons ☐ Drilling additives or muds
☐ Leaded gasoline ☐ Unleaded gasoline
☐ Fuel oil ☐ Diesel ☐ Kerosene ☐ Aviation fuel ☐ Used Oil
☐ Petroleum Solvents ☐ Other Non-Petroleum Hydrocarbons
☐ Glycols ☐ Metals ☐ Infectious Waste ☐ Pathogens
☐Pesticides ☐ Radioactive Materials
☐ RCRA 8 Metals ☐ PCBs ☐ Asbestos

CONTAMINANT DETERMINATION

The information listed is based on:
☐ Knowledge of Process ☐ Independent Analysis ☐ MSDS ☐ Other
☐ Non-Hazardous ☐ Hazardous
Analysis attached: ☐ Yes ☐ No

*RNI may request additional analytical tests to characterize and accept the waste.
$^+$As requested.

CLIENT'S AUTHORIZED SIGNATORY: I hereby certify that I have authority as generator or agent for the generator to enter into this agreement. I hereby certify that all information submitted, in this and all attached documents are complete and accurate to the best of my knowledge and ability to determine, that no deliberate or willful omission of chemical physical composition or properties exists, and that all known or suspected hazards have been disclosed. I further certify that I have read, understood and accepted all terms and conditions of this document.

SIGNATURE: ________________________________ PRINT NAME: ______________________________

TITLE: ________________________________ DATE: ______________________________

REVIEWED AND ACCEPTED BY

SIGNATURE: ________________________________ PRINT NAME: ______________________________

TITLE: ________________________________ DATE: ______________________________

NOTE: Laboratory Analytical Reports must be submitted with the Characterization Data form.

OPERATIONS PLAN - ATTACHMENT 6

WONSIT LANDFILL CELL #1

PERSONNEL TRAINING PLAN

May 2013

Prepared by:

RN INDUSTRIES
244 WEST HIGHWAY 40
ROOSEVELT, UTAH 84066

TABLE OF CONTENTS

ATTACHMENTS

1.0 TRAINING PLAN

Personnel involved in the onsite management and disposal of exploration and production (E & P) wastes are required to undergo an initial and continuing training program designed to ensure safe and efficient handling of E & P wastes and to maintain compliance with applicable regulations found in 6 CCR 1007-2 Section 17.2.2(H). The training consists of a program of classroom instruction, on-the-job training, general safety training, and specific training for E & P waste management operations. The training teaches employees how to operate the evaporation pond waste management units in ways to ensure that the facility remains in compliance with applicable regulations and the facility operates safely and efficiently. Employees will complete the required training within two months of the date of their employment, transfer, or new assignment at the facility. Employees hired will not work in unsupervised positions until they have completed the training requirements covered in the following sections.

1.1 Initial Training Program

The initial training program consists of classroom instruction directed by a person trained in all facets of the RN Industries (RNI) prepared Compliance and Task Training (CATT). The CATT consists of an initial 5 day course that covers health, safety and environmental training, which incorporates the Department of Transportation (DOT) Compliance, Defensive Driving (Certified through Smith System), Exxon Pre-mobilization, OSHA 10-hour Compliance, Brake Certification, H_2S Certification, and CPR/First Aid Certification. The majority of the information provided is supplied by a training professional who incorporates numerous types of media including videos, handouts, manuals, and props to train RNI employees. Actual certification documents are given to each employee at the end of the course and when all portions of the CATT are completed, a CATT "Passport" is provided to them showing full compliance with the CATT training requirements. Operation and maintenance supervisors, health and safety personnel, technicians, truck drivers, and all support staff that work at the facility are required to attend the training.

1.2 General Safety Training

As part of the CATT, Wonsit Facility personnel will be trained in general site safety and contingency plan procedures. These procedures include:

- Site safety;
- Emergency procedures and equipment;
- Fire prevention and control;
- Spill prevention and control;
- Contingency plan implementation;
- Safe waste loading and unloading;
- Proper inspection of facilities and equipment; and
- Proper record keeping.

Employees are trained in the following emergency response procedures:

- Use, inspection, repair, and replacement of monitoring and emergency equipment;
- Use of the communication and alarm systems that consist of two-way radios, telephones, and fire pull boxes;
- Response to chemical hazards;
- Use of personal protective equipment required for the job function;
- Response to fire, explosion, or spills, including use of the proper fire extinguishing agent for a particular type of fire, and proper containment practices for spills;
- Response to surface discharge incidents;
- Shutdown of operations;
- Implementation of contingency plans; and
- Evacuation procedures.

1.3 E & P Waste General Training

The initial training program for E & P wastes consists of classroom instruction by a person trained in E & P waste management procedures. Specific E & P waste training is provided to each RNI employee as part of the CATT. The majority of the E & P waste information provided is supplied by a training professional who incorporates numerous types of media including videos, handouts, manuals, and props to train RNI employees. The training provides general information concerning the management of E & P waste and information about the training required before employees can handle E & P wastes. The training is aimed at understanding the principle operations of the facility. It advances the employees knowledge of produced water and hydrocarbon management and should help ensure a safer working environment.

The training describes the systems that are utilized and operated at the facility. The facility layout, basic design principles, hazards associated with working with produced water and large evaporation ponds, and the precautions and safety measures are presented to each employee to promote understanding of the facility and to raise the employees' awareness of the health and safety hazards on the site.

The information covered shall include:

- An overview of the regulatory framework covering E & P waste;
- Defining E & P wastes;
- Segregation of wastes (incompatible wastes);
- Recognition of hazardous and prohibited wastes;
- Waste determination;
- Record Keeping; and
- Emergency procedures.

1.4 Site-Specific Training for E & P Waste Management Operations

As part of the on-site site-specific training, Wonsit facility personnel will also be trained according to their specific job descriptions where they involve E & P waste management activities. Training shall include:

- Operational procedures for the specific area;
- The hazards of the waste managed in the area;
- Review of Material Safety Data Sheets (MSDS);
- Facility monitoring and inspection procedures;
- Record keeping and any reporting requirements;
- Spill response and proper disposal of any E & P waste that is remediated;
- Execution of emergency and contingency plans;
- Sampling procedures for analytical testing;
- General inspection and maintenance;
- Procedures for accepting bulk deliveries;
- Procedures for inspecting trucks and feed lines before and after bulk deliveries;
- Spill containment aspects of facility design; and
- Spill containment equipment such as absorbent materials.

Site specific training will involve the new or transferred employee spending at least 3 days with his/her supervisor learning the facility processes, operations, documentation, site specific health and safety hazards, site specific environmental hazards, site specific emergency procedures, site specific contingency plans, and knowledge of the Wonsit Landfill Permit Application and UDSHW Permit. The new or transferring employee will be directly supervised by the supervisor a minimum of 3 days after the employee has received his/her RNI "Passport." If the employee has not received the RNI "Passport," he/she will not be allowed on the site unsupervised until the RNI "Passport" is received.

2.0 ANNUAL REFRESHER TRAINING

As part of the overall CATT refresher training, personnel assigned to E & P waste management activities shall complete an annual continuing training program. The annual training, specific to E & P wastes, will include a review of the E & P waste training information presented in the initial training as well as any new information relevant to the handling of E & P waste, including safety incidents or infractions observed or noted within the industry.

3.0 IMPLEMENTING THE TRAINING PROGRAM

All new employees will complete the required training within two months of beginning employment. During the initial two months of employment, on-the-job training will be provided by a supervisor that has completed the required training in each of the preceding subject areas.

4.0 OPTIONAL EXTERNAL TRAINING

External training resources may be utilized to provide or supplement the required training. Personnel may be trained by various private companies or governmental agencies to meet the requirements specified in this training plan.

5.0 JOB TITLES AND JOB DESCRIPTIONS

Environmental Manager: The Environmental Manager is responsible for ensuring that personnel receive the required training from qualified personnel or other sources regarding all aspects of E & P waste management at the Wonsit facility. The Environmental Manager will periodically attend formal seminars on E & P waste management. The Environmental Manager will not be located at the facility; however, through periodic visits, established compliance programs, and supervision of operation personnel, the Environmental Manager will support compliance of the Wonsit facility.

Operations Manager: The Operations Manager is responsible for overall operation of the facility and operational compliance with environmental and safety requirements. The Operations Manager directs all activities of the facility consistent with permit conditions and applicable environmental regulations.

Landfarm Supervisor: The Landfarm Supervisor directs all personnel and operations involving the landfarm, mud pits, and filter press. The Landfarm Supervisor will provide direction to equipment operators, perform regulatory compliance sampling of landfarmed soils, and coordinate with the Operations Manager and the Fluids Supervisor.

Landfill Supervisor: The Landfill Supervisor directs all personnel and operations involving the landfill, The Landfill Supervisor will provide direction to the equipment operators and coordinate with the Operations Manager.

Fluids Supervisor: The Fluids Supervisor manages produced water offloading, condensate and crude oil decanting, delivery of waste semisolids to the mud pits, and leak detection monitoring. The Fluids Supervisor will provide direction to equipment operators and coordinate with the Operations Manager and the Landfarm Supervisor.

Field Technician: The Field Technician is responsible for overseeing the offloading of the produced water from the tanker trucks. The Field Technician verifies that there is sufficient capacity in the oil water separator, surge/skim pond, evaporation ponds and other vessels so that the transfer of wastewater can occur efficiently and without incident.

Equipment Operator: The Equipment Operator is responsible for operating the heavy equipment on the site. Equipment may include forklifts, backhoes, excavators, bull dozers, or other heavy equipment.

Truck Driver: The Truck Driver is responsible for ensuring the produced water is safely transported to the facility. The Truck Driver is responsible for offloading wastewater from the truck in a safe and efficient manner.

6.0 PERSONNEL TRAINING RECORDS

Records of personnel training will be documented and maintained at the facility. The records need to incorporate the following information:

- The name of the employee performing that job and the job title for each position at the Wonsit facility related to E & P waste management
- A written job description for each position involved in E & P waste management. This description will include the requisite skill, education, or other qualifications and duties of employees assigned to each position
- A written description of the type and amount of both introductory and continuing training that will be given to the person filling the position
- Records documenting that the required training or job experience has been completed by the employee filling the position.

Training records on current personnel will be kept until closure of the facility. Training records on former employees will be kept for at least three years from the termination date of the employee. Non-site specific training records may accompany an employee that is being transferred within the company. Attachment 6-A contains an Employee Training Record Form specific to E & P Waste Management.

Attachment 6-A Employee Training Record Form

Personnel Training Plan

Name: ______________________________

Hire Date: ______________________________

Job Title: ______________________________

Job Description: ______________________________

____

☐ Initial Training

☐ Annual Refresher Training

The above employee has received the following RNI-specific training which is appropriate for the job description. Check all boxes that apply.

☐ I have completed the initial RNI-prepared Compliance and Task Training (CATT) and received my "Passport."

☐ I have completed general training that describes health and safety issues associated with working with exploration and production wastes.

☐ I have received site-specific health and safety training at all of the facilities I will be expected to work at.

☐ I understand how to distinguish hazardous wastes and incompatible wastes from wastes normally received by RNI facilities.

☐ I understand how to implement the contingency plan in the event of a large spill or release.

☐ I understand how to implement emergency response measures in the event there is an emergency onsite.

☐ I understand that annual refresher training is required while I am employeed with RNI.

______________________________ ______________________________

Employee Signature Date

______________________________ ______________________________

Supervisor/Trainer Signature Date

Appendix J

Closure and Post Closure Plans

Prepared for:

RN INDUSTRIES

WONSIT LANDFILL

CLOSURE AND
POST CLOSURE
PLANS

May 2013

Prepared by:

MWH

2890 East Cottonwood Parkway Suite 300

Salt Lake City, Utah 84121

Table of Contents

1.0 INTRODUCTION

Closure / Post Closure Plans have been developed for an exploration and production (E&P) Landfill to be located on RN Industries, Inc. (RNI) Wonsit Valley Disposal Facility at 374 East Chapita Grove Road in Uintah County, Utah. This landfill is formally referred to as Wonsit Disposal Facility Landfill Cell #1 or simply Cell #1 throughout the remainder of this Plan.

These Closure / Post Closure Plans have been prepared in accordance with the Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste (UDSHW) regulations outlined in Utah Administrative Code R315-302-3(2).

It is anticipated that closure of Cell #1 will involve the following tasks:

- Notifying the UDSHW Executive Secretary that RNI intends to implement the Closure Plan for Cell #1;
- Grading of the waste surface to prepare for construction of the final cover,
- Construction of a final cover and then implementation of a topographic survey,
- Continued implementation of the stormwater management plan (SMP) developed for the Phase II landfill operations and the Closure/Post Closure periods.
- Upon completion of the Final Cover, RNI will submit to UDSHW updated Closure and Post Closure Plans, as-built drawings, and a certification by a Utah registered engineer confirming that the site has been closed in accordance with the approved plan.

It is anticipated that Post Closure activities will involve the following tasks:

- Monitoring of landfill gas concentrations, monitoring of water levels in four wells (MW1, MW4, MW5, MW8), inspecting the slope and vegetation associated with the Final Cover, and surface water monitoring. For Financial Assurance purposes, it was assumed that site inspections will be required quarterly for the first two years of the Post Closure period and then semiannually for the next 28 years. Surface water sampling was assumed to be required annually for five years, biennially over the next ten years, and then every five years over the final fifteen years of the 30 year post closure period (thirteen total rounds over 30 years). No groundwater sampling was assumed since all monitoring wells installed at the site have remained dry to this point in time.

- Revegitation and regrading of up to 25% of the Final Cover or as needed,
- Annual reporting of the monitoring and maintenance activities for 30 years,
- Continued implementation of the stormwater management plan,
- Removal and disposal of leachate if needed,
- Maintenance of site security in the form of fencing and signage, and
- After the UDSHW determines that the Post Close activities are complete, an engineer registered in the state of Utah will submit certification statement indicating why Post Closure activities are no longer needed.

Specific details describing the activities and timelines for the Closure and Post Closure periods are described in Chapters 2 and 3 below.

2.0 CLOSURE PLAN

The following sections describe the activities required during the Closure period for Cell #1.

2.1 NOTIFICATIONS AND TIMELINES FOR CLOSURE

Phase I and II operations are expected to last for a combined total of approximately twelve years. Sixty days prior to final receipt of waste into Cell #1, RNI will notify the UDSHW Executive Secretary, of their intent to implement the Closure Plan. RNI will begin closure within 30 days of receipt of their final volume of waste and then will complete the closure activities within the next 180 days. If more time is needed to complete the closure, RNI will submit a written request to the UDSHW Executive Secretary explaining why an extension is needed and requesting UDSHW authorization.

Within 90 days of completion of all of the closure activities, RNI will submit to the Executive Secretary an updated Closure / Post Closure Plan, as-built drawings, and certification by an engineer registered in the State of Utah confirming that the site has been closed in accordance with the requirements of the approved Closure Plan. Inspection(s) by UDSHW personnel are anticipated during these closure activities.

2.2 FINAL GRADING OF WASTE

To begin the closure process, grading of the waste shall be completed such that the final cover can be constructed as required by Section 2.3 of the Permit Application. Final slope of the waste shall be established by a Geotechnical Engineer registered in the state of Utah. The allowable final slopes will be determined based on geotechnical testing of stabilized landfilled wastes performed during the landfilling operations and/or Closure period.

2.3 FINAL COVER AND TOPOGRAPHIC SURVEY

The Final Cover is expected to be similar to the conceptual (Phase II) drawings in Appendix G3. Once the cover is constructed, a topographic survey will be performed to document the final slopes. The survey will be tied to the Utah WGS 84 UTM Zone 12 North state plane coordinate system with units of measure in US feet. Vertical elevations shall be referenced to the North American Vertical Datum (NAVD88) and in units of US feet.

2.4 STORMWATER MANAGEMENT

Two Stormwater Management Plans (SMPs) will be prepared during the life of the landfarm. The initial SMP is included herein, as Appendix H and the second will be prepared in approximately five years from the initiation of landfilling operations. An update to the stormwater management plan will be required before waste materials fill the existing stormwater management swales on the west and south sides of Cell #1. The second SMP will address the control of run-on and run-off during Landfill Phase II operations and the Closure / Post Closure periods.

2.5 AS-BUILT DRAWINGS AND CERTIFICATION REPORT

Within 90 days of completion of all of the closure activities, RNI will submit updated Closure and Post Closure Plans including as-builts drawings, a topographic survey of the Final Cover, and a written certification by a Utah registered engineer confirming that the site has been closed in accordance with the UDSHW approved closure plans.

3.0 POST CLOSURE PLAN

The primary point of contact during the Post Closure Period will be Chris Chapman and he can be reached at the address and phone number provided below:

Chris Chapman

244 West Highway 40

Roosevelt, Utah 84066

(435)722-2800

The following sections describe the activities required during the Post Closure period.

3.1 NOTIFICATIONS CERTIFICATIONS AND TIMELINES FOR POST CLOSURE

The Post Closure period will begin immediately after the Closure Period and will extend for approximately 30 years or as directed by the UDSHW Executive Secretary. If warranted by the monitoring results for landfill gas, surface water, and the slope of the final cover, an engineer registered in the state of Utah may petition the UDSHW for a reduced post closure period. After the UDSHW determines that the Post Close activities are complete, an engineer registered in the state of Utah will submit certification statement indicating why Post Closure activities are no longer needed. This statement will be prepared to meet the requirements of regulation R315-302 3 (4)

3.2 POST CLOSURE ACTIVITIES AND REPORTING REQUIREMENTS

Post closure activities and reporting will be as follows:

Maintaining Security – Fencing and signs shall be maintained during the 30 year Post Closure Period to restrict access and notify potential trespassers of potential hazards.

Monitoring of Landfill Gas – During Post Closure site inspections, RNI personnel will monitor landfill gasses for oxygen (O_2), percent of lower explosive limit (LEL), hydrogen sulfide (H_2S), methane, and VOCs with an on-site detector. These data will be interpreted by a Utah registered engineer and the recommendations included in the annual report.

Surface and Ground Water Monitoring – Three surface water samples will be collected annually each spring and analyzed as described in Section 2.6 of the Permit Application. Groundwater elevations will be monitored in wells MW1, MW4, MW5, and MW8 during the Spring of each year and if groundwater is detected, a sampling program will be established if required by the UDSHW. To date, all monitoring wells installed at the site have been dry and therefore no groundwater sampling has been assumed for the Post Closure Period.

Revegitation and Regrading of the Final Cover as Needed - The slope and vegetation associated with the final cover will be visually inspected during each Post Closure site visit. If the top soil or underlying layers have shifted such that there is an in increased potential for infiltration into the landfill or contact of runoff with waste materials then repair of the final cover will be performed. For financial assurance purposes, it was assumed that 25% (1450 cy) of the top soil in the final cover would have to be replaced and regraded during the Post Closure period.

Operation of the Leachate Collection System (if needed) – If leachate removal and disposal is required during Post Closure, a vacuum truck would be used and the waste placed in Wonsit Disposal Facility Evaporation Pond 1. No cost for this has been assumed in the financial assurance as the water balance modeling suggest that it is reasonable to assume that leachate collection in the high desert climate of Wonsit Valley will not lead to significant volumes of leachate after installation of the Final Cover.

Annual Reporting During Post Closure

Annual reporting is required during the landfill operation, Closure, and Post Closure periods. Annual reporting during the Post Closure period will include:

- Results of all surface water, groundwater, and cover monitoring,
- Results of laboratory sampling,
- A summary of all maintenance activities performed,
- Leachate removal and disposal (if necessary), and
- A summary of the status of the financial assurance budget.

Appendix K

Financial Assurance Calculations

Estimated Life For
Wonsit Landfill Cell #1

Year	Calendar Year		Ave # of Loads Accepted Per Week	E&P Volume per Load	E&P Volume per Year	Stabilization Bulking Ratio	Landfilled Waste Volume	Cumulative Landfilled Volume	Phase I Total Volume [2]	Phase I Year End Volume Remaining	Phase I & 2 Total Volume [3]	Phase I & 2 Year End Volume Remaining [4]
	From	To		cy	cy	ratio [1]	cy	cy	cy	cy	cy	cy
1	7/1/2013	6/30/2014	14	15	10920	1.75	19,110	19,110	108,687	89,577	205,755	186,645
2	7/1/2014	7/2/2015	14	15	10920	1.75	19,110	38,220		70,467		167,535
3	7/3/2015	7/3/2016	14	15	10920	1.75	19,110	57,330		51,357		148,425
4	7/4/2016	7/5/2017	14	15	10920	1.75	19,110	76,440		32,247		129,315
5	7/6/2017	7/7/2018	14	15	10920	1.75	19,110	95,550		13,137		110,205
6	7/8/2018	7/9/2019	14	15	7507	1.75	13,137	108,687		**Full**		97,068
7	7/10/2019	7/10/2020	14	15	10920	1.75	19,110	127,797				77,958
8	7/11/2020	7/12/2021	14	15	10920	1.75	19,110	146,907				58,848
9	7/13/2021	7/14/2022	14	15	10920	1.75	19,110	166,017				39,738
10	7/15/2022	7/16/2023	14	15	10920	1.75	19,110	185,127				20,628
11	7/17/2023	7/17/2024	14	15	10920	1.75	19,110	204,237				1,518
12	7/18/2024	8/26/2025	14	15	867	1.75	1,518	205,755				**Full**
				Total =	**117,574**	**Total =**	**205,755**					

Notes:

1. Mixing at a ratio of 1 part E&P waste to 1 part soil (or other) = bulking ratio of 2. Second example: 75% of waste mixed at a ratio of 1:1 with soil and 25% does not required mixing/stabilization: bulking ratio = 1.75.

2. Total volume = 110,300 -1613 cy. 1613 is run-on volume that must be controlled during phase I.

3. Total volume = 207900 - 2145 cy. 2145 is run-on volume that must be controlled during Phase II.

4. Consolidation and/or compaction of wastes have not been accounted for in this calculation.

Estimated
Closure and Post Closure Costs

Wonsit Landfill Cell #1

Cost Item	**Estimated Cost**
Estimated Closure Cost	284,930
Estimated Post Closure Costs	83,245
subtotal =	368,174
Legal Fees for Financial Assurance estimated at approximately 5% of total Closure / Post Closure cost	18,409
Grand Total Closure / Post Closure Cost =	**386,583**

Projected Timeline
Closure and Post Closure Costs

Wonsit Landfill Cell #1

Task	Dates		Cost	Cumulative Cost Expended
	Start	Finish	$	$
Closure Construction	8/26/2025	11/25/2025	$303,338	$303,338
Post Closure Year 1	11/26/2025	11/25/2026	$5,342	$308,680
Post Closure Year 2	11/26/2026	11/26/2027	$5,342	$314,021
Post Closure Year 3	11/27/2027	11/25/2028	$4,472	$318,493
Post Closure Year 4	11/26/2028	11/25/2029	$4,472	$322,965
Post Closure Year 5	11/26/2029	11/25/2030	$4,472	$327,437
Post Closure Years 6-10	11/26/2030	11/26/2035	$13,068	$340,505
Post Closure Years 11-15	11/27/2035	11/25/2040	$16,165	$356,671
Post Closure Years 16-20	11/26/2040	11/25/2045	$9,971	$366,641
Post Closure Years 21-25	11/26/2045	11/25/2050	$9,971	$376,612
Post Closure Years 26-30	11/26/2050	11/26/2055	$9,971	$386,583

Financial Assurance Calculations For Closure of Wonsit Landfill Cell #1

Task	Description	Unit Type	Cost/Unit	No Units	Total Cost	Source of Information
1	**Engineering and Closure Site Work**					
	Topo Survey	acre	$155	15	$2,325.00	RS Means
	Final Storm Water Management Plan	Plan	$6,500	1	6500	Engineers estimate
	Closure Notification for UDSHW Executive Secretary	letter	$500	1	500	Engineers estimate
	Submit Closure Certification to County Recorder	Information Package	$2,500	1	2500	Engineers estimate
	Other Misc Engineering Support	Estimated Total	$5,000	1	5000	Engineers Estimate for Consulting Support
	PM Support	Estimated Total	$1,150	1	1150	PM and Administration estimated at 10% of Engineering Costs
2	**Construction (installed costs)**					
	Load and Haul Soil for Final Cover and Overlying Drainage Layer	cy	$4.71	23,194	$109,244	RS Means: Equip $3.59/cy, Labor $2.69/cy, Total $6.28/cy. Reduced by 25% because haul distance is only 0.25 miles.
	Placement and Grading of 18" of Compacted Clay Cover and 6" of Overlying Drainage Layer	cy	$2.85	23,194	$66,103	RS Means: Equip $2.91/cy, Labor $1.93/cy, Total $4.84/cy
	Stripping and Stockpiling of Top Soil	cy	$0.83	5,799	$4,813	RS Means
	6" top soil for Final Cover	cy	$5.50	5,799	$31,892	RS Means
	Seeding for Soil Cover	Acre	$1,125	8	$9,000	RS Means
	Final Stormwater Swales and Culverts	Estimated Total	$20,000	1	$20,000	Engineers estimate
				Preliminary Total=	$259,027	
				10% Contingency=	$25,903	
				Total Estimate=	**$284,930**	

Financial Assurance Calculations For Post Closure Care of Wonsit Landfill Cell #1

Task	Description	Unit Type	Cost/Unit	No Units	Total Cost	Notes
1	**Site Inspection and Record Keeping**					
	Quarterly and Semiannual Site Inspections and Record Keeping					
	labor	hr	$80	256	$20,480	4 inspections per yr for 2 yrs (4 hrs/trip) then Semiannual for 28 years.
	Expenses	day	$115	64	$7,347	4 inspections per yr for 2 yrs (80 miles round trip) then Semiannual for 28 years.
	Surface Water & GW Monitoring					
	labor	hr	$80	78	$6,240	Annual monitoring for five years, then biennial monitoring for the next ten years, then monitoring every fifth year for the next fifteen years. (6 hr per SW/GW Monitoring Trip). Sampling completed during Site Inspections described above.
	Annual Lab Expenses	round	$1,500	13	$19,725	Three surface water samples analyzed each round for GRO (8260), DRO (8015), BTEXN, antimony, arsenic, barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc, sodium, chloride, mercury (total) and gross alpha. Initial sampling round will also include radium 226, radium 228, and total uranium. Costs assume groundwater monitoring wells remain dry and can not be sampled.
	Other Expenses	day	$100	13	$1,300	13 rounds of sampling over 30 years.
	Lab Coordination and GW Reporting					
	labor	Annual Report	$1,000	13	$13,000	GWM Reports ($1000 per Report). 13 reports total over 30 year time frame. See sampling schedule above.
2	**Maintenance Costs**					
	Soil Replacement					Assumes 25% of top soil will have to be replaced
	Placement and Grading of 6" of Replacement Top Soil	cy	$2.85	1450	$4,131	RS Means: Equip $2.91/cy, Labor $1.93/cy, Total $4.84/cy
	Stripping and Stockpiling for Replacement Top Soil	cy	$0.83	1450	$1,203	RS Means
	Reseeding of Soil Cover	Acre	$1,125	2.0	$2,250	RS Means
				Preliminary Total=	$75,677	
				10% Contingency=	$7,568	
				Total Estimate=	**$83,245**	

Appendix L

Landfill Permit Application

Application Checklist

Application for Utah Exploration and Production Landfill

***Part I* General Information** APPLICANT: PLEASE COMPLETE ALL SECTIONS.

***Part I* General Information** (Continued)

I. Application Type

☒ New Application

☐ Renewal Application

☐ Facility Expansion

☐ Modification

For Renewal Applications, Facility Expansion Applications and Modifications Enter Current Permit Number ______

II. Facility Name and Location

Legal Name of Facility
Wonsit Disposal Facility Landfill Cell 1

Site Address (street or directions to site)
374 East Chapita Grove Road

County Uintah county

City Seven Miles East of Ouray, Utah

Zip Code 84078

Telephone 435-503-5294

Township 8S

Range 21 E

Section(s) 26 and 35

Quarter/Quarter Section See maps

Quarter Section See maps

Main Gate Latitude degrees 40 minutes 19 seconds 59.5

Longitude degrees 109 minutes 31 seconds 15.3

III. Facility Owner(s) Information

Legal Name of Facility Owner
RN Industries

Address (mailing)
244 West Highway 40 P.O. Box 98

City Roosevelt

State UT

Zip Code 84066

Telephone 435-722-2800

IV. Facility Operator(s) Information

Legal Name of Facility Operator
RN Industries

Address (mailing)
Same as above

City

State

Zip Code

Telephone

V. Property Owner(s) Information

Legal Name of Property Owner
RN Industries

Address (mailing)
Same as above

City

State

Zip Code

Telephone

VI. Contact Information

Owner Contact Roger Chapman

Title President

Address (mailing)
244 West Highway 40 P.O. Box 98

City Roosevelt

State UT

Zip Code 84066

Telephone 435-722-2800

Email Address rchapman@rnindustries.com

Alternative Telephone (cell or other)

Operator Contact Chris Chapman

Title Disposal Facility Lead Supervisor

Address (mailing)
244 West Highway 40 P.O. Box 98

City Roosevelt

State UT

Zip Code 84066

Telephone 435-503-2800

Email Address rchapman@rnindustries.com

Alternative Telephone (cell or other) 435-503-5294

Property Owner Contact Roger Chapman

Title

Address (mailing)
Same as above

City

State

Zip Code

Telephone

Application for Utah Exploration and Production Landfill

Facility Area

Facility Area.. 161 acres

Disposal Area... 7.2 acres

Design Capacity

Years.. 12

Cubic Yards.. 205,755

Tons... 277,800

VIII. Fee and Application Documents

Indicate Documents Attached To This Application ☒ Application Fee: $750.00

Review fees of $90.00 per hour apply to application review

☒ Facility Map or Maps ☒ Facility Legal Description ☒ Plan of Operation ☒ Waste Description

☐ Ground Water Report ☒ Closure Design ☒ Cost Estimates ☒ Financial Assurance

I HEREBY CERTIFY THAT THIS INFORMATION AND ALL ATTACHED PAGES ARE CORRECT AND COMPLETE.

Signature of Authorized Owner Representative	Title Environmental Mgr.	Date 30 May 2013
Gary H. Richins Name typed or printed	Address P.O. Box 98 Roosevelt, UT 84066	
Signature of Authorized Land Owner Representative (if applicable)	Title President	Date May 30 2013
Roger Chapman Name typed or printed	Address P.O. Box 98, Roosevelt, UT 84066	
Signature of Authorized Operator Representative (if applicable)	Title Disposal Manager	Date 5-30-2013
Chris Chapman Name typed or printed	Address P.O. Box 98, Roosevelt, UT 84066	

Part II

I. **Facility General Information**	
Description of Item	Location In Document
Ia. General Information For All Facilities	
Completed Part I General information	Permit Appl Section 1.1
General description of the facility (R315-310-3(1)(b))	Permit Appl Sections 1.1, 1.2, 1.3
Legal description of property (R315-310-3(1)(c))	Appendix A
Proof of ownership, lease agreement, or other mechanism (R315-310-3(1)(c))	Appendix A
A demonstration that the landfill is not a commercial facility (see Utah Code Annotated 19-6-102(3) for definition of Commercial). A statement that the facility will accept only E&P waste will meet this requirement.	Permit Appl Section 1.5
Waste type and anticipated daily volume (R315-310-3(1)(d))	Permit Appl Section 1.6
Intended schedule of construction (R315-302-2(2)(a))	Permit Appl Section 1.7
Ib. General Information - New Or Laterally Expanding E&P Landfills	
Documentation that the facility has meet the historical survey requirement of R315-302-1(2)(f) (R315-304-4(1)(a) or R315-304-4(2)(a)(iv))	Permit Appl Section 1.8
Name and address of all property owners within 1000 feet of the facility boundary (R315-310-3(2)(i))	Permit Appl Section 1.7 and Appendix C
Documentation that a notice of intent to apply for a permit has been sent to all property owners listed above (R315-310-3(2)(ii))	Permit Appl Appendix C
Name of the local government with jurisdiction over the facility site (R315-310-3(2)(iii))	Permit Appl Section 1.11
Ic. Location Standards for New E&P Landfills	
Geology	See below
Geologic maps showing significant geologic features, faults, and unstable areas	Appendix B
Maps showing site soils	Appendix B
Surface water	
Magnitude of 24 hour 25 year and 100 year storm events	Permit Appl Section 2.5 and Appendix H
Average annual rainfall	Permit Appl Appendix 2.5
Maximum elevation of flood waters proximate to the facility	Permit Appl Section 2.8
Maximum elevation of flood water from 100 year flood for waters proximate to the facility	Permit Appl Section 2.8
Floodplains as specified in R315-302-1(2)(c)(ii)	Permit Appl Section 2.8
Wetlands as specified in R35-302-1(2)(d)	Permit Appl Section 2.9

***I.* Facility General Information**	
Description of Item	Location In Document
The landfill is located so that the lowest level of waste is at least ten feet above the historical high level of ground water or the lowest liner is at least five above the historical high level of ground water	Permit Appl Section 2.10
Land use compatibility	See below
Maps showing the existing land use, topography, residences, parks, monuments, recreation areas or wilderness areas within 1000 feet of the site boundary	Appendix B
Certifications that no ecologically or scientifically significant areas or endangered species are present in site area	Appendix D
Id. Geohydrological Assessment for All E & P Landfills	
Local and regional geology and hydrology including faults, unstable slopes and subsidence areas on and surrounding the site (R315-310-4(2)(b)(i))	Appendix B
Evaluation of bedrock and soil types and properties including permeability rates (R315-310-4(2)(b)(ii))	Permit Appl Section 2.4 and Appendix B
Depth to ground water(R315-310-4(2)(b)(iii))	Permit Appl Section 2.10
Direction and estimated flow rate of ground water (R315-310-4(2)(b)(iv))	No groundwater detected. See Permit Appl Section 2.6.
Quantity, location, and construction of any private or public wells on-site or within 2,000 feet of the facility boundary (R315-310-4(2)(b)(v))	Permit Appl Section 2.7 and Attachment F3.
Identification and description of all surface waters on-site and within one mile of the facility boundary (R315-310-4(2)(b)(vii))	Permit Appl Section 2.5
Background ground water and surface water quality assessment and, for an existing facility, identification of impacts upon the ground water and surface water from leachate discharges (R315-310-4(2)(b)(viii))	Permit Appl Section 2.6
Ground Water Monitoring system design (R315-303-3(7)(b) and R315-308) or a demonstration meeting the requirements of R315-308-1(3)	Permit Appl Section 2.6
Statistical method to be used to evaluate ground water monitoring data (R315-308-2(8))	Permit Appl Section 2.6
Ie. Engineering Report - Plans, Specifications, and Calculations for All E & P Landfills	
Documentation that the facility will meet all of the performance standards of R315-303-2	Permit Appl Chapter 3
Engineering reports required to meet the standards of *Ib, Ic, and Id* above	See below

***I.* Facility General Information**	
Description of Item	Location In Document
Cell design to include liner design meeting the requirements of R315-303-3(3)(a), (b), or (c), cover design meeting R315-303-3(4)(a) or (c), fill methods, elevation of final cover including plans and drawings signed and sealed by a professional engineer registered in the State of Utah (R315-303-3(3)	Permit Appl Chapter 3 and Appendices F, G, H.
Leachate collection system design and calculations showing system meets the requirements of R315-303-3(2)	Permit Appl Section 3.1 and Appendices G1 and G3.
Run-On and run-off diversion designs (R315-303-3(1)(c), (d) and (e))	Appendix H.
Leachate collection, treatment, and disposal and documentation to show that any treatment system is being or has been reviewed by the Division of Water Quality (R315-310-4(2)(c)(v) and R315-310-3(1)(i))	Permit Appl Section 3.2.2
Ground water monitoring plan that meets the requirements of Rule R315-308 including well locations, design, and construction (R315-310-4(2)(b)(x) and R315-310-4(2)(c)(vi))	Permit Appl Section 2.6
Slope stability analysis for static and under the anticipated seismic event for the facility (R315-310-4(2)(b)(i) and R315-302-1(2)(b)(ii))	Appendix I Chapter 2 and Appendix G4
Design and location of run-on and run-off control systems (R315-310-4(2)(c)(viii))	Appendix H
If. Plan of Operations for All All E & P Landfills (R315-310-3(1)(e) and R315-302-2(2))	
Description of on-site waste handling procedures and an example of the form that will be used to record the weights or volumes of waste received (R315-302-2(2)(b) And R315-310-3(1)(f))	Appendix I Chapter 2 and Appendix I Attachment 1
Schedule for conducting inspections and monitoring, and examples of the forms that will be used to record the results of the inspections and monitoring (R315-302-2(2)(c), R315-302-2(5)(a), and R315-310-3(1)(g))	Appendix I Attachment 2
Contingency plans in the event of a fire or explosion (R315-302-2(2)(d))	Appedix I Chapter 5
Plan to control fugitive dust generated from roads, construction, general operations, and covering the waste (R315-302-2(2)(g))	Appendix I Chapter 6
Plan for letter control and collection (R315-302-2(2)(h))	Appendix I Chapter 8
Procedures for excluding the receipt of non-E & P Waste (R315-302-2(2)(j))	Appendix I Chapter 7
A plan for alternative waste handling (R315-302-2(2)(l))	Appendix I Chapter 9
A general training plan for site operations (R315-302-2(2)(o))	Appendix I Chapter 10
Any other site specific information pertaining to the plan of operation required by the Director (R315-302-2(2)(p))	Appendix I Chapter 13

***II* Facility Technical Information**	
IIa. Maps for All E & P Landfills	
Topographic map drawn to the required scale with contours showing the boundaries of the landfill unit, ground water monitoring well locations (if required), and the borrow and fill areas (R315-310-4(2)(a)(i))	Appendix B
Most recent U.S. Geological Survey topographic map, 7-1/2 minute series, showing the waste facility boundary; the property boundary; surface drainage channels; any existing utilities and structures within one-fourth mile of the site; and the direction of the prevailing winds (R315-310-4(2)(a)(ii))	Appendix B
IIb. Closure Requirements for All All E & P Landfills	
Closure plan (R315-310-3(1)(h))	Appendix J
Closure schedule (R315-310-4(2)(d)(i))	Appendix J Section 2.1 and Appendix K
Design of final cover (R315-310-4(2)(c)(iii))	Appendix J Section 2.3 and Appendix G3
Capacity of site in volume and tonnage (R315-310-4(2)(d)(ii))	Appendix K
Final inspection by regulatory agencies (R315-310-4(2)(d)(iii))	Appendix J Section 2.1
IIc. Post-Closure Care Requirements for All E & P Landfills	
Post-closure care plan (R315-310-3(1)(h))	Appendix J Chapter 3
Changes to record of title, land use, and zoning restrictions (R315-310-4(2)(e)(v))	Appendix E
Maintenance activities to maintain cover and run-on/run-off control systems (R315-310-4(2)(e)(iii))	Appendix J Section 3.2
List the name, address, and telephone number of the person or office to contact about the facility during the post-closure care period (R315-310-4(2)(e)(vi))	Appendix J Chapter 3
IId. Financial Assurance Requirements for All All E & P Landfills	
Identification of closure costs including cost calculations (R315-310-4(2)(d)(iv))	Appendix K
Identification of post-closure care costs including cost calculations (R315-310-4(2)(e)(iv))	Appendix K
Identification of the financial assurance mechanism that meets the requirements of Rule R315-309 and the date that the mechanism will become effective (R315-309-1(1) and R315-310-3(1)(j))	Landfill Appl Chapter 4 and Appendix K