Shell Exploration & Production

Shell Frontier Oil & Gas Inc.
3333 Highway 6 South, M1074A
Houston Texas 77082-3101

RECEIVED
MAR 14 2013
GRAND JUNCTION FIELD OFFICE
DIVISION OF
RECLAMATION MINING & SAFETY

FED EX Tracking # 7992 5621 7243

March 14, 2013

Mr. Travis Marshall
Colorado Department of Natural Resources
Division of Reclamation, Mining and Safety
101 South 3rd Street, Suite 301
Grand Junction, CO 81501

SUBJECT: Shell Frontier Oil & Gas Inc., Response to Notification of Deficiency
Notice of Intent (NOI) # P-2010-026, Modification #3 - ELHT Project
Piceance Creek basin, RIO BLANCO COUNTY, COLORADO

Dear Mr. Marshall:

This letter is in response to a Notice of Deficiency issued on January 8, 2013 by the Division of Reclamation, Mining and Safety (DRMS) pertaining to Shell Frontier Oil & Gas Inc. (SFOGI), application for modification No. 3 to Notice of Intent (NOI) # P-2010-026. The purpose of this modification request is to add the East Long Heater Test (ELHT) to the East RDD project. DRMS identified 7 deficiencies to be addressed before this NOI modification request can be approved. This letter provides SFOGI's responses to the deficiency comments and in addition includes a set of revised application materials. Certain aspects of the proposed drilling plan have been updated since the original NOI modification submittal, and some new application materials have been added in order to properly respond each of the Division's adequacy concerns. A summary of the documents included in the attached revised application materials is provided in this letter immediately after the discussion of identified deficiencies.

Deficiency 1

"Section 5.2.3 discusses the fate of the produced gases, oil and water. It is stated that the produced oil and water will be trucked off site. Please specify the destination of the produced liquids."

Response:

Water produced from the ELHT which meets the discharge limits established in the response to deficiency item #3 below will be allowed to infiltrate back to groundwater via the drill cuttings pit. Produced water with TDS concentrations higher than the discharge limit will be comingled with water produced from the ERDD and hauled to a licensed waste handling facility authorized to dispose of produced water. Oil produced from the ELHT will be sampled, then transported offsite, to an approved receiving facility, which can include a crude oil receiving facility, an approved recycling facility, or licensed waste disposal facilities.

Deficiency 2

"Section 5.2.5 states that topsoil will be re-applied evenly. Please specify the depth of topsoil to be replaced."

Response:

Topsoil replacement depth will be between 6 and 12 inches depending on the actual thickness of suitable in-place soil material. The bond calculation for reclamation of the ELHT pad assumes a soil replacement depth of 12 inches.

Deficiency 3

"Section 5.4.1 page 9 states that cuttings and drilling fluids will be transferred to an onsite dewatering pit where the water in the cuttings will be allowed to infiltrate back to groundwater. Please characterize the water quality and provide an estimate of the quantity of water that is proposed to be infiltrated back to groundwater."

Response:

A new Table 3 has been added to the revised NOI Modification No. 3 application materials attached to this response letter. The table provides background water quality data obtained from several monitoring wells installed on drill pad # 138-4-298 located immediately adjacent to the proposed ELHT pad. The table includes background TDS concentrations for the Uinta, L7, L6, L5 and L4 water bearing intervals (WBI's). Note the relatively low values for TDS in each of the WBI's situated above the Saline Zone (Uinta, L7, L6 and L5) compared to TDS levels within the Saline Zone (L4 and lower).

In terms of establishing a TDS discharge limit for produced water allowed to infiltrate back to groundwater via the unlined drill cuttings pit, the Uinta Formation will be the specific WBI to receive discharges from the pit. This can be seen on Figure 5 of the original NOI Modification application materials. Note also on Figure 5 that the R8 stratigraphic interval situated at the base of the Uinta Formation constitutes the 1st confining layer for water infiltrating from the surface. From Table 3, the average background TDS concentration of water in the Uinta Formation is 910 mg/L. Using the approach of setting a discharge limit at 1.25 times the average background concentration, a discharge limit for TDS of **1137.50 mg/L** can be established. Water produced during drilling at the ELHT with TDS concentrations higher than 1137.50 mg/L will be transported to a licensed waste handling facility authorized to dispose of produced water.

The estimated quantity of water that may be allowed to infiltrate back to groundwater via the cuttings pit is approximately 1,300 bbls (54,600 gal.) based on the total volume of the portion of each ELHT borehole situated above the dissolution surface. The volume of water in the portion of each borehole situated below the dissolution surface was not included in the calculation since the significantly higher TDS concentrations relative to the Uinta Formation and L7, L6 and L5 WBI's require that such water be transported offsite and disposed of at a licensed waste handling facility.

Deficiency 4

"Section 5.5.3 states that during the ELHT oil production is estimated to be small in volume. Please provide an estimate of the amount of oil expected to be produced during the test."

Response:

Section 3.0 of the original NOI modification application supplemental text indicates that oil production from the ELHT is expected to be less than 175 bbls of oil. This is based on an estimated combined total oil production from all four wells of 172 bbls over a 900 day period.

Deficiency 5

"Section 6.1 states that all chemicals will be removed from the site and properly disposed. Please disclose all chemicals that will be used on the site during the test. Also provide MSDS sheets for chemicals that may be harmful to human health, wildlife or the environment. Also, please state where the chemicals will be properly disposed."

Response:

A new Table 2 has been added to the revised NOI Modification No. 3 application materials attached to this response letter. The table provides a list of chemicals & fuels used or stored on site for the ELHT project and includes a description of where each chemical will be disposed of or recycled. An MSDS for each chemical listed in the table is also included at the end of the revised application materials in a new Section entitled "MSDS".

Deficiency 6

"Section 6.2 regarding Subsurface Reclamation states that a metal bridge plug will be placed in the heater wells just above the pyrolyzed reservoir. No statement of whether or not the heaters are to remain downhole is provided. Please state whether or not the heaters are proposed to remain in the wells permanently. If the heaters are proposed to remain in the wells permanently please provide justification."

Response:

Once completed, Shell will attempt to pull the heaters and discard these appropriately. However, in the event the heater elements cannot be pulled, these will be left in the wells permanently. The borehole P&A plan for the three heater wells is to leave the heater element in each well permanently. The heater canisters will be milled or washed over down to below the dissolution surface, cutting the canister and heater at that point, and then filling the well from that point to surface with cement. Due to the small diameter of the heated section of the borehole and presence of the heater element in the hole, subsidence of overlying strata is not considered to be significant. In addition, since the portion of the hole containing the heater element is within the same stratigraphic unit throughout its length and the area of disturbance to the surrounding rock due to heating and pyrolysis is minimal, no issues relating to the possible creation of pathways for groundwater migrating into upper water bearing intervals are anticipated.

Deficiency 7

"In the Figures section, Figure 4 displays the greatest depth of the Green River Formation at 2,200 feet. Figure 6 shows the proposed total depth to be 2,400 feet. Please explain the inconsistency and provide consistent figures."

Response:

Figure 4 provided with the original NOI modification materials is a generalized stratigraphic cross section intended to show the basic arrangement of stratigraphic and hydrostratigraphic units within the west-central portion of the Piceance Basin. In the vicinity of the East RDD and proposed ELHT, the depth of the Green River formation extends to over 2,600 feet as shown on amended Figure 4 included with the revised application materials attached to this response letter. The depth of the Green River formation in the vicinity of the ELHT is based on data obtained from well #135-4-298-SAW1 (2,607 ft. to the top of the Wasatch Formation based on well surface elevation).

Summary of Revised NOI Modification Application Materials

NOI App. Forms 1 & 2:

Page 3 - Changed project commencement date to 4/1/1013
Page 4 - Changed drill pad dimensions, borehole depth
Page 5 - Clarified size of disturbed area

Supplemental text:

Revised well construction details and specifications (casing diameter, type of steel, heater well build rate, observer well degree of inclination, 3 optional wellhead positions).
Revised Table 5.1 – Well Specifications

Figures:

Figure 2 – Revised as Figure 2a to show expanded pad area and previously approved cuttings pit
Figure 2b (new) – 3 optional wellhead patterns
Figure 3c (new) – Plan view diagram of proposed well trajectories
Figure 4 – Revised stratigraphic cross-section more site-specific to the ELHT
Figure 6 – Revised to show changes in downhole well configuration details
Figure 7 – Revised to show changes in heater well construction details
Figure 8 – Revised to show changes in observer well construction details

Tables:

Table 1 – Revised to reflect change in estimated reclamation costs due to changes in borehole dimensions
Table 2 (new) – List of Chemicals and Fuels Used or Stored at the ELHT
Table 3 (new) – ERDD / ELHT water quality data.

MSDS:

Material Safety Data Sheet for each chemical listed in Table 2

SFOGI appreciates the opportunity to work with DRMS on this modification request. If you require any additional information or clarifications, please do not hesitate to contact me at 281-544-7990 (office) or at 832-540-1622 (cell) at your convenience.

Sincerely,

DRoM
3/13/13

George K. Zimmerman
Land Administration

Attachments

Attachments (5)

Cc: Paul Daggett – BLM
FED EX Tracking # 7992 6256 7686

Sec. 3, lots 16 to 19, inclusive; sec. 4, lots 5 to 20, inclusive; sec. 5, lots 1 to 3, inclusive, S1/2 NE1/4, SE1/4 NW1/4, NE1/4 ~~SW1/4, S1/2 SW1/4, and SE1/4; sec. 8, all; sec. 9, N1/2 N1/2, SW1/4 NE1/4, and S1/2 NW1/4.~~

C. **LOCATION MAP:** Attach a USGS 7.5 minute quad, or similar map of adequate scale, which locates the prospecting site(s).

D. Are prospect sites (e.g., drill holes, trench locations, etc…) staked on the ground? Yes ☐ No ☐

E. Specify the Land Management Agency, Address and Telephone Number:

BLM, White River Field Office, Meeker, CO 970-878-3800.

F. The prospector is required to document that the NOI has been sent to the BLM or the USFS. Processing of the NOI will not begin until the prospector has submitted evidence acceptable to the Division that the NOI was sent to the BLM or USFS. Check one:

☑ Evidence of notification is attached to this NOI for BLM Land
☐ Evidence of notification is attached to this NOI for USFS Land.
☐ Other proof of notice is attached to this NOI

II. MAPS & DRAWINGS

Accurate topographic base map showing the location of the proposed project must be submitted with this notice. The prospector may submit a U.S.G.S. 7.5 minute quadrangle, or similar map of adequate scale that:

1. Identifies the proposed prospecting site(s) or activity areas involving surface disturbance. Activity areas include all drill holes, mud pits, excavations, trenches, adits, shafts, tunnels, rock dumps, stockpiles, impoundments and prospecting roads, and

2. Includes sufficient detail to identify and locate known prospecting features and facilities that may be affected and those that are not anticipated to be affected. This includes the location of all drill holes, mud pits, excavations, trenches, adits, shafts, tunnels, rock dumps, stockpiles, impoundments and prospecting roads. Color photographs, adequately labeled (including date, orientation and location), of the prospecting site may be used to fulfill this requirement if included with the NOI submittal.

III. PROJECT DESCRIPTION

1. **Mineral(s) and/or Resource(s) being Investigated:** No change
2. **Estimated dates of commencement and completion:**

Commencement: 04/01/2013, (upon approval by DRMS)

Completion: 12/31/2022,

3. **Amount of material to be extracted, moved or proposed to be moved:** No change
4. **Identify the type or method of prospecting proposed and quantity (place an "X")**

☐ Cuts ☐ Pits ☐ Trenches
☐ Shafts ☐ Tunnels ☐ Adits ☐ Declines
☑ Air Drilling ☑ Fluid Drilling ☐ Drilling & Blasting

5. Describe proposed surface excavation or other land disturbance, including roads, pits, trenches, waste piles, drill pads and collar areas of underground workings, ponds, etc…

This modification request is submitted to allow the incorporation of horizontal long heater testing at the East RDD concurrent with research activities previously approved by DRMS. Please refer to the attached supplemental text and figures for a complete description of the requested modification.

6. **Proposed Disturbance** (approximate) Describe the proposed drilling to be conducted, including anticipated number of holes, diameter, depth, location, etc… Submit additional pages if necessary:

A. Drill Pads: Quantity 1.00 Average Width 268.00 (ft) Average Length 471.00 (ft)
B. Drill Holes: Quantity 4.00 Depth 2,220 - 2,460 (ft) Diameter 17.50 -> 8.50 (in)
C. Mud Pits: Quantity 1.00 Average Width 20.00 (ft) Average Length 100.00 (ft)
Average Depth 14.00 (ft)

Described proposed underground work, including reopening of old workings, advancement of adits or shafts, trenches, pits, cuts, rock dumps, or other types of disturbance, describe type, quantity and general dimensions:

Please refer to the attached supplemental text and figures for a complete description.

D. Other Disturbances (please describe):

No change

E. Indicate Chemicals and Fuels used or stored on site. List type, quantity and method to store.

No change

F. New Road(s): Length No change (ft) Width No change (ft)
Significantly Upgraded Road(s) Length No change (ft) Width No change (ft)

Are culverts or other crossings proposed? If so, please describe:

No change

G. Total project area to be disturbed 15.36 (acres) (12.20 ac. orig. + 0.14 ac. cuttings pit + 3.02 ac. ELHT)

H. Describe the equipment to be used for the prospecting operations:

Please refer to the attached supplemental text and figures.

I. Describe and locate any structures to be constructed (i.e. stockpiles, ponds, impoundments):

Please refer to the attached supplemental text and figures.

J. Describe anticipated relationship to surface water and groundwater (proximity to streams, penetration of ground water aquifers):

Please refer to the attached supplemental text and figures.

IV. OPERATION AND RECLAMATION MEASURES:

1. The Board suggests that a photographic record of the pre-prospecting and post-prospecting conditions be kept by the prospector. These photos should be taken from the same location and by the same method to clearly show the pre-prospecting condition of the land and the reclamation efforts. Upon completion of reclamation and request for bond or surety release, the Board may consider the photos as evidence of adequate reclamation, and thus, be able to act more quickly on the request for release.

2. Provide a description of the native vegetation of the area to be disturbed, including tree, shrub, and grass communities of the area. Color photographs, sufficient to adequately represent the ecology of the site and adequately labeled (including date, orientation and location), may be used in lieu of a written description. Based on the quality of the photographs, the Division may require additional detail.

No change

NOI ATTACHMENT – EAST LONG HEATER TEST (ELHT)

1.0 INTRODUCTION

Shell Frontier Oil and Gas Inc. (Shell) has leased approximately 149 acres of oil shale-bearing land to develop a Research, Development and Demonstration (RDD) project in a nahcolite-rich zone of the Eocene Green River Formation in the Piceance Basin, NW Colorado. The East RDD project lies on federal land managed by U.S. Bureau of Land Management (BLM) (Figure 1). The target resources include oil shale and nahcolite ($NaHCO_3$). In essence, the plan is to leach nahcolite with hot water to create permeability and recover the leachate, then heat the formation to convert kerogen and recover the oil and gas products.

In October 2012, Shell met with staff from the White River Office of the Bureau of Land Management and Colorado Division of Reclamation, Mining and Safety to discuss incorporation of testing of horizontal long heaters on the East RDD lease concurrent with RDD activities described above. The Plan of Development has been updated and submitted to BLM describing Shell's plans for incorporating testing of horizontal long heaters on the East RDD lease concurrent with previously described East RDD activities. This attachment provides the details for the modification to Prospecting Notice of Intent (NOI P-2006-026) required by the Division of Reclamation, Mining and Safety (DRMS) for incorporating the East Long Heater Test (ELHT) into the East RDD.

The ELHT consists of three 1000-foot long heaters installed on the East RDD lease at a pad site located adjacent to East RDD Pilot (Figure 2a). The purpose of the ELHT is to test the tendency for hotspots to form along commercial mineral insulated (MI) heaters installed in a horizontal orientation. This testing supplements the data that will be generated at the East RDD Pilot by testing heaters in a nonvertical orientation and will inform Shell for future design and deployment.

2.0 GEOLOGY

The East RDD Pilot site lies in the northern part of the Piceance Basin in northwestern Colorado (Hail and Smith, 1994 [9]) (Figure 3). The Piceance Basin contains the world's richest deposits of oil shale and one of the most significant occurrences of the saline mineral nahcolite, which is $NaHCO_3$ (sodium bicarbonate or baking soda). An estimated one trillion barrels of oil shale resource occurs within the Parachute Creek and Garden Gulch Members of the Green River Formation. The resource area covers 1,600 square-miles and is bounded by the Colorado River on the south, the White River on the north, the Douglas Creek Arch on the west, and the White River Uplift on the east. The in-place oil shale resource lying beneath the 149-acre East RDD tract, location for the East RDD Pilot and ELHT, is estimated to be approximately 274 million barrels, based on Fischer Assay (FA) recovery rates.

The ELHT is planned for the lower saline nahcolitic oil shale zone of the Parachute Creek Member as characterized in original NOI submittals, and for the illitic sediments near the top of the underlying Garden Gulch Member. Both development intervals are within the Green River oil-shale formation.

The Garden Gulch Member illitic Interval was not deposited under the same evaporative conditions as the lower saline portion of the Parachute Creek member. A substantial decrease in the amount of nahcolite and related minerals is observed, with an increase in clastic minerals that include illite are indicative of a fresh water depositional setting contrasting with the overlying Parachute Creek Member which is indicative of a hypersaline depositional setting. The target Illite Zone for the ELHT is greater than 60% illite clay, which is the reason for the low permeability in this interval.

Although the oil shales of the Garden Gulch Member differ mineralogically and in physical character from the overlying Parachute Creek Member, the kerogen-rich oil shales of both members are vertically gradational with each other and form essentially one continuous mineral deposit. The Garden Gulch Member of the lower Green River Formation overlies the Eocene Wasatch Formation, which is comprised of mudstones, sandstones, coals, and conglomerates. The lowest test zone of the ELHT is separated from the Wasatch Formation by at least 200 ft of low permeability shales of the Garden Gulch Member. Figure 4 provides a generalized stratigraphic and hydrostratigraphic section illustrating the position of the Garden Gulch Member of the Green River Formation. Figure 5 provides a generalized hydrostratigraphic cross section across Piceance Basin and also shows the location of the Garden Gulch illitic zone and approximate test intervals of both the East RDD and ELHT.

3.0 ESTIMATED RESOURCES

The estimate resource recovery for the ELHT is de minimis because the ELHT has intentionally been designed to test horizontal heaters and to minimize hydrocarbon recovery. This is accomplished by spacing the horizontal heaters sufficiently far apart (~80-100 ft) to ensure that superposition of heating does not occur. While the East RDD Pilot production is expected to be greater than 1,500 bbls of oil, the production from the ELHT is expected to be less than 175 bbls of oil. This oil will be routed to its own separator and tanks and therefore will be kept apart from the oil produced from the East RDD Pilot to ensure clarity of results. From time to time and for short durations, the production from the two tests may need to be commingled in response to operational problems or scheduled maintenance on one of the two separators. During such times, the cumulative production from each test will be adjusted based on the rate during the time period immediately preceding the event.

For the East Long Heater Test, the primary objective is to test subsurface heater technology to inform on the heater design. The test is designed to minimize production, if any, from the pilot by placing the heaters far apart from each other so as to avoid thermal superposition between the heaters. This is expected to result in a small localized pyrolysis zone around each of the heaters. Predictive modeling suggests this zone to be confined to less than 2 ft radius in the vicinity of each heater. Heaters extend 1000 ft in the lateral direction. Average FA in 2 ft radius around the three heaters is 28, 35 and 29 gpt respectively. Assuming a 2 ft horizontal cylinder of affected kerogen around each 1000 ft long heater, the total affected FA resource is about 1645 bbls. Only a fraction of this resource will be produced as necessary to control reservoir pressure.

The ELHT does not include a leaching phase. Heating in intervals where nahcolite is present will result in thermal decomposition to soda ash. For the test interval where the nahcolite content is ~30 %wt on average (limited to the uppermost heater), it is calculated that the approximately ~ 1,200 to 1,500 tons of nahcolite will decompose to soda ash which remains in place for potential recovery.

4.0 GROUND WATER MONITORING AND RESPONSE

For the ELHT, the primary focus of the test will to evaluate the tendency for hotspots to form along the heater. The three heated intervals are widely spaced to prevent superpositioning and production rates will occur only as necessary to relieve internal pressure. Given the significant over burden pressures exerted by the rock, the lack of superpositioning of the heaters and the management of pressure by flow from the heater wells and the inclined observer/producer well, the risk of any containment breach is considered negligible. By design, the location of the heated intervals for the ELHT is located upgradient of the 138-4-298 well pattern. As such, the 138-4-298 well pad and specifically the L-4 well as well as the 135-4-298-L4 well associated with the East RDD will also provide appropriate monitoring for the ELHT. Baseline monitoring data from the 138 and 135 well pads has been collected and submitted as part of the East RDD project requirements.

5.0 IN SITU DEVELOPMENT PLAN – ELHT

5.1 Development Plan

The ELHT consists of three 1000-foot long heaters installed on the East RDD lease at a pad site located adjacent to East RDD Pilot (Figure 2a). The purpose of the ELHT is to test the tendency for hotspots to form along commercial mineral insulated (MI) heaters installed in a horizontal orientation. This testing supplements the data that will be generated at the East RDD Pilot by testing heaters in a nonvertical orientation and will inform Shell for future commercial design and deployment.

Testing will involve:

- Construction of a drilling pad located adjacent to and hydraulically up gradient of the 138 hydrology pad.
- Installation of three horizontal heaters in three characteristically different non-water-bearing intervals of oil shale to test heater performance. Two heaters will be installed in higher resource intervals within the Saline Zone and one heater will be installed in a high resource interval within the Illite Zone. The two heaters in the nahcolite interval will test a high nahcolite condition and a low nahcolite condition.
- Installation of deviated observer/producer well adjacent to the heater wells to provide additional pressure relief and gas production during heater testing.
- Tie in of ELHT wells to the East RDD Pilot production facilities (i.e., separator, tanks and flare system). To the extent possible, that East RDD and ELHT will utilize two distinct separators for monitoring of produced fluid volumes.
- Collection of temperature data along the entire length of the heaters during start up and ramp up of power to assess the development and severity of hotspot formation due to variation of the geothermal properties of the rock.

5.2 Development Details

5.2.1 Drilling

The ELHT well pattern (Figure 2b) consists of three horizontal heater wells and one inclined observer/producer well to provide pressure control. In addition to heating the formation during the heating phase, heater wells will also be used to control pressure in the immediate vicinity of the heater. The surface location for these wells will be in the northeast quadrant of the East RDD lease. None of the wells will be converted for dual use and no leaching is anticipated as the main objective for the ELHT pilot is to measure the response of the reservoir to heating (principally looking for the development of heater "hot spots"). All wells will be drilled, cased, and cemented prior to heater installation and ICP activities. Figure 6 shows a subsurface view of ELHT wells.

Drilling operations will require 3 or more months. A dedicated drilling pad will be built and used for this pilot. As shown on Figure 2a, the surface location of the conductors will be located less than 500 ft from the lease boundary but the downhole well trajectory during drilling (Figure 2c) will place the heated section or interval away from the property boundary in the central portion of the lease. As such, the ELHT testing will not affect any resource at or near the lease boundary. Well specifications and additional details for well construction are discussed in Section 6B.4.

Five hydrology monitoring wells were installed in 2009 in the northeast quadrant of the RDD Lease (hydrology well pad 138) as part of the East RDD. Data from these wells are being collected as part of the East RDD and provide baseline water quality in the near downgradient area that is also applicable to the ELHT. An additional groundwater monitor well (135-4-298-L4) was installed near the East RDD Pilot pattern with surface location approximately 60 ft NE of the East RDD pilot pattern. Elsewhere in the basin, Shell has drilled, tested, and sampled a considerable number of hydrology wells. These are discussed in the sections on hydrology and baseline water chemistry in this NOI Modification. The existing groundwater monitoring wells associated with the East RDD are sufficient for monitoring during the ELHT. As such, no additional hydrology wells will be drilled as part of the ELHT.

5.2.2 Nahcolite/Sodium Availability Assessment

It is important to assess the impact of the heating process on the viability of sodium recovery when heating near rich nahcolite beds. Only one of the three heater wells is drilled in a zone containing significant nahcolite:

- Heater 1 (2220 ft depth*) – 25.4 wt% Nahcolite (drilled near Greeno Bed)
- Heater 2 (2300 ft*) – 0.8 wt% Nahcolite
- Heater 3 (2400 ft) – 0.3 wt% Nahcolite (drilled in the illitic interval).

The ELHT pilot does not include a pre-leaching phase in which sodium is recovered. Instead, to assess the impact that heating will have on sodium recovery, Shell proposes to recover a core across the heat-affected zone near Heater 1 after the completion of the heating and production phase and prior to commencement of well abandonment activities. The core is expected to drill through (1) a virgin nahcolitic zone above the heated interval, (2) an upper nahcolite/soda ash transition zone, (3) a soda ash zone near the location of the heater, (4) a lower soda ash/nahcolite transition zone, and finally (5) a second virgin nahcolitic zone below the heated interval. Shell proposes to conduct lab testing on the core to map the location of the transition zones using the temperature fields from the reservoir model to establish the temperatures at which in situ conversion of the nahcolite to soda ash occurs. Shell further proposes to leach representative portions of the core in (1) the virgin nahcolitic zone, (2) the nahcolite/soda ash transition zone, and (3) the soda ash zone to determine the impact of heating on sodium recovery. Core previously cut from nearby wells (but never heated) can also be used in the study.[1]

Because of the very low nahcolite content near Heater 2 and Heater 3, no investigation on the impact that heating will have on sodium recovery is necessary and none is planned.

5.2.3 Pyrolysis and Production

Pyrolysis facilities will consist of the three heater wells, each equipped with an electric heater installed in a canister to heat the formation which will convert the in-situ kerogen adjacent to the heater into oil and gas. Each heater will be installed with temperature monitoring instrumentation. An inclined observer/producer well will be installed through the heated interval near the heater wells to provide additional pressure relief to the formation during heating.

During the heating process water (generated by the decomposition of nahcolite to soda ash), oil and gas are released from the kerogen and surrounding matrix increasing the subsurface pyrolysis interval pressure. To maintain the pressure in the pyrolysis intervals below the formation fracturing pressure, pressure will be bled from the formation by the heater wells and the observer/producer well. To remove liquids from the pyrolysis interval, an artificial lift system will be installed in the inclined observer/producer well. Any production from the heater or observer/producer wells will flow through piping connecting the well heads to a separator located at the East RDD Pilot. Produced gases will be flared, and the oil and water will be recovered from the separator and trucked off site. Diluent and makeup water obtained from the City of Meeker may be added to the production stream, the well casing, or well tubing (if needed) to assist in the production of bitumen which will form during the lower temperature phases of pyrolysis. Produced CO_2 and other non-combustible gases will be included in the stream of gas sent to the flare.

The heating phase of ELHT is expected to last for two or more years and is expected to run concurrently with heating at the East RDD Pilot.

5.2.4 Subsurface Reclamation Plan

Full details of subsurface reclamation are described in the Subsurface Reclamation Plan Section of this NOI Modification. A synopsis of activities for the ELHT follows.

Upon completion of the heater test, the pyrolyzed zones will be allowed to cool naturally. Natural cooling will be considered complete when the temperature at the heater wells falls below ~200 °F (i.e., boiling point of water at reservoir conditions). Once below ~200 °F, any subsurface equipment

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[1] *Reference 135-4-298-SAW1 well.

located in the four ELHT wells between depths of approximately 2,100 ft (~80 ft below the dissolution surface) and surface will be retrieved. From a depth of approximately 2,100 ft down and in the horizontal section, the heater canister, heater, and associated instrumentation will be left in the heater wells. A metal bridge plug will be placed within the casing just above 2,100 ft TVD, and the well casing will be plugged with cement above the bridge plug to approximately 3 ft below the ultimate reclaimed ground surface. Well casings will then be cut 3 or more feet below final ground surface, per BLM Gold Book Standards.

For ELHT the radial extent of thermal disturbance is expected to be small. Based on modeling, temperatures above 550 ^{0}F are predicted to be localized to ~2-ft radius around the heaters. As there is no thermal superposition in the heated volume, natural cooling is expected to be effective and will take approximately one year for the formation to cool to less than 200 ^{0}F. Thermocouples installed along the heater canisters will be used for temperature monitoring. Abandonment of the heater wells will be completed after the temperature of the thermocouples indicates temperature along the heaters is less than 200 ^{0}F.

5.2.5 Surface Reclamation Plan

Surface reclamation will be completed to return the disturbed site to a beneficial post-mining land use. A synopsis of the surface reclamation plan follows. Details may be found in the Reclamation section of this NOI Modification.

After the wells have been filled with cement, casings will be cut a minimum of 3 ft below the projected post grading ground surface level. Surface equipment not needed for steam recovery and oil water separation may be removed prior to or after decommissioning of the wells. Once all facilities are removed, concrete structures will be crushed on site, rebar will be removed and properly disposed off site, and concrete will be distributed evenly amongst the subsoil. Fill and cuts will be restored to approximate original contours, packed earth will be scarified, topsoil will be re-applied evenly, and the area will be re-seeded with the BLM-approved seed mix of native species.

5.3 Size, Location, Schematics of Structures, Facilities

5.3.1 Surface Facilities Descriptions

The ELHT includes minimal additional surface facilities as it largely ties into the existing facility for East RDD Pilot discussed in Section 6.3A. The new facilities consist of a well pad, a variable voltage transformer (VVT) skid and a ~600 ft long pipe rack enabling the tie in of the minimal production from the ELHT wells to the East RDD Pilot surface facility. The ELHT will be monitored and operated using the existing East RDD Pilot control system. All added operations infrastructure will be located inside the 8-foot tall game fence. This area is gated to prevent access by wildlife and the public. Reclamation of the minimal additional facilities at the ELHT will be consistent with the East RDD. Incremental reclamation costs for the ELHT will be calculated based on the addition of a new well pad containing three horizontal wells and one inclined well and the foundation associated with VVT, and piping connecting the ELHT to the East RDD surface facilities.

5.3.1.1 VVT Station

A VVT station, to be installed by Shell, will be placed inside the permit boundary, within the game fence. The substation will power all electric needs from the VVT. The majority of surface equipment will be used in all phases – heating and cooling – with minor variations in the equipment line-up.

A buried power cable from the substation will feed the VVT; other electrical service lines will be placed above ground on cable trays. Each pipe rack foundation will rest on a concrete footer.

5.3.2 Surface Equipment Summary - Heating Phase

During the heating phase, equipment discussed in Section 6B.3.2 will be utilized in addition to the equipment discussed in this section.

5.3.2.1 Electric Heaters

Three horizontal, down-hole heaters will be installed to heat the kerogen within the oil shale rock. The heater performance and the reservoir response will be monitored using the installed instrumentation connected to the East RDD control system. Heaters will be positioned far enough apart such that conversion of kerogen into oil and gas will be minimal. Converted oil and gas will be managed by the observer/producer well. Heater power and control will be supplied from the EIB, which in turn, receives power from the high voltage substation via VVT.

5.3.3 Surface Equipment Summary- Reclamation Phase

Equipment discussed in Section 6B.3.3 will also be used during the reclamation phase of the ELHT. No new equipment will be installed.

5.4 Well Construction

5.4.1 General

The ELHT Pilot utilizes two types of wells (Figures 7 and 8):

- Horizontal heater wells (3)
- Inclined observer / producer well (1).

The ELHT Pilot will not include additional drilling of down gradient ground water monitoring wells. Monitoring will be provided by the existing wells drilled between 2009-2010 in Pad 138-5-298 which include one well each in each hydrostratigraphic unit (Uinta, L7, L6, L5, and L4).

Specifications for each well type are discussed in the sections following. Table 5.1 lists the specifications for each well. Specifications listed are intended generally to provide for cement mixes to withstand both the composition (high salinity) and/or sulfate content of the wells plus the temperature fluctuations that will act on the casings and cement. Dimensions provided are for maximum pipe (casing) and drilled well dimensions, and may be decreased if feasible. Annular spaces may vary depending on the final borehole and casing size selection, but will be maintained to provide sufficient space for placement of cement.

Table 5.1: Well Specifications.

	Casing Depths (ft TVD)		Hole Size	Casing Description	Cement Design	Cement Installation Method
Horizontal Heater	Conductor	60-200 ft	17-1/2	13-3/8 in, 54.50 lbs/ft, J-55 Grade steel, STC, ID: 12.615	Premium Plus cement, 11.5 ppg, additives as required by lab test.	Cement annulus via tremmie pipe or through stab-in cementation.
	Intermediate	2,220 ft – 2,400 ft	12-1/4 in	9-5/8", 40 lbs/ft , J-55, LTC, ID: 8.835 in	Premium Plus cement, 9.5 to 11.5 ppg lead, and a 13.5 to 15.8 ppg tail, additives as required by lab test.	Mud flush, water flush, cement & displace by one plug system is used to pump cement job. Pump cement to surface.
	Heater Canister	Well TD	8-1/2 in	4-1/2", HS-70, ASTM A-606, Type 4, 0.25 WT Coiled Tubing canister containing heater and instrumentation	N/A	N/A
Inclined Producer	Surface	60-200 ft	17-1/2 in	13-3/8 in, 54.50 lbs/ft, J-55 Grade steel, STC, ID: 12.615 in	Premium Plus cement, 11.5 ppg, additives as required by lab test	Cement annulus via tremmie pipe or through stab-in cementation.
	Intermediate	2,460 ft	12-1/4 in	9-5/8", 40 lbs/ft , J-55, LTC or equivalent, ID: 8.835 in	Premium Plus cement, 9.5 to 11.5 ppg lead, and a 13.5 to 15.8 ppg tail, additives as required by lab test.	Mud flush, water flush, cement & displace by one plug system is used to pump cement job. Pump cement to surface.
	Production	Well TD	8-1/2 in	6-5/8" Slotted Liner	N/A	N/A

The project comprises three wells for heating and one well for observation and/or pressure control (Figure 6). Plans call for all wells to be drilled prior to deploying and activating any of the heaters.

The horizontal wells will be drilled with directional control from surface, with a kick off point (KOP) between 1,000 ft to 1,400 ft true vertical depth (TVD) and a build rate of 5.7°/100 ft (dog leg severity) to a maximum inclination of 90°. The horizontal section for these wells will be on the order of 1,000 ft to 1,150 ft and an inclination at well total depth (TD) between 90° and 93° to allow deploying the heaters in the formation bedding planes (up dip). The total depth of the deepest horizontal well (located at the heel) is projected to be less than 2,410 ft TVD.

The inclined well will be drilled with directional control from surface with a KOP between 200 ft to 400 ft TVD with a build rate between 5° to 10°/100 ft up to an inclination of 45° which will be maintained to TD. Total depth of the inclined well is projected to be less than 2,460 ft TVD.

Fresh water will be transported to the site from the White River the City of Meeker or other available sources for use in all drilling. Cuttings and drilling fluids will be transferred to an onsite dewatering pit where the water in the cuttings will be allowed to infiltrate back to ground water. Dewatered cuttings will be transferred to rolloff boxes and transported to applicable offsite facilities for permanent disposal. Surface and intermediate hole sections will be drilled with aerated mud and loss circulation material added as required, and the horizontal section with aerated mud and loss circulation material or common water well drilling lubricant depending on the borehole stability studies simulations which are yet to be concluded.

The wells will be constructed with pressure or temperature sensors to monitor changes in each pyrolysis interval and in the crown above upper pyrolysis interval. Geological conditions at the ELHT are very well informed by the recent drilling of Shell appraisal well 135-4-298 (SAW-1 well), the five hydrology wells on the 138-4-298 Pad, and of the 20 East RDD wells. Ground water is expected at about 250 ft depth, based on the water level in well 135-4-298 (SAW-1 well).

Wells drilled by Shell in the Piceance Basin in the past 10 years generally encountered small amounts of gas, particularly in the deeper formations. The gases contain mostly N_2 and CH_4, with lesser volumes of O_2 and CO_2 (Schatzel et al, 1987). Hydrogen and ammonia may be present. Samples collected in closed containers for up to 125 days contained up to 0.195 cm^3/g of gas.

A sulfur odor often is detected in drilling of Uinta and some of the shallow Parachute Creek wells. Although LEL (lower explosive limit) measurements are checked at all wells during drilling, and even though methane and sulfur gas occur typically, LELs have never been exceeded. If unusual gas levels are encountered, drilling will be shut down and the well will be allowed to vent.

5.4.2 Casing Cement Processes

Surface (conductor) casing will be set in cement by placement of cement directly in the annulus of the conductor, by a tremmie pipe or through a stab-in cementation in which a cement stinger is run and stab-in into a float shoe and pump cement into the annulus until returns are seen at surface. Conductor casing cement will be Type I/II premium plus cement.

Casing in all other sections will be cemented by displacement. With the displacement method, the casing is installed to the section TD then lifted a few feet off bottom to create a fluid pathway between the interior and exterior of the casing. Cement is next applied inside the casing and capped with a wiper plug. Displacement fluid (usually water) is then added to the column above the plug, providing weight that drives the cement down the casing and up the annulus until cement returns are observed at the surface.

All wells – horizontal heaters and observer/producer – will be cemented with Premium Plus cement and additives (as recommended by laboratory tests and simulations) which may include but are not limited to dispersant agents, antifoam material, fluid loss agents, silica flour and extender or retardant additives with a 9.5 to 11.5 lbs/gallon (ppg) lead, and a 13.5 to 15.8 ppg tail. Once cement returns are observed at the surface, the cement will be allowed to set for the prescribed setting time (usually 8 hours). Cement recipe and slurry weight may change depending on laboratory tests and simulations, however all efforts will be made and best practices applied to ensure proper zonal isolation on each interval.

A cement bond log and/or isolation scanner log will be run in each well after cementing. The cement bond log is an acoustic geophysical measurement that indicates the presence of cement as a measure of the degree of bonding in the annulus between casing and the drilled hole.

5.4.3 Conductor Casings

Conductor casing will be installed at all wells. Conductor size for both horizontal heaters and the producer / observer well will be 13-3/8 in with casing shoe located between 60 ft to 200 ft subsurface and penetrating 3 ft minimum into bedrock. Conductor casing specifications are:

- 13-3/8 in O.D. (54.5 lbs/ft, J-55 Grade steel, STC or equivalent)

Casing will be cemented from T.D. to surface with type I/II neat cement, placed in the annulus via tremmie pipe or through stab-in cementation using a cement stinger and a float shoe.

5.4.4 Heater Wells

The main function of the horizontal heater wells is to test the tendency for hotspots to form along the heater in three subsurface environments. For this purpose, two horizontal heater wells will be drilled in the Nahcolitic Oil Shale and one horizontal heater well in the Illitic Oil Shale. All horizontal drilling will occur below the dissolution surface. The minimum horizontal section requirement for active heating in each horizontal well is 1,000 ft with an additional pocket of 125 ft - 150 ft to compensate for the expansion of the canister during the heating process.

As presented in table 6.1, horizontal heater well design (Figure 7) will consist of a 13-3/8 in conductor set into the bedrock and cemented to surface, followed by a 12-1/4 in hole drilled to the end of the build-up section (i.e. 90° inclination) to run and cement to surface a 9-5/8 in casing containing pressure transducers and bubbler tube ported to the casing ID. An 8.5 in open hole section will then be drilled along the heated interval to run a 4.5 in sealed canister from surface to well TD which contains the three phase MI heater and an instrumentation package including thermocouples and an optical fiber.

5.4.5 Inclined Observer/Producer Well

The main function of the inclined observer/producer well is to provide monitoring and back-up pressure control of the fluids/gases generated during the heating process. This well will be drilled from the same pad as the horizontal heater wells to minimize surface disturbance. The well will be inclined at 45° inclination and will pass the deepest heater well at approximately 750 ft from the heel. The distance between the Producer / Observer well and each horizontal heater well will be between 10 ft and 15 ft subsurface.

As presented in table 6.1, Producer / Observer well design (Figure 8) will consist of a 13-3/8 in conductor set into the bedrock and cemented to surface, followed by a 12-1/4 in hole drilled through the bend section and inclined at 45° to the casing point (between 2,000 and 2,200 ft TVD) to run and cement to surface a 9-5/8 in casing string. Subsequently, an 8-1/2 in hole (inclined at 45°) will be drilled to well TD to run a 6-5/8 in slotted liner. The well will be completed with a 2-3/8 in tubing string containing a plunger lift system and instrumentation to monitor pressure and temperature at each pyrolysis interval. Instrumentation to monitor the temperature in the cap above the upper pyrolysis interval will be attached to the casing OD and cemented in place.

5.4.6 Cuttings and Drill Water Disposal

Cuttings and drilling fluids will be transported to a temporary cuttings pit located on the East RDD project site. Water contained in the cuttings and drilling fluid from above the L4 will be returned to the subsurface by means of infiltration and the dewatered solids will be loaded in portable tanks and transported to applicable offsite facilities for permanent disposal.

5.5 Development Methods, In Situ Methodology

5.5.1 Operational Phases and Timeline

The ELHT Pilot will span ~ 4 years and is run concurrently with the East RDD Pilot. Drilling, depending on the time needed for permitting and procurement of equipment, is expected to begin in late summer 2013. From an operational perspective, the East RDD Pilot and the ELHT will be combined into a single operation.

To gain maximum R&D learnings, a ~2 year extension may be requested to study the longer term heater performance in the resource.

5.5.1.1 Construction Phase

Pad construction of the ELHT will begin in late spring 2013 and is expected to be completed within 45 days. Drilling of the four wells at ELHT is expected to begin in late summer 2013 and is expected to require less than 120 days. Heater installation will follow and is expected to take less than 60 days. Construction of the ELHT is minimal as it will tie into the facilities constructed for East RDD Pilot. The tie-ins for ELHT to the East RDD Pilot are expected to take less than 90 days. There may be time intervals of as much as 120 days between some of these activities and some activities may overlap. Heating is expected to begin at ELHT in early 2014.

5.5.1.2 Heating Phase

Heating of the three wells is expected to require ~2 years to gain the required information to evaluate the test. The primary purpose of the heating is to measure the response of the reservoir to heating (principally looking for the development of heater "hot spots"). Other important geomechanical and reservoir learnings are expected within the 2-year heating period.

An additional 2-year heating period may be requested to study the longer term heater performance in the resource.

5.5.1.3 Cooling Phase

Upon completion of the heating phase, the pyrolyzed zone will be allowed to cool naturally. It is expected that natural cooling will be sufficient for the ELHT because of the relatively small volume of rock being heated. The wells will not be abandoned until the temperature at the heaters is below 200 °F.

5.5.1.4 Coring Phase

Upon completion of the cooling phase, Shell will drill a core in the heat affected zone near heater one to assess recovery of sodium minerals as described in section 6B.2.2.

5.5.2 Development Methods

Shell has selected three specific intervals to be heated based on the geological features of each interval. Isolation between individual heated intervals and the water-bearing zones above the crown is ensured in the selection of the heated intervals and the modeling and geomechanical analysis. In selecting the intervals to be heated, the following criteria were considered:

1. Expected operating conditions (pressure and temperature)
2. Crown thickness and composition
3. Fracture generation potential during heating
4. Possible changes in the structural strength of the crown due to heating
5. Extent of temperature and pressure front propagation during heating
6. Static geomechanical conditions
7. Heating induced changes in geomechanical conditions.

The intervals to be heated were selected to test Shell's heating technology under different subsurface conditions (i.e., kerogen richness, nahcolite and other mineral concentration, and clay content). The goal is to assess the impact of different subsurface environments on heater performance and the temperature variation along the heated section.

The top heated section has a crown thickness (distance from dissolution surface) of 180 ft. To minimize production and temperature (and consequent pressure) rise, the heated sections are placed far apart from each other (more than 50 ft) such that there is no temperature superposition between the three heated zones.

Nahcolite ($NaHCO_3$) near the upper most heater will begin to convert above ~200 °F to soda ash (Na_2CO_3), with water (steam) and CO_2[2] being released as a result of the mineral decomposition. Initially, kerogen will swell as bitumen is generated during the early, lower temperature phase of pyrolysis. With further heating, kerogen conversion will release water, gas, and liquid hydrocarbons. The volume of nahcolite converted to soda ash along the uppermost heater is estimated to be approximately 1,200 to 1,500 tons. The soda ash will remain in place and could be recovered later. The lower two heaters will be located in intervals with only minor amounts of nahcolite being present. As such, the additional volume of nahcolite converted to soda ash in these intervals is considered to be insignificant.

The ELHT predictive reservoir modeling suggests the pyrolysis zone extends to about 2 ft around the individual heaters. Minimal production is expected. The average reservoir pressures in the heated zones will be below the fracture propagation pressure. In addition, the depth of the heaters (>2,220 ft) provides sufficient crown thickness (180 ft) for containment. Hence crown integrity risks are negligible for the ELHT prohect.

5.5.3 Production Monitoring

The heater wells and the observer/producer well will be instrumented with pressure gauges and temperature sensors. Progress of heating will be monitored by temperature sensors along each heater well. The heater package installed in each heater well consists of MI heater cables attached to an electric cable and instrumentation to measure the temperature along the heater conveyed downhole inside a metal canister. Heaters will be activated and controlled from surface with electrical power supplied via a high voltage substation.

During the ELHT oil production is estimated to be small in volume. The observer/producer will be equipped with an artificial lift system to remove accumulated liquids (oil and water). Produced liquids will be transferred by piping to a separator located at the East RDD. The volume of oil transferred from the ELHT to the East RDD will be monitored and recorded.

Conversion of nahcolite to soda ash and/or pyrolysis of the oil shale in the well will increase the pressure during the heating phase. Pressure will be controlled by the gas production rate. If reservoir pressures cannot be reduced by producing gases through the observer/producer well or the heater wells, the heaters will be shut in to prevent over pressure. If uncorrectable problems develop in observer/producer well, which would be an extreme condition, the heaters will be turned off. Such a condition should provide ample warning as the array of pressure and temperature sensors throughout the field provide real-time continuous monitoring of all portions of the heating and production systems.

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[2] Water in the form of Steam and CO_2 will report to the gas phase of the separator at the East RDD, at surface where steam will cool to water and CO_2 will be vented.

5.5.4 Water Consumption

The water demands of the ELHT are much lower than East RDD Pilot primarily because no leaching will be conducted at ELHT. For ELHT water will be consumed primarily for drilling which for the ELHT is expected to require 4,000 to 5,500 bbls of water.

The other water uses shown in Table 6A.2 (such as dust control, construction, and domestic purposes) will also provide coverage for the ELHT. The same water sources for the East RDD will be utilized at the EHLT. Drilling water will be provided from the White River and water used for cementing will be obtained from potable water supplies in the city of Meeker or other available sources.

6.0 RECLAMATION PLAN

Reclamation activities associated with the ELHT will generally follow the reclamation activities described for the East RDD project. Updates to reclamation plan specific to the ELHT are provided below.

6.1 Surface Reclamation Plan

Surface facilities associated with the East RDD Pilot and ELHT will be removed when no longer needed to support the reclamation efforts. All chemicals will be removed from the site and properly disposed. Any remaining product and wastes will be removed as well; wastes will be disposed off-site and product will be shipped for additional treatment. Storage tanks for waste and product will be triple rinsed prior to removal with the rinse water removed from the site and properly disposed. Facilities equipment will be removed for disposal or reuse, followed by demolition of buildings and other project-related structures. Concrete building foundations will be broken up and buried on-site to a minimum depth of 3 ft. below final surface grade. Rebar and demolished building materials will be hauled to a licensed landfill facility.

Following completion of demolition of the facilities, land reclamation will begin. Soils at the ELHT will be visually inspected for evidence of petroleum contamination and removed to licensed facilities if necessary. Existing sediment control structures will control erosion and contain runoff and sediment within the project area during reclamation. Using typical earthmoving equipment, the disturbed area will be regraded to blend into surrounding pre-construction contours. Earthmoving should be limited based upon the minimal amount of cut/fill work needed to establish the facilities areas during site development work. Regraded surfaces will be ripped to 18 inches depth to alleviate excess compaction and provide a better bond between regraded overburden and replaced topsoil.

Once disturbed areas have been regraded and ripped, soil material salvaged and stockpiled during site development will be evenly redistributed over disturbed areas. Redistributed soil will then be tested to determine if amendments are necessary to ensure successful establishment of planted species. Fertilizer and other appropriate amendments, if needed, will be applied after soil placement.

Following soil replacement work, disturbed areas associated with the ELHT will be revegetated with seed mixes recommended in the BLM Resource Management Plan modified based upon site-specific data obtained during the baseline vegetation survey consistent with those approved in the East RDD

NOI. To ensure the seed mixes are free of noxious weed species, Shell adheres to BLM Instruction Memorandum No. 2006-073 entitled "Weed-Free Seed Use on Lands Administered by the BLM". Seed material will be certified weed-free and purchased from and blended by qualified producers and dealers.

6.2 Subsurface Reclamation Plan

Upon completion of pyrolysis and recovery of liquid hydrocarbons, the pyrolyzed zone will be allowed to cool naturally. Subsurface reclamation for both the East RDD Pilot and the ELHT will be considered complete once the average temperature in the reservoir falls below 200 °F. Once cooled, a metal bridge plug will be placed in each well just above the pyrolyzed reservoir, and the wells will be cemented from the bridge plug to approximately 3 ft below the ultimate reclaimed ground surface. Well casings will then be cut 3 ft or more below final ground surface; monumented with a brass marker placed in the cement at the top, and covered with soil.

7.0 SITE SAFETY AND EMERGENCY PROCEDURES

Site Safety and Emergency Procedures in place for the East RDD will be utilized and incorporated as those described in Section 9 off the approved NOI.

8.0 OTHER ISSUES

No surface subsidence is expected from ELHT as there will be no leaching and minimal production/mass removal.

FIGURES

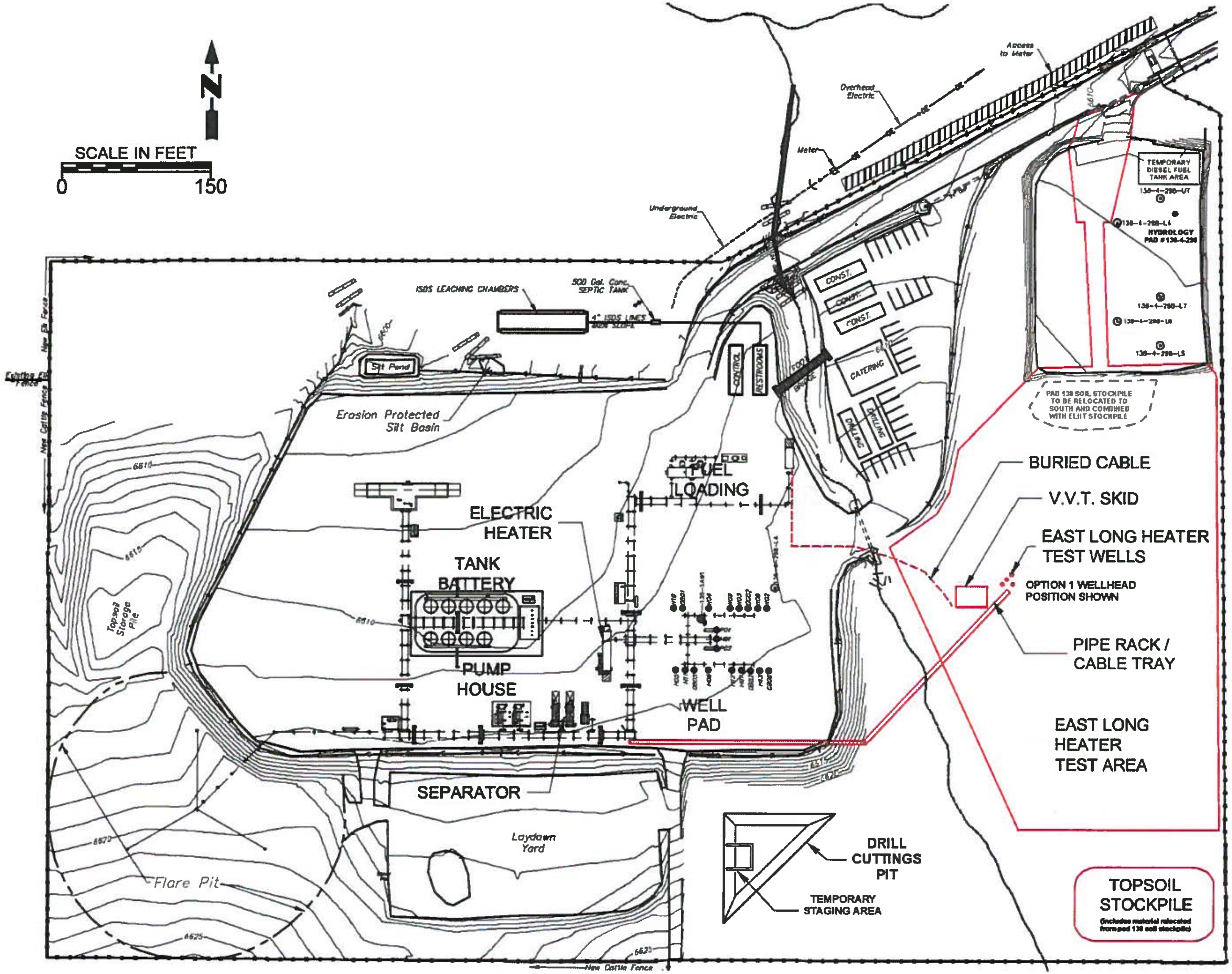


Figure 2a: ELHT Facilities Layout

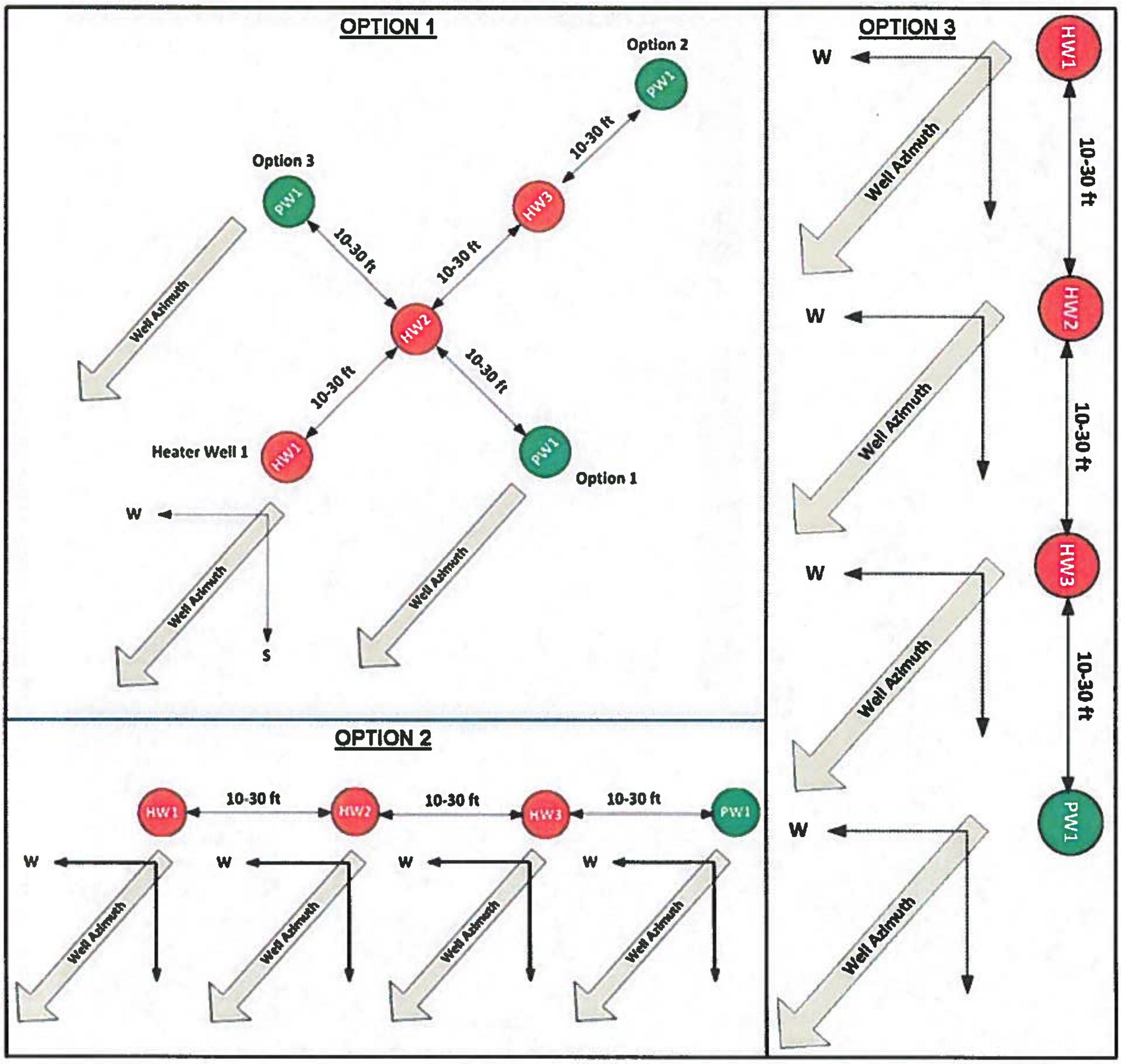


Figure 2b: ELHT Wellhead Position

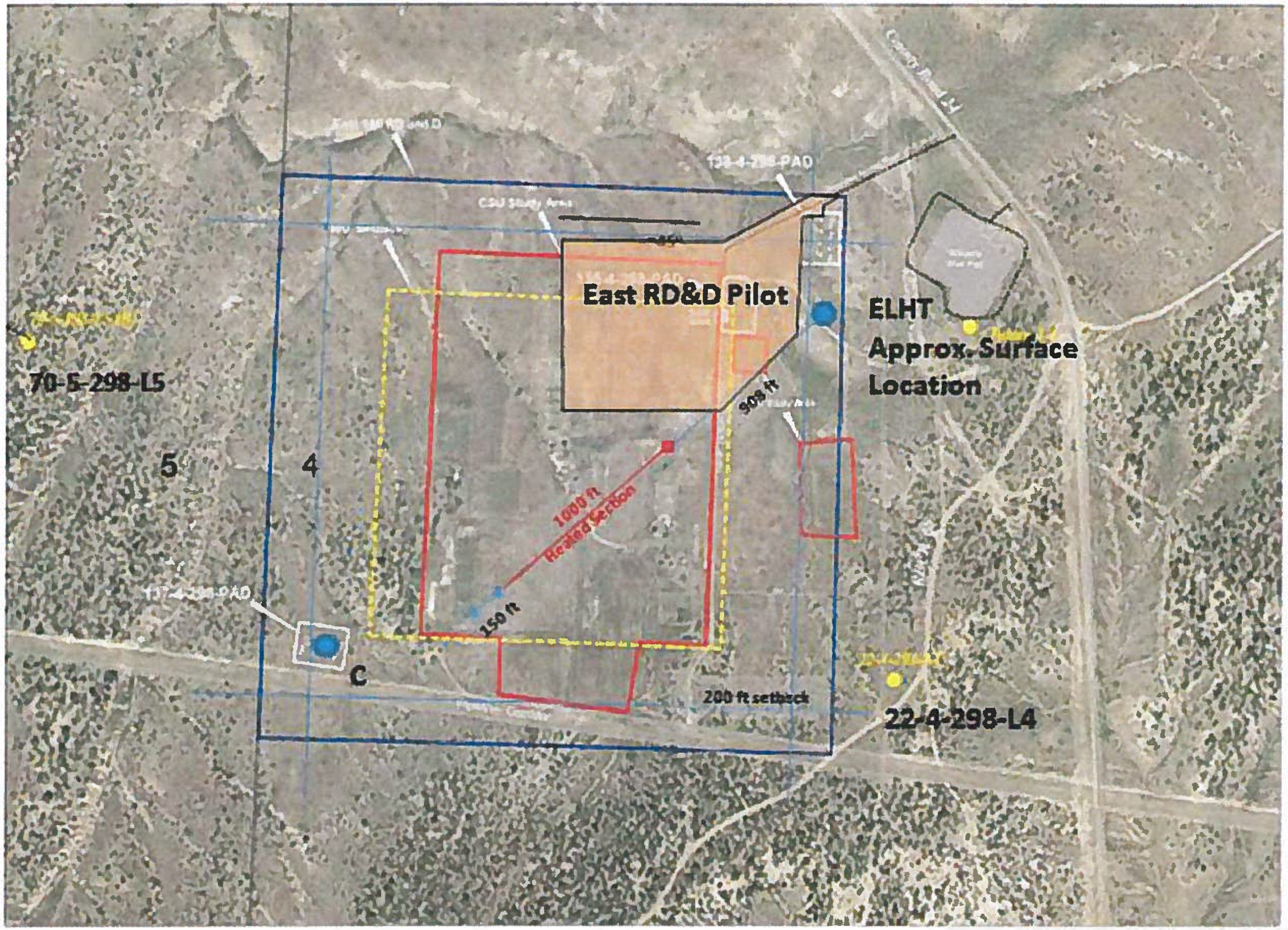


Figure 2c: Plan View of ELHT Well Trajectories

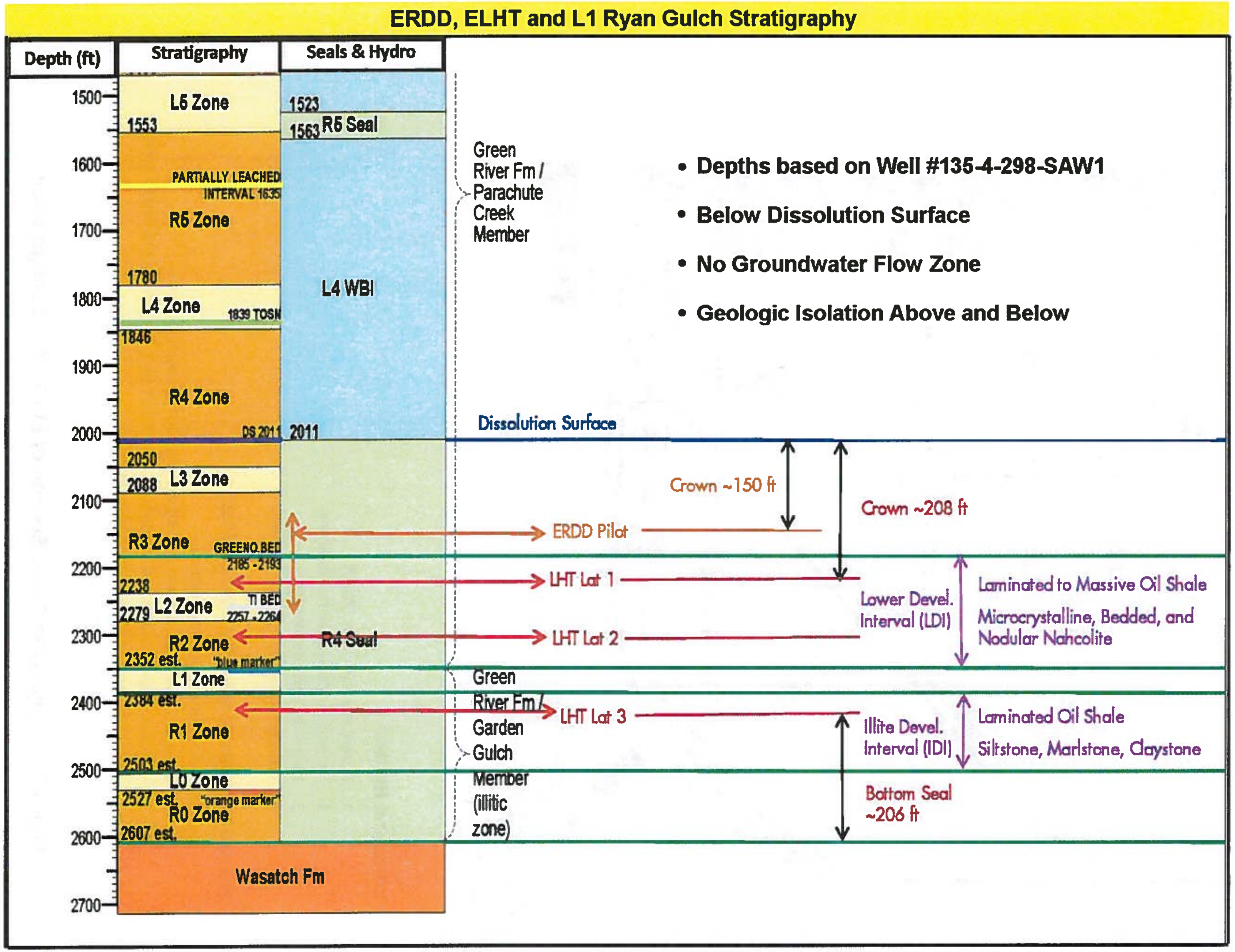
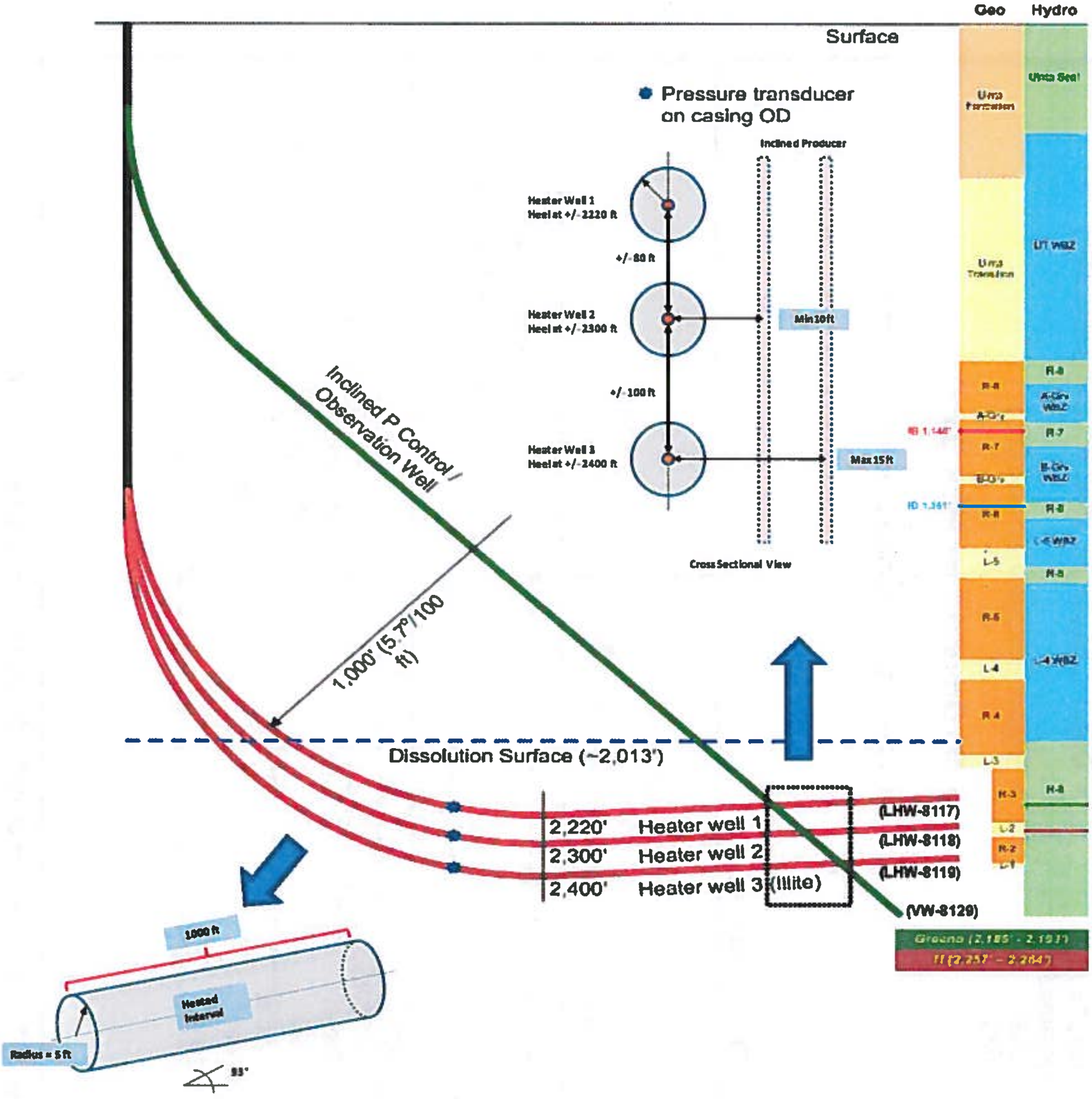


Figure 4: ERDD, ELHT and L1 Ryan Gulch Stratigraphic Cross Section



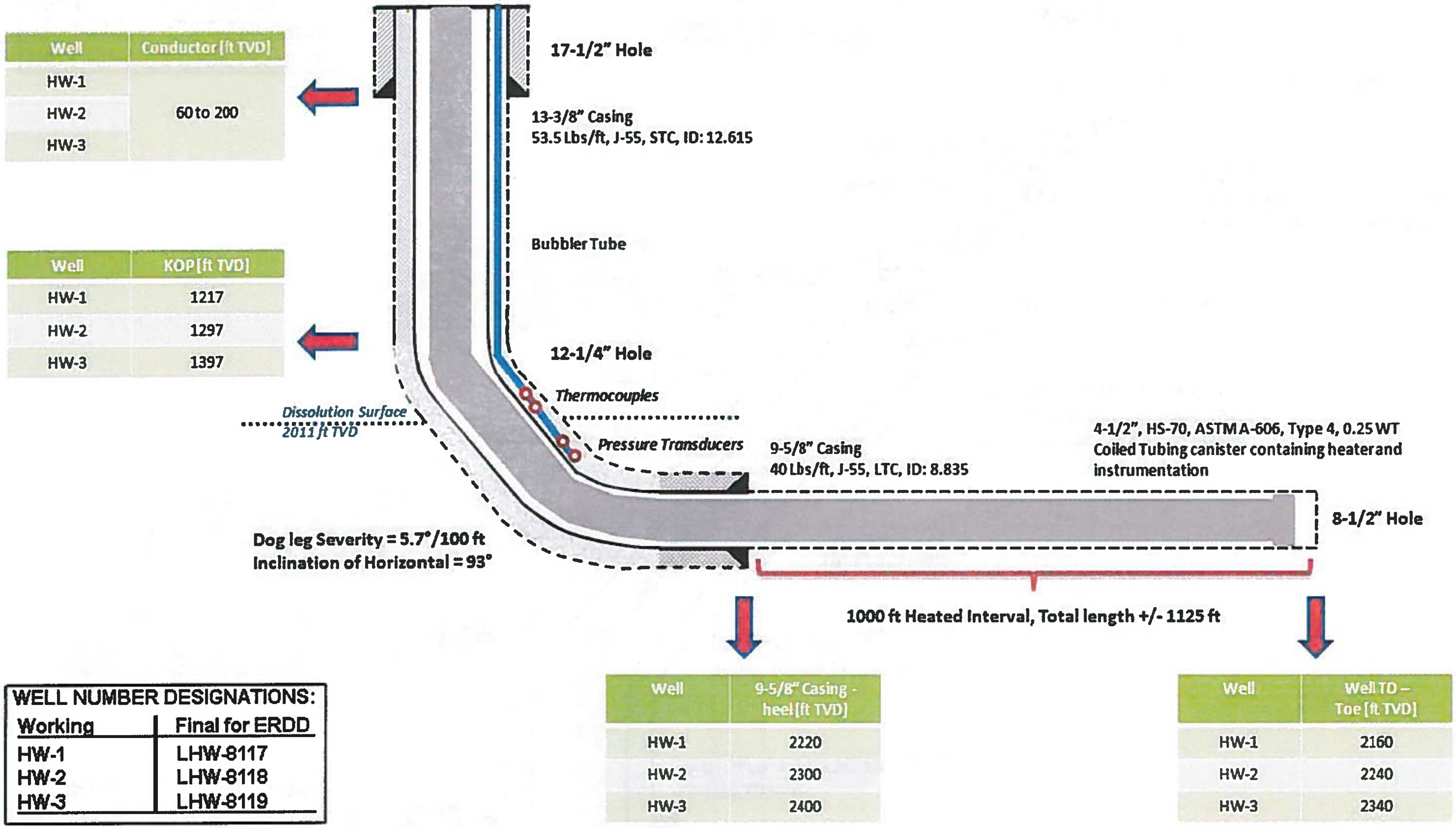
HORIZONTAL HEATERS:

1. Heated Interval length: 1000 ft.
2. Inclined 3° relative to horizontal plane.
3. Heel is deepest point in well.
4. Toe approximately 52 feet above heel.

INCLINED PRESSURE CONTROL / OBSERVATION WELL:

1. Inclined at 45° relative to vertical.
2. Distance between PC well and each Heater well: 10 ft (maximum: 15 ft).
3. Will pass deepest heater well at approximately 750 ft from the start of the heated section and 250 ft from the toe end of the heated section.

Figure 6: Schematic Cross-Section of ELHT Well Configuration



Well	Conductor [ft TVD]
HW-1	60 to 200
HW-2	
HW-3	

Well	KOP [ft TVD]
HW-1	1217
HW-2	1297
HW-3	1397

Well	9-5/8" Casing - heel [ft TVD]
HW-1	2220
HW-2	2300
HW-3	2400

Well	Well TD – Toe [ft TVD]
HW-1	2160
HW-2	2240
HW-3	2340

WELL NUMBER DESIGNATIONS:

Working	Final for ERDD
HW-1	LHW-8117
HW-2	LHW-8118
HW-3	LHW-8119

Figure 7: Schematic Diagram of an ELHT Heater Well.

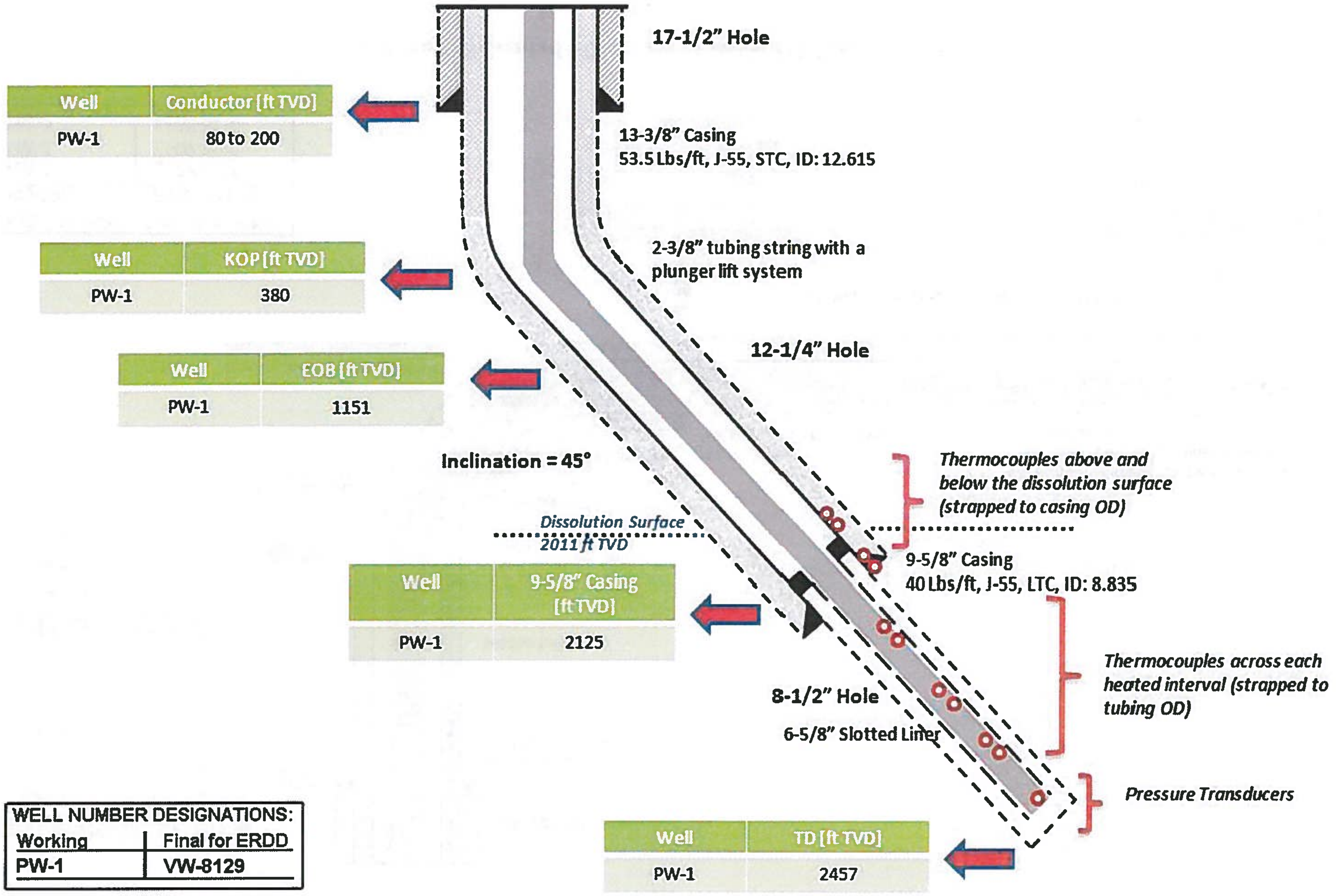


Figure 8: Schematic Diagram of the ELHT Inclined Observer / Producer Well.

TABLES

Shell Frontier Oil & Gas Inc.

TABLE 1 - FINANCIAL WARRANTY CALCULATION - EAST RDD NOI - MODIFICATION #3 - ELHT

COST SUMMARY

Site East RD&D Pilot Project **Date** March 5, 2013 **File** P-2010-026

Direct costs

Task No.	Description	Acres	Equipment	No. Units	Task Hours	Direct Cost
1	Structural demolition	na	Demo. crew	3	326.29	$242,044
2	Borehole P&A	na	Drill rig + crew	3	415.53	$1,256,870
3	Storm water pond backfill	na	Cat D8T - SU	3	1.87	$1,099
4	Site regrading	na	Cat D8T - SU	3	68.70	$40,298
5	Access road regrading	na	Cat D8T - SU	3	13.31	$7,809
6	Ripping	na	Cat D8T - SU	3	15.37	$9,335
7	Soil replacement	na	Cat 623G	2	40.31	$18,244
8a	Revegetation - Pinyon/Juniper ridgetop areas	3.91	Rev. crew	2	3.91	$14,055
8b	Revegetation - Mid-slope areas	9.82	Rev. crew	2	9.82	$32,117
8c	Revegetation - Upland drainage areas	1.63	Rev. crew	2	1.63	$4,861
9	Mobilization/demobilization	na	Transport rigs	27	4.00	$39,965
10	Subsurface reclamation	na	na	na	na	see below
	Totals:	15.36			900.75	$1,666,696

Indirect costs

Contractor's overhead & profit (O & P):

Liability insurance:	2.02%	of direct	$33,667
Performance bond:	1.55%	of direct	$25,834
Job superintendent:	per SUPERINTENDENT Tab		$24,045
Profit:	10.00%	of direct	$166,670
Reclamation contract amount (direct + O & P):	$1,916,911	Total O & P:	$250,215

Agency administrative costs:

CDRMS bond processing cost: - Corporate surety $500

Miscellaneous administrative costs:

Subsurface reclamation	per SUBSURFACE Tab	$544,109

DRMS Minerals Program project administration fee: 5% statutory $123,076

Total indirect costs: $917,900

Minimum required bond coverage Total: $2,584,596

Additional bond for future modifications 0.00% add-on Total: $0

Grand total bond amount $2,584,596

Table 2 - Chemicals and Fuels Used or Stored at ELHT

Name	Use	Location for Use	Location for Storage	Typical Quantities Used and/or Stored on Site	Disposal Location
M-I Gel (Bentonite)	Well drilling fluid additive	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Burial on-site
Safe-Scav HSW	Hydrogen sulfide scavenger	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Authorized disposal facility
Barite	Weighting agent	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Authorized disposal facility
Cement, standard	Used for zonal isolation and plugging	Drill pad	Bermed pad	Variable	Burial on-site
Gasoline	Fuel for light-duty vehicles	Drill pad	Non-leaking fuel tank on veicle	Capacity of vehicle fuel tank	NA - 100% of product consumed
Diesel Fuel	Fuel for drill rig, cement truck, water truck	Drill pad	Non-leaking fuel tank on vehicle	Capacity of vehicle fuel tank	NA - 100% of product consumed
Motor Oil	Lubricant for mobile equipment	Drill pad	Non-leaking reservoir on vehicle	Capacity of vehicle oil reservoir	Waste oil recycled
Engine Coolant	Engine coolant for mobile equipment	Drill pad	Non-leaking reservoir on vehicle	Capacity of vehicle engine radiator	Authorized disposal facility

Table 3 - ERDD / ELHT Water Quality Data - Drill Pad # 138-4-298 Monitoring Wells

Measured Concentrations of Select Constituents - Pad 138-4-298

WBI	Sample Date	As (mg/L)	Ba (mg/L)	B (mg/L)	Cl (mg/L)	F (mg/L)	SO$_4$ (mg/L)	TDS (mg/L)	pH[A] (standard units)
Uinta	3/10/2010	0.0065	0.026	0.12	8	0.4*	**310**	950	7.34
Uinta	6/8/2010	0.0034	0.027	0.13	9	0.3*	**320**	980	7.08
Uinta	8/18/2010	0.003	0.023	0.12	9	0.3*	**300**	1000	6.93
Uinta	11/10/2010	0.0017*	0.023	0.12	9	0.3*	**330**	710	7.31
L7	3/10/2010	0.0095	0.028	0.31	10	8.6	188	850	7.88
L7	6/8/2010	0.0054	0.029	0.31	11	**9.2**	175	840	7.54
L7	8/18/2010	0.0046	0.041	0.32	10	**9.1**	148	840	7.77
L7	11/9/2010	0.0034	0.027	0.31	12	**9.6**	163	830	7.78
L6	3/10/2010	**0.0493**	0.202	0.36	10	**18.5**	33	770	8.43
L6	6/8/2010	**0.0277**	0.200	0.37	11	**19.5**	20	710	8.14
L6	8/18/2010	**0.0199**	0.215	0.38	11	**19.5**	23	750	8.34
L6	11/9/2010	**0.0167**	0.205	0.38	14	**19.6**	25	760	8.36
L5	3/10/2010	<0.0005	0.228	0.32	9	**15.8**	<1	710	8.50
L5	6/8/2010	<0.0005	0.217	0.32	10	**16.1**	1*	700	8.22
L5	8/17/2010	<0.0005	0.221	0.32	9	**15.9**	1*	700	9.04
L5	11/9/2010	<0.01	0.008*	0.31	9	**16.2**	2	700	8.44
L4	11/10/2010	<0.01	**6.51**	**8.5**	**310**	55	<10	45000	7.61
Ground Water Standard		**0.01**	**2.0**	**5.0** [C]	**250**	**2**	**250**	**1.25 X Background**	**6.5 - 8.5**

Notes:

[A] Field measurement

[B] Specific conductivity not regulated

[C] Non-agriculture standard applicable due to absence of sensitive crops

Bold values exceed agriculture, drinking water, or domestic use ground water standards

* value < Practical Quantitation Limit and > Method Detection Limit

MSDS

MI SWACO

MATERIAL SAFETY DATA SHEET

MSDS NO. 12412 **Trade Name:** M-I GEL* **Revision Date:** 12/28/2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: M-I GEL*
Chemical Family: Mixture
Product Use: Oil well drilling fluid additive.
Emergency Telephone (24 hr.): 281-561-1600

Supplied by: M-I L.L.C.
P.O. Box 42842
Houston, TX 77242
www.miswaco.com
Telephone Number: 281-561-1512
Prepared by: Product Safety Group

Revision Number: 4

HMIS Rating

Health: 1* **Flammability:** 0 **Physical Hazard:** 0 **PPE:** E

HMIS Key: 4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview: Caution! May cause eye, skin, and respiratory tract irritation. Long term inhalation of particulates may cause lung damage. Cancer hazard. Contains crystalline silica which may cause cancer.

Canadian Classification:
UN PIN No: Not regulated. **WHMIS Class:** D2A

Physical State: Powder. **Odor** Odorless **Color:** Tan to grey

Potential Health Effects:

Acute Effects

Eye Contact: May cause mechanical irritation
Skin Contact: May cause mechanical irritation. Long term contact can cause skin dryness.
Inhalation: May cause mechanical irritation.
Ingestion: May cause gastric distress, nausea and vomiting if ingested.

Carcinogenicity & Chronic Effects: See Section 11 - Toxicological Information.
Routes of Exposure: Eyes. Dermal (skin) contact. Inhalation.
Target Organs/Medical Conditions Aggravated by Overexposure: Eyes. Skin. Respiratory System.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
Bentonite	1302-78-9	80 - 95	No comments.
Silica, crystalline, quartz	14808-60-7	2 - 15	No comments.
Gypsum (Calcium sulfate) (CAS 7778-18-9 also applies.)	13397-24-5	0 - 1	No comments.
Silica, crystalline, Tridymite	15468-32-3	0 - 1	No comments.

4. FIRST AID MEASURES

Eye Contact: Promptly wash eyes with lots of water while lifting eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

Skin Contact: Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if any discomfort continues.

Inhalation: Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion: Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.

General notes: Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C): NA
Flammable Limits in Air - Lower (%): NA
Flammable Limits in Air - Upper (%): NA
Autoignition Temperature: F (C): NA
Flammability Class: NA
Other Flammable Properties: ND
Extinguishing Media: This material is not combustible. Use extinguishing media appropriate for surrounding fire.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways.

Hazardous Combustion Products: Not determined.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.

Spill Procedures: Evacuate surrounding area, if necessary. Wet product may create a slipping hazard. Contain spilled material. Avoid the generation of dust. Sweep, vacuum, or shovel and place into closable container for disposal.

Environmental Precautions: Waste must be disposed of in accordance with federal, state and local laws. Do not allow to enter sewer or surface and subsurface waters.

7. HANDLING AND STORAGE

Handling: Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Avoid generating or breathing dust. Product is slippery if wet. Use only in a well ventilated area. Wash thoroughly after handling.

Storage: Store in dry, well-ventilated area. Keep container closed. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Bentonite	1302-78-9	80 - 95	NA	NA	NA	(1)
Silica, crystalline, quartz	14808-60-7	2 - 15	0.025 mg/m^3	see Table Z-3	NIOSH: 0.05 mg/m^3 TWA (10H day/40H wk)	(R)
Gypsum (Calcium sulfate) (CAS 7778-18-9 also applies.)	13397-24-5	0 - 1	10 mg/m^3	15 mg/m^3 (total); 5 mg/m^3 (respirable)	NA	None
Silica, crystalline, Tridymite	15468-32-3	0 - 1	0.05 mg/m^3	see Table Z-3	NA	(R)

Notes
(1) Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m^3 (Inhalable); 3 mg/m^3 (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m^3 (Total); 5 mg/m^3 (Respirable).
(R) Respirable fraction (ACGIH);
Table Z-3: PEL for Mineral Dusts containing crystalline silica are 10 mg/m^3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazards present and the risk of exposure to those hazards. The PPE recommendations below are based on our assessment of the chemical hazards associated with this product. The risk of exposure and need for respiratory protection will vary from workplace to workplace and should be assessed by the user.

Eye/Face Protection: Dust resistant safety goggles.

Skin Protection: Wear appropriate clothing to prevent repeated or prolonged skin contact. Chemical resistant gloves recommended for prolonged or repeated contact. Use protective gloves made of: Nitrile. Neoprene.

Respiratory Protection: All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent.

If exposed to airborne particles of this product use at least a NIOSH-approved N95 half-mask disposable or re-useable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or re-useable particulate respirator.

General Hygiene Considerations:	Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Tan to grey
Odor	Odorless
Physical State:	Powder.
pH:	ND
Specific Gravity (H2O = 1):	2.3 - 2.6
Solubility (Water):	Insoluble
Melting/Freezing Point:	ND
Boiling Point:	ND
Vapor Pressure:	NA
Vapor Density (Air=1):	NA
Evaporation Rate:	NA
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame.
Materials to Avoid:	ND.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.
Hazardous Polymerization:	Will not occur

11. TOXICOLOGICAL INFORMATION

Component Toxicological Data: Any adverse component toxicological effects are listed below. If no effects are listed, no such data were found.

Ingredient	Component Toxicological Summary
Silica, crystalline, quartz	Crystalline silica is the most widely occurring of all minerals. The most common form of silica is sand. The International Agency for Research on Cancer (IARC) has designated crystalline silica in the form of quartz or cristobalite a Group 1 (carcinogenic to humans). This designation was based on an increased risk of lung cancer among crystalline silica exposed workers. IARC did note that carcinogenicity of crystalline silica in humans was not detected in all industrial circumstances studied. Further, carcinogenicity of crystalline silica may be dependent on inherent characteristics of the crystalline silica or external factors affecting its biological activity or distribution of polymorphs. (IARC Vol. 68, 1997, p. 41). The National Toxicology Program (NTP) classifies crystalline silica as "reasonably anticipated to cause cancer in humans" (6th Annual Report on Carcinogens, 1991). Long term inhalation of crystalline silica can also result in the lung disease, silicosis. Symptoms of this disease include coughing and shortness of breath. (NJ HSFS, January 1996)

Product Toxicological Information:
Long term inhalation of particulate can cause irritation, inflammation and/or permanent injury to the lungs. Illnesses such as pneumoconiosis ("dusty lung"), pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma may develop.

12. ECOLOGICAL INFORMATION

Product Ecotoxicity Data:	Contact M-I Environmental Affairs Department for available product ecotoxicity data.

Biodegration:	ND
Bioaccumulation:	ND
Octanol/Water Partition Coefficient:	ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT Shipping Description:	Not regulated for transportation by DOT, TDG, IMDG, ICAO/IATA.
Canada TDG Shipping Description:	Not regulated.
UN PIN No:	Not regulated.
IMDG Shipping Description:	Not regulated.
ICAO/IATA Shipping Description:	Not regulated.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Delayed (chronic) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Silica, crystalline, quartz	---	---	---	X	---	---	---
Silica, crystalline, Tridymite	---	---	---	X	---	---	---

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Components are listed or exempt from listing.
European Union EINECS/ELINCS - Components are listed or exempt from listing.
Japan METI ENCS - Components are listed or exempt from listing.
Korea TCCL ECL - Components are listed or exempt from listing.
Philippine PICCS - Components are listed or exempt from listing.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: D2A

16. OTHER INFORMATION

The following sections have been revised: 1, 8, 16

NA - Not Applicable, ND - Not Determined.

*A mark of M-I L.L.C.

Disclaimer:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MI SWACO
A Schlumberger Company

MATERIAL SAFETY DATA SHEET

MSDS No. 12308 **Trade Name:** SAFE-SCAV* HSW **Revision Date:** 05/03/2011

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name:	SAFE-SCAV* HSW
Chemical Family:	Mixture
Product Use:	Drilling fluid additive. Sulfide scavenger.
Supplied by:	M-I L.L.C. P.O. Box 42842 Houston, TX 77242 www.miswaco.slb.com
Telephone Number:	281-561-1511
Emergency Telephone (24 hr.):	281-561-1600
Prepared by:	Product Safety Group
Revision No.	5

HMIS Rating
Health: 3 **Flammability:** 2 **Physical Hazard:** 0 **PPE:** X

4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview:	Danger! Combustible liquid and vapor. May cause severe eye, skin and respiratory tract irritation. Prolonged contact may damage eye. May cause skin sensitization, an allergic reaction, on repeated exposure. May be harmful if absorbed through skin. May be toxic if inhaled. Vapors or mists may cause central nervous system (CNS) effects if inhaled.

Canadian Classification:
UN PIN No: UN2929 **WHMIS Class:** B3 D1A D2B

Physical State: Liquid **Color:** Amber **Odor:** Amine

Potential Health Effects:
Acute Effects

Eye Contact:	May cause severe eye irritation. Prolonged contact may damage eye.
Skin Contact:	May cause severe skin irritation. May cause skin sensitization, an allergic reaction, on repeated exposure. May be harmful if absorbed through skin. Prolonged or repeated contact may cause defatting of the skin and/or dermatitis (inflammation).
Inhalation:	May be toxic if inhaled. May cause severe respiratory irritation. May cause central nervous system (CNS) effects.
Ingestion:	May cause severe irritation of the mouth, throat, and stomach.

Carcinogenicity & Chronic Effects:	See Section 11 - Toxicological Information.
Routes of Exposure:	Eyes. Dermal (skin) contact. Dermal (skin) absorption. Inhalation.

Target Organs/Medical Conditions Aggravated by Overexposure:	Eyes. Skin. Respiratory System. Central Nervous System (CNS). Liver. Kidney. Gastrointestinal Tract.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	30-60	No comments.
Methyl alcohol	67-56-1	5-10	No comments.
Ethanolamine	141-43-5	1-5	No comments.

Composition Comments:	Component LD50 and LC50 values are provided in Section 11, if available.

4. FIRST AID MEASURES

Eye Contact:	Immediately flush eyes with large amounts of water. Look for and remove contact lenses. Continue to rinse for at least 15 minutes. Seek immediate medical attention.
Skin Contact:	Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. If irritation persists or signs of toxicity occur, seek medical attention.
Inhalation:	Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek immediate medical attention
Ingestion:	Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.
General notes:	Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C):	125F (51C)
Flash Point Method:	SFCC
Flammable Limits in Air - Lower (%):	ND
Flammable Limits in Air - Upper (%):	ND
Autoignition Temperature: F (C):	ND
Explosion Data - Sensitivity to Mechanical Impact:	NA
Explosion Data - Sensitivity to Static Discharge:	If applicable, information is provided in Section 5 Special Fire-Fighting Procedures, Other Flammable Properties and Section 6 Spill Procedures.
Flammability Class:	II
Extinguishing Media:	Water fog, carbon dioxide, foam, dry chemical.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways. Note that flammable vapors may form an ignitable mixture with air. Vapors may travel considerable distances and flash back if ignited.

Hazardous Combustion Products: Formaldehyde. Oxides of carbon and nitrogen.

Conditions of Flammability: Products are classified as flammable/combustible based on flash point as defined in the Health Canada Controlled Products Regulations, U.S. Occupational Health and Safety Administration Hazard Communication Standard and transportation regulations. See Sections 1, 2, 5, 14 and 15 for flammable/combustible classification information. Flammable/combustible materials may ignite and burn if exposed to a flame or other sources of ignition.
Other Flammable Properties: ND

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protective equipment identified in Section 8.

Spill Procedures: Evacuate surrounding area, if necessary. Keep personnel removed and upwind of spill. Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Shut off leak if it can be done safely. Contain spilled material. Do not allow spilled material to enter sewers, storm drains or surface waters. Absorb in vermiculite, dry sand or earth. Place into containers for disposal. Use non-sparking or explosion proof means to transfer material to containers. Note that flammable/combustible vapors may form an ignitable mixture with air. Vapors may travel considerable distances from spill and flash back, if ignited.

Environmental Precautions: Waste must be disposed of in accordance with federal, state and local laws. In the U.S., for products with reportable quanitity (RQ) components - if the RQ is exceeded, report to National Spill Response Office at 1 800 424 8802.

7. HANDLING AND STORAGE

Handling: Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Do not inhale vapors. Use only in a well ventilated area. Ground and bond containers when transferring material. Wash thoroughly after handling.

Storage: Store in dry, well-ventilated area. Keep container closed. Keep away from heat, sparks and flames. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	30-60	NA	NA	NA	None

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Methyl alcohol	67-56-1	5-10	200 ppm; 250 ppm (STEL)	200 ppm; 260 mg/m^3	6000 ppm IDLH (NIOSH)	(skin)
Ethanolamine	141-43-5	1-5	3 ppm; 6 ppm (STEL)	3 ppm	30 ppm IDLH (NIOSH)	None

Notes
(skin) Potential for cutaneous absorption.

Engineering Controls: Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazards present and the risk of exposure to those hazards. The PPE recommendations below are based on our assessment of the chemical hazards associated with this product. The risk of exposure and need for respiratory protection will vary from workplace to workplace and should be assessed by the user.

Eye/Face Protection: Wear chemical safety goggles.

Skin Protection: Wear appropriate clothing to prevent repeated or prolonged skin contact. Wear chemical resistant gloves such as nitrile or neoprene.

Respiratory Protection: All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent.

A NIOSH/MSHA approved supplied air respirator is recommended if airborne concentrations exceed exposure limits for components.

General Hygiene Considerations: Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Amber
Odor:	Amine
Physical State:	Liquid
pH:	10 - 11.5 (5% in IPA/water)
Specific Gravity (H2O = 1):	1.068 - 1.08 at 60F (16C)
Solubility (Water):	Soluble
Flash Point: F (C):	125F (51C)
Melting/Freezing Point:	ND
Boiling Point:	ND
Pour Point:	-35F (-37C)
Viscosity:	17 - 18 cps at 60F (16C)
Vapor Pressure:	51.7 mm Hg at 100F (38C)
Vapor Density (Air=1):	>1
Evaporation Rate:	ND
Octanol/Water Partition Coefficient:	ND
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame.
Materials to Avoid:	Acids. Bases. Oxidizers.
Conditions of Reactivity:	See Conditions and Materials to Avoid, if applicable.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.
Hazardous Polymerization	Will not occur

11. TOXICOLOGICAL INFORMATION

Acute Exposure Effects, Irritation and Sensitization: See Section 2.
Chronic, Carcinogenicity, Reproductive Toxicity, Teratogenicity, Embryotoxicity, Mutagenicity Effects: See Component Toxicological Summary and Product Toxicological Information, if available.
Synergistic Products/Effects: ND

Component Toxicological Data: Any adverse component toxicological effects and acute toxicity values (LD50s, LC50s) are listed below. If no effects or acute values are listed for components, no such data were identified.

Ingredient	CAS No.	Acute Data
2, 2',2''-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	Oral LD50 : 763 mg/kg (rat) Dermal LD50 : >2000 mg/kg (rabbit); Inhalation LC50: 0.371 mg/l/4H (rat)
Methyl alcohol	67-56-1	Oral LD 50: 5682 mg/kg (rat); Dermal LD50: 15,800 mg/kg (rabbit); Inhalation LC50: 64,000 ppm/4H (rat)
Ethanolamine	141-43-5	Oral LD50: 1070 - 1190 mg/kg (rat); Dermal LD50: 2460 - 2830 mg/kg (rabbit)

Ingredient	Component Toxicological Summary
Methyl alcohol	Long term exposure to high concentrations of methanol via inhalation or skin absorption may cause adverse effects to vision, e.g., sensitivity to light or blurred vision. (HSDB) Repeated exposure to airborne concentrations of methanol in the range of 200 - 375 ppm have been associated with headaches. (Hazardtext) Inhalation of methanol vapors by female rats exposed during pregnancy caused fetotoxic effects at 10,000 ppm and birth defects at 20,000 ppm. These doses also caused maternal toxicity. Fetotoxic effects were observed in the offspring of female rats fed 20 - 35 g/kg methanol during pregnancy. These doses were also maternally toxic. (Vendor MSDS) Methanol is toxic to humans if ingested in amounts as small as 0.25 ml/kg of body weight. Ingestion of methanol can cause blindness and death in humans.
Ethanolamine	Adverse effects to the nasal tract, lungs, liver and kidney were noted in studies in which rats, guinea pigs and dogs were exposed to </= 102 ppm f this alkanolamine via inhalation for 3.5 to 13 weeks. Liver and kidney effects were also observed in rats exposed to </= 160 ppm this chemical by inhalation for 6 months. In a 4 week dietary study in rats, liver and kidney effects were observed at 640 mg/kg/day of this alkanolamine. (Vendor MSDS)

Product Toxicological Information: This product may contain or release trace amounts of formaldehyde. The U.S. Occupational Safety and Health Administration (OSHA) considers formaldehyde a suspect human carcinogen that is linked to nasal and lung cancer. OSHA specifically regulates formaldehyde under 29 CFR 1910.1048. The International Agency for Research on Cancer (IARC) has classified formaldehyde as a Group 1 carcinogen (carcinogenic to humans). The National Toxicology Program (NTP) considers formaldehyde to be reasonably anticipated to be a human carcinogen. Formaldehyde has caused genetic changes in in vitro and in vivo tests. (NTP) Exposure to formaldehyde has been linked to adverse reproductive effects in some human and animal studies. In other reproductive studies, however, no adverse effects were noted. (Meditext)
Formaldehyde may also cause skin and respiratory sensitization (allergic reaction).

12. ECOLOGICAL INFORMATION

Component Ecotoxicity Data: Component ecotoxicity data are listed below. If no data are listed, none were found in the component review.

Ingredient	CAS No.	Data
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	EC50 15M: 28.9 mg/l (Photobacterium phosphoreum)
Methyl alcohol	67-56-1	LC50 96H: 29,400 mg/l (fathead minnow - 24 days old); LC50 96H: 13 mg/l (rainbow trout - fingerling); LC50 48H: 8000 mg/l (trout); EC50 5M: 43 g/l (Photobacterium phosphoreum)
Ethanolamine	141-43-5	LC50 48H: 33 - 93 mg/l (Daphnia); LC50 96H: 125 - 206 mg/l (fathead minnow); LC50 96H: 170.0 mg/l (goldfish); EC50 30M: 13.7 mg/l (Photobacterium phosphoreum)

Product Ecotoxicity Data:	LC50 96H: 64 mg/l (fathead minnow); LC50 96H: 180 mg/l (sheepshead minnow)
Biodegration:	ND
Bioaccumulation:	ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT

Shipping Description:	UN2929, Toxic liquids, flammable, organic, n.o.s., (contains 2, 2',2"-(hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol, methyl alcohol), Class 6.1, (3), PG II.
Product (RQ):	6944 gallons (methanol)
Emergency Response Guide No.:	131
Canada TDG Shipping Description:	See U.S. Shipping Description.

UN PIN No:	UN2929
IMDG Shipping Description:	See U.S. Shipping Description.
ICAO/IATA Shipping Description:	See U.S. Shipping Description.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Fire hazard. Immediate (acute) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Methyl alcohol	---	1.0%	5000 lb (2270 kg)	---	---	---	---

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Components are listed or exempt from listing.
European Union EINECS/ELINCS - Components are listed or exempt from listing.
Japan METI ENCS - Components are listed or exempt from listing.
Korea TCCL ECL - Components are listed or exempt from listing.
New Zealand - Components are listed or exempt from listing.
Philippine PICCS - Components are listed or exempt from listing.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: B3 D1A D2B

16. OTHER INFORMATION

The following sections have been revised: 1, 2, 3, 4, 7, 8, 10, 11, 12, 14, 15, 16. Format changes.

NA - Not Applicable, ND - Not Determined.

Disclaimer:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
BARITE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: BARITE

OTHER NAME: Barium sulfate

APPLICATIONS: Drilling Fluid densifier

EMERGENCY TELEPHONE: 800-438-7436 (800 GETS GEO)

SUPPLIER:
Supplied by Industrial Minerals Company
A Business Unit of GEO Drilling Fluids, Inc.
1431 Union Ave. Bakersfield, California, 93305

TELEPHONE: 661-325-5919
FAX: 661-325-5648

CONTACT PERSON: Andy Philips – Safety Officer

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	4-6 %		
Barite	7727-43-7	91-93 %		
Mica	12001-26-2	1-5 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. This product is a/an transparent tan to powder. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:

HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION:	May be irritating to the respiratory tract if inhaled.
INGESTION:	May cause gastric distress, nausea and vomiting if ingested.
SKIN:	May be irritating to the skin.
EYES:	May be irritating to the eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:

Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (?F):	N/D
FLAMMABILITY LIMIT - LOWER(%):	N/D
FLAMMABILITY LIMIT - UPPER(%):	N/D

EXTINGUISHING MEDIA:

This material is not combustible. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES:

No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:

No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS: This material is not combustible.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

INGREDIENT NAME:	CAS No.:	OSHA PEL: TWA: STEL:	ACGIH TLV: TWA: STEL:	OTHER: TWA: STEL:	UNITS:
Silica, crystalline, quartz	14808-60-7	*	0.1		mg/m^3 resp.dust
Barite	7727-43-7	15	10		mg/m^3 total dust
Mica	12001-26-2	20 mppcf *	3		mg/m^3 total dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite. * mppcf = millions of particles per cubic foot of air.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION:

Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS:

Use at least a NIOSH-approved N95 half-mask disposable or reusable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reusable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:

Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	Tan to Grey.
ODOR:	Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION:	Insoluble in water.
MELT./FREEZ. POINT (?F, interval):	2876
DENSITY/SPECIFIC GRAVITY (g/ml):	4.20 - 4.25 TEMPERATURE (?F): 68
BULK DENSITY:	107 - 135 lb/cu ft; 1714 - 2163 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (?F):

10. STABILITY AND REACTIVITY

STABILITY:	Normally stable.
CONDITIONS TO AVOID:	N/A.
HAZARDOUS POLYMERIZATION:	Will not polymerize.
POLYMERIZATION DESCRIPTION:	Not relevant.
MATERIALS TO AVOID:	N/A
HAZARDOUS DECOMPOSITION PRODUCTS:	

No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:

No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ACUTE AQUATIC TOXICITY:

This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:

This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ:	N/A
U.S. DOT:	
U.S. DOT CLASS:	Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	**CAS No:**	**TSCA:**	**CERCLA:**	**SARA 302:**	**SARA 313:**	**DSL(CAN):**
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Barite	7727-43-7	Yes	No	No	No	Yes
Mica	12001-26-2	Yes	No	No	No	Yes

REPARED BY:	Andy Philips
REVISION No.:	July 10, 2006

MSDS STATUS: Approved.
DATE: July 10, 2006
DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

Holcim

MATERIAL SAFETY DATA SHEET

Material: Portland Cement

Section I - Identification

Supplier: **Name:** **Holcim (US) Inc.** **Address:** **6211 N. Ann Arbor Road** **Dundee, MI 48131** **Telephone:** **800-854-4656**	**Emergency Contact Information: (CHEMTREC)** **Health 1-800-424-9300** **Transportation 1-800-424-9300**
Product Codes: Portland Cement Type I, IA, II, III, IV, V, White Cement. CSA Type 10, 20, 30, 40, & 50. This MSDS covers many products. Individual constituents will vary.	**Formula:** This product consists of finely ground Portland cement clinker mixed with a small amount of calcium sulfate (gypsum).
Chemical Family: Chemical compounds. Calcium silicate components and other calcium compounds containing iron and aluminum make up the majority of this product.	**Chemical Name and Synonyms:** Portland cement. Portland cement is also known as hydraulic cement.

Section II - Components

Hazardous Ingredients

Component (%)	CAS No.	OSHA PEL (8-hour TWA)	ACGIH TLV-TWA (2002)
Tri-calcium silicate (20-70)	12168-85-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Di-calcium silicate (10-60)	10034-77-2	see Nuisance Dust PEL	see Nuisance Dust TLV
Tetra-calcium- alumino-ferrrite (5-15)	12068-35-8	see Nuisance Dust PEL	see Nuisance Dust TLV
Calcium sulfate (2-10)	---	see Nuisance Dust PEL	see Nuisance Dust TLV
Tri-calcium Aluminate (1-15)	12042-78-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Magnesium oxide (0-4)	1309-48-4	see Nuisance Dust PEL	see Nuisance Dust TLV
Nuisance Dusts	---	15 mg/m^3 (total dust); 5 mg/m^3 (respirable dust)	10 mg/m^3 (total dust); 3 mg/m^3 (respirable dust)
Crystalline Silica (Quartz) * (0-1%)	14808-60-7	10 mg/m^3 /percent silica + 2 (respirable dust) 30 mg total dust/m^3/percent silica + 2 (total dust)	0.10 mg/m^3
Hexavalent Chromium (measured as chromic acid and chromates)	18540-29-9	(100 mg/m3)	

Trace constituents: Portland Cement has a variable composition depending upon the cementitious products produced in the cement kiln. Small amounts of naturally occurring, but potentially harmful, chemical compounds might be detected during chemical analysis. These trace compounds might include free crystalline silica, potassium and sodium compounds; heavy metals including cadmium, chromium, nickel and lead; and organic compounds. Other trace constituents may include calcium oxide (also known as free lime or quick lime) .

Section III – Hazards Identification

Emergency Overview

Portland cement is a light gray powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure to wet portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns or an allegoric reaction. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement.

Potential Health Effects

- *Relevant Routes of Exposure:* Eye contact, skin contact, inhalation, and ingestion
- *Effects resulting from eye contact:* Exposure to airborne dust may cause immediate or delayed irritation or inflammation.

Eye contact with larger amounts of dry powder or splashes of wet Portland cement may cause effects ranging from moderate eye irritation to chemical burns and blindness. Such exposures require immediate first aid (see section IV) and medical attention to prevent significant damage to the eye.

- *Effects resulting from skin contact:* Discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly contact with wet cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred. Exposure to dry Portland cement may cause drying of the skin with consequent mild irritation or more significant effects attributable to aggravation of other conditions. Dry portland cement contacting wet skin or exposure to moist or wet portland cement may cause more severe skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (caustic) chemical burns. Some individuals may exhibit an allergic response (e.g., allergic contact dermatitis) upon exposure to portland cement, possibly due to trace amounts of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with the product. Other persons may experience this effect after years of contact with portland cement products.
- *Effects resulting from inhalation:* Portland cement contains small amounts of free crystalline silica. Prolonged exposure to respirable free crystalline silica can aggravate other lung conditions and cause silicosis, a disabling and potentially fatal lung disease and/or other diseases. Risk of injury or disease depends on duration and degree of exposure. (Also see "Carcinogenic potential" below.) Exposure to Portland cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.
- *Effects resulting from ingestion:* Although small quantities of dust are not known to be harmful, ill effects are possible if larger quantities are consumed. Portland cement should not be eaten.
- *Carcinogenic potential: NTP, OSHA, or IARC has not listed Portland cement as a carcinogen.* It may, however, contain trace amounts of substances listed as carcinogens by these organizations. Crystalline silica, which is present in Portland cement in small amounts, has been listed by IARC and NTP as a known human carcinogen (Group I) through inhalation. Hexavelant chromium is listed by IARC, EPA, NTP and OSHA as Group I known carcinogen by inhalation.
- *Medical conditions which may be aggravated by inhalation or dermal exposure*:
  - Pre-existing upper respiratory and lung diseases
  - Unusual (hyper) sensitivity to hexavalent chromium (chromium^{+6}) salts.

Section IV - First Aid

Eyes: Immediately flush eyes thoroughly with water. Continue flushing eye for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.

Skin: Wash skin with cool water and pH-neutral soap or a mild detergent. Seek medical treatment in all cases of prolonged exposure to wet cement, wet cement mixtures, wet concrete liquids from fresh cement products, or prolonged wet skin exposure to dry cement.

Inhalation of Airborne Dust: Remove to fresh air. Seek medical help if coughing or other symptoms do not subside. (Inhalation of gross amounts of portland cement requires immediate medical attention.)

Ingestion: Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section V - Fire & Explosion Data

Flash point:	*None*	Auto ignition temperature:	*Not Combustible*
Lower Explosive Limit:	*None*	Upper Explosive Limit:	*None*
Extinguishing media:	*Not Combustible*	Unusual fire & explosion hazards	*None*
Hazardous combustion products:	*None*		

Special fire fighting procedures: None. (Although portland cement poses no fire-related hazards, a self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.)

Section VI - Accidental Release Measures

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section VIII.

Scrape up wet material and place in an appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash portland cement down drains.

Dispose of waste material according to local, state, and federal regulations.

Section VII - Handling & Storage

Keep portland cement dry until used. Normal temperatures and pressures do not affect the material. Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixtures or fluids.

Section VIII - Exposure Control/Personal Protection

Skin Protection: Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened wet portland cement products. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened portland cement products might occur, wear impervious clothing and gloves to prevent skin contact. Where required, wear sturdy boots that are impervious to water to eliminate foot and ankle exposure. Do not rely on barrier creams; barrier creams should not be used in place of impervious gloves and clothing. Periodically wash areas contacted by dry portland cement or wet cement or concrete with a pH neutral soap. Wash again at the end of the work. If irritation occurs, immediately wash the affected area and seek treatment. If clothing becomes saturated with wet concrete, it should be removed and replaced with clean, dry clothing.

Respiratory protection: Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits. Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. (Advisory: Respirators and filters purchased after July 10, 1998, must be certified under 42 CFR 84.)

Ventilation: Use local exhaust or general dilution ventilation to control exposure within applicable limits.

Eye Protection: In conditions where user may be exposed to splashes or puffs of cement, wear safety glasses with side shields or goggles. In extremely dusty or unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with portland cement or fresh cement products.

Section IX - Physical & Chemical Properties

Appearance:	*Gray or white powder*	Vapor Pressure:	*Not applicable*
Odor:	*No distinct odor*	Vapor density:	*Not applicable*
Physical state:	*Solid (powder)*	Boiling point:	*Not applicable (i.e., > 1000 °C)*
pH (in water):	*12 to 13*	Melting point:	*Not applicable*
Solubility in water:	*Slightly (0.1 to 1.0%)*	Specific gravity (H_2O = 1.0):	*3.15*
Evaporation Rate:	*Not applicable*		

Section X - Stability & Reactivity

Stability: *Stable.*
Incompatibility: *Wet portland cement is alkaline. As such it is incompatible with acids, ammonium salts, and aluminum metal.*
Conditions to avoid: *Unintentional contact with water.*
Hazardous decomposition: *Will not spontaneously occur. Adding water produces (caustic) calcium hydroxide as a result of hydration.*
Hazardous polymerization: *Will not occur.*

Section XI - Toxicological Information

For a description of available, more detailed toxicological information, contact Holcim (US) Inc. (in Section I).

Section XII - Ecological Information

Ecotoxicity: *No recognized unusual toxicity to plants or animals*
Relevant physical and chemical properties: *See Sections IX & X*

Section XIII - Disposal

Dispose of waste material according to local, state, and federal regulations. (Since portland cement is stable, uncontaminated material may be saved for future use.) Dispose of bags in an approved landfill or incinerator.

Section XIV - Transportation Data

Hazardous materials description/proper shipping name: *Portland cement is not hazardous under U.S. Department of Transportation (DOT) regulations*
Hazard class: *Not applicable*
Identification class: *Not applicable*
Required label text: *Not applicable*
Hazardous substances/reportable quantities (RQ): *Not applicable*

Section XV - Other Regulatory Information

Status under USDOL-OSHA Hazard Communication Rule, 29 CFR 1910.1200:	*Portland cement is considered a "hazardous chemical" under this regulation, and should be part of any hazard communication program.*
Status under CERCLA/Superfund, 40 CFR 117 and 302:	*Not listed.*
Hazard Category under SARA (Title III), Sections 311 & 312:	*Portland cement qualifies as a "hazardous substance" with delayed health effects.*
Status under SARA (Title III) Section 313:	*Not subject to reporting requirements under section 313.*
Status under TSCA (as of May 1997):	*Some substances in portland cement are on the TSCA inventory list.*
Status under the Federal Hazardous Substances Act:	*Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.*
Status under California Proposition 65:	*WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.*
Status under Canadian Environmental Protection Act:	*Not listed.*
Workplace Hazardous Material Information System (Canada):	*Portland cement is considered to be a hazardous material under the Hazardous Product Act as defined by the Controlled Products Regulations (Class E - Corrosive Material) and is therefore subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).*

Section XVI - Other Information

Approved by: Susan Diehl, Vice President
Revision Date: February 9, 2005

Other Important Information: Portland cement should only be used by knowledgeable persons. While the information provided in the material safety data sheet is believed to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot anticipate and provide all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

A key to using the product safely requires the user to recognize that portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is, those present while a portland cement product is "setting") pose a more severe hazard than does portland cement itself. These hazards include potential injuries to eyes and skin.

The data furnished in this sheet do not address hazards that may be posed by other materials mixed with portland cement to produce portland cement products. Users should review other relevant material safety data sheets before working with this portland cement or with portland cement products, including, for example, portland cement concrete.

SELLER MAKES NO WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THERE OF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HOLCIM (US) INC., EXCEPT THAT THE PRODUCT SHALL CONFORM TO CONTRACTED SPECIFICATIONS.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732)750-6000
MSDS Internet Website	www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 "Low Expansion Foam - 1994 Edition."

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******
******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	**TWA (ppm)**	**STEL (ppm)**	**Note**
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O):	Non-oxygenated gasoline - negligible (< 0.1% @ 77 °F). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 °F); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Guinea pig sensitization: negative
Acute Oral LD50 (rat): 18.75 ml/kg
Draize eye irritation (rabbits): non-irritating

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity:OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name : **Shell Diesel**
Recommended Uses : Fuel for on-road diesel-powered engines.

Product Code : 002D1791

Manufacturer/Supplier : **The Shell Company of Australia Limited**
(ABN 46 004 610 459)
8 Redfern Road
Hawthorn East
Victoria 3123
Australia
Telephone : +61 (0)3 9666 5444
Fax : +61 (0)3 8823 4800

Emergency Telephone Number : 1800 651 818 (within Australia only) +61 3 9663 2130 (International)

2. HAZARDS IDENTIFICATION

HAZARDOUS SUBSTANCE. NON-DANGEROUS GOODS.
Classified as hazardous according to the criteria of NOHSC, and not classified as Dangerous Goods according to the Australian Dangerous Goods Code.

Symbol(s) : Xn Harmful.
N Dangerous for the environment.

R-phrase(s) : R40 Limited evidence of carcinogenic effect.
R65 Harmful: may cause lung damage if swallowed.
R66 Repeated exposure may cause skin dryness or cracking.
R51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrase(s) : S2 Keep out of the reach of children.
S36/37 Wear suitable protective clothing and gloves.
S61 Avoid release to the environment. Refer to special instructions/Safety data sheets.
S62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

Health Hazards : Slightly irritating to respiratory system. Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache and nausea. May cause moderate irritation to skin. Repeated exposure may cause skin dryness or cracking. Harmful: may cause lung damage if swallowed. Limited evidence of carcinogenic effect.

Signs and Symptoms : If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure.
Defatting dermatitis signs and symptoms may include a burning sensation and/or a dried/cracked appearance.

Safety Hazards	: May ignite on surfaces at temperatures above auto-ignition temperature. Vapour in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapour concentrations are within the flammability range. Not classified as flammable but will burn. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire.
Environmental Hazards	: Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Additional Information	: This product is intended for use in closed systems only.
SUSDP Schedule	: Not scheduled. When packed in containers having capacity of greater than 20 litres.
SUSDP Schedule	S5. When packed in containers having capacity of less than 20 litres.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Preparation description : Complex mixture of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons with carbon numbers predominantly in the C9 to C25 range. May also contain several additives at <0.1% v/v each. May contain cetane improver (Ethyl Hexyl Nitrate) at <0.2% v/v.
May contain catalytically cracked oils in which polycyclic aromatic compounds, mainly 3-ring but some 4- to 6-ring species are present.

Hazardous Components

Chemical Identity	CAS	EINECS	Symbol(s)	R-phrase(s)	Conc.
Fuels, diesel, no.2	68476-34-6	270-676-1	Xn, N	R40; R65; R66; R51/53	< 100.00 %

Additional Information : Dyes and markers can be used to indicate tax status and prevent fraud.
Refer to chapter 16 for full text of EC R-phrases.

4. FIRST AID MEASURES

Inhalation	: Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.
Skin Contact	: Remove contaminated clothing. Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
Eye Contact	: Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion	: If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101 ° F (37 ° C), shortness of breath, chest

congestion or continued coughing or wheezing.

Advice to Physician : Treat symptomatically.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific Hazards : Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Oxides of sulphur. Unidentified organic and inorganic compounds. Carbon monoxide may be evolved if incomplete combustion occurs. Will float and can be reignited on surface water. Flammable vapours may be present even at temperatures below the flash point.

Suitable Extinguishing Media : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.

Unsuitable Extinguishing Media : Do not use water in a jet.

Protective Equipment for Firefighters : Wear full protective clothing and self-contained breathing apparatus.

Additional Advice : Keep adjacent containers cool by spraying with water.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe all relevant local and international regulations. Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly.

Protective measures : Do not breathe fumes, vapour. Do not operate electrical equipment. Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Use appropriate containment (of product and fire fighting water) to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment.

Clean Up Methods : For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations.

Additional Advice	: Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP), as required by MARPOL Annex 1 Regulation 26.

7. HANDLING AND STORAGE

General Precautions	: Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Prevent spillages. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Never siphon by mouth. Contaminated leather articles including shoes cannot be decontaminated and should be destroyed to prevent reuse. For comprehensive advice on handling, product transfer, storage and tank cleaning refer to the product supplier. Maintenance and Fuelling Activities - Avoid inhalation of vapours and contact with skin. Classified as a C1 (COMBUSTIBLE LIQUID) for the purpose of storage and handling, in accordance with the requirements of AS 1940. Refer to State Regulations for storage and transport requirements. AS 1940:2004 The storage and handling of flammable and combustible liquids.
Handling	: Avoid inhaling vapour and/or mists. Avoid prolonged or repeated contact with skin. When using do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Earth all equipment. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Storage	: Drum and small container storage: Drums should be stacked to a maximum of 3 high. Use properly labelled and closeable containers. Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat. Vapours from tanks should not be released to atmosphere. Breathing losses during storage should be controlled by a suitable vapour treatment system. The vapour is heavier than air. Beware of accumulation in pits and confined spaces. Keep in a bunded area with a sealed (low permeability) floor, to provide containment against spillage. Prevent ingress of water.
Product Transfer	: Avoid splash filling. Wait 2 minutes after tank filling (for tanks

such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Keep containers closed when not in use. Do not use compressed air for filling, discharging or handling. Contamination resulting from product transfer may give rise to light hydrocarbon vapour in the headspace of tanks that have previously contained gasoline. This vapour may explode if there is a source of ignition. Partly filled containers present a greater hazard than those that are full, therefore handling, transfer and sampling activities need special care.

Recommended Materials : For containers, or container linings use mild steel, stainless steel. Aluminium may also be used for applications where it does not present an unnecessary fire hazard. Examples of suitable materials are: high density polyethylene (HDPE) and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.

Unsuitable Materials : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene.; However, some may be suitable for glove materials.

Container Advice : Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.

Additional Information : Ensure that all local regulations regarding handling and storage facilities are followed.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Naphthalene	AU OEL	TWA	10 ppm	52 mg/m3	
	AU OEL	STEL	15 ppm	79 mg/m3	
Oil mist, mineral	AU OEL	TWA [Mist.]		5 mg/m3	

Additional Information : In the absence of a national exposure limit, the American Conference of Governmental Industrial Hygienists (ACGIH) recommends the following values for Diesel Fuel: TWA - 100 mg/m3 Critical effects based on Skin and Irritation.

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use.

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers. AS/NZS 1337: Eye protectors for industrial applications. AS/NZS 2161: Occupational protective gloves - Selection, use and maintenance. AS/NZS 1715: Selection, use and maintenance of respiratory protective devices. AS/NZS 1716: Respiratory protective devices.

Respiratory Protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. All respiratory protection equipment and use must be in accordance with local regulations.

Hand Protection : Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced.
Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.

Eye Protection : Chemical splash goggles (chemical monogoggles). Approved to EU Standard EN166.

Protective Clothing : Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).

Monitoring Methods : Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.

Environmental Exposure Controls : Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Yellow. Pale straw. Colourless. Liquid.
Odour : May contain a reodorant
pH : Data not available
Initial Boiling Point and Boiling Range : 170 - 390 °C / 338 - 734 °F
Freezing/melting point : Data not available
Flash point : Typical 63 °C / 145 °F (ASTM D-93 / PMCC)
Lower / upper Flammability : 1 - 6 %(V)

or Explosion limits
Auto-ignition temperature : > 220 °C / 428 °F
Vapour pressure : < 1 hPa at 20 °C / 68 °F
Specific gravity : Data not available
Density : Typical 0.84 g/cm3 at 15 °C / 59 °F
Solubility in other solvents : Data not available
n-octanol/water partition coefficient (log Pow) : 3 - 6
Kinematic viscosity : 2 - 4.5 mm2/s at 40 °C / 104 °F
Vapour density (air=1) : Data not available

10. STABILITY AND REACTIVITY

Stability : Stable under normal conditions of use.
Conditions to Avoid : Avoid heat, sparks, open flames and other ignition sources.
Materials to Avoid : Strong oxidising agents.
Hazardous Decomposition Products : Hazardous decomposition products are not expected to form during normal storage.
Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment : Information given is based on product data, a knowledge of the components and the toxicology of similar products.
Acute Oral Toxicity : Low toxicity:LD50 >2000 mg/kg, Rat
Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Acute Dermal Toxicity : Low toxicity:LD50 >2000 mg/kg, Rabbit
Acute Inhalation Toxicity : Low toxicity: LC50 >5 mg/l / 4 h, Rat
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.
Skin Irritation : May cause moderate skin irritation (but insufficient to classify).
Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis.
Eye Irritation : Slightly irritating.
Respiratory Irritation : Slightly irritating.
Sensitisation : Not a skin sensitiser.
Repeated Dose Toxicity : Kidney: caused kidney effects in male rats which are not considered relevant to humans
Mutagenicity : In-vitro mutagenicity studies show that mutagenic activity is related to 4-6 ring polycyclic aromatic content.
Carcinogenicity : Limited evidence of carcinogenic effect.
Repeated skin contact has resulted in irritation and skin cancer in animals.
Reproductive and Developmental Toxicity : Not expected to be a developmental toxicant.

12. ECOLOGICAL INFORMATION

Information given is based on a knowledge of the components and the ecotoxicology of similar products. Fuels are typically made from blending several refinery streams. Ecotoxicological studies have been carried out on a variety of hydrocarbon blends and streams but not those containing additives.

Acute Toxicity	:	Toxic:LL/EL/IL50 1-10 mg/l(to aquatic organisms)(LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract).
Mobility	:	Floats on water. Partly evaporates from water or soil surfaces, but a significant proportion will remain after one day. Large volumes may penetrate soil and could contaminate groundwater. Contains volatile constituents.
Persistence/degradability	:	Major constituents are inherently biodegradable. The volatile constituents will oxidize rapidly by photochemical reactions in air.
Bioaccumulation	:	Contains constituents with the potential to bioaccumulate.
Other Adverse Effects	:	Films formed on water may affect oxygen transfer and damage organisms.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Container Disposal	:	Send to drum recoverer or metal reclaimer. Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard if heated above the flash point. Do not puncture, cut or weld uncleaned drums. Do not pollute the soil, water or environment with the waste container. Comply with any local recovery or waste disposal regulations.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be complied with.

14. TRANSPORT INFORMATION

ADG

This material is not classified as dangerous according to the Australian Dangerous Goods Code.

IMDG

Identification number	UN 3082
Proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.
Technical name	(Gas oil - unspecified)
Class / Division	9
Packing group	III
Marine pollutant:	Yes

IATA (Country variations may apply)

UN No.	: 3082
Proper shipping name	: Environmentally hazardous substance, liquid, n.o.s.
Technical name	: (Gas oil - unspecified)
Class / Division	: 9
Packing group	: III
Additional Information	: Not classified under ADG 07 regulations as special provision AU 02 applies

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

SUSDP Schedule	: Not scheduled. When packed in containers having capacity of greater than 20 litres. S5. When packed in containers having capacity of less than 20 litres.
AICS	: All components are listed or exempt
Classification triggering components	: Contains fuels, diesel.
Other Information	: National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011] List of Designated Hazardous Substances [NOHSC:10005]. Approved Criteria for Classifying Hazardous Substances [NOHSC:1008]. Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003]. Australian Dangerous Goods Code. Standard Uniform Scheduling of Drugs and Poisons.

16. OTHER INFORMATION

Additional Information	: This document contains important information to ensure the safe storage, handling and use of this product. The information

in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.

R-phrase(s)

R40	Limited evidence of carcinogenic effect.
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R65	Harmful: may cause lung damage if swallowed.
R66	Repeated exposure may cause skin dryness or cracking.

MSDS Version Number : 1.0

MSDS Effective Date : 12.04.2010

MSDS Revisions : A vertical bar (|) in the left margin indicates an amendment from the previous version.

MSDS Regulation :

Uses and Restrictions : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.
This product is not to be used as a solvent or cleaning agent; for lighting or brightening fires; as a skin cleanser.

MSDS Distribution : The information in this document should be made available to all who may handle the product.

Disclaimer : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

MATERIAL SAFETY DATA SHEET

QUAKER STATE® PEAK PERFORMANCE CONVENTIONAL MOTOR OIL - ALL GRADES

1. PRODUCT AND COMPANY IDENTIFICATION

MSDS Number: 14938

Version Date: 07/16/02

Product Name: QUAKER STATE® PEAK PERFORMANCE CONVENTIONAL MOTOR OIL - ALL GRADES
Product Use: Engine oil
Synonyms: 5W-30, 10W-30, 10W-40, 20W-50, 15W-40

Company Information
SOPUS Products
P.O. Box 4427
Houston, TX 77210-4427
USA

Phone Numbers
Medical Emergency: 1-800-546-6040
Transportation Emergency (USA): 1-800-424-9300
Transportation Emergency (International): 1-703-527-3887 (Call Collect)
MSDS Assistance: 1-800-546-6227
Fax On Demand: 1-800-546-6227
Technical Assistance: 1-800-458-4998
Customer Service: 1-800-468-8397
Fax Number: 713-217-3181
Internet Address: www.MSDS.PZLQS.com

2. COMPONENT INFORMATION

Component	CAS No.	Weight Percent Range	Hazardous in Blend
HYDROTREATED HEAVY PARAFFINIC PETROLEUM DISTILLATES	64742-54-7	< 70	No
SOLVENT-DEWAXED HEAVY PARAFFINIC DISTILLATE	64742-65-0	< 70	No
DETERGENT/DISPERSANT	MIXTURE	5 - 10	No
VISCOSITY MODIFIER	9003-29-6	< 10	No
POUR POINT DEPRESSANT	MIXTURE	< 2	No

Under normal conditions of use or in a foreseeable emergency, this product does not meet the definition of a hazardous chemical when evaluated according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Other: No information available

3. HAZARDS IDENTIFICATION

Emergency and Hazards Overview
CAUTION: Contains Petroleum Lubricant. Repeated skin contact can cause skin disorders.

ATTENTION: Used motor oil is a possible skin cancer hazard based on animal data. Repeated exposure to oil mist in excess of the OSHA limit (5mg/m3) can result in accumulation of oil droplets in pulmonary tissue.

NFPA Ratings: **Health** 1 **Flammability** 1 **Reactivity** 0

Primary Route of Exposure: **Skin** X **Inhalation** -- **Eye** X

Health Effect Information

Eye Contact: This product is practically non-irritating to the eyes upon direct contact. Based on testing of similar products and/or components.

Skin Contact: Avoid skin contact. This product is minimally irritating to the skin upon direct contact. Based on testing of similar products and/or components. Prolonged or repeated contact may result in contact dermatitis which is characterized by dryness, chapping, and reddening. Prolonged or repeated contact may result in oil acne which is characterized by blackheads with possible secondary infection. Avoid prolonged and repeated skin contact with used motor oils. See Section 11 - Toxicological Information.

Inhalation: This product has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting of this product. On rare occasions, prolonged and repeated exposure to oil mist poses a risk of pulmonary disease such as chronic lung inflammation. Signs of respiratory effects vary with concentration and length of exposure and include nasal discharge, sore throat, coughing, bronchitis, pulmonary edema and difficulty breathing. Shortness of breath and cough are the most common symptoms.

Ingestion: Do not ingest. This product is relatively non-toxic by ingestion. This product has laxative properties and may result in abdominal cramps and diarrhea. Exposure to a large single dose, or repeated smaller doses, may lead to lung aspiration, which can lead to lipid pneumonia or chronic lung inflammation. These are low-grade, chronic localized tissue reactions.

Medical Conditions Aggravated by Exposure: Drying and chapping may make the skin more susceptible to other irritants, sensitizers and disease.

Other: No information available

4. FIRST AID INFORMATION

Eye Contact: Immediately flush eyes with large amounts of water and continue flushing until irritation subsides. If material is hot, treat for thermal burns and seek immediate medical attention.

Skin Contact: No treatment is necessary under ordinary circumstances. Remove contaminated clothing. Wash contaminated area thoroughly with soap and water. If material is hot, submerge injured area in cold water. If victim is severely burned, remove to a hospital immediately.

Inhalation: This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions. If vapor or mist is generated when the material is heated, and the victim experiences signs of respiratory tract irritation, remove to fresh air.

Ingestion: No treatment is necessary under ordinary circumstances. Do not induce vomiting. If victim exhibits signs of lung aspiration such as coughing or choking, seek immediate medical assistance.

Notes to Physician: No information available

Other: No information available

5. FIRE AND EXPLOSION INFORMATION

Flammable Properties
Flash Point: 415 F, 212.8 C — **Test Method:** ASTM 3278 - Closed Cup
Flammable Limits in Air
Upper Percent: No data available
Lower Percent: No data available
Autoignition Temperature: No data available — **Test Method:** No information available

NFPA Classification: Class III-B combustible liquid

Extinguishing Media: Use dry chemical, foam, or carbon dioxide.

Fire Fighting Measures

Special Fire Fighting Procedures and Equipment: Water may be ineffective but can be used to cool containers exposed to heat or flame to prevent vapor pressure buildup and possible container rupture. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid.

Unusual Fire and Explosion Conditions: Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

Hazardous Combustion By-Products: None

Other: No information available

6. ACCIDENTAL RELEASE MEASURES

Personnel Safeguards: Consult Health Effect Information in Section 3, Personal Protection Information in Section 8, Fire and Explosion Information in Section 5, and Stability and Reactivity Information in Section 10.

Regulatory Notifications: Notify appropriate authorities of spill.

Containment and Clean up: Contain spill immediately. Do not allow spill to enter sewers or watercourses. Absorb with appropriate inert material such as sand, clay, etc. Large spills may be picked up using vacuum pumps, shovels, buckets, or other means and placed in drums or other suitable containers.

Other: No information available

7. HANDLING AND STORAGE INFORMATION

Handling: Fire extinguishers should be kept readily available. See NFPA 30 and OSHA 1910.106--Flammable and Combustible Liquids.

Storage: Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials.

Empty Container Warnings

Drums: Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed.

Plastic: Empty container may retain product residues.

Other: No information available

8. EXPOSURE CONTROLS / PERSONAL PROTECTION INFORMATION

Exposure Limits and Guidelines

This product does not contain any components with OSHA or ACGIH exposure limits.

Personal Protective Equipment

Eye/Face Protection: Eye protection is not required under conditions of normal use. If material is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

Skin Protection: No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot material, use insulated protective clothing (boots, gloves, aprons, etc.). Launder soiled clothes. Properly dispose of contaminated leather articles including shoes, which cannot be decontaminated.

Respiratory Protection: Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the material is heated or handled, use an organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. Do not use compressed oxygen in hydrocarbon atmospheres.

Personal Hygiene: Consumption of food and beverage should be avoided in work areas where hydrocarbons are present. Always wash hands and face with soap and water before eating, drinking, or smoking.

Engineering Controls / Work Practices

Ventilation: If vapor or mist is generated when the material is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure or flammable limits.

Other: The OSHA permissible exposure limit (PEL) and ACGIH threshold limit value (TLV) for oil mist is 5 mg/m3. The ACGIH short-term exposure limit (STEL) for oil mist is 10 mg/m3.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Amber to dark amber	
Odor: Hydrocarbon - mild	**Vapor Pressure:** No data available
Physical state: Liquid	**Vapor Density (air=1):** No data available
pH: No data available	**Percent Volatile by Volume:** No data available
Boiling Point: No data available	**Volatile Organic Content:** No data available
Melting Point: No data available	**Molecular Weight:** No data available
Specific Gravity: 0.88 - 0.9 @ 16 C / 60 F	**Average Carbon Number:** No data available
Pour Point: -15 F, -26.1 C	**Viscosity @ 100 F:** No data available
	Viscosity @ 40 C: No data available
Solubility in Water: Negligible in water	
Octanol / Water Coefficient: Log K_{ow} = No data available	

10. STABILITY AND REACTIVITY INFORMATION

Chemical Stability: Stable

Conditions to Avoid: High heat and open flames.

Incompatible Materials to Avoid: May react with strong oxidizing agents.

Other: No information available

11. TOXICOLOGICAL INFORMATION

Primary Eye Irritation: No information available

Primary Skin Irritation: No information available

Acute Dermal Toxicity: No information available

Subacute Dermal Toxicity: No information available

Dermal Sensitization: No information available

Inhalation Toxicity: No information available

Inhalation Sensitization: No information available

Oral Toxicity: No information available

Mutagenicity: No information available

Carcinogenicity: The International Agency for Research on Cancer (IARC) has concluded that there is inadequate data to evaluate the carcinogenicity to experimental animals of this class of product. IARC has concluded there is sufficient evidence that used gasoline-engine motor oils produce skin tumors in experimental animals. Also, IARC has determined this class of products belongs to Group 3-"not classifiable as to its carcinogenicity to humans".

Reproductive and Developmental Toxicity: No information available

Teratogenicity: No information available

Immunotoxicity: No information available

Neurotoxicity: No information available

Other: No information available

12. ECOLOGICAL INFORMATION

Aquatic Toxicity: No information available

Terrestrial Toxicity: No information available

Chemical Fate and Transport: No information available

Other: No information available

13. DISPOSAL INFORMATION

Regulatory Information: All disposals must comply with federal, state, and local regulations. The material, if spilled or discarded, may be a regulated waste. Refer to state and local regulations. Caution! If regulated solvents are used to clean up spilled material, the resulting waste mixture may be regulated. Department of Transportation (DOT) regulations may apply for transporting this material when spilled.

Waste Disposal Methods: Waste material may be landfilled or incinerated at an approved facility. Materials should be recycled if possible.

Other: No information available

14. TRANSPORTATION INFORMATION

U.S. Department of Transportation (DOT)
Highway / Rail (Bulk): Not Regulated
Highway / Rail (Non-Bulk): Not Regulated

For US shipments, US DOT law requires the shipper to determine the proper shipping description of the material that is being shipped. The shipping information and description contained in this section may not be suitable for all shipments of this material, but may help the shipper determine the proper shipping description for a particular shipment.

International Information

Vessel:	**IMDG Regulated:**	–	**IMDG Not Regulated:**	X
Air:	**ICAO Regulated:**	–	**ICAO Not Regulated:**	X

Other: No information available

15. Regulatory Information

Regulatory Lists Searched: The components listed in Section 2 of this MSDS were compared to substances that appear on the following regulatory lists. Each list is numerically identified. See Regulatory Search Results below.

Health & Safety: 10 - IARC carcinogen, 11 - NTP carcinogen, 12 - OSHA carcinogen, 15 - ACGIH TLV, 16 - OSHA PEL, 17 - NIOSH exposure limit, 20 - US DOT Appendix A, Hazardous substances, 22 - FDA 21 CFR Total food additives, 23 - NFPA 49 or 325

Environmental: 30 - CAA 1990 Hazardous air pollutants, 31 - CAA Ozone depletors, 33 - CAA HON rule, 34 - CAA Toxic substance for accidental release prevention, 35 - CAA Volatile organic compounds (VOC's) in SOCMI, 41 - CERCLA / SARA Section 302 extremely hazardous substances, 42 - CERCLA / SARA Section 313 emissions reporting, 43 - CWA Hazardous substances, 44 - CWA Priority pollutants, 45 - CWA Toxic pollutants, 46 - EPA Proposed test rule for hazardous air pollutants, 47 - RCRA Basis for listing - Appendix VII, 48 - RCRA waste, 49 - SDWA - (S)MCLs

International: 50 - Canada - WHMIS Classification of substance, 54 - Mexico - Drinking water - ecological criteria, 55 - Mexico - Wastewater discharges, 56 - US -TSCA Section (12)(b) - export notification

State Lists: 60 - CA - Proposition 65, 61 - FL - Substances, 62 - MI - Critical materials, 63 - MA - RTK, 64 - MA - Extraordinarily hazardous substances, 65 - MN - Hazardous substances, 66 - PA - RTK, 67 - NJ - RTK, 68 - NJ - Environmental hazardous substances, 69 - NJ - Special hazardous substances

Inventories: 80 - Canada - Domestic substances , 81 - European - EINECS, 82 - Japan - ENCS, 83 - Korea - Existing and evaluated chemical substances, 84 - US - TSCA , 85 - China Inventory

Regulatory Search Results:
HYDROTREATED HEAVY PARAFFINIC PETROLEUM DISTILLATES: 80, 81, 83, 84, 85
SOLVENT-DEWAXED HEAVY PARAFFINIC DISTILLATE: 80, 81, 83, 84, 85
VISCOSITY MODIFIER: 35, 80, 83, 84, 85

U.S. TSCA Inventory: All components of this material are on the US TSCA Inventory.

SARA Section 313: This product is not known to contain any SARA, Title III, Section 313 Reportable Chemicals at or greater than 1.0% (0.1% for carcinogens).

IARC: No information available

SARA 311 / 312 Categories
Acute: -- **Chronic:** -- **Fire:** -- **Pressure:** -- **Reactive:** --
Not Regulated: X

Canadian WHMIS Classification
Not a controlled substance under WHMIS

European Union Classification
Hazard Symbols:
No classification recommended
Risk Phrases:
No classification recommended
Safety Phrases:
No classification recommended

Other: No information available

16. OTHER INFORMATION

Health and Environmental Label Language

WARNING: Continuous contact with used gasoline engine oils has caused skin cancer in animal tests.
ATTENTION: Prolonged or repeated skin contact may cause oil acne or dermatitis. Repeated exposure to oil mist in excess of the OSHA limit (5mg/m3 can result in accumulation of oil droplets in pulmonary tissue.

Precautionary Measures: Avoid prolonged or repeated contact with eyes, skin and clothing. Avoid generation and inhalation of oil mists.

First Aid: Skin Contact: Wash skin with soap and water. Launder soiled clothes and discard oil-soaked shoes. If irritation persists seek medical attention. Eye Contact: Flush with water. If irritation persists seek medical attention. Ingestion: Do not induce vomiting. In general, no treatment is necessary unless large quantities of product are ingested. If discomfort persists seek medical assistance.

Instructions in Case of Fire or Spill: In case of fire, use water fog, foam, dry chemical or carbon dioxide. Water spray may be ineffective, but can be used to cool containers. Do not use a direct stream of water. Material will float and can be reignited on surface of water.

Spill or Leak: Dike and contain spill. Do not use water; soak up with absorbent material such as clay, sand or other suitable material. Place in non-leaking container and seal tightly for proper disposal.

Contains: highly refined petroleum distillate, mixture; zinc compounds, mixture; polymer additives, mixture.

KEEP OUT OF REACH OF CHILDREN. (If intended for retail also)

MSDS Revisions
Previous Version Date: 06/01/01

Previous Version Information
Revised Section 1 - Product Name

Other

No information available

Prepared By:

SOPUS Products
P.O. Box 4427
Houston, TX 77210-4453 USA

Disclaimer of Warranty: The information contained herein is based upon data and information available to us, and reflects our best professional judgment. This product may be formulated in part with components purchased from other companies. In many instances, especially when proprietary or trade secret materials are used, SOPUS Products must rely upon the hazard evaluation of such components submitted by that product's manufacturer or importer. No warranty of merchantability, fitness for any use, or any other warranty is expressed or implied regarding the accuracy of such data or information, the results to be obtained from the use thereof, or that any such use do not infringe any patent. Since the information contained herein may be applied under conditions of use beyond our control and with which we may be unfamiliar, we do not assume responsibility for the results of such application. This information is furnished upon the condition that the person receiving it shall make his own determination of the suitability of the material for his particular use.

Prestone

PRESTONE ANTIFREEZE/COOLANT
MSDSP149

SECTION 1: IDENTIFICATION

MSDS ID: MSDSP149

PRODUCT NAME: PRESTONE ANTIFREEZE/COOLANT
Product Number: AF777
Formula Number: YA721, YA718, YA718B

MANUFACTURER: Prestone Products Corporation
39 Old Ridgebury Road
Danbury, CT 06810-5109

INFORMATION PHONE NUMBER: (203) 731-3686

EMERGENCY PHONE NUMBER: CHEMTREC 1-800-424-9300
483-7161 in the District of Columbia

MSDS DATE OF PREPARATION/REVISION: 10/18/99

SECTION 2: PRODUCT COMPONENTS

HAZARDOUS COMPONENTS	CAS#	PERCENT	EXPOSURE LIMITS
Ethylene Glycol (aerosol)	107-21-1	80-96	None Established-OSHA PEL 100 mg/m3 Ceiling ACGIH TLV
Diethylene Glycol	111-46-6	0-8	None Established OSHA PEL, ACGIH TLV

Non-Hazardous Ingredients >1%
Water 7732-18-5

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Eye and upper respiratory irritant. May cause nausea, vomiting, headache, drowsiness, blurred vision, convulsions, coma or death if ingested or inhaled. Prolonged or repeated skin contact may cause dermatitis or skin sensitization.

POTENTIAL HEALTH EFFECTS:

INHALATION: May cause irritation of the nose and throat with headache, particularly from mists. High vapor concentrations caused, for example, by heating the material in an enclosed and poorly ventilated workplace, may produce nausea, vomiting, headache, dizziness and irregular eye movements.

SKIN CONTACT: No evidence of adverse effects from available information.

EYE CONTACT: Liquid, vapors or mist may cause discomfort in the eye with persistent conjunctivitis, seen as slight excess redness or conjunctiva. Serious corneal injury is not anticipated.

INGESTION: Following ingestion, a bitter taste may be noted. May cause abdominal discomfort or pain, nausea, vomiting, dizziness, drowsiness, malaise, blurring of vision, irritability, back pain, decrease in urine output, kidney failure, and central nervous system effects, including irregular eye movements, convulsions and coma. Cardiac failure and pulmonary edema may develop. Severe kidney damage which may be fatal may follow the swallowing of ethylene glycol. A few reports have been published describing the development of weakness of the facial muscles, diminishing hearing, and difficulty with swallowing, during the late stages of severe poisoning.

CHRONIC EFFECTS: Prolonged or repeated inhalation exposure may produce signs of central nervous system involvement, particularly dizziness and jerking eye movements. Prolonged or repeated skin contact may cause skin sensitization and an associated dermatitis in some individuals. Ethylene glycol has been found to cause birth defects in laboratory animals. The significance of this finding to humans has not been determined. See section 11 for additional information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: The available toxicological information and a knowledge of the physical and chemical properties of the material suggest that overexposure in unlikely to aggravate existing medical conditions.

CARCINOGEN: None of the components of these products is listed as a carcinogen or suspected carcinogen by IARC, NTP or OSHA.

SECTION 4: FIRST AID MEASURES

INHALATION: Remove the victim to fresh air. If breathing has stopped administer artificial respiration. If breathing is difficult, have medical personnel administer oxygen. Get medical attention.

SKIN CONTACT: Remove contaminated clothing. Immediately wash contacted area thoroughly with soap and water. If irritation persists, get medical attention.

EYE CONTACT: Immediately flush eyes with large amounts of water for 15 minutes. Get medical attention if irritation persists.

INGESTION: Seek immediate medical attention. Immediately call local poison control center or go to an emergency department. Never give anything by mouth to or induce vomiting in an unconscious or drowsy person.

NOTES TO PHYSICIAN: The principal toxic effects of ethylene glycol, when swallowed, are kidney damage and metabolic acidosis. The combination of metabolic acidosis, an osmol gap and oxalate crystals in the urine is evidence of ethylene glycol poisoning.

Pulmonary edema with hypoxemia has been described in a number of patients following poisoning with ethylene glycol. Respiratory support with mechanical ventilation may be required.

There may be cranial nerve involvement in the late stages of toxicity from swallowed ethylene glycol. In particular, effects have been reported involving the seventh, eighth, and ninth cranial nerves, presenting with bilateral facial paralysis, diminished hearing and dysphagia.

Ethanol is antidotal and its early administration may block the formation of nephrotoxic metabolites of ethylene glycol in the liver. The objective is to rapidly achieve and maintain a blood ethanol level of approximately 100 mg/dl by giving a loading dose of ethanol followed by a maintenance dose. Intravenous administration of ethanol is the preferred route. Ethanol blood levels should be checked frequently. Hemodialysis may be required.

4-Methylpyrazole (Antizole(R) or Fomepizole), a potent inhibitor of alcohol dehydrogenase, has been used therapeutically to decrease the metabolic consequences of ethylene glycol poisoning. Additional therapeutic modalities which may decrease the adverse consequences of ethylene glycol metabolism are the administration of both thiamine and pyridoxine. As there are complicated and serious overdoses, we recommend you consult with the toxicologists at your poison control center. This antidote is now approved by the F.D.A. and in many cases has replaced ethanol in the treatment of ethylene glycol poisoning.

SECTION 5: FIRE AND EXPLOSION DATA

FLASH POINT: 242 F (117 C) TOC
220 F (104 C) PMCC

AUTOIGNITION TEMPERATURE: Not determined

FLAMMABILITY LIMITS: LEL: 3.2% UEL: 15.3%

EXTINGUISHING MEDIA: For large fires, use alcohol type or all-purpose foams. For small fires, use water spray, carbon dioxide or dry chemical.

SPECIAL FIRE FIGHTING PROCEDURES: Do not spray pool fires directly. Cool fire exposed containers with water. Firefighters should wear positive pressure self-contained breathing apparatus and full protective clothing for fires in areas where chemicals are used or stored.

UNUSUAL FIRE HAZARDS: A solid stream of water or foam directed into hot, burning liquid can cause frothing.

HAZARDOUS COMBUSTION PRODUCTS: Burning may produce carbon monoxide and carbon dioxide.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Wear appropriate protective clothing and equipment (See Section 8). Collect with absorbent material and place in appropriate, labeled container for disposal or, if permitted flush spill area with water.

SECTION 7: HANDLING AND STORAGE

DANGER: Harmful or Fatal if Swallowed

Do not drink antifreeze or solution.
Avoid eye and prolonged or repeated skin contact.
Avoid breathing vapors or mists.
Wash exposed skin thoroughly with soap and water after use.
Do not store in opened or unlabeled containers.

Keep container away from open flames and excessive heat.
Do not reuse empty containers unless properly cleaned.

Empty containers retain product residue and may be dangerous. Do not cut, weld, drill, etc. containers, even empty.

Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without any obvious ignition sources. Published "autoignition" or "ignition" temperatures cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Use of this product in elevated temperature applications should be thoroughly evaluated to assure safe operating conditions.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION: Use general ventilation or local exhaust as required to maintain exposures below the occupational exposure limits.

RESPIRATORY PROTECTION: For operations where the TLV is exceeded a NIOSH approved respirator with organic vapor cartridges and dust/mist prefilters or supplied air respirator is recommended. Equipment selection depends on contaminant type and concentration. Select and use in accordance with 29 CFR 1910.134 and good industrial hygiene practice. For firefighting, use self-contained breathing apparatus.

GLOVES: Chemical resistant gloves such as neoprene or PVC where contact is possible

EYE PROTECTION: Splash-proof goggles.

OTHER PROTECTIVE EQUIPMENT/CLOTHING: Appropriate protective clothing as needed to minimize skin contact. Suitable washing and eye flushing facilities should be available in the work area. Contaminated clothing should be removed and laundered before re-use.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Yellow liquid with a mild odor.

pH: Not determined
BOILING POINT (F): 334 F
FREEZING POINT (F): -8 F
SOLUBILITY IN WATER: 100%
PERCENT VOLATILE: None

SPECIFIC GRAVITY: 1.12
VAPOR PRESSURE: Less than 0.1
VAPOR DENSITY: 2.1
EVAPORATION RATE: Less than 1
VISCOSITY: Not determine

SECTION 10: STABILITY AND REACTIVITY

STABILITY: Stable
CONDITIONS TO AVOID: None known.
INCOMPATIBILITY: Normally unreactive, however, avoid strong bases at high temperatures, strong acids, strong oxidizing agents, and materials reactive with hydroxyl compounds.
DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide.
HAZARDOUS POLYMERIZATION: Will not occur
CONDITIONS TO AVOID: None known.

SECTION 11: TOXICOLOGICAL INFORMATION

ACUTE TOXICITY VALUES:
Ethylene Glycol: LD50 Oral Rat: 4700 mg/kg
LD50 Skin Rabbit: 9530 mg/kg

Diethylene Glycol: LD50 Oral Rat: 12,565 mg/kg
LD50 Skin Rabbit: 11,890 mg/kg

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH:
Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. Also, in a preliminary study to assess the effects of exposure of pregnant rats and mice to aerosols at concentrations 150, 1,000 and 2,500 mg/m3 for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentrations, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol, percutaneous absorption of ethylene glycol from contaminated skin, or swallowing of ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure

resulted in maternal toxicity (1,000 and 2,500 mg/m3) and developmental toxicity in with minimal evidence of teratogenicity (2,500 mg/m3). The no-effects concentration (based on maternal toxicity) was 500 mg/m3. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to the skin of pregnant mice over the period of organogenesis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen; there is currently no available information to suggest that ethylene glycol caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental toxicity; exposure to high aerosol concentration is only minimally effective in producing developmental toxicity; the major route for producing developmental toxicity is perorally.

Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence or a different pattern of tumors compared with untreated controls. The absence of carcinogenic potential for ethylene glycol has been supported by numerous invitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

This products contains less than 0.5% tolytriazole which has demonstrates mutagenic activity in a bacterial test system. A correlation has been established between mutagenic activity and carcinogenic activity for many chemicals. Tolytriazole has not been identified as a carcinogen or probable carcinogen by NTP, IARC or OSHA.

SECTION 12: ECOLOGICAL INFORMATION

Ethylene Glycol: LC50 Goldfish: 5,000 mg/L/24 hr. at 20 C static conditions.

Toxicity threshold (cell multiplication inhibition test):
Bacterial (Pseudomonas putida): 10,000 mg/l
Protozoa (Entosiphon sulcatum and Uronema parduczi Chatton-Lwoff): >10,000 mg/l
Algae (Microcystis aeruginosa): 2,000 mg/l
Green algae (Scenedesmus quandricauda): >10,000 mg/l

SECTION 13: DISPOSAL INFORMATION

Dispose of product in accordance with all local, state/provincial and federal regulations.

SECTION 14: TRANSPORT INFORMATION

U.S. DOT HAZARD CLASSIFICATION

PROPER SHIPPING NAME: None
UN NUMBER: None
LABELS REQUIRED: None

DOT MARINE POLLUTANTS: This product does not contains Marine Pollutants as defined in 49 CFR 171.8.

IMDG CODE SHIPPING CLASSIFICATION

DESCRIPTION: Not Regulated

Note: IF A BULK SHIPMENT IS INVOLVED, THE FOLLOWING INFORMATION APPLIES:

U.S. DOT HAZARD CLASSIFICATION

PROPER SHIPPING NAME: Environmentally hazardous substance, liquid,
N.O.S. (Ethylene glycol)
UN NUMBER: UN3082
LABELS REQUIRED: Class 9, UN3082

SECTION 15: REGULATORY INFORMATION

EPA SARA 311/312 HAZARD CLASSIFICATION: Acute health, chronic health

EPA SARA 313: This Product Contains the Following Chemicals Subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Ethylene Glycol 107-21-1 80-96%

PROTECTION OF STRATOSPHERIC OZONE: This product is not known to contain or to have been manufactured with ozone depleting substances as defined in 40 CFR Part 82, Appendix A to Subpart A.

CERCLA SECTION 103: Spills of this product over the RQ (reportable quantity) must be reported to the National Response Center. The RQ for this product, based on the RQ for Ethylene Glycol (96% maximum) of 5,000 lbs, is 5,208 lbs. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

CALIFORNIA PROPOSITION 65 - This product may contain the following substances known to the State of California to cause Cancer and/or Reproductive Harm: 1,4-Dioxane (trace amount).

EPA TSCA INVENTORY: All of the components of this material are listed on the Toxic Substances Control Act (TSCA) Chemical Substances Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT: All of the ingredients are listed on the Canadian Domestic Substances List.

CANADIAN WHMIS CLASSIFICATION: Class D - Division 2 - Subdivision B - (A toxic material causing other chronic effects)

EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS): All of the ingredients are listed on the EINECS inventory.

AUSTRALIA: All of the ingredients of this product are listed on the Australian Inventory of Chemical Substances.

SECTION 16: OTHER INFORMATION

NFPA RATING (NFPA 704) - FIRE: 1
HEALTH: 2
REACTIVITY: 0

REVISION SUMMARY: Section 4: Notes to Physican
Section 9: Specific Gravity
Section 16: Contact Name and Address

This MSDS is directed to professional users and bulk handlers of the product. Consumer products are labeled in accordance with Federal Hazardous Substances Act regulations.

While Prestone Products Corporation believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of tests conducted, the data are not to be taken as a warranty or representation for which Prestone Products Corporation assumes legal responsibility. They are offered for your consideration, investigation and verification. Any use of these data and information must be determined by the user to be in accordance with applicable federal, state and local laws and regulations.

If more information is needed, please contact: Stan Prusakowski
Prestone Products Corporation
55 Federal Road
Danbury, CT 06810
(203)830-7865

I. **LOCATION MAP:** Attach a USGS 7.5 minute quad, or similar map of adequate scale, which locates the prospecting site(s).

J. Are prospect sites (e.g., drill holes, trench locations, etc...) staked on the ground? Yes ☐ No ☐

K. Specify the Land Management Agency, Address and Telephone Number:
BLM, White River Field Office, Meeker, CO 970-878-3800.

L. The prospector is required to document that the NOI has been sent to the BLM or the USFS. Processing of the NOI will not begin until the prospector has submitted evidence acceptable to the Division that the NOI was sent to the BLM or USFS. Check one:

☑ Evidence of notification is attached to this NOI for BLM Land
☐ Evidence of notification is attached to this NOI for USFS Land.
☐ Other proof of notice is attached to this NOI

II. MAPS & DRAWINGS

Accurate topographic base map showing the location of the proposed project must be submitted with this notice. The prospector may submit a U.S.G.S. 7.5 minute quadrangle, or similar map of adequate scale that:

3. identifies the proposed prospecting site(s) or activity areas involving surface disturbance. Activity areas include all drill holes, mud pits, excavations, trenches, adits, shafts, tunnels, rock dumps, stockpiles, impoundments and prospecting roads, and

4. includes sufficient detail to identify and locate known prospecting features and facilities that may be affected and those that are not anticipated to be affected. This includes the location of all drill holes, mud pits, excavations, trenches, adits, shafts, tunnels, rock dumps, stockpiles, impoundments and prospecting roads. Color photographs, adequately labeled (including date, orientation and location), of the prospecting site may be used to fulfill this requirement if included with the NOI submittal.

III PROJECT DESCRIPTION

7. **Mineral(s) and/or Resource(s) being Investigated:** No change

8. **Estimated dates of commencement and completion:**
Commencement: 04/01/2013, (upon approval by DRMS)
Completion: 12/31/2022,

9. **Amount of material to be extracted, moved or proposed to be moved:** No change

10. **Identify the type or method of prospecting proposed and quantity (place an "X")**

☐ Cuts ☐ Pits ☐ Trenches
☐ Shafts ☐ Tunnels ☐ Adits ☐ Declines
☑ Air Drilling ☑ Fluid Drilling ☐ Drilling & Blasting

11. Describe proposed surface excavation or other land disturbance, including roads, pits, trenches, waste piles, drill pads and collar areas of underground workings, ponds, etc…

This modification request is submitted to allow the incorporation of horizontal long heater testing at the East RDD concurrent with research activities previously approved by DRMS. Please refer to the attached supplemental text and figures for a complete description of the requested modification.

12. **Proposed Disturbance** (approximate) Describe the proposed drilling to be conducted, including anticipated number of holes, diameter, depth, location, etc… Submit additional pages if necessary:

A. Drill Pads: Quantity 1.00 Average Width 268.00 (ft) Average Length 471.00 (ft)

B. Drill Holes: Quantity 4.00 Depth 2,220 - 2,460 (ft) Diameter 17.50 -> 8.50 (in)

C. Mud Pits: Quantity 1.00 Average Width 20.00 (ft) Average Length 100.00 (ft)
Average Depth 14.00 (ft)

Described proposed underground work, including reopening of old workings, advancement of adits or shafts, trenches, pits, cuts, rock dumps, or other types of disturbance, describe type, quantity and general dimensions:

Please refer to the attached supplemental text and figures for a complete description.

F. Other Disturbances (please describe):

No change

G. Indicate Chemicals and Fuels used or stored on site. List type, quantity and method to store.

No change

F. New Road(s): Length No change (ft) Width No change (ft)
Significantly Upgraded Road(s) Length No change (ft) Width No change (ft)

Are culverts or other crossings proposed? If so, please describe:

No change

G. Total project area to be disturbed 15.36 (acres) (12.20 ac. orig. + 0.14 ac. cuttings pit + 3.02 ac. ELHT)

K. Describe the equipment to be used for the prospecting operations:
Please refer to the attached supplemental text and figures.

L. Describe and locate any structures to be constructed (i.e. stockpiles, ponds, impoundments):
Please refer to the attached supplemental text and figures.

M. Describe anticipated relationship to surface water and groundwater (proximity to streams, penetration of ground water aquifers):
Please refer to the attached supplemental text and figures.

IV. OPERATION AND RECLAMATION MEASURES:

1. The Board suggests that a photographic record of the pre-prospecting and post-prospecting conditions be kept by the prospector. These photos should be taken from the same location and by the same method to clearly show the pre-prospecting condition of the land and the reclamation efforts. Upon completion of reclamation and request for bond or surety release, the Board may consider the photos as evidence of adequate reclamation, and thus, be able to act more quickly on the request for release.

2. Provide a description of the native vegetation of the area to be disturbed, including tree, shrub, and grass communities of the area. Color photographs, sufficient to adequately represent the ecology of the site and adequately labeled (including date, orientation and location), may be used in lieu of a written description. Based on the quality of the photographs, the Division may require additional detail.

No change

NOI ATTACHMENT – EAST LONG HEATER TEST (ELHT)

1.0 INTRODUCTION

Shell Frontier Oil and Gas Inc. (Shell) has leased approximately 149 acres of oil shale-bearing land to develop a Research, Development and Demonstration (RDD) project in a nahcolite-rich zone of the Eocene Green River Formation in the Piceance Basin, NW Colorado. The East RDD project lies on federal land managed by U.S. Bureau of Land Management (BLM) (Figure 1). The target resources include oil shale and nahcolite ($NaHCO_3$). In essence, the plan is to leach nahcolite with hot water to create permeability and recover the leachate, then heat the formation to convert kerogen and recover the oil and gas products.

In October 2012, Shell met with staff from the White River Office of the Bureau of Land Management and Colorado Division of Reclamation, Mining and Safety to discuss incorporation of testing of horizontal long heaters on the East RDD lease concurrent with RDD activities described above. The Plan of Development has been updated and submitted to BLM describing Shell's plans for incorporating testing of horizontal long heaters on the East RDD lease concurrent with previously described East RDD activities. This attachment provides the details for the modification to Prospecting Notice of Intent (NOI P-2006-026) required by the Division of Reclamation, Mining and Safety (DRMS) for incorporating the East Long Heater Test (ELHT) into the East RDD.

The ELHT consists of three 1000-foot long heaters installed on the East RDD lease at a pad site located adjacent to East RDD Pilot (Figure 2a). The purpose of the ELHT is to test the tendency for hotspots to form along commercial mineral insulated (MI) heaters installed in a horizontal orientation. This testing supplements the data that will be generated at the East RDD Pilot by testing heaters in a nonvertical orientation and will inform Shell for future design and deployment.

2.0 GEOLOGY

The East RDD Pilot site lies in the northern part of the Piceance Basin in northwestern Colorado (Hail and Smith, 1994 [9]) (Figure 3). The Piceance Basin contains the world's richest deposits of oil shale and one of the most significant occurrences of the saline mineral nahcolite, which is $NaHCO_3$ (sodium bicarbonate or baking soda). An estimated one trillion barrels of oil shale resource occurs within the Parachute Creek and Garden Gulch Members of the Green River Formation. The resource area covers 1,600 square-miles and is bounded by the Colorado River on the south, the White River on the north, the Douglas Creek Arch on the west, and the White River Uplift on the east. The in-place oil shale resource lying beneath the 149-acre East RDD tract, location for the East RDD Pilot and ELHT, is estimated to be approximately 274 million barrels, based on Fischer Assay (FA) recovery rates.

The ELHT is planned for the lower saline nahcolitic oil shale zone of the Parachute Creek Member as characterized in original NOI submittals, and for the illitic sediments near the top of the underlying Garden Gulch Member. Both development intervals are within the Green River oil-shale formation.

The Garden Gulch Member illitic Interval was not deposited under the same evaporative conditions as the lower saline portion of the Parachute Creek member. A substantial decrease in the amount of nahcolite and related minerals is observed, with an increase in clastic minerals that include illite are indicative of a fresh water depositional setting contrasting with the overlying Parachute Creek Member which is indicative of a hypersaline depositional setting. The target Illite Zone for the ELHT is greater than 60% illite clay, which is the reason for the low permeability in this interval.

Although the oil shales of the Garden Gulch Member differ mineralogically and in physical character from the overlying Parachute Creek Member, the kerogen-rich oil shales of both members are vertically gradational with each other and form essentially one continuous mineral deposit. The Garden Gulch Member of the lower Green River Formation overlies the Eocene Wasatch Formation, which is comprised of mudstones, sandstones, coals, and conglomerates. The lowest test zone of the ELHT is separated from the Wasatch Formation by at least 200 ft of low permeability shales of the Garden Gulch Member. Figure 4 provides a generalized stratigraphic and hydrostratigraphic section illustrating the position of the Garden Gulch Member of the Green River Formation. Figure 5 provides a generalized hydrostratigraphic cross section across Piceance Basin and also shows the location of the Garden Gulch illitic zone and approximate test intervals of both the East RDD and ELHT.

3.0 ESTIMATED RESOURCES

The estimate resource recovery for the ELHT is de minimis because the ELHT has intentionally been designed to test horizontal heaters and to minimize hydrocarbon recovery. This is accomplished by spacing the horizontal heaters sufficiently far apart (~80-100 ft) to ensure that superposition of heating does not occur. While the East RDD Pilot production is expected to be greater than 1,500 bbls of oil, the production from the ELHT is expected to be less than 175 bbls of oil. This oil will be routed to its own separator and tanks and therefore will be kept apart from the oil produced from the East RDD Pilot to ensure clarity of results. From time to time and for short durations, the production from the two tests may need to be commingled in response to operational problems or scheduled maintenance on one of the two separators. During such times, the cumulative production from each test will be adjusted based on the rate during the time period immediately preceding the event.

For the East Long Heater Test, the primary objective is to test subsurface heater technology to inform on the heater design. The test is designed to minimize production, if any, from the pilot by placing the heaters far apart from each other so as to avoid thermal superposition between the heaters. This is expected to result in a small localized pyrolysis zone around each of the heaters. Predictive modeling suggests this zone to be confined to less than 2 ft radius in the vicinity of each heater. Heaters extend 1000 ft in the lateral direction. Average FA in 2 ft radius around the three heaters is 28, 35 and 29 gpt respectively. Assuming a 2 ft horizontal cylinder of affected kerogen around each 1000 ft long heater, the total affected FA resource is about 1645 bbls. Only a fraction of this resource will be produced as necessary to control reservoir pressure.

The ELHT does not include a leaching phase. Heating in intervals where nahcolite is present will result in thermal decomposition to soda ash. For the test interval where the nahcolite content is ~30 %wt on average (limited to the uppermost heater), it is calculated that the approximately ~ 1,200 to 1,500 tons of nahcolite will decompose to soda ash which remains in place for potential recovery.

4.0 GROUND WATER MONITORING AND RESPONSE

For the ELHT, the primary focus of the test will to evaluate the tendency for hotspots to form along the heater. The three heated intervals are widely spaced to prevent superpositioning and production rates will occur only as necessary to relieve internal pressure. Given the significant over burden pressures exerted by the rock, the lack of superpositioning of the heaters and the management of pressure by flow from the heater wells and the inclined observer/producer well, the risk of any containment breach is considered negligible. By design, the location of the heated intervals for the ELHT is located upgradient of the 138-4-298 well pattern. As such, the 138-4-298 well pad and specifically the L-4 well as well as the 135-4-298-L4 well associated with the East RDD will also provide appropriate monitoring for the ELHT. Baseline monitoring data from the 138 and 135 well pads has been collected and submitted as part of the East RDD project requirements.

5.0 IN SITU DEVELOPMENT PLAN – ELHT

5.1 Development Plan

The ELHT consists of three 1000-foot long heaters installed on the East RDD lease at a pad site located adjacent to East RDD Pilot (Figure 2a). The purpose of the ELHT is to test the tendency for hotspots to form along commercial mineral insulated (MI) heaters installed in a horizontal orientation. This testing supplements the data that will be generated at the East RDD Pilot by testing heaters in a nonvertical orientation and will inform Shell for future commercial design and deployment.

Testing will involve:

- Construction of a drilling pad located adjacent to and hydraulically up gradient of the 138 hydrology pad.
- Installation of three horizontal heaters in three characteristically different non-water-bearing intervals of oil shale to test heater performance. Two heaters will be installed in higher resource intervals within the Saline Zone and one heater will be installed in a high resource interval within the Illite Zone. The two heaters in the nahcolite interval will test a high nahcolite condition and a low nahcolite condition.
- Installation of deviated observer/producer well adjacent to the heater wells to provide additional pressure relief and gas production during heater testing.
- Tie in of ELHT wells to the East RDD Pilot production facilities (i.e., separator, tanks and flare system). To the extent possible, that East RDD and ELHT will utilize two distinct separators for monitoring of produced fluid volumes.
- Collection of temperature data along the entire length of the heaters during start up and ramp up of power to assess the development and severity of hotspot formation due to variation of the geothermal properties of the rock.

5.2 Development Details

5.2.1 Drilling

The ELHT well pattern (Figure 2b) consists of three horizontal heater wells and one inclined observer/producer well to provide pressure control. In addition to heating the formation during the heating phase, heater wells will also be used to control pressure in the immediate vicinity of the heater. The surface location for these wells will be in the northeast quadrant of the East RDD lease. None of the wells will be converted for dual use and no leaching is anticipated as the main objective for the ELHT pilot is to measure the response of the reservoir to heating (principally looking for the development of heater "hot spots"). All wells will be drilled, cased, and cemented prior to heater installation and ICP activities. Figure 6 shows a subsurface view of ELHT wells.

Drilling operations will require 3 or more months. A dedicated drilling pad will be built and used for this pilot. As shown on Figure 2a, the surface location of the conductors will be located less than 500 ft from the lease boundary but the downhole well trajectory during drilling (Figure 2c) will place the heated section or interval away from the property boundary in the central portion of the lease. As such, the ELHT testing will not affect any resource at or near the lease boundary. Well specifications and additional details for well construction are discussed in Section 6B.4.

Five hydrology monitoring wells were installed in 2009 in the northeast quadrant of the RDD Lease (hydrology well pad 138) as part of the East RDD. Data from these wells are being collected as part of the East RDD and provide baseline water quality in the near downgradient area that is also applicable to the ELHT. An additional groundwater monitor well (135-4-298-L4) was installed near the East RDD Pilot pattern with surface location approximately 60 ft NE of the East RDD pilot pattern. Elsewhere in the basin, Shell has drilled, tested, and sampled a considerable number of hydrology wells. These are discussed in the sections on hydrology and baseline water chemistry in this NOI Modification. The existing groundwater monitoring wells associated with the East RDD are sufficient for monitoring during the ELHT. As such, no additional hydrology wells will be drilled as part of the ELHT.

5.2.2 Nahcolite/Sodium Availability Assessment

It is important to assess the impact of the heating process on the viability of sodium recovery when heating near rich nahcolite beds. Only one of the three heater wells is drilled in a zone containing significant nahcolite:

- Heater 1 (2220 ft depth*) – 25.4 wt% Nahcolite (drilled near Greeno Bed)
- Heater 2 (2300 ft*) – 0.8 wt% Nahcolite
- Heater 3 (2400 ft) – 0.3 wt% Nahcolite (drilled in the illitic interval).

The ELHT pilot does not include a pre-leaching phase in which sodium is recovered. Instead, to assess the impact that heating will have on sodium recovery, Shell proposes to recover a core across the heat-affected zone near Heater 1 after the completion of the heating and production phase and prior to commencement of well abandonment activities. The core is expected to drill through (1) a virgin nahcolitic zone above the heated interval, (2) an upper nahcolite/soda ash transition zone, (3) a soda ash zone near the location of the heater, (4) a lower soda ash/nahcolite transition zone, and finally (5) a second virgin nahcolitic zone below the heated interval. Shell proposes to conduct lab testing on the core to map the location of the transition zones using the temperature fields from the reservoir model to establish the temperatures at which in situ conversion of the nahcolite to soda ash occurs. Shell further proposes to leach representative portions of the core in (1) the virgin nahcolitic zone, (2) the nahcolite/soda ash transition zone, and (3) the soda ash zone to determine the impact of heating on sodium recovery. Core previously cut from nearby wells (but never heated) can also be used in the study.[1]

Because of the very low nahcolite content near Heater 2 and Heater 3, no investigation on the impact that heating will have on sodium recovery is necessary and none is planned.

5.2.3 Pyrolysis and Production

Pyrolysis facilities will consist of the three heater wells, each equipped with an electric heater installed in a canister to heat the formation which will convert the in-situ kerogen adjacent to the heater into oil and gas. Each heater will be installed with temperature monitoring instrumentation. An inclined observer/producer well will be installed through the heated interval near the heater wells to provide additional pressure relief to the formation during heating.

During the heating process water (generated by the decomposition of nahcolite to soda ash), oil and gas are released from the kerogen and surrounding matrix increasing the subsurface pyrolysis interval pressure. To maintain the pressure in the pyrolysis intervals below the formation fracturing pressure, pressure will be bled from the formation by the heater wells and the observer/producer well. To remove liquids from the pyrolysis interval, an artificial lift system will be installed in the inclined observer/producer well. Any production from the heater or observer/producer wells will flow through piping connecting the well heads to a separator located at the East RDD Pilot. Produced gases will be flared, and the oil and water will be recovered from the separator and trucked off site. Diluent and makeup water obtained from the City of Meeker may be added to the production stream, the well casing, or well tubing (if needed) to assist in the production of bitumen which will form during the lower temperature phases of pyrolysis. Produced CO_2 and other non-combustible gases will be included in the stream of gas sent to the flare.

The heating phase of ELHT is expected to last for two or more years and is expected to run concurrently with heating at the East RDD Pilot.

5.2.4 Subsurface Reclamation Plan

Full details of subsurface reclamation are described in the Subsurface Reclamation Plan Section of this NOI Modification. A synopsis of activities for the ELHT follows.

Upon completion of the heater test, the pyrolyzed zones will be allowed to cool naturally. Natural cooling will be considered complete when the temperature at the heater wells falls below ~200 °F (i.e., boiling point of water at reservoir conditions). Once below ~200 °F, any subsurface equipment

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[1] *Reference 135-4-298-SAW1 well.

located in the four ELHT wells between depths of approximately 2,100 ft (~80 ft below the dissolution surface) and surface will be retrieved. From a depth of approximately 2,100 ft down and in the horizontal section, the heater canister, heater, and associated instrumentation will be left in the heater wells. A metal bridge plug will be placed within the casing just above 2,100 ft TVD, and the well casing will be plugged with cement above the bridge plug to approximately 3 ft below the ultimate reclaimed ground surface. Well casings will then be cut 3 or more feet below final ground surface, per BLM Gold Book Standards.

For ELHT the radial extent of thermal disturbance is expected to be small. Based on modeling, temperatures above 550 ^{0}F are predicted to be localized to ~2-ft radius around the heaters. As there is no thermal superposition in the heated volume, natural cooling is expected to be effective and will take approximately one year for the formation to cool to less than 200 ^{0}F. Thermocouples installed along the heater canisters will be used for temperature monitoring. Abandonment of the heater wells will be completed after the temperature of the thermocouples indicates temperature along the heaters is less than 200 ^{0}F.

5.2.5 Surface Reclamation Plan

Surface reclamation will be completed to return the disturbed site to a beneficial post-mining land use. A synopsis of the surface reclamation plan follows. Details may be found in the Reclamation section of this NOI Modification.

After the wells have been filled with cement, casings will be cut a minimum of 3 ft below the projected post grading ground surface level. Surface equipment not needed for steam recovery and oil water separation may be removed prior to or after decommissioning of the wells. Once all facilities are removed, concrete structures will be crushed on site, rebar will be removed and properly disposed off site, and concrete will be distributed evenly amongst the subsoil. Fill and cuts will be restored to approximate original contours, packed earth will be scarified, topsoil will be re-applied evenly, and the area will be re-seeded with the BLM-approved seed mix of native species.

5.3 Size, Location, Schematics of Structures, Facilities

5.3.1 Surface Facilities Descriptions

The ELHT includes minimal additional surface facilities as it largely ties into the existing facility for East RDD Pilot discussed in Section 6.3A. The new facilities consist of a well pad, a variable voltage transformer (VVT) skid and a ~600 ft long pipe rack enabling the tie in of the minimal production from the ELHT wells to the East RDD Pilot surface facility. The ELHT will be monitored and operated using the existing East RDD Pilot control system. All added operations infrastructure will be located inside the 8-foot tall game fence. This area is gated to prevent access by wildlife and the public. Reclamation of the minimal additional facilities at the ELHT will be consistent with the East RDD. Incremental reclamation costs for the ELHT will be calculated based on the addition of a new well pad containing three horizontal wells and one inclined well and the foundation associated with VVT, and piping connecting the ELHT to the East RDD surface facilities.

5.3.1.1 VVT Station

A VVT station, to be installed by Shell, will be placed inside the permit boundary, within the game fence. The substation will power all electric needs from the VVT. The majority of surface equipment will be used in all phases – heating and cooling – with minor variations in the equipment line-up.

A buried power cable from the substation will feed the VVT; other electrical service lines will be placed above ground on cable trays. Each pipe rack foundation will rest on a concrete footer.

5.3.2 Surface Equipment Summary - Heating Phase

During the heating phase, equipment discussed in Section 6B.3.2 will be utilized in addition to the equipment discussed in this section.

5.3.2.1 Electric Heaters

Three horizontal, down-hole heaters will be installed to heat the kerogen within the oil shale rock. The heater performance and the reservoir response will be monitored using the installed instrumentation connected to the East RDD control system. Heaters will be positioned far enough apart such that conversion of kerogen into oil and gas will be minimal. Converted oil and gas will be managed by the observer/producer well. Heater power and control will be supplied from the EIB, which in turn, receives power from the high voltage substation via VVT.

5.3.3 Surface Equipment Summary- Reclamation Phase

Equipment discussed in Section 6B.3.3 will also be used during the reclamation phase of the ELHT. No new equipment will be installed.

5.4 Well Construction

5.4.1 General

The ELHT Pilot utilizes two types of wells (Figures 7 and 8):

- Horizontal heater wells (3)
- Inclined observer / producer well (1).

The ELHT Pilot will not include additional drilling of down gradient ground water monitoring wells. Monitoring will be provided by the existing wells drilled between 2009-2010 in Pad 138-5-298 which include one well each in each hydrostratigraphic unit (Uinta, L7, L6, L5, and L4).

Specifications for each well type are discussed in the sections following. Table 5.1 lists the specifications for each well. Specifications listed are intended generally to provide for cement mixes to withstand both the composition (high salinity) and/or sulfate content of the wells plus the temperature fluctuations that will act on the casings and cement. Dimensions provided are for maximum pipe (casing) and drilled well dimensions, and may be decreased if feasible. Annular spaces may vary depending on the final borehole and casing size selection, but will be maintained to provide sufficient space for placement of cement.

Table 5.1: Well Specifications.

	Casing Depths (ft TVD)		Hole Size	Casing Description	Cement Design	Cement Installation Method
Horizontal Heater	Conductor	60-200 ft	17-1/2	13-3/8 in, 54.50 lbs/ft, J-55 Grade steel, STC, ID: 12.615	Premium Plus cement, 11.5 ppg, additives as required by lab test.	Cement annulus via tremmie pipe or through stab-in cementation.
	Intermediate	2,220 ft – 2,400 ft	12-1/4 in	9-5/8", 40 lbs/ft , J-55, LTC, ID: 8.835 in	Premium Plus cement, 9.5 to 11.5 ppg lead, and a 13.5 to 15.8 ppg tail, additives as required by lab test.	Mud flush, water flush, cement & displace by one plug system is used to pump cement job. Pump cement to surface.
	Heater Canister	Well TD	8-1/2 in	4-1/2", HS-70, ASTM A-606, Type 4, 0.25 WT Coiled Tubing canister containing heater and instrumentation	N/A	N/A
Inclined Producer	Surface	60-200 ft	17-1/2 in	13-3/8 in, 54.50 lbs/ft, J-55 Grade steel, STC, ID: 12.615 in	Premium Plus cement, 11.5 ppg, additives as required by lab test	Cement annulus via tremmie pipe or through stab-in cementation.
	Intermediate	2,460 ft	12-1/4 in	9-5/8", 40 lbs/ft , J-55, LTC or equivalent, ID: 8.835 in	Premium Plus cement, 9.5 to 11.5 ppg lead, and a 13.5 to 15.8 ppg tail, additives as required by lab test.	Mud flush, water flush, cement & displace by one plug system is used to pump cement job. Pump cement to surface.
	Production	Well TD	8-1/2 in	6-5/8" Slotted Liner	N/A	N/A

The project comprises three wells for heating and one well for observation and/or pressure control (Figure 6). Plans call for all wells to be drilled prior to deploying and activating any of the heaters.

The horizontal wells will be drilled with directional control from surface, with a kick off point (KOP) between 1,000 ft to 1,400 ft true vertical depth (TVD) and a build rate of 5.7°/100 ft (dog leg severity) to a maximum inclination of 90°. The horizontal section for these wells will be on the order of 1,000 ft to 1,150 ft and an inclination at well total depth (TD) between 90° and 93° to allow deploying the heaters in the formation bedding planes (up dip). The total depth of the deepest horizontal well (located at the heel) is projected to be less than 2,410 ft TVD.

The inclined well will be drilled with directional control from surface with a KOP between 200 ft to 400 ft TVD with a build rate between 5° to 10°/100 ft up to an inclination of 45° which will be maintained to TD. Total depth of the inclined well is projected to be less than 2,460 ft TVD.

Fresh water will be transported to the site from the White River the City of Meeker or other available sources for use in all drilling. Cuttings and drilling fluids will be transferred to an onsite dewatering pit where the water in the cuttings will be allowed to infiltrate back to ground water. Dewatered cuttings will be transferred to rolloff boxes and transported to applicable offsite facilities for permanent disposal. Surface and intermediate hole sections will be drilled with aerated mud and loss circulation material added as required, and the horizontal section with aerated mud and loss circulation material or common water well drilling lubricant depending on the borehole stability studies simulations which are yet to be concluded.

The wells will be constructed with pressure or temperature sensors to monitor changes in each pyrolysis interval and in the crown above upper pyrolysis interval. Geological conditions at the ELHT are very well informed by the recent drilling of Shell appraisal well 135-4-298 (SAW-1 well), the five hydrology wells on the 138-4-298 Pad, and of the 20 East RDD wells. Ground water is expected at about 250 ft depth, based on the water level in well 135-4-298 (SAW-1 well).

Wells drilled by Shell in the Piceance Basin in the past 10 years generally encountered small amounts of gas, particularly in the deeper formations. The gases contain mostly N_2 and CH_4, with lesser volumes of O_2 and CO_2 (Schatzel et al, 1987). Hydrogen and ammonia may be present. Samples collected in closed containers for up to 125 days contained up to 0.195 cm^3/g of gas.

A sulfur odor often is detected in drilling of Uinta and some of the shallow Parachute Creek wells. Although LEL (lower explosive limit) measurements are checked at all wells during drilling, and even though methane and sulfur gas occur typically, LELs have never been exceeded. If unusual gas levels are encountered, drilling will be shut down and the well will be allowed to vent.

5.4.2 Casing Cement Processes

Surface (conductor) casing will be set in cement by placement of cement directly in the annulus of the conductor, by a tremmie pipe or through a stab-in cementation in which a cement stinger is run and stab-in into a float shoe and pump cement into the annulus until returns are seen at surface. Conductor casing cement will be Type I/II premium plus cement.

Casing in all other sections will be cemented by displacement. With the displacement method, the casing is installed to the section TD then lifted a few feet off bottom to create a fluid pathway between the interior and exterior of the casing. Cement is next applied inside the casing and capped with a wiper plug. Displacement fluid (usually water) is then added to the column above the plug, providing weight that drives the cement down the casing and up the annulus until cement returns are observed at the surface.

All wells – horizontal heaters and observer/producer – will be cemented with Premium Plus cement and additives (as recommended by laboratory tests and simulations) which may include but are not limited to dispersant agents, antifoam material, fluid loss agents, silica flour and extender or retardant additives with a 9.5 to 11.5 lbs/gallon (ppg) lead, and a 13.5 to 15.8 ppg tail. Once cement returns are observed at the surface, the cement will be allowed to set for the prescribed setting time (usually 8 hours). Cement recipe and slurry weight may change depending on laboratory tests and simulations, however all efforts will be made and best practices applied to ensure proper zonal isolation on each interval.

A cement bond log and/or isolation scanner log will be run in each well after cementing. The cement bond log is an acoustic geophysical measurement that indicates the presence of cement as a measure of the degree of bonding in the annulus between casing and the drilled hole.

5.4.3 Conductor Casings

Conductor casing will be installed at all wells. Conductor size for both horizontal heaters and the producer / observer well will be 13-3/8 in with casing shoe located between 60 ft to 200 ft subsurface and penetrating 3 ft minimum into bedrock. Conductor casing specifications are:

- 13-3/8 in O.D. (54.5 lbs/ft, J-55 Grade steel, STC or equivalent)

Casing will be cemented from T.D. to surface with type I/II neat cement, placed in the annulus via tremmie pipe or through stab-in cementation using a cement stinger and a float shoe.

5.4.4 Heater Wells

The main function of the horizontal heater wells is to test the tendency for hotspots to form along the heater in three subsurface environments. For this purpose, two horizontal heater wells will be drilled in the Nahcolitic Oil Shale and one horizontal heater well in the Illitic Oil Shale. All horizontal drilling will occur below the dissolution surface. The minimum horizontal section requirement for active heating in each horizontal well is 1,000 ft with an additional pocket of 125 ft - 150 ft to compensate for the expansion of the canister during the heating process.

As presented in table 6.1, horizontal heater well design (Figure 7) will consist of a 13-3/8 in conductor set into the bedrock and cemented to surface, followed by a 12-1/4 in hole drilled to the end of the build-up section (i.e. 90° inclination) to run and cement to surface a 9-5/8 in casing containing pressure transducers and bubbler tube ported to the casing ID. An 8.5 in open hole section will then be drilled along the heated interval to run a 4.5 in sealed canister from surface to well TD which contains the three phase MI heater and an instrumentation package including thermocouples and an optical fiber.

5.4.5 Inclined Observer/Producer Well

The main function of the inclined observer/producer well is to provide monitoring and back-up pressure control of the fluids/gases generated during the heating process. This well will be drilled from the same pad as the horizontal heater wells to minimize surface disturbance. The well will be inclined at 45° inclination and will pass the deepest heater well at approximately 750 ft from the heel. The distance between the Producer / Observer well and each horizontal heater well will be between 10 ft and 15 ft subsurface.

As presented in table 6.1, Producer / Observer well design (Figure 8) will consist of a 13-3/8 in conductor set into the bedrock and cemented to surface, followed by a 12-1/4 in hole drilled through the bend section and inclined at 45° to the casing point (between 2,000 and 2,200 ft TVD) to run and cement to surface a 9-5/8 in casing string. Subsequently, an 8-1/2 in hole (inclined at 45°) will be drilled to well TD to run a 6-5/8 in slotted liner. The well will be completed with a 2-3/8 in tubing string containing a plunger lift system and instrumentation to monitor pressure and temperature at each pyrolysis interval. Instrumentation to monitor the temperature in the cap above the upper pyrolysis interval will be attached to the casing OD and cemented in place.

5.4.6 Cuttings and Drill Water Disposal

Cuttings and drilling fluids will be transported to a temporary cuttings pit located on the East RDD project site. Water contained in the cuttings and drilling fluid from above the L4 will be returned to the subsurface by means of infiltration and the dewatered solids will be loaded in portable tanks and transported to applicable offsite facilities for permanent disposal.

5.5 Development Methods, In Situ Methodology

5.5.1 Operational Phases and Timeline

The ELHT Pilot will span ~ 4 years and is run concurrently with the East RDD Pilot. Drilling, depending on the time needed for permitting and procurement of equipment, is expected to begin in late summer 2013. From an operational perspective, the East RDD Pilot and the ELHT will be combined into a single operation.

To gain maximum R&D learnings, a ~2 year extension may be requested to study the longer term heater performance in the resource.

5.5.1.1 Construction Phase

Pad construction of the ELHT will begin in late spring 2013 and is expected to be completed within 45 days. Drilling of the four wells at ELHT is expected to begin in late summer 2013 and is expected to require less than 120 days. Heater installation will follow and is expected to take less than 60 days. Construction of the ELHT is minimal as it will tie into the facilities constructed for East RDD Pilot. The tie-ins for ELHT to the East RDD Pilot are expected to take less than 90 days. There may be time intervals of as much as 120 days between some of these activities and some activities may overlap. Heating is expected to begin at ELHT in early 2014.

5.5.1.2 Heating Phase

Heating of the three wells is expected to require ~2 years to gain the required information to evaluate the test. The primary purpose of the heating is to measure the response of the reservoir to heating (principally looking for the development of heater "hot spots"). Other important geomechanical and reservoir learnings are expected within the 2-year heating period.

An additional 2-year heating period may be requested to study the longer term heater performance in the resource.

5.5.1.3 Cooling Phase

Upon completion of the heating phase, the pyrolyzed zone will be allowed to cool naturally. It is expected that natural cooling will be sufficient for the ELHT because of the relatively small volume of rock being heated. The wells will not be abandoned until the temperature at the heaters is below 200 °F.

5.5.1.4 Coring Phase

Upon completion of the cooling phase, Shell will drill a core in the heat affected zone near heater one to assess recovery of sodium minerals as described in section 6B.2.2.

5.5.2 Development Methods

Shell has selected three specific intervals to be heated based on the geological features of each interval. Isolation between individual heated intervals and the water-bearing zones above the crown is ensured in the selection of the heated intervals and the modeling and geomechanical analysis. In selecting the intervals to be heated, the following criteria were considered:

1. Expected operating conditions (pressure and temperature)
2. Crown thickness and composition
3. Fracture generation potential during heating
4. Possible changes in the structural strength of the crown due to heating
5. Extent of temperature and pressure front propagation during heating
6. Static geomechanical conditions
7. Heating induced changes in geomechanical conditions.

The intervals to be heated were selected to test Shell's heating technology under different subsurface conditions (i.e., kerogen richness, nahcolite and other mineral concentration, and clay content). The goal is to assess the impact of different subsurface environments on heater performance and the temperature variation along the heated section.

The top heated section has a crown thickness (distance from dissolution surface) of 180 ft. To minimize production and temperature (and consequent pressure) rise, the heated sections are placed far apart from each other (more than 50 ft) such that there is no temperature superposition between the three heated zones.

Nahcolite ($NaHCO_3$) near the upper most heater will begin to convert above ~200 °F to soda ash (Na_2CO_3), with water (steam) and CO_2[2] being released as a result of the mineral decomposition. Initially, kerogen will swell as bitumen is generated during the early, lower temperature phase of pyrolysis. With further heating, kerogen conversion will release water, gas, and liquid hydrocarbons. The volume of nahcolite converted to soda ash along the uppermost heater is estimated to be approximately 1,200 to 1,500 tons. The soda ash will remain in place and could be recovered later. The lower two heaters will be located in intervals with only minor amounts of nahcolite being present. As such, the additional volume of nahcolite converted to soda ash in these intervals is considered to be insignificant.

The ELHT predictive reservoir modeling suggests the pyrolysis zone extends to about 2 ft around the individual heaters. Minimal production is expected. The average reservoir pressures in the heated zones will be below the fracture propagation pressure. In addition, the depth of the heaters (>2,220 ft) provides sufficient crown thickness (180 ft) for containment. Hence crown integrity risks are negligible for the ELHT prohect.

5.5.3 Production Monitoring

The heater wells and the observer/producer well will be instrumented with pressure gauges and temperature sensors. Progress of heating will be monitored by temperature sensors along each heater well. The heater package installed in each heater well consists of MI heater cables attached to an electric cable and instrumentation to measure the temperature along the heater conveyed downhole inside a metal canister. Heaters will be activated and controlled from surface with electrical power supplied via a high voltage substation.

During the ELHT oil production is estimated to be small in volume. The observer/producer will be equipped with an artificial lift system to remove accumulated liquids (oil and water). Produced liquids will be transferred by piping to a separator located at the East RDD. The volume of oil transferred from the ELHT to the East RDD will be monitored and recorded.

Conversion of nahcolite to soda ash and/or pyrolysis of the oil shale in the well will increase the pressure during the heating phase. Pressure will be controlled by the gas production rate. If reservoir pressures cannot be reduced by producing gases through the observer/producer well or the heater wells, the heaters will be shut in to prevent over pressure. If uncorrectable problems develop in observer/producer well, which would be an extreme condition, the heaters will be turned off. Such a condition should provide ample warning as the array of pressure and temperature sensors throughout the field provide real-time continuous monitoring of all portions of the heating and production systems.

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[2] Water in the form of Steam and CO_2 will report to the gas phase of the separator at the East RDD, at surface where steam will cool to water and CO_2 will be vented.

5.5.4 Water Consumption

The water demands of the ELHT are much lower than East RDD Pilot primarily because no leaching will be conducted at ELHT. For ELHT water will be consumed primarily for drilling which for the ELHT is expected to require 4,000 to 5,500 bbls of water.

The other water uses shown in Table 6A.2 (such as dust control, construction, and domestic purposes) will also provide coverage for the ELHT. The same water sources for the East RDD will be utilized at the EHLT. Drilling water will be provided from the White River and water used for cementing will be obtained from potable water supplies in the city of Meeker or other available sources.

6.0 RECLAMATION PLAN

Reclamation activities associated with the ELHT will generally follow the reclamation activities described for the East RDD project. Updates to reclamation plan specific to the ELHT are provided below.

6.1 Surface Reclamation Plan

Surface facilities associated with the East RDD Pilot and ELHT will be removed when no longer needed to support the reclamation efforts. All chemicals will be removed from the site and properly disposed. Any remaining product and wastes will be removed as well; wastes will be disposed off-site and product will be shipped for additional treatment. Storage tanks for waste and product will be triple rinsed prior to removal with the rinse water removed from the site and properly disposed. Facilities equipment will be removed for disposal or reuse, followed by demolition of buildings and other project-related structures. Concrete building foundations will be broken up and buried on-site to a minimum depth of 3 ft. below final surface grade. Rebar and demolished building materials will be hauled to a licensed landfill facility.

Following completion of demolition of the facilities, land reclamation will begin. Soils at the ELHT will be visually inspected for evidence of petroleum contamination and removed to licensed facilities if necessary. Existing sediment control structures will control erosion and contain runoff and sediment within the project area during reclamation. Using typical earthmoving equipment, the disturbed area will be regraded to blend into surrounding pre-construction contours. Earthmoving should be limited based upon the minimal amount of cut/fill work needed to establish the facilities areas during site development work. Regraded surfaces will be ripped to 18 inches depth to alleviate excess compaction and provide a better bond between regraded overburden and replaced topsoil.

Once disturbed areas have been regraded and ripped, soil material salvaged and stockpiled during site development will be evenly redistributed over disturbed areas. Redistributed soil will then be tested to determine if amendments are necessary to ensure successful establishment of planted species. Fertilizer and other appropriate amendments, if needed, will be applied after soil placement.

Following soil replacement work, disturbed areas associated with the ELHT will be revegetated with seed mixes recommended in the BLM Resource Management Plan modified based upon site-specific data obtained during the baseline vegetation survey consistent with those approved in the East RDD

NOI. To ensure the seed mixes are free of noxious weed species, Shell adheres to BLM Instruction Memorandum No. 2006-073 entitled "Weed-Free Seed Use on Lands Administered by the BLM". Seed material will be certified weed-free and purchased from and blended by qualified producers and dealers.

6.2 Subsurface Reclamation Plan

Upon completion of pyrolysis and recovery of liquid hydrocarbons, the pyrolyzed zone will be allowed to cool naturally. Subsurface reclamation for both the East RDD Pilot and the ELHT will be considered complete once the average temperature in the reservoir falls below 200 °F. Once cooled, a metal bridge plug will be placed in each well just above the pyrolyzed reservoir, and the wells will be cemented from the bridge plug to approximately 3 ft below the ultimate reclaimed ground surface. Well casings will then be cut 3 ft or more below final ground surface; monumented with a brass marker placed in the cement at the top, and covered with soil.

7.0 SITE SAFETY AND EMERGENCY PROCEDURES

Site Safety and Emergency Procedures in place for the East RDD will be utilized and incorporated as those described in Section 9 off the approved NOI.

8.0 OTHER ISSUES

No surface subsidence is expected from ELHT as there will be no leaching and minimal production/mass removal.

FIGURES

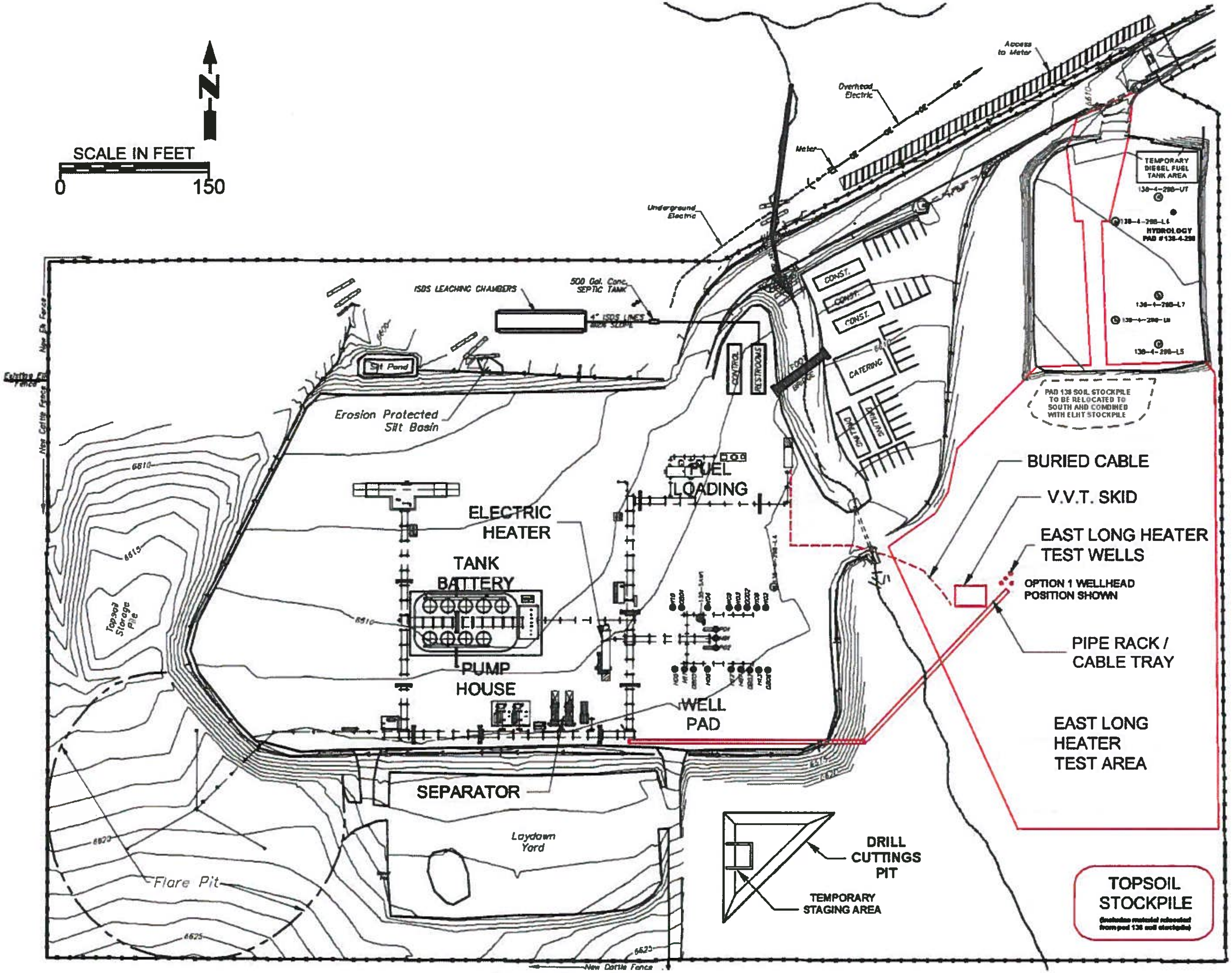


Figure 2a: ELHT Facilities Layout

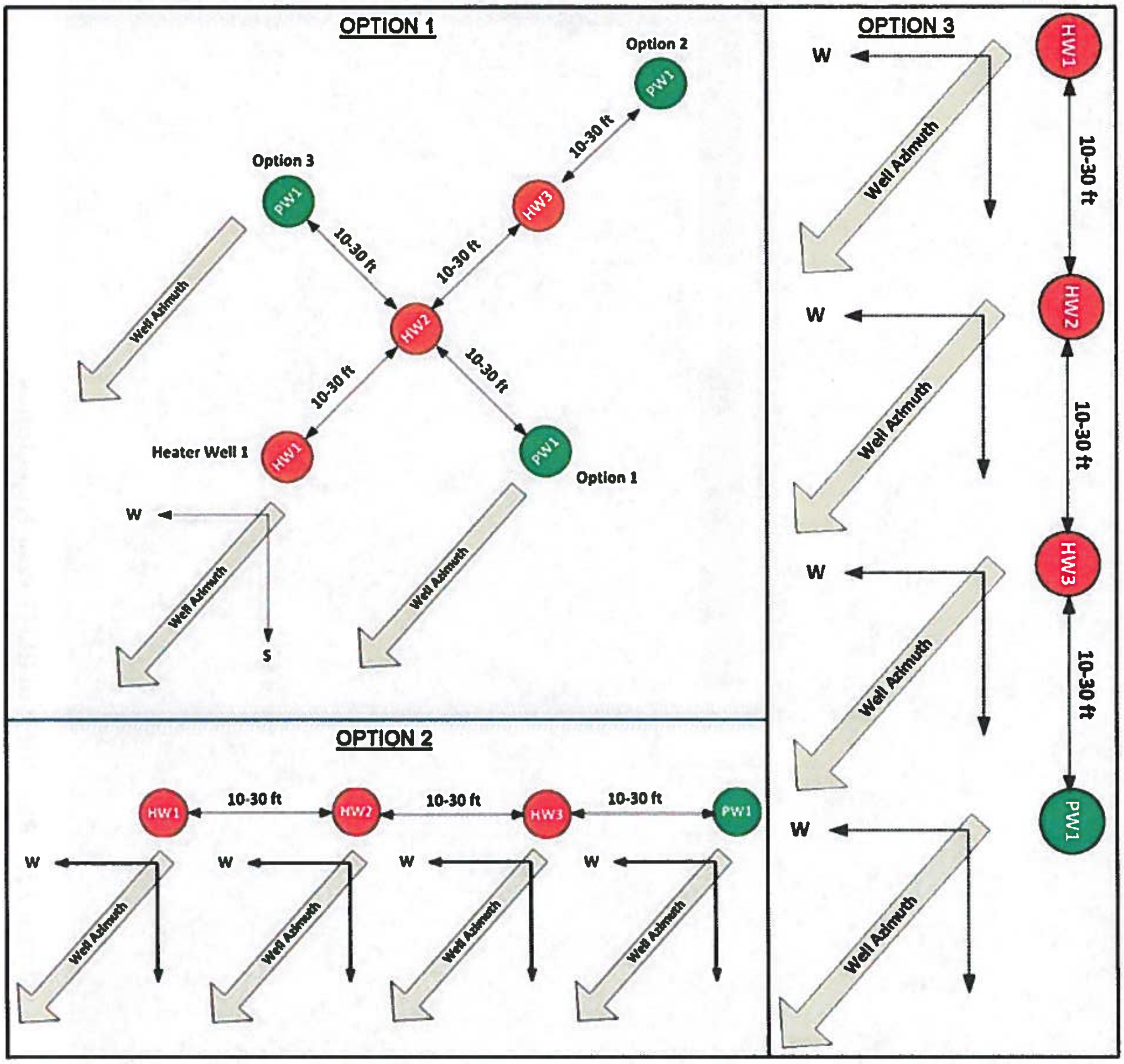


Figure 2b: ELHT Wellhead Position

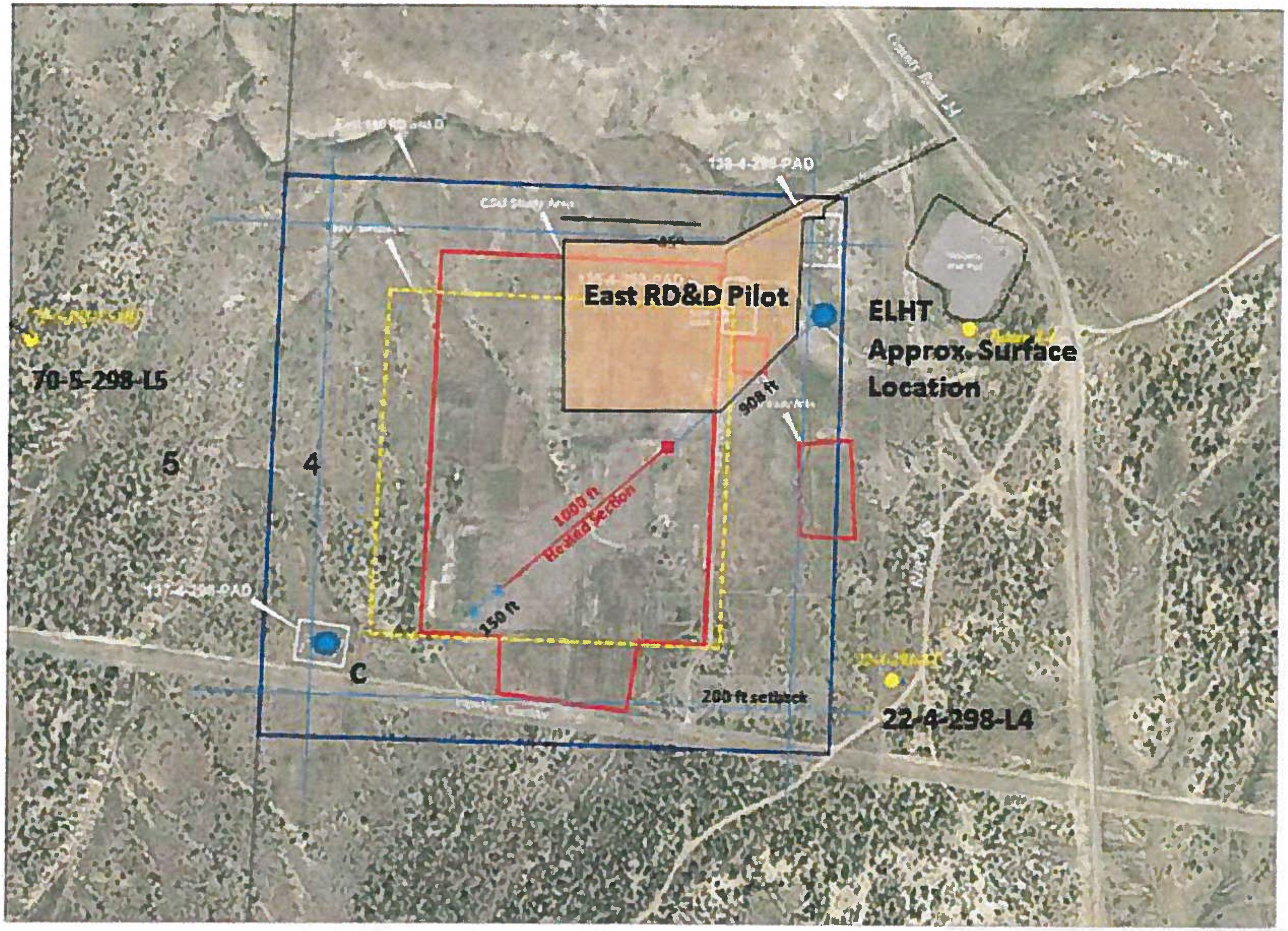


Figure 2c: Plan View of ELHT Well Trajectories

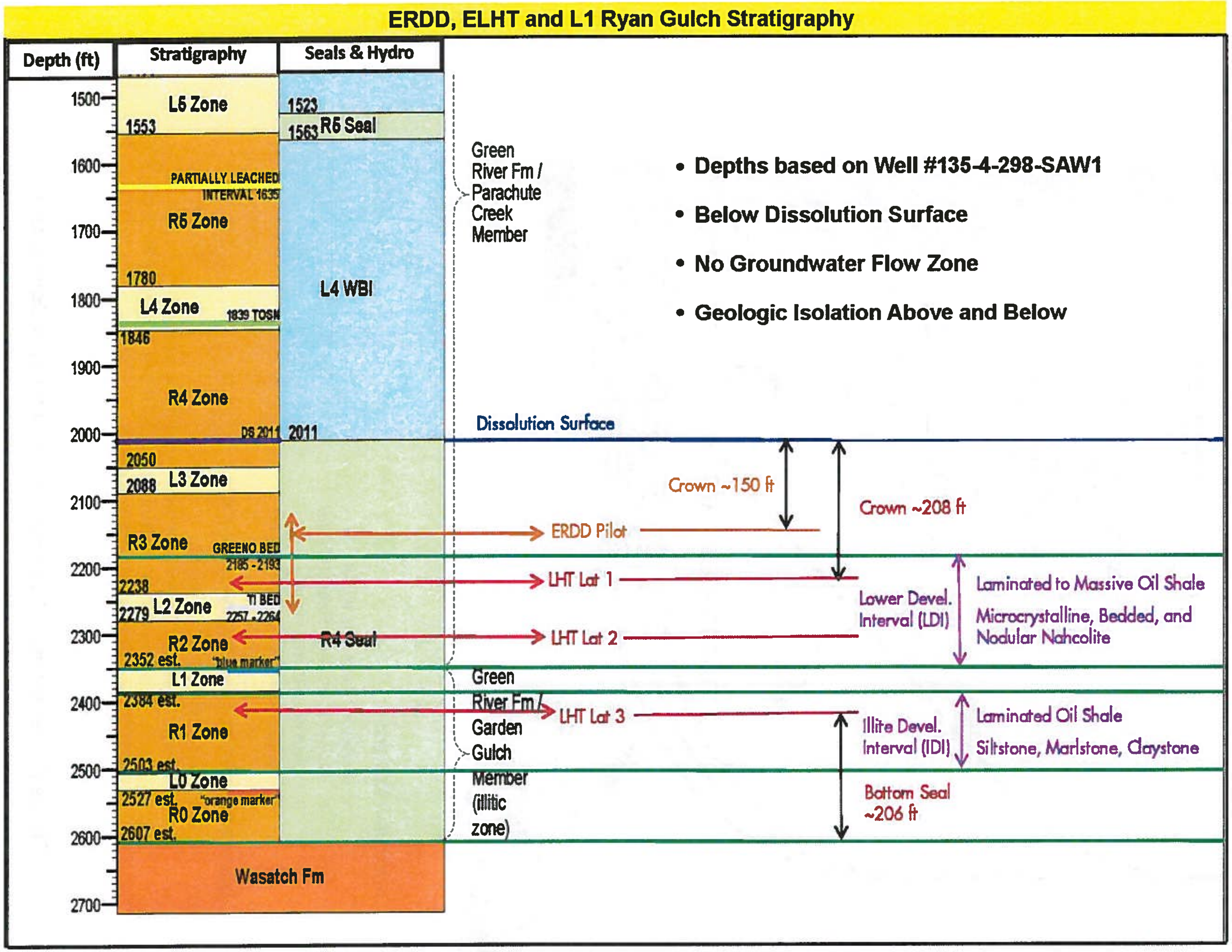
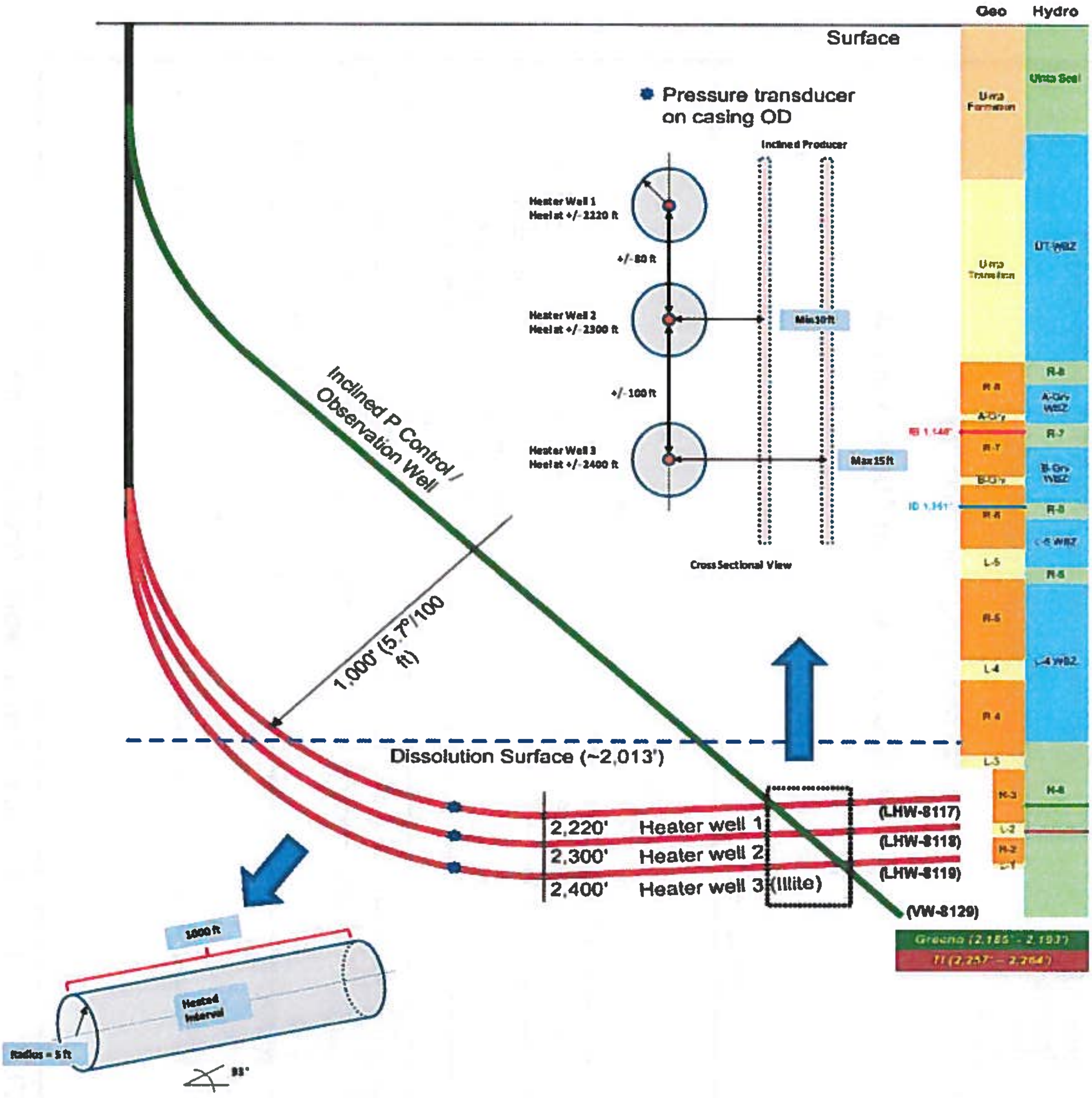


Figure 4: ERDD, ELHT and L1 Ryan Gulch Stratigraphic Cross Section



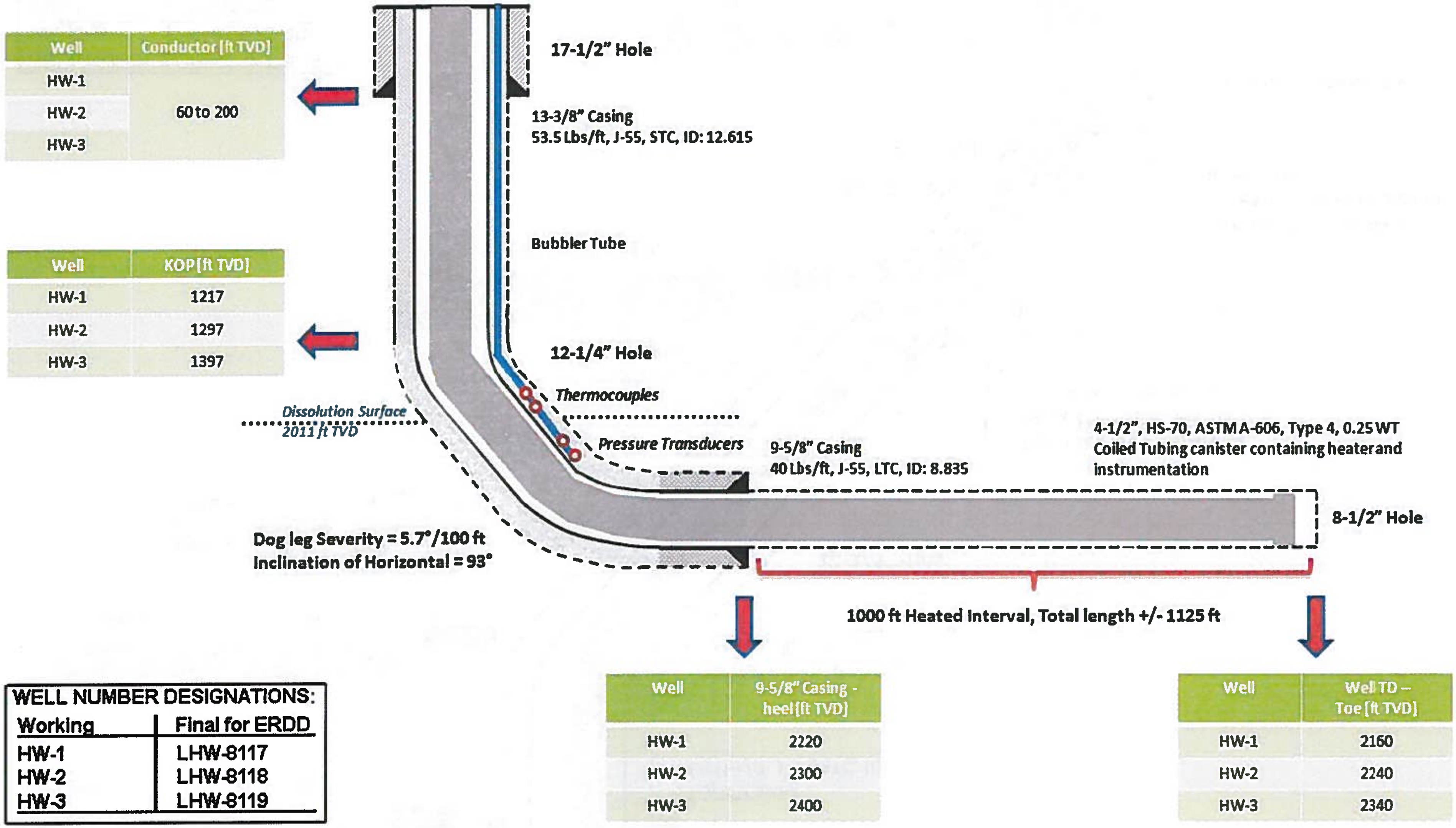
HORIZONTAL HEATERS:

1. Heated Interval length: 1000 ft.
2. Inclined 3° relative to horizontal plane.
3. Heel is deepest point in well.
4. Toe approximately 52 feet above heel.

INCLINED PRESSURE CONTROL / OBSERVATION WELL:

1. Inclined at 45° relative to vertical.
2. Distance between PC well and each Heater well: 10 ft (maximum: 15 ft).
3. Will pass deepest heater well at approximately 750 ft from the start of the heated section and 250 ft from the toe end of the heated section.

Figure 6: Schematic Cross-Section of ELHT Well Configuration



Well	Conductor [ft TVD]
HW-1	60 to 200
HW-2	
HW-3	

Well	KOP [ft TVD]
HW-1	1217
HW-2	1297
HW-3	1397

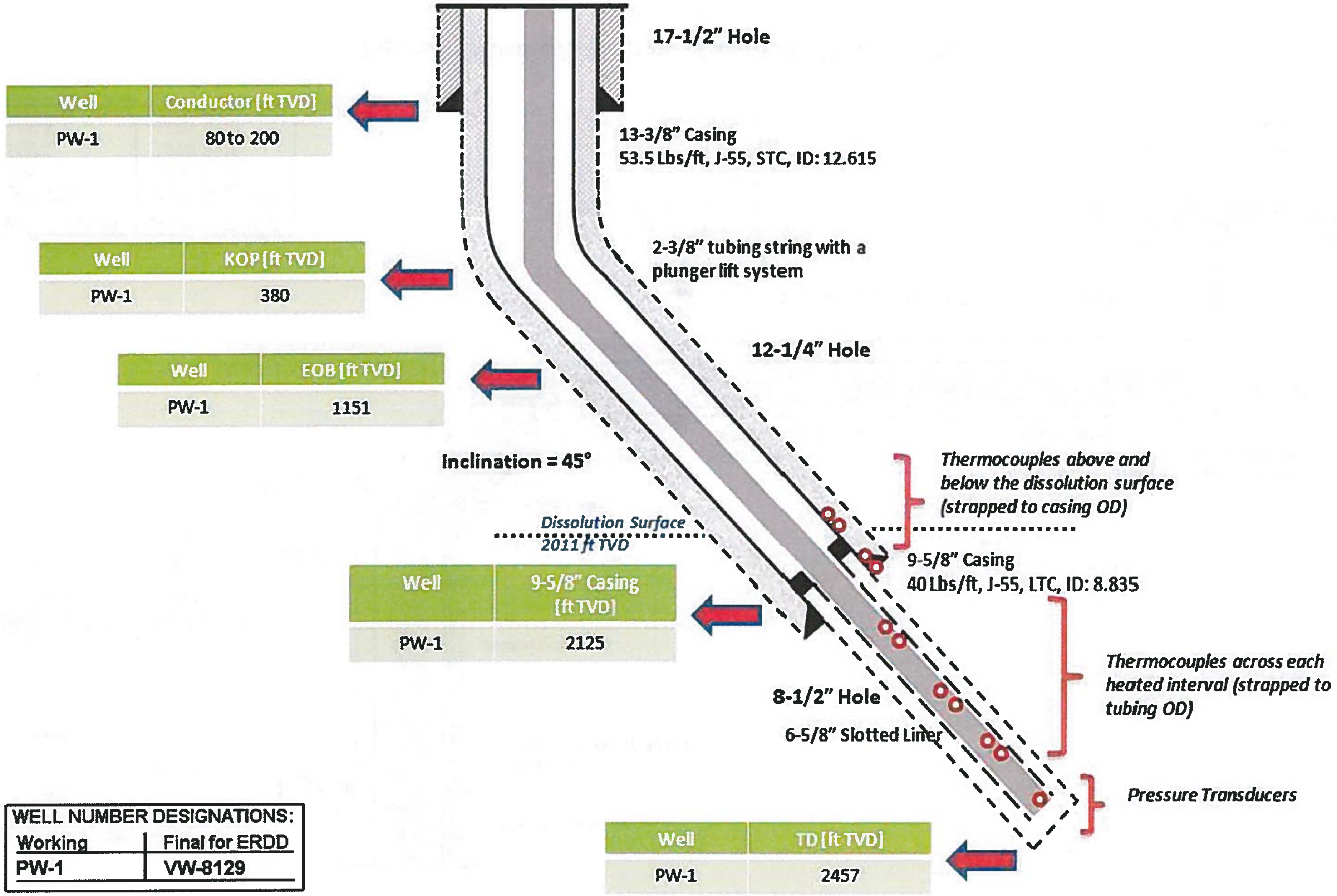
Well	9-5/8" Casing - heel [ft TVD]
HW-1	2220
HW-2	2300
HW-3	2400

Well	Well TD – Toe [ft TVD]
HW-1	2160
HW-2	2240
HW-3	2340

WELL NUMBER DESIGNATIONS:

Working	Final for ERDD
HW-1	LHW-8117
HW-2	LHW-8118
HW-3	LHW-8119

Figure 7: Schematic Diagram of an ELHT Heater Well.



Well	Conductor [ft TVD]
PW-1	80 to 200

Well	KOP [ft TVD]
PW-1	380

Well	EOB [ft TVD]
PW-1	1151

Well	9-5/8" Casing [ft TVD]
PW-1	2125

Well	TD [ft TVD]
PW-1	2457

WELL NUMBER DESIGNATIONS:

Working	Final for ERDD
PW-1	VW-8129

Figure 8: Schematic Diagram of the ELHT Inclined Observer / Producer Well.

TABLES

Shell Frontier Oil & Gas Inc.

TABLE 1 - FINANCIAL WARRANTY CALCULATION - EAST RDD NOI - MODIFICATION #3 - ELHT

COST SUMMARY

Site East RD&D Pilot Project **Date** March 5, 2013 **File** P-2010-026

Direct costs

Task No.	Description	Acres	Equipment	No. Units	Task Hours	Direct Cost
1	Structural demolition	na	Demo. crew	3	326.29	$242,044
2	Borehole P&A	na	Drill rig + crew	3	415.53	$1,256,870
3	Storm water pond backfill	na	Cat D8T - SU	3	1.87	$1,099
4	Site regrading	na	Cat D8T - SU	3	68.70	$40,298
5	Access road regrading	na	Cat D8T - SU	3	13.31	$7,809
6	Ripping	na	Cat D8T - SU	3	15.37	$9,335
7	Soil replacement	na	Cat 623G	2	40.31	$18,244
8a	Revegetation - Pinyon/Juniper ridgetop areas	3.91	Rev. crew	2	3.91	$14,055
8b	Revegetation - Mid-slope areas	9.82	Rev. crew	2	9.82	$32,117
8c	Revegetation - Upland drainage areas	1.63	Rev. crew	2	1.63	$4,861
9	Mobilization/demobilization	na	Transport rigs	27	4.00	$39,965
10	Subsurface reclamation	na	na	na	na	see below
	Totals:	15.36			900.75	$1,866,696

Indirect costs

Contractor's overhead & profit (O & P):

Liability insurance:	2.02%	of direct	$33,667
Performance bond:	1.55%	of direct	$25,834
Job superintendent:	per SUPERINTENDENT Tab		$24,045
Profit:	10.00%	of direct	$166,670
Reclamation contract amount (direct + O & P):	$1,916,911	Total O & P:	$250,215

Agency administrative costs:

CDRMS bond processing cost: - Corporate surety $500

Miscellaneous administrative costs:

Subsurface reclamation | per SUBSURFACE Tab | $544,109

DRMS Minerals Program project administration fee: 5% statutory $123,076

Total indirect costs: $917,900

Minimum required bond coverage Total: $2,584,596

Additional bond for future modifications 0.00% add-on Total: $0

Grand total bond amount $2,584,596

Table 2 - Chemicals and Fuels Used or Stored at ELHT

Name	Use	Location for Use	Location for Storage	Typical Quantities Used and/or Stored on Site	Disposal Location
M-I Gel (Bentonite)	Well drilling fluid additive	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Burial on-site
Safe-Scav HSW	Hydrogen sulfide scavenger	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Authorized disposal facility
Barite	Weighting agent	Drill pad	Non-leaking containers on drill rig	< 500 lbs.	Authorized disposal facility
Cement, standard	Used for zonal isolation and plugging	Drill pad	Bermed pad	Variable	Burial on-site
Gasoline	Fuel for light-duty vehicles	Drill pad	Non-leaking fuel tank on veicle	Capacity of vehicle fuel tank	NA - 100% of product consumed
Diesel Fuel	Fuel for drill rig, cement truck, water truck	Drill pad	Non-leaking fuel tank on vehicle	Capacity of vehicle fuel tank	NA - 100% of product consumed
Motor Oil	Lubricant for mobile equipment	Drill pad	Non-leaking reservoir on vehicle	Capacity of vehicle oil reservoir	Waste oil recycled
Engine Coolant	Engine coolant for mobile equipment	Drill pad	Non-leaking reservoir on vehicle	Capacity of vehicle engine radiator	Authorized disposal facility

Table 3 - ERDD / ELHT Water Quality Data - Drill Pad # 138-4-298 Monitoring Wells

Measured Concentrations of Select Constituents - Pad 138-4-298

WBI	Sample Date	As (mg/L)	Ba (mg/L)	B (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	TDS (mg/L)	pH[A] (standard units)
Uinta	3/10/2010	0.0065	0.026	0.12	8	0.4*	**310**	950	7.34
Uinta	6/8/2010	0.0034	0.027	0.13	9	0.3*	**320**	980	7.08
Uinta	8/18/2010	0.003	0.023	0.12	9	0.3*	**300**	1000	6.93
Uinta	11/10/2010	0.0017*	0.023	0.12	9	0.3*	**330**	710	7.31
L7	3/10/2010	0.0095	0.028	0.31	10	**8.6**	188	850	7.88
L7	6/8/2010	0.0054	0.029	0.31	11	**9.2**	175	840	7.54
L7	8/18/2010	0.0046	0.041	0.32	10	**9.1**	148	840	7.77
L7	11/9/2010	0.0034	0.027	0.31	12	**9.6**	163	830	7.78
L6	3/10/2010	**0.0493**	0.202	0.36	10	**18.5**	33	770	8.43
L6	6/8/2010	**0.0277**	0.200	0.37	11	**19.5**	20	710	8.14
L6	8/18/2010	**0.0199**	0.215	0.38	11	**19.5**	23	750	8.34
L6	11/9/2010	**0.0167**	0.205	0.38	14	**19.6**	25	760	8.36
L5	3/10/2010	<0.0005	0.228	0.32	9	**15.8**	<1	710	8.50
L5	6/8/2010	<0.0005	0.217	0.32	10	**16.1**	1*	700	8.22
L5	8/17/2010	<0.0005	0.221	0.32	9	**15.9**	1*	700	9.04
L5	11/9/2010	<0.01	0.008*	0.31	9	**16.2**	2	700	8.44
L4	11/10/2010	<0.01	**6.51**	**8.5**	**310**	**55**	<10	45000	7.61
Ground Water Standard		**0.01**	**2.0**	**5.0 C**	**250**	**2**	**250**	**1.25 X Background**	**6.5 - 8.5**

Notes:

[A] Field measurement

[B] Specific conductivity not regulated

[C] Non-agriculture standard applicable due to absence of sensitive crops

Bold values exceed agriculture, drinking water, or domestic use ground water standards

* value < Practical Quantitation Limit and > Method Detection Limit

MSDS

MATERIAL SAFETY DATA SHEET

MSDS NO. 12412 **Trade Name:** M-I GEL* **Revision Date:** 12/28/2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: M-I GEL*
Chemical Family: Mixture
Product Use: Oil well drilling fluid additive.
Emergency Telephone (24 hr.): 281-561-1600

Supplied by:
M-I L.L.C.
P.O. Box 42842
Houston, TX 77242
www.miswaco.com
Telephone Number: 281-561-1512
Prepared by: Product Safety Group

Revision Number: 4

HMIS Rating

Health: 1* **Flammability:** 0 **Physical Hazard:** 0 **PPE:** E

HMIS Key: 4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview: Caution! May cause eye, skin, and respiratory tract irritation. Long term inhalation of particulates may cause lung damage. Cancer hazard. Contains crystalline silica which may cause cancer.

Canadian Classification:
UN PIN No: Not regulated. **WHMIS Class:** D2A

Physical State: Powder. **Odor** Odorless **Color:** Tan to grey

Potential Health Effects:

Acute Effects

Eye Contact: May cause mechanical irritation
Skin Contact: May cause mechanical irritation. Long term contact can cause skin dryness.
Inhalation: May cause mechanical irritation.
Ingestion: May cause gastric distress, nausea and vomiting if ingested.

Carcinogenicity & Chronic Effects: See Section 11 - Toxicological Information.
Routes of Exposure: Eyes. Dermal (skin) contact. Inhalation.
Target Organs/Medical Conditions Aggravated by Overexposure: Eyes. Skin. Respiratory System.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
Bentonite	1302-78-9	80 - 95	No comments.
Silica, crystalline, quartz	14808-60-7	2 - 15	No comments.
Gypsum (Calcium sulfate) (CAS 7778-18-9 also applies.)	13397-24-5	0 - 1	No comments.
Silica, crystalline, Tridymite	15468-32-3	0 - 1	No comments.

4. FIRST AID MEASURES

Eye Contact:	Promptly wash eyes with lots of water while lifting eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.
Skin Contact:	Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. Get medical attention if any discomfort continues.
Inhalation:	Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:	Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.
General notes:	Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C):	NA
Flammable Limits in Air - Lower (%):	NA
Flammable Limits in Air - Upper (%):	NA
Autoignition Temperature: F (C):	NA
Flammability Class:	NA
Other Flammable Properties:	ND
Extinguishing Media:	This material is not combustible. Use extinguishing media appropriate for surrounding fire.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways.

Hazardous Combustion Products: Not determined.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Use personal protective equipment identified in Section 8.
Spill Procedures:	Evacuate surrounding area, if necessary. Wet product may create a slipping hazard. Contain spilled material. Avoid the generation of dust. Sweep, vacuum, or shovel and place into closable container for disposal.
Environmental Precautions:	Waste must be disposed of in accordance with federal, state and local laws. Do not allow to enter sewer or surface and subsurface waters.

7. HANDLING AND STORAGE

Handling:	Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Avoid generating or breathing dust. Product is slippery if wet. Use only in a well ventilated area. Wash thoroughly after handling.
Storage:	Store in dry, well-ventilated area. Keep container closed. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Bentonite	1302-78-9	80 - 95	NA	NA	NA	(1)
Silica, crystalline, quartz	14808-60-7	2 - 15	0.025 mg/m^3	see Table Z-3	NIOSH: 0.05 mg/m^3 TWA (10H day/40H wk)	(R)
Gypsum (Calcium sulfate) (CAS 7778-18-9 also applies.)	13397-24-5	0 - 1	10 mg/m^3	15 mg/m^3 (total); 5 mg/m^3 (respirable)	NA	None
Silica, crystalline, Tridymite	15468-32-3	0 - 1	0.05 mg/m^3	see Table Z-3	NA	(R)

Notes

(1) Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m^3 (Inhalable); 3 mg/m^3 (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m^3 (Total); 5 mg/m^3 (Respirable).
(R) Respirable fraction (ACGIH);
Table Z-3: PEL for Mineral Dusts containing crystalline silica are 10 mg/m^3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

Engineering Controls: Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to ensure air contamination and keep workers exposure below the applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazards present and the risk of exposure to those hazards. The PPE recommendations below are based on our assessment of the chemical hazards associated with this product. The risk of exposure and need for respiratory protection will vary from workplace to workplace and should be assessed by the user.

Eye/Face Protection:	Dust resistant safety goggles.
Skin Protection:	Wear appropriate clothing to prevent repeated or prolonged skin contact. Chemical resistant gloves recommended for prolonged or repeated contact. Use protective gloves made of: Nitrile. Neoprene.
Respiratory Protection:	All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent. If exposed to airborne particles of this product use at least a NIOSH-approved N95 half-mask disposable or re-useable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or re-useable particulate respirator.

General Hygiene Considerations:	Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Tan to grey
Odor	Odorless
Physical State:	Powder.
pH:	ND
Specific Gravity (H2O = 1):	2.3 - 2.6
Solubility (Water):	Insoluble
Melting/Freezing Point:	ND
Boiling Point:	ND
Vapor Pressure:	NA
Vapor Density (Air=1):	NA
Evaporation Rate:	NA
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame.
Materials to Avoid:	ND.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.
Hazardous Polymerization:	Will not occur

11. TOXICOLOGICAL INFORMATION

Component Toxicological Data: Any adverse component toxicological effects are listed below. If no effects are listed, no such data were found.

Ingredient	Component Toxicological Summary
Silica, crystalline, quartz	Crystalline silica is the most widely occurring of all minerals. The most common form of silica is sand. The International Agency for Research on Cancer (IARC) has designated crystalline silica in the form of quartz or cristobalite a Group 1 (carcinogenic to humans). This designation was based on an increased risk of lung cancer among crystalline silica exposed workers. IARC did note that carcinogenicity of crystalline silica in humans was not detected in all industrial circumstances studied. Further, carcinogenicity of crystalline silica may be dependent on inherent characteristics of the crystalline silica or external factors affecting its biological activity or distribution of polymorphs. (IARC Vol. 68, 1997, p. 41). The National Toxicology Program (NTP) classifies crystalline silica as "reasonably anticipated to cause cancer in humans" (6th Annual Report on Carcinogens, 1991). Long term inhalation of crystalline silica can also result in the lung disease, silicosis. Symptoms of this disease include coughing and shortness of breath. (NJ HSFS, January 1996)

Product Toxicological Information:
Long term inhalation of particulate can cause irritation, inflammation and/or permanent injury to the lungs. Illnesses such as pneumoconiosis ("dusty lung"), pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma may develop.

12. ECOLOGICAL INFORMATION

Product Ecotoxicity Data:	Contact M-I Environmental Affairs Department for available product ecotoxicity data.

Biodegration:	ND
Bioaccumulation:	ND
Octanol/Water Partition Coefficient:	ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT Shipping Description:	Not regulated for transportation by DOT, TDG, IMDG, ICAO/IATA.
Canada TDG Shipping Description:	Not regulated.
UN PIN No:	Not regulated.
IMDG Shipping Description:	Not regulated.
ICAO/IATA Shipping Description:	Not regulated.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Delayed (chronic) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Silica, crystalline, quartz	---	---	---	X	---	---	---
Silica, crystalline, Tridymite	---	---	---	X	---	---	---

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Components are listed or exempt from listing.
European Union EINECS/ELINCS - Components are listed or exempt from listing.
Japan METI ENCS - Components are listed or exempt from listing.
Korea TCCL ECL - Components are listed or exempt from listing.
Philippine PICCS - Components are listed or exempt from listing.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: D2A

16. OTHER INFORMATION

The following sections have been revised: 1, 8, 16

NA - Not Applicable, ND - Not Determined.

*A mark of M-I L.L.C.

Disclaimer:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET

MSDS No. 12308 **Trade Name:** SAFE-SCAV* HSW **Revision Date:** 05/03/2011

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name:	SAFE-SCAV* HSW
Chemical Family:	Mixture
Product Use:	Drilling fluid additive. Sulfide scavenger.
Supplied by:	M-I L.L.C. P.O. Box 42842 Houston, TX 77242 www.miswaco.slb.com
Telephone Number:	281-561-1511
Emergency Telephone (24 hr.):	281-561-1600
Prepared by:	Product Safety Group
Revision No.	5

HMIS Rating
Health: 3 **Flammability:** 2 **Physical Hazard:** 0 **PPE:** X

4=Severe, 3=Serious, 2=Moderate, 1=Slight, 0=Minimal Hazard. *Chronic effects - See Section 11. See Section 8 for Personal Protective Equipment recommendations.

2. HAZARDS IDENTIFICATION

Emergency Overview: Danger! Combustible liquid and vapor. May cause severe eye, skin and respiratory tract irritation. Prolonged contact may damage eye. May cause skin sensitization, an allergic reaction, on repeated exposure. May be harmful if absorbed through skin. May be toxic if inhaled. Vapors or mists may cause central nervous system (CNS) effects if inhaled.

Canadian Classification:
UN PIN No: UN2929 **WHMIS Class:** B3 D1A D2B

Physical State: Liquid **Color:** Amber **Odor:** Amine

Potential Health Effects:
Acute Effects

Eye Contact:	May cause severe eye irritation. Prolonged contact may damage eye.
Skin Contact:	May cause severe skin irritation. May cause skin sensitization, an allergic reaction, on repeated exposure. May be harmful if absorbed through skin. Prolonged or repeated contact may cause defatting of the skin and/or dermatitis (inflammation).
Inhalation:	May be toxic if inhaled. May cause severe respiratory irritation. May cause central nervous system (CNS) effects.
Ingestion:	May cause severe irritation of the mouth, throat, and stomach.
Carcinogenicity & Chronic Effects:	See Section 11 - Toxicological Information.
Routes of Exposure:	Eyes. Dermal (skin) contact. Dermal (skin) absorption. Inhalation.

Target Organs/Medical Conditions Aggravated by Overexposure:	Eyes. Skin. Respiratory System. Central Nervous System (CNS). Liver. Kidney. Gastrointestinal Tract.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS No.	Wt. %	Comments:
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	30-60	No comments.
Methyl alcohol	67-56-1	5-10	No comments.
Ethanolamine	141-43-5	1-5	No comments.

Composition Comments:	Component LD50 and LC50 values are provided in Section 11, if available.

4. FIRST AID MEASURES

Eye Contact:	Immediately flush eyes with large amounts of water. Look for and remove contact lenses. Continue to rinse for at least 15 minutes. Seek immediate medical attention.
Skin Contact:	Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before reuse. If irritation persists or signs of toxicity occur, seek medical attention.
Inhalation:	Move person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek immediate medical attention
Ingestion:	Dilute with 2 - 3 glasses of water or milk, if conscious. Never give anything by mouth to an unconscious person. If signs of irritation or toxicity occur seek medical attention.
General notes:	Persons seeking medical attention should carry a copy of this MSDS with them.

5. FIRE FIGHTING MEASURES

Flammable Properties

Flash Point: F (C):	125F (51C)
Flash Point Method:	SFCC
Flammable Limits in Air - Lower (%):	ND
Flammable Limits in Air - Upper (%):	ND
Autoignition Temperature: F (C):	ND
Explosion Data - Sensitivity to Mechanical Impact:	NA
Explosion Data - Sensitivity to Static Discharge:	If applicable, information is provided in Section 5 Special Fire-Fighting Procedures, Other Flammable Properties and Section 6 Spill Procedures.
Flammability Class:	II
Extinguishing Media:	Water fog, carbon dioxide, foam, dry chemical.

Protection Of Fire-Fighters:

Special Fire-Fighting Procedures: Do not enter fire area without proper personal protective equipment, including NIOSH/MSHA approved self-contained breathing apparatus. Evacuate area and fight fire from a safe distance. Water spray may be used to keep fire-exposed containers cool. Keep water run off out of sewers and waterways. Note that flammable vapors may form an ignitable mixture with air. Vapors may travel considerable distances and flash back if ignited.

Hazardous Combustion Products: Formaldehyde. Oxides of carbon and nitrogen.

Conditions of Flammability: Products are classified as flammable/combustible based on flash point as defined in the Health Canada Controlled Products Regulations, U.S. Occupational Health and Safety Administration Hazard Communication Standard and transportation regulations. See Sections 1, 2, 5, 14 and 15 for flammable/combustible classification information. Flammable/combustible materials may ignite and burn if exposed to a flame or other sources of ignition.
Other Flammable Properties: ND

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	Use personal protective equipment identified in Section 8.
Spill Procedures:	Evacuate surrounding area, if necessary. Keep personnel removed and upwind of spill. Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Shut off leak if it can be done safely. Contain spilled material. Do not allow spilled material to enter sewers, storm drains or surface waters. Absorb in vermiculite, dry sand or earth. Place into containers for disposal. Use non-sparking or explosion proof means to transfer material to containers. Note that flammable/combustible vapors may form an ignitable mixture with air. Vapors may travel considerable distances from spill and flash back, if ignited.
Environmental Precautions:	Waste must be disposed of in accordance with federal, state and local laws. In the U.S., for products with reportable quanitity (RQ) components - if the RQ is exceeded, report to National Spill Response Office at 1 800 424 8802.

7. HANDLING AND STORAGE

Handling:	Put on appropriate personal protective equipment. Avoid contact with skin and eyes. Do not inhale vapors. Use only in a well ventilated area. Ground and bond containers when transferring material. Wash thoroughly after handling.
Storage:	Store in dry, well-ventilated area. Keep container closed. Keep away from heat, sparks and flames. Store away from incompatibles. Follow safe warehousing practices regarding palletizing, banding, shrink-wrapping and/or stacking.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits (TLV & PEL - 8H TWA):

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
2, 2',2''-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	30-60	NA	NA	NA	None

Ingredient	CAS No.	Wt. %	ACGIH TLV	OSHA PEL	Other	Notes
Methyl alcohol	67-56-1	5-10	200 ppm; 250 ppm (STEL)	200 ppm; 260 mg/m^3	6000 ppm IDLH (NIOSH)	(skin)
Ethanolamine	141-43-5	1-5	3 ppm; 6 ppm (STEL)	3 ppm	30 ppm IDLH (NIOSH)	None

Notes
(skin) Potential for cutaneous absorption.

Engineering Controls: Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

Personal Protection Equipment

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazards present and the risk of exposure to those hazards. The PPE recommendations below are based on our assessment of the chemical hazards associated with this product. The risk of exposure and need for respiratory protection will vary from workplace to workplace and should be assessed by the user.

Eye/Face Protection: Wear chemical safety goggles.

Skin Protection: Wear appropriate clothing to prevent repeated or prolonged skin contact. Wear chemical resistant gloves such as nitrile or neoprene.

Respiratory Protection: All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent.

A NIOSH/MSHA approved supplied air respirator is recommended if airborne concentrations exceed exposure limits for components.

General Hygiene Considerations: Work clothes should be washed separately at the end of each work day. Disposable clothing should be discarded, if contaminated with product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Amber
Odor:	Amine
Physical State:	Liquid
pH:	10 - 11.5 (5% in IPA/water)
Specific Gravity (H2O = 1):	1.068 - 1.08 at 60F (16C)
Solubility (Water):	Soluble
Flash Point: F (C):	125F (51C)
Melting/Freezing Point:	ND
Boiling Point:	ND
Pour Point:	-35F (-37C)
Viscosity:	17 - 18 cps at 60F (16C)
Vapor Pressure:	51.7 mm Hg at 100F (38C)
Vapor Density (Air=1):	>1
Evaporation Rate:	ND
Octanol/Water Partition Coefficient:	ND
Odor Threshold(s):	ND

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Conditions to Avoid:	Keep away from heat, sparks and flame.
Materials to Avoid:	Acids. Bases. Oxidizers.
Conditions of Reactivity:	See Conditions and Materials to Avoid, if applicable.
Hazardous Decomposition Products:	For thermal decomposition products, see Section 5.
Hazardous Polymerization	Will not occur

11. TOXICOLOGICAL INFORMATION

Acute Exposure Effects, Irritation and Sensitization: See Section 2.
Chronic, Carcinogenicity, Reproductive Toxicity, Teratogenicity, Embryotoxicity, Mutagenicity Effects: See Component Toxicological Summary and Product Toxicological Information, if available.
Synergistic Products/Effects: ND

Component Toxicological Data: Any adverse component toxicological effects and acute toxicity values (LD50s, LC50s) are listed below. If no effects or acute values are listed for components, no such data were identified.

Ingredient	CAS No.	Acute Data
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	Oral LD50 : 763 mg/kg (rat) Dermal LD50 : >2000 mg/kg (rabbit); Inhalation LC50: 0.371 mg/l/4H (rat)
Methyl alcohol	67-56-1	Oral LD 50: 5682 mg/kg (rat); Dermal LD50: 15,800 mg/kg (rabbit); Inhalation LC50: 64,000 ppm/4H (rat)
Ethanolamine	141-43-5	Oral LD50: 1070 - 1190 mg/kg (rat); Dermal LD50: 2460 - 2830 mg/kg (rabbit)

Ingredient	Component Toxicological Summary
Methyl alcohol	Long term exposure to high concentrations of methanol via inhalation or skin absorption may cause adverse effects to vision, e.g., sensitivity to light or blurred vision. (HSDB) Repeated exposure to airborne concentrations of methanol in the range of 200 - 375 ppm have been associated with headaches. (Hazardtext) Inhalation of methanol vapors by female rats exposed during pregnancy caused fetotoxic effects at 10,000 ppm and birth defects at 20,000 ppm. These doses also caused maternal toxicity. Fetotoxic effects were observed in the offspring of female rats fed 20 - 35 g/kg methanol during pregnancy. These doses were also maternally toxic. (Vendor MSDS) Methanol is toxic to humans if ingested in amounts as small as 0.25 ml/kg of body weight. Ingestion of methanol can cause blindness and death in humans.
Ethanolamine	Adverse effects to the nasal tract, lungs, liver and kidney were noted in studies in which rats, guinea pigs and dogs were exposed to </= 102 ppm f this alkanolamine via inhalation for 3.5 to 13 weeks. Liver and kidney effects were also observed in rats exposed to </= 160 ppm this chemical by inhalation for 6 months. In a 4 week dietary study in rats, liver and kidney effects were observed at 640 mg/kg/day of this alkanolamine. (Vendor MSDS)

Product Toxicological Information: This product may contain or release trace amounts of formaldehyde. The U.S. Occupational Safety and Health Administration (OSHA) considers formaldehyde a suspect human carcinogen that is linked to nasal and lung cancer. OSHA specifically regulates formaldehyde under 29 CFR 1910.1048. The International Agency for Research on Cancer (IARC) has classified formaldehyde as a Group 1 carcinogen (carcinogenic to humans). The National Toxicology Program (NTP) considers formaldehyde to be reasonably anticipated to be a human carcinogen. Formaldehyde has caused genetic changes in in vitro and in vivo tests. (NTP) Exposure to formaldehyde has been linked to adverse reproductive effects in some human and animal studies. In other reproductive studies, however, no adverse effects were noted. (Meditext)
Formaldehyde may also cause skin and respiratory sensitization (allergic reaction).

12. ECOLOGICAL INFORMATION

Component Ecotoxicity Data: Component ecotoxicity data are listed below. If no data are listed, none were found in the component review.

Ingredient	CAS No.	Data
2, 2',2"-(Hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol	4719-04-4	EC50 15M: 28.9 mg/l (Photobacterium phosphoreum)
Methyl alcohol	67-56-1	LC50 96H: 29,400 mg/l (fathead minnow - 24 days old); LC50 96H: 13 mg/l (rainbow trout - fingerling); LC50 48H: 8000 mg/l (trout); EC50 5M: 43 g/l (Photobacterium phosphoreum)
Ethanolamine	141-43-5	LC50 48H: 33 - 93 mg/l (Daphnia); LC50 96H: 125 - 206 mg/l (fathead minnow); LC50 96H: 170.0 mg/l (goldfish); EC50 30M: 13.7 mg/l (Photobacterium phosphoreum)

Product Ecotoxicity Data: LC50 96H: 64 mg/l (fathead minnow); LC50 96H: 180 mg/l (sheepshead minnow)
Biodegration: ND
Bioaccumulation: ND

13. DISPOSAL CONSIDERATIONS

Waste Classification: ND

Waste Management: Under U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA), it is the responsibility of the user to determine at the time of disposal, whether the product meets RCRA criteria for the hazardous waste. This is because product uses, transformations, mixtures, processes, etc., may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

Disposal Method: Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that the containers are empty by the RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

U.S. DOT
Shipping Description: UN2929, Toxic liquids, flammable, organic, n.o.s., (contains 2, 2',2"-(hexahydro-1,3,5-triazine-1,3,5-triyl)triethanol, methyl alcohol), Class 6.1, (3), PG II.
Product (RQ): 6944 gallons (methanol)
Emergency Response Guide No.: 131
Canada TDG Shipping Description: See U.S. Shipping Description.

UN PIN No: UN2929
IMDG Shipping Description: See U.S. Shipping Description.
ICAO/IATA Shipping Description: See U.S. Shipping Description.

15. REGULATORY INFORMATION

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories: Fire hazard. Immediate (acute) health hazard.

SARA 302/304, 313; CERCLA RQ, California Proposition 65: Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Ingredient	SARA 302 / TPQs	SARA 313	CERCLA RQ	CA 65 Cancer	CA 65 Dev. Tox.	CA 65 Repro. F	CA 65 Repro. M
Methyl alcohol	---	1.0%	5000 lb (2270 kg)	---	---	---	---

International Chemical Inventories

Australia AICS - Components are listed or exempt from listing.
Canada DSL - Components are listed or exempt from listing.
China Inventory - Components are listed or exempt from listing.
European Union EINECS/ELINCS - Components are listed or exempt from listing.
Japan METI ENCS - Components are listed or exempt from listing.
Korea TCCL ECL - Components are listed or exempt from listing.
New Zealand - Components are listed or exempt from listing.
Philippine PICCS - Components are listed or exempt from listing.
U.S. TSCA - Components are listed or exempt from listing.
U.S. TSCA - No components are subject to TSCA 12(b) export notification requirements.

Canadian Classification:

Controlled Products Regulations Statement: This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Class: B3 D1A D2B

16. OTHER INFORMATION

The following sections have been revised: 1, 2, 3, 4, 7, 8, 10, 11, 12, 14, 15, 16. Format changes.

NA - Not Applicable, ND - Not Determined.

Disclaimer:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We can not make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guartantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

MATERIAL SAFETY DATA SHEET
BARITE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: BARITE

OTHER NAME: Barium sulfate

APPLICATIONS: Drilling Fluid densifier

EMERGENCY TELEPHONE: 800-438-7436 (800 GETS GEO)

SUPPLIER:
Supplied by Industrial Minerals Company
A Business Unit of GEO Drilling Fluids, Inc.
1431 Union Ave. Bakersfield, California, 93305

TELEPHONE: 661-325-5919
FAX: 661-325-5648

CONTACT PERSON: Andy Philips – Safety Officer

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	4-6 %		
Barite	7727-43-7	91-93 %		
Mica	12001-26-2	1-5 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling. This product is a/an transparent tan to powder. Slippery when wet. A nuisance dust.

ACUTE EFFECTS:

HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.
INGESTION: May cause gastric distress, nausea and vomiting if ingested.
SKIN: May be irritating to the skin.
EYES: May be irritating to the eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:

Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (?F):	N/D
FLAMMABILITY LIMIT - LOWER(%):	N/D
FLAMMABILITY LIMIT - UPPER(%):	N/D

EXTINGUISHING MEDIA:

This material is not combustible. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES:

No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:

No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS: This material is not combustible.

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6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

---

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

---

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Silica, crystalline, quartz	14808-60-7	*		0.1				mg/m^3 resp.dust
Barite	7727-43-7	15		10				mg/m^3 total dust
Mica	12001-26-2	20 mppcf *		3				mg/m^3 total dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite. * mppcf = millions of particles per cubic foot of air.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION:

Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS:

Use at least a NIOSH-approved N95 half-mask disposable or reusable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reusable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:

Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.
COLOR:	Tan to Grey.
ODOR:	Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION:	Insoluble in water.
MELT./FREEZ. POINT (?F, interval):	2876
DENSITY/SPECIFIC GRAVITY (g/ml):	4.20 - 4.25 TEMPERATURE (?F): 68
BULK DENSITY:	107 - 135 lb/cu ft; 1714 - 2163 kg/m3
VAPOR DENSITY (air=1):	N/A
VAPOR PRESSURE:	N/A TEMPERATURE (?F):

10. STABILITY AND REACTIVITY

STABILITY:

Normally stable.

CONDITIONS TO AVOID:

N/A.

HAZARDOUS POLYMERIZATION:

Will not polymerize.

POLYMERIZATION DESCRIPTION:

Not relevant.

MATERIALS TO AVOID:

N/A

HAZARDOUS DECOMPOSITION PRODUCTS:

No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:

No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ACUTE AQUATIC TOXICITY:

This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:

This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ:	N/A
U.S. DOT:	
U.S. DOT CLASS:	Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	**CAS No:**	**TSCA:**	**CERCLA:**	**SARA 302:**	**SARA 313:**	**DSL(CAN):**
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Barite	7727-43-7	Yes	No	No	No	Yes
Mica	12001-26-2	Yes	No	No	No	Yes

REPARED BY:	Andy Philips
REVISION No.:	July 10, 2006

MSDS STATUS: Approved.
DATE: July 10, 2006
DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

Holcim

MATERIAL SAFETY DATA SHEET

Material: Portland Cement

Section I - Identification

Supplier:
Name: **Holcim (US) Inc.**
Address: **6211 N. Ann Arbor Road**
Dundee, MI 48131
Telephone: **800-854-4656**

Emergency Contact Information: (CHEMTREC)
Health 1-800-424-9300
Transportation 1-800-424-9300

Product Codes: Portland Cement Type I, IA, II, III, IV, V, White Cement. CSA Type 10, 20, 30, 40, & 50. This MSDS covers many products. Individual constituents will vary.

Formula: This product consists of finely ground Portland cement clinker mixed with a small amount of calcium sulfate (gypsum).

Chemical Family: Chemical compounds. Calcium silicate components and other calcium compounds containing iron and aluminum make up the majority of this product.

Chemical Name and Synonyms: Portland cement. Portland cement is also known as hydraulic cement.

Section II - Components

Hazardous Ingredients

Component (%)	CAS No.	OSHA PEL (8-hour TWA)	ACGIH TLV-TWA (2002)
Tri-calcium silicate (20-70)	12168-85-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Di-calcium silicate (10-60)	10034-77-2	see Nuisance Dust PEL	see Nuisance Dust TLV
Tetra-calcium- alumino-ferrrite (5-15)	12068-35-8	see Nuisance Dust PEL	see Nuisance Dust TLV
Calcium sulfate (2-10)	---	see Nuisance Dust PEL	see Nuisance Dust TLV
Tri-calcium Aluminate (1-15)	12042-78-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Magnesium oxide (0-4)	1309-48-4	see Nuisance Dust PEL	see Nuisance Dust TLV
Nuisance Dusts	---	15 mg/m^3 (total dust); 5 mg/m^3 (respirable dust)	10 mg/m^3 (total dust); 3 mg/m^3 (respirable dust)
Crystalline Silica (Quartz) * (0-1%)	14808-60-7	10 mg/m^3 /percent silica + 2 (respirable dust) 30 mg total dust/m^3/percent silica + 2 (total dust)	0.10 mg/m^3
Hexavalent Chromium (measured as chromic acid and chromates)	18540-29-9	(100 mg/m3)	

Trace constituents: Portland Cement has a variable composition depending upon the cementitious products produced in the cement kiln. Small amounts of naturally occurring, but potentially harmful, chemical compounds might be detected during chemical analysis. These trace compounds might include free crystalline silica, potassium and sodium compounds; heavy metals including cadmium, chromium, nickel and lead; and organic compounds. Other trace constituents may include calcium oxide (also known as free lime or quick lime) .

Section III – Hazards Identification

Emergency Overview

Portland cement is a light gray powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure to wet portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns or an allegoric reaction. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement.

Potential Health Effects

- *Relevant Routes of Exposure:* Eye contact, skin contact, inhalation, and ingestion
- *Effects resulting from eye contact:* Exposure to airborne dust may cause immediate or delayed irritation or inflammation.

Eye contact with larger amounts of dry powder or splashes of wet Portland cement may cause effects ranging from moderate eye irritation to chemical burns and blindness. Such exposures require immediate first aid (see section IV) and medical attention to prevent significant damage to the eye.

- *Effects resulting from skin contact:* Discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing skin contact, particularly contact with wet cement. Exposed persons may not feel discomfort until hours after the exposure has ended and significant injury has occurred. Exposure to dry Portland cement may cause drying of the skin with consequent mild irritation or more significant effects attributable to aggravation of other conditions. Dry portland cement contacting wet skin or exposure to moist or wet portland cement may cause more severe skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (caustic) chemical burns. Some individuals may exhibit an allergic response (e.g., allergic contact dermatitis) upon exposure to portland cement, possibly due to trace amounts of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with the product. Other persons may experience this effect after years of contact with portland cement products.
- *Effects resulting from inhalation:* Portland cement contains small amounts of free crystalline silica. Prolonged exposure to respirable free crystalline silica can aggravate other lung conditions and cause silicosis, a disabling and potentially fatal lung disease and/or other diseases. Risk of injury or disease depends on duration and degree of exposure. (Also see "Carcinogenic potential" below.) Exposure to Portland cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.
- *Effects resulting from ingestion:* Although small quantities of dust are not known to be harmful, ill effects are possible if larger quantities are consumed. Portland cement should not be eaten.
- *Carcinogenic potential: NTP, OSHA, or IARC has not listed Portland cement as a carcinogen.* It may, however, contain trace amounts of substances listed as carcinogens by these organizations. Crystalline silica, which is present in Portland cement in small amounts, has been listed by IARC and NTP as a known human carcinogen (Group I) through inhalation. Hexavelant chromium is listed by IARC, EPA, NTP and OSHA as Group I known carcinogen by inhalation.
- *Medical conditions which may be aggravated by inhalation or dermal exposure*:
  - ■ Pre-existing upper respiratory and lung diseases
  - ■ Unusual (hyper) sensitivity to hexavalent chromium (chromium^{+6}) salts.

Section IV - First Aid

Eyes: Immediately flush eyes thoroughly with water. Continue flushing eye for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.

Skin: Wash skin with cool water and pH-neutral soap or a mild detergent. Seek medical treatment in all cases of prolonged exposure to wet cement, wet cement mixtures, wet concrete liquids from fresh cement products, or prolonged wet skin exposure to dry cement.

Inhalation of Airborne Dust: Remove to fresh air. Seek medical help if coughing or other symptoms do not subside. (Inhalation of gross amounts of portland cement requires immediate medical attention.)

Ingestion: Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section V - Fire & Explosion Data

Flash point:	*None*	Auto ignition temperature:	*Not Combustible*
Lower Explosive Limit:	*None*	Upper Explosive Limit:	*None*
Extinguishing media:	*Not Combustible*	Unusual fire & explosion hazards	*None*
Hazardous combustion products:	*None*		

Special fire fighting procedures: None. (Although portland cement poses no fire-related hazards, a self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.)

Section VI - Accidental Release Measures

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section VIII.

Scrape up wet material and place in an appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash portland cement down drains.

Dispose of waste material according to local, state, and federal regulations.

Section VII - Handling & Storage

Keep portland cement dry until used. Normal temperatures and pressures do not affect the material. Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixtures or fluids.

Section VIII - Exposure Control/Personal Protection

Skin Protection: Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened wet portland cement products. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened portland cement products might occur, wear impervious clothing and gloves to prevent skin contact. Where required, wear sturdy boots that are impervious to water to eliminate foot and ankle exposure. Do not rely on barrier creams; barrier creams should not be used in place of impervious gloves and clothing. Periodically wash areas contacted by dry portland cement or wet cement or concrete with a pH neutral soap. Wash again at the end of the work. If irritation occurs, immediately wash the affected area and seek treatment. If clothing becomes saturated with wet concrete, it should be removed and replaced with clean, dry clothing.

Respiratory protection: Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits. Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. (Advisory: Respirators and filters purchased after July 10, 1998, must be certified under 42 CFR 84.)

Ventilation: Use local exhaust or general dilution ventilation to control exposure within applicable limits.

Eye Protection: In conditions where user may be exposed to splashes or puffs of cement, wear safety glasses with side shields or goggles. In extremely dusty or unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with portland cement or fresh cement products.

Section IX - Physical & Chemical Properties

Appearance:	*Gray or white powder*	Vapor Pressure:	*Not applicable*
Odor:	*No distinct odor*	Vapor density:	*Not applicable*
Physical state:	*Solid (powder)*	Boiling point:	*Not applicable (i.e., > 1000 °C)*
pH (in water):	*12 to 13*	Melting point:	*Not applicable*
Solubility in water:	*Slightly (0.1 to 1.0%)*	Specific gravity (H_2O = 1.0):	*3.15*
Evaporation Rate:	*Not applicable*		

Section X - Stability & Reactivity

Stability: *Stable.*
Incompatibility: *Wet portland cement is alkaline. As such it is incompatible with acids, ammonium salts, and aluminum metal.*
Conditions to avoid: *Unintentional contact with water.*
Hazardous decomposition: *Will not spontaneously occur. Adding water produces (caustic) calcium hydroxide as a result of hydration.*
Hazardous polymerization: *Will not occur.*

Section XI - Toxicological Information

For a description of available, more detailed toxicological information, contact Holcim (US) Inc. (in Section I).

Section XII - Ecological Information

Ecotoxicity: *No recognized unusual toxicity to plants or animals*
Relevant physical and chemical properties: *See Sections IX & X*

Section XIII - Disposal

Dispose of waste material according to local, state, and federal regulations. (Since portland cement is stable, uncontaminated material may be saved for future use.) Dispose of bags in an approved landfill or incinerator.

Section XIV - Transportation Data

Hazardous materials description/proper shipping name: *Portland cement is not hazardous under U.S. Department of Transportation (DOT) regulations*
Hazard class: *Not applicable*
Identification class: *Not applicable*
Required label text: *Not applicable*
Hazardous substances/reportable quantities (RQ): *Not applicable*

Section XV - Other Regulatory Information

Status under USDOL-OSHA Hazard Communication Rule, 29 CFR 1910.1200:	*Portland cement is considered a "hazardous chemical" under this regulation, and should be part of any hazard communication program.*
Status under CERCLA/Superfund, 40 CFR 117 and 302:	*Not listed.*
Hazard Category under SARA (Title III), Sections 311 & 312:	*Portland cement qualifies as a "hazardous substance" with delayed health effects.*
Status under SARA (Title III) Section 313:	*Not subject to reporting requirements under section 313.*
Status under TSCA (as of May 1997):	*Some substances in portland cement are on the TSCA inventory list.*
Status under the Federal Hazardous Substances Act:	*Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.*
Status under California Proposition 65:	*WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.*
Status under Canadian Environmental Protection Act:	*Not listed.*
Workplace Hazardous Material Information System (Canada):	*Portland cement is considered to be a hazardous material under the Hazardous Product Act as defined by the Controlled Products Regulations (Class E - Corrosive Material) and is therefore subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).*

Section XVI - Other Information

Approved by:	Susan Diehl, Vice President
Revision Date:	February 9, 2005

Other Important Information: Portland cement should only be used by knowledgeable persons. While the information provided in the material safety data sheet is believed to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot anticipate and provide all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

A key to using the product safely requires the user to recognize that portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is, those present while a portland cement product is "setting") pose a more severe hazard than does portland cement itself. These hazards include potential injuries to eyes and skin.

The data furnished in this sheet do not address hazards that may be posed by other materials mixed with portland cement to produce portland cement products. Users should review other relevant material safety data sheets before working with this portland cement or with portland cement products, including, for example, portland cement concrete.

SELLER MAKES NO WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THERE OF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HOLCIM (US) INC., EXCEPT THAT THE PRODUCT SHALL CONFORM TO CONTRACTED SPECIFICATIONS.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732)750-6000
MSDS Internet Website	www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES

Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY

Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 "Low Expansion Foam - 1994 Edition."

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******
******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	**Exposure Limits** **Source**	**TWA (ppm)**	**STEL (ppm)**	**Note**
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O): Non-oxygenated gasoline - negligible (< 0.1% @ 77 °F). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 °F); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Guinea pig sensitization: negative
Acute Oral LD50 (rat): 18.75 ml/kg
Draize eye irritation (rabbits): non-irritating

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
AIHA	American Industrial Hygiene Association	OPA	Oil Pollution Act of 1990
ANSI	American National Standards Institute (212)642-4900	OSHA	U.S. Occupational Safety & Health Administration
API	American Petroleum Institute (202)682-8000	PEL	Permissible Exposure Limit (OSHA)
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act	RCRA	Resource Conservation and Recovery Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]	REL	Recommended Exposure Limit (NIOSH)
EPA	U.S. Environmental Protection Agency	SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
HMIS	Hazardous Materials Information System	SCBA	Self-Contained Breathing Apparatus
IARC	International Agency For Research On Cancer	SPCC	Spill Prevention, Control, and Countermeasures
MSHA	Mine Safety and Health Administration	STEL	Short-Term Exposure Limit (generally 15 minutes)
NFPA	National Fire Protection Association (617)770-3000	TLV	Threshold Limit Value (ACGIH)
NIOSH	National Institute of Occupational Safety and Health	TSCA	Toxic Substances Control Act
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)	TWA	Time Weighted Average (8 hr.)
		WEEL	Workplace Environmental Exposure Level (AIHA)
		WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Material Safety Data Sheet

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name : **Shell Diesel**
Recommended Uses : Fuel for on-road diesel-powered engines.

Product Code : 002D1791

Manufacturer/Supplier : **The Shell Company of Australia Limited**
(ABN 46 004 610 459)
8 Redfern Road
Hawthorn East
Victoria 3123
Australia
Telephone : +61 (0)3 9666 5444
Fax : +61 (0)3 8823 4800

Emergency Telephone Number : 1800 651 818 (within Australia only) +61 3 9663 2130 (International)

2. HAZARDS IDENTIFICATION

HAZARDOUS SUBSTANCE. NON-DANGEROUS GOODS.
Classified as hazardous according to the criteria of NOHSC, and not classified as Dangerous Goods according to the Australian Dangerous Goods Code.

Symbol(s) : Xn Harmful.
N Dangerous for the environment.
R-phrase(s) : R40 Limited evidence of carcinogenic effect.
R65 Harmful: may cause lung damage if swallowed.
R66 Repeated exposure may cause skin dryness or cracking.
R51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S-phrase(s) : S2 Keep out of the reach of children.
S36/37 Wear suitable protective clothing and gloves.
S61 Avoid release to the environment. Refer to special instructions/Safety data sheets.
S62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.
Health Hazards : Slightly irritating to respiratory system. Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache and nausea. May cause moderate irritation to skin. Repeated exposure may cause skin dryness or cracking. Harmful: may cause lung damage if swallowed. Limited evidence of carcinogenic effect.
Signs and Symptoms : If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure.
Defatting dermatitis signs and symptoms may include a burning sensation and/or a dried/cracked appearance.

Safety Hazards	: May ignite on surfaces at temperatures above auto-ignition temperature. Vapour in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapour concentrations are within the flammability range. Not classified as flammable but will burn. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire.
Environmental Hazards	: Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Additional Information	: This product is intended for use in closed systems only.
SUSDP Schedule	: Not scheduled. When packed in containers having capacity of greater than 20 litres.
SUSDP Schedule	S5. When packed in containers having capacity of less than 20 litres.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Preparation description	: Complex mixture of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons with carbon numbers predominantly in the C9 to C25 range. May also contain several additives at <0.1% v/v each. May contain cetane improver (Ethyl Hexyl Nitrate) at <0.2% v/v. May contain catalytically cracked oils in which polycyclic aromatic compounds, mainly 3-ring but some 4- to 6-ring species are present.

Hazardous Components

Chemical Identity	CAS	EINECS	Symbol(s)	R-phrase(s)	Conc.
Fuels, diesel, no.2	68476-34-6	270-676-1	Xn, N	R40; R65; R66; R51/53	< 100.00 %

Additional Information	: Dyes and markers can be used to indicate tax status and prevent fraud. Refer to chapter 16 for full text of EC R-phrases.

4. FIRST AID MEASURES

Inhalation	: Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.
Skin Contact	: Remove contaminated clothing. Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
Eye Contact	: Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.
Ingestion	: If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101 ° F (37 ° C), shortness of breath, chest

congestion or continued coughing or wheezing.

Advice to Physician : Treat symptomatically.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific Hazards : Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Carbon monoxide. Oxides of sulphur. Unidentified organic and inorganic compounds. Carbon monoxide may be evolved if incomplete combustion occurs. Will float and can be reignited on surface water. Flammable vapours may be present even at temperatures below the flash point.

Suitable Extinguishing Media : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.

Unsuitable Extinguishing Media : Do not use water in a jet.

Protective Equipment for Firefighters : Wear full protective clothing and self-contained breathing apparatus.

Additional Advice : Keep adjacent containers cool by spraying with water.

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. See Chapter 13 for information on disposal. Observe all relevant local and international regulations. Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly.

Protective measures : Do not breathe fumes, vapour. Do not operate electrical equipment. Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Use appropriate containment (of product and fire fighting water) to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment.

Clean Up Methods : For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. Shovel into a suitable clearly marked container for disposal or reclamation in accordance with local regulations.

Additional Advice : Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Local authorities should be advised if significant spillages cannot be contained. Maritime spillages should be dealt with using a Shipboard Oil Pollution Emergency Plan (SOPEP), as required by MARPOL Annex 1 Regulation 26.

7. HANDLING AND STORAGE

General Precautions : Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Prevent spillages. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Never siphon by mouth. Contaminated leather articles including shoes cannot be decontaminated and should be destroyed to prevent reuse. For comprehensive advice on handling, product transfer, storage and tank cleaning refer to the product supplier.
Maintenance and Fuelling Activities - Avoid inhalation of vapours and contact with skin.
Classified as a C1 (COMBUSTIBLE LIQUID) for the purpose of storage and handling, in accordance with the requirements of AS 1940. Refer to State Regulations for storage and transport requirements. AS 1940:2004 The storage and handling of flammable and combustible liquids.

Handling : Avoid inhaling vapour and/or mists. Avoid prolonged or repeated contact with skin. When using do not eat or drink. Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks. Earth all equipment. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. The vapour is heavier than air, spreads along the ground and distant ignition is possible.

Storage : Drum and small container storage: Drums should be stacked to a maximum of 3 high. Use properly labelled and closeable containers. Tank storage: Tanks must be specifically designed for use with this product. Bulk storage tanks should be diked (bunded). Locate tanks away from heat and other sources of ignition. Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat. Vapours from tanks should not be released to atmosphere. Breathing losses during storage should be controlled by a suitable vapour treatment system. The vapour is heavier than air. Beware of accumulation in pits and confined spaces.
Keep in a bunded area with a sealed (low permeability) floor, to provide containment against spillage. Prevent ingress of water.

Product Transfer : Avoid splash filling. Wait 2 minutes after tank filling (for tanks such as those on road tanker vehicles) before opening hatches or manholes. Wait 30 minutes after tank filling (for large storage tanks) before opening hatches or manholes. Keep containers closed when not in use. Do not use compressed air for filling, discharging or handling. Contamination resulting from product transfer may give rise to light hydrocarbon vapour in the headspace of tanks that have previously contained gasoline. This vapour may explode if there is a source of ignition. Partly filled containers present a greater hazard than those that are full, therefore handling, transfer and sampling activities need special care.

Recommended Materials : For containers, or container linings use mild steel, stainless steel. Aluminium may also be used for applications where it does not present an unnecessary fire hazard. Examples of suitable materials are: high density polyethylene (HDPE) and Viton (FKM), which have been specifically tested for compatibility with this product. For container linings, use amine-adduct cured epoxy paint. For seals and gaskets use: graphite, PTFE, Viton A, Viton B.

Unsuitable Materials : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Examples of materials to avoid are: natural rubber (NR), nitrile rubber (NBR), ethylene propylene rubber (EPDM), polymethyl methacrylate (PMMA), polystyrene, polyvinyl chloride (PVC), polyisobutylene.; However, some may be suitable for glove materials.

Container Advice : Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.

Additional Information : Ensure that all local regulations regarding handling and storage facilities are followed.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

Naphthalene	AU OEL	TWA	10 ppm	52 mg/m3	
	AU OEL	STEL	15 ppm	79 mg/m3	
Oil mist, mineral	AU OEL	TWA [Mist.]		5 mg/m3	

Additional Information : In the absence of a national exposure limit, the American Conference of Governmental Industrial Hygienists (ACGIH) recommends the following values for Diesel Fuel: TWA - 100 mg/m3 Critical effects based on Skin and Irritation.

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Eye washes and showers for emergency use.

Personal Protective Equipment	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers. AS/NZS 1337: Eye protectors for industrial applications. AS/NZS 2161: Occupational protective gloves - Selection, use and maintenance. AS/NZS 1715: Selection, use and maintenance of respiratory protective devices. AS/NZS 1716: Respiratory protective devices.
Respiratory Protection	If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. All respiratory protection equipment and use must be in accordance with local regulations.
Hand Protection	Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Select gloves tested to a relevant standard (e.g. Europe EN374, US F739). When prolonged or frequent repeated contact occurs, Nitrile gloves may be suitable. (Breakthrough time of > 240 minutes.) For incidental contact/splash protection Neoprene, PVC gloves may be suitable.
Eye Protection	Chemical splash goggles (chemical monogoggles). Approved to EU Standard EN166.
Protective Clothing	Chemical resistant gloves/gauntlets, boots, and apron (where risk of splashing).
Monitoring Methods	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.
Environmental Exposure Controls	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Yellow. Pale straw. Colourless. Liquid.
Odour	May contain a reodorant
pH	Data not available
Initial Boiling Point and Boiling Range	170 - 390 °C / 338 - 734 °F
Freezing/melting point	Data not available
Flash point	Typical 63 °C / 145 °F (ASTM D-93 / PMCC)
Lower / upper Flammability	1 - 6 %(V)

or Explosion limits
Auto-ignition temperature : > 220 °C / 428 °F
Vapour pressure : < 1 hPa at 20 °C / 68 °F
Specific gravity : Data not available
Density : Typical 0.84 g/cm3 at 15 °C / 59 °F
Solubility in other solvents : Data not available
n-octanol/water partition coefficient (log Pow) : 3 - 6
Kinematic viscosity : 2 - 4.5 mm2/s at 40 °C / 104 °F
Vapour density (air=1) : Data not available

10. STABILITY AND REACTIVITY

Stability : Stable under normal conditions of use.
Conditions to Avoid : Avoid heat, sparks, open flames and other ignition sources.
Materials to Avoid : Strong oxidising agents.
Hazardous Decomposition Products : Hazardous decomposition products are not expected to form during normal storage.
Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment : Information given is based on product data, a knowledge of the components and the toxicology of similar products.
Acute Oral Toxicity : Low toxicity:LD50 >2000 mg/kg, Rat
Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.
Acute Dermal Toxicity : Low toxicity:LD50 >2000 mg/kg, Rabbit
Acute Inhalation Toxicity : Low toxicity: LC50 >5 mg/l / 4 h, Rat
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.
Skin Irritation : May cause moderate skin irritation (but insufficient to classify).
Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis.
Eye Irritation : Slightly irritating.
Respiratory Irritation : Slightly irritating.
Sensitisation : Not a skin sensitiser.
Repeated Dose Toxicity : Kidney: caused kidney effects in male rats which are not considered relevant to humans
Mutagenicity : In-vitro mutagenicity studies show that mutagenic activity is related to 4-6 ring polycyclic aromatic content.
Carcinogenicity : Limited evidence of carcinogenic effect.
Repeated skin contact has resulted in irritation and skin cancer in animals.
Reproductive and Developmental Toxicity : Not expected to be a developmental toxicant.

12. ECOLOGICAL INFORMATION

Information given is based on a knowledge of the components and the ecotoxicology of similar products. Fuels are typically made from blending several refinery streams. Ecotoxicological studies have been carried out on a variety of hydrocarbon blends and streams but not those containing additives.

Acute Toxicity	: Toxic:LL/EL/IL50 1-10 mg/l(to aquatic organisms)(LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract).
Mobility	: Floats on water. Partly evaporates from water or soil surfaces, but a significant proportion will remain after one day. Large volumes may penetrate soil and could contaminate groundwater. Contains volatile constituents.
Persistence/degradability	: Major constituents are inherently biodegradable. The volatile constituents will oxidize rapidly by photochemical reactions in air.
Bioaccumulation	: Contains constituents with the potential to bioaccumulate.
Other Adverse Effects	: Films formed on water may affect oxygen transfer and damage organisms.

13. DISPOSAL CONSIDERATIONS

Material Disposal	: Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do not dispose into the environment, in drains or in water courses. Do not dispose of tank water bottoms by allowing them to drain into the ground. This will result in soil and groundwater contamination. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Container Disposal	: Send to drum recoverer or metal reclaimer. Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard if heated above the flash point. Do not puncture, cut or weld uncleaned drums. Do not pollute the soil, water or environment with the waste container. Comply with any local recovery or waste disposal regulations.
Local Legislation	: Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be complied with.

14. TRANSPORT INFORMATION

ADG

This material is not classified as dangerous according to the Australian Dangerous Goods Code.

IMDG

Identification number	UN 3082
Proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.
Technical name	(Gas oil - unspecified)
Class / Division	9
Packing group	III
Marine pollutant:	Yes

IATA (Country variations may apply)

UN No. : 3082
Proper shipping name : Environmentally hazardous substance, liquid, n.o.s.
Technical name : (Gas oil - unspecified)
Class / Division : 9
Packing group : III

Additional Information : Not classified under ADG 07 regulations as special provision AU 02 applies

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

SUSDP Schedule : Not scheduled. When packed in containers having capacity of greater than 20 litres.

S5. When packed in containers having capacity of less than 20 litres.

AICS : All components are listed or exempt

Classification triggering components : Contains fuels, diesel.

Other Information : National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011] List of Designated Hazardous Substances [NOHSC:10005]. Approved Criteria for Classifying Hazardous Substances [NOHSC:1008]. Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003]. Australian Dangerous Goods Code. Standard Uniform Scheduling of Drugs and Poisons.

16. OTHER INFORMATION

Additional Information : This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety matters.

R-phrase(s)

R40	Limited evidence of carcinogenic effect.
R51/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R65	Harmful: may cause lung damage if swallowed.
R66	Repeated exposure may cause skin dryness or cracking.

MSDS Version Number : 1.0

MSDS Effective Date : 12.04.2010

MSDS Revisions : A vertical bar (|) in the left margin indicates an amendment from the previous version.

MSDS Regulation :

Uses and Restrictions : This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.
This product is not to be used as a solvent or cleaning agent; for lighting or brightening fires; as a skin cleanser.

MSDS Distribution : The information in this document should be made available to all who may handle the product.

Disclaimer : This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

MATERIAL SAFETY DATA SHEET

QUAKER STATE® PEAK PERFORMANCE CONVENTIONAL MOTOR OIL - ALL GRADES

1. PRODUCT AND COMPANY IDENTIFICATION

MSDS Number: 14938
Version Date: 07/16/02

Product Name: QUAKER STATE® PEAK PERFORMANCE CONVENTIONAL MOTOR OIL - ALL GRADES
Product Use: Engine oil
Synonyms: 5W-30, 10W-30, 10W-40, 20W-50, 15W-40

Company Information
SOPUS Products
P.O. Box 4427
Houston, TX 77210-4427
USA

Phone Numbers
Medical Emergency: 1-800-546-6040
Transportation Emergency (USA): 1-800-424-9300
Transportation Emergency (International): 1-703-527-3887 (Call Collect)
MSDS Assistance: 1-800-546-6227
Fax On Demand: 1-800-546-6227
Technical Assistance: 1-800-458-4998
Customer Service: 1-800-468-8397
Fax Number: 713-217-3181
Internet Address: www.MSDS.PZLQS.com

2. COMPONENT INFORMATION

Component	CAS No.	Weight Percent Range	Hazardous in Blend
HYDROTREATED HEAVY PARAFFINIC PETROLEUM DISTILLATES	64742-54-7	< 70	No
SOLVENT-DEWAXED HEAVY PARAFFINIC DISTILLATE	64742-65-0	< 70	No
DETERGENT/DISPERSANT	MIXTURE	5 - 10	No
VISCOSITY MODIFIER	9003-29-6	< 10	No
POUR POINT DEPRESSANT	MIXTURE	< 2	No

Under normal conditions of use or in a foreseeable emergency, this product does not meet the definition of a hazardous chemical when evaluated according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Other: No information available

3. HAZARDS IDENTIFICATION

Emergency and Hazards Overview
CAUTION: Contains Petroleum Lubricant. Repeated skin contact can cause skin disorders.

ATTENTION: Used motor oil is a possible skin cancer hazard based on animal data. Repeated exposure to oil mist in excess of the OSHA limit (5mg/m3) can result in accumulation of oil droplets in pulmonary tissue.

NFPA Ratings: **Health** 1 **Flammability** 1 **Reactivity** 0

Primary Route of Exposure: **Skin** X **Inhalation** -- **Eye** X

Health Effect Information

Eye Contact: This product is practically non-irritating to the eyes upon direct contact. Based on testing of similar products and/or components.

Skin Contact: Avoid skin contact. This product is minimally irritating to the skin upon direct contact. Based on testing of similar products and/or components. Prolonged or repeated contact may result in contact dermatitis which is characterized by dryness, chapping, and reddening. Prolonged or repeated contact may result in oil acne which is characterized by blackheads with possible secondary infection. Avoid prolonged and repeated skin contact with used motor oils. See Section 11 - Toxicological Information.

Inhalation: This product has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting of this product. On rare occasions, prolonged and repeated exposure to oil mist poses a risk of pulmonary disease such as chronic lung inflammation. Signs of respiratory effects vary with concentration and length of exposure and include nasal discharge, sore throat, coughing, bronchitis, pulmonary edema and difficulty breathing. Shortness of breath and cough are the most common symptoms.

Ingestion: Do not ingest. This product is relatively non-toxic by ingestion. This product has laxative properties and may result in abdominal cramps and diarrhea. Exposure to a large single dose, or repeated smaller doses, may lead to lung aspiration, which can lead to lipid pneumonia or chronic lung inflammation. These are low-grade, chronic localized tissue reactions.

Medical Conditions Aggravated by Exposure: Drying and chapping may make the skin more susceptible to other irritants, sensitizers and disease.

Other: No information available

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4. FIRST AID INFORMATION

Eye Contact: Immediately flush eyes with large amounts of water and continue flushing until irritation subsides. If material is hot, treat for thermal burns and seek immediate medical attention.

Skin Contact: No treatment is necessary under ordinary circumstances. Remove contaminated clothing. Wash contaminated area thoroughly with soap and water. If material is hot, submerge injured area in cold water. If victim is severely burned, remove to a hospital immediately.

Inhalation: This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions. If vapor or mist is generated when the material is heated, and the victim experiences signs of respiratory tract irritation, remove to fresh air.

Ingestion: No treatment is necessary under ordinary circumstances. Do not induce vomiting. If victim exhibits signs of lung aspiration such as coughing or choking, seek immediate medical assistance.

Notes to Physician: No information available

Other: No information available

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5. FIRE AND EXPLOSION INFORMATION

Flammable Properties
Flash Point: 415 F, 212.8 C — **Test Method:** ASTM 3278 - Closed Cup
Flammable Limits in Air
Upper Percent: No data available
Lower Percent: No data available
Autoignition Temperature: No data available — **Test Method:** No information available

NFPA Classification: Class III-B combustible liquid

Extinguishing Media: Use dry chemical, foam, or carbon dioxide.

Fire Fighting Measures

Special Fire Fighting Procedures and Equipment: Water may be ineffective but can be used to cool containers exposed to heat or flame to prevent vapor pressure buildup and possible container rupture. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid.

Unusual Fire and Explosion Conditions: Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

Hazardous Combustion By-Products: None

Other: No information available

6. ACCIDENTAL RELEASE MEASURES

Personnel Safeguards: Consult Health Effect Information in Section 3, Personal Protection Information in Section 8, Fire and Explosion Information in Section 5, and Stability and Reactivity Information in Section 10.

Regulatory Notifications: Notify appropriate authorities of spill.

Containment and Clean up: Contain spill immediately. Do not allow spill to enter sewers or watercourses. Absorb with appropriate inert material such as sand, clay, etc. Large spills may be picked up using vacuum pumps, shovels, buckets, or other means and placed in drums or other suitable containers.

Other: No information available

7. HANDLING AND STORAGE INFORMATION

Handling: Fire extinguishers should be kept readily available. See NFPA 30 and OSHA 1910.106--Flammable and Combustible Liquids.

Storage: Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials.

Empty Container Warnings

Drums: Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner, or properly disposed.

Plastic: Empty container may retain product residues.

Other: No information available

8. EXPOSURE CONTROLS / PERSONAL PROTECTION INFORMATION

Exposure Limits and Guidelines

This product does not contain any components with OSHA or ACGIH exposure limits.

Personal Protective Equipment

Eye/Face Protection: Eye protection is not required under conditions of normal use. If material is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

Skin Protection: No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot material, use insulated protective clothing (boots, gloves, aprons, etc.). Launder soiled clothes. Properly dispose of contaminated leather articles including shoes, which cannot be decontaminated.

Respiratory Protection: Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the material is heated or handled, use an organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. Do not use compressed oxygen in hydrocarbon atmospheres.

Personal Hygiene: Consumption of food and beverage should be avoided in work areas where hydrocarbons are present. Always wash hands and face with soap and water before eating, drinking, or smoking.

Engineering Controls / Work Practices

Ventilation: If vapor or mist is generated when the material is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure or flammable limits.

Other: The OSHA permissible exposure limit (PEL) and ACGIH threshold limit value (TLV) for oil mist is 5 mg/m3. The ACGIH short-term exposure limit (STEL) for oil mist is 10 mg/m3.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Amber to dark amber	
Odor: Hydrocarbon - mild	**Vapor Pressure:** No data available
Physical state: Liquid	**Vapor Density (air=1):** No data available
pH: No data available	**Percent Volatile by Volume:** No data available
Boiling Point: No data available	**Volatile Organic Content:** No data available
Melting Point: No data available	**Molecular Weight:** No data available
Specific Gravity: 0.88 - 0.9 @ 16 C / 60 F	**Average Carbon Number:** No data available
Pour Point: -15 F, -26.1 C	**Viscosity @ 100 F:** No data available
	Viscosity @ 40 C: No data available
Solubility in Water: Negligible in water	
Octanol / Water Coefficient: Log K_{ow} = No data available	

10. STABILITY AND REACTIVITY INFORMATION

Chemical Stability: Stable

Conditions to Avoid: High heat and open flames.

Incompatible Materials to Avoid: May react with strong oxidizing agents.

Other: No information available

11. TOXICOLOGICAL INFORMATION

Primary Eye Irritation: No information available

Primary Skin Irritation: No information available

Acute Dermal Toxicity: No information available

Subacute Dermal Toxicity: No information available

Dermal Sensitization: No information available

Inhalation Toxicity: No information available

Inhalation Sensitization: No information available

Oral Toxicity: No information available

Mutagenicity: No information available

Carcinogenicity: The International Agency for Research on Cancer (IARC) has concluded that there is inadequate data to evaluate the carcinogenicity to experimental animals of this class of product. IARC has concluded there is sufficient evidence that used gasoline-engine motor oils produce skin tumors in experimental animals. Also, IARC has determined this class of products belongs to Group 3-"not classifiable as to its carcinogenicity to humans".

Reproductive and Developmental Toxicity: No information available

Teratogenicity: No information available

Immunotoxicity: No information available

Neurotoxicity: No information available

Other: No information available

12. ECOLOGICAL INFORMATION

Aquatic Toxicity: No information available

Terrestrial Toxicity: No information available

Chemical Fate and Transport: No information available

Other: No information available

13. DISPOSAL INFORMATION

Regulatory Information: All disposals must comply with federal, state, and local regulations. The material, if spilled or discarded, may be a regulated waste. Refer to state and local regulations. Caution! If regulated solvents are used to clean up spilled material, the resulting waste mixture may be regulated. Department of Transportation (DOT) regulations may apply for transporting this material when spilled.

Waste Disposal Methods: Waste material may be landfilled or incinerated at an approved facility. Materials should be recycled if possible.

Other: No information available

14. TRANSPORTATION INFORMATION

U.S. Department of Transportation (DOT)
Highway / Rail (Bulk): Not Regulated
Highway / Rail (Non-Bulk): Not Regulated

For US shipments, US DOT law requires the shipper to determine the proper shipping description of the material that is being shipped. The shipping information and description contained in this section may not be suitable for all shipments of this material, but may help the shipper determine the proper shipping description for a particular shipment.

International Information

Vessel:	**IMDG Regulated:**	–	**IMDG Not Regulated:**	X
Air:	**ICAO Regulated:**	–	**ICAO Not Regulated:**	X

Other: No information available

15. Regulatory Information

Regulatory Lists Searched: **The components listed in Section 2 of this MSDS were compared to substances that appear on the following regulatory lists. Each list is numerically identified. See Regulatory Search Results below.**

Health & Safety: 10 - IARC carcinogen, 11 - NTP carcinogen, 12 - OSHA carcinogen, 15 - ACGIH TLV, 16 - OSHA PEL, 17 - NIOSH exposure limit, 20 - US DOT Appendix A, Hazardous substances, 22 - FDA 21 CFR Total food additives, 23 - NFPA 49 or 325

Environmental: 30 - CAA 1990 Hazardous air pollutants, 31 - CAA Ozone depletors, 33 - CAA HON rule, 34 - CAA Toxic substance for accidental release prevention, 35 - CAA Volatile organic compounds (VOC's) in SOCMI, 41 - CERCLA / SARA Section 302 extremely hazardous substances, 42 - CERCLA / SARA Section 313 emissions reporting, 43 - CWA Hazardous substances, 44 - CWA Priority pollutants, 45 - CWA Toxic pollutants, 46 - EPA Proposed test rule for hazardous air pollutants, 47 - RCRA Basis for listing - Appendix VII, 48 - RCRA waste, 49 - SDWA - (S)MCLs

International: 50 - Canada - WHMIS Classification of substance, 54 - Mexico - Drinking water - ecological criteria, 55 - Mexico - Wastewater discharges, 56 - US -TSCA Section (12)(b) - export notification

State Lists: 60 - CA - Proposition 65, 61 - FL - Substances, 62 - MI - Critical materials, 63 - MA - RTK, 64 - MA - Extraordinarily hazardous substances, 65 - MN - Hazardous substances, 66 - PA - RTK, 67 - NJ - RTK, 68 - NJ - Environmental hazardous substances, 69 - NJ - Special hazardous substances

Inventories: 80 - Canada - Domestic substances , 81 - European - EINECS, 82 - Japan - ENCS, 83 - Korea - Existing and evaluated chemical substances, 84 - US - TSCA , 85 - China Inventory

Regulatory Search Results:
HYDROTREATED HEAVY PARAFFINIC PETROLEUM DISTILLATES: 80, 81, 83, 84, 85
SOLVENT-DEWAXED HEAVY PARAFFINIC DISTILLATE: 80, 81, 83, 84, 85
VISCOSITY MODIFIER: 35, 80, 83, 84, 85

U.S. TSCA Inventory: All components of this material are on the US TSCA Inventory.

SARA Section 313: This product is not known to contain any SARA, Title III, Section 313 Reportable Chemicals at or greater than 1.0% (0.1% for carcinogens).

IARC: No information available

SARA 311 / 312 Categories
Acute: -- **Chronic:** -- **Fire:** -- **Pressure:** -- **Reactive:** --
Not Regulated: X

Canadian WHMIS Classification
Not a controlled substance under WHMIS

European Union Classification
Hazard Symbols:
No classification recommended
Risk Phrases:
No classification recommended
Safety Phrases:
No classification recommended

Other: No information available

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16. OTHER INFORMATION

Health and Environmental Label Language

WARNING: Continuous contact with used gasoline engine oils has caused skin cancer in animal tests.
ATTENTION: Prolonged or repeated skin contact may cause oil acne or dermatitis. Repeated exposure to oil mist in excess of the OSHA limit (5mg/m3 can result in accumulation of oil droplets in pulmonary tissue.

Precautionary Measures: Avoid prolonged or repeated contact with eyes, skin and clothing. Avoid generation and inhalation of oil mists.

First Aid: Skin Contact: Wash skin with soap and water. Launder soiled clothes and discard oil-soaked shoes. If irritation persists seek medical attention. Eye Contact: Flush with water. If irritation persists seek medical attention. Ingestion: Do not induce vomiting. In general, no treatment is necessary unless large quantities of product are ingested. If discomfort persists seek medical assistance.

Instructions in Case of Fire or Spill: In case of fire, use water fog, foam, dry chemical or carbon dioxide. Water spray may be ineffective, but can be used to cool containers. Do not use a direct stream of water. Material will float and can be reignited on surface of water.

Spill or Leak: Dike and contain spill. Do not use water; soak up with absorbent material such as clay, sand or other suitable material. Place in non-leaking container and seal tightly for proper disposal.

Contains: highly refined petroleum distillate, mixture; zinc compounds, mixture; polymer additives, mixture.

KEEP OUT OF REACH OF CHILDREN. (If intended for retail also)

MSDS Revisions
Previous Version Date: 06/01/01

Previous Version Information
Revised Section 1 - Product Name

Other

No information available

Prepared By:

SOPUS Products
P.O. Box 4427
Houston, TX 77210-4453 USA

Disclaimer of Warranty: The information contained herein is based upon data and information available to us, and reflects our best professional judgment. This product may be formulated in part with components purchased from other companies. In many instances, especially when proprietary or trade secret materials are used, SOPUS Products must rely upon the hazard evaluation of such components submitted by that product's manufacturer or importer. No warranty of merchantability, fitness for any use, or any other warranty is expressed or implied regarding the accuracy of such data or information, the results to be obtained from the use thereof, or that any such use do not infringe any patent. Since the information contained herein may be applied under conditions of use beyond our control and with which we may be unfamiliar, we do not assume responsibility for the results of such application. This information is furnished upon the condition that the person receiving it shall make his own determination of the suitability of the material for his particular use.

PRESTONE ANTIFREEZE/COOLANT
MSDSP149

SECTION 1: IDENTIFICATION

MSDS ID: MSDSP149

PRODUCT NAME: PRESTONE ANTIFREEZE/COOLANT
Product Number: AF777
Formula Number: YA721, YA718, YA718B

MANUFACTURER: Prestone Products Corporation
39 Old Ridgebury Road
Danbury, CT 06810-5109

INFORMATION PHONE NUMBER: (203) 731-3686

EMERGENCY PHONE NUMBER: CHEMTREC 1-800-424-9300
483-7161 in the District of Columbia

MSDS DATE OF PREPARATION/REVISION: 10/18/99

SECTION 2: PRODUCT COMPONENTS

HAZARDOUS COMPONENTS	CAS#	PERCENT	EXPOSURE LIMITS
Ethylene Glycol (aerosol)	107-21-1	80-96	None Established-OSHA PEL 100 mg/m3 Ceiling ACGIH TLV
Diethylene Glycol	111-46-6	0-8	None Established OSHA PEL, ACGIH TLV

Non-Hazardous Ingredients >1%
Water 7732-18-5

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Eye and upper respiratory irritant. May cause nausea, vomiting, headache, drowsiness, blurred vision, convulsions, coma or death if ingested or inhaled. Prolonged or repeated skin contact may cause dermatitis or skin sensitization.

POTENTIAL HEALTH EFFECTS:

INHALATION: May cause irritation of the nose and throat with headache, particularly from mists. High vapor concentrations caused, for example, by heating the material in an enclosed and poorly ventilated workplace, may produce nausea, vomiting, headache, dizziness and irregular eye movements.

SKIN CONTACT: No evidence of adverse effects from available information.

EYE CONTACT: Liquid, vapors or mist may cause discomfort in the eye with persistent conjunctivitis, seen as slight excess redness or conjunctiva. Serious corneal injury is not anticipated.

INGESTION: Following ingestion, a bitter taste may be noted. May cause abdominal discomfort or pain, nausea, vomiting, dizziness, drowsiness, malaise, blurring of vision, irritability, back pain, decrease in urine output, kidney failure, and central nervous system effects, including irregular eye movements, convulsions and coma. Cardiac failure and pulmonary edema may develop. Severe kidney damage which may be fatal may follow the swallowing of ethylene glycol. A few reports have been published describing the development of weakness of the facial muscles, diminishing hearing, and difficulty with swallowing, during the late stages of severe poisoning.

CHRONIC EFFECTS: Prolonged or repeated inhalation exposure may produce signs of central nervous system involvement, particularly dizziness and jerking eye movements. Prolonged or repeated skin contact may cause skin sensitization and an associated dermatitis in some individuals. Ethylene glycol has been found to cause birth defects in laboratory animals. The significance of this finding to humans has not been determined. See section 11 for additional information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: The available toxicological information and a knowledge of the physical and chemical properties of the material suggest that overexposure in unlikely to aggravate existing medical conditions.

CARCINOGEN: None of the components of these products is listed as a carcinogen or suspected carcinogen by IARC, NTP or OSHA.

SECTION 4: FIRST AID MEASURES

INHALATION: Remove the victim to fresh air. If breathing has stopped administer artificial respiration. If breathing is difficult, have medical personnel administer oxygen. Get medical attention.

SKIN CONTACT: Remove contaminated clothing. Immediately wash contacted area thoroughly with soap and water. If irritation persists, get medical attention.

EYE CONTACT: Immediately flush eyes with large amounts of water for 15 minutes. Get medical attention if irritation persists.

INGESTION: Seek immediate medical attention. Immediately call local poison control center or go to an emergency department. Never give anything by mouth to or induce vomiting in an unconscious or drowsy person.

NOTES TO PHYSICIAN: The principal toxic effects of ethylene glycol, when swallowed, are kidney damage and metabolic acidosis. The combination of metabolic acidosis, an osmol gap and oxalate crystals in the urine is evidence of ethylene glycol poisoning.

Pulmonary edema with hypoxemia has been described in a number of patients following poisoning with ethylene glycol. Respiratory support with mechanical ventilation may be required.

There may be cranial nerve involvement in the late stages of toxicity from swallowed ethylene glycol. In particular, effects have been reported involving the seventh, eighth, and ninth cranial nerves, presenting with bilateral facial paralysis, diminished hearing and dysphagia.

Ethanol is antidotal and its early administration may block the formation of nephrotoxic metabolites of ethylene glycol in the liver. The objective is to rapidly achieve and maintain a blood ethanol level of approximately 100 mg/dl by giving a loading dose of ethanol followed by a maintenance dose. Intravenous administration of ethanol is the preferred route. Ethanol blood levels should be checked frequently. Hemodialysis may be required.

4-Methylpyrazole (Antizole(R) or Fomepizole), a potent inhibitor of alcohol dehydrogenase, has been used therapeutically to decrease the metabolic consequences of ethylene glycol poisoning. Additional therapeutic modalities which may decrease the adverse consequences of ethylene glycol metabolism are the administration of both thiamine and pyridoxine. As there are complicated and serious overdoses, we recommend you consult with the toxicologists at your poison control center. This antidote is now approved by the F.D.A. and in many cases has replaced ethanol in the treatment of ethylene glycol poisoning.

SECTION 5: FIRE AND EXPLOSION DATA

FLASH POINT: 242 F (117 C) TOC
220 F (104 C) PMCC

AUTOIGNITION TEMPERATURE: Not determined

FLAMMABILITY LIMITS: LEL: 3.2% UEL: 15.3%

EXTINGUISHING MEDIA: For large fires, use alcohol type or all-purpose foams. For small fires, use water spray, carbon dioxide or dry chemical.

SPECIAL FIRE FIGHTING PROCEDURES: Do not spray pool fires directly. Cool fire exposed containers with water. Firefighters should wear positive pressure self-contained breathing apparatus and full protective clothing for fires in areas where chemicals are used or stored.

UNUSUAL FIRE HAZARDS: A solid stream of water or foam directed into hot, burning liquid can cause frothing.

HAZARDOUS COMBUSTION PRODUCTS: Burning may produce carbon monoxide and carbon dioxide.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Wear appropriate protective clothing and equipment (See Section 8). Collect with absorbent material and place in appropriate, labeled container for disposal or, if permitted flush spill area with water.

SECTION 7: HANDLING AND STORAGE

DANGER: Harmful or Fatal if Swallowed

Do not drink antifreeze or solution.
Avoid eye and prolonged or repeated skin contact.
Avoid breathing vapors or mists.
Wash exposed skin thoroughly with soap and water after use.
Do not store in opened or unlabeled containers.

Keep container away from open flames and excessive heat.
Do not reuse empty containers unless properly cleaned.

Empty containers retain product residue and may be dangerous. Do not cut, weld, drill, etc. containers, even empty.

Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without any obvious ignition sources. Published "autoignition" or "ignition" temperatures cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Use of this product in elevated temperature applications should be thoroughly evaluated to assure safe operating conditions.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION: Use general ventilation or local exhaust as required to maintain exposures below the occupational exposure limits.

RESPIRATORY PROTECTION: For operations where the TLV is exceeded a NIOSH approved respirator with organic vapor cartridges and dust/mist prefilters or supplied air respirator is recommended. Equipment selection depends on contaminant type and concentration. Select and use in accordance with 29 CFR 1910.134 and good industrial hygiene practice. For firefighting, use self-contained breathing apparatus.

GLOVES: Chemical resistant gloves such as neoprene or PVC where contact is possible

EYE PROTECTION: Splash-proof goggles.

OTHER PROTECTIVE EQUIPMENT/CLOTHING: Appropriate protective clothing as needed to minimize skin contact. Suitable washing and eye flushing facilities should be available in the work area. Contaminated clothing should be removed and laundered before re-use.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Yellow liquid with a mild odor.

pH: Not determined
BOILING POINT (F): 334 F
FREEZING POINT (F): -8 F
SOLUBILITY IN WATER: 100%
PERCENT VOLATILE: None

SPECIFIC GRAVITY: 1.12
VAPOR PRESSURE: Less than 0.1
VAPOR DENSITY: 2.1
EVAPORATION RATE: Less than 1
VISCOSITY: Not determine

SECTION 10: STABILITY AND REACTIVITY

STABILITY: Stable
CONDITIONS TO AVOID: None known.
INCOMPATIBILITY: Normally unreactive, however, avoid strong bases at high temperatures, strong acids, strong oxidizing agents, and materials reactive with hydroxyl compounds.
DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide.
HAZARDOUS POLYMERIZATION: Will not occur
CONDITIONS TO AVOID: None known.

SECTION 11: TOXICOLOGICAL INFORMATION

ACUTE TOXICITY VALUES:

Ethylene Glycol: LD50 Oral Rat: 4700 mg/kg
LD50 Skin Rabbit: 9530 mg/kg

Diethylene Glycol: LD50 Oral Rat: 12,565 mg/kg
LD50 Skin Rabbit: 11,890 mg/kg

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH:
Ethylene glycol has been shown to produce dose-related teratogenic effects in rats and mice when given by gavage or in drinking water at high concentrations or doses. Also, in a preliminary study to assess the effects of exposure of pregnant rats and mice to aerosols at concentrations 150, 1,000 and 2,500 mg/m3 for 6 hours a day throughout the period of organogenesis, teratogenic effects were produced at the highest concentrations, but only in mice. The conditions of these latter experiments did not allow a conclusion as to whether the developmental toxicity was mediated by inhalation of aerosol, percutaneous absorption of ethylene glycol from contaminated skin, or swallowing of ethylene glycol as a result of grooming the wetted coat. In a further study, comparing effects from high aerosol concentration by whole-body or nose-only exposure, it was shown that nose-only exposure

resulted in maternal toxicity (1,000 and 2,500 mg/m3) and developmental toxicity in with minimal evidence of teratogenicity (2,500 mg/m3). The no-effects concentration (based on maternal toxicity) was 500 mg/m3. In a further study in mice, no teratogenic effects could be produced when ethylene glycol was applied to the skin of pregnant mice over the period of organogenesis. The above observations suggest that ethylene glycol is to be regarded as an animal teratogen; there is currently no available information to suggest that ethylene glycol caused birth defects in humans. Cutaneous application of ethylene glycol is ineffective in producing developmental toxicity; exposure to high aerosol concentration is only minimally effective in producing developmental toxicity; the major route for producing developmental toxicity is perorally.

Two chronic feeding studies, using rats and mice, have not produced any evidence that ethylene glycol causes dose-related increases in tumor incidence or a different pattern of tumors compared with untreated controls. The absence of carcinogenic potential for ethylene glycol has been supported by numerous invitro genotoxicity studies showing that it does not produce mutagenic or clastogenic effects.

This products contains less than 0.5% tolytriazole which has demonstrates mutagenic activity in a bacterial test system. A correlation has been established between mutagenic activity and carcinogenic activity for many chemicals. Tolytriazole has not been identified as a carcinogen or probable carcinogen by NTP, IARC or OSHA.

SECTION 12: ECOLOGICAL INFORMATION

Ethylene Glycol: LC50 Goldfish: 5,000 mg/L/24 hr. at 20 C static conditions.

Toxicity threshold (cell multiplication inhibition test):
Bacterial (Pseudomonas putida): 10,000 mg/l
Protozoa (Entosiphon sulcatum and Uronema parduczi Chatton-Lwoff): >10,000 mg/l
Algae (Microcystis aeruginosa): 2,000 mg/l
Green algae (Scenedesmus quandricauda): >10,000 mg/l

SECTION 13: DISPOSAL INFORMATION

Dispose of product in accordance with all local, state/provincial and federal regulations.

SECTION 14: TRANSPORT INFORMATION

U.S. DOT HAZARD CLASSIFICATION

PROPER SHIPPING NAME: None
UN NUMBER: None
LABELS REQUIRED: None

DOT MARINE POLLUTANTS: This product does not contains Marine Pollutants as defined in 49 CFR 171.8.

IMDG CODE SHIPPING CLASSIFICATION

DESCRIPTION: Not Regulated

Note: IF A BULK SHIPMENT IS INVOLVED, THE FOLLOWING INFORMATION APPLIES:

U.S. DOT HAZARD CLASSIFICATION

PROPER SHIPPING NAME: Environmentally hazardous substance, liquid, N.O.S. (Ethylene glycol)
UN NUMBER: UN3082
LABELS REQUIRED: Class 9, UN3082

SECTION 15: REGULATORY INFORMATION

EPA SARA 311/312 HAZARD CLASSIFICATION: Acute health, chronic health

EPA SARA 313: This Product Contains the Following Chemicals Subject to Annual Release Reporting Requirements Under SARA Title III, Section 313 (40 CFR 372):

Ethylene Glycol	107-21-1	80-96%

PROTECTION OF STRATOSPHERIC OZONE: This product is not known to contain or to have been manufactured with ozone depleting substances as defined in 40 CFR Part 82, Appendix A to Subpart A.

CERCLA SECTION 103: Spills of this product over the RQ (reportable quantity) must be reported to the National Response Center. The RQ for this product, based on the RQ for Ethylene Glycol (96% maximum) of 5,000 lbs, is 5,208 lbs. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

CALIFORNIA PROPOSITION 65 - This product may contain the following substances known to the State of California to cause Cancer and/or Reproductive Harm: 1,4-Dioxane (trace amount).

EPA TSCA INVENTORY: All of the components of this material are listed on the Toxic Substances Control Act (TSCA) Chemical Substances Inventory.

CANADIAN ENVIRONMENTAL PROTECTION ACT: All of the ingredients are listed on the Canadian Domestic Substances List.

CANADIAN WHMIS CLASSIFICATION: Class D - Division 2 - Subdivision B - (A toxic material causing other chronic effects)

EUROPEAN INVENTORY OF EXISTING COMMERCIAL CHEMICAL SUBSTANCES (EINECS): All of the ingredients are listed on the EINECS inventory.

AUSTRALIA: All of the ingredients of this product are listed on the Australian Inventory of Chemical Substances.

SECTION 16: OTHER INFORMATION

NFPA RATING (NFPA 704) - FIRE: 1
HEALTH: 2
REACTIVITY: 0

REVISION SUMMARY: Section 4: Notes to Physican
Section 9: Specific Gravity
Section 16: Contact Name and Address

This MSDS is directed to professional users and bulk handlers of the product. Consumer products are labeled in accordance with Federal Hazardous Substances Act regulations.

While Prestone Products Corporation believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of tests conducted, the data are not to be taken as a warranty or representation for which Prestone Products Corporation assumes legal responsibility. They are offered for your consideration, investigation and verification. Any use of these data and information must be determined by the user to be in accordance with applicable federal, state and local laws and regulations.

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