NM1 - ___35______

Part 36

MAJOR MODIFICATION Application

2 of 5

July 30, 2019

Permit Application

FOR MODIFICATION

Lea Land Landfill
OCD Facility Permit No.: NM-1-0035
Lea County, New Mexico

VOLUME II:
FACILITY MANAGEMENT PLANS

Submitted To:

New Mexico Energy, Minerals, and Natural Resources Department
Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, NM 87505
505.476.3440

Prepared For:

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June 2019
Gordon/PSC Project #: 01041618.00

GORDON ENVIRONMENTAL PSC

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

The existing Lea Land Landfill is equipped with a composite liner design with an inclined leachate collection geopipe system and extraction point in the northeast corner. Liner Installation Records and Engineering Certification/CQA Reports document that the liner segments were constructed in compliance with current industry and engineering standards. Routine attempts to monitor and collect leachate flow from "Unit I" have demonstrated that oil field waste solids do not generate fluids, as no free liquids are allowed, and does not produce water.

1.1 Purpose

The purpose of this Operations, Inspection & Maintenance Plan (the Plan) is provide guidance to the Lea Land SWMF staff in the daily operational procedures that have been established in compliance with 19.15.36.8 and 19.15.36.13 NMAC with the purpose of providing protection of fresh water, public health and the environment. **Table II.1.1** (OCD Requirements) provides an outline of the specific 19.15.36 NMAC requirements addressed by this Plan.

TABLE II.1.1 - OCD Requirements [19.15.36 NMAC]

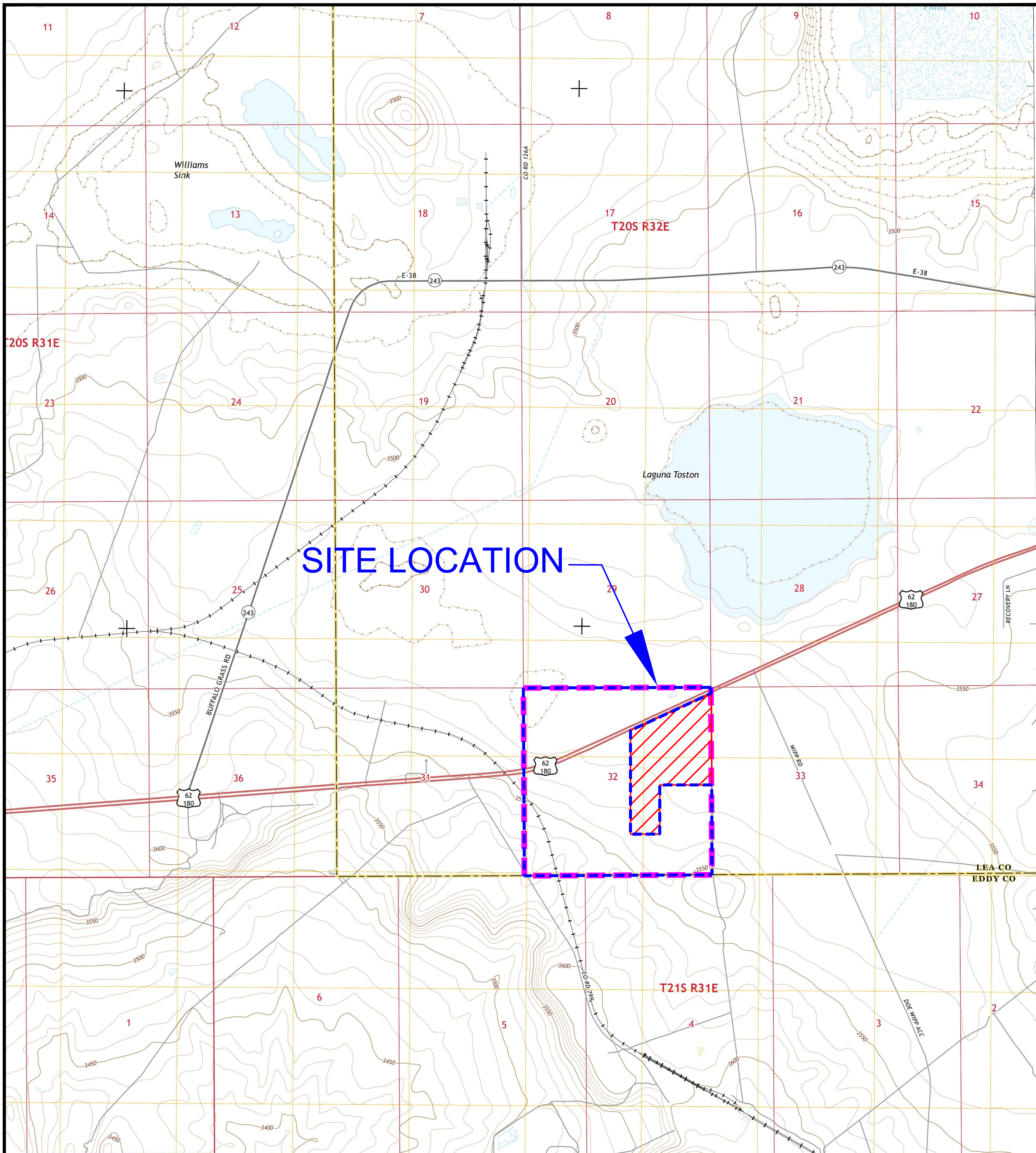
19.15.36.8.C(4)	*a description of the surface waste management facility with a diagram indicating the location of fences and cattle guards, and detailed construction/installation diagrams of pits, liners, dikes, piping, sprayers, tanks, roads, fences, gates, berms, pipelines crossing the surface waste management facility, buildings and chemical storage areas;*
19.15.36.8.C(7)	*an inspection and maintenance plan that complies with the requirements contained in Subsection L of 19.15.36.13 NMAC;*
19.15.36.8.C(14)	*a best management practice plan to ensure protection of fresh water, public health and the environment;*
19.15.36.13.L	*Each operator shall have an inspection and maintenance plan that includes the following:* ***(1)*** *monthly inspection of leak detection sumps including sampling if fluids are present with analyses of fluid samples furnished to the division; and maintenance of records of inspection dates, the inspector and the leak detection system's status;* ***(3)*** *inspections of the berms and the outside walls of pond levees quarterly and after a major rainfall or windstorm, and maintenance of berms in such a manner as to prevent erosion.*

1.2 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.1.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.3 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area (i.e., evaporation, storage, treatment) and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The Site Plan provided as **Figure II.1.2** identify the locations of the Processing Area and Land Disposal facilities, which are further detailed on the **Permit Plans** (**Attachment III.1.A**). The proposed facilities are detailed in **Table II.1.2**, and are anticipated to be developed in four primary phases as described in **Table II.1.3**.



LEGEND

- PROPERTY BOUNDARY
- LEA LAND LLC FACILITY BOUNDARY
- INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

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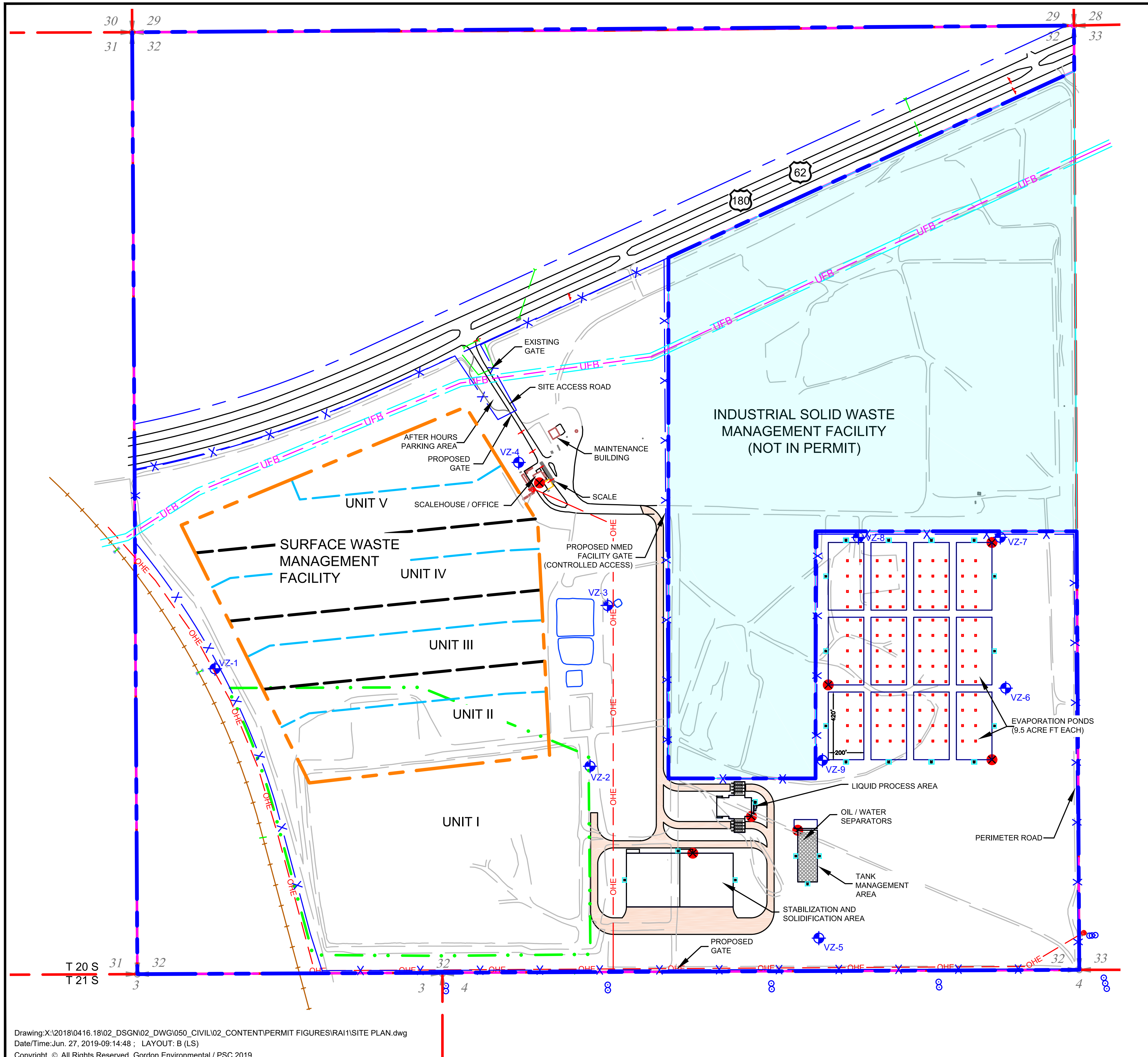
SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.1
APPROVED BY: CWF	www.team-psc.com	



LEGEND

- SECTION BOUNDARY
- PROPERTY BOUNDARY
- SURFACE WASTE MANAGEMENT BOUNDARY
- EXISTING OCD PERMIT BOUNDARY
- PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
- INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
- CELL BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING RAILROAD
- UFB — PROPOSED UNDERGROUND FIBER OPTIC
- OHE — PROPOSED OVERHEAD POWER LINE
- EXISTING CULVERT
- PROPOSED UNPAVED ROAD (GRAVEL)
- NOT IN OCD PERMIT
- EXISTING TRANSMISSION LINE
- M — H_2S MONITORING LOCATION
- VZ-2 — PROPOSED VADOSE ZONE MONITORING WELL
- PPE AND EMERGENCY EQUIPMENT

NORTH

0 300' 600'

SITE PLAN

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.2
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:Jun. 27, 2019-09:14:48 ; LAYOUT: B (LS)

TABLE II.1.2: Proposed Facilities[1]

Description	No.
SWMF disposal landfill	1
Produced water load-out points	8
Produced water receiving tanks	12
Produced water settling tanks	48
Oil/water separation units (Gun Barrels)	4
Evaporation ponds	12
Stabilization and Solidification Process Area (Drying Pad)	1
Oil treatment plant (Liquids Processing)	1
Crude oil recovery tanks	5
Oil sales tanks	5
Customer jet wash – bays	8
75 horsepower boiler	1
Centrifuge	1

Note:
[1]Subject to change. The proposed facilities are based on projected waste types and volumes; therefore this list may be modified in response to changes in waste streams, market conditions, technology innovations, etc. OCD will be routinely updated on changes

TABLE II.1.3 - Lea Land LLC Site Development Sequence[1]
(projected)

Description	Summary	Year No.[2]
Phase I - Continued Operations		
• Existing Landfill ~30.8 acres	Continued operation of the existing landfill as development of additional infrastructure is completed.	1
Phase II - Landfill Cell & Liquids/Solids Processing Operation.		
• New Landfill Cell (Unit II - 5 acre Cell IIA out of a total of 70 acre Unit) • Liquids load-out points (4) with Jet-Outs for handling basic sediment and water (BS&W), tank bottoms, liquid drilling muds and tank wash-outs • The Liquids Process Area • Tank farm berm (complete) • Boiler (75 HP) running heat transfer fluid tank farm • Oil/Water Separation Unit (Gun Barrel) • Produced Water Receiving Tanks (3), 1,000 bbl capacity[3] • Settling Tanks (16), 1,000 bbl capacity • Crude Oil Recovery Tank (1), 1,000 bbl capacity • Oil Sale Tank (1), 1,000 bbl capacity • Evaporation Ponds (4) capable of evaporating 4,000 bbl of liquid per day • Install Stabilization and Solidification (Drying Pad) Area	**Construction of a 5-acre cell (Cell IIA) in Unit II of the Landfill. Installation of four liquids load-out points with jet-out capabilities. Installation of the Liquids Processing Area. Installation of the Solidification and Stabilization Area**. Liquids recovered from the Liquids Processing Operations will be pumped through the Oil/Water Separator (Gun-Barrel) with oil discharged to the heated Crude Oil Recovery Tank for further processing before being pumped to the Oil Sale Tank. The oil recovered from the Liquids Processing Operations is anticipated to be 6 bbl per day. Solids recovered from the Liquids Process will be tested for liquids and if they pass the Paint Filter Test, will be transferred to the landfill for disposal. If they do not pass the Paint Filter Test, they will be delivered to the Stabilization and Solidification Area for processing prior to landfilling. Solids received in roll-off containers that do not pass the Paint Filter Test will be deposited at the Drying Pad where they will be mixed with dry soil until they are dry enough to pass the Paint Filter Test allowing them to be transferred to the landfill for disposal.	2
Phase III - Expanded Liquids/Solids Processing Operation.		
• Liquids load-out points (4) • Additional Oil/Water Separation Units (2 Gun Barrels) • Additional Produced Water Receiving Tanks (3), 1,000 bbl capacity • Additional Settling Tanks (16), 1,000 bbl capacity • Additional Crude Oil Recovery Tanks (3), 1,000 bbl capacity • Additional Oil Sales Tanks (2), 1,000 bbl capacity • Additional evaporation ponds (4) capable of evaporating an additional 4,000 bbl per day of liquid	The additional oil recovered from the expanded Produced Water Processing Operation process, anticipated to be 6 bbl per day (for a total of 12 bbls per day), will pumped to the Crude Oil Recovery tanks for further processing.	3
Phase VI - Ultimate Produced Water Processing Facility.		
• Additional Oil/Water Separation Unit (1 Gun Barrel) • Additional Produced Water Receiving Tank (3), 1,000 bbl capacity • Additional Settling Tanks (16), 1,000 bbl capacity • Additional Oil Sales Tanks (1), 1,000 bbl capacity • Additional evaporation ponds (4) capable of evaporating an additional 4,000 bbl per day of liquid	The additional oil recovered from the ultimate Produced Water Processing Facility will be pumped to the Crude Oil Recovery Tank for further processing.	4

Notes:

[1] The Lea Land LLC site development sequence is subject to change. Differing combinations of these improvements may be constructed at any time. OCD will be notified in advance of construction.

[2] Estimated number of years following OCD Surface Waste Management Facility Permit issuance.

[3] bbl = barrels of oil

2.0 GENERAL FACILITY INFORMATION

2.1 Land Use and Zoning

Lea Land is located within a 642 acre ± tract in unincorporated western Lea County, approximately 27 miles northeast of Carlsbad, NM (**Figure II.1.1**). The Facility is surrounded by undeveloped pastureland on all sides with US Highway 62 bisecting the northern 1/3 of the property. The closest permanent residence appears to be two company houses located approximately 0.5 mile to the west of the site on and owned by the Transwestern Pipeline Company – Carlsbad Compressor Station. Lea County does not have zoning specifications on land use in unincorporated areas.

2.2 Access Control

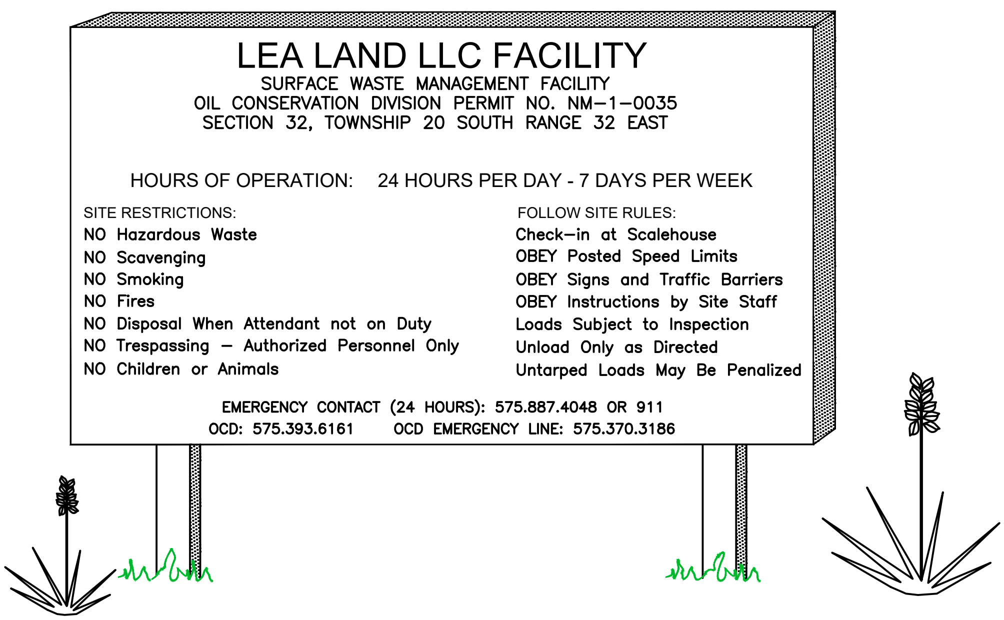
Access control for Lea Land is provided by perimeter fencing for both the Processing Area and the Landfill; locking gates; and employee presence when open for waste receipts. No oil field waste is accepted unless an attendant is on duty. The Facility is gated and locked when the site is not attended. The Site Location Map is plotted on the most recent United States Geological Survey (USGS) map (**Figure II.1.1**) and shows the Facility location in relation to state roads and adjacent features. The Site Plan, provided as **Figure II.1.2,** provides a plan view of the Facility showing the proposed layout.

2.3 Site Signs

A sign is posted at the Facility entrance which identifies the location of the site, hours of operation, emergency telephone numbers, and delivery instructions (**Figure II.1.3A**). Additional site rules that are applicable to both Facility personnel and customers will be posted at the receiving areas and along the access roads to advise drivers concerning speed limits, prohibited activities, acceptable waste types, delivery instructions, and other health and safety precautions. Example signs are provided in **Figure II.1.3B**. Identification and cautionary signs specific to pits, ponds, and tanks in the Processing Area will also be installed at the Facility once constructed.

EXISTING SIGNAGE

PROPOSED SIGN



SITE ENTRANCE SIGN (TYPICAL)

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: ENTRANCE SIGN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CWF	FIGURE II.1.3A
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:Mar. 31, 2019-11:13:33

LEA LAND LLC
SURFACE WASTE
MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO
SECTION 32,
TOWNSHIP 20 SOUTH
RANGE 32 EAST
OIL CONSERVATION DIVISION PERMIT NO. NM-1-0035

SITE SIGNS (TYPICAL)

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: SITE SIGNS.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.3B
APPROVED BY: CWF	www.team-psc.com	

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2.4 Traffic

Traffic arrives at Lea Land by traveling east or west on US Highway 62, turning south at the site access point checking in at the Scalehouse to complete the disposal transaction and to determine of where they will be depositing their load prior to proceeding onto the Processing Area (jet-out/unloading or stabilization/solidification), the Landfill or the NMED Industrial Waste Landfill. Current and projected traffic flows on US Highway 62 already include a high proportion of similar truck traffic. The Federal Highway is a four-lane thoroughfare with an extensive shoulders and medians and the existing entrance to Lea Land has excellent sight-lines in both directions. Vehicles accessing the Facility, including staff, currently average 100 vehicles per day (vpd), and daily traffic flow into the Facility is projected to increase as oil field production activities continue to increase and more companies utilize the Facility. On-site traffic flow for the Lea Land Facility is depicted on **Figures II.1.4A** (Processing Area) and **II.1.4B** (Landfill).

3.0 FACILITY PERSONNEL

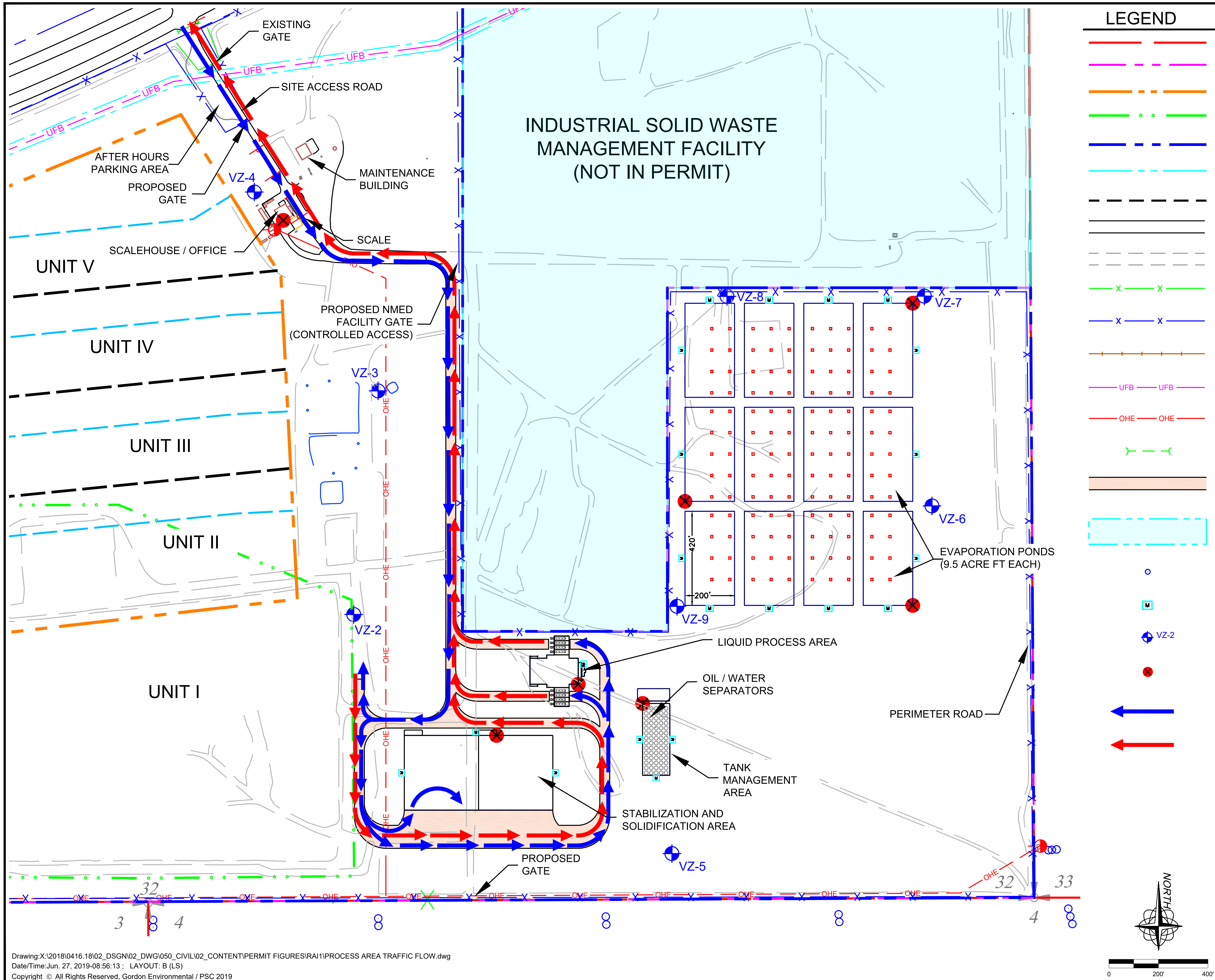
3.1 Requirements and Duties

Daily operations at the Facility are supervised by the Lea Land management team officed onsite in the Scalehouse (**Figure II.1.2**). Management and administrative support are provided by Lea Land personnel routinely on-site. Disposal operations are only conducted when an attendant is on duty. Acceptance criteria for the oil field waste are described in the Oil Field Waste Management Plan (**Volume II.2**). The general staffing list for the Facility is provided in **Table II.1.4**, subject to adjustment in response to changes in incoming waste volumes, market demands, technology updates, etc.

TABLE II.1.4 - Facility Staffing List[1]

Description	Number
Facility Manager	1
Plant Supervisor	1-2
Gate Attendant	1-2
Equipment Operator	4-6
General Laborer	2-4

[1] *Subject to adjustment*



PROCESS AREA TRAFFIC FLOW PLAN

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991
www.team-psc.com

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.4A
APPROVED BY: CWF		

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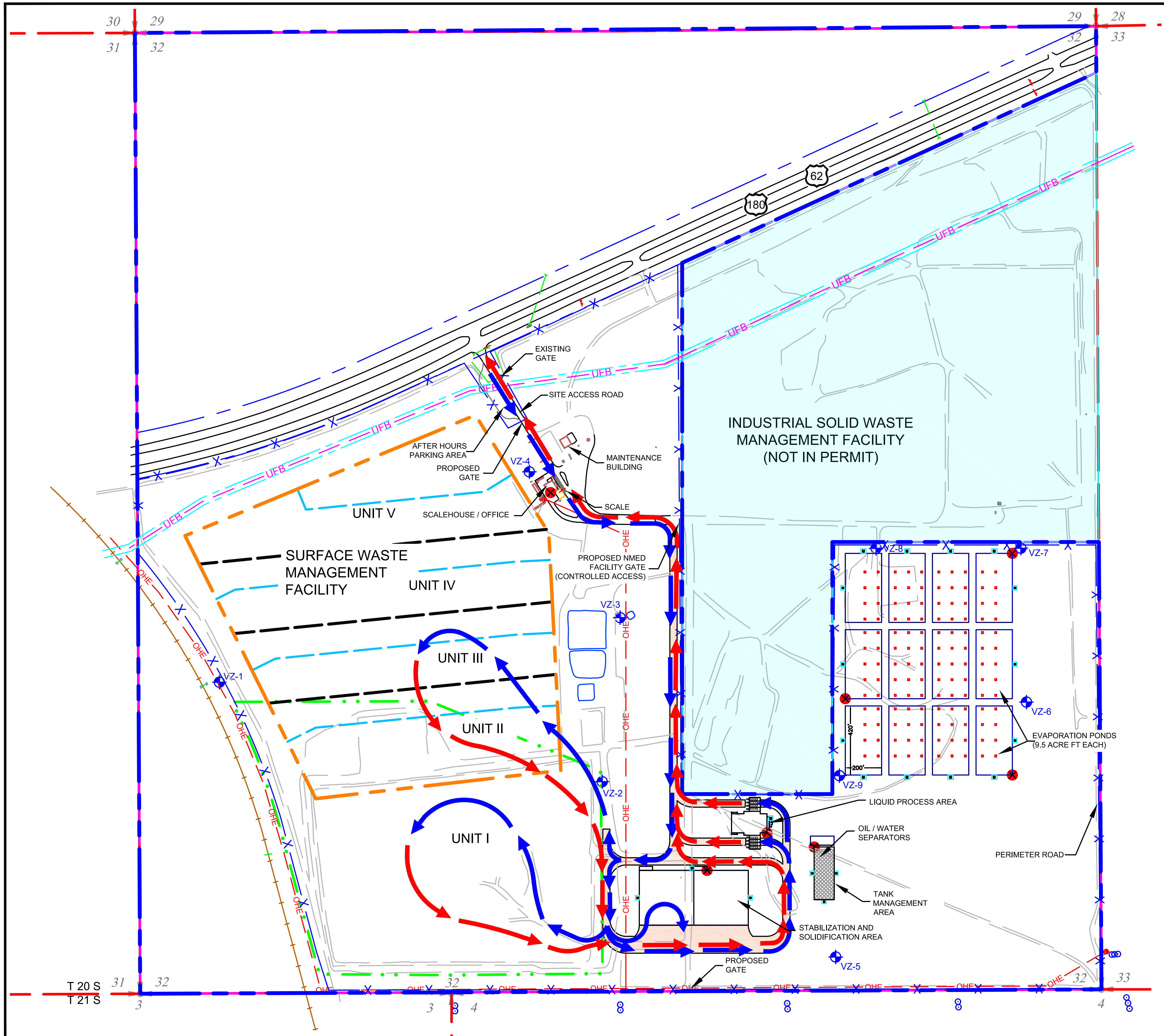

LEGEND

SECTION BOUNDARY
PROPERTY BOUNDARY
SURFACE WASTE MANAGEMENT BOUNDARY
EXISTING OCD PERMIT BOUNDARY
PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
CELL BOUNDARY
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EXISTING UNPAVED ROAD
EXISTING FENCE
PROPOSED FENCE
EXISTING RAILROAD
UFB — UFB PROPOSED UNDERGROUND FIBER OPTIC
OHE — OHE PROPOSED OVERHEAD POWER LINE
EXISTING CULVERT
PROPOSED UNPAVED ROAD (GRAVEL)
NOT IN OCD PERMIT
EXISTING TRANSMISSION LINE
M H_2S MONITORING LOCATION
VZ-2 PROPOSED VADOSE ZONE MONITORING WELL
PPE AND EMERGENCY EQUIPMENT
PRIMARY INBOUND TRAFFIC
PRIMARY OUTBOUND TRAFFIC

LANDFILL TRAFFIC FLOW

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991
www.team-psc.com

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.4B
APPROVED BY: CWF		

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Date/Time:Jun. 27, 2019-08:46:31 ; LAYOUT: B (LS)

3.2 Training Requirements

Annual training for personnel will include health and safety protection, waste screening, fire prevention, emergency response, etc. Emergency Coordinators for the proposed Facility are identified in the Contingency Plan (**Volume II.5**). A trained operator or designated representative with full knowledge of the 19.15.36 NMAC Rules and the Lea Land Permit requirements will be present at all times while the Facility is in operation. Facility staff will be required to read this Plan, the Oil Field Waste Management Plan (**Volume II.2**), the Hydrogen Sulfide (H_2S) Prevention and Hydrogen Sulfide (H_2S Plan (**Volume II.3**), the Contingency Plan (**Volume II.5**) and the Migratory Bird Protection Plan (**Volume II.6)**. Signature sheets acknowledging that this requirement has been met will be retained in the Facility Operating Record in accordance with the Safety Communications Program (**Attachment II.1.A**). Lea Land personnel are encouraged to take outside training as well (e.g., NMED/MOLO).

4.0 FACILITY OPERATIONAL PROCEDURES

The operational procedures for the Lea Land SWMF are designed to maximize the efficiency of waste receiving, processing, and disposal; and to protect the health and safety of Facility staff and delivery personnel. Detailed operational procedures are enumerated in each of the applicable sections of this Plan for oil field waste stream acceptance processing, landfill disposal, contingency planning, recordkeeping, personnel training, etc. Oil field waste disposal operations will be conducted in a safe and environmentally sound manner in accordance with 19.15.36 NMAC.

4.1 Noise Control

The are two permanent residences (“company houses”) associated with the Transwestern Pipeline Company-Carlsbad Compressor Station approximately 0.5 miles west of the Facility and only five additional residences within ten miles of the facility. Most heavy equipment operations (i.e., the Landfill) will be conducted below grade and behind berms, which will aid in noise control. Surrounding lands are unoccupied, or consist of cattle grazing and development related to oil and gas exploration. The site development sequence involves continued landfilling from the south of the property progressing north to the highway where construction of 10 ft high screening berms to the north (downwind) and west using soils from the excavation will screen the landfill operations. Existing above-grade (NMED MSW) disposal units will shield most of the waste processing operations from the Highway in the downwind direction; as well as setbacks > 2,000 ft.

4.2 Odor Control

Prior to oil field waste acceptance, vehicles will be screened for the presence of hydrogen sulfide (H_2S). If H_2S is detected above 10 parts per million (ppm), the load will be treated with calcium hypochlorite [$Ca(ClO)_2$] to lower the H_2S to acceptable levels prior to unloading operations. In addition, at least 1,000 gallons of chemicals will be maintained on-site to control H_2S and its associated odors originating from the evaporation ponds or other operating units. Downwind land uses (i.e., primarily to the north and northwest) are vacant, and downwind screening berms will limit air dispersion of potential odors during processing.

4.3 Dust Control

The access roads and active areas within the Facility will be treated with water, approved recycled waters or dust palliatives, as needed, from a water truck to reduce dust. The posted speed limit will be 15 miles per hour (mph) inside the property which will assist in limiting the amount of dust generated by onsite traffic. Routine operations listed on **Table II.1.5** are the most likely sources of dust, along with recommended primary and secondary control measures:

TABLE II.1.5- Dust Control

A water truck will be available to apply water, approved recycled waters, or dust palliatives to the access roads and active areas within the Lea Land SWMF as needed to reduce dust. In addition, the posted speed limit will be 15 mph inside the property. Listed below are routine operations that are the most likely sources of dust, along with recommended primary and secondary control measures:

- **Disposal Operations -**
  - Primary Control Measure: Paving of high-traffic areas, apply water to unpaved roads as necessary, enforce speed limit posted on-site.
  - Secondary Control Measure: Apply dust palliatives to unpaved portions of the Facility, provide additional pavement as necessary to high-traffic areas.
- **Excavations -**
  - Primary Control Measure: Water areas prior to and during excavation. Water areas of excavation and haul roads during and at the end of each day to form a dust-binding soil crust.
  - Secondary Control Measure: Phase work to reduce the amount of disturbed surfaces, apply additional water, work at lower elevations when wind velocity is high.
- **Stockpiles -**
  - Primary Control Measure: Pre-water areas prior to excavation. Apply water to short-term stockpiles and when transporting soils, stockpile below-grade or behind berms.

  - Secondary Control Measure: Control vehicle access to the area. Apply dust surfactant to long-term stockpiles or apply seed/mulch or proven stabilization measures to prevent erosion.
- **Track out extending onto public roadways –**
  - Primary Control Measure: Pave permanent on-site entrance roadways, sweep as necessary.
  - Secondary Control Measure: Apply recycled asphalt, caliche/gravel pads or similar materials at the transition from unpaved to paved roadways.
- **Unpaved roadways and parking areas –**
  - Primary Control Measure: Limit vehicle speed via posting speed limits; apply water, use aggregate or caliche.
  - Secondary Control Measure: Apply water and surfactants to unpaved roads and parking lots, as needed, provide additional pavement.

4.4 Minor Spills/Releases

The spill or release of a potentially hazardous material at the Facility is most likely to involve fuel or various vehicle fluids (i.e., engine oil, hydraulic oil, antifreeze, etc.) which are managed at the fuel dispensing tanks near the scalehouse. Other materials most likely to present a concern as a result of normal operations include petroleum products and petroleum wastes delivered to the Facility. Spills involving these types of materials could occur during fueling, routine maintenance operations or during unloading for processing/disposal of waste. These minor spills will be cleaned up immediately upon discovery.

The Facility will maintain spill clean-up kits on-site that include absorbent materials, shovels, and small containment buckets. Waste materials resulting from minor spills and clean-up will be managed and disposed of in accordance with the Oil Field Waste Management Plan (**Volume II.2**). Although highly unlikely, large spill/releases from onsite ponds and tanks may occur. The response procedures for this type of release are detailed in the Contingency Plan (**Volume II.5**).

5.0 LANDFILL OPERATIONS

The Lea Land Landfill operation will continue to provide for the permanent disposal of exempt and non-hazardous waste solid generated in the development and production of oil and gas resources and properly documented non-exempt, non-hazardous oil field wastes. The Landfill operation will be guided by the Landfill design presented in **Volume III** (Engineering Design and Calculations); and detailed in the **Permit Plans** (**Volume III.1**).

5.1 Landfill Equipment

Table II.1.6 identifies the equipment planned for the landfill operations. This inventory has proven effective in efficiently managing ongoing construction and operations. Equipment units may be added or subtracted from the list corresponding to the rate of waste flow, projected earthmoving activities, changes in technology, etc. Some operating and construction functions, such as mass excavation and geosynthetic liner installation, will be subcontracted to qualified firms. The equipment inventory demonstrates both the redundancy and back-up capabilities of the on-site Landfill equipment. Following is a summary of functions and capabilities of the major units:

- The compactors are high-ground-pressure pieces of equipment specially designed for waste receiving; compaction, daily cover application, and related fill face activities.
- The scrapers are used primarily for earthmoving activities, such as excavation of new cells and hauling of cover material from designated stockpiles. Scrapers will often deliver soil directly from the excavation of a new cell to an area near the active fill face. The scrapers can apply daily, intermediate, and final cover at a high rate of delivery.
- Dozers are tracked pieces of equipment that are used to move soil and waste, usually for short distances. The dozers assist the scrapers in preparation of new cells, and can apply cover at the fill face. Dozers are versatile pieces of equipment that are also valuable in cover maintenance, road grading, and waste compaction as back-ups to the compactors, graders, and front-end loaders.
- Front-end loaders are used for earthmoving activities and cell construction tasks. They can be used for excavation of soil or movement of waste, and for delivery and application of cover material. Front-end loaders can provide back-up to scrapers and dozers, and can be used for road and drainage maintenance, if necessary.
- The water wagon will be used on a daily basis to control dust that could originate from on-site roads, active excavations, covered areas, etc. The water sources for the wagon will be on-site tanks and ponds.
- The motor grader is effective for temporary roadway construction, maintenance, and drainage improvements.

TABLE II.1.6 – Inventory of Landfill Equipment (Typical)

Type	Number	Primary Purpose
CAT 963 Track Loader	1	Earthmoving/waste placement
L150G Loader	1	Earthmoving/waste placement
150F Loader	1	Earthmoving/waste placement
L90 Loader	1	Earthmoving/waste placement
L60 Loader	1	Earthmoving/waste placement
CAT 816 Compacter	2	Waste compaction
CAT D8R Dozer	1	Waste and soil spreading/compaction
CAT D8N Dozer	1	Waste and soil spreading/compaction
G720 Motor Grader	1	Road and drainageway maintenance
CAT 324 Excavator	1	Waste Solidification

Notes:

1. *Equivalent models may be substituted.*
2. *The number of each equipment type is matched to the projected waste types and volumes; the list may be modified in response to changes in waste streams, technology, etc.*
3. *Equipment is subject to routine replacement.*
4. *There will be arrangements made with local equipment vendors for maintenance and back-up leasing.*

5.2 Waste Characteristics

Lea Land Landfill accepts exempt and non-hazardous oil field waste solids generated from oil and gas exploration and production operations. No hazardous waste will be accepted at Lea Land. The Facility will require documentation from the Generators for accepting oil field wastes, including OCD Form C-138 *(Request for Approval to Accept Solid Waste*; **Attachment II.2.A***)*, and will screen incoming waste in accordance with the Oil Field Waste Management Plan (**Volume II.2**). **Table II.1.7** lists proposed waste receipts sorted by type with a corresponding estimate of volume and proportion. The current average daily solid waste disposal (oil field waste) acceptance rate is 500 cubic yards (yd^3) per day, equal to approximately 500 tons per day (@ 2,000 pounds per yd^3).

TABLE II.1.7 - Landfill Waste Characterization and Anticipated Daily Waste Receipts[1]

Origin	Approximate Proportion	Daily Average (yd^3)[1,2]
Contaminated Soil	60%	300
Drilling Mud	30%	150
Stabilized Tank Bottoms	5%	25
Other Wastes	5%	25
Totals	**100%**	**500**

Notes:

[1]Values based on current volumes of waste that are delivered from area oil field production activities. Actual future volumes and types will vary dependent upon market conditions.
[2]yd^3 = cubic yards
[3]1 yd^3 oil field waste = 2,000 pounds (lbs)

5.3 Sequence of Landfill Development

The Lea Land Landfill Site Development Plan is presented on the Site Plan (**Figure II.1.2**) and on **Permit Plans** (**Volume III.1**); and is further described in **Table II.1.8**. The Landfill will consist of the existing Unit (Unit I) and four new Units (II-V), each of which will contain several waste cells (typically 2-3). As Unit I reaches capacity, landfill development will continue with the development of a cell within Unit II adjacent to the north side of the Unit I as shown on **Permit Plans** (**Volume III.1**). Unit II will be developed (once Unit I reaches capacity) with the construction of portions of Cells II-A. Cell development will progress through Unit II before continuing in future Units. The disposal process will continue to utilize the "area fill" method for all cells. Each cell will be equipped with a composite liner/leachate collection system and stormwater controls demonstrated to meet applicable engineering standards and OCD Part 36 requirements. Construction plans and specifications will be submitted to OCD in advance of installation of each cell.

Cells may be developed in segments and combinations, and more than one cell may be in operation at any one time in response to incoming waste volumes, the progress of site development, and providing available disposal volume below-grade for odor and dust control. The objective is to provide a sufficient area for disposal while keeping the total disturbed area to a minimum. When individual units or sub-units reach interim or final grade, additional cover will be applied as needed to achieve the required cover thickness, and the area at finished elevation may be graded and stabilized once the final grade is achieved. Non-contaminated soils and soil wastes may be temporarily stored and covered above interim or final grade.

TABLE II.1.8-Landfill Development Sequence

1. **Planning**
   a. Confirm that the cell area has been cleared for excavation (e.g., utilities).
   b. Review Permit Plans, Construction Plans, and any pertinent Permit Documents and Permit Conditions.
   c. Establish survey line/grade controls, construction benchmarks, etc.
   d. Develop cell-specific sequence of development, contractor coordination, equipment, and staffing requirements.
2. **Earthwork**
   a. Clear and dispose of vegetation.
   b. Stockpile select surface soils for later use as topsoil.
   c. Install stormwater management systems (e.g., drainage basins and drainageways).
   d. Excavate cell to design grades.
   e. Extend on-site access roads to provide cell ingress and egress.
3. **Environmental Control Systems**
   a. Compact and test subgrade, prepare for liner installation (CQA Plan, **Volume II.7**).
   b. Notify OCD via a milestone schedule and at least 72 hours prior to liner installation.
   c. Install FML composite liner system on cell floor.
   d. Construct leachate collection systems for cells, including risers and sumps as shown on the **Permit Plans** (**Volume III.1**) as applicable.
   e. Install protective soil layer from designated stockpile (and stormwater segregation systems if applicable).
   f. Submit Engineering Certification of completed construction to OCD.
4. **Operations**
   a. Use excavated soil from next cell for daily, intermediate, and final cover for current or previously filled cells.
   b. Use stockpiles as necessary to supplement cover supplies.
   c. Install subsequent cells consistent with 1, 2, and 3 above.
   d. Extend roadways, drainage systems, etc., in advance of need.

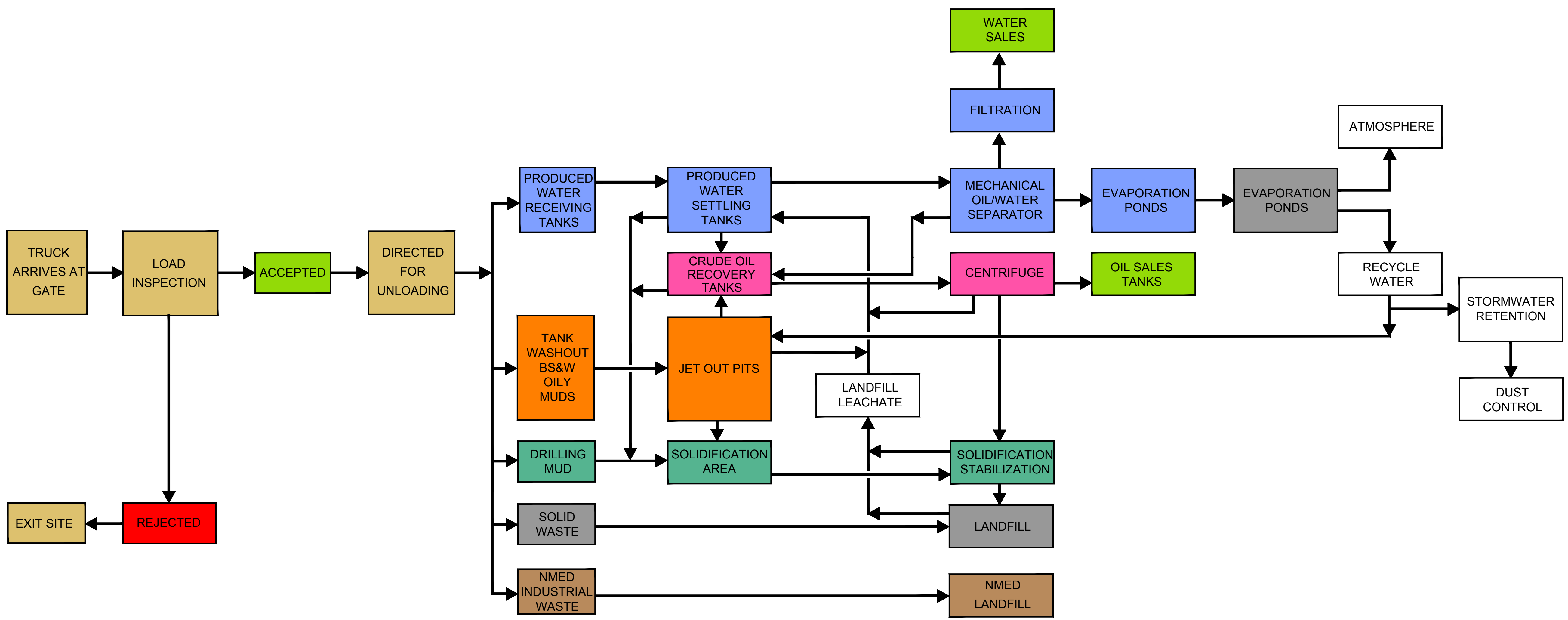
5.4 Daily Landfill Operating Procedures

Vehicles delivering waste will approach the Lea Land SWMF entrance from the east or west on US Highway 62, which bisects the northern third of the site. US Highway 62 is a paved, divided, four-lane highway with no special weight restrictions, and paved, full-width shoulders. Lea Land has an existing suitable intersection design that provides for safe ingress and egress. The site entrance sign identifies prohibited materials and rules of conduct on-site (**Figure II.1.3**). Disposal operations are only conducted when an attendant is on duty. At the Facility Scalehouse, waste loads are screened to confirm that the solid waste materials are acceptable for disposal at Lea Land. Waste identification, tracking, and screening are addressed in the Oil Field Waste Management Plan provided in **Volume II.2**. Vehicles with acceptable loads are directed to proceed on the interior roads in accordance with signs and direction by facility personnel to the working face for unloading. A description of the solid waste disposal process is included on the Process Flow Diagram (**Figures II.1.5A** and **II.1.5B**).

Unacceptable waste loads will be managed in accordance with the Contingency Plan (**Volume II.5**). If a load is rejected it will be returned to the generator. The width of the daily cell and working face is maintained to the minimum dimensions necessary to accommodate peak flow traffic. At the current average rate of waste receipts (approximately 500 gate yd^3/day), the unloading area is generally maintained at a width of 50-100 ft to accommodate peak hourly traffic flow. Soil cover (or an appropriate alternate cover) will be applied to the Landfill's active face on an as-needed basis to control dust, debris, odors, vectors or other potential nuisances.

The **Permit Plans** (**Attachment III.1.A**) illustrate that the Facility will utilize the "area method" of filling in vertical lifts. The first lift of waste placed over a newly constructed liner segment will be a minimum of 5 ft in thickness, which will then be carefully worked out over the leachate collection protective soil layer from the edge of the cell (i.e., uncompacted). The first lift of waste over the leachate pipe may be pushed off from prior fill areas to avoid landfill equipment traffic over the geopipe. If necessary, temporary "ramps" of waste and/or clean fill will be constructed over the leachate pipes and protective layer in order to facilitate traffic flow. The waste in the first lift will be carefully inspected to ensure that waste types that could impact the liner system (e.g., pipes, metal debris) are excluded from the initial lift. This layer will be placed in a manner that protects the liner and leachate collection system, with minimal compaction.

Waste placement will generally move from the lower (downgradient) portions of the cell to the higher (upgradient) elevations. With the exception of the first "fluff" lift of oil field waste being spread on a newly constructed cell, waste will be compacted in shallow lifts (e.g., 2 – 3 ft thick) by specialized waste compaction equipment. Repeated passes by the waste compactor



PROCESS FLOW DIAGRAM

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/15/2019	CAD: PROCESS FLOW.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CWF	FIGURE II.1.5A
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:May. 31, 2019-06:32:36 ; LAYOUT: B (LS)

PROCESS DESCRIPTION:

1. A WASTE VEHICLE ARRIVES AT THE GATE.
2. PAPERWORK IS CHECKED AGAINST LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY RECORDS TO CONFIRM ACCEPTABLE DOCUMENTATION.
3. THE WASTE LOAD IS VISUALLY AND PHYSICALLY INSPECTED, AND EITHER ACCEPTED TO PROCEED FOR UNLOADING, OR REJECTED AND RETURNED TO THE GENERATOR.
4. ACCEPTED LOADS ARE DIRECTED TO ONE OF FOUR LOCATIONS:

TANKERS CONTAINING PRODUCED WATER ARE DIRECTED TO ONE OF EIGHT LOAD OUT POINTS AT THE PRODUCED WATER TANKS MANIFOLD.
PRODUCED WATER IS DISCHARGED INTO A 1,000 BBL TANK FOR INITIAL SETTLING AND SEPARATION.
OIL ACCUMULATING AT THE TOP OF THE TANKS IS TRANSFERRED TO THE CRUDE OIL RECOVERY TANKS IF ADDITIONAL PROCESSING IS REQUIRED.
PRODUCED WATER IS TRANSFERRED IN SERIES THROUGH FOUR ADDITIONAL 1,000 BBL PRODUCED WATER TANKS.
UP TO FIVE DAYS TOTAL SETTLING TIME IS PROVIDED FOR THE PRODUCED WATER WITH AT LEAST ONE DAY HEATED.
LIQUIDS ARE REMOVED FROM THE PRODUCED WATER TANKS AND TRANSFERRED TO FILTRATION OR THE EVAPORATION PONDS THROUGH A MECHANICAL OIL/WATER SEPARATOR.
SLUDGES AND SEDIMENT SETTLING TO THE BOTTOM OF THE TANK IS TRANSFERRED TO THE SOLIDIFICATION AND STABILIZATION AREA.
MECHANICAL EVAPORATORS CIRCULATE THE WATER WITHIN THE EVAPORATION PONDS TO ENHANCE EVAPORATION TO THE ATMOSPHERE.
SOME WATER IS RECYCLED TO THE TANKER JET OUT FOR TANK CLEANING.

TANKERS CONTAINING BS&W PROCESS WATER AND LIQUID TANK BOTTOMS ARE DIRECTED TO THE JET OUT PIT.
ALL BS&W TANK BOTTOM LIQUIDS RECEIVED ARE DISCHARGED INTO THE JET OUT PIT.
TANK TRUCKS ACCEPTED FOR WASHOUT ARE DIRECTED TO ONE OF SIX JET OUT PITS.
APPROXIMATELY 10 BBLS OF FRESH/RECYCLED WATER ARE PROVIDED TO RINSE OUT THE INTERIOR OF THE TANKS.
THE CLEANED TANK TRAILER IS RETURNED FOR SERVICE.
OIL THAT ACCUMULATES AT THE TOP OF THE JET OUT PITS IS TRANSFERRED TO THE CRUDE OIL RECOVERY TANK FOR PROCESSING, IF REQUIRED.
WATER THAT SETTLES TO THE BOTTOM OF THE TANKS IS TRANSFERRED TO THE PRODUCED WATER TANKS.
SLUDGES AND SEDIMENT SETTLING TO THE BOTTOM OF THE TANK IS TRANSFERRED TO THE SOLIDIFICATION AND STABILIZATION AREA.

THE CRUDE OIL RECOVERY TANKS FEED THE CENTRIFUGE WHICH SEPARATES THE OIL FROM ANY REMAINING WATER. WATER IS RETURNED TO THE PRODUCED WATER TANKS.
SOLIDS RECOVERED FROM THE CRUDE OIL RECOVERY TANKS AND CENTRIFUGE ARE REMOVED TO THE STABILIZATION/SOLIDIFICATION PROCESSING AREA.
OIL RECOVERED FROM THE CRUDE OIL RECOVERY TANKS AND CENTRIFUGE IS TRANSFERRED TO THE OIL SALES TANKS.

TANKERS CONTAINING DRILLING MUD AND CUTTINGS ARE DIRECTED TO THE SOLIDIFICATION AND STABILIZATION AREA.
SLUDGES AND SEDIMENT COLLECTED FROM THE BOTTOM OF THE TANKS ARE SOLIDIFIED WITH A BULKING MATERIAL LIKE SAND OR FLY ASH.
DRILLING MUDS ARE SOLIDIFIED AND STABILIZED USING THREE PARTS SOIL TO ONE PART MUD PRIOR TO LANDFILLING.
LIQUIDS RECOVERED FROM THE SOLIDIFICATION/STABILIZATION PROCESS ARE TRANSFERRED TO THE PRODUCED WATER TANKS.

LOADS OF CONTAMINATED SOIL AND SOLID WASTE ARE DIRECTED TO THE LANDFILL FOR DISPOSAL.
LEACHATE GENERATED BY LANDFILL OPERATION MAY BE TRANSFERRED TO PRODUCED WATER TANKS.

NMED REGULATED INDUSTRIAL WASTE ARE DIRECTED TO THE NMED PERMITTED LANDFILL

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PROCESS FLOW DESCRIPTION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/15/2019	CAD: PROCESS FLOW DESCRIPTION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CWF	FIGURE II.1.5B
APPROVED BY: CWF	www.team-psc.com	

or dozer will consolidate the material to the smallest practical volume. This practice will confine the dimensions of the working face, maximize the use of available capacity, reduce the potential for future settlement, and limit the amount of cover required.

In order to control litter and mitigate potential odors, the active working face will be covered with 6 inches of soil cover, or an approved alternate cover, as needed. Lea Land will place an intermediate cover at least 6-inches thick, in addition to routine cover, over areas of the landfill that will not receive further oil field waste for one month or more, but have not reached final elevation. Areas of intermediate cover will be properly sloped to promote clean run-off and minimize leachate generation, and may be used for temporary cover stockpiles. When weather conditions are favorable, intermediate cover may be vegetated with temporary grasses such as rye if the area will not be subject to additional landfilling within 12 months. Alternative stabilization methods for either intermediate or final cover may be deployed as described in **Attachment II.4.A**. If long-term revegetation is required, native grass will be applied following the local Natural Resources Conservation Service (NRCS) recommendations (see Closure/Post-closure Plan, **Volume II.4**). Areas of intermediate cover will be inspected periodically for erosion and settlement, and prompt regrading and maintenance action will be initiated as required. An Intermediate Cover Inspection and Maintenance Plan is provided as **Attachment II.1.G**.

5.5 Waste Capacity and Longevity

Table II.1.6 provides a projection of daily waste receipts and lists the categories of anticipated wastes that will continued to be received at this facility. This projection is based on historical daily waste receipts of 500 yd^3 per day average. Volumetrics (**Volume III.2**), summarizes the capacity and longevity calculations for the engineering design provided in this Application for Permit and Modification. The volume of excavation (cut) from the cells and drainage basins is designed to provide more than sufficient soil for daily, intermediate, and final cover for all Units. The Lea Land Landfill (new Cells) gross airspace is approximately 12,000,000 yd^3, with approximately 10,000,000 yd^3 (i.e., 10,000,000 tons) of net airspace (i.e., waste capacity). The longevity of the Landfill, operating 365 days per year, is projected as follows:

- 96 years @ 500 tons per day
- 48 years @ 1,000 tons per day
- 32 years @ 2,500 tons per day

Note: @ 2000 lbs/cy waste density

There are many factors that can have an impact on the duration of operations of the Lea Land Landfill. Oil field activity, the price of oil in the marketplace spurring new development activities, closure of other disposal facilities, new processing technologies and the introduction of new waste streams have the potential to increase or decrease the rate at which airspace is depleted. In response to these factors, Lea Land may make arrangements for the purchase or temporary lease of additional equipment to accommodate variations in waste receipts that impact the site development timeline.

5.6 Landfill Gas Safety Management

Surface waste management facilities that include a landfill are required to have a gas safety management plan per 19.15.36.13.O NMAC. The Plan should describe in detail the procedures and methods that will be used to prevent landfill-generated gases from interfering or conflicting with the landfill's operation, and methods to protect fresh water, public health and the environment.

Landfill Gas (LFG) is typically produced when there is a significant supply of readily putrescible organic material, moisture; and a lack of oxygen in the fill. Oil field wastes do not contain significant amounts of putrescible (organic) wastes and will not provide a suitable environment for LFG production. Typical oil field wastes do not generate significant quantities of LFG, nor the requisite pressure to promote migration. Conventional landfill gas monitoring and control systems will not be effective at the Lea Land SWMF. The waste matrix itself will inhibit migration or collection of LFG if it is comprised primarily of soils with <5% degradable organics, as anticipated; therefore no conventional LFG monitoring or controls are proposed in this Application for Permit.

However, Lea Land will implement a gas monitoring program consisting of testing incoming vehicles during unloading to ensure that hydrogen sulfide (H_2S) gas concentrations do not exceed 10 ppm on-site or at the facility boundary. H_2S monitors that issue a visual and audible signal at 10 ppm will be installed in areas around the solid waste disposal cells, treating plant, liquid solidification, and evaporation ponds to ensure compliance with regulatory alert levels. Monitoring points may be added or replaced as operations are extended. Details of the H_2S gas monitoring program are presented in the Hydrogen Sulfide (H_2S) Prevention Contingency Plan provided in **Volume II.5.** In addition, the proposed vadose zone monitoring wells will be monitored for methane and H_2S as part of routine subsurface monitoring as described in the Vadose Zone

Monitoring Plan (**Volume II.9**). These wells are capable of detecting gas in the flow zone before it could potentially reach the property line.

5.7 Leachate Monitoring

A leachate management plan that describes the anticipated amount of leachate, leachate handling, storage and disposal is required for new landfills per 19.15.36.8.C(12) NMAC. The Leachate Management Plan for the Lea Land Landfill is provided as **Volume II.8**. The Leachate Management Plan details the procedures that will be used to manage contact waters generated at the Lea Land Landfill during the permit period and following closure. The Leachate Management Plan has been developed to address the design and performance requirements of 19.15.36.14 NMAC; and to addresses leachate management, including amounts and rates of leachate generation, treatment alternatives, disposal options, etc. Historical leachate generation/collection rates over the composite-lined area of Unit I have been limited.

5.8 Waste Disposal Alternatives

The Lea Land Landfill is designed to operate as an all-weather facility under most foreseeable conditions with stormwater management systems installed in advance of need (see Permit Plans, **Volume III.1**). The site's proposed layout, paved and gravel surfaced roadways, and operating practices provide flexibility with regard to fill face location and access. In the event of a temporary disruption to service such as severe storms or high winds, the following alternatives may be implemented:

- In the event of inclement weather, select a daily fill face location that is readily accessible to established roadways.
- The proposed equipment available for daily operations (see **Table II.1.5**) includes significant back-up for any unplanned downtime.
- Additional waste compacting and earthmoving equipment can be leased under routine arrangements with suppliers.
- Temporary storage of waste at the fill face could be implemented to address short-term equipment shortages.
- Waste compaction and covering tasks could be extended beyond normal hours to complete the day's activities.

In the unlikely event of a complete disruption of access, the Facility would be temporarily closed and the customers notified. The commercial waste flow could be temporarily stored at generator sites, or diverted to other OCD permitted facilities. Waste deliveries destined for processing could be delayed.

5.9 Operating Hours

Lea Land plans to have continuous waste receiving services available twenty-four hours per day, seven days per week if market conditions warrant. These hours will be posted at the site entrance and will be subject to routine review and adjustment as required to match the rate of waste deliveries for disposal. Lea Land may truncate operating hours due to reduced waste receipts, inclement weather conditions (e.g., high winds), etc. Site maintenance and construction activities, including cell preparation and application of cover, may take place at any time, even if the Landfill is not open for receiving waste.

5.10 Vadose Zone Monitoring

Vadose zone monitoring is described in detail in the Vadose Zone Monitoring Plan provided as **Volume II.9**. The proposed vadose zone monitoring protocol will initially include inspection of each well for the presence of fluid in advance of the applicable disposal area construction. After the initial inspection, each vadose zone well (VZ) will be monitored for the presence of free liquids on a monthly basis for a period of 12 months. If the monthly monitoring results continually indicate the absence of fluid, the subject wells will be transitioned to quarterly monitoring. The continued lack of fluids in the VWs may be the subject of future specific approvals by OCD for a reduced monitoring frequency (i.e., semi-annual or annual). Additional details are provided in **Volume II.9**.

6.0 LIQUID WASTE PROCESSING

6.1 Operational Rate

Liquid oil field wastes (produced water) will be accepted for processing at the Lea Land SWMF. The average operational rate for the fully developed Lea Land SWMF is estimated at 9,000 barrels per day (bbl/day) of liquid oil field waste. The operational rate may increase to over 12,000 bbl/day dependent upon market conditions and the rate of generator facilities development.

Basic Sediments and Water (BS&W) wastes will be accepted for processing at the Lea Land Jet-Out Pit. The average operational rate for the fully developed Jet-Out operation is estimated at 1,000 bbl/day of BS&W wastes. The operational rate may increase to over 2,000 bbl/day dependent upon market conditions and the rate of facility development.

Drilling Mud waste will also be accepted for stabilization and solidification. The average operational rate for the fully developed stabilization and solidification area is estimated at 2,000 bbl/day depending on market conditions.

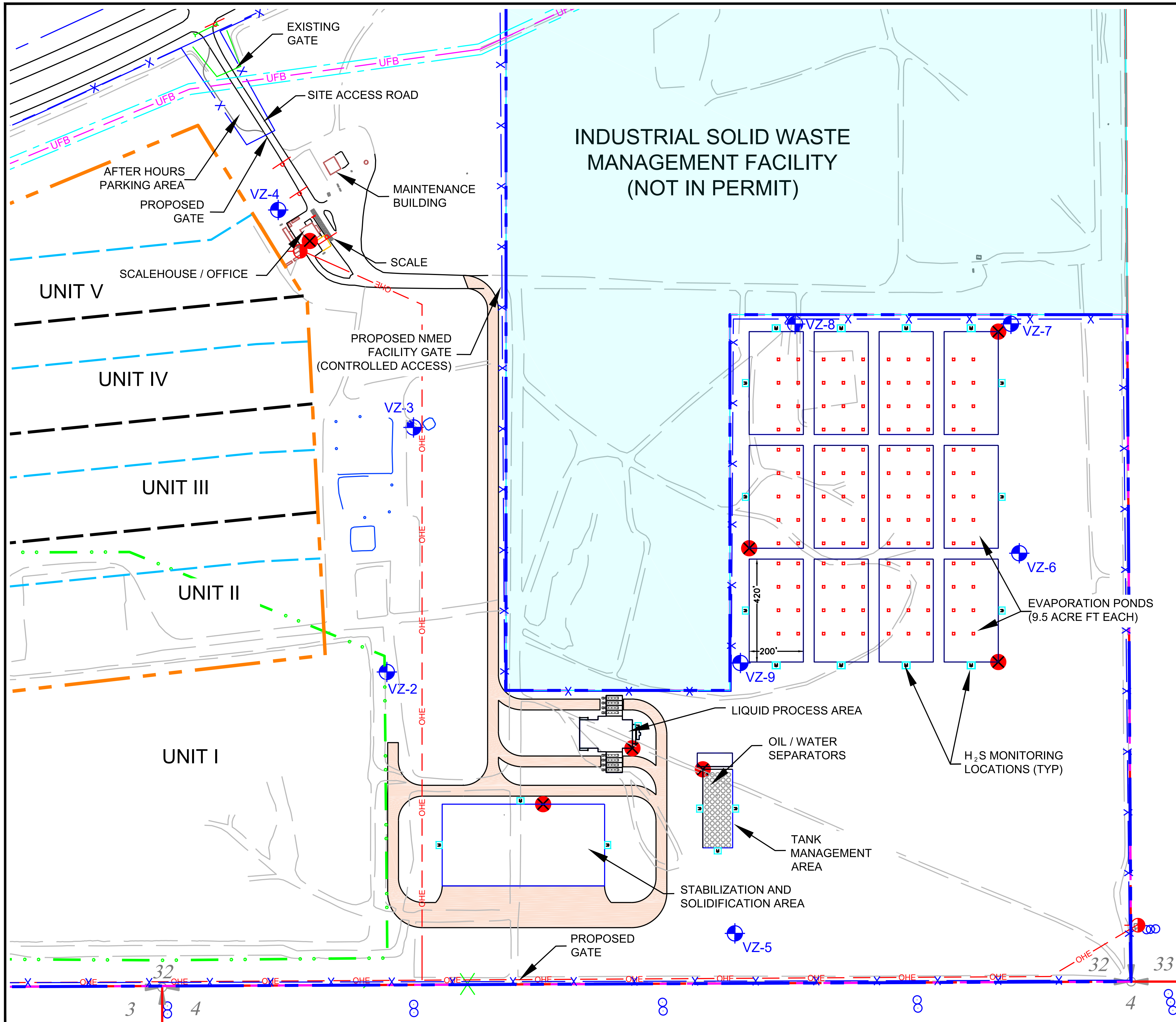
6.2 Processing

The equipment that is anticipated to be used for liquid oil field waste processing is listed in **Table II.1.9**. Oil field waste receiving and processing activities will take place within the fenced Facility (**Figures II.1.2** and **II.1.6**). A description of the liquid waste processing operation is provided on the Process Flow Diagram (**Figures II.1.5A** and **II.1.5B**). The location of the liquid waste processing facilities at Lea Land is provided on the Processing Facility Layout provided as **Figure II.1.6** and detailed in the **Permit Plans** (**Volume III.1**).

TABLE II.1.9 - Processing Equipment

Description	Number	Capacity
Stationary		
Produced Water Tanks	60	1,000 bbl
Crude Oil Receiving Tanks	5	1,000 bbl
Oil Sales Tanks	5	1,000 bbl
Oil/water separation units (Gun Barrels)	1	1,000 bbl
Evaporation Ponds (1-12)	12	73,700 bbl
Evaporation Units	130	340 bbl/day/unit
Jet-Out Pit	1	1,200 bbl
Stabilization and Solidification Process	1	2,000 bbl
Centrifuge	1	1,000 bbl/day
Boiler/Heat exchanger	1	Each
Boiler fuel tanks	1	238 bbl
Mobile		
Track Loader	1	CAT 963 or equivalent
Tracked Excavator	1	CAT 324 or equivalent
Floatation Track-Dozer	1	CAT D-6 or equivalent
Off Road Dump Truck	1	CAT 725 or equivalent
Roll-off Boxes	5	5-40 cy
Roll-off Tilt-frames	1	Up to 40 cy boxes

Note: The number, type, and capacity of the processing may be adjusted in response to changes in waste receipts, waste types, new technologies, etc.



LEGEND

- SECTION BOUNDARY
- PROPERTY BOUNDARY
- SURFACE WASTE MANAGEMENT BOUNDARY
- EXISTING OCD PERMIT BOUNDARY
- PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
- INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
- CELL BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING RAILROAD
- PROPOSED UNDERGROUND FIBER OPTIC
- PROPOSED OVERHEAD POWERLINE
- EXISTING CULVERT
- PROPOSED UNPAVED ROAD (GRAVEL)
- NOT IN OCD PERMIT
- EXISTING TRANSMISSION LINE
- H_2S MONITORING LOCATION
- VZ-2 PROPOSED VADOSE ZONE MONITORING WELL
- PPE AND EMERGENCY EQUIPMENT

PROCESS FACILITY LAYOUT

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.1.6
APPROVED BY: CWF	www.team-psc.com	

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The produced water processing rate is highly dependent upon evaporation, which is also influenced by climate, seasonal fluctuations, and equipment efficiency (Evaporation Calculations, **Volume III.8**). When tanks and ponds are approaching capacity, acceptance of liquid oil field waste may be temporarily suspended. Specifications for the proposed treatment plant equipment, including the produced water processing tanks, boilers, centrifuge, the diffused air floatation system, and mechanical evaporation systems are included in **Attachment II.1.B**. Receiving and storage tanks used at the Facility will be leak-proof; compatible with the proposed waste stream; and manufactured of non-biodegradable materials (e.g., fiber reinforced plastics or steel).

Produced Water will be received through the Produced Waste Load-Out stations and transferred to the heated Produced Water Receiving Tanks. Oil, water and sediments will be removed as the Produced Water passes through a series of these tanks (i.e., Treatment Plant). Water will be discharged into an initial oil/water separation tank (i.e., a Gun Barrel) to remove residual oils prior to entering the evaporation ponds. Discharges to the ponds will be routinely sampled to ensure the function of the oil/water separation process. If oil is found in the discharge, immediate actions will be implemented to remove the oil. These actions may include additional water processing through a second oil/water separation tank. The ponds will be monitored to confirm the absence of oil from the liquids discharged to the pond. If oil is found on the evaporation ponds, immediate efforts will be undertaken to remove any oil that accumulates in the ponds. They will be skimmed, and the oil will be removed for additional processing. A review and evaluation of the oil removal process will be undertaken to identify the process allowing oil release to the ponds and corrective actions will be taken to resolve the oil discharge. Oil collected from the Produced Water Receiving Tanks will be transferred to the Crude Oil Receiving Tanks for final dewatering prior to storage in the Oil Sales Tanks. Liquids within the ponds will be pumped through mechanical evaporators to dissipate the water to the atmosphere.

BS&W waste will be discharged to the Jet-Out Pit where solids will be allowed to settle, and liquids will be removed for processing through the Produced Water processing system. Solids removed from the Jet-Out Pit will be transferred to the Stabilization and Solidification Process Area for processing prior to landfilling. Fresh water or recycled water will be available to flush out the tankers after they discharge their contents.

Drilling Muds and other wet solids are typically delivered in two distinct transport containers, tank trailers delivering liquid drilling mud and enclosed roll-off containers delivering drill cuttigs. Two proposed processes will be developed to handle these distinct transport containers. The closed containers will be deposited in the Stabilization and Solidification Process Area (Drying Pad). Dry soil will be mixed with the deposited materials to solidify them to a level that will pass the Paint Filter Test (**Attachment II.1.F**). The tank trailers will deliver liquid drilling muds through the Jet-Out Pits (Liquids Process) to a mechanical dewatering process that may be accomplished through several processes including drilling mud shakers, belt presses and centrifuges to remove liquids from the drilling muds to the point they will pass the Paint Filter Test. Once solidified by either process, the resulting material will be transported to the landfill for disposal. Liquids collected in both of these processes will be transferred for processing through the Produced Water Processing System.

7.0 FACILITY INSPECTION AND MAINTENANCE

General inspection of the overall physical condition of the Lea Land SWMF, including pond operations, treatment plant, tank farm, evaporation spray system, jet-out pit, stabilization and solidification area and the landfill will be conducted on an ongoing basis by Lea Land personnel when operations are active. Additional formal inspections will be conducted and recorded on the appropriate recordkeeping forms as listed in **Table II.1.10**. Templates for the inspection forms are provided as **Attachments II.1.C** and **II.1.D**; and will include the inspection date, and the name and signature of the inspector. Inspections and maintenance operations will be completed in compliance with 19.15.36.13.L NMAC. The following sections describe the formal inspections for each component of the Lea Land SWMF.

7.1 Mechanical Evaporation System (Processing Area)

The evaporation ponds will rely on mechanical evaporators to enhance the rate of evaporation of the overall system. Specifications for typical spray systems are included in **Attachment II.1.B**. The mechanical evaporation system will be inspected on a daily basis when operations are active with maintenance performed on an as-needed basis. The inspections will be documented on the Inspection Form included as **Attachment II.1.C**. At a minimum, the mechanical evaporation system weather station (set at a sustained wind velocity threshold of 12 mph) and spray system plume height will be checked during the daily inspection. The plume height will be adjusted to an elevation that prevents overspray from leaving the confines of the lined evaporation pond area.

TABLE II.1.10 - Facility Inspections

Section	Component/Details	Frequency[1]	Recording Form
7.1	**Evaporation Spray System** Weather station Plume height Over spray Freeboard	Daily	Facility Inspection Form (Attachment II.1.C)
7.2	**Solid Waste Disposal Landfill** Disposal operations and location Free liquids Stormwater controls Litter, vectors, odors Daily cover	Daily	Facility Inspection Form (Attachment II.1.C)
7.3	**Overall Facility Operation** Signs Security (fencing/gates) Stormwater control systems (runon/runoff) Sumps Access roads OCD Permit compliance Construction activity	Weekly	Facility Inspection Form (Attachment II.1.C)
7.4	**Treatment Plant, Tanks and Sumps** Containment berm Tank condition Tank leak test (annual) Signage Pipe and valve condition Sump condition	Weekly	Facility Inspection Form (Attachment II.1.C)
7.5	**Tank Farm & Pump System (Process Area)** Containment and liner Tank condition Tank leak test (annual) Signage Pipe and valve condition Sump condition	Weekly	Facility Inspection Form (Attachment II.1.C)
7.6	**Pit and Pond Operation** Depth of liquids in sumps Pond levees Piping condition and status	Weekly	Pit/Pond Integrity/Leak Detection Inspection Form (Attachment II.1.D)
7.7	**Solid Waste Disposal Landfill** Leachate Collection Sump	Monthly	Facility Inspection Form (Attachment II.1.C)
7.8	**Pond Containment System** Rainfall Berms Levees Liners Wind speed/direction Damage assessment	Quarterly	Pit/Pond Integrity/Leak Detection Inspection Form (Attachment II.1.D)
7.9	**Landfill and Process Area** Vadoze Zone Monitoring	Monthly	Facility Inspection Form (Attachment II.1.C)

Notes:

[1] *When operations are active.*

[2] *Report discovery of significant liquid in the leak detection system to OCD within 24-hrs of observation.*

7.2 Surface Waste Management Facility Landfill

The solid waste disposal area will typically be inspected on a daily basis when operations are active. The inspections will be documented on the Inspection Form, included as **Attachment II.1.C**. At a minimum, the items listed in **Table II.1.10** will be checked during the daily inspection. During the inspection, current disposal locations and operations will be compared to the OCD-approved Lea Land Permit, with any deviations recorded and reported to the Facility Manager. The inspector will also evaluate and record the potential presence of free liquids derived from disposal or precipitation; the condition of stormwater run-on/runoff controls; and the presence of windblown debris, vectors, or odors. Finally, the inspector will record the condition of previously applied soil or alternative cover and identify need for additional cover, grading or vegetation. Deficiencies will be repaired or addressed as soon as practical; but not to exceed 30 days, and the results recorded in the permanent Facility Operating Record.

7.3 Overall Facility Operation

A thorough inspection of the specific processing areas, landfill, and sumps will be conducted on a weekly basis when operations are active and documented on the Facility Inspection Form included as **Attachment II.1.C.** The overall Facility inspection portion of the form will, at a minimum, document the items listed in **Table II.1.10**. Inspection forms will be kept and maintained at the Lea Land SWMF Administrative Office or other secure location and be made available for OCD review upon request.

7.4 Treatment Plant, Tanks and Sumps (Processing Area)

The processing area physically separates oil from water through the use of tanks and other equipment. Weekly inspections of the processing area and tanks will be conducted when operations are active. The inspections will be documented on the Inspection Form included as **Attachment II.1.C**. At a minimum, the inspections will include and document the items listed in **Table II.1.10**. Equipment identified during inspections or mechanical testing which require corrective action will be taken offline until repairs are completed and documented as necessary.

The Treatment Plant will be inspected for proper function of the boiler plant, piping and proper liquid flow operation. Should any defect that seriously jeopardizes the plant operation or safety of the operation be identified, the system will be decommissioned until repairs are completed.

Pond detection sumps will be inspected at least weekly, and fluid will be removed as necessary to prevent overflow. If the sump integrity has failed, OCD will be notified within 48 hours of discovery, and the sump contents and associated contaminated soil will be removed and disposed of in the solid waste disposal area following solidification, if necessary. A report describing subsequent investigations and remedial actions taken will be submitted to OCD and maintained in the Facility Operating Record.

7.5 Oil Treatment Plant (Processing Area)

The Tank Farm is designed to contain the capacity of the maximum number of interconnected tanks plus 30%. In this case, there is a maximum of five 1,000 bbl tanks connected for a total of 5,000 bbl. The tank farm is designed to accommodate in excess of 6,500 bbl of containment upon full development. At a minimum, the inspections will include and document the items listed in **Table II.1.10**. The inspections will be documented on the Inspection Form included as **Attachment II.1.C**. Items identified during inspections which require corrective action will be addressed immediately, and if required, the specific process equipment will be taken offline until repairs are completed. Detection sumps will be inspected at least weekly, and if deficiencies are noted, OCD will be notified within 48 hours of discovery, and the sump contents and sediments will be removed, stabilized and disposed of at Lea Land or another OCD-approved facility. A report describing subsequent investigations and remedial actions taken will be submitted to the OCD and maintained in the Facility Operating Record.

7.6 Pit and Pond Operation (Processing Area)

A thorough inspection of the leak detection system and sump will be conducted on a weekly basis and documented on the Pit/Pond Integrity/Leak Detection Inspection Form included in **Attachment II.1.D**. At a minimum, the items listed in **Table II.1.10** will be documented. Prior to placing a newly constructed pit or pond, or a pond that has undergone repair or cleaning into service, liquids will be removed from above the primary liner and from the leak detection system. Once in service, it is anticipated nominal liquids may be present in the leak detection system due to condensation and nominal flow through the primary liner. The pond sumps are 2 ft deep and have a capacity of >1,200 gallons (gal) using a porosity of 35% for the granular material (3/4 to 2-inch select aggregate). **Attachment II.1.E** is a summary table from an authoritative publication on potential geomembrane liner leakage for 40 mil high density polyethylene (HDPE) lined ponds. As shown on the table, the combined projected permeation/pinhole leakage rate ranges from 1.5

to 130 gal/acre/day. Using a very conservative value of 8 gal/acre/day for the combined leakage/permeation rate (**Attachment II.1.E**), this provides 16 days of storage at a depth of 2 ft in the sump. The rate of 8 gal/acre/day is considered very conservative as it is based on 40 mil HDPE (vs. the actual 60 mil HDPE pond liner provided); a fluid depth of 10 ft; and a high number of large pin holes. As additional protection, a geosynthetic clay liner (GCL) will be installed under the leak detection sumps (**Volume III.1**, **III.3,** and **Permit Plans**).

The liquid levels in the sumps will be monitored approximately weekly immediately after pits and ponds are put into service and documented. Should the consistent lack of liquids become apparent after a series of inspections, the monitoring frequency may be extended to monthly. Upon discovery of excessive liquid presence in a leak detection system (i.e., > 2 ft), OCD will be notified within 24 hours and the affected pond area drained. Prior to placing the pond back into service, Lea Land will initiate corrective action which may include but is not limited to:

- Actions undertaken to locate source(s) of leakage
- Repair procedures
- More frequent sump liquid level monitoring and/or pumping
- Liquids testing
- Increased vadose monitoring (if required)

The results of the corrective actions will be recorded and placed in the Facility Operating Record.

7.7 Evaporation Pond Containment System (Processing Area)

A thorough inspection of the berms, the outside walls of pond levees and the berm liner will be conducted at least quarterly, and after any major rainfall or windstorm. For purposes of this inspection frequency, a major rainfall is defined as a documented 25-year, 24-hour rainfall event, and a major windstorm is defined as sustained wind speeds in excess of 30 mph for a one hour period. The inspections will be documented and retained on the Pit/Pond Integrity/Leak Detection Inspection Form such as the template included in **Attachment II.1.D**. At a minimum, the inspection shall consist of the items listed in **Table II.1.10**. The inspection will address erosion, liner damage and maintenance required with a timeframe to complete required repairs. In addition, the depth of sludge build-up in the bottom of the pond will be measured during the quarterly inspections and documented. Sludge in excess of 12 inches will be removed, dewatered, stabilized and disposed of on-site or at another OCD-approved facility.

7.8 Below-grade Tanks and Sumps

No below-grade tanks or sumps, other than the pit sumps previously discussed with the leak detection system, are proposed for the Lea Land SWMF.

8.0 EMERGENCY SITUATIONS AND EQUIPMENT BREAKDOWN

Response to emergency situations involving the actions of the Emergency Coordinator, fire prevention and protection, incident response, and notification procedures are described in detail in the Contingency Plan (**Volume II.5**).

8.1 Equipment Breakdown

In the case of unplanned equipment downtime, the following measures will be deployed:

- Delivery of liquid oil field waste will be delayed if storage capacity is unavailable in the receiving tanks.
- Downtime associated with mobile equipment (i.e., skid-steer loader, forklift) will be addressed by deploying alternative on-site units (e.g., end loaders) and arrangements with local equipment vendors for immediate maintenance and lease of temporary replacement units.
- Lea Land's proposed preventive maintenance plan has proven to be highly effective at preventing unplanned downtime through routine inspection and regular maintenance of mobile and stationary equipment.

9.0 RECORD KEEPING REQUIREMENTS

Lea Land is required to keep detailed records for the Lea Land SWMF as described throughout this Application. In addition, the Facility will meet the OCD requirements for reporting as detailed in the Management Plans provided elsewhere in **Volume II** of this Application. Records will be retained for a minimum of 5 years and will be made available for OCD review and inspection upon request. Lea Land has a demonstrated history of maintaining its equipment in optimum condition, resulting in uninterrupted service to the industry.

ATTACHMENT II.1.A

SAFETY COMMUNICATIONS PROGRAM (TYPICAL)

ATTACHMENT II.1.A - Safety Communications Program (Typical)

Safety Meeting Attendance Sheet

Date: ______________________________ Time: ______________________________

Topic: ____

Presenter: _________________________ Department: _________________________

Instructions:

1. This form must be completed at each safety meeting.
2. Make additional copies as required.
3. Keep copy of completed attendance sheets in binder.

Printed Name	Signature

Absent	Date Covered

ATTACHMENT II.1.A - Safety Communications Program (Typical)

Annual Training Schedule[1]

Month	Yard Topics	Office Topics
January	Lockout/Tagout Program SWPPP Good Housekeeping Permit Conditions Incompatible Waste	Lockout/Tagout Program SWPPP Good Housekeeping Permit Conditions Incompatible Waste
February	Material Acceptance & Handling Form C-133 & C-138 reconciliation H_2S screening	Material Acceptance & Handling Form C-133 & C-138 reconciliation H_2S screening
March	Non-exempt liquids recognition H_2S Treatment Procedures	Non-exempt liquids recognition H_2S Treatment Procedures
April	Site Contingency Plan H_2S Contingency Plan Hazard Communications Emergency Evacuation Drill	Site Contingency Plan H_2S Contingency Plan Hazard Communications Emergency Evacuation Drill
May	Spill Prevention & Control Site Generated Waste Disposal Heat Stress	Spill Prevention & Control Site Generated Waste Disposal Heat Stress
June	Confined Space Site Inspection Incident & Injury reporting First Aid/Bloodborne Pathogens	Confined Space Site Inspection Incident & Injury reporting First Aid/Bloodborne Pathogens
July	Migratory Bird Prevention	Migratory Bird Prevention
August	Employee Safety PPE 3-Point Contact	Employee Safety PPE 3-Point Contact
September	Industrial Powered Trucks Skid Loader Sky Trak Loader High Voltage Training	Recordkeeping
October	Cold Weather Stress Fire Extinguisher Use	Cold Weather Stress Fire Extinguisher Use
November	Sexual Harassment Drug & Alcohol Cell Phone usage	Sexual Harassment Drug & Alcohol Cell Phone usage
December	Employee Benefits Temp. Employee Safety	Employee Benefits Temp. Employee Safety

Note:
[1] *Typical training schedule and content subject to change*

ATTACHMENT II.1.B
EQUIPMENT SPECIFICATIONS

Thermal Fluid Heaters

Vertical Coil, Vertical Tubeless, Electric and Horizontal

Sizes from 75,000 to 40,000,000 BTU/HR

RUGGED ROBUST RELIABLE

The heat transfer innovators.

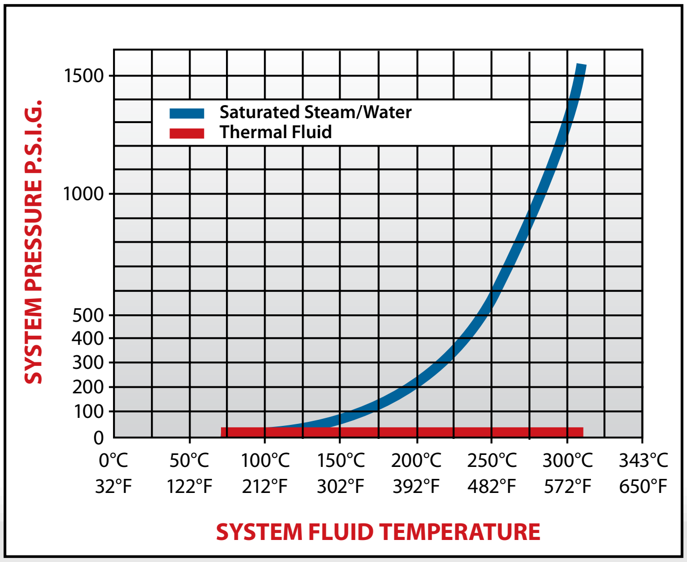
THERMAL FLUID FEATURES AND BENEFITS

KEY FEATURES

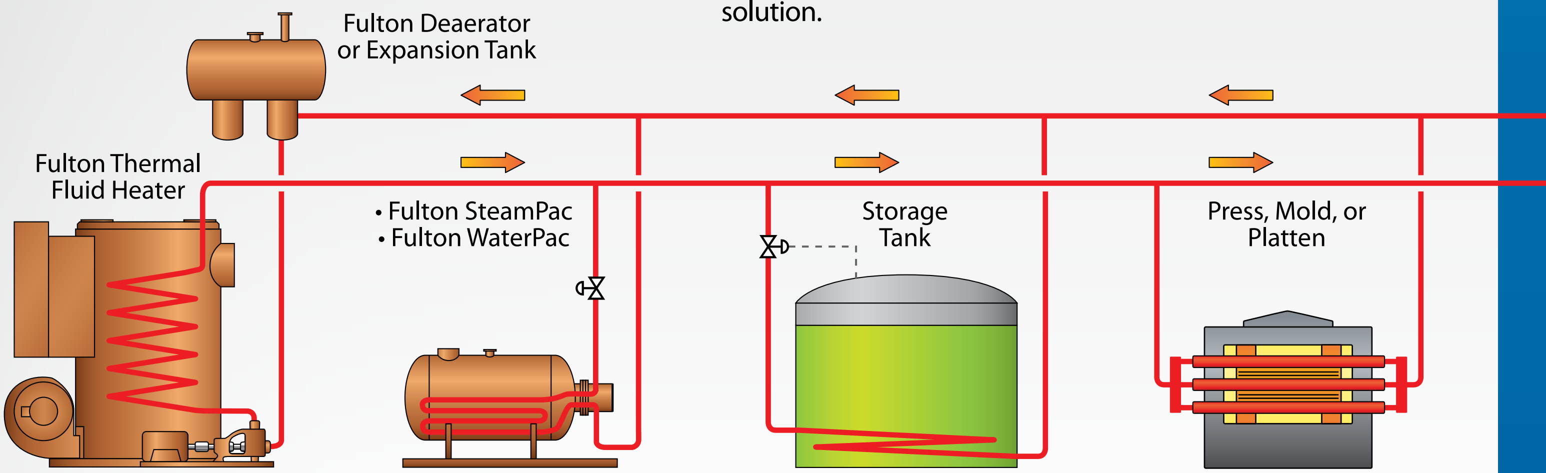
- No Corrosion or Freezing
- High Operating Temperatures (up to 750° F) with Low System Pressure
- Minimum Maintenance - Burner, Pump and Controls
- Simple Circuit; No Blow-Downs, Steam Traps or Condensate Return Systems
- Fulton's Combination Expansion / Deaerator Thermal Buffer Tank Provides Pipework Simplification, Protection of Thermal Fluid from Oxidation and Continuous Deaeration of Fluid to Avoid Pump Cavitation
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request
- Fulton Heaters are Manufactured Individually for Maximum Flexibility and to Customer Specifications
- Fulton Heaters and Accessory Components (Pumps, Expansion Tanks, Control Valves, etc.) Can Be Skid Mounted to Save Time and On-Site Fabrication

THERMAL FLUID VS. STEAM

A thermal fluid (hot oil) system operates in a closed loop circulation system with minimal pressure. Fulton thermal fluid systems can reach 750° F (345° C) making them an ideal choice for many process heat applications.



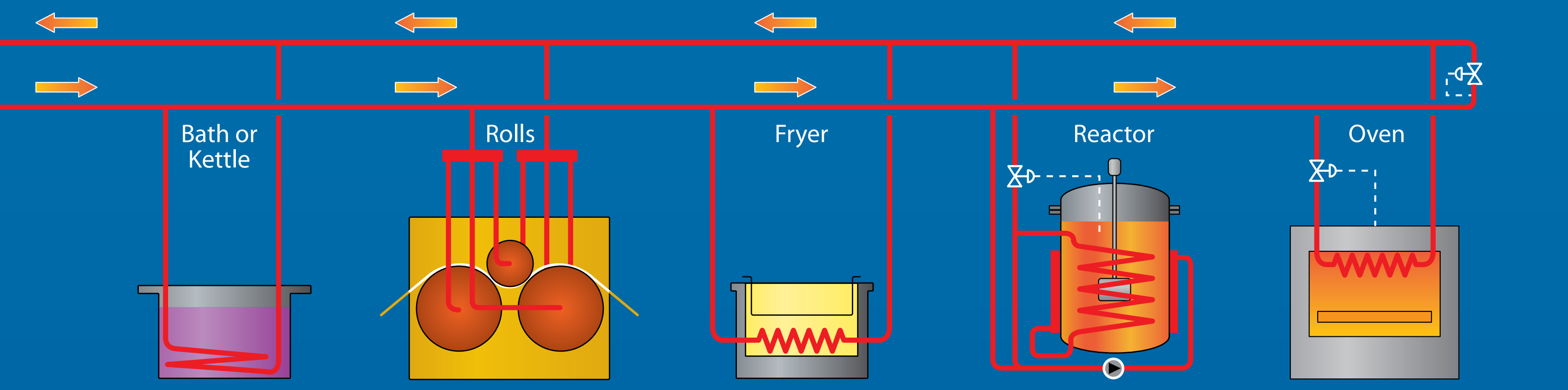
The choice between a steam system or a thermal fluid system is governed by the process requirements. The range or process temperature is a deciding factor. If the system's required temperature is above the freezing point of water (32° F) and below approximately 350° F, the choice is usually steam. However, if the required temperature is below 32° F or above 350° F, thermal fluid may be a better solution.



APPLICATIONS

Fulton heaters are used in a variety of applications throughout many industries. Food, plastic and chemical processing, as well as pharmaceutical and bio-fuel production, are only a few examples of the many existing applications using Fulton equipment.

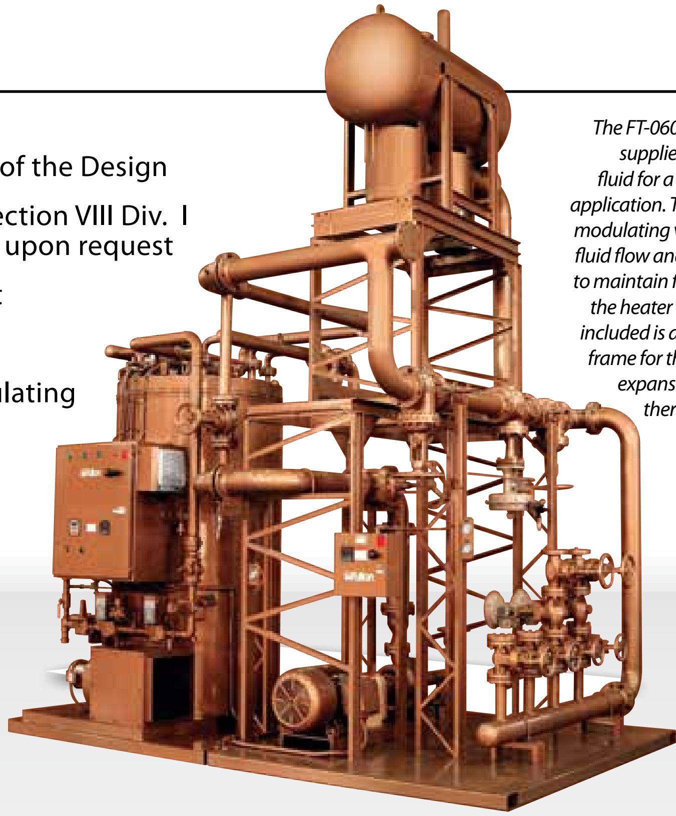
- Adhesives
- Asphalt
- Autoclaves
- Bio-fuel
- Chemical Reactors
- Deodorization
- Distillation
- Food Processing (frying, baking, etc.)
- Gas Processing / Oil Processing
- Inks & Dyes
- Laminating
- Laundry
- Marine Heating and Shipboard Services
- Metal Finishing
- Mining
- Ovens
- Paint and Varnish Manufacture
- Paper Converting Machinery
- Plastics
- Printing and Packaging Machinery
- Rubber and Rubber Compounds
- Surface Pre-Treatment and Finishing
- Tank Farms/Pipe and Pump Tracing
- Textile Machinery
- Unfired Steam or Hot Water Generation
- Uranium Processing
- Waste Treatment/Dryers



C-MODEL
VERTICAL COIL DESIGN

KEY FEATURES

- Vertical 4-Pass Design
- Preheated Combustion Air is an Integral Part of the Design
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request
- 800,000 BTU/Hr to 14,000,000 BTU/Hr Output
- Operating Temperatures to 750°F
- Gas, Oil or Dual Fuel Burners; On/Off or Modulating
- Low Emission Natural Gas Burners are Available
- Minimal Refractory Results in Low Thermal Inertia and Prevents Overheating of the Fluid in the Event of a Pump or Power Failure
- Customized Controls Available
- Customized Heaters Available
- High Efficiencies
- Even Heating



The FT-0600-C shown here supplies 600°F thermal fluid for a food processing application. The skid includes modulating valves to control fluid flow and a bypass valve to maintain flow throughout the heater at all times. Also included is a custom 3-piece frame for the top-mounted expansion / deaerator / thermal buffer tank.

MODELS	FT-C	0080	0120	0160	0240	0320	0400	0600	0800	1000	1200	1400
Specifications												
Heat Output	1,000 BTU/HR	800	1,200	1,600	2,400	3,200	4,000	6,000	8,000	10,000	12,000	14,000
	1,000 KCAL/HR	200	300	400	600	800	1,000	1,500	2,000	2,500	3,000	3,500
Thermal Fluid Content	Gallons	10	21	19	31	68	76	132	201	290	383	460
	Liters	38	80	72	116	258	288	498	648	1,097	1,448	1,741
Recommended Flow Rate	GPM	50	75	100	150	250	250	375	500	615	730	800
	M3/HR	11.4	17	22.7	34	56.8	56.8	85.2	113.6	139	167	182
Approximate Fuel Usage												
Light Oil *	GPH	7.1	10.7	14.3	21.4	28	35.3	53	69.3	87.1	104.5	122
	LPH	27	40.6	54.1	81	108.8	136	201	263.7	329.6	395.5	461.5
Natural Gas *	FT3/HR	998	1,498	1,998	2,999	4,000	4,997	7,498	9,997	12,496	14,998	17,500
	M3/HR	38.3	42.4	56.5	84.9	113.2	141.5	212.3	283	353.8	424.6	495.5
Power												
Typical Circulating Pump	HP	10	10	15	15	20	20	30	40	50	50	60
	KW	7.5	7.5	11.2	11.2	14.9	14.9	22.5	29.5	37.3	37.3	45
Typical Burner Motor	HP	1.5	3	3	3	5	7.5	7.5	15	20	20	20
	KW	1.1	2.2	2.2	2.2	3.7	5.6	5.6	11.2	11.2	15	15

* Please consult factory for additional fuel options. Fuel up to No. 6 Oil available for large units (FT-0600-C and larger). Voltage 3 Phase for Burner and Pump - Each unit has an incorporated step down transformer. Efficiency up to 80% Minimum Based on High Heating Value of the Fuel (No. 2 Oil @ 140,000 BTU/GHHV; Natural Gas @ 1,000 BTU/ft3HHV) Circulating pump motor sizes based on standard pressure (55 PSIG) and viscosity 1 cs, specific gravity 0.7, with 25-37 PSID available head for installation. All Units are Modulated. Operating specifications may change based on field conditions.

A LOOK INSIDE

THE COMBUSTION PROCESS

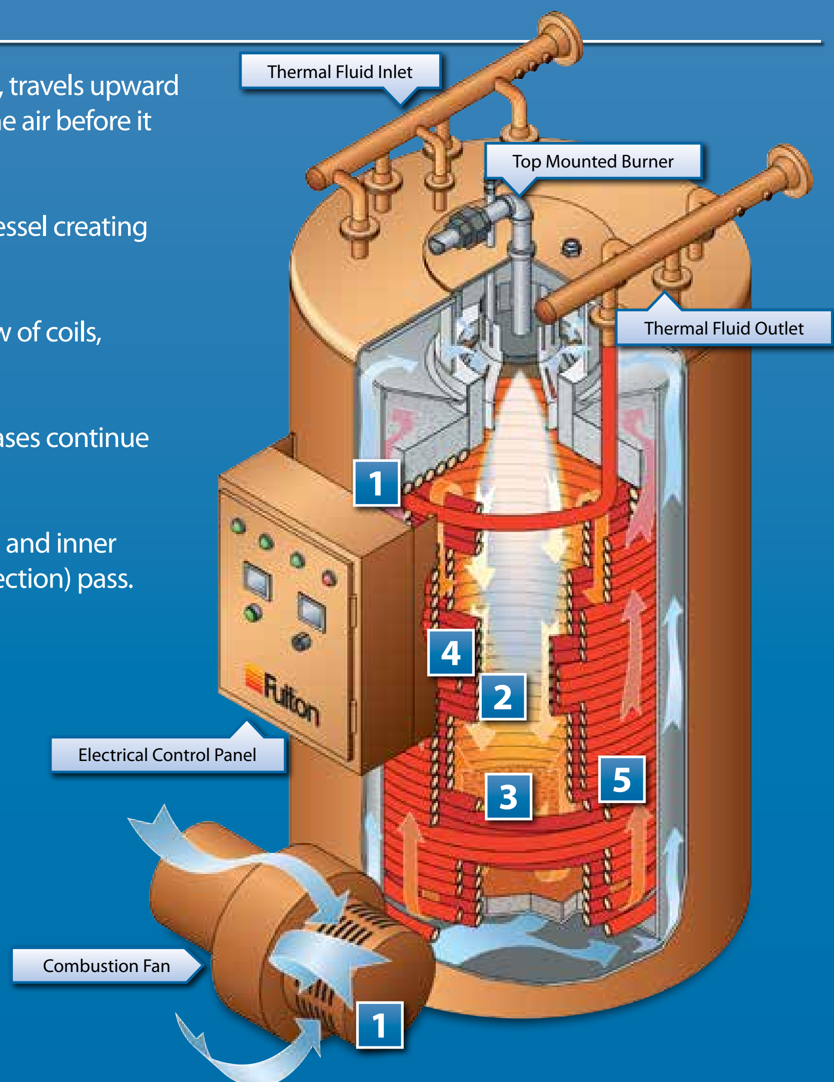
1 The combustion air enters the burner fan inlet, travels upward between the inner and outer jacket, preheating the air before it enters the top mounted burner.

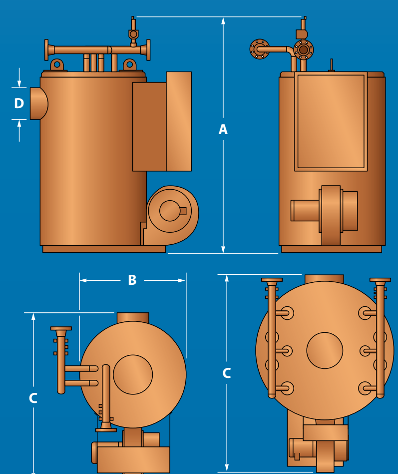
2 Hot gases travel down the full length of the vessel creating the first (radiant) pass.

3 The gases then travel back across the inner row of coils, creating the second (convection) pass.

4 The third (convection) pass is created as the gases continue back down between the inner and outer coil.

5 The last pass is upward between the outer coil and inner jacket to the flue outlet, creating the fourth (convection) pass.





TOP VIEW
FT-0080-C through FT-0400-C

TOP VIEW
FT-0600-C to FT-1400-C
Front and Side not shown

MODELS	FT-C	0080	0120	0160	0240	0320	0400	0600	0800	1000	1200	1400
Dimensions												
Heater Inlet/Outlet Connections	IN	1.25	1.5	2	2.5	3	3	4	4	6	6	6
	MM	32	38	51	64	76.3	76	102	102	152	152	152
(A) Overall Height	IN	73.7	80.7	80.6	89.7	100.6	112.4	143.6	143	146.5	146.4	163.1
	MM	1,872	2,050	2,046	2,278	2,556	2,856	3,648	3,632	3,721	3,718	4,144
(B) Heater Width	IN	31.6	34.4	45.9	50.1	49.3	49.3	63.4	70.5	95	108.4	108.4
	MM	803	873	1,165	1,273	1,252	1,252	1,611	1,791	2,413	2,753	2,753
(C) Overall Depth	IN	46.2	60.6	60.6	66.6	80.6	80.6	88.1	107.75	135.1	152.9	152.9
	MM	1,173	1,540	1,540	1,691	2,046	2,046	2,237	2,736	3,432	3,882	3,882
(D) Flue Outlet Diameter	IN	10	10	10	12	14	14	18	20	20	22	22
	MM	254	254	254	305	356	356	457	508	508	559	559
Recommended Stack Diameter	IN	10	12	12	14	18	18	22	24	24	26	26
	MM	254	304	304	356	457	457	558	609	609	661	661
Approximate Dry Weight	LB	1,500	2,100	2,550	3,400	5,300	5,300	8,250	11,450	19,250	21,700	23,000
	KG	700	950	1,150	1,550	2,400	2,400	3,750	5,200	8,750	9,850	10,455

Specifications and Dimensions are approximate. Consult factory for model specific electrical requirements. We reserve the right to change specifications and/or dimensions without notice. Diagram for guidance purposes only. Comprehensive details of dimensions, connections, etc. for each model are given on product dimension data sheets available from Fulton.

A-MODEL
VERTICAL TUBELESS DESIGN

KEY FEATURES

- Vertical Annular Design
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request
- 207,000 BTU/Hr to 1,736,000 BTU/Hr Output
- Operating Temperatures to 600° F
- Gas or Oil Fired Burners, On/Off or Modulating
- Low Emission Gas Burners are Available
- Customized Controls Available
- Customized Heaters Available

Pictured here is a skid mounted FT-0690-A thermal fluid heater with a deaerator / thermal buffer tank and a circulation pump.

MODELS	FT-A	0200	0380	0520	0690	1050	1740
Specifications							
Heat Output	1,000 BTU/HR	207	348	519	693	1,052	1,736
	1,000 KCAL/HR	52	88	131	175	265	437
Thermal Fluid Content	Gallons	23	38	45	65	98	117
	Liters	87	144	170	246	371	443
Recommended Flow Rate	GPM	90	90	125	125	150	200
	M3/HR	21	21	28	28	34	46
Approximate Fuel Usage • Light Oil	GPH	2.2	3.2	4.7	6.7	9.4	15.8
	LPH	8.3	11.9	17.8	25.4	35.6	60
Approximate Fuel Usage • Natural Gas	FT3/HR	259	435	649	866	1,315	2,170
	M3/HR	7.2	12.2	18.4	24.2	36.8	60.8
Power							
Typical Circulating Pump	HP	10	10	15	15	15	20
	KW	7.5	7.5	11.2	11.2	11.2	14.9
Typical Burner Motor	HP	.33	.33	.33	.75	.75	1.5
	KW	.248	.248	.248	.56	.56	1.1

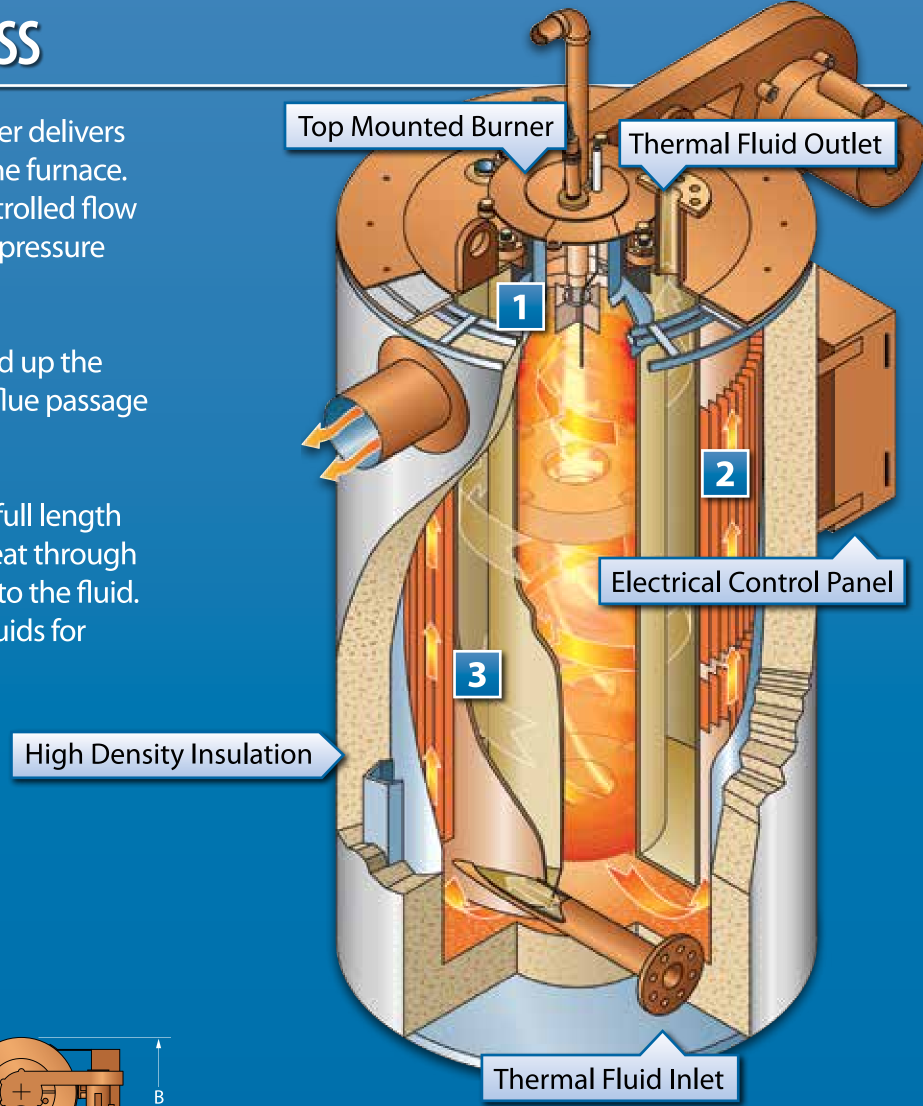
A LOOK INSIDE

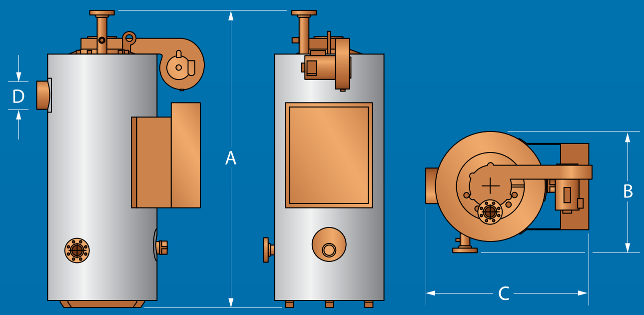
THE COMBUSTION PROCESS

1 The top-mounted down-fired burner delivers a spinning flame down the length of the furnace. As the flame swirls downward in a controlled flow pattern, the fluid spirals upward in the pressure vessel.

2 Hot gases from the flame are carried up the outside of the vessel in the secondary flue passage convection area.

3 Convection fins welded along the full length of the vessel transmit the remaining heat through the outer side of the fluid vessel and into the fluid. The result is even heating of thermal fluids for optimum thermal efficiency.





Specifications and Dimensions are approximate. Consult factory for model specific electrical requirements. We reserve the right to change specifications and/or dimensions without notice.

Diagram for guidance purposes only. Comprehensive details of dimensions, connections, etc. for each model are given on product dimension data sheets available from Fulton.

MODELS	FT-A	0200	0380	0520	0690	1050	1740
Dimensions							
Heater Inlet/Outlet Connections	IN	1.5	1.5	2	2	2	2.5
	MM	38	38	51	51	51	64
(A) Overall Height	IN	69	75	85	86	86	110
	MM	1,752	1,905	2,159	2,185	2,185	2,794
(B) Heater Width	IN	26	28	30	36	44	44
	MM	660	710	760	915	1,120	1,120
(C) Overall Depth	IN	43	45.5	46	56	64	64
	MM	1,092	1,156	1,168	1,422	1,626	1,626
(D) Flue Outlet Diameter	IN	6	6	8	10	12	12
	MM	152	152	203	254	305	305
Approximate Dry Weight	LB	1,850	2,100	2,300	3,400	4,400	7,200
	KG	840	955	1,045	1,540	1,995	3,275

N-MODEL
VERTICAL ELECTRIC DESIGN

KEY FEATURES

- Compact Vertical Design
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request
- 74,000 BTU/Hr to 1,685,000 BTU/Hr Output
- Operating Temperatures to 650° F
- Low Watt Density Elements Result in Low Film Temperatures and Long Element Life
- Customized Controls Available, Including (but not limited to) Class 1, Division 1 or 2 groups C&D of NEC Code
- Customized Heaters Available

Pictured here is a skid mounted FT-0640-N electric thermal fluid heater with an expansion / deaerator / thermal buffer tank and a circulation pump.

MODELS	FT-N	0075	0150	0225	0300	0375	0430	0640	0860	1070	1290	1500	1720
Specifications													
	KW	22	44	66	88	110	126	189	252	315	378	441	504
Heat Input	1,000 BTU/HR	75	150	225	300	375	429	644	859	1,074	1,289	1,504	1,719
	1,000 KCAL/HR	18.9	37.8	56.7	75.6	94.5	108	162	216	271	325	379	433
Heat Output	1,000 BTU/HR	74	148	222	294	368	420	631	842	1,053	1,263	1,474	1,685
	1,000 KCAL/HR	18.6	37.3	59.9	74.1	92.7	105.8	159	212.2	265.4	318.3	371.4	424.6
Thermal Fluid Content	Gallons	18	36	42	54	63	79	79	102	127	152	168	185
	Liters	68	136	159	204	238	299	299	386	480	575	636	700
Recommended Flow Rate	GPM	50	50	50	90	90	125	125	150	150	175	200	200
	M3/HR	11.4	11.4	11.4	20.5	20.5	28.4	28.4	34	34	39.8	45.5	45.5
Power													
Typical Circulating Pump Motor	HP	7.5	7.5	7.5	10	10	15	15	15	15	15	20	20
	KW	5.6	5.6	5.6	7.5	7.5	11.2	11.2	11.2	11.2	11.2	14.9	14.9
Amps	208V	61	122	183	245	306	350	525	700	875	1,050	1,224	1,399
	220V	53	106	159	212	265	303	455	607	758	910	1,061	1,212
	480V	26	53	79	106	132	151	228	303	379	455	531	606

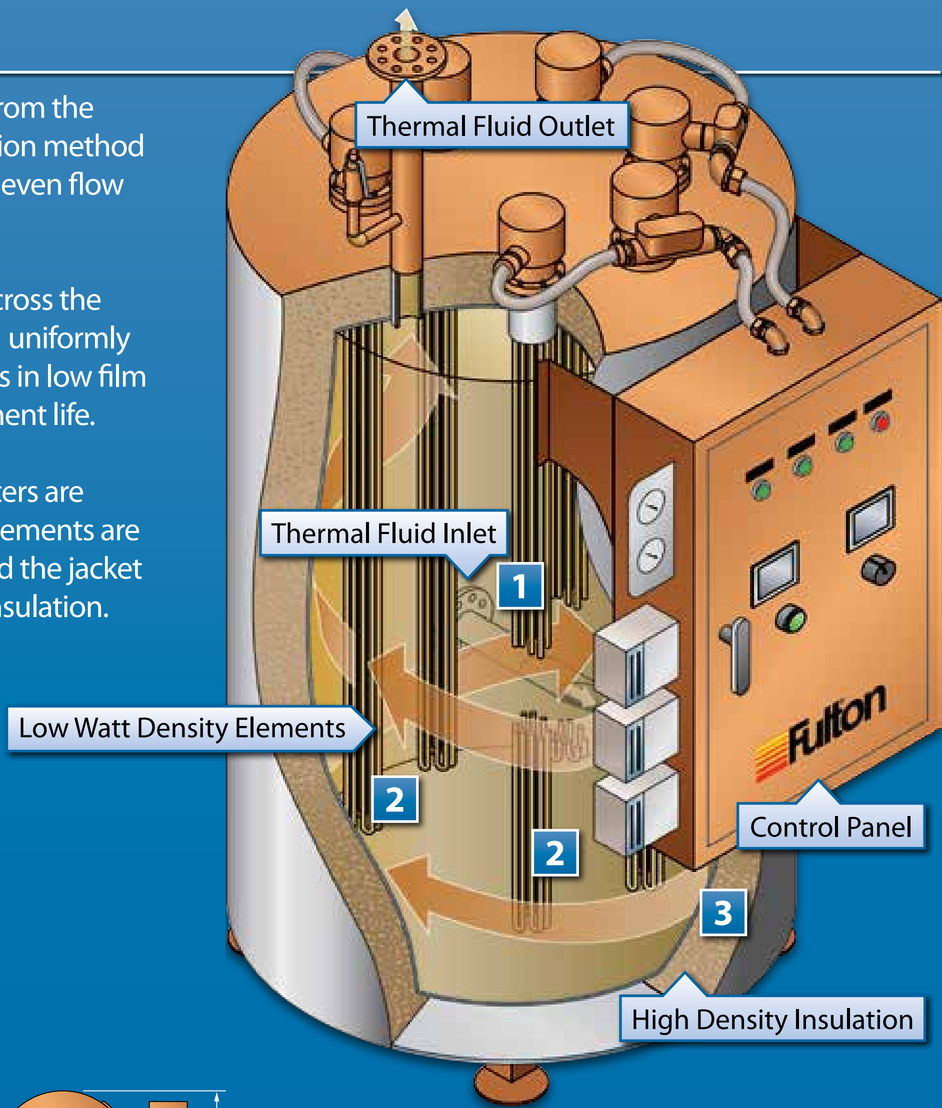
A LOOK INSIDE

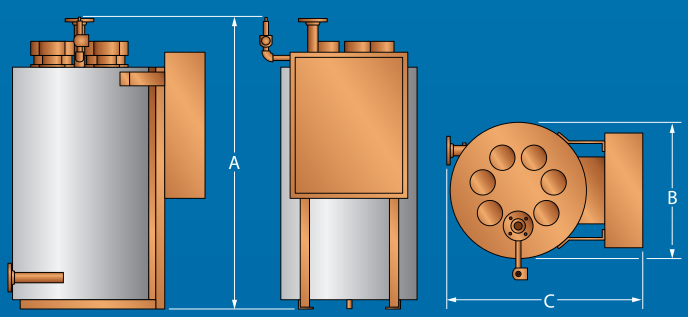
OPERATING PRINCIPLE

1 Thermal fluid enters the heater from the lower right side. This unique circulation method (upward spiraling fluid) results in an even flow of thermal fluid within the vessel.

2 The thermal fluid flows evenly across the multiple low watt density elements, uniformly heating the thermal fluid. This results in low film temperatures and assures long element life.

3 Fulton electric thermal fluid heaters are nearly 100% efficient because the elements are totally immersed in thermal fluid and the jacket is fully insulated with high density insulation.





Specifications and Dimensions are approximate. Consult factory for model specific electrical requirements. We reserve the right to change specifications and/or dimensions without notice.

Diagram for guidance purposes only. Comprehensive details of dimensions, connections, etc. for each model are given on product dimension data sheets available from Fulton.

MODELS	FT-N	0075	0150	0225	0300	0375	0430	0640	0860	1070	1290	1500	1720
Dimensions													
Heater Inlet	IN	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2	2.5	2.5
	MM	38	38	38	38	38	51	51	51	51	51	64	64
(A) Overall Height	IN	70	70	70.5	70	70	90.5	90.4	90.8	89.8	91.2	93	93
	MM	1,778	1,778	1,791	1,778	1,778	2,299	2,296	2,306	2,281	2,317	2,362	2,362
(B) Heater Width	IN	20	26	28	32	32	32	32	38	44	50	54	58
	MM	508	660	711	813	813	813	813	965	1,118	1,270	1,372	1,473
(C) Overall Depth	IN	37.5	43	43.5	47.5	47.5	47.5	49.5	53.8	58.4	65.7	71.8	75.7
	MM	953	1,092	1,105	1,207	1,207	1,207	1,257	1,365	1,257	1,669	1,823	1,993
Approximate Dry Weight	LB	1,060	1,220	1,400	1,540	1,660	2,040	2,200	2,370	2,650	2,950	2,950	3,600
	KG	481	555	636	700	756	927	1,000	1,077	1,205	1,341	1,341	1,636

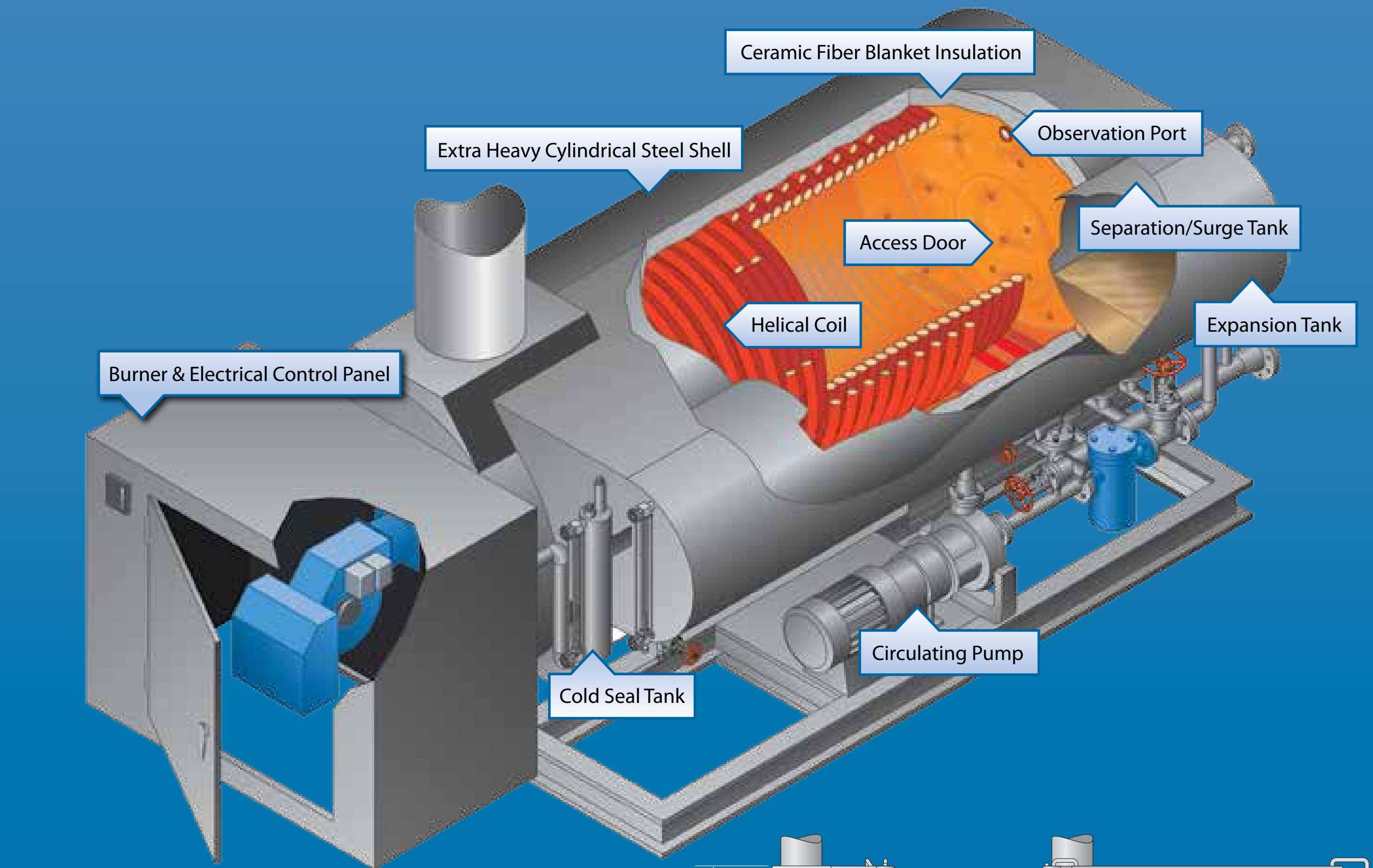
HOPKINS
HORIZONTAL COIL DESIGN

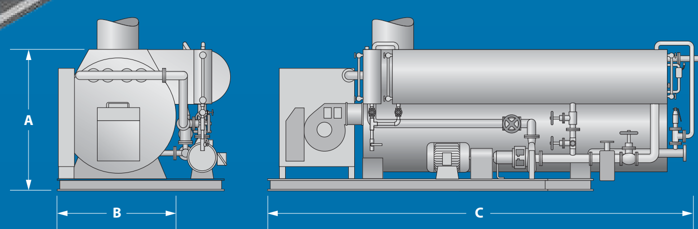
KEY FEATURES

- Horizontal 2-Pass Design
- 1,000,000 BTU/Hr to 40,000,000 BTU/Hr Output
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request
- Operating Temperatures to 650° F
- Modulating Gas, Oil or Dual Fuel Burners
- Alternative Fuel Capabilities
- Open Protocol Burner
- Skid-Mounted Systems Available, Including Circulating Pump and Expansion Tank
- Customized Controls and Coil Designs Available
- Water - Glycol Heaters Available
- Available With or Without Integral Expansion Tank

MODELS	HPN	100S	200S	350S	600S	800S	1000S	1200S	1400S	1600S	2000S	2400S	3000S	4000S
Specifications														
Heat Output	Million BTU/hr	1	2	3.5	6	8	10	12	14	16	20	24	30	40
	Million Kcal/hr	.25	.5	.875	1.5	2	2.5	3	3.5	4	5	6	7.5	10
Flow Rate-Standard *1	GPM	75	150	265	425	600	725	900	1050	1200	1500	1800	2250	3000
	M3/min	18	35	61	97	137	165	205	239	273	341	409	511	682
Flow Rate-Low Flow *2	GPM	40	75	135	225	300	375	450	525	600	750	900	1125	1500
	M3/min	10	18	31	52	69	86	103	120	97	171	205	256	341
Circulating Pump Motor-STD	HP	7.5	15	20	30	40	50	60	75	100	100	125	150	200
	kW	5.6	11.2	14.9	22.5	29.8	37.3	45	56	74.5	74.5	93.2	111.8	149
Circulating Pump Motor-LF	HP	7.5	7.5	15	20	30	30	40	30	40	50	60	75	100
	kW	5.6	5.6	11.2	14.9	22.5	22.5	29.8	22.5	29.8	37.3	45	56	74.5
Blower Motor	HP	1/3	1	2	7.5	10	10	5	7.5	7.5	15	20	25	30
	kW	.25	.7	1.5	5.6	7.5	7.5	4.3	5.6	5.6	11.2	14.9	18.6	22.5
Light Oil (approx. fuel usage)*3	GPH	8.8	17.5	30.6	52.5	70	87.5	104.9	122.4	139.9	174.9	209.8	262.3	349.7
	LPH	33.3	66.2	115.8	198.7	265	331.2	397	463.3	529.5	662	794	992.8	1324
Natural Gas (approx. fuel usage)*3	FT3/hr	1,334	2,667	4,667	8,000	10,667	13,334	16,000	18,667	21,334	26,667	32,000	40,000	53,334
	M3/hr	37.4	75	131	224	299	373.4	448	522.7	597.4	747	896	1120	1493.4

A LOOK INSIDE





Specifications and Dimensions are approximate. Consult factory for model specific electrical requirements. We reserve the right to change specifications and/or dimensions without notice.

Diagram for guidance purposes only. Comprehensive details of dimensions, connections, etc. for each model are given on product dimension data sheets available from Fulton.

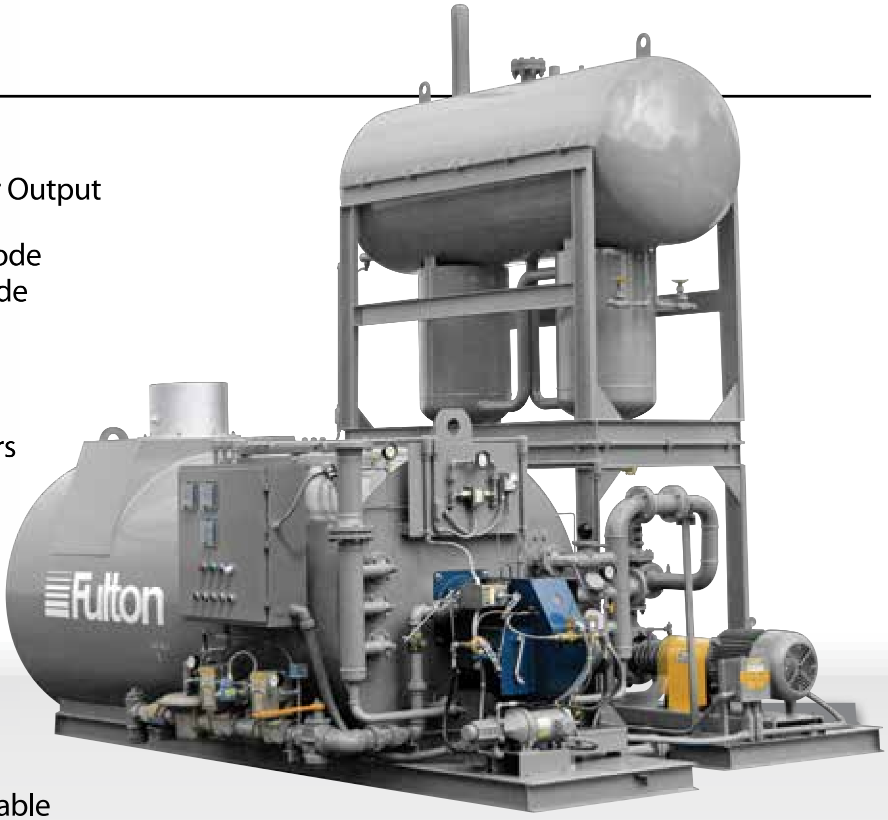
***NOTE:** Dimensions shown are for the Hopkins model without the integral expansion tank.

MODELS	HPN	100S	200S	350S	600S	800S	1000S	1200S	1400S	1600S	2000S	2400S	3000S	4000S
Dimensions														
(A) Overall Height (w/o Stack)	IN	51	60	62	82	82	105	105	106	106	125	133	133	142
	MM	1,295.4	1,524	1,575	2,083	2,083	2,667	2,667	2,692.4	2,692.4	3,175	3,378	3,378	3,607
(B) Overall Width	IN	42	50	50	74	93	87	103	110	110	123	130	130	142
	MM	1,067	1,270	1,270	1,880	2,362	2,210	2,617	2,794	2,794	3,124	3,302	3,302	3,607
(C) Overall Length	IN	115	152	211	231	302	311	360	408	444	450	550	575	648
	MM	2,921	3,861	5,359	5,867	7,671	7,899	9,144	10,363	11,278	11,430	13,970	14,605	16,459
Inlet/Outlet Connections	IN	2	3	3	4	6	6	8	8	8	10	12	12	12
	MM	51	76.2	76.2	102	152.4	152.4	203	203	203	254	305	305	305
Thermal Liquid Volume	Gallons	45	86	168	426	661	724	853	1,168	1,400	1,721	2,322	3,180	4,626
	Liters	170	325	635	1,612	2,502	2,740	3,228	4,421	5,299	6,514	8,789	12,037	17,511
Approx. Dry Weight	LB	3,936	6,800	9,052	14,350	18,500	23,100	26,800	30,500	32,600	41,400	68,000	74,000	80,000
	KG	1,785	3,084	4,106	6,509	8,392	10,478	12,156	13,835	14,787	18,779	30,844	33,566	36,287
Approx. Flooded Weight	LB	4,310	7,514	10,447	17,886	23,987	29,110	33,880	40,195	44,220	55,685	87,273	100,394	118,396
	KG	1,955	3,408	4,739	8,113	10,880	13,204	15,368	18,232	20,058	25,258	39,586	45,538	53,704
Floor Loading	LB/FT3	129	143	143	151	123	155	132	129	131	145	176	194	186
	KG/M3	2,066	2,291	2,291	2,419	1,970	2,483	2,115	2,066	2,099	2,323	2,819	3,108	2,980

ALLIANCE
HORIZONTAL COIL DESIGN

KEY FEATURES

- Compact Horizontal 3-Pass Design
- 2,400,000 BTU/Hr to 20,000,000 BTU/Hr Output
- Heaters are Built and Tested to ASME Code Section VIII Div. I as standard. ASME Code Section I is available upon request.
- Operating Temperatures to 650° F
- Modulating Gas, Oil or Dual Fuel Burners
- Low Emission Gas Burners
- Alternative Fuel Capabilities
- Open Protocol Burner
- Skid Mounted Systems Available, Including Circulating Pump and Expansion Tank
- Customized Controls and Heaters Available



Shown here is an FT-0600-HC horizontal heater skid mounted with circulation pump and a combination expansion / deaerator / thermal buffer tank, designed for barge cargo heating.

MODELS	HC	0240	0400	0600	0800	1000	1200	1600	2000
Specifications									
Heat Output	1,000 BTU/HR	2,400	4,000	6,000	8,000	10,000	12,000	16,000	20,000
	1,000 KCAL/HR	600	1,000	1,500	2,000	2,500	3,000	4,032	5,040
Thermal Fluid Content	Gallons	75	115	190	264	325	508	480	1,150
	Liters	284	435	719	998	1,230	1,921	1,817	4,353
Recommended Flow Rate	GPM	150	300	400	600	850	1,200	1,200	1,500
	M3/HR	35	69	91	137	193	273	273	341
Approximate Fuel Usage									
Light Oil	GPH	23	39	58	77	96	115	143	179
	LPH	88	148	220	292	364	436	542	678
Natural Gas	FT3/HR	3,200	5,340	8,000	10,700	13,340	16,000	20,000	25,000
	M3/HR	91	152	227	304	378	454	566	708
Power									
Typical Circulating Pump Motor	HP	15	25	30	50	60	75	100	125
	KW	11.2	18.7	22.5	37.3	45	56	74.5	93.2
Typical Burner Motor	HP	2	5	7.5	10	15	15	30	30
	KW	1.5	3.7	5.6	7.5	11.2	11.2	22.4	22.4

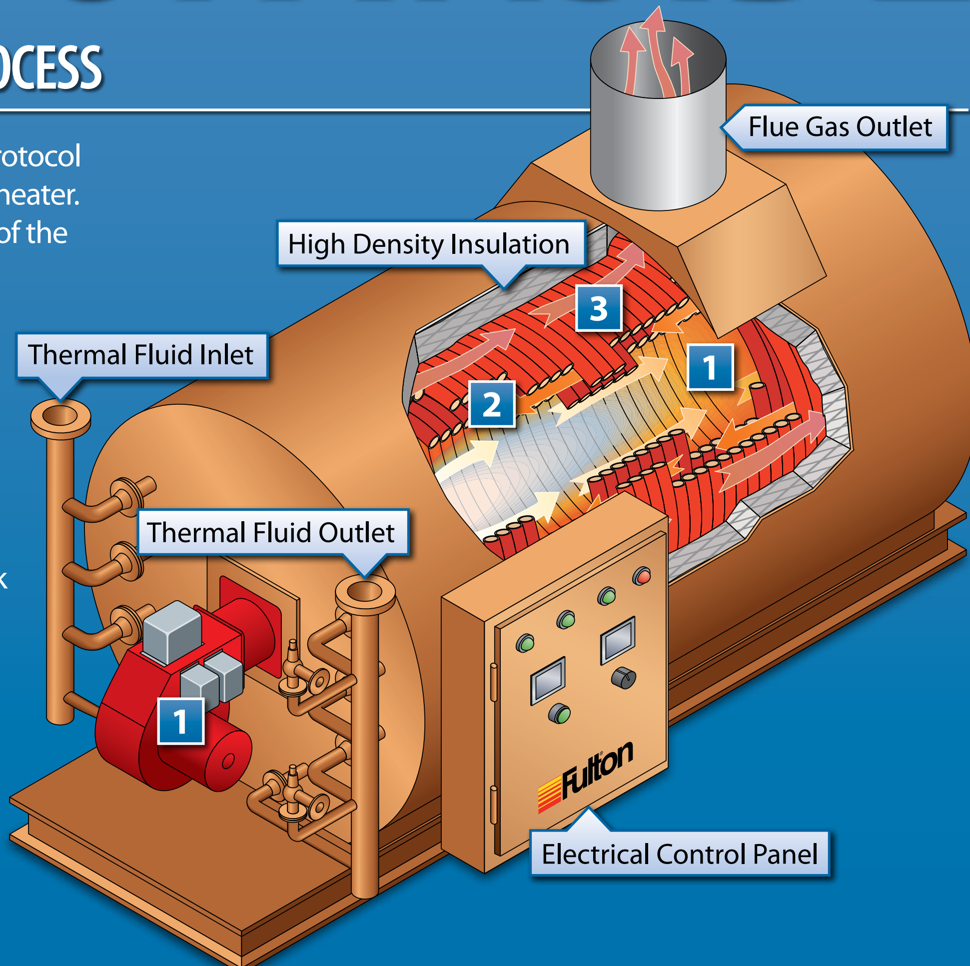
A LOOK INSIDE

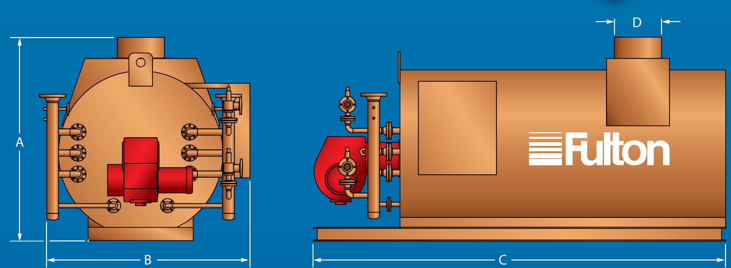
THE COMBUSTION PROCESS

1 Air and fuel mix in the open protocol burner located at the front of the heater. The burner fires down the center of the vessel forming the first pass.

2 The hot gases turn at the rear of the vessel and return between two rolls of coils to the front end plate forming the second pass.

3 The hot gases then flow along the outside of the coils to the back of the heater, forming the third pass and then exit out the flue.





Specifications and Dimensions are approximate. Consult factory for model specific electrical requirements. We reserve the right to change specifications and/or dimensions without notice.

Diagram for guidance purposes only. Comprehensive details of dimensions, connections, etc. for each model are given on product dimension data sheets available from Fulton.

MODELS	HC	0240	0400	0600	0800	1000	1200	1600	2000
Dimensions									
Heater Inlet/Outlet Connections	IN	2.5	3	4	6	6	6	8	8
	MM	64	76	102	152	152	152	203	203
(A) Overall Height	IN	64	68	78	107	107	131	114	118
	MM	1,626	1,727	1,981	2,718	2,718	3,327	2,896	2,997
(B) Heater Width	IN	62	62	81	95	95	130	118.5	119.5
	MM	1,575	1,575	2,057	2,413	2,413	3,302	3,010	3,035
(C) Overall Depth	IN	134	137	157	208	182	240	327	351
	MM	3,404	3,480	3,988	4,623	4,623	6,096	8,306	8,915
(D) Flue Outlet Diameter	IN	12	14	18	22	22	22	36	36
	MM	305	356	457	559	559	559	914	914
Approximate Dry Weight	LB	5,000	7,500	9,500	12,500	19,250	21,700	39,000	39,000
	KG	2,272	3,409	5,455	5,682	8,750	9,864	17,728	17,728

UNFIRED STEAM AND HOT WATER GENERATORS

STEAM GENERATOR KEY FEATURES

- Vertical Design 10 HP to 100 HP
- Horizontal Design 70 HP to 415 HP (Custom sizes are available)
- Standard Designs 15 PSIG to 150 PSIG (custom operating pressures are available)
- Built and Stamped to ASME Code Section VIII Div. I
- Complete with Modulating Thermal Fluid Control Valve and Custom Control Panel
- May be Skid Mounted with Blowdown Separators, Return Tanks, Deaerator Tanks, Feedwater Pumps, Chemical Tanks and Water Softeners

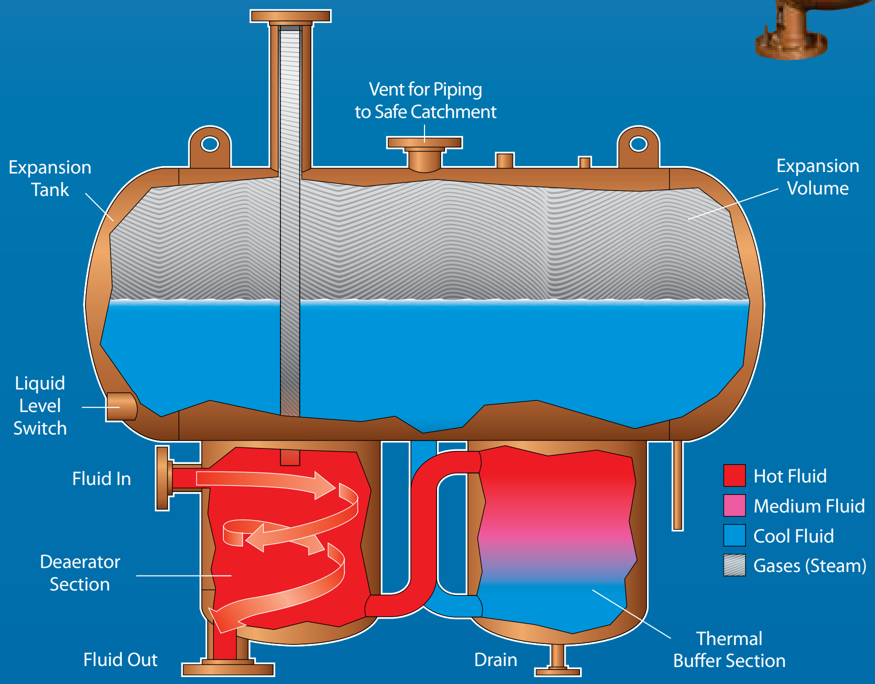
HOT WATER GENERATOR KEY FEATURES

- Custom Designs Available
- Carbon Steel or Stainless Steel
- Built and Stamped to ASME Code Section VIII Div. I
- Complete with Modulating Thermal Fluid Control Valve
- Instantaneous Hot Water Generation, or Can Be Used with a Storage Tank

EXPANSION/DEAERATOR/ THERMAL BUFFER TANK

KEY FEATURES

- Designed to Work as an Open-Atmospheric System Where Applicable, Eliminating the Expense of an Inert Gas Blanket
- Continuous Deaeration of Steam and Other Non-Condensibles
- Protects Fluid from Oxidation
- Simplification of Pipework
- Ease of Installation
- Standard 2-Pipe Expansion Tanks also Available



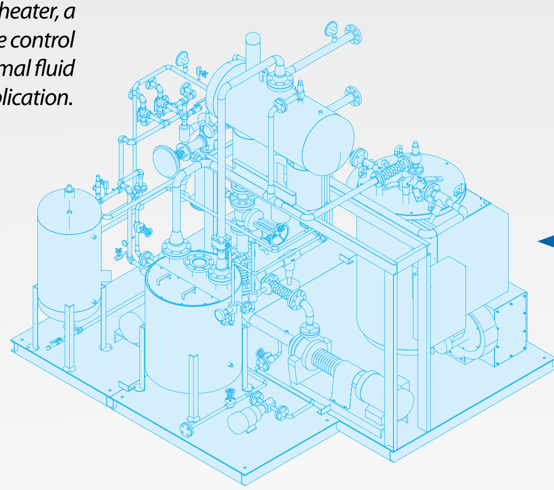
MODELS	FT-L	0200	0500	1000	1500	2000	3000	5000
Tank Sizing and Capacities								
Capacity	Gallons	52	132	264	397	528	793	1,310
	Liters	196	499	999	1,502	1,998	3,001	4,958
Initial Fill	Gallons	25	40	80	90	145	215	300
	Liters	94	151	302	340	548	813	1,135
Available for Expansion	Gallons	46	121	232	380	444	717	1,168
	Liters	174	458	878	1,438	1,680	2,714	4,421
Max System Volume	Gallons	184	525	1,000	1,400	1,700	2,600	4,600
	Liters	696	1,987	3,785	5,299	6,435	9,842	17,412
Dry Weight	LB	636	970	1,350	1,710	2,550	3,200	5,300
	KG	289	440	612	776	1,134	1,451	1,637

CUSTOM ENGINEERED SKIDDED SYSTEMS

Fulton's engineering and design capabilities are unmatched in the industry, providing comprehensive solutions to custom-designed thermal fluid systems. Our team of engineers and project managers assist in the specification and design of a "turnkey" system for each application. All engineered systems come with state-of-the-art operating controls and can have single-point electric, fuel supply, thermal fluid drain/fill, inlet/outlet, and any other applicable connection. From design to complete fabrication, trust Fulton and our many years of experience to build a system you can rely on for years to come.

The skid system shown here included one FT-0240-C heater, a circulating pump, expansion tank and a temperature control unit (TCU). This system was designed to provide thermal fluid and hot water to several dryers for a wastewater application.

This system includes two FT-0600-C thermal fluid heaters skid mounted with three circulating pumps (one pump acts as a backup for either heater), and one FT-5000-L expansion tank (not shown). These heaters are used to provide process heat for the manufacture of asphalt roofing shingles.



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FTC-BRO_2013-1218

BELCO TANKS AND GUNBARRELS

DESIGN FEATURES

- Designed exclusively for rigorous oil and gas exploration field use.
- Will not rust, rot or corrode.
- Manufactured using computer-controlled technology to provide you with the highest quality products.
- Filament wound offering one-piece construction along with high strength.
- Designed to withstand the harsh sun, wind, rapidly changing weather this part of our country offers.
- Wide range of oil field tanks to suit your particular storage.
- Delivered by Belco's fleet of delivery trucks and custom designed tank trailers to assure prompt and proper handling of your tank.

API CONFIGURED TANKS

BELCO builds all its tanks to API 12-P specifications for thickness and connection configuration.

- Standard sizes from 5BBL - 1500BBL
- Diameters from 2-foot to 20-foot
- Standard closed top
- Open top
- Custom fabrication
  ★ Resin type ★ Connections ★ Color matching
- Secondary containment vessels

GUNBARRELS

Gunbarrels are an economical low maintenance oil separator. Production enters into the flume. Through retention, the oil and water separate and the oil is drawn off the top and the water is drained off the bottom.

Belco offers several types:

- Single chamber
- Dual chamber
- Custom built
- *Retention example:* Customer is processing 1000 bbls per day. As a general rule, a 6 hour retention time is used. So, for a 24 hour period, customer will divide daily throughput by 4. For this example, 1000 bbl divided by 4 would require a 250 bbl gun barrel.**

**Note: Retention time can change depending on the consistency of crude.

SALTWATER DISPOSALS

It used to be that the industry had to separate a little water from a lot of oil. Now it is important to get all of the oil from the water before it is injected back into the ground. Belco, with our 30 years of fiberglass experience, has built numerous Saltwater Disposals in Texas, New Mexico, Oklahoma, Louisiana, Colorado and North Dakota. Disposals can be made up of standard API design or custom built tank systems for the customer's needs. Belco can help build your disposal from the ground up, including engineered drawings and all that is required to get your disposal up and running.

SHIPPING

Belco maintains a new fleet of trucks, and custom built trailers.

- Trailers designed to ship multiple tanks per load, lowering your cost.
- Lowboy trailers allow shipment of tanks up to 20-foot diameter with up to 54-foot of load space.
- Crane trucks allow for delivery and setting of most tanks.
- Belco ships coast to coast on our trucks and has extensive experience with oversized loads.

STANDARD SIZES

CLOSED TOP API

Capacity BBL	Inside Dia. (Ft)	Height (Ft)	Part #
50	8	6	OA850B
100	10	7	OA10100B
120	10	8.5	OA10120B
120	12	6	OA12120B
150	10	10.5	OA10150B
168	15.5	5	OA156168
210	10	15	OA10210B
210	12	10.5	OA12210B
210	15.5	6	OA156210B
250	12	12.5	OA12250B
250	15.5	8	OA156250B
300	12	15	OA12300B
300	15.5	9	OA156300B
400	12	20	OA12400B
400	15.5	12	OA156400B
500	12	25	OA12500B
500	15.5	16	OA156500B
750	15.5	24	OA156750B
1000	15.5	30	OA1561000B

GUNBARREL SEPARATOR

Capacity BBL	Inside Dia. (Ft)	Height (Ft)	Part #
45	4	20	GB445B
100	6	20	GB6100B
120	6	24	GB6120B
180	8	20	GB8180B
215	8	24	GB8215B
270	9	24	GB9270B
280	10	20	GB10280B
400	12	20	GB12400B
480	12	24	GB12480B
500	12	25	GB12500B
750	15.5	24	GB156750B
1000	15.5	30	GB1561000B

OPEN TOP

Capacity BBL	Inside Dia. (Ft)	Height (Ft)	Part #
50	8	6	OT850B
100	10	7	OT10100B
110	12	5	OT12110B
120	10	8.5	OT10120B
120	12	6	OT12120B
150	10	10.5	OT10150B
150	12	7.5	OT12150B
210	10	15	OT10210B
210	12	10.5	OT12210B
210	15.5	6	OT156210B
250	12	12.5	OT12250B
300	12	15	OT12300B
300	15.5	9	OT156300B
400	12	20	OT12400B

CLOSED TOP STANDARD

Capacity BBL	Inside Dia. (Ft)	Height (Ft)	Part #
50	8	6	OS850B
100	10	7	OS10100B
120	10	8.5	OS10120B
120	12	6	OS12120B
150	10	10.5	OS10150B
150	12	7.5	OS12150B
210	10	15	OS10210B
210	12	10.5	OS12210B
210	15.5	6	OS156210B
250	15.5	8	OS156250B
300	12	15	OS12300B
300	15.5	9	OS156300B
400	12	20	OS12400B
400	15.5	12	OS156400B
500	12	25	OS12500B
500	15.5	16	OS156500B

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Solutions Pond-Based
Return to Previous

Evaporation Pond Solutions

What is a pond based evaporator?

The pond-based or surface evaporator is an evaporator system that sets or floats directly on the surface.

Request A Quote

What are the key advantages/benefits of using a pond-based evaporator?

The advantage of a pond-based evaporator is the system has greater airflow directly to the boundary layer between the pond, lake or water surface and the atmosphere. This allows enhancement of both pan and/or lake evaporation rates. The APEX 2.0 not only enhances the pond evaporation rates with fluid injection, it also enhances the overall evaporation rates of the entire system to dispose of more wastewater.

Another key advantage of a pond-based evaporator is its control of salt drift; dry aerosol particles are controlled and kept in the boundaries of the operation area. The APEX 2.0 pond-based evaporator has unique controls over airflow and water flow to provide maximum protection against pollution drift. The APEX 2.0 has control over the droplet size and airspeed which allows the unit to have control over any pollution plume. The down draft configuration keeps lofted aerosols to a minimum allowing operation over a wide range of environmental conditions without the pollution drift.

What applications are most commonly associated with pond-based evaporation?

Pond-based evaporators offer a solution for a wide range of applications including applications where overspray is more of a concern.

Oil & Gas operations handling production water can deploy pond-based evaporators to reduce disposal and truck transport cost drastically. This also allows the facilities to concentrate their wastewater to heavy brine for resale in the industry.

Oil & Gas Salt Water Disposal Wells benefit greatly from the use of pond-based evaporators by hyper concentrating the liquids prior to injection, the disposal well life is maximized offering the greatest return on CAPEX for the well.

Power Generation can significantly reduce their blow down water volumes by using pond-based evaporators. Both solar and fossil fuel power generation plants can reduce the cooling tower blown down water volumes using a pond-based evaporator as part of the water management plan.

Food Processing operations deal with excess water by using a pond-based evaporator in its compact area of operation which allows for the disposal of wastewater without the impact to areas outside the operations boundary.

Fermentation operations can reduce liquid waste streams by utilizing pond-based evaporators. Washing water and/or other process wastewater can be effectively concentrated to reduce the water stream and environmental impacts when the waste liquids are concentrated to reduce volume.

What industries are most commonly associated with pond-based evaporation?

- Mining
- Oil & Gas
- Power Plants
- Refineries
- Wineries
- Food Processing

- Distilleries
- Landfills
- Chemical Plants
- Municipalities
- Textile
- Palm Oil

What sets your pond-based evaporator apart?

Evaporation is a natural way of reducing the amount of fluid that needs to be disposed of and is an economical alternative to truck transport.

The APEX 2.0 operates at the leading industry low energy efficient horsepower of 5HP.

With the down draft system, the APEX 2.0 has superior surface disturbance evaporation enhancement with maximum control over droplet size and pollution drift plume.

How Can We Help You?

Give us a call at +1 (866) 956-9378 or use the following form to contact us with your questions or comments.

Name *

Company *

Phone Number *

Email *

Message *

Product/Service * Select One

Attach a File

Upload Delete all

Submit

Contact Us

+1 970-245-7104 Find us on Ariba Network

Our Office

2245 Colex Dr
Grand Junction, CO 81505

Latest News

Resource West, Inc. Announces the Purchase of PCI Manufacturing, LLC Assets

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ATTACHMENT II.1.C

WEEKLY INSPECTION FORM (TYPICAL)

ATTACHMENT II.1.C - Inspection Form (Typical)

Date: ______________________ **Print Name:** ______________________________

Others: ______________________ **Signature:** ______________________________

Inspection will be in accordance with NMOCD operational conditions.

Item	Satisfactory	Action Required
Entrance Sign		
Berms and outside pond levees		
Tank Labels		
Sumps		
Pond levels three-foot free board		
Free oil on Pits-Ponds		
Pit and Pond condition		
Pit and Pond marker numbers		
Treatment Plant inspection		
Solid waste disposal area inspection		
Blowing trash		
Fences and Gates		
Leak detection sumps - Landfill - Liquid present?		(Monthly analysis required if yes)
Leak detection sumps - Evaporation Ponds - Liquid present?		(Monthly analysis required if yes)
Leak detection sumps - Jet Out Pit - Liquid present?		(Monthly analysis required if yes)
Leak detection sumps - Stab. & Solid. - Liquid present?		(Monthly analysis required if yes)
Landfill Leachate Sump		
Vadose Zone Monitoring		
Pond Sludge Depth		

***Comments & Repairs:** ______________________________

H_2S

READINGS ARE TO BE TAKEN 4 FT DOWNWIND FROM EVAPORATION PONDS

Evaporation Pond (readings in ppm):

POND
1
2
3
4
5
6
7
8
9
10
11
12

*In the event that a reading of 10 ppm is registered at the Facility, **IMPLEMENT THE CONTINGENCY PLAN!**
Personnel will evacuate the area and operator will monitor H_2S levels downwind of the Pond.
If H_2S levels reach 20 ppm, the Facility will be closed and notification will be given to the following:

Lea Land Office	575-887-4048	NMOCD Hobbs	575-393-6161
New Mexico State Police	575-392-5580	NMOCD Santa Fe	505-476-3440
Eddy County Sheriff	575-887-1888		
Lea County Sheriff	575-397-3611		

Receipt & Approval

Name: ______________________

Date: ______________________

ATTACHMENT II.1.D

PIT/POND INTEGRITY/LEAK DETECTION INSPECTION FORM (TYPICAL)

ATTACHMENT II.1.D - Pit/Pond Integrity/Leak Detection Inspection Checklist (Typical)

Page _____ of _____

Date: ______________________ **Inspector(s):**

Time: ______________________ ____

Weather:

Temperature ______________________ deg. F Precipitation (last 24 hours) ______________ inches

Skies ______________________

Wind Speed ______________________ mph

Wind Direction ______________________ *(direction blowing from)*

NOTES:
"X" indicates that a Deficiency has been noted. "P" indicates that a Photograph has been taken. "S" indicates that a Sample has been collected. Complete descriptions of Deficiencies, Photographs, and Samples are provided on attached pages. Items are referenced by Location.

POND CONDITION

Location	Item			
	Erosion	Slopes	Vectors	Sample

LEAK DETECTION SYSTEM

Riser #	Deficiency	
	Depth of H_2O	Structural Defect

NOTES: ____

____

____

ATTACHMENT II.1.E

POTENTIAL GEOMEMBRANE LINER LEAKAGE

Title: Leakage Through Liners Constructed with Geomembranes - Part 1. Geomembrane Liners

Written by: J.P. Giroud and R. Bonaparte
Published in: Geotextiles and Geomembranes **Volume:** 8 **Issue:** 2 **Pages:** 27 to 67
Phone: +31 20-485-3757 ~ **Web Site:** http://www.elsevier.com

How impermeable are 'impermeable liners'? All liners leak, including geomembranes, but how much? What are the mechanisms of leakage through liners constructed with geomembranes? To answer these questions, a detailed review of leakage mechanisms, published and unpublished data, and analytical studies has been carried out with the goal of providing practical design recommendations. In particular, it appears that a composite liner (i.e. geomembrane on low-permeability soil) is more effective in reducing the rate of leakage through the liner than either a geomembrane alone or a soil liner (low-permeability soil layer) alone. However, the paper shows that the effectiveness of composite liners depends on the quality of the contact between the geomembrane and the underlying low-permeability soil layer.

Table 1
Calculated Leakage Rates Due to Pinholes and Holes in a Geomembrane

		Water depth on top of the geomembrane, h_w				
	Defect Diameter	0.003 m (0.01 ft)	0.03 m (0.1 ft)	0.3 m (1 ft)	3 m (10 ft)	30 m (100 ft)
Pinholes	0.1 mm (0.004 in)	0.006 (0.0015)	0.06 (0.015)	0.6 (0.15)	6 (1.5)	60 (15)
	0.3 mm (0.012 in)	0.5 (0.1)	5 (1)	50 (13)	500 (130)	5000 (1 300)
Holes [a]	2 mm (0.08 in)	40 (10)	130 (30)	400 (100)	1300 (300)	4000 (1 000)
	11.3 mm (0.445 in)	1 300 (300)	4 000 (1 000)	13 000 (3 000)	40 000 (10 000)	130 000 (30 000)
Values of leakage rate in liters/day (gallons/day)						

Table 2
Calculated Unitized Leakage Rates Due to Permeation of Water Through an HDPE Geomembrane

	Water depth on top of the geomembrane, h_w					
	0 m (0 ft)	*0.003 m (0.01 ft)*	*0.03 m (0.1 ft)*	*0.3 m (1 ft)*	*3 m (10 ft)*	*>10 m (>30 ft)*
Coefficient of migration, m_g (m^2/s)	0	9×10^{-20}	9×10^{-18}	9×10^{-16}	9×10^{-14}	3×10^{-13}
Unitized leakage rate, q_q (m/s)	0	9×10^{-17}	9×10^{-15}	9×10^{-13}	9×10^{-11}	3×10^{-10}
(lphd)	0	8×10^{-5}	0.008	0.8	80	260
(gpad)	0	8×10^{-6}	0.0008	0.08	8	28

Notes: These values of utilized leakage rates were calculated using eqn (5) and assuming a geomembrane thickness of 1 mm (40 mils). The coefficients of migration used to calculate the unitized leakage rates in this table were obtained from eqns (19) and (20), with $C_1 = 1 \times 10^{-22}$ m^4 $kg^{-2}s^3$, $n = 2$, and $m_{gmax} = 3 \times 10^{-13}$ m^2/s.

The water depths used here correspond to the typical values defined in Section1.3.6. (To use eqn (19), it is necessary to know the pressure difference, Δp. According to eqn (1), water depths, h_w, are approximately equal to hydraulic head differences, Δh, which are related by eqn (12) to pressure differences, Δp.)

ATTACHMENT II.1.F
PAINT FILTER TEST PROTOCOL
USEPA 9095B

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 ^{o}C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the <u>inside</u> of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

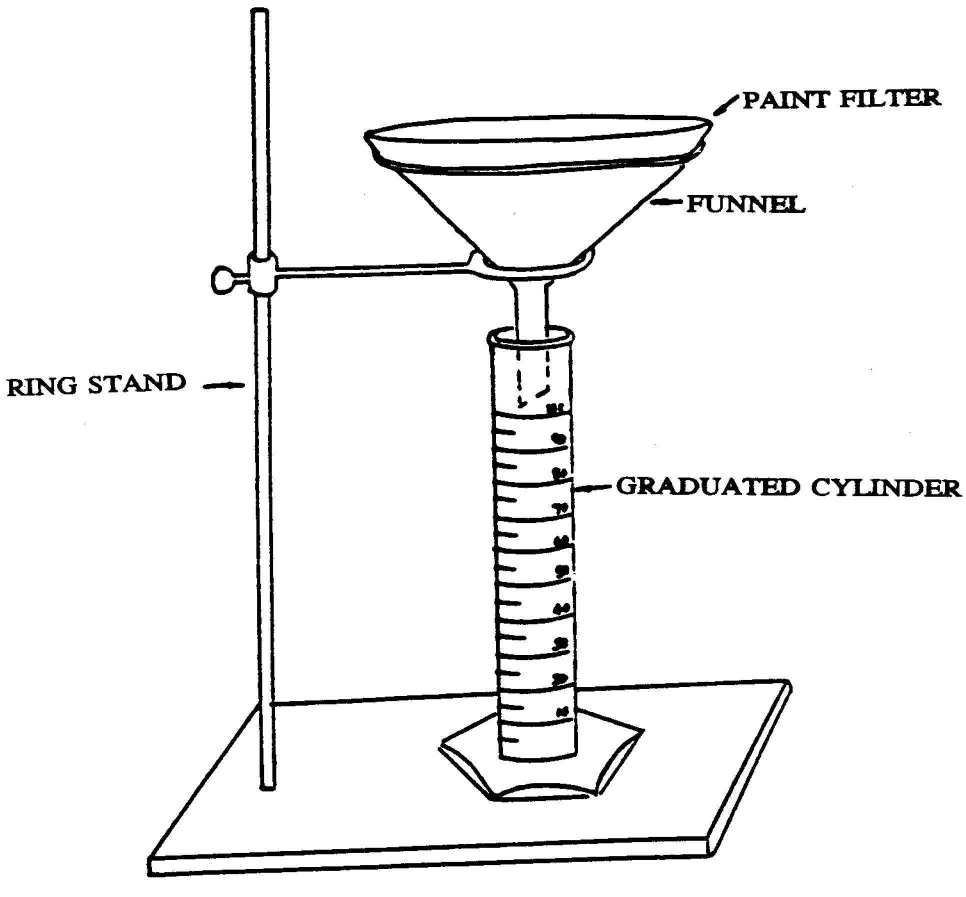
9.0 METHOD PERFORMANCE

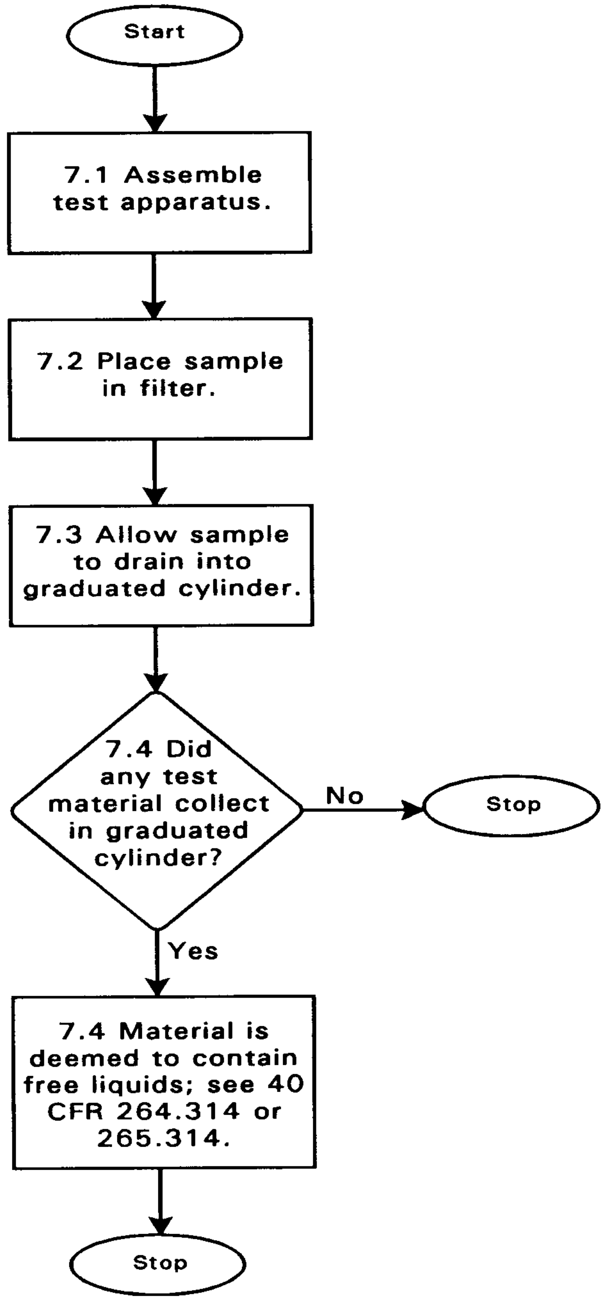
9.1 No data provided.

10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS




Start
7.1 Assemble test apparatus.
7.2 Place sample in filter.
7.3 Allow sample to drain into graduated cylinder.
7.4 Did any test material collect in graduated cylinder?
No
Stop
Yes
7.4 Material is deemed to contain free liquids; see 40 CFR 264.314 or 265.314.
Stop

ATTACHMENT II.1.G

INTERMEDIATE COVER INSPECTION AND MAINTENANCE PLAN

ATTACHMENT II.1.G – Intermediate Cover Inspection and Maintenance Plan

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1.0 INTRODUCTION

In accordance with 19.15.36.14(7)(a-c) NMAC landfills are required to provide intermediate cover for areas that will not receive additional oil field waste for one month or more. In addition to being approved by the Oil Conservation Division, intermediate cover must be stabilized with vegetation, and inspected and maintained to prevent erosion and manage infiltration or leachate during the oil field waste deposition process. Lea Land, LLC (Lea Land) is requesting an exception from the vegetation requirement. Lea Land proposes to maintain, to the extent practical, natural vegetation on the intermediate cover, but does not plan to seed intermediate cover that will be inactive less than 12 months. This Intermediate Cover Inspection and Maintenance Plan (the Plan) provides a protocol for regular monitoring and maintenance of intermediate cover at the Lea Land Surface Waste Management Facility Landfill.

2.0 INTERMEDIATE COVER

At Lea Land, intermediate landfill cover is proposed to consist of a soil cover a minimum of 12-inches thick. Intermediate cover will be placed over areas of the landfill that will not receive further oil field waste for one month or more, but have not reached final grades. Intermediate cover is graded to promote positive drainage and limit erosion and infiltration. The intermediate cover will be inspected and maintained until additional waste placement has been conducted or final cover is constructed. If additional waste placement is to occur, the upper layer of intermediate cover may be repurposed prior to additional waste placement. Inactive areas with intermediate cover will be stabilized via the routine inspection and maintenance program described below:

2.1 Intermediate Cover Inspection Program

Areas of the Lea Land SWMF that have intermediate cover installed will be inspected, at a minimum of once per month and also after significant (≥ 0.5 inches) rain events. Inspections will be recorded on a form similar to that provided as **Figure II.1.G.1** (Intermediate Cover Inspection Form). The form will be used to record intermediate cover observations, and photo-documentation will supplement the record as necessary. The Intermediate Cover Inspection Forms will be maintained as part of the Facility Operating Record, and will elaborate on the following items, as applicable:

- Unusual odors
- Exposed waste

- Rills greater than one inch in width and six inches in depth
- Surface water ponding
- Eroded or scoured soils
- Dead or stressed vegetation (if applicable)
- Vegetation growing taproots in areas not designated to accommodate them
- Vectors, such as flies and rodents
- Recordkeeping and reporting

Deficiencies identified during site inspections will be corrected within 30 days. Upon completion of the corrective action, appropriate documentation will be made on the Intermediate Cover Inspection Form and placed in the Facility Operating Record.

2.2 Intermediate Cover Maintenance Program

It is expected that routine site maintenance will be necessary to maintain intermediate cover. Intermediate cover is expected to require periodic maintenance such as soil enhancement/repair, and attention to naturally established vegetative cover.

2.2.2 Soil Repair

Intermediate cover repairs may be necessary due to ponding, surface water erosion or wind erosion. Ponding can result from differential settlement of the landfill contents, and erosion can be caused by runoff in areas without established vegetation or by repeated wind gusts. Areas where impacts are evident will be promptly repaired to maintain the integrity of the cover. Recently filled and covered areas will require the most maintenance since differential settlement decreases rapidly with time, and erosion is minimized as vegetation is established. Soil for repairs will be obtained from on-site sources. Repairs will be made on an as-needed basis.

2.2.3 Stabilization

Intermediate cover will not be seeded for vegetative growth; however, Lea Land will routinely attempt to maintain any naturally-established vegetative cover. Routine care includes, but is not limited to, the removal of undesirable plant species (e.g., taproots) and maintenance of native plant species as appropriate.

FIGURE II.1.G.1 - Intermediate Cover Inspection Form

Date: ____________________ **Page** _____ of _____

Inspector(s):

____

____

Weather: Temperature:____________________°F

Skies: ____________________

Precipitation:__________ inches (last 24 hours)

Intermediate Cover										
Location	Odor	Leachate Seep	Exposed Waste	Cracks	Ponding	Erosion	Vegetation		Vectors	Sample
							Stress	Taproots		

"X" indicates that a Deficiency has been noted. "P" indicates that a Photograph has been taken. "S" indicates that a Sample has been collected. Complete descriptions of Deficiencies, Photographs, and Samples are provided on attached pages. Items are referenced by Location.

Field Notes: ____

Corrective Action Required: ____

Corrective Action Completed: ______________________________ ______________
Signature Date

Use additional sheets as necessary.

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

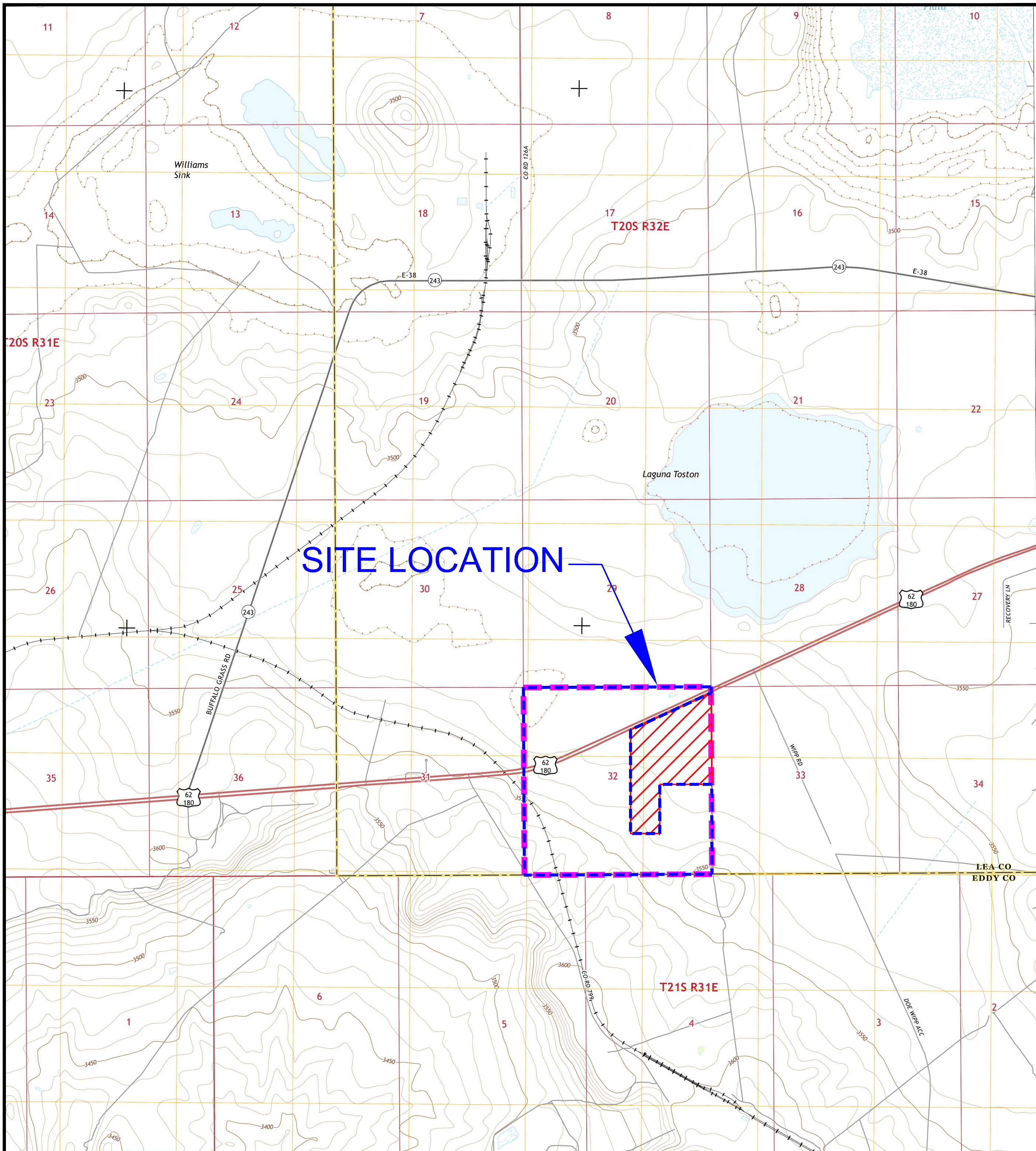
The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.2.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The **Permit Plans** (**Volume III.1**) identify the locations of the Processing Area and Landfill Disposal facilities.



LEGEND

	PROPERTY BOUNDARY
	LEA LAND LLC FACILITY BOUNDARY
	INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE LOCATION.dwg
Date/Time:May. 31, 2019-06:24:59 ; LAYOUT: A (P)

SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.2.1
APPROVED BY: CWF	www.team-psc.com	

2.0 PURPOSE

This Oil Field Waste Management Plan (the Plan) addresses the requirements of 19.15.36.13, 14, 15, and 17 NMAC, and establishes a program of internal controls that will be followed by Lea Land to ensure that oil field wastes receive attention commensurate with the specific waste streams. The purpose of this Plan is to provide waste identification, tracking and screening mechanisms for OCD waste that may require special handling to meet applicable regulatory requirements and to protect public health and safety. The oil field wastes discussed in this Plan are limited to those materials that have met specific disposal requirements as described in Sections 13, 14, 15, and 17 of 19.15.36 NMAC; as well as 19.15.35.8 NMAC.

3.0 OIL FIELD WASTE ACCEPTANCE PROGRAM

A decision to accept incoming oil field waste for management at the Lea Land Facility will be clearly documented for each load received at the Facility, as delineated on **Table II.2.1**. Disposal operations at Lea Land will only be conducted when an attendant is on duty. Lea Land may plan to conduct Facility operations 24 hours a day, 7 days a week. The Facility is completely secured by competent A-strand with barbed wire fencing, cattle guards, and locking gates to prevent any unauthorized access or disposal when an attendant is not on duty. The temporary parking area (**Permit Plans**) will be inspected for leakage, and vehicles will be required to have any valves or access ports secured and locked to prevent spillage or tampering. At a minimum, the following Waste Acceptance Protocol (**Table II.2.1**) requirements must be met prior to managing oil field waste at Lea Land.

3.1 Prohibited Wastes

Non-exempt hazardous waste and non-exempt Naturally Occurring Radioactive Material (NORM) wastes which are subject to other Federal or State regulations are prohibited at Lea Land. Generators/haulers with these wastes will be referred to a United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) permitted facility (i.e., WCS, Andrews County, TX).

TABLE II.2.1 - Waste Acceptance Protocol

The Facility will notify the customer of necessary conditions/limitations that apply to managing the waste, and the customer will be required to comply with these restrictions.

The Facility will make an initial determination with the customer regarding which facility (i.e., NMED or OCD) will receive the waste. If the NMED facility is the proposed destination, the NMED Permit Protocols for waste receipt and disposal will be followed. If the waste is being delivered to the Lea Land Surface Waste Management Facility the following protocols will be followed:

The customer must provide an executed OCD Form C-138, *Request for Approval to Accept Solid Waste* (**Attachment II.2.A**) to the Facility that issues the following certification by the generator that the waste is exempt oil field waste:

> *I do hereby certify that, according to the Resource Conservation and Recovery Act (RCRA) and Environmental Protection Agency's July, 1988, regulatory determination, any and all waste delivered to Lea Land from the above locations is: EXEMPT oilfield waste. This waste is in compliance with Regulated Levels of Naturally Occurring Radioactive Material (NORM) pursuant to 20 NMAC 3.1 Subpart 1403.C and D.*

Should the generator or their authorized representative fail to sign the OCD Form C-138, the load of oil field waste will be rejected.

1. For Exempt Liquid Wastes:

Commercial or industrial customers will also be required to provide a valid, executed, *Authorization to Move Produced Water*, OCD Form C-133 (**Attachment II.2.B**). After authenticating the OCD Form C-133, Lea Land will verify that the customer is an authorized hauler by checking it against the OCD (updated monthly) list located at http://www.emnrd.state.nm.us/ocd/Statistics.htm. Lea Land will pursue the following protocol in managing the OCD Form C-133:

a) Monthly, the designated Manager will provide the Facility personnel an updated list.
b) The OCD Form C-133 list will be maintained on-site in the Lea Land administrative files.
c) Prior to accepting any material, Facility personnel will ensure that the hauling company has a valid OCD Form C-133 approval.
d) If a valid OCD Form C-133 is not on file, the hauler will not be allowed to unload the liquid waste.
e) The designated Manager or other appropriate Lea Land management personnel will be contacted if assistance is needed.

2. For Solid Waste:

In addition to providing OCD Form C-138, solid waste receipts will be subject to confirmation that the materials pass the Paint Filter Test (EPA 9095B). The protocol for this test is included as **Attachment II.2.C.** Lea Land may implement its own confirmatory solids testing program on a random basis, or to evaluate specific waste streams.

3. For Materials Delivered to be Stabilized and Solidified:

These materials will be stabilized and solidified utilizing the procedures outlined in **Volume II.1** and confirmed to pass the Paint Filter Test prior to transporting them to the landfill for disposal.

3.2 Oil Field Waste Inspection and Management

Once the required paperwork has been reviewed and verified, each load will be inspected to ensure compliance with 19.15.36.13.F NMAC. Inspections consist of:

3.2.1 Examination of Loads for Fluids

a) Loads will be checked prior to acceptance for the presence of non-permitted materials (e.g., compressor oil) and to determine the solid content of the load (i.e., "clean" or "dirty") for the purposes of proper management.
b) Every truck will stop at an inspection landing (similar to the one shown in **Figure II.2.2**) for evaluation by site personnel.
c) Facility personnel will not step onto the truck until the driver has placed the truck in park with the brake applied, opened the door, and has his/her legs outside the cab. This is to ensure the truck does not move while Facility personnel are on the truck.
d) Facility personnel will position themselves upwind, and will wear neoprene or other heavy duty non-permeable gloves.
e) The cap on the tank will be opened and a metal rod will be inserted to the bottom of the tank.
f) Care will be exercised because hydrogen sulfide (H_2S) may be present when the cap is opened. If there is any indication that H_2S may be present, the H_2S safety procedures will be followed (**Volume II.3**).
g) Based on whether the rod contacts the metal bottom of the tank, or is slowed by sludge/solid material, Facility personnel will be able to gauge if the load may potentially be laden with sediment.
h) The metal rod will be pulled out from the tank and the fluid on the rod examined for the presence of oils or other non-exempt materials.
i) Odor can also be an indication if the load contains fluids that are non-exempt. Non-exempt waste with potential odors include:
    a. Septic conditions
    b. Caustic or acid cleaners
    c. Methanol, unused
    d. Pesticide and herbicide wastes
    e. Solvents, spent (including waste solvents)
j) Non-compliant wastes are not accepted and will be rejected and returned to the Hauler/Generator.

3.2.2 Presence of H_2S

Lea Land will monitor for H_2S on a continual basis for each oil field delivery waste vehicle arriving at the site. Monitoring for H_2S will be completed as follows:

a) The battery and calibration date on the monitoring instrument will be checked to ensure both are current.

INSPECTION LANDING EXAMPLE

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 11/09/2018	CAD: INSPECTION.dwg	PROJECT #: 0416.18
DRAWN BY: DDN	REVIEWED BY: DRT	FIGURE II.2.2
APPROVED BY: IKG	www.team-psc.com	

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\INSPECTION.dwg
Date/Time:Mar. 21, 2019-12:25:46

b) Lea Land personnel will position themselves upwind as far away from the cap opening on the tank as possible, in order to minimize the potential for exposure. Safety is the most important consideration when checking for H_2S.
c) Lea Land personnel will use the H_2S monitor to determine the potential presence and concentration of H_2S (for specific operational instructions, refer to specific owner's manual for the monitoring instrument).
d) The tube wand will be used to acquire a sample, and the H_2S reading and related notes will be recorded on the Lea Land Disposal Log (**Attachment II.2.D**).

In the event of an H_2S detection of 1 ppm or greater, the following procedures will also be implemented by Lea Land personnel:

a) Notification of the presence of H_2S will be provided to both the driver (hauler) and the generator.
b) The generator will be provided the option of allowing Lea Land to treat the load on-site. Should the generator decline treatment, the load will be rejected and directed to leave the Lea Land Facility.
c) If the generator requests treatment, Lea Land personnel will add calcium hypochlorite ($Ca(ClO)_2$) to the load at the levels corresponding to **Table II.3.6.**
d) Once the $Ca(ClO)_2$ has been added, the load will be "rolled" [i.e., trucks will use their air pumps to "roll" air through the tank to allow for mixing of the contents and the added $Ca(ClO)_2$] to assist the chemical reaction. After approximately 20 minutes, the load will be re-sampled for the presence of H_2S. Treatment will continue until the H_2S reading is below 1 ppm. Once the H_2S measurement reads below 1 ppm, the load will be directed to the receiving area for processing.
e) Treatment information and the final H_2S measurement will be recorded on the Lea Land Disposal Log (**Attachment II.2.D**).
f) Lea Land personnel will contact the Generator's Plant Manager or General Manager if assistance is needed.

3.2.3 Presence of Non-exempt fluids

a) In the event compressor oil or other non-exempt fluids are detected, a sample of the fluid will be collected in a sample container.
b) The date, generating company, hauler, and location will be noted on the container.
c) The hauler will be prevented from unloading at the Facility.
d) The Facility will contact the generator's Plant Manager or General Manager if assistance is needed.
e) Samples will be maintained at the Facility for two weeks for inspection/testing by the generator's personnel and OCD, as necessary.

3.2.4 Presence of High Solids Content

a) In the event high solid/sludge content is suspected, a sample of the material will be collected in a sample container.
b) The date, company, hauler, and location will be noted on the container.
c) If the load cannot be accepted through the Produced Water Receiving Tanks due to high solids content, the hauler will contact the generator for permission to be charged for the cost of discharging through the Jet-Out Pits; or the Stabilization and Solidification Process.
d) If the load cannot be accepted due to high solids content, the hauler will contact the production company to inform them that the load has been rejected, and the hauler will be prevented from unloading at the Facility.
e) The Facility will contact the Generator's Plant Manager or General Manager if assistance is needed.
f) Samples will be maintained at the Facility for two weeks for inspection/testing by the generator's personnel.

3.2.5 Unloading

a) Lea Land anticipates a maximum of 8 unloading stations at the Liquids Processing Facility capable of managing both the Produced Water Receiving and Jet-Out Pit Bay functions for the Process Area. In addition, the Drying Pad will be able to accommodate 6 roll-off containers discharging simultaneously at full development.
b) To minimize the chance for conflicts between trucks, only 14 trucks will be allowed past the inspection platform(s) at any one time once the Facility is fully operational. Prior to ultimate development, the number of trucks allowed past the inspection platform(s) will be limited to the total number of Liquids and container receiving stations that are available for use.
c) Trucks will pull through the load-out stations or back into the Drying Pad as instructed by Facility personnel.
d) Drivers will connect their grounding straps to the grounding stakes at their specific Load-Out Point.
e) Trucks will off-load materials as appropriate.
f) Trucks will exit the Facility as instructed.
g) Failure of drivers to follow these procedures will be brought to the attention of Facility management for proper resolution with the hauling company.

3.3 Recordkeeping

Upon receipt of oil field waste, Facility employees will record the following into the Facility Disposal Log Book or similar template (**Attachment II.2.D**):

- Generator
- Origin
- Date received

- Quantity
- Transporter
- Disposal location

Logbooks will be maintained for a minimum of 5 years after operations at the Facility have ceased. If required by OCD, Lea Land will compile waste receipts information to be submitted to OCD.

4.0 TRAINING

Facility personnel will be trained and updated in the identification of oil field waste and excluded wastes (including industrial waste delivered for the co-located NMED facility) on at least an annual basis. Spotters and/or equipment operators will be present at the Facility when oil field waste is unloaded in order to check for unauthorized waste and confirm compliance with proper site rules. In addition to the routine customer screening process, new customer oil field waste deliveries will receive focused supervision and scrutiny.

At a minimum, inspection personnel will be trained to identify suspicious wastes based on visual (and olfactory) characteristics in addition to the waste screening procedures outlined in Section 3.2 of this Plan. Specific items that will be on the training agenda include:

- Hazardous placarding or markings
- Proper form identification and use
- H_2S screening
- Non-exempt liquids recognition
- "Chemical" odors
- Excessive solids recognition
- Employee safety and personal protective equipment (PPE) use
- Site-generated waste handling and disposal

Whenever a suspicious waste is identified, Facility inspection personnel will follow specific procedures that may include:

- Identifying the unacceptable waste by characteristic, estimated quantity, transport vehicle, and the names and addresses of those associated with the waste load
- Questioning the driver of the vehicle
- Reviewing existing and historic generator paperwork
- Contacting the possible source (i.e., generator) and questioning the originator of waste pursuant to the Rules.

- Denying access to the vehicle
- Contacting the Division and/or Hazardous Waste Bureau, as applicable
- Using protective equipment
- Calling an emergency response agency, if required
- Contacting laboratory support, if necessary
- Document load refusal on C-138 (**Attachment II.2.A**)

Wastes initially designated as “solids” destined for landfill disposal that do not pass the on-site confirmatory paint filter test will be so documented; and may be directed to the Stabilization/Solidification area or rejected.

ATTACHMENT II.2.A

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE,

OCD FORM C-138

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-138
Revised August 1, 2011

*Surface Waste Management Facility Operator and Generator shall maintain and make this documentation available for Division inspection.

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE

1. Generator Name and Address:

2. Originating Site:

3. Location of Material (Street Address, City, State or ULSTR):

4. Source and Description of Waste:

Estimated Volume ___________yd^3 / bbls   Known Volume (to be entered by the operator at the end of the haul) ___________ yd^3 / bbls

5. GENERATOR CERTIFICATION STATEMENT OF WASTE STATUS

I, ____________________________, representative or authorized agent for ____________________________ do hereby certify that according to the Resource Conservation and Recovery Act (RCRA) and the US Environmental Protection Agency's July 1988 regulatory determination, the above described waste is: (Check the appropriate classification)

☐ RCRA Exempt: Oil field wastes generated from oil and gas exploration and production operations and are not mixed with non-exempt waste. *Operator Use Only: Waste Acceptance Frequency* ☐ *Monthly* ☐ *Weekly* ☐ *Per Load*

☐ RCRA Non-Exempt: Oil field waste which is non-hazardous that does not exceed the minimum standards for waste hazardous by characteristics established in RCRA regulations, 40 CFR 261.21-261.24, or listed hazardous waste as defined in 40 CFR, part 261, subpart D, as amended. The following documentation is attached to demonstrate the above-described waste is non-hazardous. (Check the appropriate items)

☐ MSDS Information ☐ RCRA Hazardous Waste Analysis ☐ Process Knowledge ☐ Other (Provide description in Box 4)

GENERATOR 19.15.36.15 WASTE TESTING CERTIFICATION STATEMENT FOR LANDFARMS

I, ____________________________, representative for ____________________________ do hereby certify that representative samples of the oil field waste have been subjected to the paint filter test and tested for chloride content and that the samples have been found to conform to the specific requirements applicable to landfarms pursuant to Section 15 of 19.15.36 NMAC. The results of the representative samples are attached to demonstrate the above-described waste conform to the requirements of Section 15 of 19.15.36 NMAC.

5. Transporter:

OCD Permitted Surface Waste Management Facility

Name and Facility Permit #:

Address of Facility:

Method of Treatment and/or Disposal:

☐ Evaporation ☐ Injection ☐ Treating Plant ☐ Landfarm ☐ Landfill ☐ Other

Waste Acceptance Status:

☐ **APPROVED** ☐ **DENIED** (Must Be Maintained As Permanent Record)

PRINT NAME: ____________________ TITLE: ____________________ DATE: ____________

SIGNATURE: ______________________________ TELEPHONE NO.: ____________________
Surface Waste Management Facility Authorized Agent

ATTACHMENT II.2.B

AUTHORIZATION TO MOVE PRODUCED WATER, OCD FORM C-133

Submit a single copy to
Santa Fe Office

State of New Mexico
Energy Minerals and Natural Resources

Form C-133
Revised August 1, 2013

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

AUTHORIZATION TO MOVE PRODUCED WATER

Transporter Name:____

Business (Physical) Address in New Mexico: ______________________________ ______________________________

Contact Mailing Address (If different): ______________________________ ______________________________

Business Phone: ________________________ Contact Phone: ________________________
Business Fax: ________________________ Contact Fax: ________________________

1. <u>Attach a copy of the applicant's New Mexico Public Regulation Commission (PRC) Warrant for Transportation Services.</u>

2. Identify the form of the applicant's business entity: (Example: corporation, limited liability company [LLC], limited partnership, limited liability partnership, partnership, sole proprietor): ________________________

   A. If the applicant is a corporation or LLC, provide the Secretary of State corporation number: ____

   B. If the applicant is a limited partnership or limited liability partnership, provide the Secretary of State file number: ____

   C. If the applicant is any other form of partnership, identify all partners: ____

   D. If the applicant is a sole proprietor, provide the name of the sole proprietor: ____

(Note: If the form of your business entity changes, the name of your business changes, or the business address changes, you must re-apply for authorization.)

It is the responsibility of each holder of an approved Form C-133 to comply with 19.15.34 NMAC and familiarize its personnel with that rule's requirements. Failure to move or dispose of produced water in accordance with 19.15.34 NMAC may be cause for cancellation of the Form C-133.

"I hereby certify that the information above is true and complete to the best of my knowledge and belief." (Application must be signed by person who is authorized to obligate the company applying for the permit)

Signature:____________________________ Date:____________________________

Printed Name:____________________________ Title:____________________________

E-mail Address:____________________________

(This space for State use)

Approved by:____________________________ Title:____________________________

Date:____________________________

ATTACHMENT II.2.C

PAINT FILTER TEST PROTOCOL, USEPA METHOD 9095B

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 ^{o}C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the inside of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

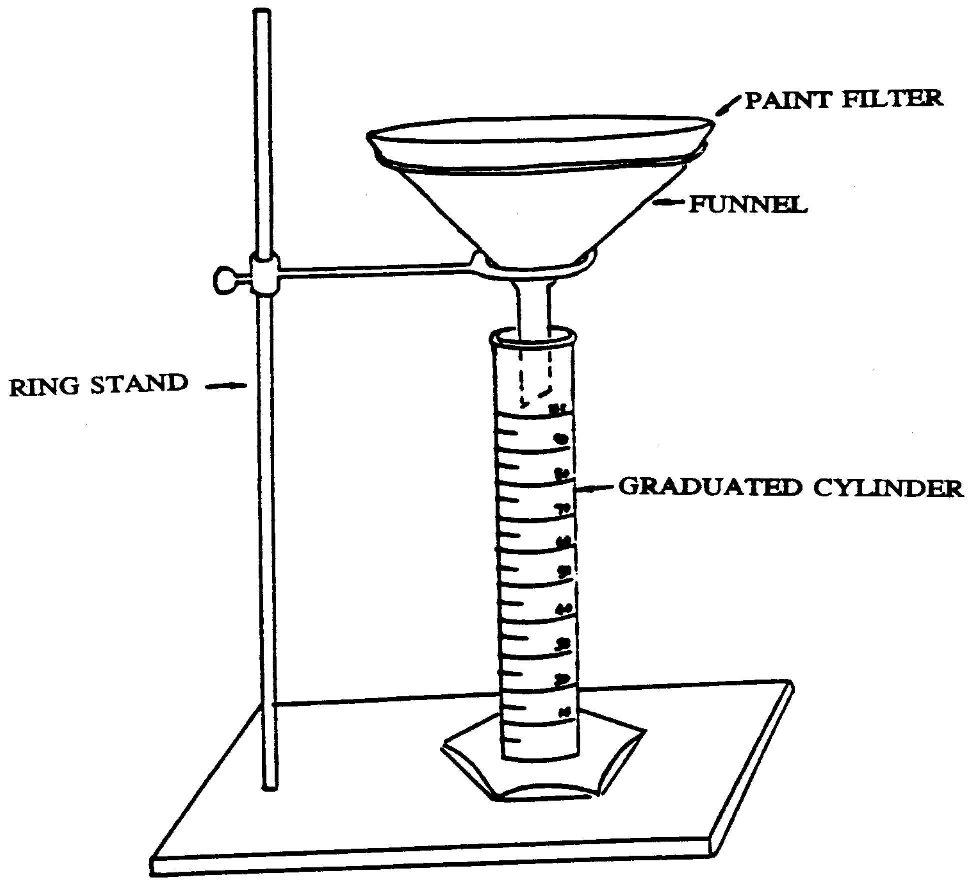
9.0 METHOD PERFORMANCE

9.1 No data provided.

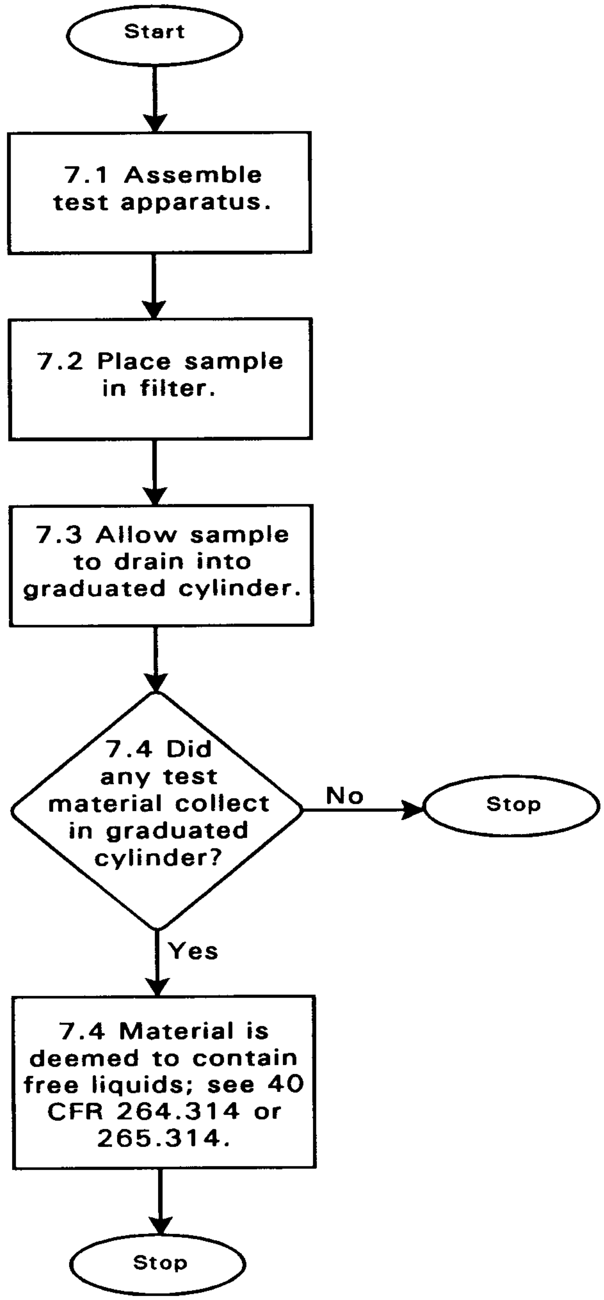
10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS



PAINT FILTER LIQUIDS TEST



ATTACHMENT II.2.D
DISPOSAL LOG BOOK (TYPICAL)

ATTACHMENT II.2.D - Disposal Log (Typical)

NMOCD #_______________

Date: __________________ Page ______ of ______

Generator	Origin	Hauler	Soil (yards)	Mud (bbls)	Fluids (bbls)	Bottoms (bbls)	Cuttings (yards)	Washout	Sulfur (tons or bbls)	Trash (sales)	Disposal Location
		Totals:									

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

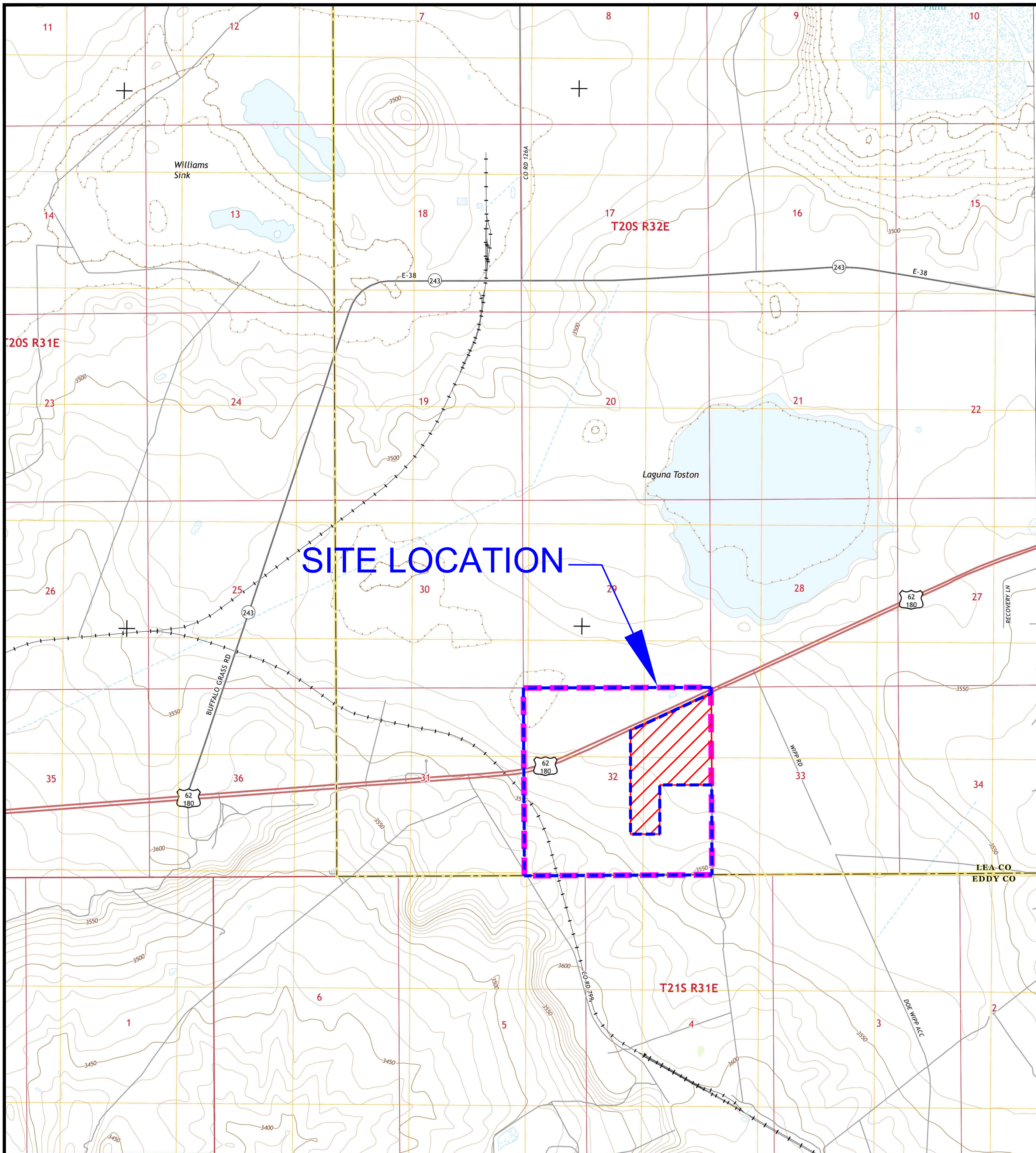
The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.3.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The Site Plan provided as **Figure II.3.2** identify the locations of the Processing Area and Land Disposal facilities, which are further detailed on the **Permit Plans** (**Attachment III.1.A**). The proposed facilities are detailed in **Table II.3.1**, and are anticipated to be developed in four primary phases.



LEGEND

PROPERTY BOUNDARY

LEA LAND LLC FACILITY BOUNDARY

INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

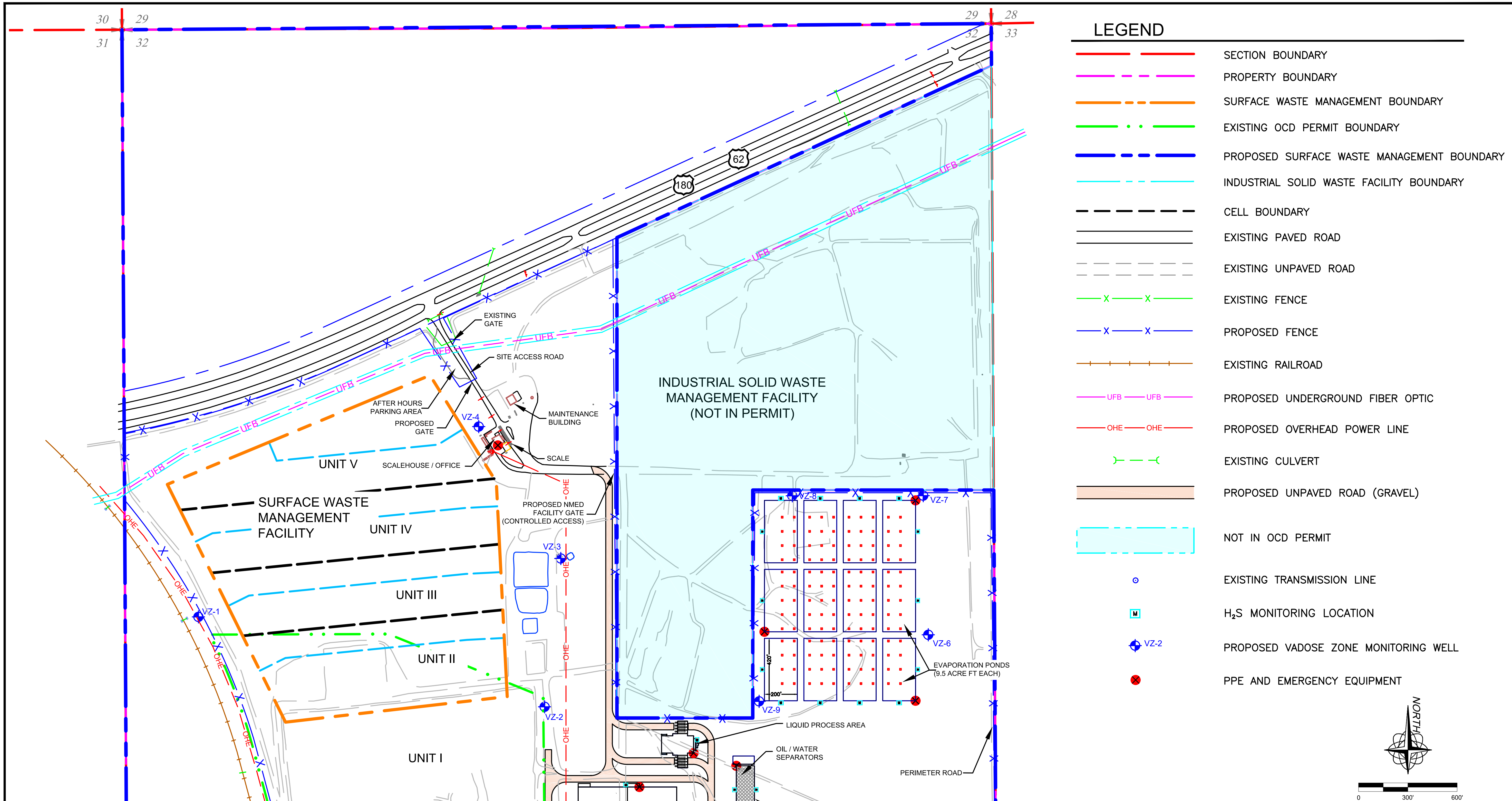
Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE LOCATION.dwg
Date/Time:May. 31, 2019-06:27:56 ; LAYOUT: A (P)

SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.3.1
APPROVED BY: CWF	www.team-psc.com	



SITE PLAN

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.3.2
APPROVED BY: CWF	www.team-psc.com	

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE PLAN.dwg
Date/Time:Jun. 27, 2019-09:22:27 ; LAYOUT: B (LS)

TABLE II.3.1 - Proposed Facilities[1]

Description	No.
SWMF disposal landfill	1
Produced water load-out points	8
Produced water receiving tanks	12
Produced water settling tanks	48
Oil/water separation units (Gun Barrels)	4
Evaporation ponds	12
Stabilization and Solidification Process Area (Drying Pad)	1
Oil treatment plant (Liquids Processing)	1
Crude oil receiving tanks	5
Oil sales tanks	5
Customer jet wash – bays	8
75 horsepower boiler	1
Centrifuge	1

Note:
[1]Subject to change. The proposed facilities are based on projected waste types and volumes; therefore this list may be modified in response to changes in waste streams, technology innovations, etc. OCD will be routinely updated on changes

1.3 Purpose

The purpose of this Hydrogen Sulfide (H_2S) Prevention and Contingency Plan (the Plan) is to enhance awareness and establish measures to protect employees from occupational exposure to H_2S while allowing them to perform their assigned duties. The Plan is also designed to protect customers and visitors to the Lea Land Facility, as well as the general public and nearby land users in conformance with 19.15.36.13.O NMAC.

This Plan prescribes measures for:

- Providing routine H_2S monitoring of incoming wastes.
- Installation of monitoring points at the Facility evaporation ponds.
- Routine perimeter monitoring, and the potential for permanent monitoring stations.
- Regular monitoring in and around incoming oil field waste transportation vehicles.
- Augmenting the monitoring and response procedures in the event that H_2S is detected at ≥ 1 part per million (ppm).

Lea Land has an established relationship with the local emergency response authorities identified in **Table II.3.2;** and one of the staff members, Joe Ontiveros, is the Facility Manager. Lea Land will invite first responders to discuss notification, emergency response procedures, and evacuation plans. The H_2S monitoring program will be implemented during the active life of the Facility and following closure, as necessary.

TABLE II.3.2 - Emergency Response Agencies and Contacts

Agency/Organization	Emergency Number
1. Local Emergency Response Contacts	
Eddy County Emergency Management	575.628.5450
Lea County Emergency Management	575.393.2983
2. Fire	
Eddy County Fire Services	911 or 575.628.5450
3. Police	
Eddy County Sheriff's Department	911 or 575.887.1888
Lea County Sheriff's Department	911 or 575.396.3611
New Mexico State Police	911 or 575.392.5580
4. Medical/Ambulance	
Eddy County Emergency Dispatch Authority	911 or 575.616.7155
Carlsbad Medical Center 2430 West Pierce St Carlsbad, NM 88220	575.887.4100
5. Response Firm	
Southwest Environmental, LLC. 110 Comanche Drive Carlsbad, NM 88220	575.361.9425
6. OCD Emergency Response Contacts	
Oil Conservation Division 1625 N. French Drive Hobbs, NM 88240	575.393.6161
Mobile Phone	575.370.3180
Oil Conservation Division 1220 South St. Francis Drive Santa Fe, NM 87505	505.476.3440
7. State Emergency Response Contacts	
Environmental Emergency 24 hr. (NMED)	505.827.9329
New Mexico Environment Department Solid Waste Bureau, Santa Fe	505.827.0197
8. Federal Emergency Response Contacts	
National Emergency Response Center (U.S. Coast Guard)	800.424.8802
Region VI Emergency Response Hotline (USEPA – Dallas, Texas)	800.887.6063

To be posted prominently on-site

1.4 Hydrogen Sulfide Characteristics

H_2S is a colorless and flammable gas with a distinct odor (i.e., rotten eggs). Being heavier than air, H_2S tends to accumulate at the floor of poorly ventilated spaces. It is found in petroleum and natural gas and is sometimes present in groundwater. The odor of hydrogen sulfide gas can be perceived at levels as low as 10 parts per billion (ppb). At levels of 50-100 ppm, it may cause the human sense of smell to fail. Limited exposure to low concentrations of H_2S can result in eye irritation, sore throat, coughing, shortness of breath, and fluid in the lungs. These symptoms usually recede in a few weeks in the absence of continued exposure. Long-term, low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory, and dizziness. Exposure to high concentrations of H_2S can lead to eye damage, loss of sense of smell, pulmonary edema (swelling and/or fluid accumulation in the lungs), loss of breathing and death. General risks associated with H_2S contact are summarized on **Table II.3.3**, and more detailed chemical hazard information for H_2S is provided on the safety data sheet (SDS) furnished in **Attachment II.3.A**.

TABLE II.3.3 - H_2S Exposure Health Risk

H_2S EXPOSURE LEVEL[1]	HEALTH RISK
Low (0-10 ppm)	Eye, nose, and throat irritation; coughing, shortness of breath, fluid in the lungs
>1 ppm	Background level assumed acceptable for material acceptance. A reading above 1 ppm will require material remediation prior to acceptance.
Moderate (10-50 ppm)	Headache, dizziness, nausea and vomiting, coughing and breathing difficulty, loss of sense of smell
10 ppm	A reading of 10 ppm represents the NIOSH Recommended Exposure Limit (REL). This will represent the Sundance West “Alert Level”. A sustained reading of 10 ppm or above will initiate an operational response and notifications.
20 ppm	A reading of 20 ppm represents the OSHA Permissible Exposure Limit (PEL). This will represent the Sundance West “Evacuation Level”. A sustained reading of 20 ppm or above will initiate facility evacuation and notifications.
30 ppm	A reading of 30 ppm represents the API RP-55 exposure limit when all “public areas” within the radius of Exposure (ROE) must be notified.
High (50-200 ppm)[2]	Severe respiratory tract irritation, loss of sense of smell, eye damage, shock, convulsions, coma, pulmonary edema (swelling and/or fluid accumulation in the lungs), death

[1]*General data obtained from www.safetydirectory.com*
[2]*NIOSH Immediate Danger to Life or Health (IDLH) is 100 ppm*

The acceptable oil field waste types, and engineering design and operating procedures specific to the Lea Land Facility, will mitigate against the potential release of H_2S in to the environment. The measures deployed by Lea Land that minimize the potential generation of releases include:

- Screening of existing and new deliveries
- Load inspections for the presence of H_2S as outlined in the Oil Field Waste Management Plan (**Volume II.2**)
- Onsite H_2S treatment of incoming loads to ensure that the acceptance criteria of non-detectable measurable H_2S (< 1 ppm) is met
- Continual evaporation pond testing
- Employee training

The cornerstone of this Plan consists of routine H_2S monitoring conducted for the Facility incoming waste streams and evaporation ponds to ensure that the regulatory limits for H_2S are not exceeded. The monitoring is intended to confirm that the H_2S concentration being accepted at the Facility is less than 1 ppm, and that the evaporation ponds are <10 ppm. This approach to monitoring and treatment has proven effective in reducing H_2S concentrations and successful in eliminating the need for H_2S Contingency Plan implementation as described in 19.15.11.9 NMAC (i.e., to address H_2S > 100 ppm). In addition, this Plan follows American Petroleum Institute (API) Recommended Practice 55 (RP-55), paragraph 7.6 to address H_2S >30 ppm (**Table II.3.4**).

1.5 Regulatory Requirements: 19.15.36 NMAC and 19.15.11 NMAC

The Rules for Surface Waste Management Facilities (19.15.36 NMAC) address the monitoring and management of H_2S in 19.15.36.8.C(8) and 19.15.36.13.N NMAC:

19.15.36.8 SURFACE WASTE MANAGEMENT FACILITY PERMITS AND APPLICATION REQUIREMENTS

C. Application requirements for new facilities, major modifications and permit renewals. An applicant or operator shall file an application, form C-137, for a permit for a new surface waste management facility, to modify an existing surface waste management facility or for permit renewal with the environmental bureau in the division's Santa Fe office. The application shall include:

(8) a hydrogen sulfide prevention and contingency plan that complies with those provisions of 19.15.11 NMAC that apply to surface waste management facilities;

TABLE II.3.4 - API Recommended Practice 55

7.6 IMMEDIATE ACTION PLAN

Each contingency plan should contain a condensed "Immediate Action Plan" to be followed by designated personnel any time they receive notice of a potentially hazardous hydrogen sulfide or sulfur dioxide discharge. For the protection of personnel (including the general public) and abatement of the discharge, this "Immediate Action Plan" should include, but not be limited to, the following provisions:

a. Alert and account for facility personnel.
   1. Move away from the hydrogen sulfide or sulfur dioxide source and get out of the affected area.
   2. Don proper personal breathing equipment.
   3. Alert other affected personnel.
   4. Assist personnel in distress.
   5. Proceed to the designated emergency assembly area.
   6. Account for on-site personnel.

b. Take immediate measures to control the present or potential hydrogen sulfide or sulfur dioxide discharge and to eliminate possible ignition sources. Emergency shutdown procedures should be initiated as deemed necessary to correct or control the specific situation. When the required action cannot be accomplished in time to prevent exposing operating personnel or the public to hazardous concentrations of hydrogen sulfide or sulfur dioxide, proceed to the following steps, as appropriate for the site specific conditions.

c. Alert the public (directly or through appropriate government agencies) that may be subjected to an atmosphere exposure exceeding 30 ppm[21] of hydrogen sulfide or 10[21] ppm of sulfur dioxide.

d. Initiate evacuation operations.

e. Contact the first available designated supervisor on the call list (refer to Par. 7.4.a). Notify the supervisor of circumstances and whether or not immediate assistance is needed. The supervisor should notify (or arrange for notification of) other supervisors and other appropriate personnel (including public officials) on the call list.

f. Make recommendations to public officials regarding blocking unauthorized access to the unsafe area and assist as appropriate.

g. Make recommendations to public officials regarding evacuating the public and assist as appropriate.

h. Notify, as required, state and local officials and the National Response Center to comply with release reporting requirements (i.e., 40 Code of Federal Regulations Parts 302 and 355) (refer to Par. 4.4).

i. Monitor the ambient air in the area of exposure (after following abatement measures) to determine when it is safe for re-entry.

[21]Emergency Response Planning Guide Level 2 (ERPG-2), refer to Reference 27. ERPG-2 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

Note: This sequence (Par. 7.6) should be altered to fit the prevailing situation. Certain actions, especially those dealing with the public, should be coordinated with public officials.

This Table is extracted from the American Petroleum Institute (API) Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide, Recommended Practice 55, Second Edition, February 15, 1995, Reaffirmed, January 2013.

19.15.36.13 SITING AND OPERATIONAL REQUIREMENTS APPLICABLE TO ALL PERMITTED SURFACE WASTE MANAGEMENT FACILITIES:

N. Contingency plan. Each operator shall have a contingency plan. The operator shall provide the division's environmental bureau with a copy of an amendment to the contingency plan, including amendments required by Paragraph (8) of Subsection N of 19.15.36.13 NMAC; and promptly notify the division's environmental bureau of changes in the emergency coordinator or in the emergency coordinator's contact information. The contingency plan shall be designed to minimize hazards to fresh water, public health or the environment from fires, explosions or an unplanned sudden or non-sudden release of contaminants or oil field waste to air, soil, surface water or ground water. The operator shall carry out the plan's provisions immediately whenever there is a fire, explosion or release of contaminants or oil field waste constituents that could threaten fresh water, public health or the environment; provided that the emergency coordinator may deviate from the plan as necessary in an emergency situation. The contingency plan for emergencies shall:

Additionally, this H_2S monitoring program is intended to demonstrate compliance with 19.15.36.8.C(8) NMAC (Surface Waste Management), and the requirements of 19.15.11 NMAC (Hydrogen Sulfide Gas), as well as other permit conditions that may apply to this Facility. Should monitoring results identify unexpected concentrations of H_2S in excess of 30 ppm (i.e., RP-55 limit) in a public area, the requirements of 19.15.11.8.C NMAC will be implemented and this Plan, developed specifically to be responsive to 19.15.11.9 NMAC, will be implemented as required, with proper notification (**Volume II.5**). The RP-55 limit of 30 ppm will result in a radius of exposure (ROE) of 250 ft from the point of release (assuming a release rate of 100 SCFH on Figure C-2 of RP-55). This ROE is depicted on **Figure II.3.3**, and there are no "public areas" within this ROE. **Attachment II.3.B** includes a copy of API-RP 55.

2.0 EMERGENCY COORDINATORS

Lea Land has designated individual specialists with the responsibility and authority to implement response measures in the event of an emergency which threatens freshwater, public health or the environment per 19.15.36.13.N(3) NMAC. The Primary, Alternate, and on-site Emergency Coordinators (ECs; **Table II.3.5**) will be thoroughly familiar with all aspects of this Plan; operations and activities at the Facility; location and characteristics of waste to be managed; the repository of all records within the Facility; and the Facility layout. **Table II.3.5** provides a list of names, designations, titles, and phone numbers for each EC.

TABLE II.3.5 - List of Emergency Coordinators*

Primary Emergency Coordinator

Name:	Joe Ontiveros	Work Phone:	575.887.4048
Title:	Facility Manager	Mobile Phone:	575.302.1584
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		

Alternate Emergency Coordinator

Name:	Carl Sunderland	Work Phone:	575.887.4048
Title:	Facility Operator	Mobile Phone:	214.471.3423
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		

Onsite Emergency Coordinator

Name:	Smiley Ontiveros	Work Phone:	575.887.4048
Title:	Facility Operator	Mobile Phone:	575.302.7177
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		

The ECs are responsible for coordinating emergency response measures and have the authority to commit the resources required for implementation of this Plan. A designated EC will be available to respond to emergencies 24 hours a day, 7 days a week. The Lea Land employee who identifies an emergency situation will contact an EC directly; or via phone or radio. Contact will be attempted with each EC (Primary, Alternate, and the On-site) until communication is achieved (**Table II.3.5**). Upon arrival at the scene of an emergency, the first EC to arrive will assume responsibility for initiating response measures. If more than one EC responds, authority is assigned to the highest-ranking EC.

In the rare case that an EC cannot be contacted in an emergency, the Lea Land employee who identifies the emergency will make every effort to follow the emergency procedures outlined in this Plan until an EC or emergency authority (local, state, or federal; **Table II.3.2**) arrives to assist or take charge. The term "EC" as used throughout this Plan to references the responsible Emergency Coordinator at the scene of an emergency regardless of whether that EC is the Primary, Alternate, On-site EC, or EC designee. This Plan will be amended as described in Section 8.0 if the list of ECs changes, with updates submitted in a timely manner to OCD and filed on-site.

3.0 MONITORING

3.1 Incoming Processing Loads

Lea Land will monitor for H_2S on a continual basis on every oil field delivery waste vehicle arriving for processing at the site, as described in the Oil Field Waste Management Plan (**Volume II.2**). Monitoring results will be recorded on the OCD Form-C138 under "Source and Description of

Waste" (**Attachment II.3.C**) and retained as part of the Facility Operating Record. Lea Land personnel will wear H_2S personal monitors under circumstances where H_2S may be present, including when they are testing or unloading materials that may contain H_2S. The monitors will issue a visual and audible signal at 10 ppm of H_2S in the ambient air that becomes more rapid at 20 ppm. In the event of an H_2S detection of 1 ppm or greater, the following procedures will be implemented:

- Notification of the presence of H_2S will be provided to both the driver (hauler) and the generator.
- The generator will be provided the option of allowing Lea Land to treat the load on-site. Should the generator decline treatment, the load will be rejected and directed to leave the Lea Land Facility.
- If the generator requests treatment, Lea Land personnel will add calcium hypochlorite ($Ca(ClO)_2$) to the load at the levels corresponding to **Table II.3.6.**
- Once the $Ca(ClO)_2$ has been added, the load will be "rolled" (i.e., trucks will use their air pumps to "roll" air through the tank to allow for mixing of the contents and the added $Ca(ClO)_2$ to assist the chemical reaction. After approximately 20 minutes, the load will be re-sampled for the presence of H_2S. Treatment will continue until the H_2S reading is below 1 ppm. Once the H_2S measurement reads below 1 ppm, the load will be directed to the receiving area for processing.
- Treatment information and the final H_2S measurement will be recorded on the OCD Form-C138 under "Source and Description of Waste" (**Attachment II.3.C**).
- Lea Land personnel will contact the generator's Plant Manager or General Manager if assistance is needed.

3.2 Evaporation Pond Monitoring

3.2.1 Stationary Monitors

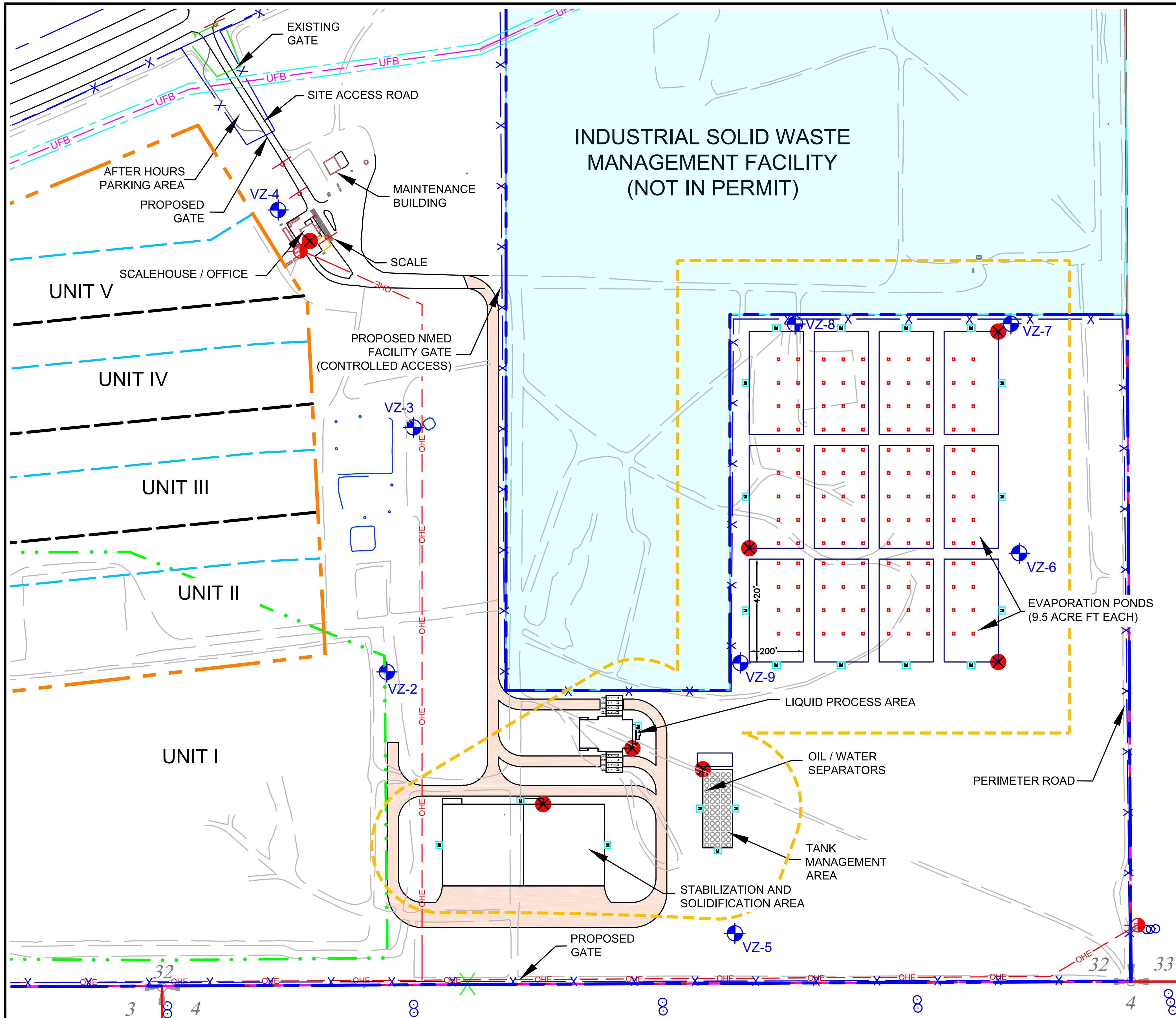
Evaporation ponds will be monitored for the presence of H_2S by recording at continuous stations maintained along the outside perimeter of the pond area as shown on **Figure II.3.3**. These monitors will be wired directly to the office for remote observation. H_2S readings and wind speed/direction will be logged and recorded twice daily on the Lea Land Daily Air and Water Inspection Form (**Attachment II.3.D**). The EC will be notified, and will implement the procedures outlined below if H_2S readings are ≥ 10 ppm. If H_2S readings are ≥ 20 ppm, the employee will implement the procedures listed in **Table II.3.7**.

- A second reading will be taken on the downwind berm within one hour
- The dissolved oxygen and dissolved sulfide levels of the pond will be tested immediately and the need for immediate treatment determined
- Tests for H_2S levels will be made at the fenceline downwind from the area of concern

TABLE II.3.6 - H_2S Treatment for Vehicles [1]

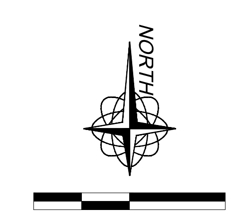
H_2S PPM[2]	$Ca(ClO)_2$ "Coffee Cans" Required[3]
<50	1.0
50-100	1.5
100-150	2.0
150-200	2.5
200-250	3.0
250-300	3.5
300-350	4.0
350-400	4.5
400-450	5.0
450-500	5.5
500-550	6.0
550-600	6.5
600-650	7.0
650-700	7.5
700-750	8.0
750-800	8.5
800-850	9.0
850-900	9.5
900-950	10.0
950-1000	10.5

Notes:
[1]*Typical volume of truck is 80 bbl. One coffee can equals 34.5 oz of product.*
[2]*PPM = parts per million*
[3]*$Ca(ClO)_2$ = calcium hypochlorite*



LEGEND

- SECTION BOUNDARY
- PROPERTY BOUNDARY
- SURFACE WASTE MANAGEMENT BOUNDARY
- EXISTING OCD PERMIT BOUNDARY
- PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
- INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
- CELL BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING RAILROAD
- PROPOSED UNDERGROUND FIBER OPTIC
- PROPOSED OVERHEAD POWER LINE
- 250 FOOT H_2S RADIUS OF EXPOSURE (ROE)
- EXISTING CULVERT
- PROPOSED UNPAVED ROAD (GRAVEL)
- NOT IN OCD PERMIT
- EXISTING TRANSMISSION LINE
- H_2S MONITORING LOCATION
- VZ-2 PROPOSED VADOSE ZONE MONITORING WELL
- PPE AND EMERGENCY EQUIPMENT



EVAPORATION POND STATIONARY MONITORING

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.3.3
APPROVED BY: CWF	www.team-psc.com	

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\EVAPORATION POND STATIONARY MONITORING.dwg
Date/Time:Jul. 23, 2019-12:37:32 ; LAYOUT: B (LS)

If two (2) consecutive H_2S readings of 10 ppm or greater are recorded:

- The EC will notify the Hobbs office of the OCD immediately (**Table II.3.2**)
- Lea Land will commence hourly monitoring on a 24-hour basis
- Lea Land will lower the pond level so that the mechanical evaporation system are able to circulate the entire pond fluid volumes
- Lea Land will obtain daily analysis of dissolved sulfides in the pond

TABLE II.3.7 - Implementation, Assessment, and Notification Procedures for H_2S

1. **EVACUATE AREA AND NOTIFY THE ECs:** The employee who first becomes aware of the H_2S alarm will immediately evacuate the area, don protective personal breathing equipment and notify the Primary EC, and the Alternate EC and On-site EC if necessary. Notification will be made in person, via telephone, or via radio. The responding EC will assume full authority over the situation. Properly protected responders will then assist any affected personnel or customers.
2. **REMAIN UPWIND OF RELEASE:** Persons evacuated from the release area should remain away and upwind from the area of the release until an assessment of the conditions has been made.
3. **ASSESS THE AMOUNT OF RELEASE:** The EC will assess the source, severity, and extent of the alarm. Monitoring equipment will be operated by trained personnel.
4. **MONITOR DOWNWIND IF $H_2S \geq 10$ PPM**: In the event a reading of 10 ppm is registered, the area will be evacuated, and Facility personnel will monitor the H_2S levels along the downwind boundary of the Facility.
5. **EVACUATE AND CLOSE THE FACILITY IF $H_2S \geq 20$ PPM AT DOWNWIND BOUNDARY:** If levels reach 20 ppm at the downwind boundary, the Facility will be evacuated and closed. Evacuation procedures are enumerated the Site Evacuation Plan provided as **Figure II.3.4**. Additionally, Lea Land will notify all persons within one-half mile of the fence line. The closest permanent residence appears to be two company houses located approximately 0.5 mile to the west of the site on the Transwestern Pipeline Company – Carlsbad Compressor Station. (62180 Hobbs Hwy MM 63, Carlsbad, Eddy NM 88220, (575) 885 8525)
6. **NOTIFICATION OF AUTHORITIES:** Notification will be provided to the New Mexico State Police, Eddy County Sheriff, Lea County Sheriff, Eddy County Emergency Management, Lea County Emergency Management, and OCD (**Table II.3.2**). In addition, medical authorities will be contacted if needed. Lea Land will also notify Southwest Environmental (if necessary) in Carlsbad (**Table II.3.2**) to provide response personnel, equipment, and supplies to mitigate the source of an H_2S reading of ≥10 ppm.
7. **RECORDKEEPING:** Lea Land will log and report to the OCD all incidences where an H_2S reading of ≥10 ppm is registered at the ponds (also see Section 6.0). Records will be maintained for at least 5 years at the Lea Land administrative offices.

3.2.2 Dissolved Oxygen and pH Monitoring

Dissolved oxygen (DO) and pH levels are key indicators of the efficacy of treatment and removal of H_2S during the aeration process in the evaporation ponds. The chemical reaction of H_2S and oxygen to produce sulfate as an end product is dependent upon the level of both dissolved oxygen and pH. Daily tests will be conducted and records made for each pond. If the pH falls below 8.0, remedial steps will be taken immediately to raise the pH. Lea Land proposes to use sodium hydroxide (caustic agent) to raise the pH to the optimal level of 8.2-9.0. Dissolved oxygen levels will be tested on a daily basis to ensure a residual of 0.5 ppm is maintained. The dissolved oxygen level will be taken at the beginning of each day (or at least once per 24-hour period), approximately one foot off the floor of each pond at various locations, and recorded. If tests show a dissolved residual oxygen level of less than 0.5 ppm, immediate steps will be undertaken to oxygenate the pond and create a residual oxygen level within the pond of at least 0.5 ppm. Remedial measures may include addition of chemicals or increased aeration. The pH readings will be recorded daily on the Daily Air and Water Inspection Form or similar template (**Attachment II.3.D**).

4.0 IMPLEMENTATION, ASSESSMENT, AND NOTIFICATION

The following subsections present a series of procedures for assessment, implementation, and notification of appropriate authorities in the unlikely event that a H_2S emergency develops (19.15.11.9 NMAC).

4.1 Implementation

This H_2S Contingency Plan will be implemented when an imminent or actual emergency situation develops that represents a potential impact to fresh water, public health or the environment. The circumstances that could require implementation of this Plan includes the potential release of H_2S gas.

Table II.3.7 lists the assessment, implementation, and notification procedures that will be followed in the event of an emergency. Assessment and notification are discussed further in Sections 4.2 and 4.3.

4.2 Assessment

In the event of a release, the EC will immediately identify the character, source, amount and extent of released materials, if possible; and assess the potential impact to fresh water, public health or the environment. Following an emergency, the EC may amend this Plan, as necessary, to protect fresh water, public health or the environment (19.15.11.9.F NMAC) based on lesson learned. The EC will also assess the circumstances of an emergency situation and determine the responses required to:

- implement immediate response procedures
- provide notifications to appropriate agencies and the general public
- implement appropriate recordkeeping procedures and Plan amendments

The assessment provides the EC with critical data needed to determine whether an evacuation is necessary, whether emergency authorities should be contacted, and whether Lea Land should attempt to control the release with on-site personnel and equipment. **Table II.3.8** provides OCD descriptions of “major” and “minor” releases which are applicable for assessment purposes per 19.15.29.7 – 11 NMAC. This Section contains additional, detailed information regarding the Site Evacuation Plan, and Section 5.0 addresses control procedures.

4.2.1 Site Evacuation Plan

Based upon the type of waste materials and treatment received at Lea Land and the rigorous operational safety protocols prescribed, the potential for a Facility evacuation is unlikely (19.15.11.9.B(2)(a) NMAC). However, various circumstances could arise warranting a Facility evacuation. In an emergency situation, the EC is the individual responsible for determining when evacuation of the Facility is required. Imminent or actual concerns that constitute a situation that could require evacuation include:

- Detection of H_2S levels at ≥10 ppm (i.e., evacuate the immediate area and monitor downwind levels)
- Detection of H_2S levels at ≥20 ppm (i.e., evacuate and close the Facility)

TABLE II.3.8 - Part 29: Release Notification (1 of 3)

19.15.29.7 DEFINITIONS:

A. "Major release" means:
  (1) an unauthorized release of a volume, excluding gases, of 25 barrels or more;
  (2) an unauthorized release of a volume that:
    (a) results in a fire or is the result of a fire;
    (b) may with reasonable probability reach a watercourse;
    (c) may with reasonable probability endanger public health; or
    (d) substantially damages property or the environment;
  (3) an unauthorized release of gases exceeding 500 MCF; or
  (4) a release of a volume that may with reasonable probability be detrimental to fresh water.

B. "Minor release" means an unauthorized release, which is not a major release and is a volume greater than five barrels but less than 25 barrels; or for gases, greater than 50 MCF but less than 500 MCF.

C. "Responsible party" means the operator, as defined in 19.15.2 NMAC. Notwithstanding the foregoing, the division, in its sole discretion, may also consider a person causing the release, or controlling the location of the release as the responsible party.

D. "Wellstream" means the gas, oil, water, suspended constituents, or any combination thereof, which comes from the wellbore.

19.15.29.8 RELEASES:

A. Requirements. For all releases regardless of volume, the responsible party shall comply with 19.15.29.8 NMAC and shall remediate the release. For major and minor releases, the responsible party shall also comply with 19.15.29.9, 19.15.29.10, 19.15.29.11, 19.15.29.12 and 19.15.29.13 NMAC.

B. Initial response. The responsible party must take the following immediate actions unless the actions could create a safety hazard that would result in injury.
  (1) Source elimination and site security. The responsible party must take appropriate measures to stop the source of the release and limit access to the site as necessary to protect human health and the environment.
  (2) Containment. Once the site is secure, the responsible party must contain the materials released by construction of berms or dikes, the use of absorbent pads or other containment actions to limit the area affected by the release and prevent potential fresh water contaminants from migrating to watercourses or areas that could pose a threat to public health and environment. The responsible party must monitor the containment to ensure that it is effectively containing the material and not being degraded by weather or onsite activity.
  (3) Site stabilization. After containment, the responsible party must recover any free liquids and recoverable materials that can be physically removed from the surface within the containment area. The responsible party must deliver material removed from the site to a division-approved facility.
  (4) Remediation. The responsible party may commence remediation immediately.

19.15.29.9 RELEASE NOTIFICATION:

A. The responsible party must notify the division on form C-141 of a major or minor release occurring during the drilling, producing, storing, disposing, injecting, transporting, servicing or processing of oil, gases, produced water, condensate or oil field waste including regulated NORM, or other oil field related chemicals, contaminants or mixture of the chemicals or contaminants, in accordance with the requirements of 19.15.29 NMAC.

B. If state, federal or tribal lands are involved, the responsible party must send a copy of the form C-141 to the appropriate land managing agency including the state land office, the BLM or tribal authority, as applicable.

TABLE II.3.8 - Part 29: Release Notification (2 of 3)

19.15.29.10 RELEASE NOTIFICATION REPORTING REQUIREMENTS: The responsible party must notify the division of releases in 19.15.29.9 NMAC as follows.

A. Reporting a major release.
  (1) The responsible party must notify the division's environmental bureau chief and the appropriate division district office verbally or by e-mail within 24 hours of discovery of the release. The notification must provide the information required on form C-141.
  (2) The responsible party must also notify the appropriate division district office in writing within 15 days of discovering the release by completing and filing form C-141. The written notification must verify the prior verbal or e-mail notification and include additions or corrections to the information contained in the prior verbal or e-mail notification.

B. Reporting a minor release. The responsible party must notify the appropriate division district office in writing within 15 days of discovery of the release by completing and filing form C-141.

19.15.29.11 SITE ASSESSMENT/CHARACTERIZATION: After the responsible party has removed all free liquids and recoverable materials, the responsible party must assess soils both vertically and horizontally for potential environmental impacts from any major or minor release containing liquids.

A. Characterization requirements. The responsible party must submit information characterizing the release to the appropriate division district office within 90 days of discovery of the release or characterize the release by submitting a final closure report within 90 days of discovery of the release in accordance with Subsection E of 19.15.29.12 NMAC. The responsible party may seek an extension of time to submit characterization information for good cause as determined by the division. The responsible party must submit the following information to the division.
  (1) Site map. The responsible party must provide a scaled diagram that shows the potentially impacted area, significant surface features including roads and site infrastructure, location of borings, sample points, monitoring wells and subsurface features such as known pipelines to the extent known at the time of submittal including the source of information regarding subsurface features.
  (2) Depth to ground water. The responsible party must determine the depth to ground water where the release occurred. If the exact depth to ground water is unknown, the responsible party must provide a reasonable determination of probable ground water depth using data generated by numeric models, cathodic well lithology, water well data, published information or other tools as approved by the appropriate division district office. If the responsible party uses water well data, the responsible party must provide all pertinent well information.
  (3) Wellhead protection area. The responsible party must determine the horizontal distance from all known water sources within a half mile of the release including private and domestic water sources. Water sources are wells, springs or other sources of fresh water extraction. Private and domestic water sources are those water sources used by less than five households for domestic or stock purposes.
  (4) Distance to nearest significant watercourse. The responsible party must determine the horizontal distance to the nearest significant watercourse as defined in Subsection P of 19.15.17.7 NMAC within a half mile of any horizontal boundary of the release.
  (5) Soil/waste characteristics. The responsible party must determine the lateral and vertical extents of soil contamination, as follows.
    (a) If the release occurred within a lined containment area, the responsible party must demonstrate liner integrity after affected material is removed and the affected area of the liner is exposed and provide:
      (i) certification on form C-141 that the responsible party has visually inspected the liner where the release occurred and the liner remains intact and had the ability to contain the leak in question; and
      (ii) at least two business days' notice to the appropriate division district office before conducting the liner inspection.

TABLE II.3.8 - Part 29: Release Notification (3 of 3)

(b) If the responsible party is unable to demonstrate liner integrity or the release occurred outside of a lined containment area, the responsible party must delineate the release horizontally and vertically using Table I of 19.15.29.12 NMAC constituents or as required by Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC based on the type of release. The responsible party shall use one or more of the following soil sampling methods for characterization:
(i) NRCS Field Guide;
(ii) EPA SW-846;
(iii) ASTM Method 4547;
(iv) EPA 600; or
(v) or other division-approved methods.

(c) In addition to Subparagraph (b) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, if the release occurred outside of a lined containment area and is in an area where depth to ground water is greater than 50 feet and less than or equal to 100 feet, the responsible party must delineate the vertical extent of the release to the greater of 600 mg/kg chloride or background chloride level, if:
(i) the release contains produced water that exceeds 10,000 mg/l of chloride (if the responsible party contends the fluid is less than 10,000 mg/l, the responsible party must provide current sample results to the division); and
(ii) the release is of an unknown quantity or results in greater than 200 barrels of unrecovered produced water.

(d) If the conditions are met in Subparagraph (c) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the responsible party must submit at least two soil samples for laboratory analysis from each borehole or sample point (highest observed contamination and deepest depth investigated). Field screening and assessment techniques are acceptable (headspace, titration, electrical conductivity [include algorithm for validation purposes], electromagnetics, etc.), but the sampling procedures must be clearly defined. The responsible party must submit copies of field notes attributable to field sampling and provide copies of the actual laboratory results including chain of custody documentation.

(e) If a known release of other oil field related chemicals occurs that is not included in Table I of 19.15.29.12 NMAC, and does not include oil, gas, produced water or other fluids from the wellstream, the standards for remediation shall be as follows:
(i) if the constituent appears on Table 1 of 40 C.F.R. 261.24(b), then that constituent shall be remediated according to 40 C.F.R. 261.24;
(ii) if the constituent is not identified in Table 1 of 40 C.F.R. 261.24(b), but is identified in the New Mexico environment department's Risk Assessment Guidance for Site Investigations and Remediation Volumes I and II (assessment), the division will determine the appropriate Assessment Volume and remediation shall occur pursuant to the assessment;
(iii) if the constituent is not identified in Items (i) or (ii) of Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the division shall consult with the responsible party to determine appropriate remediation of the release.

B. Unless the site characterization report includes completed efforts at remediation, the report must include a proposed remediation plan in accordance with 19.15.29.12 NMAC, which includes the anticipated timelines for beginning and completing the remediation.

C. If the division determines that more information is needed to understand the character of the release and its potential impact on fresh water, public health and the environment, the division may request the responsible party submit additional information. Should the division request additional information, it must do so in writing to the responsible party within 30 days from receipt of the characterization report or remediation plan with what specific information the division is requesting and reasons why the additional information is needed. The responsible party has 14 days to respond to a written request for additional information. If the responsible party disagrees with the request for additional information, it may consult with the division, or file an application for hearing pursuant to 19.15.4 NMAC within 30 days of the issuance of the request for additional information.

When conditions warrant immediate evacuation (e.g., H_2S ≥20 ppm), on-site persons (e.g., Facility personnel, haulers, visitors, vendors, etc.) will be directed to proceed immediately to the Facility Scalehouse for directions to evacuate through the main gates (**Figure II.3.4**), the primary evacuation route. Lea Land Personnel will exercise good judgment and common sense in using the primary evacuation route to exit the Facility, or selecting the most appropriate alternative evacuation route, if necessary. Assembly points and primary/secondary evacuation routes are provided on **Figure II.3.4.** Driving directions to the nearest hospital are included as **Figure II.3.5**, and **Table II.3.9** provides detailed procedures for evacuating the Facility.

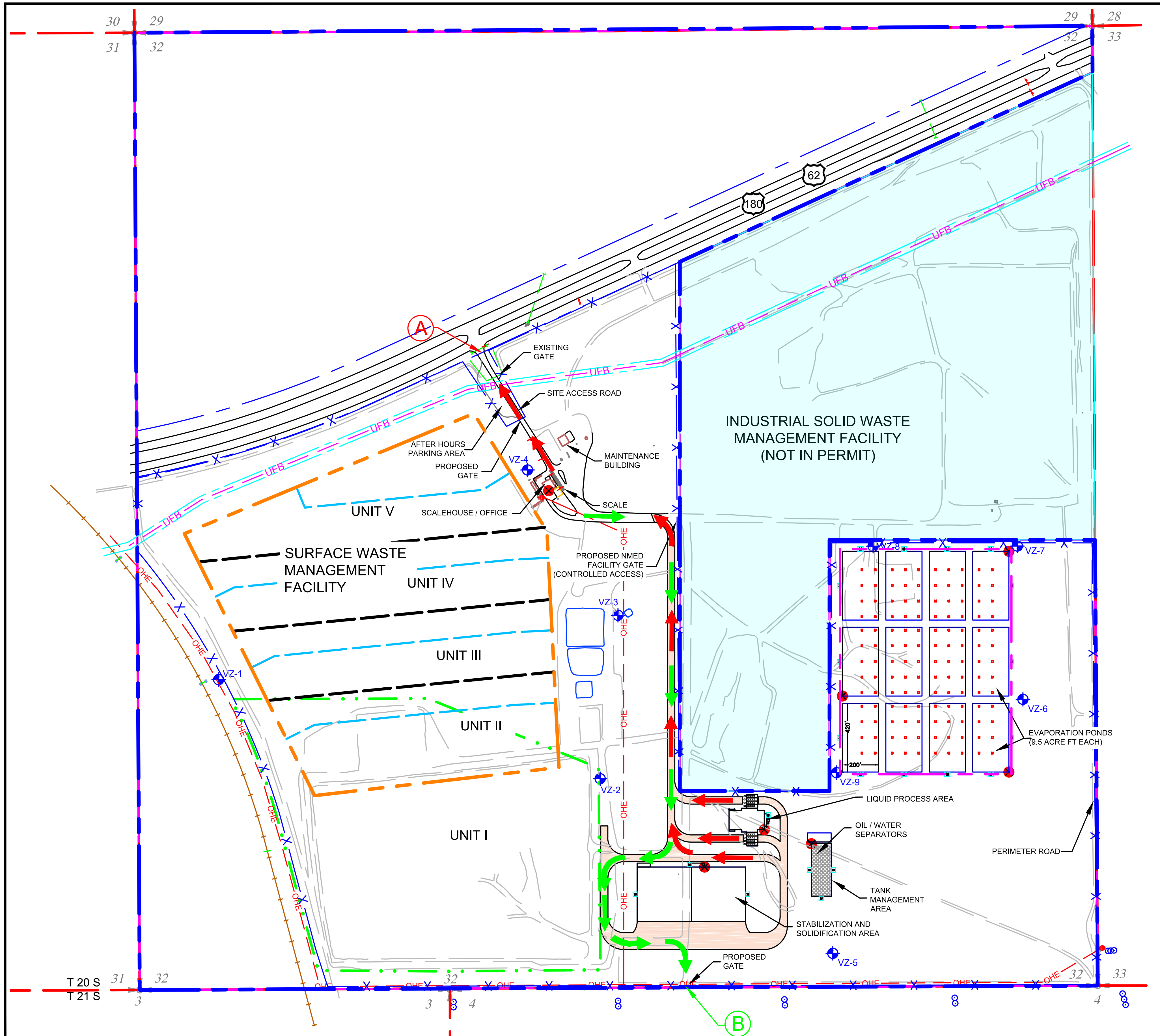
4.3 Notification of Authorities and General Public

This Section provides a series of procedures for implementation and notification of appropriate authorities in the event that a specific emergency develops (19.15.11.16 NMAC). Whenever there is an imminent or actual emergency, the EC will immediately contact on-site persons (Facility personnel, visitors, vendors, haulers, etc.) via on-site communication systems, as well as notify the appropriate state and local agencies (**Table II.3.2**), as determined. OCD will be notified within 4 hours after the Contingency Plan has been activated.

TABLE II.3.9 - Evacuation Procedures

When evacuation is required, the following procedures will be implemented:

1. Facility personnel will be alerted directly or using the Facility telephone, cellular telephones, or radios.
2. Vehicles delivering waste will be diverted away from the location of the emergency and routed towards the Facility exit (**Figure II.3.2**).
3. Stationary Facility operating equipment will be shut down.
4. Personnel will be directed to proceed to the Scalehouse, which will be the primary meeting location (**Figure II.3.4**). The EC will identify missing persons at that time.
5. If the emergency involves the Scalehouse or its immediate environs, the Facility secondary assembly point and evacuation routes will be utilized (as applicable).
6. Once assembled, Facility personnel will stand by to afford assistance and coordinate further actions.



LEGEND

SECTION BOUNDARY
PROPERTY BOUNDARY
SURFACE WASTE MANAGEMENT BOUNDARY
EXISTING OCD PERMIT BOUNDARY
PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
CELL BOUNDARY
EXISTING PAVED ROAD
EXISTING UNPAVED ROAD
EXISTING FENCE
PROPOSED FENCE
EXISTING RAILROAD
PROPOSED UNDERGROUND FIBER OPTIC
PROPOSED OVERHEAD POWER LINE
EXISTING CULVERT
PROPOSED UNPAVED ROAD (GRAVEL)
EXISTING TRANSMISSION LINE
H_2S MONITORING LOCATION
PROPOSED VADOSE ZONE MONITORING WELL
PPE AND EMERGENCY EQUIPMENT
PRIMARY EVACUATION ROUTE
SECONDARY EVACUATION ROUTE
PRIMARY MEETING LOCATION
SECONDARY MEETING LOCATION

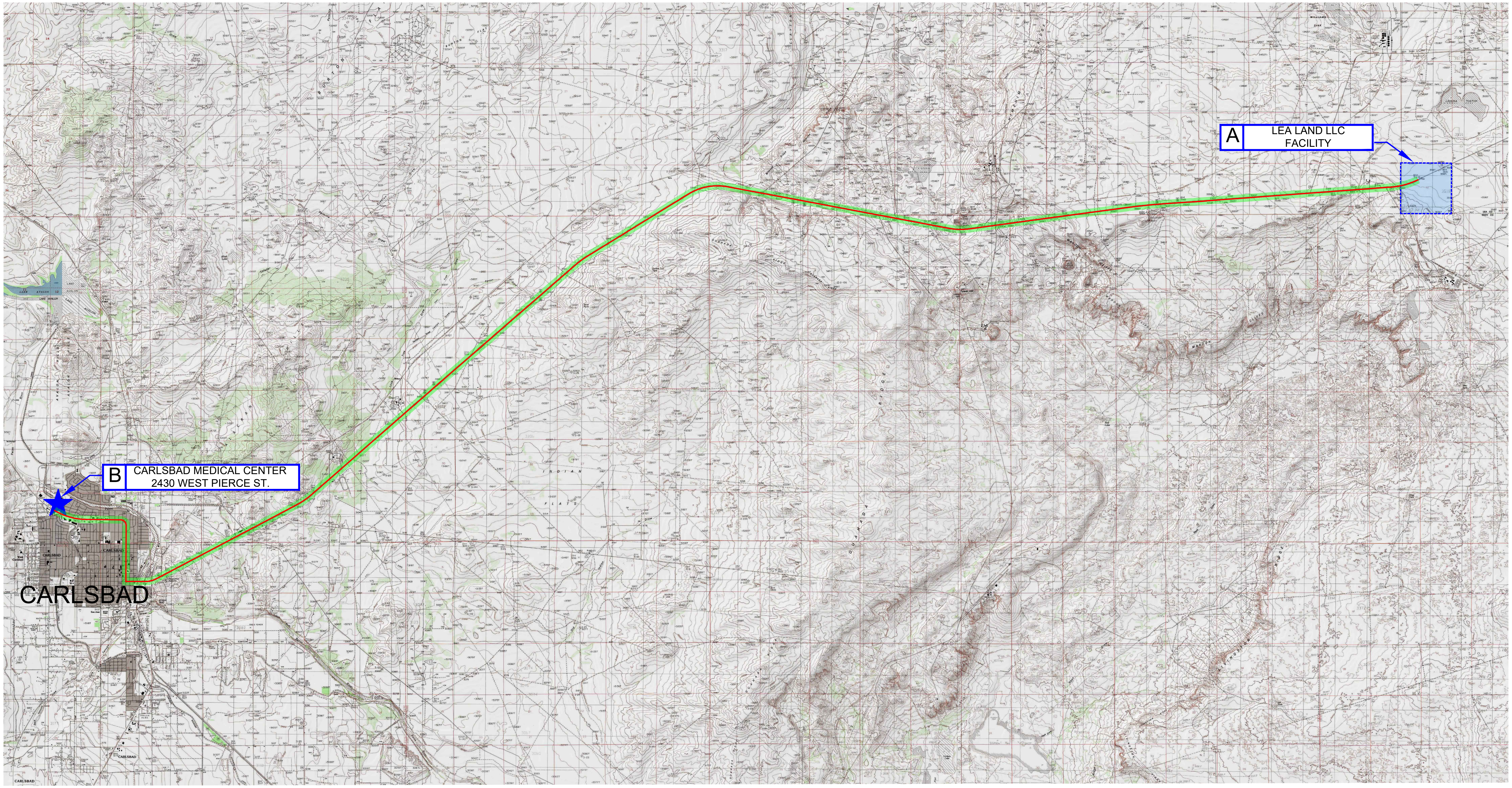
SITE EVACUATION MAP

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991
www.team-psc.com

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.3.4
APPROVED BY: CWF		

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE EVACUATION MAP.dwg
Date/Time:Jun. 27, 2019-10:37:09 ; LAYOUT: B (LS)



A: LEA LAND LLC FACILITY. HIGHWAY 62/180
1. Head EAST on HWY 62/180 toward CARLSBAD
2. North on Canal street to West Pierce street.
3. West on Pierce street to 2430 West Pierce street

B: CARLSBAD MEDICAL CENTER *Note: A to B Travel Estimates: 25 minutes / 30.9 miles*

MAP REFERENCE:
USGS JAL QUADRANGLE
NEW MEXICO–TEXAS 1:100,000 SCALE SERIES 1978

NORTH

0 1 MILE 2 MILES

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\HOSPITAL LOCATION.dwg
Date/Time:Apr. 01, 2019-11:14:25 ; LAYOUT: B (LS)

HOSPITAL LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: HOSPITAL.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.3.5
APPROVED BY: CWF	www.team-psc.com	

Table II.3.2 provides a list of emergency response agencies and contacts that may need to be notified depending on the type and extent of an emergency situation. **Table II.3.2** will be posted prominently near on-site telephones and provided as handouts to Lea Land personnel, customers, response personnel, etc. Fire, police, and medical authorities will be contacted, as necessary, in an emergency situation (**Table II.3.2**).

In the case of an H_2S emergency where H_2S is ≥10 ppm, notification will be provided to the New Mexico State Police, Lea County Sheriff, and OCD (also listed on **Table II.3.2**):

- OCD
  Hobbs, NM 575.393.6161
  Mobile Phone 575.370.3180
  Santa Fe, NM 505.476.3440
- New Mexico State Police 911 or 575.392.5580
- Eddy County Sherriff's Dept 911 or 575.887.1888
- Eddy County Emergency Management 575.628.5450
- Lea County Sherriff's Dept. 911 or 575.396.3611
- Lea County Emergency Management 575.391.2983

Lea Land will also notify Southwest Environmental, a third-party response specialist (if necessary) in Hobbs (**Table II.3.2**) to provide response personnel, equipment, and supplies to mitigate the source of an H_2S reading ≥10 ppm.

Table II.3.8 provides specific information regarding notification of OCD in the case of a release, which by definition includes "*breaks, leaks, spills, releases, fires or blowouts*". In addition, **Table II.3.8** also provides OCD definitions for "major" and "minor" releases.

Additional State, Federal, and other local emergency contact numbers are provided and should be used as deemed appropriate to the situation (**Table II.3.2**) by the EC. If the EC determines that the incident could threaten fresh water, human health, public safety or the environment beyond the limits of the Facility, the EC will notify the National Response Center and USEPA at the following phone numbers (also included on **Table II.3.2**):

- National Response Center - 24 Hr. Hotline: 800.424.8802
- Region VI Emergency Response Hotline (USEPA – Dallas, Texas): 800.887.6063

The EC's notification to authorities will include the following information, as listed on the Incident Report Form (**Attachment II.3.E**):

- name and telephone number of person reporting the incident
- name and address of Facility
- time and type of incident (e.g., hazardous material release, fire)
- name and quantity of material(s) involved, to the extent known
- extent of injuries, if any
- possible hazards to human health or the environment
- other information requested by the response entity

Recordkeeping will be recorded as detailed in Section 6.0, and Plan Amendments accomplished in accordance with Section 8.0 with revisions that reflect “lessons learned” from the incident.

5.0 EMERGENCY EQUIPMENT

The following sections describe emergency equipment at Lea Land that will be available for responding to emergency situations. An Emergency Response Equipment List describing the equipment, quantity, location, and uses is provided as **Table II.3.10**.

5.1 Internal Communications

Communications at Lea Land will be accomplished via cellular telephones, land lines, two-way radios, etc. These systems provide Facility personnel with immediate emergency notification capabilities, and the opportunity to receive instructions in the event of an emergency incident. Any mechanical difficulties with the communications equipment will be promptly repaired. Internal communication devices are listed on **Table II.3.10.**

5.2 External Communications

The land-line telephones and cell phones located at Lea Land will have outside access in the event that notification of the local emergency response authorities is required (i.e., fire department, ambulance, etc.). Key Facility personnel including the ECs, Facility Manager, etc., will carry cellular telephones for contacting outside agencies. The cellular telephones also provide a backup means for contacting emergency authorities in the event they cannot be reached by conventional (hard-line) telephone. Emergency phone numbers will be posted in the Facility Scalehouse and provided to employees and key customers on laminated pocket cards. External communication devices are also listed on **Table II.3.10.**

TABLE II.3.10 - Emergency Response Equipment List[1]

Equipment Description	Quantity	Location	Use(s)
10 lb ABC rated fire extinguisher (1 min)	2	Scalehouse	Firefighting
10 lb ABC rated fire extinguisher (1 min)	1 per vehicle	Trucks	Firefighting
10 lb ABC rated fire extinguisher (1 min)	1 per vehicle	Heavy Equipment	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Oil Process Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Oil Sales Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Produced Water Receiving Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Diesel Storage Tank	Firefighting
Loader (3-55 cy/load)	1	Facility	Berm Repair & Smothering Fires
Water Truck (1,000 gal/load)	1	Facility	Dust Control
Oil Booms (200 ft)	4	NE Corner of Pond	Oil Containment
Self-contained Breathing Apparatus	1 per employee	Scalehouse	Protective gear for employees
Pair leather gloves	1 per employee	Assigned to Employee	Protective gear for employees
NOMEX Coveralls	7 per Employee	Assigned to Employee	Protective gear for employees
Pair safety glasses	1 per employee	Employee workstations	Protective gear for employees
Round-point wood handled shovels	2	Scalehouse	Contain spillage, putting out fires
First Aid Kit	1	Scalehouse	First Aid
First Aid Kit	1	Processing Area	First Aid
First Aid Kit	1	Produced Water Facility	First Aid
First Aid Kit	1 per vehicle	Facility Vehicles	First Aid
Eye Wash Station	1	Produced Water Receiving Tanks	First Aid
Emergency Shower	1	Produced Water Facility	First Aid
Portable 2-way radio	1 per employee	Base unit at Scalehouse	Communications
Cell Phones (Unlimited Range)	min. 3	Facility Manager Facility Operator Facility Operator	Communications
Office Phone	2	Scalehouse	Communications
Mobile pressure washer	1	Mobile	Decontaminating equipment

Notes:
[1]*Subject to change in response to waste receipts, regulatory requirements, technology, etc.*

5.3 Personnel Protection, First Aid, and Safety Equipment

Personal protective equipment (PPE) necessary for responding to a potential release of hazardous materials will be maintained in on-site buildings (Processing Area, the Scalehouse, and the Produced Water Facility) and/or issued to each employee (**Table II.3.10**). These items include Tyvek suits, gloves, safety glasses, hearing protection, self-contained breathing apparatus (SCBA), etc.

First aid and safety equipment will be maintained at strategic locations at Lea Land as shown on **Table II.3.10**. Safety equipment located at the Facility includes industrial first aid kits, fire extinguishers, an eye wash station, etc. An emergency shower will be located at the Produced Water Facility. First aid kits will be placed in the Processing Area, at the Scalehouse, and the Produced Water Facility. In addition, first aid kits will be maintained in Facility vehicles, including heavy equipment. Prominent signs will be placed identifying the location of health and safety equipment, and emergency response items (e.g., fire extinguishers).

6.0 RECORDKEEPING

The EC will be responsible for ensuring that emergency response actions are fully documented. The Primary EC may complete the documentation requirements or delegate to another EC. The Incident Report Form (**Attachment II.3.E**) illustrates the information that will be recorded as a result of an emergency incident and related response action. This form will be signed by both the EC and the Facility Manager. Copies of the form filed for each incident will be retained for OCD review as part of the Facility Operating Record.

In addition, in the case of an unauthorized release at Lea Land, the OCD will be notified pursuant to 19.15.29 NMAC. As defined by OCD a "release" is any *"breaks, leaks, spills, releases, fires or blowouts involving crude oil, produced water, condensate, drilling fluids, completion fluids or other chemical or contaminant or mixture thereof, including oil field wastes and natural gases to the environment"* (19.15.2.7.R(4) NMAC). A major release (19.15.29 NMAC; **Table II.3.8**) includes an unauthorized release of any volume which may, with reasonable probability, endanger public health; or an unauthorized release of natural gases in excess of 500 thousand cubic feet (mcf); or a release of any volume which may with reasonable probability endanger public health or results in substantial damage to property or to the environment, or with reasonable probility be detrimental to fresh water. A major release requires both immediate verbal or e-mail notification (within 24 hours), as well as timely written notification to OCD (within 15 days) using OCD Form C-141 (*Release Notification and Corrective Action*).

A minor release (**Table II.3.8**) is an unauthorized release of greater than 50 mcf but less than 500 mcf of natural gases. A minor release requires timely written notice within 15 days of discovery. A copy of OCD Form C-141 is provided as **Attachment II.3.F**. Copies of the Form filed for each incident will be retained on-site as part of the Facility Operating Record.

7.0 COORDINATION AGREEMENTS

A copy of this Plan will be made available to the local organizations identified in **Table II.3.2**. This Plan serves to familiarize each of the identified organizations with the operations of the Facility and types of emergencies and responses that may be required. Each agency will be encouraged to visit the Facility for purposes of assessing site operations, access, etc,; and providing input regarding emergency response procedures (19.15.11.9.B(2)(e) NMAC).

8.0 PLAN AMENDMENT

The EC will be responsible for assuring that updates to or amendments of this Plan are conducted and recorded in the event of any of the following (19.15.11.9.F NMAC):

1. The Facility Permit is revised or modified with potential impacts on this Plan.
2. The OCD mandates it, including responses to regulatory updates.
3. The Plan fails in an emergency, resulting in Plan Amendments.
4. Modification to the Facility design, construction, operation, maintenance or other circumstances that changes the potential circumstance or locations for fires, explosion, or releases of hazardous oil field waste constituents; or related changes in the appropriate emergency response.
5. The list of ECs changes.
6. The list of emergency equipment changes significantly.

The updated Plan will be distributed to OCD and made available to the local organizations identified in **Table II.3.2** with a cover letter highlighting any substantive changes. Proposed changes will be in compliance with 19.15.36 NMAC.

9.0 TRAINING

The EC or Facility training representative will ensure that new and existing employees are trained on the H_2S Prevention and Contingency Plan at least annually; or when significant changes to the Plan have been made, whichever is more frequent. Prior to any new employee commencing work, a training session separate from the standard annual training will be conducted to provide specific proficiency in H_2S safety and procedures. Training will include both classroom drills and field exercises simulating H_2S monitoring, potential releases, and evacuation procedures. Included in this training are H_2S hazards identification and detection, personal protection, contingency procedures, etc.

ATTACHMENT II.3.A

SAFETY DATA SHEET FOR H_2S

SAFETY DATA SHEET

Hydrogen Sulfide

Section 1. Identification

GHS product identifier : Hydrogen Sulfide

Chemical name : hydrogen sulfide

Other means of identification : Hydrogen sulfide; Hydrogen sulfide (H2S); Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : Hydrogen sulfide; Hydrogen sulfide (H2S); Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide

SDS # : 001029

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas
ACUTE TOXICITY (inhalation) - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
Fatal if inhaled.
May cause respiratory irritation.
Very toxic to aquatic life.
Extended exposure to gas reduces the ability to smell sulfides.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Do not depend on odor to detect presence of gas. Approach suspected leak area with caution.

Prevention : Wear respiratory protection. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe gas.

Section 2. Hazards identification

Response	: Collect spillage. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or physician. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
Storage	: Store locked up. Protect from sunlight. Store in a well-ventilated place.
Disposal	: Dispose of contents and container in accordance with all local, regional, national and international regulations.
Hazards not otherwise classified	: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture	: Substance
Chemical name	: hydrogen sulfide
Other means of identification	: Hydrogen sulfide; Hydrogen sulfide (H2S); Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide
Product code	: 001029

CAS number/other identifiers

CAS number : 7783-06-4

Ingredient name	%	CAS number
hydrogen sulfide	100	7783-06-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact	: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.
Inhalation	: Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
Skin contact	: Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.
Ingestion	: As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact	: No known significant effects or critical hazards.
Inhalation	: Fatal if inhaled. May cause respiratory irritation.
Skin contact	: No known significant effects or critical hazards.
Frostbite	: Try to warm up the frozen tissues and seek medical attention.
Ingestion	: As this product is a gas, refer to the inhalation section.

Section 4. First aid measures

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. This material is very toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials: sulfur oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Section 6. Accidental release measures

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
Use only non-sparking tools. Avoid release to the environment. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
hydrogen sulfide	**ACGIH TLV (United States, 3/2017).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **NIOSH REL (United States, 10/2016).** CEIL: 15 mg/m³ 10 minutes. CEIL: 10 ppm 10 minutes. **OSHA PEL 1989 (United States, 3/1989).** STEL: 21 mg/m³ 15 minutes. STEL: 15 ppm 15 minutes. TWA: 14 mg/m³ 8 hours. TWA: 10 ppm 8 hours. **OSHA PEL Z2 (United States, 2/2013).** AMP: 50 ppm 10 minutes. CEIL: 20 ppm

Section 8. Exposure controls/personal protection

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless.

Odor : Rotten eggs.

Odor threshold : Not available.

pH : Not available.

Melting point : -82°C (-115.6°F)

Boiling point : -60°C (-76°F)

Critical temperature : 100.5°C (212.9°F)

Flash point : Not available.

Evaporation rate : Not available.

Section 9. Physical and chemical properties

Flammability (solid, gas)	:	Not available.
Lower and upper explosive (flammable) limits	:	Lower: 4.3% Upper: 45%
Vapor pressure	:	252 (psig)
Vapor density	:	1.19 (Air = 1)
Specific Volume (ft^3/lb)	:	11.236
Gas Density (lb/ft^3)	:	0.089
Relative density	:	Not applicable.
Solubility	:	Not available.
Solubility in water	:	5 g/l
Partition coefficient: n-octanol/water	:	Not available.
Auto-ignition temperature	:	270°C (518°F)
Decomposition temperature	:	Not available.
Viscosity	:	Not applicable.
Flow time (ISO 2431)	:	Not available.
Molecular weight	:	34.08 g/mole

Section 10. Stability and reactivity

Reactivity	:	No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	:	The product is stable.
Possibility of hazardous reactions	:	Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	:	Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.
Incompatible materials	:	Oxidizers
Hazardous decomposition products	:	Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	:	Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
hydrogen sulfide	LC50 Inhalation Gas.	Rat	712 ppm	1 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Section 11. Toxicological information

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
hydrogen sulfide	Category 3	Not applicable.	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.
Inhalation : Fatal if inhaled. May cause respiratory irritation.
Skin contact : No known significant effects or critical hazards.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : Adverse symptoms may include the following:, respiratory tract irritation, coughing
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Other information : IDLH : 100 ppm

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
hydrogen sulfide	Acute EC50 62 µg/l Fresh water	Crustaceans - Gammarus pseudolimnaeus	2 days
	Acute LC50 2 µg/l Fresh water	Fish - Coregonus clupeaformis - Yolk-sac fry	96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

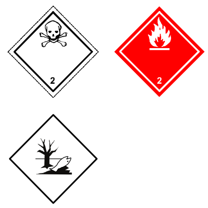
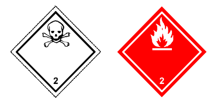
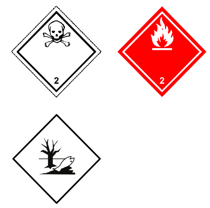
Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Hydrogen sulfide; Hydrogen sulfide H2S	7783-06-4	Listed	U135

Section 14. Transport information

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1053	UN1053	UN1053	UN1053	UN1053
UN proper shipping name	HYDROGEN SULFIDE	HYDROGEN SULFIDE; OR HYDROGEN SULPHIDE	HYDROGEN SULFIDE	HYDROGEN SULPHIDE	HYDROGEN SULPHIDE
Transport hazard class(es)	2.3 (2.1)  	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 	2.3 (2.1) 
Packing group	-	-	-	-	-
Environmental hazards	No.	Yes.	Yes. The environmentally hazardous substance mark is not required.	Yes.	Yes. The environmentally hazardous substance mark is not required.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : Toxic - Inhalation hazard Zone B
Reportable quantity 100 lbs / 45.4 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: Forbidden.
Special provisions 2, B9, B14

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2), 2.13-2.17 (Class 2), 2.7 (Marine pollutant mark).
The marine pollutant mark is not required when transported by road or rail.
Explosive Limit and Limited Quantity Index 0
ERAP Index 0
Passenger Carrying Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden

IMDG : The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.

IATA : The environmentally hazardous substance mark may appear if required by other transportation regulations.
Quantity limitation Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: Forbidden.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Water Act (CWA) 311: hydrogen sulfide

Clean Air Act (CAA) 112 regulated toxic substances: hydrogen sulfide

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

			SARA 302 TPQ		SARA 304 RQ	
Name	**%**	**EHS**	**(lbs)**	**(gallons)**	**(lbs)**	**(gallons)**
hydrogen sulfide	100	Yes.	500	-	100	-

SARA 304 RQ : 100 lbs / 45.4 kg

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	hydrogen sulfide	7783-06-4	100
Supplier notification	hydrogen sulfide	7783-06-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Section 15. Regulatory information

Inventory list

Australia	: This material is listed or exempted.
Canada	: This material is listed or exempted.
China	: This material is listed or exempted.
Europe	: This material is listed or exempted.
Japan	: **Japan inventory (ENCS)**: This material is listed or exempted. **Japan inventory (ISHL)**: Not determined.
Malaysia	: Not determined.
New Zealand	: This material is listed or exempted.
Philippines	: This material is listed or exempted.
Republic of Korea	: This material is listed or exempted.
Taiwan	: This material is listed or exempted.
Thailand	: Not determined.
Turkey	: Not determined.
United States	: This material is listed or exempted.
Viet Nam	: Not determined.

Section 16. Other information

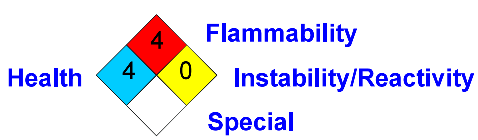
Hazardous Material Information System (U.S.A.)

Health	/	4
Flammability		4
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Section 16. Other information

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
ACUTE TOXICITY (inhalation) - Category 2	On basis of test data
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Expert judgment
AQUATIC HAZARD (ACUTE) - Category 1	Expert judgment

History

Date of printing : 11/30/2017

Date of issue/Date of revision : 11/30/2017

Date of previous issue : 3/23/2017

Version : 1

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

AFROX
A Member of The Linde Group

MATERIAL SAFETY DATA SHEET (MSDS)
HYDROGEN SULPHIDE (H2S)
Please ensure that this MSDS is received by the appropriate person

DATE: April 2011 Version 2

Ref. No.: MS033

1 PRODUCT AND COMPANY IDENTIFICATION

Product Name HYDROGEN SULPHIDE

Chemical Formula H2S

Trade Name Hydrogen Sulphide

Company Identification African Oxygen Limited
23 Webber Street
Johannesburg, 2001
Tel. No: (011) 490-0400
Fax No: (011) 490-0506

EMERGENCY NUMBER 0860111185 or (0860 02 02 02) (24 hours)

2 COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name: Hydrogen Sulphide
Chemical Abstract Service Number (CAS No.): 07783-06-04
UN No.: 1053
ERG No.: 117

3. HAZARDS IDENTIFICATION

Main Hazards in concentrations of 20 to 50ppm , hydrogen sulphide irritates the eyes. Slightly higher concentrations irritate The upper respiratory tract and, may result in pulmonary edema.
Inhalation of 500ppm for 30 minutes produces headache, dizziness, excitement, staggergering, and gastroenteric disorder, followed in some cases by bronchitis and bronchial pneumonia.
Concentrations above 600pm can be fatal within 30 minutes through respiratory paralysis.
Although the foul odor of hydrogen sulphide is readily detectable in low concentrations, it becomes unreliable as a warning of dangerous concentrations of gas since continuous inhalation leads rapidly to olfactory fatigue.

Vapour Inhalation Hydrogen sulfide reacts with enzymes in the bloodstream and inhibits cellular respiration resulting in pulmonary paralysis, sudden collapse and death. Continuous exposure to low (15-50 ppm) concentrations will generally cause irritation to mucous membranes, and may also cause headache, dizziness or nausea. Higher concentrations (200-300 ppm) may result in respiratory arrest leading to coma or unconsciousness. Exposures for more than 30minutes at concentrations greater than 700 ppm have been fatal.
Continuous inhalation of low concentrations may cause olfactory fatigue or paralysis of the sense of smell.Thus, detection of hydrogen sulfide by its odor is not effective.

Eye Contact Low concentrations will generally cause irritation to the conjunctiva. Repeated exposure to low concentrations is reported to cause conjunctivitis, photo phobia, corneal bullae, tearing, pain and blurred vision.

Skin Contact May irritate the skin upon contact

Ingestion Ingestion is unlikely. Hydrogen sulfide will irritate the mucous membranes causing a burning feeling with excess salivation likely. Irritation of the gastrointestinal tract may also occur.

4 FIRST AID MEASURES

Inhalation: Very toxic by inhalation.
May cause damaging effects to central nervous system, metabolism and gastrointestinal tract.
Prolonged exposure to small concentrations may result in pulmonary oedema.
Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor.
Apply artificial respiration if breathing stopped.
Delayed adverse effects possible.

Skin/Eye: Remove contaminated clothing.
In case of frostbite spray with water for at least 15minutes. Apply a sterile dressing.
Immediately flush eyes thoroughly with water for at least minutes. Obtain medical assistance.

Ingestion: It is not considered a potential route of exposure

5 FIRE FIGHTING MEASURES

Extinguishing media Suitable extinguishing media: all known extinguishants can be used.

Specific Hazards Exposure to fire may cause containers to rupture/explode.
Hazardous combustion products: If involved in a fire, the following toxic and/or corrosive fumes may be produced by thermal decomposition: Sulfur dioxide,
Suitable extinguishing media: all known extinguishants can be used.

Emergency Actions stop flow of product if possible. Move away from the container and cool with water from a protected position. Do not extinguish a leaking gas flame unless absolutely necessary.
Spontaneous/explosive re-ignition may occur.

Protective Clothing Use a self contained breathing apparatus and chemically protective clothing.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions Evacuate area.
Eliminate ignition sources. Ensure adequate air ventilation.
Wear self- contained breathing apparatus when entering area unless atmosphere is proved to be safe.

Environmental Precautions Do not allow the product from entering sewers and storm water drains.

Methods for cleaning up Ventilate area. Keep area evacuated and free from ignition sources until any spilled liquid has evaporated, that is ground free from frost

MATERIAL SAFETY DATA SHEET (MSDS)
HYDROGEN SULPHIDE (H2S)
Please ensure that this MSDS is received by the appropriate person

7 HANDLING AND STORAGE

Ensure equipment is adequately earthed.
Purge air from system before introducing gas.
Do not allow backfeed into the container.
Cylinders should be stored upright and prevented from falling.
Suck back of water into the container must be prevented.
Use only properly specified equipment, which is suitable for this product, its supply pressure and temperature.
Contact your gas supplier if in doubt.
Keep away from ignition sources (including static discharges).
Secure them away from flammable or combustible materials; in a dry, well ventilated constructed of non -combustible material with firm level floor.
Keep container below 50 deg. Celsius in a well ventilated place.
Use the "first in – first out" inventory system to prevent full cylinders from being stored for excessive period of time. Compliance of all relevant legislation is essential. Keep away from children

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational exposure hazards Hydrogen sulfide – TLV: 10ppm; STEL: 15ppm

Engineering control measures Filling or withdrawal from a Hydrogen Sulfide cylinder must be performed in a well ventilated area and if possible should be in a forced ventilation system or using a hood over the valve.

9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL DATA

Chemical Symbol	H2S
Molecular Weight	34.08 g/mol
Melting point @ 224 kPa	-86°C
Appearance/Colour:	Colourless gas
Odour:	Rotten eggs
Relative density, Gas @ 101.325kPa @ 25°C	1.188
Specific Volume @ 21.1°C, 101.325 kPa	70.11 dm^3/kg
Dielectric constant; Gas @ 0°C, @ 101.325kPa	1.004

10 STABILITY AND REACTIVITY

Conditions to avoid avoid heat, flames, sparks and other source of ignition.
Minimise contact with material
Avoid inhalation of material or combustion by products.
Keep out of water suppliers and sewers.

Incompatible Materials Do not store reserve stocks of hydrogen sulphide cylinder with cylinders containing oxygen or other highly oxidising or combustible materials.

11 TOXICOLOGICAL INFORMATION

Acute Toxicity	unknown
Skin & eye contact	unknown
Chronic Toxicity	unknown
Carcinogenicity	unknown
Mutagenicity	unknown
Reproductive Hazards	unknown

12 ECOLOGICAL INFORMATION

General: Toxic to water organisms.

13 DISPOSAL CONSIDERATIONS

Disposal methods Avoid discharge to atmosphere.
Do not discharge into any place where its accumulation could be dangerous.
Toxic and corrosive gases formed during combustion should be scrubbed before discharge to atmosphere.
Do not discharge into areas where there is a risk of forming an explosive mixture with air. Waste gas should be flared through a suitable burner with flash back arrestor.
Contact supplier if further guidance is required

14 TRANSPORT INFORMATION

UN No.	1053
Class	2.3
ADR/RID Item Nr.	2,2 deg. TIF
ADR/RID Hazard Nr.	263
Labelling ADR	Label 6.1 Toxic Substance Label 3 Flammable substance

Other transport information Avoid transport on vehicles where load space is not separated from the driver's compartment. Ensure vehicle driver is aware of potential hazards of the load and knows what to do in the event of an accident or an emergency.
Before transporting product containers ensure that they are firmly secured and valve outlet cap, nut or plug (where provided) is correctly fitted. Valve protection device (where provided) is correctly fitted. Ensure that there is adequate ventilation. Comply with applicable transport regulation.

15 REGULATORY INFORMATION

Risk phrases R26 Very toxic by inhalation

Safety phrases
S (1/2) Keep locked up and out of reach of children
S9 Keep container in a well ventilated place
S16 Keep away from ignition sources – No smoking
S28 After contact with skin, immediately wash with plenty of ... (to be specified by manufacturer)
S36/37 Wear suitable protective clothing and gloves
S45 In case of accident or if you feel unwell, seek medical advice immediately
S61Avoid release into environment; refer to special instructions/material safety data sheet

Reference: SANS 10265

16 OTHER INFORMATION

Ensure all national/local regulations are observed. Ensure operators understand the asphyxiation hazard.

Bibliography
Compressed Gas Association, Arlington, Virginia
Handbook of Compressed Gases – 3rd Edition
Matheson Gas Data Book – 6th Edition

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ATTACHMENT II.3.B

API RP-55

Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

API RECOMMENDED PRACTICE 55
SECOND EDITION, FEBRUARY 15, 1995

STEP
Strategies for Today's Environmental Partnership

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005

STEP

Strategies for Today's Environmental Partnership

One of the most significant long-term trends affecting the future vitality of the petroleum industry is the public's concerns about the environment. Recognizing this trend, API member companies have developed a positive, forward looking strategy called STEP: Strategies for Today's Environmental Partnership. This program aims to address public concerns by improving industry's environmental, health and safety performance; documenting performance improvements; and communicating them to the public. The foundation of STEP is the API Environmental Mission and Guiding Environmental Principles.

API ENVIRONMENTAL MISSION AND GUIDING ENVIRONMENTAL PRINCIPLES

The members of the American Petroleum Institute are dedicated to continuous efforts to improve the compatibility of our operations with the environment while economically developing energy resources and supplying high quality products and services to consumers. The members recognize the importance of efficiently meeting society's needs and our responsibility to work with the public, the government, and others to develop and to use natural resources in an environmentally sound manner while protecting the health and safety of our employees and the public. To meet these responsibilities, API members pledge to manage our businesses according to these principles:

- To recognize and to respond to community concerns about our raw materials, products and operations.
- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment, and the safety and health of our employees and the public.
- To make safety, health and environmental considerations a priority in our planning, and our development of new products and processes.
- To advise promptly appropriate officials, employees, customers and the public of information on significant industry-related safety, health and environmental hazards, and to recommend protective measures.
- To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
- To economically develop and produce natural resources and to conserve those resources by using energy efficiently.
- To extend knowledge by conducting or supporting research on the safety, health and environmental effects of our raw materials, products, processes and waste materials.
- To commit to reduce overall emissions and waste generation.
- To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.

Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

Exploration and Production Department

API RECOMMENDED PRACTICE 55
SECOND EDITION, FEBRUARY 15, 1995

American Petroleum Institute

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This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API *standard*. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the director of the Exploration and Production Department, American Petroleum Institute, 700 North Pearl, Suite 1840, Dallas, Texas 75201. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

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FOREWORD

These recommended practices were prepared by the API Subcommittee on Production Operations Involving Hydrogen Sulfide. This standard is under the administration of the American Petroleum Institute Exploration & Production Department's Executive Committee on Drilling & Production Practices.

It is intended that these voluntary recommended practices serve as a guide to promote and maintain integrity of oil and/or gas producing and gas processing facilities in the interests of public safety, personnel safety, and protection of the environment. Users of this publication are reminded that constantly developing technology, specific company requirements and policy, and specialized or limited operations do not permit coverage of all possible operations, practices, or alternatives. This standard is not so comprehensive as to present *all* of the recommended practices for oil and gas well producing operations and gas processing plant operations involving hydrogen sulfide. Alternative operating procedures and/or equipment are available and routinely used to meet or exceed recommended practices or performance levels set forth herein. Recommendations presented in this publication are based on industry experience and expertise involving a wide range of operating locations and conditions. Recommendations presented in this publication are not intended to inhibit developing technology and equipment improvements or improved operating procedures. This publication, or portions thereof, cannot be substituted for qualified technical/operations analysis and judgment to fit a specific situation.

There may be federal, state, or local statutes, rules, or regulations requiring oil and gas producing and gas processing operations to be conducted in a safe or environmentally sound manner. Organizations and individuals using this standard are cautioned that requirements of federal, state, or local laws and regulations are constantly evolving. These requirements should be reviewed to determine whether the practices recommended herein and the operations being planned or conducted are consistent with current laws and regulations.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet (MSDS).

Provisions of these voluntary recommended practices include use of the verbs "shall" and "should", whichever is deemed most applicable for the specific situation. For purposes of this publication, the following definitions are applicable.

Shall: Indicates the "recommended practice(s)" has universal applicability to that specific activity.

Should: Denotes a "recommended practice(s)" 1) where a safe comparable alternative practice(s) is available; 2) that may be impractical under certain circumstances; or 3) that may be unnecessary under certain circumstances.

Suggested revisions to these recommended practices are invited and should be submitted in writing to: Director, Exploration & Production Department, American Petroleum Institute, 700 North Pearl Street, Suite 1840, Dallas, Texas 75201-2845.

Recommended Practices for Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide

0 Introduction

The petroleum industry, through many years of research and operating experience, has developed guidelines for safe operations under conditions involving hydrogen sulfide. Continuing industry efforts, which include planning, prudent selection and layout of equipment, prudent selection of materials, operating and emergency procedures, specialized safety equipment, and appropriate personnel training are all necessary to ensure successful and safe operations. Effective response to emergencies requires prior planning. *Good engineering practice (engineering and administrative controls) dictates that producing and gas processing systems be designed to minimize exposure of personnel and the public to hydrogen sulfide and sulfur dioxide.*

1 Scope

Recommendations set forth in this publication apply to oil and gas producing and gas processing plant operations conducted with hydrogen sulfide present in the fluids being handled. The presence of hydrogen sulfide in these operations also presents the possibility of exposure to sulfur dioxide from the combustion of hydrogen sulfide. *Refer to Section 4 for applicability of this standard.*

2 References

2.1 STANDARDS

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision, and users are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ACGIH[1]

1. *Threshold Limit Values and Biological Exposure Indices (1993-94).*

ANSI[2]

2.	B31.3	*Chemical Plant and Petroleum Refining Piping.*
3.	B31.4	*Liquid Petroleum Transportation Piping Systems.*
4.	B31.8	*Gas Transmission and Distribution Piping Systems.*
5.	CGA G-7.1	*Breathing Air, Grade D.*
6.	ISEA 102	*Standard for Gas Detector Tube Units—Short Term Type for Toxic Gases and Vapors in Working Environments.*
7.	Z88.2	*Practices for Respiratory Protection.*

API[3]

8.	BUL E1	*Bulletin on the Generic Hazardous Chemical Category List and Inventory for the Oil and Gas Exploration & Production Industry.*
9.	BUL E2	*Bulletin on Management of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Production.*
10.	BUL E3	*Well Abandonment and Inactive Well Practices for U.S. Exploration and Production Operations.*
11.	BUL E4	*Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA, and SARA Title III.*
12.	RP12R1	*Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service.*
13.	RP14C	*Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms.*
14.	RP49	*Recommended Practice for Drilling and Drill Stem Testing Operations Involving Hydrogen Sulfide.*
15.	RP500	*Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities.*
16.	API 510	*Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration.*
17.	RP576	*Inspection of Pressure Relieving Devices.*
18.	RP750	*Management of Process Hazards.*
19.	STD 1104	*Welding of Pipelines and Related Facilities.*
20.	PUBL 2217A	*Guidelines for Work in Inert Confined Spaces in the Petroleum Industry.*

ASME[4]

21. *Boiler & Pressure Vessel Code.*

[1]American Conference of Governmental Industrial Hygienists, 1330 Kemper Drive, Cincinnati, OH 45240.
[2]American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.
[3]American Petroleum Institute, Publications & Distribution Section, 1220 L Street NW, Washington, D.C. 20005.
[4]American Society of Mechanical Engineers, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

EPA[5]

22.	EPA/600/8-86/026A	*Health Assessment Document for Hydrogen Sulfide.*

ISA[6]

23.	S12.15, Part I	*Performance Requirements for Hydrogen Sulfide Detection Instruments.*
24.	RP12.15, Part II	*Installation, Operation, and Maintenance of Hydrogen Sulfide Detection Instruments.*

NACE[7]

25.	MR0175-94	*Standard Material Requirements Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment.*

National Response Team[8]

26.	NRT-1	*Hazardous Materials Emergency Planning Guide.*
27.	*Technical Guidance for Hazards Analysis, Emergency Planning for Extremely HazardousSubstances.*	

NFPA[9]

28.	NFPA 70	*National Electrical Code.*
29.	NFPA 496	*Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations.*

NIOSH[10]

30.	NIOSH 74-111	*Criteria for a Recommended Standard for Occupational Exposure to Sulfur Dioxide (GPO No. 017-033-00029).*
31.	NIOSH 77-158	*Criteria for a Recommended Standard for Occupational Exposure to Hydrogen Sulfide (GPO No. 017-033-00217-7).*
32.	DHHS 85-114	*NIOSH Pocket Guide to Chemical Hazards.*

PACE[11]

33.	Report 85-5	*Review of Ambient Hydrogen Sulfide Standards in Canada.*

2.2 REGULATIONS

The following regulations are referenced in this standard. All regulations are subject to revision, and users should determine the latest version to ensure compliance.

Bureau of Mines (DOI)[12]

34.	30 *CFR* Chapter 1, Subchapter B, Part II, Subpart H	*Respiratory Protection Devices.*

Coast Guard (DOT)[13]

35.	33 *CFR* Parts 140, 143, and 146	*Emergency Evacuation Plans for Manned OCS Facilities.*
36.	54 *FR* 21566, May 18, 1989	*Emergency Evacuation Plans for Manned OCS Facilities.*

DOT[14]

37.	49 *CFR* Part 178, Subpart C	*Shipping Container Specifications.*

EPA[5]

38.	40 *CFR* Part 264, Subpart D	*Contingency Plans and Emergency Procedures.*
39.	40 *CFR* Part 302	*Designation, Reportable Quantities, and Notification.*
40.	40 *CFR* Part 355	*Emergency Planning and Notification.*
41.	40 *CFR* Part 370	*Hazardous Chemical Reporting: Community Right-to-Know.*

MMS (DOI)[15]

42.	30 *CFR* Parts 250 & 256	*Oil, Gas, and Sulphur Operations in the Outer Continental Shelf.*
43.	53 *FR* 10596-10777, April 1, 1988	*Oil, Gas, and Sulphur Operations in the Outer Continental Shelf.*
44.	MMS-OCS-1	*Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf. (February 1976).*

[5]Environmental Protection Agency, available from U.S. Government Printing Office, Washington, D.C. 20402.

[6]Instrument Society of America, Box 12277, Research Triangle Park, NC 27709.

[7]National Association of Corrosion Engineers, NACE International, Box 218340, Houston, Texas 77218-8340.

[8]National Response Team, National Oil and Hazardous Substances Contingency Plan GWDR/12, 2100 Second Street SW, Washington, D.C. 20593.

[9]National Fire Protection Association, 60 Batterymarch Park, Quincy, MA 02269.

[10]National Institute for Occupational Safety and Health (U.S. Department of Health, Education, and Welfare), available from U.S. Government Printing Office, Washington, D.C. 20402.

[11]Petroleum Association for Conservation of the Canadian Environment, 12002-275 Slater Street, Ottawa, Ontario, Canada L1P-5H9.

[12]Bureau of Mines, U.S. Department of Interior, available from U.S. Government Printing Office, Washington, D.C. 20402.

[13]Coast Guard, U.S. Department of Transportation, available from U.S. Government Printing Office, Washington, D.C. 20402.

[14]U.S. Department of Transportation, available from U.S. Government Printing Office, Washington, D.C. 20402.

[15]Minerals Management Service, U.S. Department of Interior, 381 Elden Street, Herndon, VA 22070-4817. Available from U.S. Government Printing Office, Washington, D.C. 20402.

45.	47 *FR* 28888, July 1, 1982	*Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf. (July 1, 1982).*
OSHA[16]		
46.	29 *CFR* Part 1910.38	*Employee Emergency Plan and Fire Prevention Plans.*
47.	29 *CFR* Part 1910.119	*Process Safety Management of Highly Hazardous Chemicals.*
48.	29 *CFR* Part 1910.120	*Hazardous Waste Operations and Emergency Response.*
49.	54 *FR* Part 9294, March 6, 1989	*Hazardous Waste Operations and Emergency Response.*
50.	29 *CFR* Part 1910.134	*Respiratory Protection Standard.*
51.	29 *CFR* Part 1910.146	*Permit-required Confined Spaces.*
52.	29 *CFR* Part 1910.1000	*Toxic and Hazardous Substances (Air Contaminants).*
53.	54 *FR* 2332, January 19, 1989	*Air Contaminants.*
54.	58 *FR* 35338, June 30, 1993	*Air Contaminants.*
55.	29 *CFR* Part 1910.1200	*Hazard Communication Standard.*

2.3 OTHER REFERENCES

56. Poda, George A., "Hydrogen Sulfide Can Be Handled Safely", *Archives of Environmental Health,* Vol. 12, 795-800, June 1966.

57. Ronk, Richard and White, M. K., "Hydrogen Sulfide and the Probabilities of Inhalation Through a Tympanic Membrane Defect", *Journal of Occupational Medicine,* Vol. 25, No. 5, 337-340, May 1985.

58. *Synopsis of Boiler & Pressure Vessel Laws, Rules, and Regulations by States, Cities, Counties, and Provinces (United States and Canada),* available from Uniform Boiler and Pressure Vessel Laws Society, P. O. Box 1521, Oceanside, New York, NY 11572.

59. Pasquill, F., *Atmospheric Difusion,* Second Edition, John Wiley & Sons, New York, NY, 1947.

60. Slade, D. H., *Metrology and Atomic Energy* NTIS-TID 24190 (1968), National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

61. Wilson, D. J., "Release and Dispersion of Gas from Pipeline Ruptures", Department of Mechanical Engineering, University of Alberta, Edmonton, Canada.

62. Jann, P. R., "Evaluation of Sheltering In Place", *Journal of Loss Prevention in the Process Industry,* Vol. 2, No. 1, Jan. 1989, pp 33-38.

63. MacFarlane, D. R. and Ewing, T. F., "Acute Health Effects From Accidental Releases of High Toxic Hazard Chemicals", *Journal of Loss Prevention in the Process Industry,* Vol. 3, No. 1, January 1990, pp 167-176.

64. Wilson, D. J., "Stay Indoors or Evacuate to Avoid Exposure to Toxic Gas?", *Emergency Preparedness Digest,* Ottawa, Canada, January-March 1987, pp 19-24.

65. Davies, P. C. and Purdy, G., "Toxic Gas Risk Assessments—The Effects of Being Indoors", North Western Branch Papers 1986 No. 1, Institution of Chemical Engineers, Health and Safety Executive, Major Hazards Assessment Unit, St. Annes House, Stanly Precinct, Bootle, Merseyside, England.

66. Glickman, T.S. and Ujrhara, A. M., "Protective Action Decision Making in Toxic Vapor Cloud Emergencies", Center for Risk Management, Resources for the Future, Washington, D. C. 20036.

67. Wilson, D. J., "Variation of Indoor Shelter Effectiveness Caused by Air Leakage Variability of Houses in Canada and the USA", US EPA/FEMA Conference on Effective Use of In-place Sheltering as a Potential Option to Evacuation During Chemical Release Emergencies, Emmitsburg, MD, November 30-December 1, 1988.

2.4 BIBLIOGRAPHY

The following publications contain information related to this subject:

API RP14F *Recommended Practice for Design and Installation of Electrical Systems for Offshore Production Platforms.*

API RP54 *Recommended Practices for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations.*

Recommended Standard for Occupational Exposure to Hydrogen Sulfide, National Institute for Occupational Safety and Health, 125 Baker Drive, Morgantown, WV.

Texas Railroad Commission Rule 36: *Oil, Gas, and Geothermal Resources Operations in Hydrogen Sulfide Areas,* Texas Railroad Commission, Austin, TX.

Public Health Service Publication 999-AP-26, *Workbook on Atmospheric Dispersion Estimates,* D. Bruce Tanner, available from U.S. Department of Health, Education, and Welfare, Cincinnati, OH.

[16] Occupational Safety & Health Administration (U.S. Department of Labor), available from U.S. Government Printing Office, Washington, D.C. 20402.

GPA 2145-85 *Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas*, available from Gas Processors Association, 6526 E. 60th Street, Tulsa, OK 74145.

2.5 ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this publication:

ACC	Acceptable Ceiling Concentration
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CWA	*Clean Water Act*
DC	Direct Current
DOI	U. S. Department of Interior
DOL	U. S. Department of Labor
DOT	U. S. Department of Transportation
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ERPG	*Emergency Response Planning Guide*
FR	*Federal Register*
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	Immediately Dangerous to Life or Health
ISA	Instrument Society of America
LEL	Lower Explosive Limit
LEPC	Local Emergency Planning Committee
MMS	Minerals Management Service
MSDS	Material Safety Data Sheet
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NORM	Naturally Occurring Radioactive Material
NRTL	National Recognized Testing Laboratory
NTIS	National Technical Information Service
OCS	Outer Continental Shelf
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PG	Pasquill-Gifford
RCRA	*Resource Conservation & Recovery Act*
REL	Recommended Exposure Level
RFI	Radio Frequency Interference
ROE	Radius of Exposure
RP	*Recommended Practice*
RQ	Reportable Quantity
SARA	*Superfund Amendments and Reauthorization Act*
SCF	Standard Cubic Foot
SSC	Sulfide Stress Cracking
STEL	Short Term Exposure Level
TLV	Threshold Limit Value
TPQ	Threshold Planning Quantity
WPS	Welding Procedure Specification

3 Definitions

For the purposes of this standard, the following definitions are applicable.

3.1 acceptable ceiling concentration: (ACC). The designated level of an air contaminant to which an employee may be exposed at any time during an 8-hour shift, except for a specified time period and up to a specified concentration not exceeding the "acceptable maximum peak concentration" above the acceptable ceiling concentration for an 8-hour shift. Refer to 29 *CFR* 1910.1000 and Appendix A, Par. A.2.

3.2 breathing zone: A hemisphere forward of the shoulders with a radius of 6 to 9 inches. Refer to OSHA Instruction CPL 2-2.20A, March 30, 1984; amended by CPL 2-20A CH-1, October 29, 1984.

3.3 continuous hydrogen sulfide monitoring equipment: Equipment capable of continuously measuring and displaying the concentration of hydrogen sulfide in ambient air.

3.4 emergency response planning guide—level 2: (ERPG-2). The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective actions. Refer to *Technical Guidance for Hazards Analysis; Emergency Planning for Extremely Hazardous Substances.*

3.5 enclosed facility: A three-dimensional space enclosed by more than two-thirds (2/3) of the possible projected plane surface and of sufficient size to allow the entry of personnel. For a typical building, this would require that more than two-thirds of the walls, ceiling, and floor be present. Refer to *API Recommended Practice 500.*

3.6 essential personnel: Those individuals required to provide proper and prudent safe operations activities and those required to effect control of the hazardous hydrogen sulfide or sulfur dioxide conditions.

3.7 gas detection instrument: An assembly of electrical, mechanical, and chemical components designed to sense and respond continuously to the presence of chemical gases in atmospheric mixtures.

3.8 hydrogen sulfide: Chemical formula is H_2S. A flammable, toxic gas that is heavier than air and sometimes found in fluids encountered in oil and gas producing and gas processing operations. *Inhalation at certain concentrations can lead to injury or death.* Refer to Appendix A.

3.9 immediately dangerous to life and health: (IDLH). An atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. The National Institute for Occupational Safety & Health (NIOSH) considers 300 ppm and 100 ppm to be the IDLH concentrations for hydrogen sulfide and sulfur dioxide, respectively. *API Publication 2217A* specifies an oxygen content of less than 19.5% as oxygen deficient and an oxygen content of less than 16% is considered IDLH.

3.10 inadequately ventilated: Ventilation (natural or artificial) that is *not* sufficient to prevent the accumulation of significant quantities of hydrogen sulfide-air mixtures in excess of 10 ppm.

3.11 length-of-stain detector: A specially designed pump and colorimetric indicator tube detector (length-of-stain), with a supply of detector tubes, that operates by using the pump to pull a known volume of air or gas through a detector tube. The tubes contain chemical reagents that are designed to detect the presence and display the concentration of hydrogen sulfide or sulfur dioxide in the sample. The length of the resultant color band in the tube indicates an instantaneous quantitative concentration of the specific chemical in the sample.

3.12 permissible exposure limit: (PEL). The designated level of any airborne contaminant to which an employee may be exposed. The PEL may be expressed as an eight-hour time weighted average (TWA), a ceiling value, a short term exposure level (STEL), or a skin designation. PELs are subject to change and users should check the latest version of *29 Code of Federal Regulations* Part 1910.1000 for compliance.

3.13 shall: Indicates the "recommended practice(s)" has universal applicability to that specific activity.

3.14 shelter-in-place: The concept of providing the public additional protection by having residents stay indoors until emergency evacuators arrive or the emergency is over. Refer to references *62, 63, 64, 65, 66,* and *67.*

3.15 should: Denotes a "recommended practice(s)" 1) where a safe comparable alternative practice(s) is available; 2) that may be impractical under certain circumstances; or 3) that may be unnecessary under certain circumstances.

3.16 sulfur dioxide: Chemical formula is SO_2. A toxic product of combustion of hydrogen sulfide. This gas is heavier than air. *Inhalation at certain concentrations can lead to injury or death.* Refer to Appendix B.

3.17 threshold limit value: (TLV). The maximum airborne concentration of a substance to which, it is believed that, nearly all workers may be repeatedly exposed day after day without adverse effects, as determined by the responsible committees of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *"Threshold Limit Values and Biological Indices.* "TLV" is a trademarked term of ACGIH. TLVs are subject to change and users should check the latest edition of the forestated reference.

4 Applicability

4.1 PERSONNEL AND EQUIPMENT PROTECTION

In oil and gas producing operations and gas processing plant operations, severity of the environment shall be assessed. As a minimum, the following measures shall be implemented:

a. Personnel protection should be provided if the work area concentration of hydrogen sulfide (refer to Par. 3.8) exceeds 10 ppm eight-hour time weighted average (TWA) or 15 ppm as a short term exposure level (STEL) averaged over 15 minutes (refer to Appendix A); or the work area concentration of sulfur dioxide (refer to Par. 3.16) exceeds 2 ppm as an eight-hour TWA or 5 ppm as a STEL averaged over 15 minutes (refer to Appendix B). Personnel safety provisions of this publication do not apply when:
1. the atmospheric concentration of hydrogen sulfide could not exceed 10 ppm (by volume), or
2. the atmospheric concentration of sulfur dioxide could not exceed 2 ppm (by volume).

b. Equipment and materials shall be selected on the basis of resistance to sulfide stress cracking and corrosion. Refer to Section 8, "Design and Construction Practices", Appendix D, and *NACE Standard MR0175* for recommendations for selection of equipment and materials. The equipment and materials provisions of this publication do not apply when the partial pressure of hydrogen sulfide in the gas could not exceed 0.05 psia or 10 psia in the gas phase of sour crude systems (refer to Appendix D, Par. D.1.1.2).

Some conditions may require extensive personnel safety measures but only the use of conventional equipment and materials; other conditions may require the use of special equipment and materials but only minimal personnel safety measures; still other conditions may require both.

Throughout this publication, "trigger levels" for various actions are used to ensure safety of employees and the public. These trigger levels have been established considering threshold limit values (TLVs—refer to Par. 3.17). These TLVs are subject to change and users should check the latest edition of *Threshold Limit Values and Biological Exposure Indices* and the latest revision of 29 *Code of Federal Regulations* Part 1910.1000, "Toxic and Hazardous Substances", for compliance.

In 1989, the U. S. Department of Labor, Occupational Safety and Health Administration (OSHA) issued updated permissible exposure limits (PELs) for several hundred chemicals, including revised PELs for hydrogen sulfide (10 ppm as an eight-hour TWA or 15 ppm STEL averaged over 15 minutes) and sulfur dioxide [2 ppm as an eight-hour TWA or 5 ppm STEL averaged over 15 minutes (refer to 54 *Federal Register (FR)* 2333, January 19, 1989]. A federal court set aside the OSHA 1989 rule (refer to 58 *Federal Register* 35338, June 30, 1993).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a hydrogen sulfide TLV of 10 ppm (eight-hour TWA) and a STEL of 15 ppm averaged over 15 minutes and recommends 2 ppm as an eight-hour TWA TLV and 5 ppm as a STEL averaged over 15 minutes for sulfur dioxide (refer to *Threshold Limit Values for Chemical Substances and Biological Exposure Indices*).

In the interest of safety and health, this standard recommends use of the ACGIH TLVs (refer to *Threshold Limit Values for Chemical Substances and Biological Exposure Indices 1993-94*) as trigger levels for employee safety (refer to Appendices A and B). Some states have adopted these levels as requirements for personal safety.

Individual employers may set their own trigger levels after review and due consideration of site specific conditions, various regulatory requirements, and material safety data sheet (MSDS) information. Users should check the current status of OSHA PELs, OSHA acceptable ceiling concentrations (ACCs), ACGIH TLVs, and applicable regulatory requirements concerning substances of interest.

4.2 LEGAL REQUIREMENTS

This publication presents recommended practices and precautions deemed pertinent to protect personnel and the public from exposure to potentially hazardous concentrations of hydrogen sulfide and sulfur dioxide. These recommended practices recognize that owners, operators, contractors, and their employees have separate responsibilities that may be contractual in nature. It is not the intent of these recommended practices to alter the contractual relationship(s) between the parties. Some of the practices recommended herein are mandatory by local, state, or federal laws, rules, and regulations. Because of the functional and geographical diversity of these requirements, no attempt has been made in these recommended practices to designate which are optional and which are required. Furthermore, even if all the practices recommended herein are followed, there still may be existing or future legally imposed laws or regulations which would not be met. *In the event of any omission or conflict between these recommended practices and legally required action(s) the requirements of laws and regulations must control.* Some of the federal regulations pertinent to safe production operations involving hydrogen sulfide are listed in Section 2, "References". Users of this publication shall review these regulations and other federal, state, and local laws to assure appropriate compliance in their specific operations.

4.3 HAZARD COMMUNICATION (WORKER RIGHT-TO-KNOW)

This publication contains important information that is intended as a guide but may not comply in all respects with OSHA's Hazard Communication Standard. Appropriate counsel should be sought to assure compliance with hazard communication requirements for the specific operations. Refer to OSHA rules on hazard communication in 29 *Code of Federal Regulations* Part 1910.1200, "Hazard Communication Standard" (52 *Federal Register (FR)* 31877-31886, August 24, 1987).

4.4 *COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT* (CERCLA) AND *SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT* (SARA) TITLE III (EMERGENCY) PLANNING AND COMMUNITY RIGHT-TO-KNOW)

Environmental Protection Agency (EPA) regulations implementing Title III of the *Superfund Amendments and Reauthorization Act of 1986* (SARA Title III) set threshold levels (threshold planning quantities, i.e., TPQs) for emergency planning at a local level. Both SARA Title III and CERCLA set reportable quantities (RQs) for reporting releases to the environment. The TPQ for both hydrogen sulfide and sulfur dioxide is 500 pounds; RQs for release reporting are 100 pounds for hydrogen sulfide and 1 pound for sulfur dioxide. TPQs and RQs (trigger levels) and the regulations requiring response plans and release reports under both SARA Title III and CERCLA are set forth in 40 *Code of Federal Regulations* Part 302, and 40 *Code of Federal Regulations* Part 355. Refer to *API Bulletin E-4* for guidance on release reporting requirements. "Trigger levels" for response plan and release reporting requirements are subject to change and users shall check the latest revisions for compliance. SARA Title III also requires submission of periodic and annual reports of information to state and local officials on the presence of hazardous chemicals at production and gas processing facilities. Those regulations are set forth in 40 *Code of Federal Regulations* Part 370, and API has published suggested generic reporting forms (refer to *API Bulletin E-1*) that are acceptable to EPA. Appropriate guidance should be sought to assure compliance with these programs for the specific operations.

4.5 HAZARDOUS WASTE OPERATIONS AND AND EMERGENCY RESPONSE (HAZWOPER)

OSHA's standard, 29 *Code of Federal Regulations* Part 1910.120, sets requirements for safety and health protection of employees involved in cleanup operations at uncontrolled hazardous waste sites being performed under government mandate; certain hazardous waste treatment, storage, and disposal operations conducted under the *Resource Conservation and Recovery Act* (RCRA); and emergency response to incidents involving hazardous substances. Appropriate guidance should be sought to assure compliance with 29 *Code of Federal Regulations* Part 1910.120 requirements for the specific operations (refer to 54 *Federal Register* 9294-9336, March 6, 1989).

5 Personnel Training

5.1 INTRODUCTION

Operators of oil and gas producing and gas processing operations involving hydrogen sulfide shall alert personnel (including employees, service companies, and contractors) of the possibility of hydrogen sulfide atmospheric concentrations greater than 10 ppm and sulfur dioxide atmospheric concentrations greater than 2 ppm that may be encountered in the performance of their work. All personnel working in an area where concentrations of hydrogen sulfide or sulfur dioxide may exceed the levels stipulated in Par. 4.1.a should be provided with training prior to beginning the work assignment. All employers, whether operator, contractor, or subcontractor, shall be responsible for training and instruction of their own employees. Personnel assigned to work in areas where they may be exposed to hydrogen sulfide or sulfur dioxide shall be trained by a hydrogen sulfide safety instructor, as defined in Par. 5.6.

5.2 MINIMUM TRAINING

The value of training and periodic drills in all oil and gas producing and gas processing plant operations cannot be over emphasized. The uniqueness or complexity of a specific facility or operation will determine the extent of the training (e.g., SARA Title III and HAZWOPER; refer to Pars. 4.4 and 4.5) deemed necessary for the assigned personnel. However, the following elements are considered a minimum level of training for regularly assigned personnel:

a. The hazards, characteristics, and properties of hydrogen sulfide and sulfur dioxide (refer to Appendices A and B).
b. Sources of hydrogen sulfide and sulfur dioxide.
c. Proper use of hydrogen sulfide and sulfur dioxide detection methods used at the workplace.
d. Recognition of and proper response to the warning signals for hydrogen sulfide and sulfur dioxide detection systems used at the workplace.
e. Symptoms of hydrogen sulfide exposure (refer to Appendix A); symptoms of sulfur dioxide exposure (refer to Appendix B).
f. Rescue techniques and first aid to victims of hydrogen sulfide and sulfur dioxide exposure.
g. Proper use and maintenance of breathing equipment for working in a hydrogen sulfide and sulfur dioxide atmosphere (theory and hands-on practice, with demonstrated proficiency). Refer to 29 *Code of Federal Regulations* Part 1910.134.
h. Workplace practices and relevant maintenance procedures that have been established to protect personnel from the hazards of hydrogen sulfide and sulfur dioxide.
i. Wind direction awareness and routes of egress (refer to Par. 6.7).
j. Confined space and enclosed facility entry procedures (if applicable).
k. Emergency response procedures that have been established for the facility. Refer to Section 7, "Contingency Planning Including Emergency Procedures".
l. Locations and use of safety equipment.
m. Locations of emergency assembly areas, if so designated.

5.3 ADDITIONAL TRAINING FOR ONSITE SUPERVISORY PERSONNEL

Those personnel assigned supervising responsibilities at the site shall have additional training in the following elements:

a. Supervisor responsibilities of the contingency plan (refer to Section 7).
b. Effects of hydrogen sulfide on components of the hydrogen sulfide handling system (i.e., corrosion, embrittlement, etc.).

5.4 REFRESHER TRAINING

A formal recurring training program shall be implemented to maintain proficiency in the elements listed in Pars. 5.2 and 5.3, as appropriate.

5.5 TRAINING VISITORS AND OTHER NON-REGULARLY ASSIGNED PERSONNEL

Prior to entering a potentially hazardous area, visitors and other non-regularly assigned personnel shall be briefed on route(s) of egress, emergency assembly area(s), applicable warning signals, and how to respond in the event of an emergency, including use of personal protective equipment, if required. These personnel may be allowed in potentially hazardous areas only in the presence of trained personnel, after being briefed on emergency action and evacuation procedures. In the event of an emergency, these personnel shall be immediately evacuated or immediately supplied with proper personal protective equipment.

5.6 HYDROGEN SULFIDE SAFETY INSTRUCTORS

Hydrogen sulfide safety instructors are persons who have successfully completed a course in hydrogen sulfide instructor training from an institution or organization offering such courses, or have received equivalent instruction from a company-designated hydrogen sulfide safety instructor/trainer, or have had equivalent instructor/trainer experience. A recurring training program shall be implemented to maintain proficiency of the hydrogen sulfide safety instructor.

5.7 SAFETY REVIEW

Before any persons unfamiliar with the job site enter the location, they shall, as a minimum, be briefed on emergency evacuation procedures.

5.8 SUPPLEMENTAL TRAINING

Training should be a continuing educational program for personnel (including personnel engaged in maintenance and repair work) whose work may involve exposure to hydrogen sulfide or sulfur dioxide. Effective ongoing training will ensure that personnel have current knowledge of potential job hazards, procedures for dealing with confined space entry, procedures for enclosed facilities work, relevant maintenance procedures, and cleanup methods. Depending on the nature of the programs, certain appropriate training aids may be very useful. These aids may include, but are not limited to, films, manuals, and industry publications or documents (refer to Section 2 "References"). Guest speakers, demonstrations, and consultants are also recommended.

5.9 RECORDS

Dates, instructors, attendees, and subjects for all personnel training sessions shall be documented and appropriate records should be retained for a minimum of one year.

5.10 OTHER PERSONNEL CONSIDERATIONS

5.10.1 Enclosed Facilities and Confined Space Entry

Refer to 29 *Code of Federal Regulations* Part 1910.146 for OSHA's confined space entry regulations. Refer to Section 12, "Operations Involving Enclosed Facilities", for some topics that may be used in training personnel for enclosed facilities work. Refer to Pars. 9.17 and 9.18 for further precautionary information on entry into confined spaces (including vessels) and enclosed facilities.

5.10.2 Respiratory Problems

Personnel with known physiological or psychological conditions which impair normal respiration shall not be assigned to jobs involving potential exposure to a hydrogen sulfide or sulfur dioxide environment if use of the breathing equipment or exposure will complicate their respiratory problems. Refer to OSHA's Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134).

Note: Personnel assigned job-related tasks requiring routine use of breathing equipment shall have a periodic review to determine their physiological and psychological adequacy for use of this equipment (refer to 29 *Code of Federal Regulations* Part 1910.134 and *ANSI Z88.2*.

5.10.3 Perforated Eardrums

There are differences of opinion[17] in the medical community about whether a person with a perforated eardrum can become overexposed to a toxic substance via the ear even when wearing properly functioning breathing apparatus (refer to Par. 6.4). Refer to Appendix A.

6 Personnel Protective Equipment

6.1 INTRODUCTION

Section 6 discusses some personnel protective equipment that can be used in oil and gas well producing and gas processing plant operations where the work atmosphere concentration of hydrogen sulfide could exceed 10 ppm or sulfur dioxide atmospheric concentration could exceed 2 ppm (refer to Par. 4.1 and Appendices A and B). Having personnel protective equipment available is not enough; training personnel in the selection, use, inspection, and maintenance of the equipment is essential.

6.2 STATIONARY HYDROGEN SULFIDE MONITORING SYSTEMS

Stationary hydrogen sulfide atmospheric monitoring systems used in oil and gas producing and gas processing plant operations shall include visual or audible alarm(s), located where the alarm can be seen or heard throughout the work area. The batteries of direct current (DC) systems should be checked daily during operation unless an automatic low voltage alarm is provided. Instrument Society of America publications, *ISA-S12.15*, Part I, and *ISA-RP12.15*, Part II, contain equipment performance requirements and

[17]Note: Compare Poda, George A., "Hydrogen Sulfide Can Be Handled Safely"[55], *Archives of Environmental Health*, Vol. 112, 795-800, June 1966, and Ronk, Richard and White, M. K., "Hydrogen Sulfide and the Probabilities of Inhalation Through a Tympanic Membrane Defect"[56], *Journal of Occupational Medicine*, Vol. 25, No. 5, 337-340, May 1985.

recommendations for installation, operation, and maintenance of hydrogen sulfide monitoring and detection instruments, respectively. Refer to Section 10 for additional details regarding evaluation and selection of hydrogen sulfide monitoring equipment.

6.3 PORTABLE DETECTION EQUIPMENT

If the atmospheric concentration of hydrogen sulfide could reach or exceed those levels stipulated in Par. 6.1, portable hydrogen sulfide detection instruments[18] shall be available. Refer to Section 10 for details regarding evaluation, selection, maintenance, and use of hydrogen sulfide detection equipment. In those instances where the hydrogen sulfide atmospheric concentration may exceed the measurement range of the detection instruments in use, a pump and colorimetric indicator tube detector[19] (length-of-stain), with a supply of detector tubes, shall be available to take instantaneous "grab" samples to determine hydrogen sulfide concentrations in enclosed facilities, storage tanks, vessels, etc.

If sulfur dioxide levels could reach or exceed those stipulated in Par. 6.1 (e.g., during flaring or other operations producing sulfur dioxide), either portable sulfur dioxide detection instruments or length-of-stain detectors, with a supply of detector tubes, shall be available for determining the sulfur dioxide concentration in the area and to monitor areas impacted by sulfur dioxide gas when fluids containing hydrogen sulfide are burned. Personnel shall wear appropriate personal breathing equipment (refer to Par. 6.4) unless it is established that the work area atmosphere is safe.

6.4 BREATHING (RESPIRATORY PROTECTION) EQUIPMENT

Site specific contingency plans shall be prepared to specify the quantity and location of breathing equipment to be available. Respirators shall meet the requirements of OSHA's Respiratory Protection Standard (refer to 29 *Code of Federal Regulations* Part 1910.134) and be approved under procedures outlined in *ANSI Z88.2*. All breathing air cylinders shall meet U.S. Department of Transportation (DOT) or other appropriate regulatory requirements (refer to 30 *Code of Federal Regulations*, Part 1910.134, Chapter 1, Subchapter B, Part II, Subpart H, Par. 11.80 and 49 *Code of Federal Regulations* Part 178, Subpart C). The following types of breathing equipment with full face piece meet these requirements and should be used where the work area atmospheric concentration exceeds 10 ppm for hydrogen sulfide or 2 ppm for sulfur dioxide:

a. Self-contained, positive-pressure/pressure-demand breathing equipment that provides respiratory protection in any atmospheric concentration of hydrogen sulfide or sulfur dioxide.

b. Positive-pressure/pressure-demand air-line breathing equipment coupled with a self-contained breathing apparatus equipped with a low pressure warning alarm and rated for fifteen minutes (minimum). This equipment permits the wearer to move from one work area to another.

c. Positive-pressure/pressure-demand, air-line breathing equipment, with an auxiliary self-contained air supply (rated for a minimum of 5 minutes). This type unit can be used for entry as long as the air line is connected to a source of breathing air. *The auxiliary self-contained air supply (rated for less than 15 minutes) is suitable only for escape or self-rescue use.*

Notes:

1. Personnel assigned job-related tasks requiring routine use of breathing equipment shall have a periodic review to determine their physiological and psychological adequacy for use of this equipment (refer to *ANSI Z 88.2* and 29 *Code of Federal Regulations* Part 1910.134).
2. Positive-pressure/pressure-demand, air-line or self-contained breathing apparatus, as appropriate, with full face piece shall be worn by personnel exposed to atmospheres containing concentrations of hydrogen sulfide or sulfur dioxide above OSHA's ACCs and PELs for air contaminants (refer to 29 *Code of Federal Regulations* Part 1910.1000.

CAUTION: Gas mask canister type breathing and demand type (negative pressure) equipment shall not be used in oil and gas producing and gas processing plant operations when a hydrogen sulfide or sulfur dioxide environment could be encountered.

6.4.1 Storage and Maintenance

Personal breathing equipment shall be strategically located so that this equipment is quickly and easily available to essential personnel. Essential personnel are those required to provide proper and prudent safe operations activities and those required to effect control of the hazardous hydrogen sulfide or sulfur dioxide conditions (refer to Par. 7.5). Additional breathing equipment may be required by site specific contingency plans (refer to Section 7). Breathing equipment shall be maintained and stored in a convenient, clean, and sanitary location, in accordance with OSHA's Respiratory Protection Standard (refer to 29 *Code of Federal Regulations* Part 1910.134). All breathing equipment shall be checked before and after each use and inspected at least monthly to ensure that it is maintained in satisfactory condition. A record of the monthly inspections, including dates and findings, shall be retained [refer to 29 *Code of Federal Regulations* 1910.134(f)]. These records should be retained for a minimum of twelve (12) months and longer if dictated by company policy. Equipment needing repair shall be appro-

[18]A gas detection instrument is an assembly of electricl, mechanical, and chemical components designed to sense and respond continuously to the presence of chemical gases (hydrogen sulfide or sulfur dioxide) in atmospheric mixtures.

[19]A pump and colorimetric indicator tube detector (length-of-stain), with a supply of detector tubes, is an assembly of specially designed pump and detector tubes that operates by using the pump to pull a known volume of air or gas through a detector tube. The tubes contain chemical reagents that are designed to detect the presence and display the concentration of hydrogen sulfide or sulfur dioxide in the sample. The length of the resultant color band in the tube indicates an instantaneous quantitative concentration of the specific chemical in the sample.

priately tagged and removed from equipment stock until it is suitably repaired or replaced. Proper storage, maintenance, handling, and inspection is essential to the integrity of personal breathing equipment. Personnel with assigned breathing equipment should be instructed in proper maintenance of this equipment, or other steps shall be taken to ensure its integrity. NIOSH, OSHA, and manufacturer's recommendations shall be followed.

6.4.2 Face Piece Restrictions

Full face piece breathing equipment meeting requirements of Par. 6.4 should be used where the work area atmosphere concentration exceeds 10 ppm for hydrogen sulfide or 2 ppm for sulfur dioxide. Personnel shall not wear eyeglasses with temple bars that extend through the sealing edge of the face piece. Using approved adapters, corrective prescription lenses may be mounted inside the breathing apparatus face piece.

As of this writing, U. S. Department of Labor (OSHA) does not permit wearing contacts when using respirator breathing equipment [refer to 29 *Code of Federal Regulations* Part 1910.134(e)(5)(ii)]. OSHA has investigated the prohibition of contact lenses used under respirator breathing equipment and issued a field memorandum (February 8, 1989, Thomas Shepich, Director, Directorate of Compliance Programs) stating their intent to modify the rule and issuing an interim enforcement policy as follows:

a. Violations of the Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134) involving the use of gas permeable and soft contact lenses shall continue to be documented in the case file and recorded as de minimis; citations shall not be issued.

b. Evidence indicating any negative effect(s) associated with the use of contact lenses with respirator breathing equipment should be provided to U. S. Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), Directorate for Compliance Programs, Washington, D. C. 20210. Benefits associated with the use of contact lenses with respirator breathing equipment would be useful to OSHA. The issue of use of non-gas-permeable hard contact lenses will be resolved in OSHA's revision of 29 *Code of Federal Regulations* Part 1910.134.

Note: Companies should review available information and provide employee guidance regarding the use of contact lenses under respirator breathing equipment.

Personnel shall not wear facial hair that may prevent proper sealing of the face mask. Personnel shall be satisfied that a face seal can be obtained with the assigned equipment or randomly selected unassigned equipment before they use the equipment. If a seal cannot be obtained, either satisfactory equipment must be provided or the individual shall be disqualified from working in areas where hazardous conditions are anticipated or existent.

6.4.3 Air Supply

Breathing air quality shall meet requirements set forth in OSHA's Respiratory Protection Standard, 29 *Code of Federal Regulations* Part 1910.134, and shall at least meet Grade D requirements as described in *ANSI CGA G-7.1.*

6.4.4 Compressors

All breathing air compressors used shall meet the requirements set forth in 29 *Code of Federal Regulations* Part 1910.134 of OSHA's Respiratory Protection Standard. The air intake for such compressors must be located in a contaminant-free area that is unclassified by *API RP500,* Section B. Inlet air for such compressors shall be monitored when conditions arise which permit possible contamination of the inlet air by toxic, flammable, or combustible gases.

6.4.5 Breathing Equipment Use

Personnel shall use breathing equipment prior to entering an area where OSHA ACCs and PELs for hydrogen sulfide and sulfur dioxide, respectively, are exceeded (refer to Par. 4.1, Appendices A and B, and 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z.1) until either the area is made or tested safe or they return to a safe area. *Breathing equipment shall be put on in a safe area prior to either beginning a rescue operation or entering a hazardous environment.*

6.5 STANDBY RESCUE PERSONNEL

When personnel work in locations with hydrogen sulfide or sulfur dioxide concentrations considered immediately dangerous to life or health (IDLH) (refer to Appendices A and B) in the working breathing zone, a standby rescue person trained in rescue techniques and with suitable rescue equipment, including appropriate breathing apparatus (refer to Par. 6.4), shall be provided.

6.6 RESCUE EQUIPMENT

At locations with hydrogen sulfide, sulfur dioxide, or oxygen concentration considered immediately dangerous to life or health (IDLH), suitable rescue equipment [for example, appropriate breathing equipment, lifeline(s), and harness(es)] shall be provided. Types of rescue equipment required will vary and will depend on the type of job and work being performed. Appropriate counsel with qualified health and safety professional personnel should be effected to determine what rescue equipment should be available for site-specific job and work conditions.

6.7 WIND DIRECTION INDICATORS

Consideration should be given to locating windsocks, streamers, flags, or other suitable devices for indicating wind direction at the producing or gas processing site. These devices shall be readily visible to personnel on or approaching the work location.

Note: Regulatory requirements for wind direction indicators shall be observed.

6.8 WARNING SIGNS

Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS—ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION EQUIPMENT MUST BE WORN BEYOND THIS POINT," should be prominently posted at appropriate locations (e.g., entrance points) for facilities where produced fluids containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being processed or handled.

Note: Regulatory requirements for sign posting shall be observed.

7 Contingency Planning Including Emergency Procedures

7.1 INTRODUCTION

Operators shall evaluate existing and new operations involving hydrogen sulfide and sulfur dioxide to determine if contingency plans, special emergency procedures, and/or training are required. The evaluation process shall identify potential emergencies and their impact on operating personnel and the general public. The contingency plan, if required, shall conform to all applicable local, state, and federal regulations regarding notifications, precautions, evacuations, and other requirements (refer to 40 *Code of Federal Regulations* Part 264, Subpart D; 29 *Code of Federal Regulations* Part 1910.120; and 29 *Code of Federal Regulations* Part 1910.38 for EPA and OSHA requirements, respectively, for contingency plans and emergency procedures).

7.2 SCOPE

The contingency plan should contain emergency response procedures that provide an organized immediate action plan for alerting and protecting operating personnel and the public. Contingency plans should be site specific for the facility operations and should consider the severity and extent of the anticipated atmospheric hydrogen sulfide and sulfur dioxide concentrations. Contingency plans should consider the dispersion characteristics of hydrogen sulfide and sulfur dioxide (refer to Appendix C or other recognized dispersion modelling techniques). Contingency plans should contain provisions for all applicable items listed in this section. (Refer to *Hazardous Materials Emergency Planning Guide, NRT-1*, and *Technical Guidance For Hazards Analysis*. In addition to the contingency plan, Sections 302 and 303 of the *Superfund Amendments and Reauthorization Act of 1986* (SARA Title III) can require a facility operator to name a facility emergency coordinator to work with a local emergency planning committee (LEPC) in the development of an emergency response plan (refer to 40 *Code of Federal Regulations* Part 355).

7.3 AVAILABILITY OF PLAN

The contingency plan shall be available to all personnel responsible for implementation, regardless of their normal location assignment.

7.4 PLAN INFORMATION

Contingency plans should contain, but not be limited to, information on the following subjects, as appropriate:

a. Emergency Procedures:
   1. Responsibilities of personnel (refer to Par. 7.5).
   2. Immediate action plan (refer to Par. 7.6).
   3. Telephone numbers and communication methods (refer to Par. 7.7).
   4. Locations of nearby residences, businesses, parks, schools, churches, roads, medical facilities, etc.
   5. Evacuation routes and road block locations.
   6. Safety equipment and supplies available (e.g., number and location of breathing equipment).

b. Characteristics of Hydrogen Sulfide and Sulfur Dioxide:
   1. Refer to Appendix A for hydrogen sulfide characteristics.
   2. Refer to Appendix B for sulfur dioxide characteristics.

c. Facility Description, Maps, and Drawings:
   1. Plants.
   2. Water injection stations.
   3. Wells, tank batteries, gas conditioning facilities, flowlines.
   4. Compression facilities.

d. Training and Drills (refer to Par. 7.8):
   1. Responsibilities and duties of essential personnel.
   2. On-site or classroom (tabletop) drills.
   3. Informing nearby residents on protective measures in emergency situations, as appropriate.
   4. Training and attendance documentation.
   5. Briefing of public officials on issues such as evacuation or *shelter-in-place*[20] plans.

7.5 RESPONSIBILITIES OF PERSONNEL

The contingency plan shall outline responsibilities and duties of all essential personnel. Visitors and other non-essential personnel should be prohibited from remaining in or entering an area contaminated by hydrogen sulfide exceeding an atmospheric concentration of 10 ppm or a concentra-

[20]Shelter-in-place refers to the concept of providing the public additional protection by having residents stay indoors until emergency evacuators arrive or the emergency is over (refer to References *62, 63, 64, 65, 66,* and *67*).

tion of sulfur dioxide exceeding 2 ppm in the atmosphere (refer to Par. 4.1 and Appendices A and B).

7.6 IMMEDIATE ACTION PLAN

Each contingency plan should contain a condensed "Immediate Action Plan" to be followed by designated personnel any time they receive notice of a potentially hazardous hydrogen sulfide or sulfur dioxide discharge. For the protection of personnel (including the general public) and abatement of the discharge, this "Immediate Action Plan" should include, but not be limited to, the following provisions:

a. Alert and account for facility personnel.
 1. Move away from the hydrogen sulfide or sulfur dioxide source and get out of the affected area.
 2. Don proper personal breathing equipment.
 3. Alert other affected personnel.
 4. Assist personnel in distress.
 5. Proceed to the designated emergency assembly area.
 6. Account for on-site personnel.

b. Take immediate measures to control the present or potential hydrogen sulfide or sulfur dioxide discharge and to eliminate possible ignition sources. Emergency shutdown procedures should be initiated as deemed necessary to correct or control the specific situation. When the required action cannot be accomplished in time to prevent exposing operating personnel or the public to hazardous concentrations of hydrogen sulfide or sulfur dioxide, proceed to the following steps, as appropriate for the site specific conditions.

c. Alert the public (directly or through appropriate government agencies) that may be subjected to an atmosphere exposure exceeding 30 ppm[21] of hydrogen sulfide or 10[21] ppm of sulfur dioxide.

d. Initiate evacuation operations.

e. Contact the first available designated supervisor on the call list (refer to Par. 7.4.a). Notify the supervisor of circumstances and whether or not immediate assistance is needed. The supervisor should notify (or arrange for notification of) other supervisors and other appropriate personnel (including public officials) on the call list.

f. Make recommendations to public officials regarding blocking unauthorized access to the unsafe area and assist as appropriate.

g. Make recommendations to public officials regarding evacuating the public and assist as appropriate.

h. Notify, as required, state and local officials and the National Response Center to comply with release reporting requirements (i.e., 40 *Code of Federal Regulations Parts* 302 and 355) (refer to Par. 4.4).

i. Monitor the ambient air in the area of exposure (after following abatement measures) to determine when it is safe for re-entry.

Note: This sequence (Par. 7.6) should be altered to fit the prevailing situation. Certain actions, especially those dealing with the public, should be coordinated with public officials.

7.7 EMERGENCY TELEPHONE LISTS

A list of emergency telephone numbers should be prepared and maintained as a part of the contingency plan, considering the need to contact any of the following:

a. Emergency Services
 1. Ambulances
 2. Hospitals
 3. Medical personnel (e.g., doctors)
 4. Helicopter services
 5. Veterinarians

b. Government Agencies and Contacts
 1. Local Emergency Planning Committee
 2. National Response Center
 3. State Emergency Response Commission
 4. State and Local Law Enforcement Agencies
 5. Civil Defense
 6. Fire Departments
 7. Other applicable government agencies.

c. Operator and Contractors
 1. Operator personnel
 2. Contractor personnel
 3. Applicable service companies

d. Public

7.8 TRAINING AND DRILLS

The value of training and drills in emergency response procedures for oil and gas operations involving hydrogen sulfide or sulfur dioxide cannot be over emphasized. All personnel identified in the plan shall have appropriate training. It is important that the training conveys a full appreciation of the importance of each role and the effect that each person has on implementing an effective emergency response.

Exercises or drills that simulate an emergency in which personnel perform or demonstrate their duties are important tools that can convey the importance of contingency plans and result in their being kept current. The exercise can be a tabletop or classroom discussion; or can be a realistic drill in which equipment is deployed, communication equipment is tested, and "victims" are sent to hospital facilities with simulated injuries. Public officials should be informed of (and preferably involved in) these exercises. After a plan is tested, it should be revised and retested until those responsible for the plan are confident the plan is operational. Refer to *NRT-1: Hazardous Materials Emergency Planning Guide.*

[21]Emergency Response Planning Guide Level 2 (ERPG-2), refer to Reference 27. ERPG-2 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

7.9 UPDATING PROVISIONS

A contingency plan shall be periodically reviewed and updated any time its provisions or coverage change (refer to Par. 9.24).

8 Design and Construction Practices

8.1 DESIGN GUIDELINES

Recommendations presented in Section 8 apply to producing and gas processing plant operations where the fluids handled contain sufficient hydrogen sulfide to be within the scope of *NACE Standard MR0175. NACE Standard MR0175* may also be a useful reference when designing and constructing other facilities handling hydrogen sulfide. Refer to Appendix D for information on defining a sour environment. All pressure vessels should be designed and constructed in accordance with *ASME Boiler and Pressure Vessel Code* [refer to *Synopsis of Boiler and Pressure Vessel Laws, Rules, and Regulations by States, Cities, Counties, and Provinces (United States and Canada)*]. All piping systems should be designed and constructed in accordance with applicable provisions of *ANSI B31.3, ANSI B31.4*, OR *ANSI B31.8.*

Manufactured equipment shall be designed, constructed, tested, and approved to meet or exceed system requirements for hydrogen sulfide service and should be installed in compliance with applicable codes and industry-accepted standards.

8.1.1 Process and Mechanical Considerations

Factors to be considered in facility design include, but are not limited to, the hydrogen sulfide concentration and impact of atmospheric and operating temperatures, system pressures, pH and water content of system fluids, mechanical stresses imposed on system components, operating and physical strength changes of system components resulting from corrosion and scale deposits, and conditions peculiar to individual processes that could be of a detrimental nature to the system.

8.1.2 Design Considerations

To minimize internal corrosion, piping and vessels should be designed and installed in such a way that areas of insufficient flow (including dead-end piping) are eliminated. Where this cannot be accomplished, provisions should be made for draining of accumulated fluids. Drain systems for hydrogen sulfide laden fluids should be designed to prevent migration of hydrogen sulfide from one point in the facility to another.

8.1.3 Materials Considerations

When exposed to an environment containing hydrogen sulfide, many materials may suddenly fail in a brittle manner. Failure occurs by a form of embrittlement known as sulfide stress cracking (SSC). Susceptibility of a given material to sulfide stress cracking increases as strength and tensile stress (residual or applied) increase. Material hardness frequently is used as an indirect measure of strength and sometimes is referenced as a limiting parameter. The failure of certain producing and gas processing plant equipment components used in the sulfide stress cracking regime could result in the uncontrolled release of hydrogen sulfide to the atmosphere. Such components should be made from sulfide stress cracking resistant materials (refer to Par. 8.1.4).

8.1.4 Materials Selection

Metallic materials satisfactory for use in hydrogen sulfide environments and the conditions under which they should be used are described in *NACE Standard MR0175.* The latest revision of this standard should be consulted when selecting materials for use in hydrogen sulfide environments. The provisions of *NACE Standard MR0175* should be considered minimum standards, with the equipment user free to apply more stringent specifications. The material requirements of *NACE Standard MR0175* offer resistance to sulfide stress cracking (SSC); however, other forms of corrosion and modes of failure (such as pitting, hydrogen-induced cracking, and chloride cracking) should be considered in the design and operation of equipment. Control of failures by mechanisms other than SSC should be mitigated by chemical inhibition, material selection, and environmental controls (refer to *NACE Standard MR0175*, Par. 1.1). Appendix D includes excerpts from *NACE Standard MR0175*, providing the definition of a sour environment and graphs that may be used to determine when sulfide stress cracking resistant materials should be used. Users of this publication should check the latest edition of *NACE Standard MR0175* for revisions to the defining criteria for a sour environment.

8.1.4.1 Manufacturer certification of compliance with *NACE Standard MR0175* for equipment intended for hydrogen sulfide service may be required by the user, depending on severity of the service. Adequate quality assurance procedures should be followed to verify compliance by the manufacturer for the original equipment and for any subsequent equipment modifications.

8.1.4.2 Materials not covered in *NACE Standard MR0175* that have been qualified for hydrogen sulfide environment service by the user or manufacturer, using recognized and acceptable testing procedures, may be used. A written agreement between the manufacturer and user may be appropriate. Recognized and acceptable testing procedures are those that demonstrate that the material(s) performs as well as or superior to similar material(s) set forth in *NACE Standard MR0175*, using laboratory procedures or procedures for which testing has been completed under actual or simulated environmental conditions. The suitability of materials must be supported by appropriate documentation that should include a complete description of the materials, processing, and testing procedure. Laboratory, field, or other environmental testing results or service performance should be recorded in writing. Full documentation supporting the suitability of the material(s) for the selected service should be maintained by the user, manufacturer, or both. Materials use is subject to compliance with applicable regulations.

8.1.5 Site Selection

In selecting a facility site, consideration should be given to taking advantage of the prevailing wind direction, climatic conditions, terrain, transportation routes, and the proximity of populated or public areas. Site selection should consider maintenance of clear entrance and exit routes and should minimize existence of confined spaces. Applicable regulatory requirements concerning location, spacing, and height of flares or vent stacks shall be considered in site selection.

8.1.6 Warning Method

Facility design should incorporate a means to provide a warning of a hazardous upset or condition. Devices and equipment such as hydrogen sulfide monitoring equipment, hazardous warning equipment (audible or visual), and process monitoring devices (such as pressure and flow rate sensors) should be considered. The operator should specify, and the design should consider, the physical and environmental conditions that will be present at the installation site.

8.2 CONSTRUCTION GUIDELINES

Construction of facilities within the scope described in Paragraph 8.1 should be conducted in accordance with the following recommendations, as applicable.

8.2.1 Fabrication and Joining System Components

Welding rods of proper composition and size, applied at recommended temperature and rate, should be used to join pipe and system components by welding. Preheating, postheating, stress relieving, and hardness control requirements should be in accordance with a welding procedure specification (WPS). Proper bolting and gasket materials should be selected in accordance with *NACE Standard MR0175*. Proper alignment should be maintained for all piping, and all system components should be adequately supported to reduce stresses.

8.2.2 Qualification of Personnel

Fabrication of system components and joining of pipe should be done by experienced and qualified workers. Piping system welders should have passed a performance qualification test in accordance with Section IX, *ASME Boiler and Pressure Vessel Code* or *API Standard 1104*. Qualification under *API Standard 1104* will satisfy U. S. Department of Transportation (DOT) requirements for pipelines. Welders shall be permitted only to weld on materials, and to use only procedures, for which they are currently qualified.

8.2.3 Handling and Storage of Equipment

Materials and equipment used in facility construction, reconstruction, repair, or in routine maintenance should be stored and handled in a manner that will not jeopardize their integrity. Where equipment storage is required or where use after installation is delayed, adequate precautionary measures against corrosion, fouling, deterioration, and other harmful effects should be employed. Reliable warehouse control methods shall be employed to assure that material and equipment unsuitable for hydrogen sulfide service is not inadvertently used in hydrogen sulfide service.

8.2.4 Inspection

Pressure-containing components should be thoroughly cleaned and pressure tested in accordance with applicable construction codes. Welded connections should be tested by non-destructive tests (such as ultrasonic or radiographic methods). Final facility inspection should be conducted by knowledgeable personnel to determine that the completed facility complies with design specifications and material records and that markings indicate materials used are suitable for the intended service. Refer to *API 510* and *API Recommended Practice 12R1*.

8.2.5 Repairs

Equipment or systems damaged or worn to the extent that their safety and reliability are doubtful shall not be placed or retained in service. Vessel, piping, and equipment repairs shall be made by qualified and, where required, certified personnel in accordance with applicable codes and good work practices. Only compatible materials, suitable for use in the existing hydrogen sulfide environment shall be used to repair or replace equipment for use in this service. Refer to *API 510*.

8.3 ELECTRICAL DESIGN CONSIDERATIONS

In addition to being toxic, hydrogen sulfide is flammable at concentrations of 4.3 to 46 percent (by volume) in air. Electrical equipment installed in areas subject to exposure to a methane-hydrogen sulfide mixture composed of 25% or more (by volume) of hydrogen sulfide should be suitable for Class I, Group C classified areas (refer to Par. 3.5, "National Electric Code Grouping of Atmospheric Mixtures," in *API Recommended Practice 500*).

9 Operating Practices

9.1 INTRODUCTION

Section 9 discusses operating practices that should be followed to provide integrity of equipment and continuity of work practices in operations involving the design and handling of materials in hydrogen sulfide service (refer to Par. 4.1 and applicable regulatory requirements). Each equipment installation or work procedure should be reviewed and observed as often as necessary to detect when changes may be needed in operating practices or equipment. *Water injection and other enhanced recovery operations may result in the introduction of bacteria that can cause water soluble hydrogen sulfide to develop over time and be present in produced fluids.*

9.2 EMERGENCY PROCEDURES

Emergency operating and shutdown procedures shall be posted or readily available to operating personnel.

9.3 TEST PROCEDURES

Tests of the gas phase of produced fluids shall be conducted periodically to determine the hydrogen sulfide concentration. Procedures should be established and routine operational tests should be conducted periodically for hydrogen sulfide detection and monitoring equipment and alarm devices, forced air ventilation systems, and similar safety devices. Results of these tests should be recorded.

9.4 SAFE WORK PRACTICES

Safe operating procedures should be developed for performing operations and maintenance (e.g., tank gauging, water line blowdown, line repair, valve replacement, and sampling) so hazards due to the release of hydrogen sulfide can be avoided. A safety review of the work should be performed prior to beginning any maintenance or operating work activities requiring personnel to be in areas that could contain concentrations of hydrogen sulfide or sulfur dioxide exceeding the levels stipulated in Par. 4.1. Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS—ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION MUST BE WORN BEYOND THIS POINT", should be prominently posted in the area where produced fluids containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being handled or processed.

Note: Regulatory requirements for sign posting shall be observed.

9.5 LEAK DETECTION

In produced fluids handling systems containing hydrogen sulfide in concentrations capable of causing atmosphere concentrations in excess of 10 ppm, monitoring techniques or procedures (for example, visual observation, soap bubble test, portable detection equipment, fixed monitoring equipment) should be employed to detect leaks. Particular attention should be given to enclosed facilities (refer to Section 12).

9.6 SAFE WORK PERMITS

For activities without previously established operating procedures, special safety review documentation (e.g., hot work permits and check-off lists) outlining specific safety precautions with specific authorization should be used. Documentation should include personnel protective equipment required; equipment that should be properly blinded, blanked, or disconnected; equipment and piping that should be properly vented; procedures for excavation of buried lines in processing areas; etc.

9.7 VALVES, CONNECTIONS, AND GAUGES

Valves, flanges, gauges, connections, and other components should be observed for evidence of needed inspection, repair, or maintenance. The cause of equipment failure should be investigated and determined. If failure is caused by exposure to hydrogen sulfide, alternate methods or equipment should be considered.

9.8 ARTIFICIAL LIFT WELLS

Artificial lift wells should be observed for any change in operating conditions that could cause leaks or failures. Significant changes in wellhead pressure, gas-oil-water ratios, flow rates, and similar parameters should be evaluated to prevent leaks or failures.

9.9 FLOWING WELLS

Annuli of flowing wells should be tested at regular intervals for any pressure changes. Such pressure changes may indicate a downhole failure of the packer, tubing, or casing. Changes in fluid volumes or ratios, fluid corrosiveness, and surface pressures should be evaluated to determine the need for corrective measures.

9.10 FLOW/GATHERING LINES

Flow line and gathering line right-of-ways should be observed for conditions conducive to pipeline failures, such as those caused by excavation, construction, trespassing, or surface erosion.

9.11 PRESSURE VESSELS

Relief valves and other applicable components on pressure vessels shall be tested according to regulatory requirements or company policy. Refer to *API 510* and *API*

Recommended Practice 576.

9.12 PRESSURE RELIEF AND NORMALLY VENTING DEVICES

The discharge of pressure relief and normally venting devices should be located away from work areas and designed to maximize dispersion and minimize personnel exposure to hydrogen sulfide. Refer to Par. 8.1.4 for considerations for materials applications in hydrogen sulfide service.

9.13 STORAGE TANKS

Produced liquids storage tanks should be observed for needed repairs or maintenance. The tank thief hatch seals, inspection and clean-out plate seals, vent line back-pressure valves, etc., should be serviced or replaced as appropriate. Refer to *API Recommended Practice 12R1.*

9.14 FLARE SYSTEMS

Ignition devices for flare systems handling hydrogen sulfide in hazardous concentrations should be inspected and serviced regularly to ensure proper operation.

9.15 MONITORING EQUIPMENT—MAINTENANCE, TESTING, AND CALIBRATION

Monitoring equipment used to detect occupational exposure levels of hydrogen sulfide shall be serviced and tested at intervals recommended by the manufacturer, and possibly more frequently under extreme humidity, temperature, dust, or other adverse environmental operating conditions. The monitoring equipment should be calibrated by qualified individuals at intervals frequent enough to enable the user to determine an acceptable calibration schedule. The equipment should be calibrated once every three (3) months, at intervals not exceeding 100 days. Refer to *ISA Recommended Practice 12.15,* the equipment manufacturer's instruction manual, and Section 10.

9.16 CORROSION MONITORING

A corrosion monitoring program should be established to detect and mitigate internal and external corrosion activity that can affect equipment in hydrogen sulfide service.

9.17 CONFINED SPACE ENTRY

Enclosures with known or potential hydrogen sulfide hazards and restricted means of entrance and exit deserve special attention. These enclosures are not normally occupied by people nor well ventilated. Examples of such enclosures in the oil and gas producing and gas processing plant industries may include tanks, cellars, process vessels, tank trucks, temporary and permanent pits and trenches, and barges. A confined space entry permit shall be required for entry into a confined space. A confined space entry permit should as a minimum:

a. identify the job site.
b. indicate the date and duration of the permit.
c. specify testing requirements and other conditions to safely perform the job.
d. ensure that sufficient monitoring is conducted to ascertain that the hydrogen sulfide, oxygen,[22] or hydrocarbon concentrations do not become a health or fire hazard, and
e. bear the approval specified in the operator's procedure.

As an alternate to foregoing Par. 9.17, Item d, proper personal protective breathing equipment may be worn during the work operation; however, sufficient monitoring of the enclosure atmosphere shall be performed to ensure that it is free of an ignitable mixture of hydrocarbons. Refer to OSHA's Confined Space Entry Standard (29 *Code of Federal Regulations* Part 1910.146)

9.18 ENCLOSED FACILITY ENTRY

Personnel shall use extreme caution before entering enclosed facilities such as buildings housing oil, gas, or produced water processing and handling equipment containing hazardous concentrations of hydrogen sulfide. Personnel shall either establish that entry without personal protective breathing (respiratory protection) apparatus will be safe or shall wear protective breathing equipment. Refer to Section 12 for additional details and precautions.

9.19 IRON SULFIDE PRECAUTIONS

Iron sulfide, a reaction product of hydrogen sulfide and iron or spent iron sponge (a treating material), when exposed to air, can autoignite (spontaneous combustion) and burn. Iron sulfide, when exposed to air, should be kept wet until it can be disposed of in accordance with applicable regulations. Iron sulfide scale can accumulate on inside surfaces of vessels and on filter elements used in amine systems and become an autoignition hazard if exposed to atmospheric oxygen. One of the products of burning iron sulfide is sulfur dioxide; proper safety procedures must be effected to deal with this toxic substance.

9.20 DRILLING OPERATIONS

Refer to *API Recommended Practice 49* for recommended procedures for drilling and drill stem testing operations involving hydrogen sulfide.

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[22] *API PUBL 2217A: Guidelines for Work in Confined Spaces in the Petroleum Industry* specifies an oxygen content of less than 19.5% as oxygen deficient and an oxygen content of less than 16% is considered immediately dangerous to life and helath (IDLH).

9.21 SAFETY PRECAUTIONS FOR SAMPLING AND TANK GAUGING OPERATIONS

When it is known or suspected that the system to be sampled or gauged may contain hydrogen sulfide, special precautions shall be observed. Production tanks shall be tested to determine their hydrogen sulfide content (refer to Par. 9.3). Tests should also be conducted within the normal worker breathing zone to determine if the levels stipulated in Par 4.1 may be exceeded and if engineering controls, administrative procedures, or personal protective breathing equipment (refer to Par. 6.4) may be required for sampling or tank gauging operations. The tests should be conducted under operating and atmospheric conditions to determine the maximum hydrogen sulfide exposure level.

If the hydrogen sulfide level in the worker breathing zone exceeds IDLH level (300 ppm), in addition to appropriate personal protective breathing equipment (refer to Par. 6.4), rescue precautions and procedures (refer to Pars. 6.5 and 6.6) shall be utilized.

9.22 FACILITIES ABANDONMENT—SURFACE EQUIPMENT

Precautions should be taken to ensure that hazardous quantities of hydrogen sulfide do not remain in abandoned surface equipment, including buried pipelines and flow lines. Pipelines and flow lines left in place should be purged, bullplugged, or otherwise capped. Vessels should be flushed with water, purged, drained, and left open to the atmosphere. Precautions should be taken to prevent an iron sulfide fire (refer to Par. 9.19).

CAUTION: Prior to abandonment, vessels should be checked for the presence of naturally occurring radioactive material (NORM) and appropriate safety and handling procedures should be exercised. Refer to *API Bulletin E-2* for guidance on management of NORM.

9.23 WELL ABANDONMENT

The following recommended practices are not intended to supersede federal, state, or local regulations for well abandonment. Where not covered by applicable regulations, the practices and well conditions should be considered in planning and effecting permanent well abandonment. It is recommended that cement be set across formations that are known to produce or could produce hydrogen sulfide in hazardous concentrations. Refer to *API Bulletin E-3* for guidance and procedures for plugging and abandoning wells.

9.24 CONTINGENCY PLAN REVISIONS

Operating personnel should be observant for changes that would make reconsiderations and possible revisions advisable in contingency plan coverage, location(s) of monitoring equipment, and location(s) of lease equipment. Some changes that should be observed and considered are new residences or residential areas, stores, businesses, parks, schools, or roads; changes in well operations; and changes in lease facilities. Refer to Section 7 for suggested procedures for planning and implementing contingency plans and emergency procedures.

10 Guidelines for Evaluation and Selection of Continuous Hydrogen Sulfide Monitoring Equipment

10.1 INTRODUCTION

Section 10 is provided to make users of hydrogen sulfide monitoring equipment aware of some equipment limitations and certain desirable features of such equipment. There are a number of detection principles and analytical procedures available for monitoring the concentration of hydrogen sulfide in ambient air where the potential exists for exposure to levels that may be hazardous to health. These guidelines are intended to aid in the selection and application of continuous monitoring equipment for use in production operations involving hydrogen sulfide. The term "continuous hydrogen sulfide monitoring equipment" as used herein is defined as equipment capable of continuously measuring and displaying the concentration of hydrogen sulfide in ambient air. Section 10 is not applicable to personnel monitoring badges or length-of-stain or color-comparison type detector devices (refer to *ANSI/ISEA 102*).

10.2 GENERAL

All monitors, both portable and stationary, shall be designed on sound engineering and scientific principles and constructed of materials suitable for the application. Their design and construction should allow for ease of maintenance and repair. Instruments should be verified by a national recognized testing laboratory (NRTL) as meeting the minimum performance requirements of *ISA-S12.15,* Part I. Equipment should be installed, operated, and maintained in accordance with *ISA Recommended Practice 12.15,* Part II.

It generally is recommended (and frequently required) that electrical controls for safety systems such as hydrogen sulfide monitoring equipment and other gas detector systems be installed normally-energized ("fail-safe"). This means that power is supplied continuously during normal operations to devices which provide alarm(s) and corrective action if concentrations corresponding to specific alarm set points are reached. Under these conditions, interruption of power due to either deliberate safety device actuation or loss of power will initiate corrective action. It is desirable to provide a test means that will allow the system to be tested (and calibrated) without shutting in producing or gas processing plant operations (or other corrective action), but it should be evident to operating personnel that the system is in the test (bypass) mode.

To better ensure proper application, it is recommended that an environmental and application checklist (similar to the example shown in Appendix 1, *ISA Recommended Practice 12.15*, Part II) be provided to prospective vendors by the user.

10.3 CONSTRUCTION CHARACTERISTICS

The following construction and useability characteristics are desirable for hydrogen sulfide monitoring equipment.

10.3.1 Portability

Portable monitors, including all required parts and accessories, should weigh a maximum of ten (10) pounds and have a maximum volume of one (1) cubic foot.

10.3.2 Power Supply, Portable Monitoring Equipment

Portable hydrogen sulfide monitoring equipment is defined as self-contained, battery-operated, carriable or transportable instruments capable of operating within specifications from integral batteries for a period of eight hours minimum, including a 15 minute period of maximum load conditions (with alarms, lights, etc. activated), while exposed to clean air at a nominal temperature of 14°F (-10°C). Applications requiring in excess of eight hours of continuous operation or operation at lower temperatures should be specified by the end user.

10.3.3 Readout

Monitors should provide a direct readout of hydrogen sulfide concentration in parts per million (ppm) by volume.

10.3.4 Recorder Output

For certain applications, it may be desirable for monitors to provide an output signal (e.g., 4-20 ma) proportional to hydrogen sulfide concentration for use in connection with recorders or for other purposes.

10.3.5 Simplicity of Operation

Monitoring and detection equipment should be readily operable by personnel without scientific background or training in instrumentation.

10.3.6 Instruction Manuals

An instruction manual should be provided by the manufacturer with each instrument. The instruction manual should contain complete operating instructions, including procedures for startup, warm-up time, zero checks, calibration, alarm setting and testing, preventive maintenance, performance checks, and trouble-shooting. Monitors with rechargeable power supplies should be furnished with instructions for charging, storing, and maintaining the power supply. Information also should be included regarding instrument recovery time after the exposure of sensor(s) to hydrogen sulfide. The manufacturer should provide response time data and a list of interfering, desensitizing, or contaminating substances or water vapor concentrations known to the instrument manufacturer which may adversely affect proper operation and performance of the instrument (refer to Par. 10.4.7). Instruction manuals should include wiring diagrams and estimates of the life expectancy of all consumables. The manual should include a complete parts list suitable for identification of all replaceable parts and sources for procurement of these parts.

10.3.7 Electrical Approval

Any portion of a stationary hydrogen sulfide monitoring instrument intended for installation or use in a hazardous (classified) location and all portable monitoring instruments shall be approved for use in such a hazardous (classified) location and marked accordingly. Refer to *NFPA 70*, Article 500-3, FPN No. 2.

10.3.8 Ruggedness

Portable monitoring units should be sufficiently rugged to withstand routine transporting, handling, and use in the field environment, as specified by the user. Refer to *ISA-S12.15* for details of a recommended "drop test" to evaluate portable unit ruggedness and a "vibration test" to evaluate ruggedness of fixed and portable monitors.

10.3.9 Calibration Equipment

All accessories required to calibrate the instruments should be made available by the manufacturer. The life expectancy and any special handling required of any hydrogen sulfide test concentrations should be provided by the supplier.

10.3.10 Zero and Span Adjustments

Zero and span adjustment controls should be readily accessible for field adjustment, and the monitor design should include provisions to apply zero and calibration gases to the sensor(s) in a non-laboratory environment. All accessories for calibration and zero should be made available with the monitor and should be useable under field conditions.

10.3.11 Alarm Systems

Fixed monitors shall have provisions for external alarms. Portable monitor units should contain integral audible, visual, or physical presentation (e.g., vibrator signal) alarms as specified by the user. Hydrogen sulfide alarms should be unique to the location.

10.3.12 Testing Alarm Circuitry

Provisions should be included for the testing of alarms and alarm outputs. The test procedure should be included in the equipment instruction manual.

10.3.13 Remote Sampling

A remote sampling accessory (such as a probe) may be desirable for use with a portable monitoring unit.
CAUTION: Optional probe attachments for portable monitoring units, which allow the user to manually draw samples from remote locations, inherently prevent continuous monitoring of the immediate local environment. Users should consult the manufacturer's instruction manual to determine the proper number of bulb strokes required to draw samples when non-continuous monitoring attachments are used. The remote sampling attachment should be removed after use to restore the instrument to the normal continuous monitoring mode.

10.3.14 Equipment Trouble (Malfunction) Alarm

A trouble (malfunction) signal (indicator or output) should be provided for all monitors.

10.3.15 Detection Range Indication

The range(s) of detection should be conspicuously marked on the instrument.

10.4 PERFORMANCE GUIDELINES

The following recommended performance parameters are applicable to fixed and portable hydrogen sulfide monitoring equipment.

10.4.1 Accuracy

Instruments should meet requirements of the accuracy test specified in *ISA-S12.15,* Part I. Users are cautioned that the class of instruments suitable for field use are not "laboratory-grade" instruments, and *an equivalent degree of precision should not be expected.*

10.4.2 Zero Drift

Instruments should meet the requirements of the "Long-term Stability Test" specified in *ISA-S12.15,* Part I. Excessive zero drift is undesirable and can require instrument calibration at unreasonably short intervals.

10.4.3 Warm-up Time

The minimum warm-up time when power is first applied should be stated in the equipment instruction manual. A monitor ready-status indicator is a desirable feature.

10.4.4 Response Time

ISA-S12.15, Part I specifies monitoring equipment minimum response time to input step changes. The toxicity of hydrogen sulfide requires that monitoring equipment have rapid response time to alert personnel of potentially dangerous concentrations. Hence, response time of monitoring equipment is an important parameter for consideration in evaluation and selection of such equipment.

10.4.5 Operating Humidity Range

Monitoring equipment should meet the "Humidity Variation Test" specified in *ISA-S12.15,* Part I. Users should advise equipment manufacturers of the humidity ranges expected for specific equipment applications.

10.4.6 Operating Temperature Range

Monitoring equipment should be suitable for viable use in an ambient temperature range of 14°F to 122°F (-10°C to 50°C). Applications requiring equipment exposure to temperatures outside this range should be specified by the user.

10.4.7 Interferences

A list of interfering, desensitizing, and contaminating substances (e.g., carbon monoxide, sulfur dioxide, aromatic mercaptans, methanol, oxides of nitrogen, aldehydes, carbon sulfide, monoethanolamine, carbon dioxide, benzene, and methane) known by the manufacturer should be listed in the equipment instruction manual. Also, water vapor concentrations which may adversely affect proper equipment operation should be included in the instruction manual.
CAUTION: Monitoring and detector equipment and sensors should be protected from exposure to liquid spray or wash down. Such exposure can affect equipment performance and reliability.

10.4.8 Functional Field Test

Functional field testing of monitoring equipment should be conducted under "as installed" or "as used" conditions. All instrument and system accessories normally used with this equipment should be installed and operated during functional field tests. Functional field tests may include, but are not limited to, exposing the sensor to a sample containing sufficient hydrogen sulfide to cause response of the system. Functional field testing *does not* necessarily include zero and span adjustments. The hydrogen sulfide concentration used in functional field testing of monitoring equipment should not exceed the maximum operating range of the equipment being tested.

10.4.9 Air Velocity

Monitoring equipment should meet the "Air Velocity Variation Test" specified in *ISA-S12.15,* Part I. Accessories are often available and may be desirable for use with detector equipment installed in areas of high air velocity.

10.4.10 Electromagnetic Interference (EMI)

Some monitoring equipment may be susceptible to electromagnetic interference (EMI), particularly radio frequency interference (RFI). Caution should be taken when using monitoring equipment in close proximity to a radio transmitter or other EMI generators. Refer to *ISA-S12.15,* Part I, Sections 9.5 and 11.6.

11 Offshore Operations

11.1 INTRODUCTION

Section 11 presents some additional recommendations that are needed offshore due to the uniqueness of offshore operations. Many recommendations in other sections of this publication also are applicable to offshore operations. Refer to Appendix F, "Toxic Gases", *API Recommended Practice 14C.*

11.2 UNIQUENESS OF OFFSHORE OPERATIONS

Problems that might be considered minor in onshore operations can be more critical in offshore operations. This is due to the remoteness of offshore operations, compactness of facilities, limited escape and evacuation routes, and sophisticated escape and evacuation equipment.

11.3 FEDERAL REGULATORY REQUIREMENTS

Refer to 30 *Code of Federal Regulations* Parts 250 and 256 for Minerals Management Service, U. S. Department of Interior (DOI) requirements for Outer Continental Shelf (OCS) oil and gas producing operations involving hydrogen sulfide. These regulations include requirements for training personnel involved in OCS oil and gas producing operations and for hydrogen sulfide contingency plans for OCS oil and gas producing operations.

11.4 CONTINGENCY PLANNING

Where potentially hazardous atmospheric concentration of hydrogen sulfide could occur offshore, contingency planning is particularly essential due to the uniqueness of facilities as discussed in Par. 11.2. Although the recommendations for contingency planning presented in Section 7 are applicable to offshore operations, there are additional items that should be addressed. These include, but are not limited to, the following:

a. Training. All personnel shall be familiar with the location and use of emergency escape equipment and routes. Personnel regularly assigned to offshore facilities shall be trained in the requirements of Par. 5.2, as well as be proficient in the use of oxygen resuscitation equipment.

b. Evacuation Procedures. The U. S. Coast Guard's (Department of Transportation) requirements for emergency evacuation plans for manned Outer Continental Shelf facilities are contained in 33 *Code of Federal Regulations* Parts 140, 143, and 146 (refer to 54 *Federal Register,* May 18, 1989, 21566). Surface and/or air transportation to the site should be available since it may be necessary to evacuate visitors and other non-essential personnel and to bring in specialists or equipment if a hazardous hydrogen sulfide condition is suspected or does occur. Monitoring for combustible gases (primarily methane) and hydrogen sulfide should be provided to avoid unnecessarily exposing personnel and equipment to the dangers of a fire, explosion, or hazardous concentration during transport or transfer operations. If a hazardous hydrogen sulfide condition is known or suspected to be imminent, boats and helicopters should approach the site from an upwind direction, when possible.

Proper personal protective breathing equipment must be provided for helicopter and boat crew members and all passengers. Evacuation routes and deboarding procedures shall be well planned and posted. Evacuation drills shall be regularly performed.

11.5 SIMULTANEOUS OPERATIONS

Particular emphasis must be given to coordination between drilling, well servicing, producing, and construction operations when two or more of these activities are conducted simultaneously. An individual shall be designated to be the person-in-charge for simultaneous operations, and the chain of command shall be communicated to all applicable personnel.

12 Operations Involving Enclosed Facilities

12.1 INTRODUCTION

Section 12 presents some additional recommendations that are unique to oil and gas producing and gas processing plant operations in enclosed facilities[23] and involving hydrogen sulfide (refer to Par. 4.1). An enclosed facility may be as simple as a single piece of equipment within an enclosure or as complicated as complex onshore or offshore enclosed facilities located in cold climates.

12.2 UNIQUENESS OF OPERATIONS INVOLVING ENCLOSED FACILITIES

The uniqueness of oil and gas producing and gas processing plant operations in enclosed facilities is due to the potential that escaping quantities of hydrocarbon gases containing hydrogen sulfide can be contained in an enclosed space[23], particularly if ventilation is inadequate. This space may be entered by personnel. A small leak of product containing hydrogen sulfide gas that would normally dissipate as it escaped can be contained in the enclosed space surrounding the leak and increase the hazard to entering personnel unless adequate ventilation is provided to reduce the hazard.

12.3 DESIGN CONSIDERATION

The design and construction practices of Section 8 generally apply to enclosed facilities, but there are areas of design that should be considered due to the unique operating situations they present. Additional design considerations for enclosed facilities can include, but are not limited to, the following:

a. Means to prevent flammable liquids and gases from coming into contact with surfaces hot enough to cause ignition. The autoignition temperature for natural gas is approximately 900°F (482°C). The autoignition temperature for other natural gas mixtures ranges from 700°F to 900°F (371°C to 482°C). The autoignition temperature for hydrogen sulfide is approximately 500°F (260°C).
b. Ventilation.
c. Onsite respiratory protection equipment.
d. Electrical equipment (possibly Group C versus Group D equipment required). Refer to Par. 3.5, "National Electrical Code Grouping of Atmospheric Mixtures", of *API Recommended Practice 500.*
e. Emergency relief and depressuring devices and their discharge points.
f. Hydrocarbon vents from diaphragm valves, machinery, and regulators.
g. Compressor depressuring and blowdown lines.
h. Floor drains.
i. Process drains, manual and automatic.
j. Vents from gas conditioning equipment (glycol and amine).
k. Hydrogen sulfide monitoring system.

12.4 FIXED HYDROGEN SULFIDE MONITORING SYSTEM

In many locations where personnel enter frequently, on a regular basis, or occupy enclosed facilities for relatively long periods of time, fixed hydrogen sulfide monitoring systems (with adequate alarms) can enhance safety. In some locations, an alternative to fixed monitoring systems may be implementation of personnel entry procedures (refer to Pars. 9.18 and 12.5).

Fixed hydrogen sulfide monitoring systems should be installed in facilities containing process equipment (vessels, machinery, etc.) handling gases or fluids containing hydrogen sulfide when a release of these gases or fluids is capable of causing atmospheres with hydrogen sulfide in concentrations exceeding 10 ppm when the locations are both:

a. an enclosed area (room, building, or space) as defined by Par. 12.1 and *API Recommended Practice 500.*
b. inadequately ventilated. [*Inadequately ventilated* is defined as ventilation (natural or artificial) which is *not* sufficient to prevent the accumulation of significant quantities of hydrogen sulfide-air mixtures in concentrations exceeding 10 ppm]. Adequacy of ventilation should be assessed on a site-specific basis.

Fixed monitoring systems shall contain audible alarm devices (and visual alarm devices in high noise areas, refer to Par. 10.3.11) activated by hydrogen sulfide concentrations at preset levels (not to exceed 10 ppm), as required to alert personnel. Hydrogen sulfide monitoring equipment should be calibrated in accordance with Par. 9.15.

It is recognized in specific instances that a fixed combustible gas detection system may detect the existence of a potentially hazardous atmospheric condition before a fixed hydrogen sulfide monitoring system that is set to alarm at 10 ppm of hydrogen sulfide would be activated. For example, in a release of a 300 ppm hydrogen sulfide in methane mixture, a combustible gas detector set to alarm at 20% lower explosive limit (LEL) would activate and sound an alarm at a hydrogen sulfide concentration of approximately 3 ppm.

In such instances, a regular testing program should be established to monitor content of the process stream to ensure that the concentration of hydrogen sulfide has not increased. If an increase in the hydrogen sulfide concentration is confirmed, the user should verify adequacy of the detection system in use. This verification should consider all variable criteria that will affect performance of the detection equipment as well as factors that could increase the concentration of hydrogen sulfide in the work atmosphere should a malfunction or equipment failure occur.

CAUTION: This option is limited in its scope and should be used only when all applicable limitations and site specific parameters have been duly considered.

Fixed monitoring systems are also desirable to monitor the air intake for enclosed areas when the air is used for makeup or for pressurizing the enclosed facilities (refer to *NFPA 496*).

12.5 PERSONNEL PROTECTION TECHNIQUES

A method of protecting personnel from exposure to atmospheric concentrations of hydrogen sulfide exceeding 10 ppm should be provided in all enclosed facilities containing process equipment (vessels, machinery, etc.) handling hydrogen sulfide bearing fluids and capable of causing hydrogen sulfide atmospheric concentrations in excess of 10 ppm. Acceptable methods include:

[23]An enclosed facility (room, building, or space) is defined as a three-dimensional space enclosed by more than two-thirds (2/3) of the possible projected plane surface and of sufficient size to allow the entry of personnel. For a typical building, this would require that more than two-thirds (2/3) of the walls, ceiling, and/or floor be present. Refer to *API Recommended Practice 500.*

a. Requiring personnel to wear proper protective breathing apparatus (refer to Par. 6.4) before entering and when in the facility.
b. Installing fixed hydrogen sulfide monitoring equipment (refer to Par. 6.2, Section 10, and Par. 12.4).
c. Properly ventilating the facility to maintain hydrogen sulfide concentrations in the work atmosphere less than 10 ppm, confirmed by monitoring with a fixed hydrogen sulfide monitoring system. Recirculation of air is allowed, but recirculated air streams should be monitored with fixed monitoring systems to alarm when concentrations of hydrogen sulfide exceed 10 ppm in the recirculated air.
d. Testing the facility before entry and continuously while in the facility, using portable hydrogen sulfide detection equipment (refer to Par. 6.3), to ensure that hydrogen sulfide concentration in the work area atmosphere does not exceed 10 ppm.

Note: Personnel shall either establish that entry without protective breathing (respiratory protection) equipment will be safe or shall wear appropriate personal protective breathing equipment (refer to Par. 6.4).

12.6 WARNING SIGNS

Legible warning signs, such as "HYDROGEN SULFIDE OPERATIONS—ENTER ONLY WHEN MONITORING SHOWS THE AREA TO BE SAFE" or "RESPIRATORY PROTECTION EQUIPMENT MUST BE WORN BEYOND THIS POINT", shall be prominently posted outside all access doorways leading into enclosed facilities where produced fluids or gases containing hydrogen sulfide (refer to Par. 4.1 for applicability) are being processed or handled.

Note: Regulatory requirements for sign posting shall be observed.

13 Gas Processing Plant Operations

13.1 INTRODUCTION

Section 13 presents some additional recommendations that are unique to gas processing plant operations involving hydrogen sulfide (refer to Par. 4.1.). Some recommendations in other sections of this publication also are applicable to gas processing plant operations.

13.2 GENERAL CONSIDERATIONS

Gas processing plant operations typically include more complex processes than field operations (e.g., gas conditioning facilities). Some differences include:

a. potentially higher volumes of gas containing hydrogen sulfide,
b. potentially higher concentrations of hydrogen sulfide,
c. generally a greater number of personnel and more equipment, and
d. the assignment of personnel on a more regular basis.

These differences often require special considerations to ensure safe operations involving activities such as vessel and line openings and confined space entry. When such activities are to take place, a coordinating meeting between operations, maintenance, contractor, and other involved parties should be held to ensure that facility personnel are aware of the activities involved, their effect(s) on plant operations, and the necessary safety precautions that are to be followed.

13.3 GAS CONDITIONING FACILITIES

Many gas treating and sulfur recovery processes are employed in gas processing plants. These processes can be classified into chemical reaction, physical solution, and adsorption processes, and can be further subdivided into regenerable and non-regenerable processes. Regenerable type processes include amine solvents, hot potassium carbonate, molecular sieve, and chelants. Non-regenerable type processes include iron sponge, caustic scrubbers, metal oxides, direct oxidation, and various other sulfur recovery processes. Because most of these methods result in a concentrated hydrogen sulfide stream or reaction product, operators shall be familiar with the various chemical and physical characteristics of the process(es) at the particular facility. The amount of hydrogen sulfide in residence within a process may be sufficient to require implementation of requirements contained in 29 *Code of Federal Regulations* Part 1910.119.

13.4 MATERIALS OF CONSTRUCTION

The failure of gas processing plant equipment components can permit the uncontrolled release of hydrogen sulfide to the atmosphere. Those equipment components in the sulfide stress cracking regime should be made from sulfide stress cracking resistant materials (refer to Par. 8.1.3).

13.5 CORROSION MONITORING

A corrosion monitoring program should be established to minimize internal and external corrosion activity which can affect equipment in hydrogen sulfide service.

13.6 LEAK DETECTION

In gas or liquid handling systems containing hydrogen sulfide in concentrations capable of causing atmospheric concentrations of 10 ppm or more of hydrogen sulfide, monitoring techniques or procedures (for example, visual observation, soap bubble test, portable detectors, or fixed monitoring equipment) should be employed to detect leaks. Particular attention should be given to enclosed facilities, such as control rooms, compressor buildings, cellars, and sumps (refer to Section 12). Regularly scheduled inspection of equipment for leaks, such as pump seals, is recommended. Results should be retained for a minimum of one year as a part of the facility or equipment operating and maintenance records. Fixed hydrogen sulfide ambient air monitoring systems are recommended (refer to Section 10 and Appendix C) in gas processing plants located near populated areas to facilitate early detection and necessary warning to the general public.

13.7 CONTINGENCY PLANNING

Contingency plans for gas processing plant facilities shall cover plant personnel and the general public that could be exposed to a release of hydrogen sulfide (refer to Appendix B of *API Recommended Practice 750*. Operating personnel must be familiar with emergency plant shutdown procedures, rescue operations, notification procedures, briefing areas, and locations of emergency equipment (refer to Section 7). Visitors shall be briefed on the physical layout of the gas processing facility, applicable warning signals, and how to respond in the event of an emergency.

APPENDIX A—PHYSICAL PROPERTIES AND PHYSIOLOGICAL EFFECTS OF HYDROGEN SULFIDE

A.1 Physical Data

Chemical Name: Hydrogen Sulfide

CAS Number: 7783-06-4

Synonyms: Sulfureted hydrogen, hydrosulfuric acid, dihydrogen sulfide.

Chemical Family: Inorganic sulfide.

Chemical Formula: H_2S.

Normal Physical State: Colorless gas, slightly heavier than air. Vapor density (specific gravity) at 59°F (15°C) and 1 atmosphere = 1.189.

Autoignition Temperature: 500°F (260°C).

Boiling Point: -76.4°F (-60.2°C).

Melting Point: -117.2°F (-82.9°C).

Flammable Limits: 4.3 - 46 percent vapor by volume in air.

Solubility: Soluble in water and oil; solubility decreases as the fluid temperature increases.

Combustibility: Burns with a blue flame to produce sulfur dioxide (SO_2). Refer to Appendix B.

Odor and Warning Properties: Hydrogen sulfide has an extremely unpleasant odor, characteristic of rotten eggs, and is easily detected at low concentrations. However, due to rapid onset of olfactory fatigue and paralysis (inability to smell) ODOR *SHALL NOT* BE USED AS A WARNING MEASURE.

A.2 Exposure Limits

The Occupational Safety and Health Administration (OSHA) has established 20 ppm by volume as an acceptable ceiling concentration (ACC) and 50 ppm by volume as an acceptable maximum peak above the ACC for an 8-hour shift for hydrogen sulfide (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a Threshold Limit Value (TLV)®[1] of 10 ppm (eight-hour TWA) and a short term exposure limit (STEL) of 15 ppm averaged over fifteen minutes. Exposure at the STEL should not be repeated more than four times per day with at least sixty minutes between successive exposures in this range. For Outer Continental Shelf (OCS) oil and gas producing operations, exposure levels exceeding 20 ppm instantaneous exposure require use of personal protective breathing equipment pursuant to U. S. Department of Interior, Minerals Management Service Final Rule, 30 *Code of Federal Regulations* Part 250.67, as published at 53 *Federal Register* 10596-10777, April 1, 1988[2]. The *NIOSH Recommended Standard for Occupational Exposure to Hydrogen Sulfide* should be consulted for additional detailed information. Refer to Table A-2 for additional information on exposure values. CHECK WITH THE EMPLOYER CONCERNING EXPOSURE LIMITS FOR PARTICULAR CIRCUMSTANCES.

A.3 Physiological Effects

INHALATION AT CERTAIN CONCENTRATIONS CAN LEAD TO INJURY OR DEATH (refer to Table A-1). Hydrogen sulfide is an extremely toxic, flammable gas that may be encountered in the production and processing of gas well gas, high-sulfur-content crude oil, crude oil fractions, associated gas, and waters. Since hydrogen sulfide is heavier than air, it can collect in low places. It is colorless and has a foul, rotten-egg odor. In low concentrations, it is detectable by its characteristic odor. However, smell cannot be relied on to forewarn of dangerous concentrations because exposure to high concentrations (greater than 100 ppm) of the gas rapidly paralyzes the sense of smell due to paralysis of the olfactory nerve. A longer exposure to lower concentrations has a similar desensitizing effect on the sense of smell. IT SHOULD BE WELL UNDERSTOOD THAT THE SENSE OF SMELL WILL BE RENDERED INEFFECTIVE BY HYDROGEN SULFIDE, WHICH CAN RESULT IN AN INDIVIDUAL FAILING TO RECOGNIZE THE PRESENCE OF DANGEROUSLY HIGH CONCENTRATIONS. Excess exposure to hydrogen sulfide causes death by poisoning the respiratory system *at the cellular level*. There is some indication that the presence of alcohol in the blood aggravates the effects of hydrogen sulfide in acute poisoning cases. Even at low concentrations (10-50 ppm) hydrogen sulfide is irritating to the eyes and respiratory tract. Closely repeated short-term exposures at low concentrations may lead to irritation of the eyes, nose, and throat. Symptoms from repeated exposures to low concentrations usually disappear after not being exposed for a period of time. Repeated exposures to low concentrations that do not produce effects initially may eventually lead to irritation if the exposures are frequent.

A.4 Respiratory Protection

The National Institute for Occupational Safety and Health (NIOSH) has examined the criteria for respirator tests and sources of respirator leakage and recommends that positive pressure, either supplied-air or self-contained breathing apparatus, as appropriate, with a full face piece be worn by

[1] "TLV" is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Exposure Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240 (check latest edition).

[2] Available from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

anyone exposed to atmosphere containing hydrogen sulfide concentrations above OSHA's ACC (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2) Refer to Par. 6.4 for proper breathing equipment recommendations for oil and gas producing and gas processing plant operations involving hydrogen sulfide.

Note: There are differences of opinion in the medical community about whether a person with a perforated eardrum can become overexposed to a toxic substance via the ear, even when wearing proper personal breathing apparatus, and whether they should be excluded from work in a hydrogen sulfide environment[3]. Theoretical calculations by Richard Ronk and M. K. White[3] have led the authors to conclude that tympanic membrane (eardrum) defects do not significantly compromise respiratory protection against hydrogen sulfide and that individuals with perforated tympanic membranes should not be excluded from work in a hydrogen sulfide environment. The validity of these calculations is supported by the absence of case reports of hydrogen sulfide poisoning due to tympanic membrane defect.

Ronk and White[3] also concluded that wearers of positive-pressure, either supplied-air or self-contained personal breathing apparatus, with a full face piece, as recommended by the National Institute for Occupational Safety and Health (NIOSH), who have a tympanic membrane defect and a concurrent tympanomaxillary shunt or a patulous eustachian tube (the tube remains open) may experience the sensation of outward air flow which can be annoying.

In 1982, the Minerals Management Service (MMS), U. S. Department of Interior, amended requirements of the Outer Continental Shelf (OCS) Hydrogen Sulfide Standard, *MMS-OCS-1*, "Safety Requirements for Drilling Operations in a Hydrogen Sulfide Environment, Outer Continental Shelf", Section 5.2, February 1976. MMS rescinded the requirement for personnel eardrum examinations and rescinded the prohibition against persons with perforated eardrums working in a hydrogen sulfide environment (refer to 47 *Federal Register* 28888-28890, July 1, 1982).

The U. S. Occupational Safety and Health Administration may address this subject in future revision of its Respiratory Protection Standard (29 *Code of Federal Regulations* Part 1910.134).

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[3]Compare Poda, George A., "Hydrogen Sulfide Can Be Handled Safely", *Archives of Environmental Health*, Vol. 12, 795-800, June 1966, and Ronk, Richard and White, M. K., "Hydrogen Sulfide and the Probabilities of Inhalation Through Tympanic Membrane Defect", *Journal of Occupational Medicine*, Vol. 25, No. 5, 337-340, May 1985.

Table A-1—Hydrogen Sulfide

Concentration in Air				
Percent by Volume	Parts Per Million By Volume	Grains Per 100 Std. Cubic Feet	Milligrams Per Cubic Meter[(4)]	Typical Characteristics Regarding Hydrogen Sulfide Exposure[(5)]
0.000013	0.13[(6)]	0.008[(6)]	0.18[(6)]	Obvious and unpleasant odor generally at 0.13 ppm and quite noticeable at 4.6 ppm. As the concentration increases, the sense of smell fatigues and the gas can no longer be detected by odor.[(6)]
0.001	10	0.63	14.41	Unpleasant odor. Possible eye irritation. ACGIH recommended Threshold Limit Value (TLV)® (eight-hour TWA).[(7)]
0.0015	15	0.94	21.61	ACGIH STEL averaged over 15 minutes.[(7)]
0.002	20	1.26	28.83	Burning sensation in eyes and irritation of the respiratory tract after one hour or more exposure. OSHA ACC (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2).
0.005	50	3.15	72.07	Loss of sense of smell after about 15 or more minutes exposure. Exposure over one hour may lead to headache, dizziness, and/or staggering. Pulmonary edema reported following extended exposure to greater than 50 ppm.[(8)] Exposure at 50 ppm or greater can cause serious eye irritation or damage.
0.01	100	6.30	144.14	Coughing, eye irritation, loss of sense of smell after 3 to 15 minutes. Altered respiration, pain in eyes, and drowsiness after 15 to 20 minutes, followed by throat irritation after one hour. Prolonged exposure results in a gradual increase in the severity of these symptoms.
0.03	300	18.90	432.40	Marked conjunctivitis and respiratory tract irritation. Note: Concentration considered immediately dangerous to life or health (IDLH)[(9)] (refer to *DHHS No. 85-114, NIOSH Pocket Guide to Chemical Hazards*.[(10)]
0.05	500	31.49	720.49	Unconsciousness after short exposure, cessation of breathing if not treated quickly. Dizziness, loss of sense of reasoning and balance. Victims need prompt artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques.
0.07	700	44.08	1008.55	Unconscious quickly. Breathing will stop and death will result if not rescued promptly. Artificial ventilation and/or cardiopulmonary resuscitation (CPR) is needed immediately.
0.10+	1000+	62.98+	1440.98+	Unconsciousness at once. Permanent brain damage or death may result. Rescue promptly and apply artificial ventilation and/or cardiopulmonary resuscitation (CPR).

Note: Data in Table A-1 are approximate values for guidance. There are published data that show slightly different values.

[(4)]Based on 1% hydrogen sulfide = 629.77 gr/100 SCF @ 14.696 psia and 59°F (101.325 KPa and 15°C).

[(5)]Hydrogen sulfide has physiological effects on humans. These effects vary from person to person. FOR ADDITIONAL INFORMATION, CONSULT WITH THE EMPLOYER AND RESEARCH THE MATERIAL SAFETY DATA SHEETS (MSDS).

[(6)]There are wide variations in reported odor thresholds for hydrogen sulfide. A U.S. Environmental Protection Agency draft report states a range for the odor threshold of 0.1-0.2 ppm (refer to Review Draft: *Health Assessment Document for Hydrogen Sulfide*, EPA/600/8-86/026A, August 1986). A Petroleum Association for Conservation of the Canadian Environment (PACE) report, *Review of Ambient Hydrogen Sulfide Standards in Canada*, No. 85-5, December 1985, cites an odor threshold range of 0.005-0.05 ppm from the National Resource Council of Canada (1981) at Table 3.1 (page 3-10). The PACE document also cites reports of wider ranges of odor threshold from 0.0005-1.4 ppm at Table 4.1 (page 4-4).

[(7)]"TLV" is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240 (check latest edition).

[(8)]EPA Draft Review Document, supra Note *(6)*, page 1-2.

[(9)]IDLH means an atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere (refer to 29 *Code of Federal Regulations* Part 1910.120). NIOSH considers 300 ppm or more to be the IDLH concentration for hydrogen sulfide (refer to *NIOSH Pocket Guide to Chemical Hazards*).

[(10)]Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Table A-2—Summary of Occupational Exposure Values for Hydrogen Sulfide

OSHA ACCs(11)				ACGIH TLVs(12)				NIOSH RELs(13)			
ACC		Maximum Peak Above ACC For 8-hours		TWA		STEL		TWA		CEIL(C)	
ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
20	29	50	72	10	14	15	21	N/A	N/A	C10	C15

ACC Acceptable Ceiling Concentration.
TLVs Threshold Limit Values.
RELs Recommended Exposure Limits.
TWA Eight-hour Time Weighted Average (refer to specific reference document for different methods of weighting used).
STEL Short Term Exposure Limit averaged over a period of 15 minutes.
N/A Not Applicable.
CEIL(C) NIOSH Ceiling Exposure Limit averaged over a period of 10 minutes.

(11)Refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-2.
(12)Refer to *Threshold Limit Values and Biological Exposure Indices, 1993-94.*
(13)Refer to *NIOSH 77-158: Criteria for a Recommended Standard for Occupational Exposure to Hydrogen Sulfide.*

APPENDIX B—PHYSICAL PROPERTIES AND PHYSIOLOGICAL EFFECTS OF SULFUR DIOXIDE

B.1 Physical Data

Chemical Name: Sulfur Dioxide.

CAS Number: 7446-09-05.

Synonyms: Sulfurous anhydride, sulfurous oxide.

Chemical Family: Inorganic.

Chemical Formula: SO_2.

Normal Physical State: Colorless gas appreciably heavier than air. Vapor density (specific gravity) at 32°F (0°C) and 1 atmosphere = 2.26.

Boiling Point: 14°F (-10.0°C).

Flammable Limits: Non-flammable (produced from burning hydrogen sulfide).

Solubility: Readily soluble in water and oil; solubility decreases as the fluid temperature increases.

Odor and Warning Properties: Sulfur dioxide has a pungent odor associated with burning sulfur. It produces a suffocating effect and produces sulfurous acid on membranes of the nose and throat.

B.2 Exposure Limits

The Occupational Safety and Health Administration (OSHA) has established a permissible exposure limit (PEL) of 5 ppm as an 8-hour TWA for sulfur dioxide (refer to 29) *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends 2 ppm as an eight-hour TWA Threshold Limit Value (TLV)® and 5 ppm as a STEL averaged over 15 minutes for sulfur dioxide.[14] Refer to Table B-2 for additional information on exposure values. CHECK WITH THE EMPLOYER CONCERNING EXPOSURE LIMITS FOR PARTICULAR CIRCUMSTANCES.

B.3 Physiological Effects

B.3.1 ACUTE TOXICITY

INHALATION AT CERTAIN CONCENTRATIONS CAN LEAD TO INJURY OR DEATH (refer to Table B-1). Exposure to concentrations below 20 ppm can cause eye irritation, throat irritation, respiratory tract irritation, chest constriction, and some nausea. Exposure to concentrations above 20 ppm can result in marked coughing, sneezing, eye irritation, and chest constriction. Exposure to 50 ppm causes irritation to the nose and throat, running nose, coughing, reflex broncho-constriction with possible increase in bronchial mucous secretion, and increased pulmonary resistance to air flow (breathing congestion) occurs promptly. This atmosphere (50 ppm or more) will not be tolerated by most persons for more than 15 minutes. Some reported acute reactions of exposure to high concentrations include, but are not limited to, inflammation of the eyes, nausea, vomiting, abdominal pain, and sore throat. These symptoms are sometimes followed by bronchitis, pneumonia, and /or complaints of weakness for a period of weeks.

[14]"TLV" is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Exposure Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240 (check latest edition).

B.3.2 CHRONIC TOXICITY

It has been reported that prolonged exposures to sulfur dioxide may lead to increased risk of chronic nasopharyngitis, alteration in sense of smell and taste, shortness of breath on exertion, and a higher frequency of respiratory tract infections compared to unexposed persons. It has also been postulated that sulfur dioxide in the work environment "possibly enhances" the suspected carcinogenic (cancer) effect of arsenic or other cancer agents[15]. No definite evidence is available regarding co-carcinogenesis or promotion of cancer by sulfur dioxide exposure. A few persons apparently have or develop a hypersusceptibility to sulfur dioxide. Decrements in pulmonary function tests have been noted after both acute and chronic exposures.

B.3.3 EXPOSURE RISKS

It is not yet clear what concentrations of low level exposure or lengths of exposure increase the risks, nor by how much the risks are increased. Sulfur dioxide exposures should be minimized. Smoking by persons exposed to sulfur dioxide should be strongly discouraged.

Note: Any pre-existing chronic respiratory impairment must be considered in regard to job placement since these conditions can be aggravated by exposure to sulfur dioxide.

B.4 Respiratory Protection

The National Institute for Occupational Safety and Health (NIOSH) has examined the criteria for respirator tests and sources of respirator leakage and recommends that positive pressure, either supplied-air or self-contained personal breathing apparatus, as appropriate, with a full face piece be worn by anyone exposed to atmosphere containing sulfur dioxide concentrations above OSHA's permissible exposure limit (PEL) (refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1). Refer to Par. 6.4 for proper breathing equipment recommendations for oil and gas producing and gas processing operations involving sulfur dioxide.

[15]*Criteria for a Recommended Standard for Occupational Exposure to Sulfur Dioxide*, NIOSH, 1974, P. 26. Refer also to the 1977 edition.

Table B-1—Sulfur Dioxide

Concentration in Air				
Percent by Volume	Parts Per Million By Volume	Grains Per 100 Std. Cubic Feet	Milligrams Per Cubic Meter[16]	Typical Characteristics Regarding Hydrogen Sulfide Exposure[17]
0.0001	1	0.12	2.71	Pungent odor, may cause respiratory changes.
0.0002	2	0.24	5.42	*ACGIH TLV®*[18], and *NIOSH REL*.
0.0005	5	0.59	13.50	Burning eyes, breathing irritation, and minor throat irritation. Note: OSHA PEL (refer to *29 CFR* 1910.1000, Table Z-1; ACGIH and NIOSH STEL as averaged over 15 minutes.
0.0012	12	1.42	32.49	Throat-irritating cough, constriction in chest, watering eyes, and nausea.
0.010	100	12.0	271.00	Concentration considered immediately dangerous to life or health (IDLH).[19] Refer to *DHHS No. 85-114, NIOSH Pocket Guide to Chemical Hazards*.[20]
0.015	150	17.76	406.35	Extreme irritation. Can be tolerated for only a few minutes.
0.05	500	59.2	1354.50	Causes a sense of suffocation, even with the first breath. Rescue promptly and apply artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques.
0.10	1000	118.4	2708.99	Death may result unless rescued promptly. Artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques should be immediately applied.

Note: Data in Table B-1 are approximate values for guidance. There are published data that show slightly different values.

[16]*Based on 1% sulfur dioxide = 1184 gr/100 SCF @ 14.696 psia and 59°F* (101.315 kPa and 15°C).

[17]Sulfur dioxide has physiological effects on humans. These effects vary from person to person. FOR ADDITIONAL INFORMATION, CONSULT WITH THE EMPLOYER AND RESEARCH THE MATERIAL SAFETY DATA SHEETS (MSDS).

[18]"TLV is a trademarked term of American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Indices* and companion documents available from ACGIH, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240.

[19]IDLH means an atmospheric concentration of any toxic, corrosive, or *asphyxiant substance that poses an immediate threat to life or would cause* irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere (refer to 29 *Code of Federal Regulations* Part 1910.120). NIOSH considers 100 ppm or more to be the IDLH concentration for sulfur dioxide (refer to *NIOSH Pocket Guide to Chemical Hazards*).

[20]Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Table B-2—Summary of Occupational Exposure Values for Sulfur Dioxide

OSHA PELs[21]				ACGIH TLVs[22]				NIOSH RELs[23]			
TWA		STEL		TWA		STEL		TWA		STEL	
ppm	mg/m³	ppm	ppm	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
5	14	N/A	N/A	2	5	5	13	2	5	5	13

PELs Permissible Exposure Limits.
TLVs Threshold Limit Values.
RELs Recommended Exposure Limits.
TWA Eight-hour Time Weighted Average (refer to specific reference document for different methods of weighting used).
STEL Short Term Exposure Limit averaged over a period of 15 minutes.
N/A Not Applicable.

[21]Refer to 29 *Code of Federal Regulations* Part 1910.1000, Subpart Z, Table Z-1.

[22]Refer to *Threshold Limit Values and Biological Exposure Indices, 1993-94* (check latest edition).

[23]Refer to *NIOSH 77-158: Criteria for a Recommended Standard for Occupational Exposure to Sulfur Dioxide.*

APPENDIX C—A SCREENING APPROACH TO DISPERSION OF HYDROGEN SULFIDE

Note: The exposure radii shown in Figures C-1 through C-4 represent estimates developed by API's Air Modeling Task Force (AQ7) using simple screening models and modeling techniques. These models should be reasonably accurate for low velocity releases of neutrally-buoyant mixtures of hydrogen sulfide and carrier gas. Figures C-1 through C-4 are useful as a conservative screening tool for high velocity releases and for light hydrogen sulfide carrier gas mixtures. Figures C-1 through C-4 are not recommended for low velocity releases of heavier-than-air hydrogen sulfide/carrier gas mixtures or of potential aerosol-generating mixtures, since these illustrations sometimes will underpredict exposure radii for these mixtures. Site specific conditions should be assessed to determine the need for additional, more rigorous modeling techniques. Users should evaluate their operations and select proper modeling applications for their specific emergency planning purposes.

C.1 Introduction

The material presented in Appendix C is generic in nature and is intended for emergency response planning purposes to arrive at conservative hydrogen sulfide dispersion estimates. Figures C-1 through C-4 present the screening-level, model-predicted radius of exposure (ROE) for atmospheric concentrations of hydrogen sulfide at 10, 30, 100, 300, and 500 ppm for both continuous and puff (instantaneous) releases of pure hydrogen sulfide. The ROE represents the distance from the emission source to the concentration of interest measured along the plume's centerline at ground level. Equations were developed for predicting the ROE as a function of the quantity/rate of hydrogen sulfide released for each of the hydrogen sulfide concentrations modeled and the type of release (continuous and puff). The equations and corresponding coefficients are presented in Par. C.8 and Table C-1. Meteorological conditions typical of worst-case daytime and nighttime conditions were modeled.

Various regulations dealing with hydrogen sulfide operations prescribe a method(s) or technique(s) for ROE predictions. Such methods must be taken into account because specific compliance actions may require use of a method(s) specified by the regulation, unless use of other methods are allowed.

C.2 Methodology

The ROEs shown in Figures C-1, C-2, C-3, and C-4 were predicted using standard EPA-approved modeling procedures based on Gaussian dispersion theory. The ROEs shown in Figures C-1 and C-2 were predicted by modeling a continuous, steady-state point source release of 100 percent hydrogen sulfide. The ROEs shown in Figures C-3 and C-4 were predicted by modeling an instantaneous hydrogen sulfide release. Both hydrogen sulfide release types were modeled as releases of a neutrally-buoyant material under steady-state meteorological conditions. An effective plume height (release height plus plume rise) of 10 feet was used in all the modeling work. It was assumed that the predicted ROEs do not vary significantly with effective plume height in the range of 0-50 feet.

Table C-1—Linear Regression Coefficients for Mathematical Predictions of ROE as a Function of Downwind Hydrogen Sulfide Concentration and Release Quantity/Rate

Time*	Type of Release	Concentration, ppm	Coefficients A	Coefficients B
Day	Continuous	10	0.61	0.84
Day	Continuous	30	0.62	0.59
Day	Continuous	100	0.58	0.45
Day	Continuous	300	0.64	-0.08
Day	Continuous	500	0.64	-0.23
Night	Continuous	10	0.68	1.22
Night	Continuous	30	0.67	1.02
Night	Continuous	100	0.66	0.69
Night	Continuous	300	0.65	0.46
Night	Continuous	500	0.64	0.32
Day	Puff	10	0.39	2.23
Day	Puff	30	0.39	2.10
Day	Puff	100	0.39	1.91
Day	Puff	300	0.39	1.70
Day	Puff	500	0.40	1.61
Night	Puff	10	0.39	2.77
Night	Puff	30	0.39	2.60
Night	Puff	100	0.40	2.40
Night	Puff	300	0.40	2.20
Night	Puff	500	0.41	2.09

*Day Meteorological Conditions: Stability Class PG D (Neutral)—5 mph Wind Speed.
*Night Meteorological Conditions: Stability Class PG F (Stable)—2.2 mph Wind Speed.

For the purposes of dispersion modeling, the amount of turbulence in the ambient air is categorized into defined increments or stability classes. The most widely used categories are the Pasquill-Gifford (PG) Stability Classes A, B, C, D, E, and F (Pasquill, F., *Atmospheric Difusion*, Second Edition, John Wiley & Sons, New York, New York, 1974). PG Stability Class A denotes the most unstable (most turbulent) air conditions and PG Stability Class F denotes the most stable (least turbulent) air conditions. PG Stability Class D denotes neutral atmospheric conditions where the ambient temperature gradient is essentially the same as the adiabatic lapse rate. Under neutral conditions, rising or sinking air parcels cool or heat at the same rate as the ambient air, resulting in no enhancement or suppression of vertical air motion.

Standard Pasquill-Gifford (PG) dispersion coefficients for flat, open grassland were used in the continuous hydrogen sulfide release model. The Slade (refer to *NTIS-TID 24190:* Slade, D. H., *Meteorology and Atomic Energy*, 1968) dispersion coefficients for flat, open grassland were used in the puff (instantaneous) release model. When modeling instantaneous hydrogen sulfide releases it was assumed that the downwind (x) and the crosswind (y) dispersion coefficients

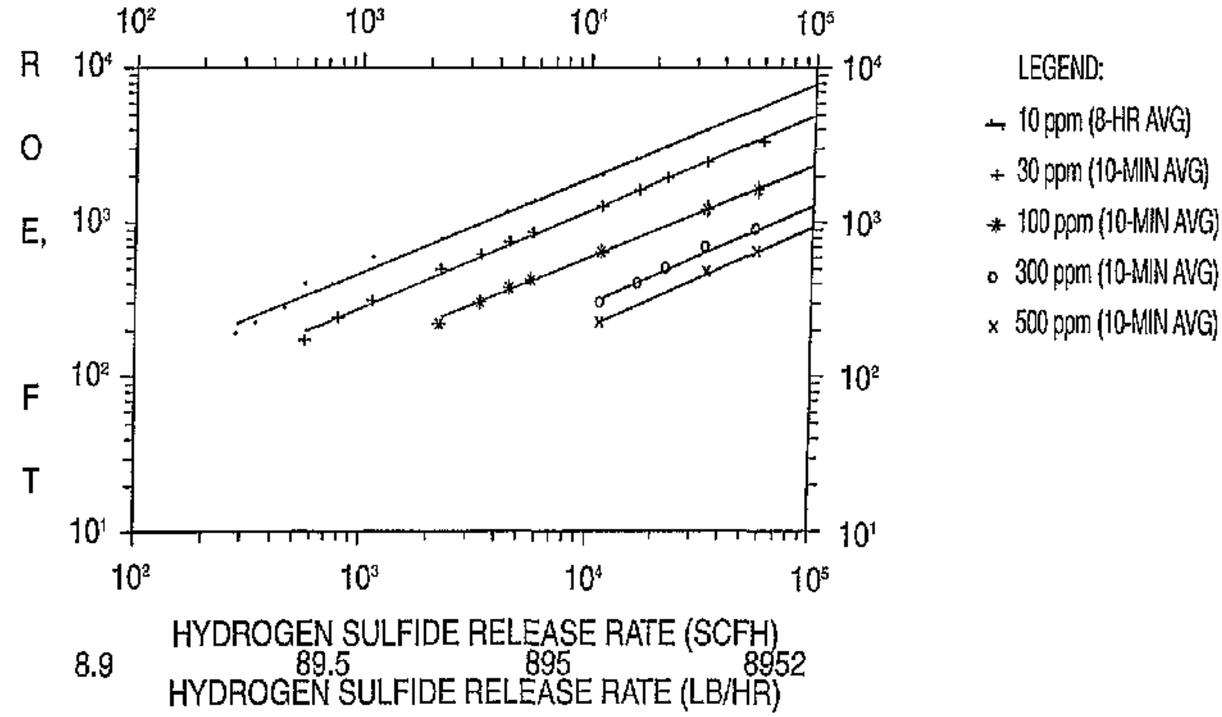


Figure C-1—Radius of Hydrogen Sulfide Exposure
Continuous Daytime Hydrogen Sulfide Releases [PG D (Neutral)—5 MPH Wind Speed]

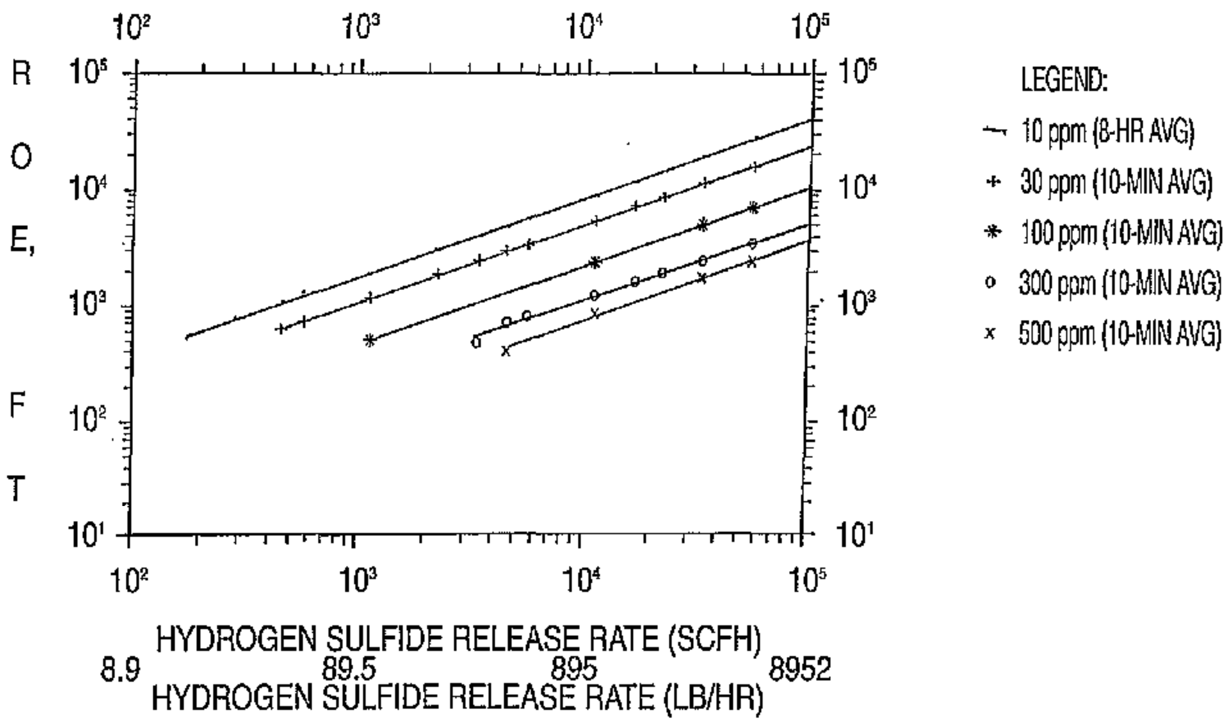


Figure C-2—Radius of Hydrogen Sulfide Exposure
Continuous Nighttime Hydrogen Sulfide Releases [PG F (Stable)—2.2 MPH Wind Speed]

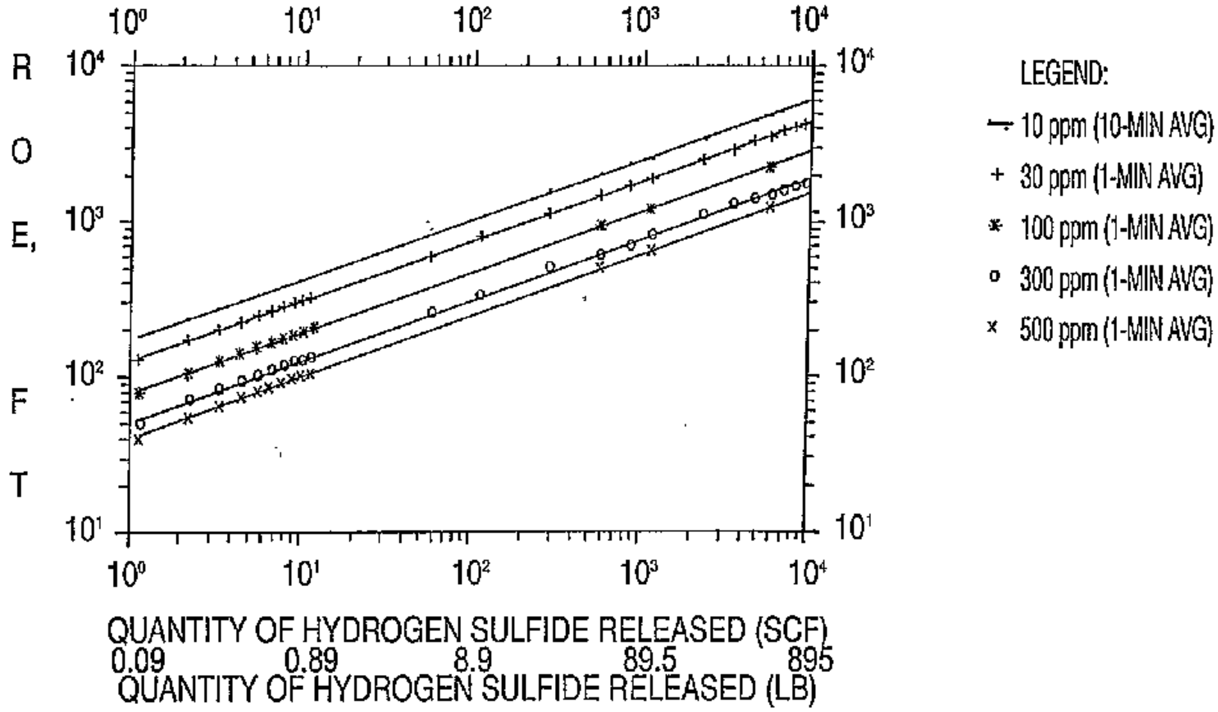


Figure C-3—Radius of Hydrogen Sulfide Exposure
Instantaneous Daytime Hydrogen Sulfide Releases [Slade A (Slightly Unstable)—5 MPH Wind Speed]

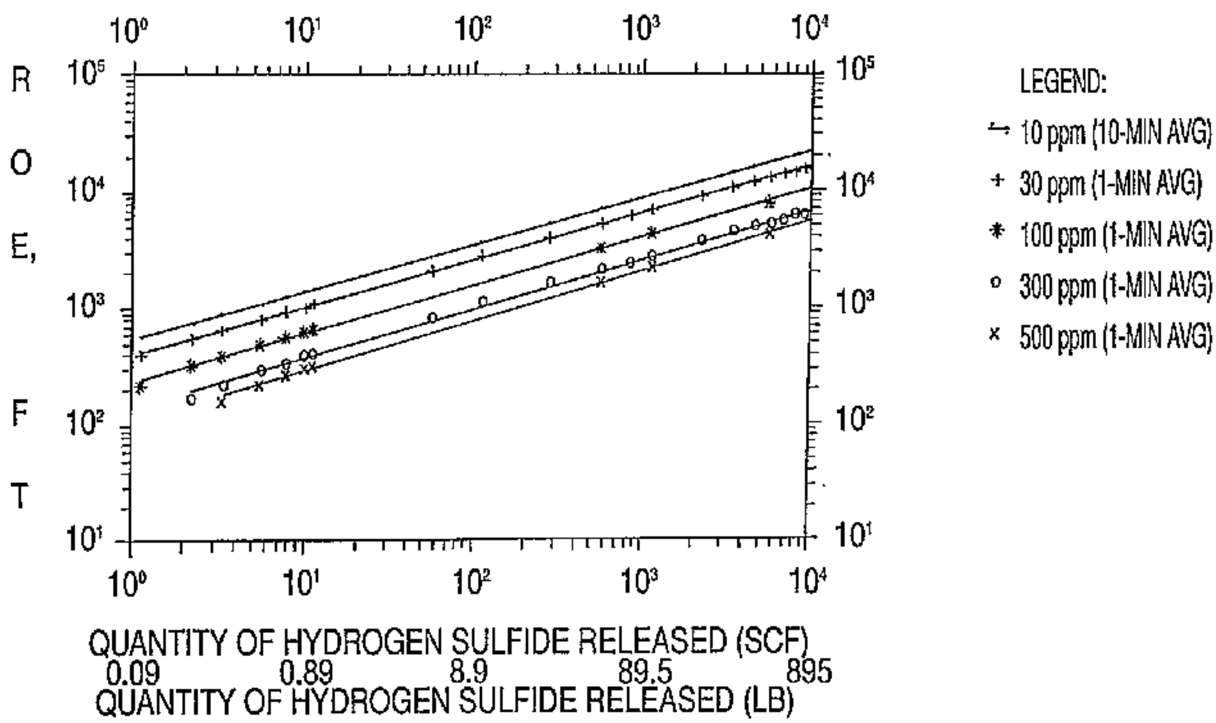


Figure C-4—Radius of Hydrogen Sulfide Exposure
Instantaneous Nighttime Hydrogen Sulfide Releases [Slade B (Neutral)—2.2 MPH Wind Speed]

were equivalent. This assumption results in conservative (worst case) estimates of the ROEs. The following meteorological conditions were assumed to be representative of worst case daytime and nighttime conditions. For continuous daytime releases a neutral Stability Class (PG D) and 5 miles per hour wind speed were chosen. For continuous nighttime releases, a stable Stability Class (PG F) and a 2.2 miles per hour wind speed were chosen. For instantaneous (puff) daytime releases, a slightly unstable Stability Class (Slade A) and a 5 miles per hour wind speed were chosen. For instantaneous nighttime releases, a neutral-to-stable Stability Class (Slade B) and a 2.2 miles per hour wind speed were chosen.

The ROEs for continuous hydrogen sulfide releases at 30, 100, 300, and 500 ppm are valid for averaging times of 10 minutes to 1 hour. The ROEs shown for 10 ppm (continuous hydrogen sulfide release) are based on an 8-hour average concentration, since 10 ppm represents the 8-hour time weighted average (TWA) for hydrogen sulfide. To obtain the 8-hour/10 ppm average concentration a factor of 0.7 was used to convert the 1-hour concentrations (refer to EPA-450/4-88-009: *A Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants*). The ROEs for the puff (instantaneous) hydrogen sulfide releases at 30, 100, 300, and 500 ppm are valid for averaging times of 1 to 10 minutes. EPA's 0.7 conversion factor was used to obtain the 10 minute/10 ppm time averaged concentrations from instantaneous peak concentrations predicted by the model. For continuous releases, the EPA considers 10-minute and 1-hour averaging times to be equivalent. The modeling reported herein assumed that an instantaneous release would be of a very short duration (10 to 15 minutes maximum).

Brief descriptions of the models used to predict the ROEs for both continuous and puff (instantaneous) hydrogen sulfide releases are presented in Par. C.13.

C.3 Results

ROEs for atmospheric plume-centerline, ground-level concentrations of hydrogen sulfide resulting from instantaneous and continuous hydrogen sulfide releases were predicted and are presented in Figures C-1 through C-4. Figures C-1 and C-2 present the predicted ROEs for continuous hydrogen sulfide releases during worst case daytime and nighttime meteorological conditions, respectively. Figures C-3 and C-4 present the predicted ROEs for instantaneous hydrogen sulfide releases during worst case daytime and nighttime meteorological conditions, respectively. The ROEs for concentrations of 10, 30, 100, 300 and 500 ppm were modeled for both release types. The 10 ppm concentration ROEs represent an 8-hour averaging time for the continuous hydrogen sulfide release and a 10-minute averaging time for the instantaneous release. The 30, 100, 300, and 500 ppm concentration ROEs represent a 10-minute averaging time for the continuous hydrogen sulfide release and a 1-minute averaging time for the instantaneous release. A hydrogen sulfide release rate range of 10 to 10,000 lb/hr (111.8 to 111,765 SCFH) was modeled for the continuous type release. For the puff (instantaneous) type hydrogen sulfide release, a release quantity range of 0.1 to 1000 lbs (1.1 to 11,177 SCF) was modeled. If the hydrogen sulfide release is based on pounds, standard cubic feet (SCF) can be obtained by multiplying pounds by a factor of 11.2.

Note: The ROEs presented in Figures C-1 through C-4 are plotted against the amount of hydrogen sulfide released. For the release of a multi-component gas stream, the actual amount of hydrogen sulfide released should be used to determine the ROE.

Equation coefficients based on linear regression for predicting the ROE as a function of the release type (continuous/puff) and quantity/rate of hydrogen sulfide released for both daytime and nighttime meteorological conditions are presented in Table C-1. The equation is given in Par. C.8. The coefficients are applicable only over the ranges presented in Figures C-1 through C-4, and extrapolation could result in overly conservative estimates of the ROEs. Any release lasting significantly longer than 15 minutes should be interpreted as a continuous release. The modeling work presented in Appendix C assumes steady-state meteorological conditions. ROEs predicted for a long averaging time (8-hour) and long downwind distances are conservative because it is unlikely that the same meteorological conditions will persist during that time period.

C.4 Additional Considerations

The modeling work presented in Appendix C assumes a neutrally-buoyant, gaseous hydrogen sulfide release in flat, rural terrain under steady-state meteorological conditions. Also, the ROEs shown in Figures C-1 through C-4 are for a generic class of hydrogen sulfide releases covering a wide range of site and release conditions. Actual ROEs will be dependent on the specifics of the type of release, release conditions, and release site. For instance, the ROEs for a release in a more urban setting where structures, buildings, etc. are present will be reduced significantly due to structure-induced turbulence. Some other conditions that could significantly affect the actual ROE include: a liquid/aerosol release, dense cloud behavior, a buoyant cloud (plume liftoff), a jet release, time-dependent release (well blowout, pipeline ruptures, etc.), and complex terrain. If any of these phenomena are present, then more rigorous modeling may be necessary.

The ROE curves of Figures C-1 through C-4 should not be used when the mixture of hydrogen sulfide and carrier gas being dispersed is significantly heavier than air and the mixture is released at a low velocity. If the hydrogen sulfide/carrier gas mixture specific gravity exceeds approximately 1.2, Figures C-1 through C-4 may not give conservative ROEs for all release rates and meteorological conditions. Hydrogen sulfide, as encountered in the petroleum industry, is usually a minor constituent of a carrier gas, such as natural gas or carbon dioxide. Carbon dioxide has a specific gravity of 1.52. Dispersion predictions for hydrogen sulfide/carbon dioxide mixtures, using a dense gas model sometimes underpredict hydrogen sulfide ROEs for low velocity gas releases. Low velocity gas releases would include those with initial velocities less than 200 feet/second and releases greater than 200 feet/second involve impact of the gas jet from the leak with a nearby surface, thereby breaking the jet's momentum. Likewise, Figures C-1 through C-4 should not be used with any hydrogen sulfide/carrier gas release that potentially could form an aerosol.

Figures C-1 through C-4 can also substantially overpredict ROEs. In the case of hydrogen sulfide/carrier gas mixtures significantly lighter than air (i.e., specific gravity less than 0.8) released at low velocity, use of these illustrations may overpredict ROEs by a factor of 2 to 3. Use of these illustrations can result in overestimation of ROEs for high velocity hydrogen sulfide/carrier gas releases (i.e., gas release velocities greater than 200 feet/second) regardless of the orientation of the release. However, this overprediction is particularly significant in the case of vertical, high-velocity releases. In such situations, the overprediction can be two orders of magnitude. The user should consult more rigorous atmospheric dispersion models.

When calculating the ROE for dilute concentrations of hazardous gases, a significant overestimation can result. For example, it would not be practical to expect higher downwind atmospheric concentrations than are present in the released gas stream. The user should consult more rigorous atmospheric dispersion models.

In summary, the composition of the hydrogen sulfide/carrier gas and the velocity and orientation of the release are critical variables, dramatically affecting predicted hydrogen sulfide ROEs. Also, other variables, such as released gas temperature and flashing or aerosol formation involving liquid containing dissolved hydrogen sulfide, can have significant impacts on ROE predictions. Accurate atmospheric dispersion techniques are, of necessity, complex. Under some circumstances, such as those mentioned above, more rigorous modeling may be required.

References and models are available to address special release scenarios. A partial list of models that may be used in such cases is shown in Pars. C.5 and C.6. API does not endorse any one particular model. Further guidance on appropriate model selection and application can be obtained from the model developers as well as other individuals experienced in this field. A specific reference to address well blowout and pipeline ruptures is *"Release and Dispersion of Gas from Pipe Line Ruptures,"* Wilson, D. J., Department of Mechanical Engineering, University of Alberta, Edmonton, Canada.

In the event that hydrogen sulfide release quantities calculated by the user are below the ranges shown in Figures C-1 through C-4, extensions of the ROE curves are allowed to a minimum ROE of 50 feet. In some cases, ROEs of less than 50 feet may be inferred from extrapolation of the curves. Figures C-1 through C-4 were developed using an assumed release height plus plume rise of 10 feet. Actual release heights of other than 10 feet will result in different ROEs.

C.5 Proprietary Dispersion Models

Note: Users should carefully evaluate applicability of these models to prevailing conditions.

A list of some proprietary models that can be used to address special site-specific scenarios follows:

CHARM—(Radian Corporation): CHARM is a Gaussian puff model for continuous and instantaneous releases of gases or liquids. The model is configured to handle chemicals that are buoyant, neutrally buoyant, and heavier than air. Heavy gas dispersion is estimated using the Eidsvik model. Source components in the model include a modified version of Shell Oil Company's SPILLS Model. (Radian Corp., 8501 MOPAC Blvd., Austin, TX 78759.)

FOCUS—(Quest Consultants, Inc.): FOCUS is a modeling package that includes both emission rate models (two-phase discharges, pool evaporation, jet vapor releases, etc.) and dispersion models for both neutrally-buoyant and dense-gas plumes. The models can be run separately or in a linked mode. (Quest Consultants, Inc., 908 26th Avenue, NW, Suite 103, Norman, OK 73069-6216.)

TRACE—(Dupont): TRACE uses a multiple Lagrangian Wall dispersion model to handle both puff and continuous releases. Wind channeling can be incorporated. Liquid evaporation and buoyancy effects are considered also. (E. I. Dupont de Nemours & Company, 5700 Corea Avenue, Westlake Village, CA 91362.)

WHAZAN—(Technica International): WHAZAN is a package of dispersion models for both neutrally-buoyant and dense-gas plumes. Submodels are included to handle two-phase discharges, evaporation, and vapor dispersion as a free jet. The model can be run both individually and in a linked mode. (Technica International Associates, Inc., Box 187, Woodstock, GA 30128-4420.)

C.6 Publicly-available Models

Note: Users should carefully evaluate applicability of these models to prevailing conditions.

A list of some publicly-available models that can be used to address special site-specific scenarios follows:

DEGADIS—(U. S. Coast Guard): DEGADIS, the Dense Gas Dispersion Model, is designed to simulate dispersion of heavier-than-air gas releases. It can handle both evaporative emissions from liquid spills and jet emissions. It is basically steady-state but simulates transient conditions by a series of steady-state calculations. Vapor generation rate, spill area, and meteorological parameters are important inputs to the model. Information available through National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

HEGADAS—(Shell Research B.V.): HEGADAS is a dispersion model for neutrally-buoyant and dense gases. The basic model components are solutions to the advection/diffusion equations and are in the standard form of Gaussian dispersion models. The model can handle a wide variety of source types, including transient horizontal jets. Information available through National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

SLAB—(Lawrence Livermore National Laboratory): SLAB is designed for application to dense gases that are emitted from liquid spills. The model considers the concentration integrated over a cross-section perpendicular to the plume centerline. The downwind variation of the integrated concentration is calculated. The size and emission rate of the liquid spill are required inputs to the model. Information available through Lawrence Livermore National Laboratory, Box 808, Livermore, CA 94550, or contact American Petroleum Institute, Health & Environmental Sciences Department, 1220 L Street, NW, Washington, D.C. 20005.

C.7 Sample Calculations for Figures C-1 through C-4

The following calculations may be used to estimate volume and mass of hydrogen sulfide when total gas volume and its hydrogen sulfide content are known:

Continuous Release.

Assume: Release of 5,000,000 SCFD of natural gas containing 8,000 ppm (by volume) of hydrogen sulfide.

Note: The user must know both the volume (or flow rate) of natural gas and its hydrogen sulfide concentration so that Figures C-1 through C-4 can be effectively used.

To determine standard cubic feet per hour (SCFH) of hydrogen sulfide released, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{5{,}000{,}000 \text{ SCFD} \times 8{,}000 \text{ ppm } H_2S}{24{,}000{,}000}$$
$$= 1{,}667 \text{ SCFH of } H_2S \text{ released.}$$

To determine the pounds of hydrogen sulfide released per hour, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{5{,}000{,}000 \text{ SCFD} \times 8{,}000 \text{ ppm } H_2S}{267{,}605{,}634}$$
$$= 150 \text{ lb/hr of } H_2S \text{ released.}$$

Instantaneous Release.

Assume: Release of 100,000 SCF of natural gas containing 8,000 ppm (by volume) of hydrogen sulfide. Also, assume this example is a daytime release, 5 miles per hour wind speed (refer to Figure C-3).

To determine the volume (SCF) of hydrogen sulfide released, the following calculations should be performed using appropriate values for the conditions being evaluated:

$$\frac{100{,}000 \text{ SCF} \times 8{,}000 \text{ ppm H2S}}{1{,}000{,}000}$$
$$= 800 \text{ SCF of } H_2S \text{ released}$$

After applying the appropriate calculations and using known factors to arrive at either hydrogen sulfide release rate or quantity of hydrogen sulfide released, refer to the appropriate chart (Figs. C-1 through C-4) or the equation in Par. C.8 (example calculations in Pars. C.9 through C.12) for obtaining radius of exposure (ROE) information.

The following equation can be used to convert percent hydrogen sulfide to parts per million on a volume basis:

$$\text{Percent } H_2S \times 10{,}000 = \text{ppm } H_2S$$

C.8 Radius of Exposure (ROE) Calculation

Using the values of coefficients "A" and "B" in Table C-1, the radius of exposure (ROE) for various hydrogen sulfide release rates (H_2S) can be mathematically predicted using the following equation:

$$\text{ROE} = \text{Antilog } [A \times \log (H_2S) + B]$$

For a continuous release, enter the hydrogen sulfide release rate (H_2S) in standard cubic feet per hour (SCFH). For a puff (instantaneous) release, enter the quantity of hydrogen sulfide (H_2S) released in standard cubic feet (SCF).

C.9 Sample Calculation—Continuous Release (Daylight)

Determine the $\text{ROE}_{100\text{ ppm}}$ for a continuous release of 100 percent hydrogen sulfide gas at a rate of 11,170 SCFH in daylight (PG D stability) conditions and 5 mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A = 0.58; B = 0.45. Using the equation in Par. C.8:

$$\text{ROE}_{100\text{ ppm}} = \text{Antilog } [0.58 \times \log (11{,}170) + 0.45] = 628 \text{ feet.}$$

C.10 Sample Calculation—Continuous Release (Nighttime)

Determine the $\text{ROE}_{100\text{ ppm}}$ for a continuous release of 100 percent hydrogen sulfide gas at a rate of 11,170 SCFH in nighttime (PG F stability) conditions and 2.2 mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A = 0.66; B = 0.69. Using the equation in Par. C.8:

$$\text{ROE}_{100\text{ppm}} = \text{Antilog } [0.66 \times \log (11{,}170) + 0.69]$$
$$= 2{,}300 \text{ feet}$$

C.11 Sample Calculation—Instantaneous Release (Daylight)

Determine the ROE_{100ppm} for an instantaneous release of 100 percent hydrogen sulfide gas of 1,117 SCF in daylight (Slade A stability) conditions and 5 mph wind speed. Using Table C-1, the coefficients applicable to this scenario are: A = 0.39; B = 1.91. Using the equation in Par. C.8:

ROE_{100ppm} = Antilog [0.39 × log (1,117) + 1.91] = 1,255 feet.

C.12 Sample Calculation—Instantaneous Release (Nighttime)

Determine the ROE_{100ppm} for an instantaneous release of 100 percent hydrogen sulfide gas of 1,117 SCF in nighttime (Slade B stability) conditions and 2.2 mph wind speed. From Table C-1, the coefficients applicable to this scenario are: A = 0.40; B = 2.40. Using the equation in Par. C.8:

ROE_{100ppm} = Antilog [0.40 × log (1,117) + 2.40] = 4,161 feet.

C.13 Descriptions of Gaussian and Puff Dispersion Models

C.13.1 INTRODUCTION

The emergency response Gaussian and Puff screening models are designed to predict the downwind dispersion (plume-centerline, ground-level concentration and maximum ground-level plume width as a function of downwind distance) of a neutrally-buoyant, steady-state point source gaseous release under steady-state meteorological conditions. Classical EPA-approved Gaussian dispersion theory is applied in the models. The programs are in BASIC and are designed for use on personal computers. The models are described below. The program listings and runs should use the IDLH, ERPG-2, and TLV and STEL levels as the concentrations of interest because they usually are the concentration values of concern. Both models can be run for other concentrations by substituting the values of interest in place of the values for IDLH, ERPG-2, and TLV and STEL in the computer programs. Copies of the example program listings and computer runs are available on request from American Petroleum Institute, Exploration & Production Department, 700 North Pearl Street, Suite 1840, Dallas, Texas 75201-2845.

C.13.2 Gaussian Model

This model calculates the plume-centerline, ground-level concentration, and maximum ground-level plume width for a single, steady-state, continuous-point release at user-specified, steady-state meteorological conditions and downwind distances. The model uses standard Gaussian dispersion modeling with Pasquill-Gifford dispersion coefficients. The user inputs the release rate, effective release height (release height plus plume rise), nominal wind speed, incremental downwind distance for which calculations are to be made, type of material released, and the stability class. A total of eight compounds are currently accepted by this model. Additional compounds can be entered by replacing compounds presently in the model. The model uses a default D Stability Class; but, can be run with any of the standard six Pasquill-Gifford Stability Classes (A, B, C, D, E, or F—with A being the most unstable and F being the most stable).

C.13.3 Puff Model

This model calculates the plume-centerline, ground-level concentration, and maximum ground-level plume width for a single, instantaneous-point release at user-specified, steady-state meteorological conditions and downwind distances. The model uses standard Gaussian dispersion theory for an instantaneous (puff) release with Slade dispersion coefficients. User inputs to the model are the same as those used in the Gaussian model except that the total amount of material released is entered rather than the rate of release. Three values are accepted for the Stability Class (A, B, or C—with A being unstable, B being neutral, and C being stable).

APPENDIX D—DEFINITION OF A SOUR ENVIRONMENT (REPRINTED FROM *NACE STANDARD MR0175-94: STANDARD MATERIAL REQUIREMENTS SULFIDE STRESS CRACKING RESISTANT METALLIC MATERIALS FOR OILFIELD EQUIPMENT*[24])

D.1 Sour Environments

D.1.1 Sour Environments are defined as fluids containing water as a liquid and hydrogen sulfide exceeding the limits defined in Pars. D.1.1.1 and D.1.1.2; these environments may cause sulfide stress cracking (SSC) of susceptible materials.

CAUTION: It should be noted that highly susceptible materials may fail in less severe environments. The SSC phenomenon is affected by complex interactions of parameters including:

a. chemical composition, strength, heat treatment, and microstructure of the material;
b. hydrogen ion concentration (pH) of the environment;
c. hydrogen sulfide concentration and total pressure;
d. total tensile stress (applied plus residual);
e. temperature; and
f. time.

The user shall determine whether the environmental conditions fall within the scope of this standard. (*Editorial Comment:* The critical hydrogen sulfide levels in D.1.1.1 and D.1.1.2 and Figures D-1 and D-2 were developed from data derived from low alloy steel.)

D.1.1.1 Sour Gas

Materials shall be selected to be resistant to SSC or the environment should be controlled if the gas being handled is at a total pressure of 0.4 MPa (65 psia) or greater and if the partial pressure of hydrogen sulfide in the gas is greater than 0.0003 MPa (0.05 psia). Systems operating below 0.4 MPa (65 psia) total pressure or below 0.0003 MPa (0.05 psia) hydrogen sulfide partial pressure are outside the scope of this standard. Partial pressure is determined by multiplying the mole fraction (mol % ÷ 100) of hydrogen sulfide in the gas by the total system pressure. Figure D-1 provides a convenient method for determining whether the partial pressure of hydrogen sulfide in a sour environment exceeds 0.0003 MPa (0.05 psia). A few examples are provided:

a. partial pressure of hydrogen sulfide in a system containing 0.01 mol % hydrogen sulfide (100 ppm or 6.7 grains per 100 standard cubic feet [SCF]) at a total pressure of 7 MPa (1,000 psia) exceeds 0.0003 MPa (0.05 psia) (Point A on Figure D-1).
b. partial pressure of hydrogen sulfide in a system containing 0.005 mol % hydrogen sulfide (50 ppm or 3.3 grains per 100 SCF) at a total pressure of 1.4 Mpa (200 psia) does not exceed 0.0003 Mpa (0.05 psia) (Point B on Figure D-1).

D.1.1.2 Sour Oil and Multiphases

Sour crude oil systems that have operated satisfactorily using standard equipment are outside the scope of this standard when the fluids being handled are either crude oil, or two- or three-phase crude, water, and gas when:

a. the maximum gas:oil ratio is 5000 SCF:bbl (barrel of oil);
b. the gas phase contains a maximum of 15% hydrogen sulfide;
c. the partial pressure of hydrogen sulfide in the gas phases is a maximum of 0.07 MPa (10 psia);
d. the surface operating pressure is a maximum of 1.8 MPa (265 psia) (see Figure D-2); and
e. when pressure exceeds 1.8 MPa (265 psia), refer back to D.1.1.1.

The satisfactory service of the standard equipment in these low-pressure systems is believed to be a result of the inhibitive effect of the oil and the low stresses encountered under the low-pressure conditions.

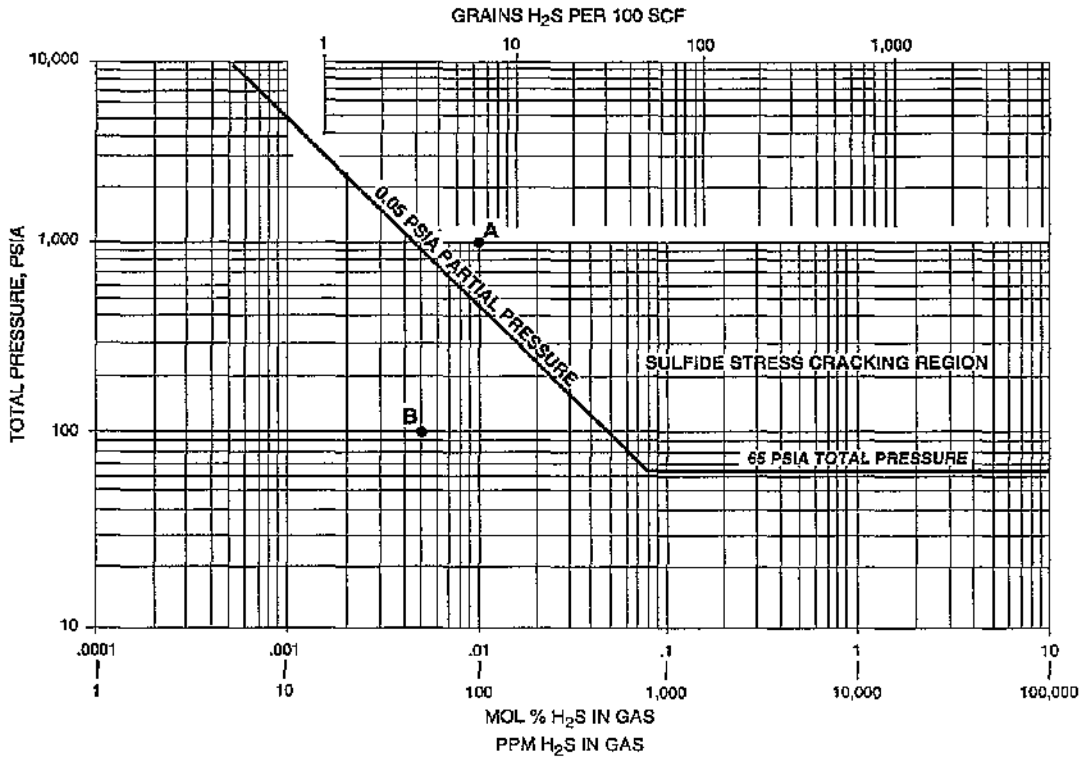
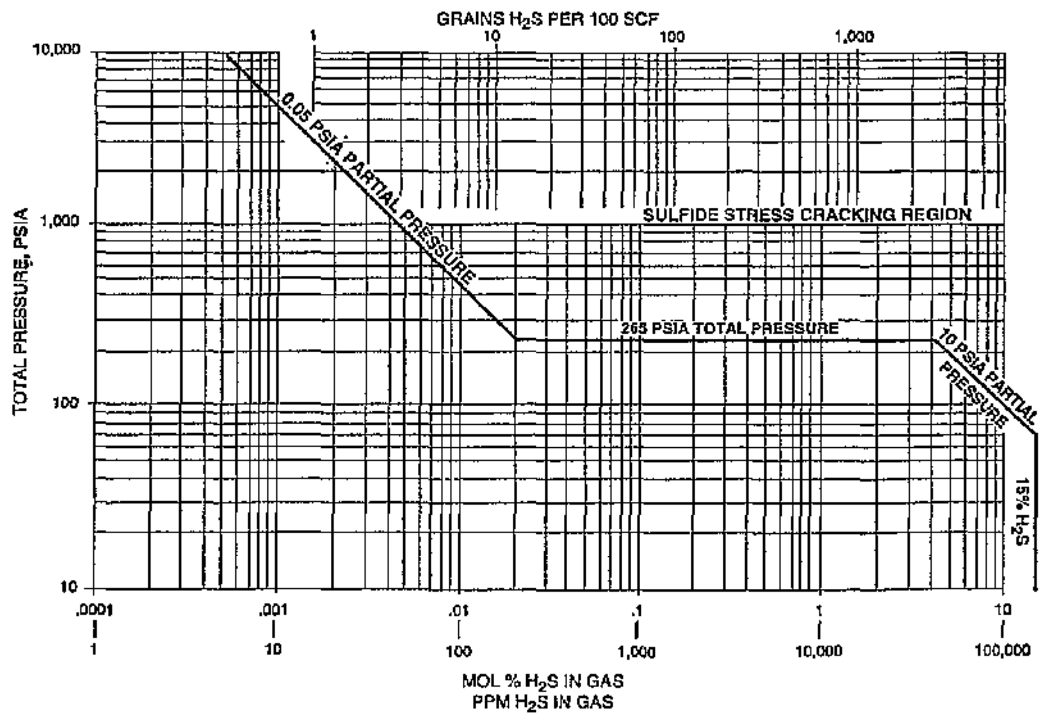


Figure D1*—Sour Gas Systems (Refer to Par. D.1.1.1)



Metric Conversion Factor: 1 MPa = 145.089 psia

Figure D2*—Sour Multiphase Systems (Refer to Par. D.1.1.2)

ATTACHMENT II.3.C

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE

OCD FORM C-138

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-138
Revised August 1, 2011

*Surface Waste Management Facility Operator and Generator shall maintain and make this documentation available for Division inspection.

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE

1. Generator Name and Address:

2. Originating Site:

3. Location of Material (Street Address, City, State or ULSTR):

4. Source and Description of Waste:

Estimated Volume ____________ yd^3 / bbls   Known Volume (to be entered by the operator at the end of the haul) ____________ yd^3 / bbls

5. GENERATOR CERTIFICATION STATEMENT OF WASTE STATUS

I, ____________________________, representative or authorized agent for ____________________________ do hereby certify that according to the Resource Conservation and Recovery Act (RCRA) and the US Environmental Protection Agency's July 1988 regulatory determination, the above described waste is: (Check the appropriate classification)

☐ RCRA Exempt: Oil field wastes generated from oil and gas exploration and production operations and are not mixed with non-exempt waste. *Operator Use Only: Waste Acceptance Frequency* ☐ *Monthly* ☐ *Weekly* ☐ *Per Load*

☐ RCRA Non-Exempt: Oil field waste which is non-hazardous that does not exceed the minimum standards for waste hazardous by characteristics established in RCRA regulations, 40 CFR 261.21-261.24, or listed hazardous waste as defined in 40 CFR, part 261, subpart D, as amended. The following documentation is attached to demonstrate the above-described waste is non-hazardous. (Check the appropriate items)

☐ MSDS Information ☐ RCRA Hazardous Waste Analysis ☐ Process Knowledge ☐ Other (Provide description in Box 4)

GENERATOR 19.15.36.15 WASTE TESTING CERTIFICATION STATEMENT FOR LANDFARMS

I, ____________________________, representative for ____________________________ do hereby certify that representative samples of the oil field waste have been subjected to the paint filter test and tested for chloride content and that the samples have been found to conform to the specific requirements applicable to landfarms pursuant to Section 15 of 19.15.36 NMAC. The results of the representative samples are attached to demonstrate the above-described waste conform to the requirements of Section 15 of 19.15.36 NMAC.

5. Transporter:

OCD Permitted Surface Waste Management Facility

Name and Facility Permit #:

Address of Facility:

Method of Treatment and/or Disposal:

☐ Evaporation ☐ Injection ☐ Treating Plant ☐ Landfarm ☐ Landfill ☐ Other

Waste Acceptance Status:

☐ **APPROVED** ☐ **DENIED** (Must Be Maintained As Permanent Record)

PRINT NAME: ____________________________ TITLE: ____________________ DATE: ____________

SIGNATURE: ____________________________ TELEPHONE NO.: ____________________
Surface Waste Management Facility Authorized Agent

ATTACHMENT II.3.D

DAILY AIR AND WATER INSPECTION REPORT FORM H_2S MONITOR (TYPICAL)

ATTACHMENT II.3.D - Daily Air and Water Inspection Report Form H_2S Monitor (Typical)

YEAR___________ MONTH_______________ WEEK BEGINNING______________

AMBIENT AIR WIND SPEED/DIRECTION
A.AM READINGS, NOTE INTIALS AND TIME
B.PM READINGS, NOTE INTIALS AND TIME
SUMP LEVELS
A. POND AND SLAB CHECKED DAILY,NOTE INTIALS AND TIME
B. PUMP SUMP CHECKED AM & PM,NOTE INTIALS AND TIME
C. LOADING AREA SUMP CHECKED AM & PM, NOTE INTIALS AND TIME

LOADING SUMP EMPTIED
A. LOADING AREA SUMP EMPTIED AT 4 PM, NOTE INTIALS AND TIME
CONCRETE SLAB EMPTIED
A.SLAB EMPTIED AT 4 PM, NOTE INTIALS AND TIME

Date	Sun	Mon	Tues	Wed	Thu	Fri	Sat
Ambient Air H2S (AM)							
H2S Reading (ppm)							
Wind Speed (mph)							
Wind Direction							
Initials and Time							
Ambient Air H2S (PM)							
H2S Reading (ppm)							
Wind Speed (mph)							
Wind Direction							
Initials and Time							
Sump Levels							
AM Pond Sump (ft)							
AM Cement Slab (ft)							
AM Loading Area (ft)							
AM Pump House Sump (ft)							
Intials and Time							
PM Loading Area (ft)							
PM Pump House(ft)							
Intials and Time							
Loading Sump Emptied							
Intials and Time							
H2S Monitors							
Concrete Slab Emptied							
Intials and Time							
H2S Monitors							
Pond Conditions							
Pond Level							
Overflow Color							
Pond Color							
Water Temperature							
pH							
Dissolved Oxygen							
H2S Monitors							
Total Chlorine							
Dissolved H2S/Sulfides							
Bleach/Chemical							
Volume							
Time							
Initials							
Volume							
Time							
Initials							
Volume							
Time							
Initials							
Manager Verification							
Intials and Time							

ATTACHMENT II.3.E

INCIDENT REPORT FORM (TYPICAL)

INCIDENT REPORT FORM

Facility Information

Facility Name: ____

Location: ____

Permit No: ______________________ Phone No: ____________________

Type of Incident and General Information

- ❑ Work Related Injury/Illness
- ❑ Property Damage
- ❑ Vehicular Accident
- ❑ Unsafe Act/Near Miss
- ❑ Vandalism/Criminal Activity
- ❑ Other _______________ (i.e., spill, release, fire, explosion, hot load, etc.)

Employee Name: ______________________ Job Title: ____________________

Phone No: ___________ Date of Incident: _________ Time of Incident: _______ AM/PM

Location of Incident: ____

Start of Shift:______________________ Weather:____________________

Date and Time Reported to Management: Date: ___________ Time: _________ AM/PM

Reported to: _______________ Title: _______________ Reported by: ____________

What was the injury category of incident at the time it was first reported to management?

[ ] N/A. Employee does not claim an injury associated with this incident
[ ] Notice Only of Injury, Declined Medical Treatment at this time
[ ] First Aid done on site, Declined Medical Treatment at this time
[ ] Medical Treatment. Transported by ________________ to ________________
[ ] Fatality, employee

THIS SECTION FILLED OUT BY **EMPLOYEE**

Employee's Description of Incident / Declaración del empleado de los hechos

Were you injured? *(Ud. se lastimó ?)* **Yes [ ]** **No [ ]**

Type of Injury: *(Tipo de lesión)* ______________________________________

Part of Body: ______________________ Left ___________ Right ___________
(Parte del cuerpo) *(Izq)* *(Der)*

Explain in your own words what happened. *(Explique en sus propias palabras lo que sucedió)*

____

____

____

____

____

Employee Signature: (*Firma del empleado*) ______________________________

Date: (*Fecha*) ____

INCIDENT REPORT FORM

TO BE FILLED OUT BY EMERGENCY COORDINATOR

Describe in order of occurrence the events leading to the incident and/or injury. Reconstruct the sequence of events that led to the incident. ______________________________

____

____

____

Identify possible hazards to human health or the environment: ______________________________

____

____

____

Identify name and quantity of material(s) involved: ______________________________

____

____

____

CORRECTIVE ACTIONS. (Equipment, Practices, Environment, Retraining) Steps that have been, or will be taken to prevent recurrence: ______________________________

____

____

____

Date Corrective Action Completed: ______________________________

- I have been briefed on the corrective actions outlined above
- *Estoy consciente de las acciones correctivas mencionadas anteriormente en esta hoja*

____
Employee's Signature

____
Date

Report Reviewed and Concluded By:

____
Emergency Coordinator's Signature

____
Date

ATTACHMENT II.3.F

RELEASE NOTIFICATION AND CORRECTIVE ACTION

OCD FORM C-141

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-141
Revised August 24, 2018
Submit to appropriate OCD District office

Incident ID	
District RP	
Facility ID	
Application ID	

Release Notification

Responsible Party

Responsible Party	OGRID
Contact Name	Contact Telephone
Contact email	Incident # *(assigned by OCD)*
Contact mailing address	

Location of Release Source

Latitude ______________________ Longitude ______________________
(NAD 83 in decimal degrees to 5 decimal places)

Site Name	Site Type
Date Release Discovered	API# *(if applicable)*

Unit Letter	Section	Township	Range	County

Surface Owner: ☐ State ☐ Federal ☐ Tribal ☐ Private (*Name:* ______________________)

Nature and Volume of Release

Material(s) Released (Select all that apply and attach calculations or specific justification for the volumes provided below)

☐ Crude Oil	Volume Released (bbls)	Volume Recovered (bbls)
☐ Produced Water	Volume Released (bbls)	Volume Recovered (bbls)
	Is the concentration of dissolved chloride in the produced water >10,000 mg/l?	☐ Yes ☐ No
☐ Condensate	Volume Released (bbls)	Volume Recovered (bbls)
☐ Natural Gas	Volume Released (Mcf)	Volume Recovered (Mcf)
☐ Other (describe)	Volume/Weight Released (provide units)	Volume/Weight Recovered (provide units)
Cause of Release		

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Was this a major release as defined by 19.15.29.7(A) NMAC? ☐ Yes ☐ No	If YES, for what reason(s) does the responsible party consider this a major release?
If YES, was immediate notice given to the OCD? By whom? To whom? When and by what means (phone, email, etc)?	

Initial Response

The responsible party must undertake the following actions immediately unless they could create a safety hazard that would result in injury

☐ The source of the release has been stopped.

☐ The impacted area has been secured to protect human health and the environment.

☐ Released materials have been contained via the use of berms or dikes, absorbent pads, or other containment devices.

☐ All free liquids and recoverable materials have been removed and managed appropriately.

If all the actions described above have not been undertaken, explain why:

Per 19.15.29.8 B. (4) NMAC the responsible party may commence remediation immediately after discovery of a release. If remediation has begun, please attach a narrative of actions to date. If remedial efforts have been successfully completed or if the release occurred within a lined containment area (see 19.15.29.11(A)(5)(a) NMAC), please attach all information needed for closure evaluation.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: ____________

email: ______________________________ Telephone: ______________________

OCD Only

Received by: ______________________________ Date: ____________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Site Assessment/Characterization

This information must be provided to the appropriate district office no later than 90 days after the release discovery date.

What is the shallowest depth to groundwater beneath the area affected by the release?	_________ (ft bgs)
Did this release impact groundwater or surface water?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a continuously flowing watercourse or any other significant watercourse?	☐ Yes ☐ No
Are the lateral extents of the release within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark)?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of an occupied permanent residence, school, hospital, institution, or church?	☐ Yes ☐ No
Are the lateral extents of the release within 500 horizontal feet of a spring or a private domestic fresh water well used by less than five households for domestic or stock watering purposes?	☐ Yes ☐ No
Are the lateral extents of the release within 1000 feet of any other fresh water well or spring?	☐ Yes ☐ No
Are the lateral extents of the release within incorporated municipal boundaries or within a defined municipal fresh water well field?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a wetland?	☐ Yes ☐ No
Are the lateral extents of the release overlying a subsurface mine?	☐ Yes ☐ No
Are the lateral extents of the release overlying an unstable area such as karst geology?	☐ Yes ☐ No
Are the lateral extents of the release within a 100-year floodplain?	☐ Yes ☐ No
Did the release impact areas **not** on an exploration, development, production, or storage site?	☐ Yes ☐ No

Attach a comprehensive report (electronic submittals in .pdf format are preferred) demonstrating the lateral and vertical extents of soil contamination associated with the release have been determined. Refer to 19.15.29.11 NMAC for specifics.

Characterization Report Checklist: ***Each of the following items must be included in the report.***

☐ Scaled site map showing impacted area, surface features, subsurface features, delineation points, and monitoring wells.
☐ Field data
☐ Data table of soil contaminant concentration data
☐ Depth to water determination
☐ Determination of water sources and significant watercourses within ½-mile of the lateral extents of the release
☐ Boring or excavation logs
☐ Photographs including date and GIS information
☐ Topographic/Aerial maps
☐ Laboratory data including chain of custody

If the site characterization report does not include completed efforts at remediation of the release, the report must include a proposed remediation plan. That plan must include the estimated volume of material to be remediated, the proposed remediation technique, proposed sampling plan and methods, anticipated timelines for beginning and completing the remediation. The closure criteria for a release are contained in Table 1 of 19.15.29.12 NMAC, however, use of the table is modified by site- and release-specific parameters.

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature:______________________________ Date: ____________

email: ______________________________ Telephone: ______________________________

OCD Only

Received by: ______________________________ Date**:** ______________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Remediation Plan

Remediation Plan Checklist: ***Each of the following items must be included in the plan.***

☐ Detailed description of proposed remediation technique
☐ Scaled sitemap with GPS coordinates showing delineation points
☐ Estimated volume of material to be remediated
☐ Closure criteria is to Table 1 specifications subject to 19.15.29.12(C)(4) NMAC
☐ Proposed schedule for remediation (note if remediation plan timeline is more than 90 days OCD approval is required)

Deferral Requests Only: ***Each of the following items must be confirmed as part of any request for deferral of remediation.***

☐ Contamination must be in areas immediately under or around production equipment where remediation could cause a major facility deconstruction.

☐ Extents of contamination must be fully delineated.

☐ Contamination does not cause an imminent risk to human health, the environment, or groundwater.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____________________ Title: ____________________

Signature: ____________________ Date: __________

email: ____________________ Telephone: ____________________

OCD Only

Received by: ____________________ Date: __________

☐ Approved ☐ Approved with Attached Conditions of Approval ☐ Denied ☐ Deferral Approved

Signature: ____________________ Date: __________

State of New Mexico
Oil Conservation Division

Incident ID	
District RP	
Facility ID	
Application ID	

Closure

The responsible party must attach information demonstrating they have complied with all applicable closure requirements and any conditions or directives of the OCD. This demonstration should be in the form of a comprehensive report (electronic submittals in .pdf format are preferred) including a scaled site map, sampling diagrams, relevant field notes, photographs of any excavation prior to backfilling, laboratory data including chain of custody documents of final sampling, and a narrative of the remedial activities. Refer to 19.15.29.12 NMAC.

Closure Report Attachment Checklist: ***Each of the following items must be included in the closure report.***

☐ A scaled site and sampling diagram as described in 19.15.29.11 NMAC

☐ Photographs of the remediated site prior to backfill or photos of the liner integrity if applicable (Note: appropriate OCD District office must be notified 2 days prior to liner inspection)

☐ Laboratory analyses of final sampling (Note: appropriate ODC District office must be notified 2 days prior to final sampling)

☐ Description of remediation activities

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations. The responsible party acknowledges they must substantially restore, reclaim, and re-vegetate the impacted surface area to the conditions that existed prior to the release or their final land use in accordance with 19.15.29.13 NMAC including notification to the OCD when reclamation and re-vegetation are complete.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: ________________

email: ___________________________ Telephone: ______________________

OCD Only

Received by: ______________________________ Date: ___________

Closure approval by the OCD does not relieve the responsible party of liability should their operations have failed to adequately investigate and remediate contamination that poses a threat to groundwater, surface water, human health, or the environment nor does not relieve the responsible party of compliance with any other federal, state, or local laws and/or regulations.

Closure Approved by: ______________________________ Date: ___________

Printed Name: ______________________________ Title: ______________________________

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the “Application for Permit Modification” that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

1.1 Purpose

The purpose of this Closure/Post-Closure (C/PC) Plan (the “Plan”) is to comply with the requirements of 19.15.36.8.C(9) and 19.15.36.18 NMAC, and to provide guidance for partial or complete closure of surface waste management units. This Plan describes the proposed procedures for closure and post-closure of the Lea Land Facility, including a C/PC Cost Estimate sufficient to close the Facility in a manner that will protect fresh water, public health and the environment.

The oil field waste processing and disposal infrastructure is anticipated to be developed and operated in four phases (i.e., Phases I-IV) over a projected multi-year time period to allow for the development of services in response to the needs of the oil and gas industry. **Table II.4.1**, Lea Land Development Sequence, provides an outline of the projected phased development, including an implementation schedule for the installation of waste processing and disposal activities at the Lea Land SWMF. However, different combinations of these improvements may

TABLE II.4.1 - Lea Land LLC Site Development Sequence[1]
(projected)

Description	Summary	Year No.[2]
Phase I - Continued Operations		
• Existing Landfill ~30.8 acres	Continued operation of the existing landfill as development of additional infrastructure is completed.	1
Phase II - Landfill Cell & Liquids/Solids Processing Operation.		
• New Landfill Cell (Unit II - 5 acre Cell IIA out of a total of 70 acre Unit) • Liquids load-out points (4) with Jet-Outs for handling basic sediment and water (BS&W), tank bottoms, liquid drilling muds and tank wash-outs • The Liquids Process Area • Tank farm berm (complete) • Boiler (75 HP) running heat transfer fluid tank farm • Oil/Water Separation Unit (Gun Barrel) • Produced Water Receiving Tanks (3), 1,000 bbl capacity[3] • Settling Tanks (16), 1,000 bbl capacity • Crude Oil Recovery Tank (1), 1,000 bbl capacity • Oil Sale Tank (1), 1,000 bbl capacity • Evaporation Ponds (4) capable of evaporating 4,000 bbl of liquid per day • Install Stabilization and Solidification (Drying Pad) Area	**Construction of a 5-acre cell (Cell IIA) in Unit II of the Landfill. Installation of four liquids load-out points with jet-out capabilities. Installation of the Liquids Processing Area. Installation of the Solidification and Stabilization Area**. Liquids recovered from the Liquids Processing Operations will be pumped through the Oil/Water Separator (Gun-Barrel) with oil discharged to the heated Crude Oil Recovery Tank for further processing before being pumped to the Oil Sale Tank. The oil recovered from the Liquids Processing Operations is anticipated to be 6 bbl per day. Solids recovered from the Liquids Process will be tested for liquids and if they pass the Paint Filter Test, will be transferred to the landfill for disposal. If they do not pass the Paint Filter Test, they will be delivered to the Stabilization and Solidification Area for processing prior to landfilling. Solids received in roll-off containers that do not pass the Paint Filter Test will be deposited at the Drying Pad where they will be mixed with dry soil until they are dry enough to pass the Paint Filter Test allowing them to be transferred to the landfill for disposal.	2
Phase III - Expanded Liquids/Solids Processing Operation.		
• Liquids load-out points (4) • Additional Oil/Water Separation Units (2 Gun Barrels) • Additional Produced Water Receiving Tanks (3), 1,000 bbl capacity • Additional Settling Tanks (16), 1,000 bbl capacity • Additional Crude Oil Recovery Tanks (3), 1,000 bbl capacity • Additional Oil Sales Tanks (2), 1,000 bbl capacity • Additional evaporation ponds (4) capable of evaporating an additional 4,000 bbl per day of liquid	The additional oil recovered from the expanded Produced Water Processing Operation process, anticipated to be 6 bbl per day (for a total of 12 bbls per day), will pumped to the Crude Oil Recovery tanks for further processing.	3
Phase VI - Ultimate Produced Water Processing Facility.		
• Additional Oil/Water Separation Unit (1 Gun Barrel) • Additional Produced Water Receiving Tank (3), 1,000 bbl capacity • Additional Settling Tanks (16), 1,000 bbl capacity • Additional Oil Sales Tanks (1), 1,000 bbl capacity • Additional evaporation ponds (4) capable of evaporating an additional 4,000 bbl per day of liquid	The additional oil recovered from the ultimate Produced Water Processing Facility will be pumped to the Crude Oil Recovery Tank for further processing.	4

Notes:

[1] The Lea Land LLC site development sequence is subject to change. Differing combinations of these improvements may be constructed at any time. OCD will be notified in advance of construction.

[2] Estimated number of years following OCD Surface Waste Management Facility Permit issuance.

[3] bbl = barrels of oil

be constructed at any time dependent on market conditions and logistical considerations. This C/PC Plan may be modified by Lea Land to address changes in site or operating conditions; and submitted and approved by OCD 30 days prior to implementation of the proposed changes. This Plan may also be amended at the request of OCD per 19.15.36.18.A(5) NMAC.

1.2 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.4.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.3 Facility Description

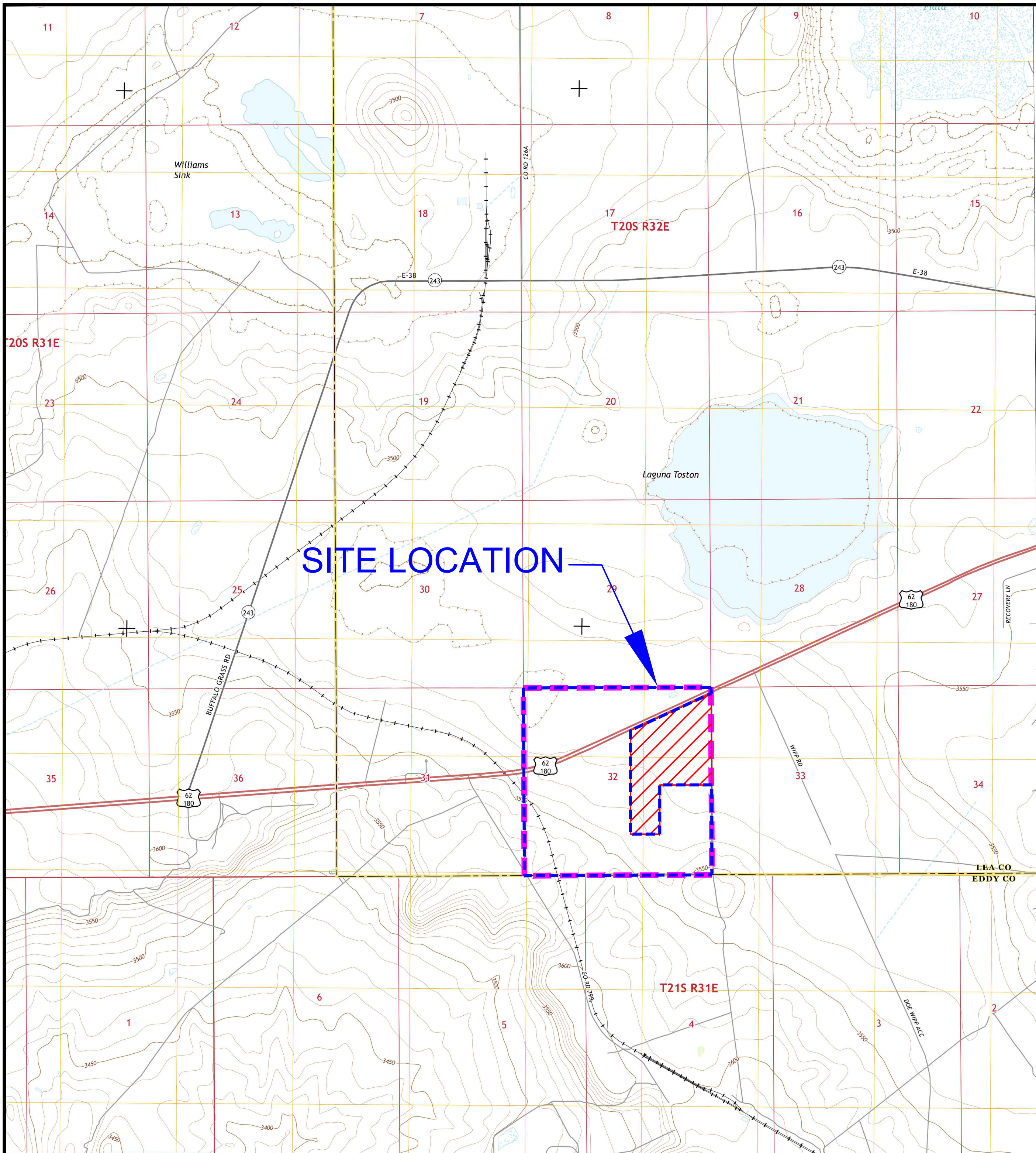
The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The **Permit Plans** (**Volume III.1**) identify the locations of the Processing Area and Landfill Disposal facilities.

2.0 CLOSURE PLAN

Surface Waste Management Facility closure may be initiated by the Operator, or by the Division in accordance with 19.15.36.18.G NMAC. Closure of the Lea Land facility is required to be conducted per the terms of its Permit and this Plan.

2.1 Construction Schedule

Lea Land will notify OCD's Environmental Bureau at least 60 days prior to cessation of permanent operations at the Facility. Included in this notification will be a proposed schedule for closure and monitoring activities that will reuse, recycle or remove tanks and equipment from the site within 90 days of closure. During the 90-day period after notification, it is anticipated that Lea Land will coordinate the required site inspection by OCD. Lea Land and OCD will additionally review



LEGEND

- PROPERTY BOUNDARY
- LEA LAND LLC FACILITY BOUNDARY
- INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

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SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.4.1
APPROVED BY: CWF	www.team-psc.com	

and modify parts of this Plan and proposed schedule that may be required for the protection of fresh water, public health or the environment that may result from the required OCD review or site inspection(s). Should OCD not notify Lea Land of modifications or additions to this Plan, Lea Land will commence the following closure activities at the Facility provided the Director has not extended, for good cause, the OCD's response to the closure notification, as summarized on **Table II.4.2**.

TABLE II.4.2 - Closure Procedures

- Processing Area:
  - Liquids Removal
  - Evaporation Pond Liner Removal
  - Tank Removal
  - Jet Wash Facility Closure
  - Treatment Plant Disassembly
  - Stabilization & Solidification Drying Pad Removal
  - Liquid Processing Removal
  - Site Sampling
  - Final Site Closure
- Solid Waste Disposal Area:
  - Landfill Closure Construction
  - Final Cover/CQA Stabilization
  - Landfill closure documentation
- Miscellaneous Building and Structure Removal
- Engineering Certification (PE) of Closure Completion
  - Commence Post-Closure Care and Monitoring

2.2 Liquids Removal

Produced water remaining in receiving tanks will be processed and pumped or transported to the evaporation ponds. Once produced water is placed into the ponds, and free-floating crude oil is removed and delivered to the Treatment Plant, evaporation will be conducted possibly with the aid of a mechanical evaporation system. Lea Land may introduce soils when sufficient evaporation has taken place to expedite solidification. Once solidification has been completed and the waste has been tested (i.e., paint filter), the material will be encapsulated at the solid waste disposal area (Lea Land Landfill). Although highly unlikely, should the Lea Land Landfill not be in operation at the time of closure, remaining liquids or solids will be removed from the ponds and disposed of in an OCD-approved surface waste management facility.

2.3 Evaporation Pond Liner Removal

Upon successful liquids removal, the remaining sludge, if any, will be allowed to dry to a consistency that lends itself to management and removal (i.e., passing the paint filter test). Testing of the sludge will be performed prior to removal and disposal of the material in the Lea Land Landfill. Although highly unlikely, should the Lea Land Landfill not be in operation at the time of closure, remaining solids will be removed from the ponds and disposed of in an OCD-approved surface waste management facility as self-generated exempt waste in conformance with current operating standards.

Once the sludge has been removed, the high-density polyethylene (HDPE) liner system components will be thoroughly cleaned in accordance with 19.15.35.8 NMAC. Lea Land proposes to cut the HDPE liner material and geocomposite into manageable pieces and dispose of the material in the Lea Land Landfill; or to transport the material to a New Mexico Environment Department Solid Waste Bureau approved recycling or disposal facility upon approval from OCD.

2.4 Tank Removal

Upon closure, tanks, piping and equipment will be emptied and cleaned. Lea Land will test accordingly and dispose of the residual exempt oil field waste removed from the tanks and deposit it in the solidification waste disposal area. If the Lea Land Landfill is not in operation at time of closure, remaining solids will be removed and disposed of in an OCD-approved surface waste management facility capable of managing the exempt waste stream. Lea Land will, to the extent practical, reuse, recycle or remove the tanks, infrastructure, and equipment from the site within 90 days of closure and notify OCD accordingly.

2.5 Jet-Out Facility

Closure of the Jet-Out Facility will consist of dismantling the above-grade installations for recycling (of clean elements) or on-site disposal. The tanks will be cleaned for reuse or recycled as scrap metal. The liner and gravel from the leak detection zone will be exhumed and disposed of on-site as described in Section 2.3. If the Lea Land Landfill is not in operation at time of closure, all remaining solids will be removed from the Facility and disposed of in an OCD-approved surface waste management facility following OCD procedures.

2.6 Treatment Plant

Once crude oil recovery processes have been completed, the treatment plant will be disassembled. Associated piping leading to or from the treatment plant will be removed, cleaned and recycled for reuse. Once equipment, tanks, piping, and buildings have been dismantled (if applicable), the treatment plant will be inspected for contamination. If contamination is encountered, the affected zone will be excavated and disposed of in the solid waste disposal area; and the area will be tested until confirmed to meet applicable regulatory standards. If the Lea Land Landfill is not in operation at time of closure, remaining solids will be removed from the Facility and disposed of in an OCD-approved surface waste management facility following OCD disposal protocols.

2.7 Stabilization & Solidification Drying Pad Process Area

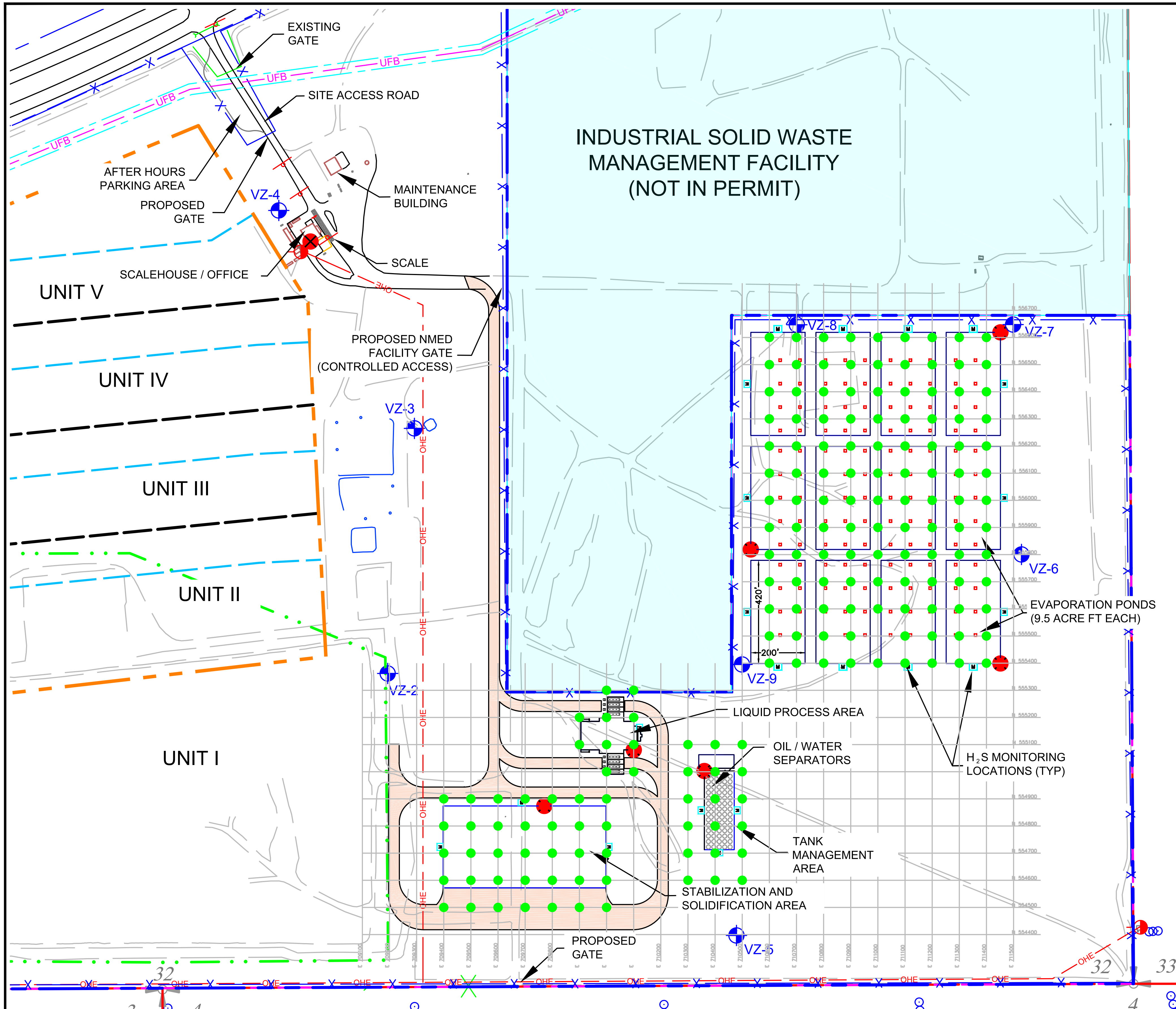
Closure of the Drying Pad will consist of dismantling the above-grade installations for recycling (of clean elements) or on-site disposal. The tanks will be cleaned for reuse or recycled as scrap metal. The concrete pad will be removed for disposal. The liner and gravel from the leak detection zone will be exhumed and disposed of on-site as described in Section 2.3. If the Lea Land Landfill is not in operation at time of closure, all remaining solids will be removed from the Facility and disposed of in an OCD-approved surface waste management facility following OCD procedures.

2.8 Liquid Processing Area

Closure of the Liquid Process will consist of dismantling the above-grade installations for recycling (of clean elements) or on-site disposal. The equipment and tanks will be cleaned for reuse or recycled as scrap metal. The concrete pad will be removed for disposal. If the Lea Land Landfill is not in operation at time of closure, all remaining solids will be removed from the Facility and disposed of in an OCD-approved surface waste management facility following OCD procedures.

2.9 Site Sampling

Once Processing Area tanks, equipment, and liners have been removed, but prior to backfilling the pond area and site grading, the site will be sampled in accordance with Chapter Nine of United States Environmental Protection Agency (EPA) publication SW-846; *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (per 19.15.36.18.C(1)(b) and 19.15.29.11.A(5)(b) NMAC). A typical sampling grid is provided as **Figure II.4.2** (at 5 tests/acres), which illustrates the proposed testing configuration for the Lea Land Processing Area to document proper closure.



LEGEND

- SECTION BOUNDARY
- PROPERTY BOUNDARY
- SURFACE WASTE MANAGEMENT BOUNDARY
- EXISTING OCD PERMIT BOUNDARY
- PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
- INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
- CELL BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING RAILROAD
- PROPOSED UNDERGROUND FIBER OPTIC
- PROPOSED OVERHEAD POWERLINE
- EXISTING CULVERT
- PROPOSED UNPAVED ROAD (GRAVEL)
- NOT IN OCD PERMIT
- EXISTING TRANSMISSION LINE
- H_2S MONITORING LOCATION
- PROPOSED VADOSE ZONE MONITORING WELL
- PPE AND EMERGENCY EQUIPMENT
- SAMPLING POINT
- 100' SITE GRID

NORTH

0 200'

TYPICAL SAMPLING GRID

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.4.2
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:Jul. 19, 2019-05:40:56 ; LAYOUT: B (LS)

Soil samples will be collected at select locations in the areas used for shipping and receiving, treatment and storage areas, and the evaporation ponds area. The soil samples will be collected at select depths within the in-situ soil, including at least one from the first foot of soil; and one within 36 to 42 inches below the surface. Oil treating plant closure samples will be evaluated for the following constituents:

- TPH
- BTEX
- RCRA Metals
- Major cations and anions

Pond and pit samples will be evaluated for the previous constituents excluding major cations and anions but including inorganics listed in Subsections A and B of 20.6.2.3103 NMAC

Sample results will be submitted to the OCD's Environmental Bureau (Santa Fe). Provided the sample results indicate that no contamination commences at the Facility in excess of allowable levels, Lea Land will proceed with final site closure and post-closure activities. If contamination is observed at 42 inches, sampling and excavation will continue to the depth where no contamination is observed.

2.10 Final Site Closure – Processing Area

Upon OCD determination that no contamination is present at Lea Land at regulatory thresholds, the Processing Area will be re-graded to the intended final use. Activities to be conducted during this period include:

- Evaporation and sedimentation pond berm removal and backfilling
- Site grading and re-contouring
- Site revegetation/ Stabilization

Re-vegetation of the Lea Land site (equal to 70% of the native perennial vegetative cover) may be conducted during the optimum planting period, whenever possible. Examples of seed types identified and recommended by the NRCS as acceptable cover for the local and are described in **Table II.4.3.** Lea Land is seeking an exception to the Oil & Gas Rule in order to have the option for stabilization methods alternative to vegetation; if needed. Potential alternative stabilization options for final cover are presented in **Attachment II.4.A**. The Closure Documentation Record (**Attachment II.4.B**), or a similar template, will be used to record the field activities specific to final site closure. A licensed New Mexico Professional Engineer, experienced in environmental engineering, will supervise closure construction and certify completion of closure activities.

2.11 Final Site Closure - Solid Waste Disposal Area

It is anticipated that the Lea Land Landfill will be the final area closed at the Lea Land Facility due to the need for disposal of wastes from other on-site process units under either premature or planned final closure conditions. Final cover will be installed within one year of achieving the final waste elevations, or an intermediate grading plan approved by OCD under early closure. The overall final grading contours for the Landfill are provided in the **Permit Plans** (**Volume III.1**). The final cover proposed for the Lea Land Landfill includes an alternative design for crown and sideslope evaporation/transpiration ("ET") cap configuration.

The alternative ET cap configuration will consist of a 30-inch vegetative (erosion) layer; a 6-inch barrier (infiltration) layer ($k \leq 2 \times 10^{-4}$ cm/sec); and a 12-inch intermediate cover layer as shown on **Figure II.4.3**. Based on the results provided in **Volume III.4** (HELP Model), the proposed alternative final cover is proven to provide superior performance in preventing liquid migration through the landfill when compared to the prescriptive cap outlined in the regulations.

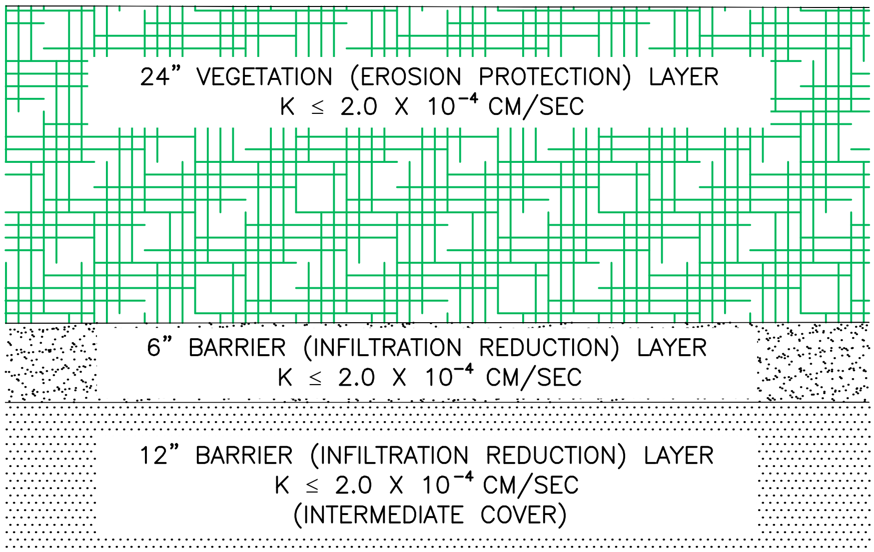
Final slopes will be constructed in accordance with the Final Grading Plan (**Permit Plans, Volume III.1**). The design sideslopes will be no greater than 25% and the top crown will be constructed at a design grade of 5.0%. Details for the final cover design are shown on the **Permit Plans**. The final cover, as well as other disturbed areas of the site, may be seeded with native vegetation. Vegetation on the site will be planted during the optimum planting period, whenever possible. Examples of seed types identified and recommended by the Natural Resource Conservation Service (NRCS) as acceptable cover for the local climate and precipitation are provided in **Table II.4.3**:

TABLE II.4.3 - NRCS Recommended Seed Mix

Grass Species	% of Mix	Rate (PLS/Acre)[5]	Lbs. (PLS/Acre[6])
Bluegrama (Native)	40	1.5	1.2
Buffalograss (burs)	10	16	3.2
Green Sprangletop	10	1.7	0.34
Sand Dropseed	10	0.5	0.1
Sideoats (Vaughn)	20	4.5	1.8
Western Wheatgrass (Native)	10	8	1.6
Totals	**100%**	**32.2**	**8.24**

Notes:

1. *Lea County NRCS recommends doubling the seeding rate on critical area plantings.*
2. *These grasses are fairly shallow rooted; well adapted to Lea County; are available from area growers; and will aid in erosion control once established.*
3. *NRCS recommends that seeding a cover crop of sorghum in the spring at 8 lbs/acre will stabilize the site initially.*
4. *Subject to change based on changes in NRCS requirements, new technology, etc.*
5. *PLS = pure live seed per acre*
6. *Lbs. = pounds of PLS per acre*



LANDFILL FINAL COVER SECTION

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Date/Time:Jul. 25, 2019-10:19:31

PROPOSED ALTERNATIVE FINAL COVER (ET) PROFILE

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: FINAL COVER.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.4.3
APPROVED BY: CWF	www.team-psc.com	

In addition, alternative stabilization options are provided in **Attachment II.4.A**. The Closure Documentation Record (**Attachment II.4.B**), or a similar template, will be used to record the field activities specific to final site closure. Documentation of closure activities including, but not limited to, monitoring results, site inspection data, soil sampling and maintenance procedures, etc., will be submitted to OCD in the Final Closure Report. Closure construction activities will be supervised by a licensed New Mexico Professional Engineer experienced in waste facility technology, who will also certify the closure.

2.12 Miscellaneous Building and Structure Removal

At this time, it is anticipated that, following closure, the Lea Land Facility will revert to open space or livestock grazing. Should an alternate land use be identified that could utilize the remaining structures and buildings, they will be cleaned and left in place with the exception of below-grade sumps. If not, buildings and miscellaneous structures will be dismantled and, where practical, recycled or reused. Non-recyclable material will be disposed of in the Lea Land Landfill, or another OCD-approved landfill. Once buildings, structures and sumps are removed, these areas will be inspected for contamination (see Site Sampling, Section 2.7). Should contamination be encountered, the zone will be excavated and disposed of in the solid waste disposal unit, and the area will be tested until confirmed to meet regulatory standards. If the Lea Land Landfill is not in operation at time of closure, remaining materials will be removed from the Facility and disposed of in an OCD-approved surface waste management facility.

2.13 Final Land Use

At this time Lea Land has not established a use for the Facility after closure beyond open space/livestock grazing or oil and gas exploration/development activities. Should a specific use be determined, Lea Land will notify OCD and request approval to be released from the following post-closure activities provided there has not been a release to the vadose zone or groundwater pursuant to 19.15.30 and 19.15.29 NMAC.

3.0 POST-CLOSURE PLAN

3.1 Post-Closure Maintenance

Landfill Area

Lea Land will monitor and provide post-closure maintenance for the Lea Land Landfill for a period of not less than 30 years, or as otherwise approved by OCD. During the post-closure care period, Lea Land proposes to inspect and maintain the site at least semi-annually, and immediately after a documented 24 hour, 25-year storm event, whichever is more frequent, utilizing the Site Inspection Checklist (**Attachment II.4.C**). Upon successful re-vegetation efforts resulting in at least 70% coverage (not including noxious weeds) or other approved stabilization methods (see **Attachment II.4.A**), Lea Land plans to reduce the inspection frequency subject to OCD approval. Post-closure care inspections will typically include:

- Vegetative growth observation
- Erosion
- Differential settlement
- Vegetative stress (i.e., potential gas migration)

In addition, vadose zone monitoring will be performed and reported on an annual basis; or a reduced frequency if negative results warrant, pursuant to OCD approval.

Processing Area

Lea Land will conduct semi-annual post-closure monitoring of the Processing Area (i.e. oil treating plant, evaporation/storage/treatment ponds) for a period of not less than 3 years. Should deficiencies or discrepancies be discovered during the site inspections in these or other areas of the Landfill, Lea Land will implement corrective measures. Should a documented release to the vadose zone or groundwater occur, Lea Land will comply with the requirements of 19.15.30 and 19.15.29 NMAC.

3.2 Reporting

Reports of post-closure activities, including but not limited to site inspection data and maintenance procedures, will be submitted to OCD within 45 days from the end of each calendar year or as otherwise required.

4.0 FINANCIAL ASSURANCE

4.1 Closure/Post Closure Cost Estimate

The Cost Estimates (**Attachment II.4.D**) for the closure (assuming the Performance-Based Alternative Final Cover Demonstration represented in **Volume III.4**) and post-closure activities described in this Plan are presented in current dollars; and conservatively assume that third party contractors will perform closure and post closure activities at the site, as required by 19.15.36.8.C(9) NMAC. The unit costs for closure implementation are based on several current earthwork and geosynthetic projects in southeast New Mexico. The C/PC Cost Estimates are based on the predicate that no contamination or remedial activities are required due to releases into the environment.

The current estimates for Phase I (**Table II.4.1**) of Lea Land closure construction and post-closure operations are provided as **Attachment II.4.D**. These estimates will be revised accordingly as additional Phases (**Table II.4.1**) of Lea Land construction and operations are implemented, or should unforeseen conditions arise; as well as annually once a Phase of Development is complete. Upon Division approval of the requested Permit, Lea Land will select a financial assurance mechanism pursuant to 19.15.36.11.E NMAC; and will submit the appropriate documentation to OCD based on the estimates provided in this Plan prior to OCD issuance of the Permit.

4.2 Release of Financial Assurance

Upon successful completion of closure activities for the entire Facility, or portions of the operation (i.e., sections of the Landfill that have reached final grade; components of the process that have ceased operation, etc.), and after OCD concurrence, Lea Land will request the release of the financial assurance mechanism in place for that proportional component of closure of the Facility. After the post-closure periods have expired (i.e., 3 years for waste processing pits/ponds, and 30 years for the Landfill), provided there is no contamination evident and the site has established cover stabilization in accordance with the rules, Lea Land will request release from the remaining financial assurance requirements for the Facility or portions that have been successfully closed.

ATTACHMENT II.4.A
ALTERNATIVE STABILIZATION OPTIONS
FOR INTERMEDIATE AND FINAL COVER

ATTACHMENT II.4.A - Alternative Stabilization Options for Intermediate and Final Cover

Lea Land LLC (Lea Land) proposes an "exception" per 19.15.36.19.A NMAC to the Oil & Gas Rules for stabilization of intermediate and final cover with vegetation, i.e., 19.15.36.14.A(7)(b) NMAC and 19.15.36.18.D(2)(b) NMAC, respectively. Lea Land proposes the use of sustainable alternative stabilization materials and methods as may be needed where vegetation cannot be adequately established as required for both intermediate and final cover. With final sideslopes of 4:1 to 5:1, and the design crown at 5%, the landfill surface is not prone to soil erosion.

Intermediate Cover Stabilization
Lea Land may implement the use of alternative methods of cover stabilization for areas of intermediate cover which have been inactive for greater than two years and have not been adequately stabilized with vegetation. The top layer of the intermediate cover may be repurposed as soil cover.

Final Cover Stabilization
In addition, for areas that will receive final cover (per 19.15.36.14.C(8) NMAC), Lea Land plans to implement these alternative methods for the vegetative (erosion) layer where vegetation has not been adequately established. Final cover is proposed to include a layer for minimizing erosion which is a minimum of 12 inches thick and capable of sustaining native plant growth

Alternative Stabilization Materials and Methods
For those areas that have not been successfully stabilized with vegetation as required for intermediate or final cover, Lea Land will implement the use of one or more alternative stabilization options:

- Compost/organics
- Wood chips/shredded green waste
- Mixtures (e.g., compost, wood chips, soil)
- Vertical tracking of slopes
- Gravel/rock (to simulate desert pavement)
- Inert fill
- Bermed materials

Materials such as compost, wood chips, shredded green waste, mixtures of organic materials, gravel, etc. may be applied at depths determined to be effective based on potential pilot study evaluations and experience. Berms comprised of organic or other materials (identified above) may be constructed perpendicular to the intermediate or final cover slopes to aid in the mitigation of wind and water erosion. In addition, vertical tracking of slopes with a dozer to allow the dozer's track segment grouser pattern to imprint the soil and slow the progress of water and wind erosion may also be implemented.

Inspection, Repair, and Maintenance
Areas that have intermediate cover will be inspected at least once per month and after significant rain events as described **Attachment II.1.G**. Final cover inspection will be conducted at least quarterly during the initial post-closure phase as detailed in the Closure/Post-Closure Plan (**Volume II.4**), Section 3.1.

Approval for Alternative Stabilization Methods
Alternative stabilization methods may be implemented upon approval from the Oil Conservation Division.

ATTACHMENT II.4.B

CLOSURE DOCUMENTATION RECORD (TYPICAL)

ATTACHMENT II.4.B - Closure Documentation Record (Typical)

Pond or Tank	Location		Closure Location				Surface Stabilization			
			Liner		Tank					
Number	Lat. (Northing)	Lon. (Easting)	Removed	Tested	Cleaned	Removed	Installed	Date	Certified	Date

Date: ____________________ Recorded By: ______________________

Inspected By: ____ Certified By: ______________________

Comments: ____

ATTACHMENT II.4.C

POST-CLOSURE SITE INSPECTION CHECKLIST (TYPICAL)

ATTACHMENT II.4.C - Post-Closure Site Inspection Checklist (Typical)

Page _____ of _____

Date: ______________________ **Inspector(s):** ______________________

Time: ______________________ ______________________

Weather:

Temperature ______________________ deg. F Precipitation (last 24 hours) _________________ inches

Skies ______________________

Wind Speed ______________________ mph

Wind Direction ______________________ *(direction blowing from)*

NOTES:
"X" indicates that a Deficiency has been noted. "P" indicates that a Photograph has been taken. "S" indicates that a Sample has been collected. Complete descriptions of Deficiencies, Photographs, and Samples are provided on attached pages. Items are referenced by Location.

Soil Cover Conditions

Location	Item			
	Vegetation Stress	Stabilization Progress	Vectors	Sample

Surface Water Management System

Location	Deficiency			Sample
	Erosion/ Siltation	Structural Defect	Flow Obstruction	

NOTES: ____

____

ATTACHMENT II.4.D

CLOSURE/POST-CLOSURE COST ESTIMATES

(PERFORMANCE-BASED FINAL COVER DEMONSTRATION)

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates

ATTACHMENT II.4.D.1 - Phase I Closure/Post-Closure Cost Estimate Summary

TASK	COST ESTIMATE
1.0 LANDFILL CLOSURE CONSTRUCTION (See Att. II.4.E.3)	$600,933
2.0 LANDFILL MAINTENANCE (See Att. II.4.E.5)	$547,800
3.0 ENVIRONMENTAL MONITORING (See Att. II.4.E.6)	$165,000
4.0 POND AREA CLOSURE (Not included in Phase I)	$0
5.0 PROCESS AREA CLOSURE (Not included in Phase I)	$0
6.0 POST-CLOSURE MAINTENANCE (See Att. II.4.E.9)	$71,940
TOTAL COST ESTIMATE	$1,385,673

ATTACHMENT II.4.D.2 - Facility Closure/Post-Closure Cost Estimate Summary

TASK	COST ESTIMATE
1.0 LANDFILL CLOSURE CONSTRUCTION (See Att. II.4.E.4)	$2,035,367
2.0 LANDFILL MAINTENANCE (See Att. II.4.E.5)	$547,800
3.0 ENVIRONMENTAL MONITORING (See Att. II.4.E.6)	$165,000
4.0 POND CLOSURE (See Att. II.4.E.7)	$934,338
5.0 PROCESS AREA CLOSURE (See Att. II.4.E.8)	$584,034
6.0 POST-CLOSURE MAINTENANCE (See Att. II.4.E.9)	$71,940
TOTAL COST ESTIMATE	$4,338,478

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates
Performance-Based Alternative Final Cover Demonstration

ATTACHMENT II.4.D.3-Unit I Landfill Closure Construction Closure Cost Estimate (Unit I - 30.8 ± acres)

TASK 1.0	Unit Quantity	Unit	Unit Cost	Total Cost
1.1 Final Cover Installation				
1.1.1 Install and compact 12" Intermediate Cover Layer	49,691	CY	$2.50	$124,227
1.1.2 Install and compact 6" Barrier Layer	24,845	CY	$2.50	$62,113
1.1.3 Install 24" Erosion/Vegitation Layer	99,381	CY	$2.00	$198,763
1.1.4 Vegetative Layer Seeding (Class A)	30.8	AC	$1,500.00	$46,200
			Task Subtotal	**$431,303**
1.2 Final Cover CQA				
1.2.1 Inspection and Testing	1	LS	$100,000	$100,000
1.2.2 Certification	1	LS	$15,000	$15,000
			Task Subtotal	**$115,000**
			TASK TOTALS	**$546,303**
Independent Project Manager and Contract Administration Cost (10% of Task Totals)				$54,630
			TOTAL COST	**$600,933**

Notes:

1. *Unit I closure costs are based on contracting with a qualified third party to complete and certify closure. The activities included in this cost estimate are based on current dollars, previous experience with landfills located in arid climates, and current subcontractor costs for similar earthwork/geosynthetic in southeastern New Mexico.*
2. *Final cover installation costs assume that:*
   - ►*The greatest area requiring final cover is 30.8 acres ± (Unit I).*
   - ► *All soils necessary for closure are available on-site.*
3. *CY = Cubic Yard*
   AC = Acre
   LS = Lump Sum
4. *Due to the perimeter location there is no final cover "crown" and related geosynthetic layers in Unit I.*

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates
Performance-Based Alternative Final Cover Demonstration

ATTACHMENT II.4.D.4 - Landfill Closure Construction Closure Cost Estimate (100 ± acres)

TASK 1.0	Unit Quantity	Unit	Unit Cost	Total Cost
1.1 Final Cover Installation				
1.1.1 Install and compact 12" Intermediate Cover Layer	161,333	CY	$2.50	$403,333
1.1.2 Install and compact 6" Barrier Layer	80,667	CY	$2.50	$201,667
1.1.3 Install 24" Erosion/Vegitation Layer	322,667	CY	$2.00	$645,333
1.1.4 Vegetative Layer Seeding (Class A)	100.0	AC	$1,500.00	$150,000
			Task Subtotal	**$1,400,333**
1.2 Final Cover CQA				
1.2.1 Inspection and Testing	1	LS	$375,000	$375,000
1.2.2 Certification	1	LS	$75,000	$75,000
			Task Subtotal	**$450,000**
			TASK TOTALS	**$1,850,333**
Independent Project Manager and Contract Administration Cost (10% of Task Totals)				$185,033
			TOTAL COST	**$2,035,367**

Notes:

1. *Closure costs are based on contracting with a qualified third party to complete and certify closure. The activities included in this cost estimate are based on current dollars, previous experience with landfills located in arid climates, and current subcontractor costs for similar earthwork/geosynthetic in southeastern New Mexico.*
2. *Final cover installation costs assume that:*
   - ►*The greatest area requiring final cover is 100 acres ± (Unit I).*
   - ► *All soils necessary for closure are available on-site.*
3. *CY = Cubic Yard*
   AC = Acre
   LS = Lump Sum
4. *Due to the perimeter location there is no final cover "crown" and related geosynthetic layers in Unit I.*

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates
Performance-Based Alternative Final Cover Demonstration

ATTACHMENT II.4.D.5 - Unit I Landfill Maintenance Post-Closure Cost Estimate

TASK 2.0	Unit Quantity	Unit	Unit Cost	Total Cost Per Year	Total Cost For 30 Years
2.1 Final Cover Inspection and Reporting					
2.1.1 Inspection	2	events/yr	$2,500	$5,000	$150,000
2.1.2 Recordkeeping and Reporting	2	events/yr	$500	$1,000	$30,000
			Task Subtotals	**$6,000**	**$180,000**
2.2 Final Cover Maintenance					
2.2.1 Cover Maintenance	1	AC/yr	$1,000	$1,000	$30,000
2.2.2 Vegetation	2	AC/yr	$1,500	$3,000	$90,000
			Task Subtotals	**$4,000**	**$120,000**
2.3 Leachate System					
2.3.1 Inspection/Repair	1	events/yr	$400	$400	$12,000
2.3.2 Disposal	1	events/yr	$1,000	$1,000	$30,000
			Task Subtotals	**$1,400**	**$42,000**
2.4 Surface Water Management Systems					
2.4.1 Inspection/Repairs	4	events/yr	$1,000	$4,000	$120,000
			Task Subtotals	**$4,000**	**$120,000**
2.5 Fencing					
2.5.1 Inspection/Repairs	2	events/yr	$600	$1,200	$36,000
			Task Subtotals	**$1,200**	**$36,000**
			TASK TOTALS	**$16,600**	**$498,000**
			Independent Project Manager and Contract Administration Cost (10% of Task Totals)	$1,660	$49,800
			TOTAL COST	**$18,260**	**$547,800**

Notes:

1. *Post-closure maintenance costs are based on contracting with a qualified third party to conduct post-closure care maintenance for the landfill. The activities included in this cost estimate are based on current dollars, previous experience with landfills located in arid climates, and current subcontractor costs in southeastern New Mexico.*
2. *AC = Acre*
   LS = Lump Sum

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates

ATTACHMENT II.4.D.6 - Unit I Environmental Monitoring Post-Closure Cost Estimate

TASK 3.0	Unit Quantity	Unit	Unit Cost	Total Cost Per Year	Total Cost
3.1 Vadose Zone Monitoring					
3.1.1 Field Services/Lab Analysis/Reporting (30 years)	1	event/yr	$5,000	$5,000	$150,000
Task Subtotal				**$5,000**	**$150,000**
TASK TOTALS				**$5,000**	**$150,000**
Independent Project Manager and Contract Administration Cost (10% of Task Totals)				$500	$15,000
TOTAL COST				**$5,500**	**$165,000**

Notes:

1. *Closure costs are based on contracting with a qualified third party to conduct post-closure monitoring for the landfill. The activities included in this cost estimate are based on current dollars, previous experience with landfills located in arid climates, and current subcontractor costs.*
2. *Assume no water in vadose wells (i.e., sampling and analysis costs not included).*

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates

ATTACHMENT II.4.D.7 - Evaporation Pond Closure Construction Closure Cost Estimate

Task 4.0	Units	Unit Cost	Total (36 acres)	
			Quantity	Cost
4.1 Evaporation Pond				
4.1.1 Liquids Transport/Disposal				
4.1.1.1 Transport Liquid	bbl	$1.75	240	$420
4.1.1.2 Disposal Liquids	bbl	$0.95	240	$228
4.1.1.3 Remove/Transport Sludge	ton	$6.50	1,000	$6,500
4.1.1.4 Disposal Sludge	ton	$20.00	1,000	$20,000
4.1.1.5 Liner Removal/Transport	CY	$4.00	1,000	$4,000
4.1.1.6 Disposal Liner	CY	$4.25	1,000	$4,250
			Task Subtotal	**$35,398**
4.1.2 Pond Backfill and Contouring				
4.1.2.1 Soil On-site	CY	$1.00	0	$0
4.1.2.2 Place and Compact Soil	CY	$3.00	200,000	$600,000
			Task Subtotal	**$600,000**
4.1.3 Sampling	each	$200	300	$60,000
4.1.4 Seeding	acres	$1,500	36	$54,000
			Task Subtotal	**$114,000**
Pond Closure Subtotal:				**$749,398**
4.3 Engineering				
4.3.1 CQA/Certification	LS			$100,000
Engineering Subtotal:	LS			**$100,000**
4.4 Totals				
4.4.1 Subtotal				$849,398
4.4.2 Adminstration Cost (10%)				$84,940
			Total:	**$934,338**

Notes:

1. *Closure costs are based on contracting with a qualified third party to complete and certify closure.*
2. *Assume residual liquids in each pond transported up to 50 miles for disposal.*
3. *Assume 6" of sludge remaining in each pond at closure transported up to 50 miles for disposal.*
4. *Site Sampling is conducted during the CQA phase.*
5. *CY = Cubic Yard*
   bbl = Barrel
   LS = Lump Sum

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates

ATTACHMENT II.4.D.8 - Processing Area Closure Construction Closure Cost Estimate

Task 5.0	**Units**	**Unit Cost**	**Total (36 acres)**	
			Quantity	**Cost**
5.1 Drying Pad				
5.1.1 Liquids Transport/Disposal				
5.1.1.1 Transport Liquid	bbl	$1.75	200	$350
5.1.1.2 Disposal Liquids	bbl	$0.95	200	$190
5.1.1.3 Remove/Transport Sludge	ton	$6.50	500	$3,250
5.1.1.4 Disposal Sludge	ton	$15.00	500	$7,500
5.1.1.5 Concrete Demolition and Removal	CY	$50.00	200	$10,000
5.1.1.6 Liner Removal/Transport	CY	$4.00	200	$800
5.1.1.7 Disposal Liner	CY	$4.25	200	$850
			Task Subtotal	**$22,940**
5.1.2 Pond Backfill and Contouring				
5.1.2.1 Soil On-site	CY	$1.00	0	$0
5.1.2.2 Place and Compact Soil	CY	$3.00	15,000	$45,000
			Task Subtotal	**$45,000**
5.1.3 Sampling	each	$200	300	$60,000
5.1.4 Seeding	acres	$1,500	36	$54,000
			Task Subtotal	**$114,000**
Drying Pad Closure Subtotal:				**$181,940**
5.2 Liquid Processing Area Closure				
5.2.1 Tank Removal	LS	$25,000	1	$25,000
5.2.2 Process Equipment Removal	LS	$100,000	1	$100,000
5.2.3 Building/Concrete Pad Removal	LS	$100,000	1	$100,000
5.2.4 Earthwork	LS	$10,000	1	$10,000
5.2.5 Sampling	each	$200	40	$8,000
5.2.6 Seeding	acres	$1,500	4	$6,000
Process Area Closure Subtotal:				**$249,000**
5.3 Engineering				
5.3.1 CQA/Certification	LS			$100,000
Engineering Subtotal:	LS			**$100,000**
5.4 Totals				
5.4.1 Subtotal				$530,940
5.4.2 Adminstration Cost (10%)				$53,094
			Total:	**$584,034**

Notes:

1. *Closure costs are based on contracting with a qualified third party to complete and certify closure.*
2. *Assume 1,000 gallons of residual water transported up to 50 miles for disposal.*
3. *Assume 6" of sludge remaining in drying pad at closure transported up to 50 miles for disposal.*
4. *Site Sampling is conducted during the CQA phase.*
5. *CY = Cubic Yard*
   bbl = Barrel
   LS = Lump Sum

ATTACHMENT II.4.D - Closure/Post-Closure Cost Estimates

ATTACHMENT II.4.D.9 - Pond and Processing Area Maintenance Post-Closure Cost Estimate

TASK 6.0	Unit Quantity	Unit	Unit Cost	Total Cost Per Year	Total Cost For 3 Years
6.1 Surface Inspection and Reporting					
6.1.1 Inspection	2	events/yr	$2,500	$5,000	$15,000
6.1.2 Recordkeeping and Reporting	2	events/yr	$400	$800	$2,400
			Task Subtotals	**$5,800**	**$17,400**
6.2 Surface Maintenance					
6.2.1 Cover Maintenance	1	AC/yr	$1,000	$1,000	$3,000
6.2.2 Vegetation	2	AC/yr	$1,500	$3,000	$9,000
			Task Subtotals	**$4,000**	**$12,000**
6.3 Fencing					
6.3.1 Inspection/Repairs	2	events/yr	$600	$1,200	$3,600
			Task Subtotals	**$1,200**	**$36,000**
			TASK TOTALS	**$11,000**	**$65,400**
Independent Project Manager and Contract Administration Cost (@ 10%)				$1,100	$6,540
			TOTAL COST	**$11,000**	**$71,940**

Notes:

1. *Phase I post-closure maintenance costs are based on contracting with a qualified third party to conduct post-closure care maintenance for the Processing Area. The activities included in this cost estimate are based on current dollars, previous experience with closures located in arid climates, and current subcontractor costs.*
2. *AC = Acre*
   LS = Lump Sum

ATTACHMENT II.4.E
FINANICAL ASSURANCE DOCUMENTATION
(TO BE PROVIDED UPON PERMIT APPROVAL)

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

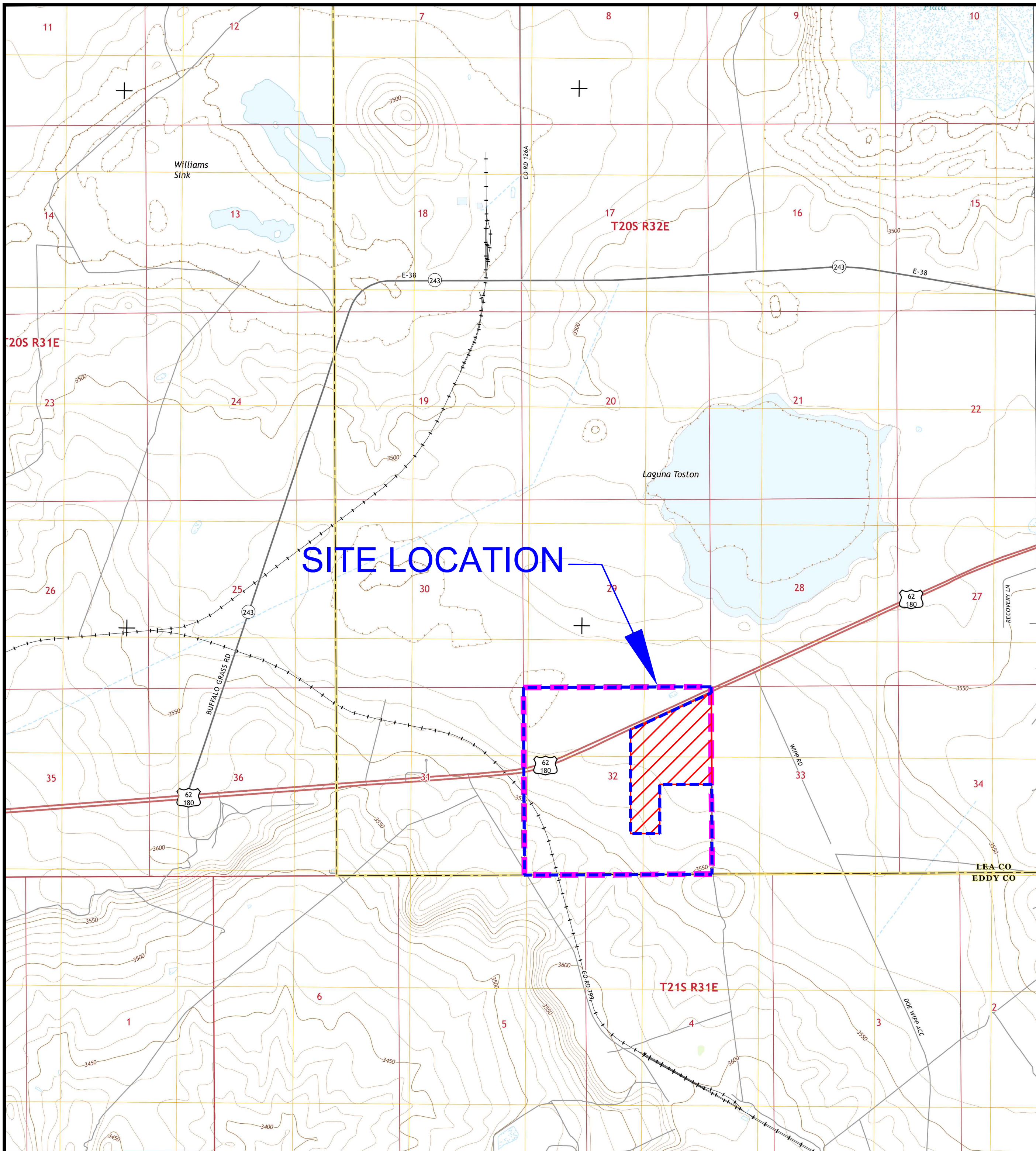
The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.5.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The Site Plan provided as **Figure II.5.2** identify the locations of the Processing Area and Land Disposal facilities, which are further detailed on the **Permit Plans**



LEGEND

PROPERTY BOUNDARY

LEA LAND LLC FACILITY BOUNDARY

INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE LOCATION.dwg
Date/Time:May. 31, 2019-06:27:02 ; LAYOUT: A (P)

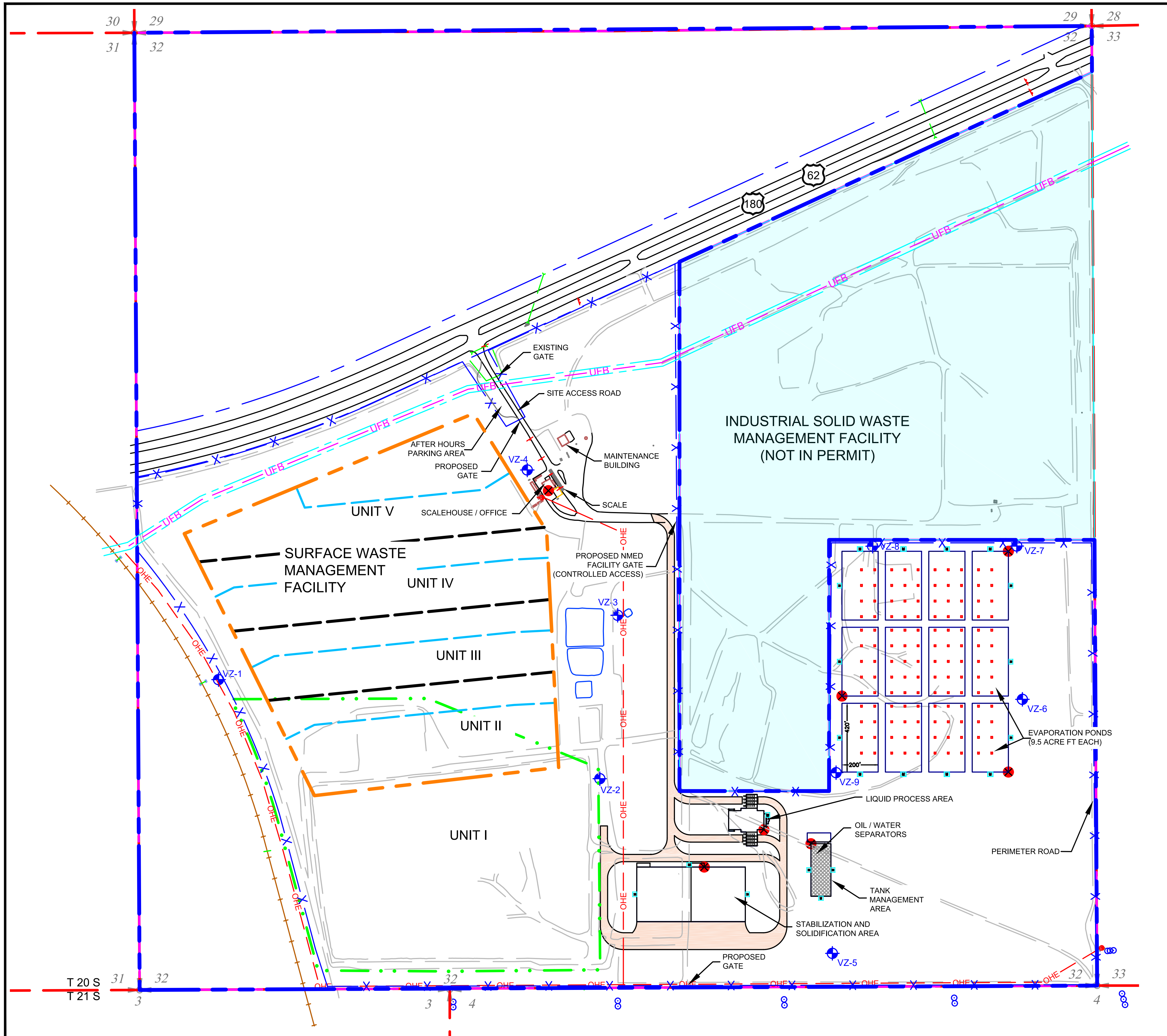
SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.5.1
APPROVED BY: CWF	www.team-psc.com	



LEGEND

- SECTION BOUNDARY
- PROPERTY BOUNDARY
- SURFACE WASTE MANAGEMENT BOUNDARY
- EXISTING OCD PERMIT BOUNDARY
- PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
- INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
- CELL BOUNDARY
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING RAILROAD
- PROPOSED UNDERGROUND FIBER OPTIC
- PROPOSED OVERHEAD POWER LINE
- EXISTING CULVERT
- PROPOSED UNPAVED ROAD (GRAVEL)
- NOT IN OCD PERMIT
- EXISTING TRANSMISSION LINE
- H_2S MONITORING LOCATION
- VZ-2 PROPOSED VADOSE ZONE MONITORING WELL
- PPE AND EMERGENCY EQUIPMENT

SITE PLAN

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/27/2019	CAD: SITE PLAN.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.5.2
APPROVED BY: CWF	www.team-psc.com	

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE PLAN.dwg
Date/Time:Jun. 27, 2019-09:20:41 ; LAYOUT: B (LS)

(**Volume III.1**). The proposed facilities are detailed in **Table II.5.1**, and are anticipated to be developed in four primary phases.

TABLE II.5.1 - Proposed Facilities[1]

Description	No.
SWMF disposal landfill	1
Produced water load-out points	8
Produced water receiving tanks	12
Produced water settling tanks	48
Oil/water separator units (Gun Barrels)	4
Evaporation ponds	12
Stabilization and Solidification Area (Drying Pad)	1
Oil treatment plant (Liquids Processing)	1
Crude oil receiving tanks	5
Oil sales tanks	5
Customer jet wash – bays	8
75 horse power boiler	1
Centrifuge	1

Note:
[1]Subject to change. The proposed facilities are based on projected waste types and volumes; therefore this list may be modified in response to changes in waste streams, technology innovations, etc. OCD will be routinely updated on changes.

1.3 Purpose

This document has been prepared to address the requirements of 19.15.36.13.N NMAC which specify that each operator of a Surface Waste Management Facility must prepare and have available a Contingency Plan (the Plan). This Plan is designed to minimize hazards to fresh water, public health or the environment from fires, explosions or an unplanned sudden or non-sudden release of contaminants or oil field waste to air, soil, surface water or ground water in conformance with 19.15.36.13.N NMAC. Applicable provisions of this Plan will be implemented immediately whenever there is a fire, explosion or release of contaminants or oil field waste constituents that could threaten fresh water, public health or the environment. This Plan is supplemented by the H_2S Prevention and Contingency Plan (**Volume II.3**), as a cross-reference.

This Plan is organized for easy reference by Facility personnel, whom will be required to read and comprehend it. Copies of this Plan will be maintained in a readily accessible location at the Scalehouse. In addition, copies of the Plan will be made available to the emergency agencies identified in **Table II.5.2**. Agencies listed on **Table II.5.2** will be invited to the site for the purposes of familiarizing themselves with the Facility and reviewing the Plan's contents with Lea Land (19.15.36.13.N(2) NMAC). As detailed in Section 10 of this Plan, whenever significant changes

TABLE II.5.2 - Emergency Response Agencies and Contacts

Agency/Organization	Emergency Number
1. Local Emergency Response Contacts	
Eddy County Emergency Management	575.628.5450
Lea County Emergency Management	575.393.2983
2. Fire	
Eddy County Fire Services	911 or 575.628.5450
3. Police	
Eddy County Sheriff's Department	911 or 575.887.1888
Lea County Sheriff's Department	911 or 575.396.3611
New Mexico State Police	911 or 575.392.5580
4. Medical/Ambulance	
Eddy County Emergency Dispatch Authority	911 or 575.616.7155
Carlsbad Medical Center 2430 West Pierce St Carlsbad, NM 88220	575.887.4100
5. Response Firm	
Southwest Environmental, LLC. 110 Comanche Drive Carlsbad, NM 88220	575.361-9425
6. OCD Emergency Response Contacts	
Oil Conservation Division 1625 N. French Drive Hobbs, NM 88240	575.393.6161
Mobile Phone	575.370.3180
Oil Conservation Division 1220 South St. Francis Drive Santa Fe, NM 87505	505.476.3440
7. State Emergency Response Contacts	
Environmental Emergency 24 hr. (NMED)	505.827.9329
New Mexico Environment Department Solid Waste Bureau, Santa Fe	505.827.0197
8. Federal Emergency Response Contacts	
National Emergency Response Center (U.S. Coast Guard)	800.424.8802
Region VI Emergency Response Hotline (USEPA – Dallas, Texas)	800.887.6063

To be posted prominently on-site

to the Plan are made, revised copies of the Plan will replace existing copies, and the agencies listed in **Table II.5.2** will be provided with the most recent Plan updates. Definitions specific to this Plan are provided in **Table II.5.3** as specified in 19.15.2.7 NMAC, and a more comprehensive list of definitions is included as **Table I.5** (**Volume I**).

2.0 EMERGENCY COORDINATORS

Lea Land has designated specific individuals with the responsibility and authority to implement response measures in the event of an emergency which may threaten freshwater, public health or the environment per 19.15.36.13.N(3) NMAC. The Primary, Alternate, and On-site Emergency Coordinators (ECs; **Table II.5.4**) will be thoroughly familiar with aspects of this Plan; operations and activities at the Lea Land SWMF; location and characteristics of waste to be managed; the location of records within the Facility; and the Facility layout. **Table II.5.4** lists the names, designations, titles, and phone numbers for each EC.

The ECs are responsible for coordinating emergency response measures and have the authority to commit the resources required for implementation of this Plan. A designated EC is available to respond to emergencies 24 hours a day, 7 days a week. The Lea Land employee who identifies an emergency situation will contact an EC directly or via phone. Contact will be attempted with each EC (Primary, Alternate, and the On-site) until communication is achieved (**Table II.5.4**). Upon arrival at the scene of an emergency, the first EC to arrive will assume responsibility for initiating response measures. If more than one EC responds, authority is assigned to the highest-ranking EC.

In the rare case that an EC cannot be contacted in an emergency, the Lea Land employee who identifies the situation should make every effort to follow the emergency procedures outlined in this Plan until an EC or emergency authority (local, state, or federal; **Table II.5.2**) arrives to assist or take control. The term "EC" as used throughout this Plan, references the responsible Emergency Coordinator at the scene of an emergency regardless of whether that EC is the Primary, Alternate, On-site EC, or EC designee. This Plan will be amended as described in Section 10.0, if the list of ECs changes.

TABLE II.5.3 – Definitions [19.15.2.7.B. – W. NMAC]

Barrel:

means 42 United States gallons measured at 60 degrees fahrenheit and atmospheric pressure at the sea level. [19.15.2.7.B.(3) NMAC]

Division:

means the New Mexico energy, minerals and natural resources department, oil conservation division. [19.15.2.7.D.(4) NMAC]

Fresh water:

to be protected includes the water in lakes and playas (regardless of quality, unless the water exceeds 10,000 mg/l TDS and it can be shown that degradation of the particular water body will not adversely affect hydrologically connected fresh ground water), the surface waters of streams regardless of the water quality within a given reach, and underground waters containing 10,000 mg/l or less of TDS except for which, after notice and hearing, it is found there is no present or reasonably foreseeable beneficial use that contamination of such waters would impair. [19.15.2.7.F.(3) NMAC]

Hazard to public health:

exists when water that is used or is reasonably expected to be used in the future as a human drinking water supply exceeds at the time and place of the use, one or more of the numerical standards of Subsection A of 20.6.2.3103 NMAC, or the naturally occurring concentrations, whichever is higher, or if a toxic pollutant as defined at Subsection WW of 20.6.2.7 NMAC affecting human health is present in the water. In determining whether a release would cause a hazard to public health to exist, the director investigates and considers the purification and dilution reasonably expected to occur from the time and place of release to the time and place of withdrawal for use as human drinking water. [19.15.2.7.H.(2) NMAC]

Non-hazardous Waste:

means non-exempt oil field waste that is not hazardous waste. [19.15.2.7.N.(3) NMAC]

Oil field waste:

means non-domestic waste resulting from the exploration, development, production or storage of oil or gas pursuant to Paragraph (21) of Subsection B of Section 70-2-12 NMSA 1978 and the oil field service industry, the transportation of crude oil or natural gas, the treatment of natural gas or the refinement of crude oil pursuant to Paragraph (22) of Subsection B of Section 70-2-12 NMSA 1978, including waste generated from oil field remediation or abatement activity regardless of the date of release. Oil field waste does not include waste not generally associated with oil and gas industry operations such as tires, appliances or ordinary garbage or refuse unless generated at a division-regulated facility, and does not include sewage, regardless of the source. [19.15.2.7.O.(3) NMAC]

Release:

means all breaks, leaks, spills, releases, fires or blowouts involving oil, produced water, condensate, drilling fluids, completion fluids or other chemical or contaminant or mixture thereof, including oil field wastes and gases to the environment. [19.15.2.7.R.(4) NMAC]

TABLE II.5.4 - List of Emergency Coordinators

Primary Emergency Coordinator			
Name:	Joe Ontiveros	Work Phone:	575.887.4048
Title:	Facility Manager	Home/Mobile:	575.302.1584
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		
Alternate Emergency Coordinator			
Name:	Carl Sunderland	Work Phone:	575.887.4048
Title:	Facility Operator	Home/Mobile:	214.471.3423
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		
Onsite Emergency Coordinator			
Name:	Smiley Ontiveros	Work Phone:	575.887.4048
Title:	Facility Operator	Home/Mobile:	575.302.7177
Address:	Lea Land, LLC, 6387 Hobbs Highway, Carlsbad, NM 88220		

3.0 PREVENTION MEASURES

3.1 Waste Inspection and Screening

Non-hazardous and RCRA-exempt oil field wastes will be accepted at the Lea Land SWMF. It is unlikely that defined hazardous wastes will be delivered to this Facility, and Lea Land has implemented a waste inspection and screening program at the Facility Scalehouse to preclude acceptance of unauthorized wastes as described in the Oil Field Waste Management Plan (**Volume II.2**). The OCD Form C-138 (Request for Approval to Accept Solid Waste) is provided as **Attachment II.5.A**, which identifies the documentation required for each generator to certify the waste characteristics. It is possible that hazardous materials could become a concern if they arrive with other typical waste materials (19.15.36.13.N(6) NMAC). If this occurs, the generator will be notified and the entire load will be rejected and returned for proper management. The waste inspection and screening program has been established in order to identify hazardous materials before they become a health and safety liability.

3.2 Fire Prevention and Preparedness

Lea Land has implemented a program of fire preventative and preparedness measures, as well as employee training. Preventive measures taken to avoid fires will include regular inspections of incoming vehicles to identify incompatible or problematic wastes, and indication of suspect loads.

A list of available emergency response equipment is provided in **Table II.5.5** in accordance with the requirements of 19.15.36.13.N(4) NMAC. Control preparation procedures for potential fire emergencies include:

TABLE II.5.5 - Emergency Response Equipment List[1]

Equipment Description	Quantity	Location	Use(s)
10 lb ABC rated fire extinguisher (1 min)	2	Scalehouse	Firefighting
10 lb ABC rated fire extinguisher (1 min)	1 per vehicle	Trucks	Firefighting
10 lb ABC rated fire extinguisher (1 min)	1 per vehicle	Heavy Equipment	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Oil Process Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Oil Sales Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Produced Water Receiving Tanks	Firefighting
20 lb ABC rated fire extinguisher (2 min)	1	Diesel Storage Tank	Firefighting
Loader (3-55 CY/LOAD)	1	Facility	Berm Repair & Smothering Fires
Water Truck (1,000 GAL/LOAD)	1	Facility	Dust Control
Oil Booms (200 ft)	4	NE Corner of Ponds	Oil Containment
Self-contained Breathing Apparatus	1 per employee	Scalehouse	Protective gear for employees
Pair leather gloves	1 per employee	Assigned to Employee	Protective gear for employees
NOMEX Coveralls	7 per Employee	Assigned to Employee	Protective gear for employees
Pair safety glasses	1 per employee	Employee workstations	Protective gear for employees
Round-point wood handle shovels	2	Scalehouse	Contain spillage, putting out fires
First Aid Kit	3	Scalehouse, Processing Area, Produced Water Facility	First Aid
First Aid Kit	1 per vehicle	Facility Vehicles	First Aid
Eye Wash Station	1	Produced Water Receiving Tanks	First Aid
Emergency Shower	1	Produced Water Facility	First Aid
Portable 2-way radio	1 per employee	Base unit at the Scalehouse	Communications
Cell Phones (Unlimited Range)	min. 3	Facility Manager, Facility Operator, Facility Operator	Communications
Office Phone	2	Scalehouse	Communications
Mobile pressure washer	1	Mobile	Decontaminating equipment

Notes:
[1]*Subject to change in response to waste receipts, regulatory requirements, technology, etc.*

- Placement and maintenance of ABC-type fire extinguishers in structures and equipment.
- Implementation of a site-wide communication network to optimize mobilization of appropriate response personnel and equipment.
- Well established emergency response procedures, documented and posted at the Facility Scalehouse and provided to each employee on a laminated pocket cards.

Employee fire prevention and preparedness training will include the following:

- Training of equipment operators to identify suspect incompatible problematic wastes loads and measures for mitigation.
- Training of site personnel in waste screening (see Section 3.1), flammables identification, etc.
- Training on fire response technique, notification procedures, fire response equipment, etc.

4.0 IMPLEMENTATION, ASSESSMENT, AND NOTIFICATION

The following subsections present a series of procedures for implementation, assessment, and notification of appropriate authorities in the unlikely event that a specific emergency develops (19.15.36.13.N(1) NMAC).

4.1 Implementation

This Contingency Plan will be implemented when an imminent or actual emergency situation develops that represents a potential impact to freshwater, public health or the environment. Situations that could require implementation of this Plan include:

- fire/explosions
- release of contaminants or oil field waste constituents

Table II.5.6 lists the implementation, assessment, and notification procedures that will be followed in the case of an emergency. Assessment and notification are discussed further in subsections 4.2 and 4.3.

4.1.1 Fires/Explosions

Potential scenarios for fires include ignition of mobile equipment while operating or during servicing, or the ignition of oil-contaminated wastes. It is also possible that a chemically incompatible material may be transported to the Facility. Personnel are trained in the identification, prevention and control of fires or explosions.

TABLE II.5.6 - Implementation, Assessment, and Notification Procedures for Releases (Breaks, Leaks, Spills, Releases, Fires or Blowouts)

1. **NOTIFY THE ECs:** The employee who first becomes aware of the emergency will immediately notify the Primary EC, and the Alternate EC and On-site EC if necessary. Notification will be made in person, via telephone, or via radio. The responding EC will assume full authority over the situation. Properly protected responders will then assist any affected personnel or customers.
2. **ASSESS SOURCE, AMOUNT, AND EXTENT OF RELEASE:** The EC will assess the source, amount, and extent of spill or release, or released material resulting from a fire or explosion and determine possible hazards to fresh water, public health or the environment.
3. **CONTROL MEASURES OR EVACUATION:** The EC's assessment of the emergency situation will be the basis for attempting to control the release or for implementing an evacuation, as well as for notifying the appropriate state and local authorities if their assistance is needed. **Table II.5.8** provides Evacuation Procedures and a Site Evacuation Plan is provided as **Figure II.5.3** (also refer to control measures in Section 5.0).
4. **CONTAIN AND PREVENT SPREAD OF RELEASE:** If deemed safe by the EC, the appropriate Lea Land response equipment and personnel will be dispatched to the scene of the release. Personnel will initiate actions within their scope of training to contain the release and prevent the spread and/or windblown dispersion of the release. Depending on the type of release, appropriate equipment may include deployment of absorbents for spills, fire extinguishers, and/or earthmoving equipment.
5. **NOTIFICATION OF EMERGENCY AUTHORITIES:** If the EC's assessment indicates a need to notify appropriate state and local emergency authorities, notification will be initiated immediately. A list of state and local response agencies with phone numbers is provided as **Table II.5.2**. OCD will be notified as necessary in accordance with **Table II.5.7** (Release Notification and Corrective Action).
6. **DIVERT TRAFFIC AND RESTRICT PERSONS FROM AREA:** Lea Land personnel not actively involved in release control operations will be restricted from the area until the area is determined to be safe by the EC and, if appropriate, the on-scene senior emergency authority (i.e., fire, police, hazard or other official). Vehicular traffic will be diverted away from release response activities until the situation is abated.

4.1.2 Spills/Releases

The spill or release of a hazardous material at Lea Land is most likely to involve fuel or various vehicle maintenance materials (i.e., engine oil, hydraulic oil, antifreeze, etc.) at the vehicle service area depicted on the Site Plan (**Figure II.5.2**). Routine releases will be managed according to the protocol outlined in the Operations, Inspection, and Maintenance Plan (**Volume II.1**). Other materials most likely to present a concern as a result of normal operations include petroleum products and petroleum wastes delivered to the Facility for processing or disposal. Spills involving these types of materials could potentially occur during fueling, routine maintenance operations or during unloading or processing of waste. In addition, the possibility exists for a spill of a hazardous material that may be inadvertently transported to the Facility. Although highly unlikely, spill/releases from pond and tanks on-site are addressed in Section 5.2.

4.2 Assessment

In the event of a spill, release, fire, or explosion the EC will immediately identify the character, source, amount and extent of released materials, if possible; as well as assessing the potential impact to fresh water, public health or the environment (19.15.36.13.N(10) NMAC). Following an emergency, the EC may amend this Plan as necessary to protect fresh water, public health or the environment (19.15.36.13.N(14) NMAC). The EC will also assess the circumstances of an emergency situation and determine the responses required to:

- implement immediate response procedures
- provide notifications to appropriate agencies
- implement appropriate recordkeeping procedures and Plan amendments

This assessment provides the EC with critical data needed to determine whether an evacuation is necessary, whether emergency authorities are needed, and whether Lea Land will attempt to control the release with on-site personnel and equipment. **Table II.5.7** provides OCD descriptions of “major” and “minor” releases which are applicable for assessment purposes per 19.15.29.7 – 11 NMAC. This Section prescribes additional detailed information regarding the Site Evacuation Plan, and Section 5.0 addresses control restrictions.

4.2.1 Site Evacuation Plan

Based upon the type of waste materials proposed for receipt at Lea Land and the rigorous operational safety protocols prescribed, the potential for a Facility evacuation is unlikely (19.15.36.13.N(5) NMAC). In an emergency situation, the EC is the individual responsible for determining when evacuation of the Lea Land SWMF is required. Imminent or actual concerns that constitute a situation that could require evacuation include:

- A generalized fire or threat of fire that cannot be avoided.
- An explosion or the threat of explosion that cannot be averted.
- A major spill or leak that cannot be contained and constitutes a potential threat to human health or the environment.

TABLE II.5.7 - Part 29: Release Notification (1 of 3)

19.15.29.7 DEFINITIONS:

A. "Major release" means:
   (1) an unauthorized release of a volume, excluding gases, of 25 barrels or more;
   (2) an unauthorized release of a volume that:
      (a) results in a fire or is the result of a fire;
      (b) may with reasonable probability reach a watercourse;
      (c) may with reasonable probability endanger public health; or
      (d) substantially damages property or the environment;
   (3) an unauthorized release of gases exceeding 500 MCF; or
   (4) a release of a volume that may with reasonable probability be detrimental to fresh water.

B. "Minor release" means an unauthorized release, which is not a major release and is a volume greater than five barrels but less than 25 barrels; or for gases, greater than 50 MCF but less than 500 MCF.

C. "Responsible party" means the operator, as defined in 19.15.2 NMAC. Notwithstanding the foregoing, the division, in its sole discretion, may also consider a person causing the release, or controlling the location of the release as the responsible party.

D. "Wellstream" means the gas, oil, water, suspended constituents, or any combination thereof, which comes from the wellbore.

19.15.29.8 RELEASES:

A. Requirements. For all releases regardless of volume, the responsible party shall comply with 19.15.29.8 NMAC and shall remediate the release. For major and minor releases, the responsible party shall also comply with 19.15.29.9, 19.15.29.10, 19.15.29.11, 19.15.29.12 and 19.15.29.13 NMAC.

B. Initial response. The responsible party must take the following immediate actions unless the actions could create a safety hazard that would result in injury.
   (1) Source elimination and site security. The responsible party must take appropriate measures to stop the source of the release and limit access to the site as necessary to protect human health and the environment.
   (2) Containment. Once the site is secure, the responsible party must contain the materials released by construction of berms or dikes, the use of absorbent pads or other containment actions to limit the area affected by the release and prevent potential fresh water contaminants from migrating to watercourses or areas that could pose a threat to public health and environment. The responsible party must monitor the containment to ensure that it is effectively containing the material and not being degraded by weather or onsite activity.
   (3) Site stabilization. After containment, the responsible party must recover any free liquids and recoverable materials that can be physically removed from the surface within the containment area. The responsible party must deliver material removed from the site to a division-approved facility.
   (4) Remediation. The responsible party may commence remediation immediately.

19.15.29.9 RELEASE NOTIFICATION:

A. The responsible party must notify the division on form C-141 of a major or minor release occurring during the drilling, producing, storing, disposing, injecting, transporting, servicing or processing of oil, gases, produced water, condensate or oil field waste including regulated NORM, or other oil field related chemicals, contaminants or mixture of the chemicals or contaminants, in accordance with the requirements of 19.15.29 NMAC.

B. If state, federal or tribal lands are involved, the responsible party must send a copy of the form C-141 to the appropriate land managing agency including the state land office, the BLM or tribal authority, as applicable.

TABLE II.5.7 - Part 29: Release Notification (2 of 3)

19.15.29.10 RELEASE NOTIFICATION REPORTING REQUIREMENTS: The responsible party must notify the division of releases in 19.15.29.9 NMAC as follows.

A. Reporting a major release.
  (1) The responsible party must notify the division's environmental bureau chief and the appropriate division district office verbally or by e-mail within 24 hours of discovery of the release. The notification must provide the information required on form C-141.
  (2) The responsible party must also notify the appropriate division district office in writing within 15 days of discovering the release by completing and filing form C-141. The written notification must verify the prior verbal or e-mail notification and include additions or corrections to the information contained in the prior verbal or e-mail notification.

B. Reporting a minor release. The responsible party must notify the appropriate division district office in writing within 15 days of discovery of the release by completing and filing form C-141.

19.15.29.11 SITE ASSESSMENT/CHARACTERIZATION: After the responsible party has removed all free liquids and recoverable materials, the responsible party must assess soils both vertically and horizontally for potential environmental impacts from any major or minor release containing liquids.

A. Characterization requirements. The responsible party must submit information characterizing the release to the appropriate division district office within 90 days of discovery of the release or characterize the release by submitting a final closure report within 90 days of discovery of the release in accordance with Subsection E of 19.15.29.12 NMAC. The responsible party may seek an extension of time to submit characterization information for good cause as determined by the division. The responsible party must submit the following information to the division.
  (1) Site map. The responsible party must provide a scaled diagram that shows the potentially impacted area, significant surface features including roads and site infrastructure, location of borings, sample points, monitoring wells and subsurface features such as known pipelines to the extent known at the time of submittal including the source of information regarding subsurface features.
  (2) Depth to ground water. The responsible party must determine the depth to ground water where the release occurred. If the exact depth to ground water is unknown, the responsible party must provide a reasonable determination of probable ground water depth using data generated by numeric models, cathodic well lithology, water well data, published information or other tools as approved by the appropriate division district office. If the responsible party uses water well data, the responsible party must provide all pertinent well information.
  (3) Wellhead protection area. The responsible party must determine the horizontal distance from all known water sources within a half mile of the release including private and domestic water sources. Water sources are wells, springs or other sources of fresh water extraction. Private and domestic water sources are those water sources used by less than five households for domestic or stock purposes.
  (4) Distance to nearest significant watercourse. The responsible party must determine the horizontal distance to the nearest significant watercourse as defined in Subsection P of 19.15.17.7 NMAC within a half mile of any horizontal boundary of the release.
  (5) Soil/waste characteristics. The responsible party must determine the lateral and vertical extents of soil contamination, as follows.
    (a) If the release occurred within a lined containment area, the responsible party must demonstrate liner integrity after affected material is removed and the affected area of the liner is exposed and provide:
      (i) certification on form C-141 that the responsible party has visually inspected the liner where the release occurred and the liner remains intact and had the ability to contain the leak in question; and
      (ii) at least two business days' notice to the appropriate division district office before conducting the liner inspection.

TABLE II.5.7 - Part 29: Release Notification (3 of 3)

(b) If the responsible party is unable to demonstrate liner integrity or the release occurred outside of a lined containment area, the responsible party must delineate the release horizontally and vertically using Table I of 19.15.29.12 NMAC constituents or as required by Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC based on the type of release. The responsible party shall use one or more of the following soil sampling methods for characterization:
- (i) NRCS Field Guide;
- (ii) EPA SW-846;
- (iii) ASTM Method 4547;
- (iv) EPA 600; or
- (v) or other division-approved methods.

(c) In addition to Subparagraph (b) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, if the release occurred outside of a lined containment area and is in an area where depth to ground water is greater than 50 feet and less than or equal to 100 feet, the responsible party must delineate the vertical extent of the release to the greater of 600 mg/kg chloride or background chloride level, if:
- (i) the release contains produced water that exceeds 10,000 mg/l of chloride (if the responsible party contends the fluid is less than 10,000 mg/l, the responsible party must provide current sample results to the division); and
- (ii) the release is of an unknown quantity or results in greater than 200 barrels of unrecovered produced water.

(d) If the conditions are met in Subparagraph (c) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the responsible party must submit at least two soil samples for laboratory analysis from each borehole or sample point (highest observed contamination and deepest depth investigated). Field screening and assessment techniques are acceptable (headspace, titration, electrical conductivity [include algorithm for validation purposes], electromagnetics, etc.), but the sampling procedures must be clearly defined. The responsible party must submit copies of field notes attributable to field sampling and provide copies of the actual laboratory results including chain of custody documentation.

(e) If a known release of other oil field related chemicals occurs that is not included in Table I of 19.15.29.12 NMAC, and does not include oil, gas, produced water or other fluids from the wellstream, the standards for remediation shall be as follows:
- (i) if the constituent appears on Table 1 of 40 C.F.R. 261.24(b), then that constituent shall be remediated according to 40 C.F.R. 261.24;
- (ii) if the constituent is not identified in Table 1 of 40 C.F.R. 261.24(b), but is identified in the New Mexico environment department’s Risk Assessment Guidance for Site Investigations and Remediation Volumes I and II (assessment), the division will determine the appropriate Assessment Volume and remediation shall occur pursuant to the assessment;
- (iii) if the constituent is not identified in Items (i) or (ii) of Subparagraph (e) of Paragraph (5) of Subsection A of 19.15.29.11 NMAC, the division shall consult with the responsible party to determine appropriate remediation of the release.

B. Unless the site characterization report includes completed efforts at remediation, the report must include a proposed remediation plan in accordance with 19.15.29.12 NMAC, which includes the anticipated timelines for beginning and completing the remediation.

C. If the division determines that more information is needed to understand the character of the release and its potential impact on fresh water, public health and the environment, the division may request the responsible party submit additional information. Should the division request additional information, it must do so in writing to the responsible party within 30 days from receipt of the characterization report or remediation plan with what specific information the division is requesting and reasons why the additional information is needed. The responsible party has 14 days to respond to a written request for additional information. If the responsible party disagrees with the request for additional information, it may consult with the division, or file an application for hearing pursuant to 19.15.4 NMAC within 30 days of the issuance of the request for additional information.

When conditions warrant immediate evacuation of on-site persons (e.g., Facility personnel, transporters, visitors, vendors, etc.) everyone will be directed to proceed immediately to the Facility Scalehouse for directions, Lea Land's primary evacuation route. Lea Land Personnel will exercise good judgment and common sense in using the primary evacuation route to exit the Facility, or selecting the most appropriate alternative evacuation route, if necessary. Assembly points, primary and secondary evacuation routes are provided on **Figure II.5.3**. Driving directions to the nearest hospital are included as **Figure II.5.4**, and **Table II.5.8** provides detailed procedures for evacuating the Facility.

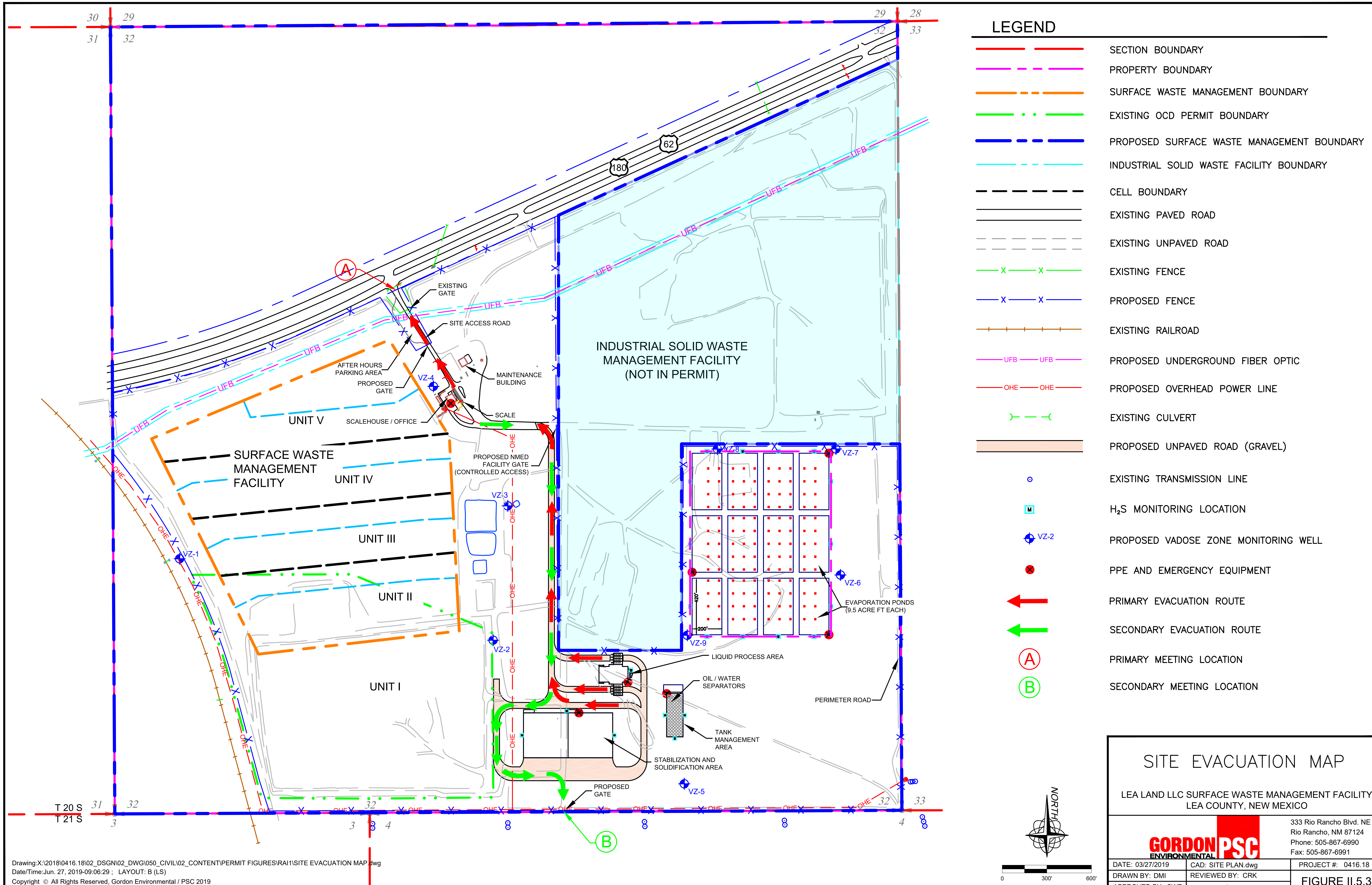
TABLE II.5.8 - Evacuation Procedures

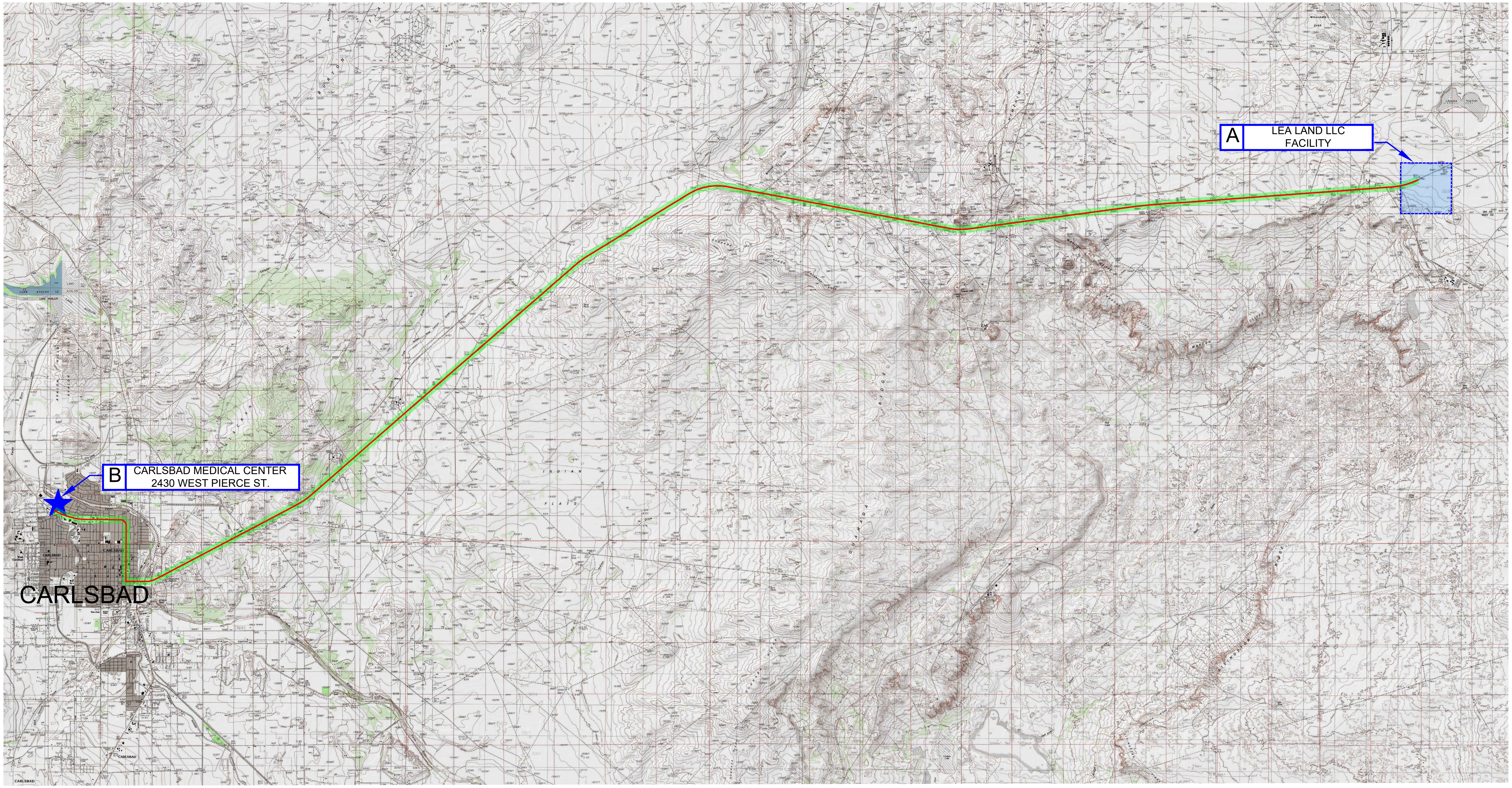
When evacuation is required, the following procedures will be implemented:

1. Facility personnel will be alerted directly or using the Facility telephone, cellular telephones, or radios.
2. Vehicles delivering waste will be diverted away from the location of the emergency and routed towards the Facility exit (**Figure II.5.3**).
3. Stationary Facility operating equipment will be shut down.
4. Personnel will be directed to proceed to the Facility Scalehouse, which will be the primary meeting location (**Figure II.5.3**). The EC will identify missing persons at that time.
5. If the emergency involves the Scalehouse or its immediate environs, the Facility secondary assembly point and evacuation routes will be utilized (as applicable).
6. Once assembled, Facility personnel will stand by to afford assistance, if and as needed, or to evacuate the Site.

4.3 Notification of Authorities

The following discussion presents a series of procedures for implementation and notification of appropriate authorities in the event that a specific emergency develops (19.15.36.13.N(1) NMAC). Whenever there is an imminent or actual emergency, the EC will immediately notify on-site persons (Facility personnel, visitors, vendors, transporters, etc.) via on-site communication systems, as well as notify the appropriate state and local agencies as necessary (19.15.36.13.N(9) NMAC).


LEGEND
SECTION BOUNDARY
PROPERTY BOUNDARY
SURFACE WASTE MANAGEMENT BOUNDARY
EXISTING OCD PERMIT BOUNDARY
PROPOSED SURFACE WASTE MANAGEMENT BOUNDARY
INDUSTRIAL SOLID WASTE FACILITY BOUNDARY
CELL BOUNDARY
EXISTING PAVED ROAD
EXISTING UNPAVED ROAD
EXISTING FENCE
PROPOSED FENCE
EXISTING RAILROAD
PROPOSED UNDERGROUND FIBER OPTIC
PROPOSED OVERHEAD POWER LINE
EXISTING CULVERT
PROPOSED UNPAVED ROAD (GRAVEL)
EXISTING TRANSMISSION LINE
H_2S MONITORING LOCATION
PROPOSED VADOSE ZONE MONITORING WELL
PPE AND EMERGENCY EQUIPMENT
PRIMARY EVACUATION ROUTE
SECONDARY EVACUATION ROUTE
PRIMARY MEETING LOCATION
SECONDARY MEETING LOCATION
INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY (NOT IN PERMIT)
SURFACE WASTE MANAGEMENT FACILITY
UNIT V
UNIT IV
UNIT III
UNIT II
UNIT I
EXISTING GATE
SITE ACCESS ROAD
AFTER HOURS PARKING AREA
PROPOSED GATE
MAINTENANCE BUILDING
SCALE
SCALEHOUSE / OFFICE
PROPOSED NMED FACILITY GATE (CONTROLLED ACCESS)
EVAPORATION PONDS (9.5 ACRE FT EACH)
LIQUID PROCESS AREA
OIL / WATER SEPARATORS
TANK MANAGEMENT AREA
STABILIZATION AND SOLIDIFICATION AREA
PERIMETER ROAD
PROPOSED GATE
VZ-1
VZ-2
VZ-3
VZ-4
VZ-5
VZ-6
VZ-7
VZ-8
VZ-9
420'
200'
62
180
T 20 S
T 21 S
NORTH
0
300'
600'
SITE EVACUATION MAP
LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO
GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991
DATE: 03/27/2019
CAD: SITE PLAN.dwg
PROJECT #: 0416.18
DRAWN BY: DMI
REVIEWED BY: CRK
APPROVED BY: CWF
www.team-psc.com
FIGURE II.5.3
Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE EVACUATION MAP.dwg
Date/Time:Jun. 27, 2019-09:06:29 ; LAYOUT: B (LS)
Copyright © All Rights Reserved, Gordon Environmental / PSC 2019



A: LEA LAND LLC FACILITY. HIGHWAY 62/180

1. Head EAST on HWY 62/180 toward CARLSBAD
2. North on Canal street to West Pierce street.
3. West on Pierce street to 2430 West Pierce street

B: CARLSBAD MEDICAL CENTER *Note: A to B Travel Estimates: 25 minutes / 30.9 miles*

MAP REFERENCE:
USGS JAL QUADRANGLE
NEW MEXICO-TEXAS 1:100,000 SCALE SERIES 1978

NORTH

0 1 MILE 2 MILES

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\HOSPITAL LOCATION.dwg
Date/Time:Apr. 01, 2019-11:10:31 ; LAYOUT: B (LS)

HOSPITAL LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: HOSPITAL.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.5.4
APPROVED BY: CWF	www.team-psc.com	

Table II.5.2 provides a list of emergency response agencies and contacts that may need to be notified depending on the type and extent of an emergency situation. **Table II.5.2** will be posted prominently near on-site telephones and provided as handouts to Lea Land personnel, customers, response personal, etc. Fire, police, and medical authorities should be contacted as necessary in an emergency situation (**Table II.5.2**). The adjacent property users should be notified if there is an immediate threat to human health and the environment in the area, such as fire, explosions or H_2S release (land currently vacant).

In the case of an H_2S emergency where H_2S ≥10 ppm site personnel will follow the H_2S plan in **Volume II.3**. However**,** notification will be provided to the New Mexico State Police, Lea County Sheriff, and OCD (also listed on **Table II.5.2**):

• OCD	
Hobbs, NM	575.393.6161
Mobile Phone	575.370.3180
Santa Fe, NM	505.476.3440
• New Mexico State Police	911 or 575.392.5580
• Eddy County Sherriff's Dept	911 or 575.887.1888
• Eddy County Emergency Management	575.628.5450
• Lea County Sherriff's Dept.	911 or 575.396.3611
• Lea County Emergency Management	575.391.2983

Lea Land will also notify Southwest Environmental, a third-party response specialist (if necessary) in Hobbs (**Table II.5.2**) to provide response personnel, equipment, and supplies to mitigate the source of an H_2S reading of ≥10 ppm at the property boundary.

Table II.5.7 provides specific information regarding notification of OCD in the case of a release, which by definition includes "*breaks, leaks, spills, releases, fires or blowouts*" (**Table II.5.3**). In addition, **Table II.5.7** also provides OCD definitions for "major" and "minor" releases.

Additional State, Federal, and other local emergency contact numbers are provided and should be used as deemed appropriate to the situation by the EC. If the EC determines that the incident could threaten fresh water, human health, public safety or the environment beyond the limits of the Lea Land SWMF, the EC will notify the National Response Center and New Mexico Environment

Department (NMED) spill emergencies at the following phone numbers (also included on **Table II.5.2**):

- National Response Center - 24 Hr. Hotline: 800.424.8802
- NMED Environmental Emergencies - 24 Hr. Hotline: 505.827.9329

The EC's notification to authorities must include the following information, as listed on the Emergency Response Record Keeping Form:

- name and telephone number of person reporting the incident
- name and address of Facility
- time and type of incident (e.g., hazardous material release, fire)
- name and quantity of material(s) involved, to the extent known
- extent of injuries, if any
- possible hazards to human health or the environment

Recordkeeping will be recorded as detailed in Section 8.0, and Plan Amendments accomplished in accordance with Section 10.0.

5.0 CONTROL PROCEDURES

This section provides information for the EC and Lea Land personnel regarding control procedures for different types of releases including fires, explosions, spills, and releases. The focus of the EC's initial efforts will be the protection of Facility personnel and those using the Facility. Control procedures should only be implemented by the EC and Lea Land personnel once an assessment of the situation and possible hazards to fresh water, public health or the environment has been completed. Staff or the public should not attempt to contain or control fires, explosions, spills, leaks, breaks, or blowouts that are beyond the scope of their safety, training, and available response equipment. Once the appropriate state and local agencies arrive on scene, these authorities will take control of the situation, as appropriate.

The following subsections provide the EC and Lea Land personnel with specific control procedures for emergency situations. Note that in the case of an H_2S emergency situation, the procedures outlined in **Volume II.3** (Hydrogen Sulfide (H_2S) Prevention and Contingency Plan) should be followed.

5.1 Fire Control Guidelines

Fire response equipment available at Lea Land is identified on **Table II.5.5**. Fire control efforts will not be initiated until untrained personnel or customers are at a safe distance. The following general guidelines for fire control will be followed in the event of a fire or explosion at Lea Land:

TABLE II.5.9 - Fire/Explosion: Control Guidelines

1. **INITIATE FIRE CONTROL:** The EC and Lea Land personnel will initiate response actions within the scope of their training to control the spread of the fire.
2. **P.A.S.S. METHOD:** Fires will generally be controlled with ABC-type fire extinguishers using the P.A.S.S. method (Pull pin, Aim nozzle, Squeeze trigger, Sweep from side to side to extinguish).
3. **SMOTHER METHOD:** Fires may also be smothered with cover materials (i.e., soil, caliche) when possible to extinguish.
4. **AVAILABLE WATER SOURCES:** Fires may be doused or hosed with available equipment, water truck, etc. Water will not be used on petroleum fires.
5. **EVACUATE AND NOTIFY EMERGENCY AUTHORITIES:** If at any time the scope of the fire is beyond the capabilities of Lea Land personnel to contain and/or extinguish it, the EC will contact the local Fire Department or the Lea County Emergency Management (**Table II.5.2**) for assistance. Personnel and visitors will be instructed to evacuate the area.
6. **MONITOR SITUATION:** The EC will monitor for leaks, pressure buildup, gas generation or rupture in valves, pipes or equipment as appropriate (19.15.36.13.N(11) NMAC).
7. **RECORDKEEPING/REPORTING:** The EC will complete an Incident Report Form (**Attachment II.5.B**) and maintain a copy in the Facility Operating Record, readily accessible for OCD inspection.

After responding to the incident, the EC will meet with involved personnel and response agencies, if appropriate, to assess the cause of the emergency and document the incident. The Incident Report Form (**Attachment II.5.B**) will reflect the details of the emergency and the resulting actions. The identified causative agent will be removed from the vicinity of the Facility if the possibility of re-ignition exists. Appropriate actions to prevent recurrence of fire will be developed and implemented. Personnel involved with the handling, transport, and placement of materials at the Facility will be informed of the resultant actions. Significant changes in operating protocol or procedures resulting from this meeting will be documented and added as an amendment to the Plan (see Section 10.0) as appropriate.

5.2 Spills/Release Control Guidelines

The waste inspection and screening program (see Section 3.0) has been implemented in order to intercept potential unauthorized wastes inadvertently delivered to Lea Land before they are unloaded at the Facility. Emergency equipment for response to such releases includes, but is not limited to, the items provided in the Emergency Response Equipment List (**Table II.5.5**). Containment/control and characterization of potential releases will be conducted only after untrained personnel are at a safe distance. At that point, the EC will then implement the following procedures for managing existing or potential release (19.15.36.13.N(6) NMAC):

TABLE II.5.10 - Spill/Release: Control Guidelines

1. **INITIATE CONTROL:** The EC and Lea Land personnel will initiate response actions within the scope of their training to control the spill/release.
2. **REMOVAL OR SEGREGATION:** Determine if the material can be safely removed to a designated waste inspection/segregation area for further evaluation. If the materials cannot be safely relocated, contain them for investigation and sampling using the spill control list. If necessary, shut down operations until safe conditions are restored.
3. **CONTAIN RELEASE:** Attempt to contain the release to the smallest area possible. Examples of equipment available for spill containment are non-reactive sorbent materials, oil booms, sand, shovels and heavy equipment. A third-party contractor is also available for emergency response to augment efforts by on-site personnel.
4. **SAMPLING:** After isolating the contaminants and contaminated media, inspect them to determine if sampling is appropriate. If appropriate, isolate contaminants in the waste inspection or segregation area, or in designated leak-proof containers, until characterization is complete.
5. **CLEANUP:** After the release has been contained and necessary samples have been obtained, cleanup will be initiated by removing the spilled materials, sorbent materials, soils used for containment, etc.
6. **EQUIPMENT MONITORING:** Pertinent liners and equipment, including valves and pipes, will be monitored for leaks, pressure buildup, gas generation or rupture as appropriate (19.15.36.13.N(11) NMAC).
7. **VERIFICATION SAMPLING:** Dependent on the type of material spilled, the EC will assess requirements for cleanup verification including the collection of samples for appropriate analytical testing.
8. **DISPOSAL OR PROCESSING:** When visual and/or laboratory characterization is complete, determine appropriate processing or disposal procedures for that waste type. Send residuals for disposal to a Facility that is approved for managing that type of waste.
9. **EVACUATE AND NOTIFY EMERGENCY AUTHORITIES:** If at any time the scope of the spill/release is beyond the capabilities of the on-site personnel to contain and/or extinguish it, the EC will contact the local Fire Department or Lea County Emergency Management (**Table II.5.2**) for assistance. Personnel and visitors will be instructed to evacuate the area.
10. **RECORDKEEPING/REPORTING:** The EC will complete an Incident Report Form (**Attachment II.5.B**) and maintain a copy in the Facility Operating Record, readily accessible for OCD inspection.

Immediately after an emergency situation, the EC will make arrangements for the segregation, storage, or disposal of recovered wastes, water, or contaminated materials resulting from the incident. An evaluation of the contamination will be carried out as soon as time permits to prevent future accidents. The Incident Report Form (**Attachment II.5.B**) will reflect the details of the emergency and the resulting actions.

Although operating procedures, roadways, unloading areas, and general areas surrounding the Lea Land SWMF will be maintained in an effort to minimize the potential for a release or spill of hazardous materials, provisions have been developed to improve procedures if an event warrants review and modification. After responding to the incident, the EC will meet with involved personnel to determine the cause of the spill. Appropriate actions to prevent its recurrence will be developed and implemented. Personnel involved with the handling and transport of hazardous materials will be informed of the procedures/protocol that is developed in response to knowledge gained from past response procedures. Significant changes in operating protocol or procedures resulting from this meeting will be documented and added as an amendment to this Plan. Plan amendments will be documented and disseminated as outlined in Section 10.0, including OCD within 5 days.

5.3 Clean, Replace, and Inspect Equipment

Following an emergency incident, emergency response equipment used will be inspected, decontaminated/cleaned and made fit for re-use, or replaced as necessary, so that the equipment will be available when Facility operations resume. The inspection of equipment will take place before operations resume ensuring that each item is in proper working condition. This inspection will include a review of the Facility infrastructure to ensure that a potential hazard has not been created as a result of responding to the emergency. Prescribed procedures may include lock-out/tag-out on processing equipment until inspection and repairs can be completed. Remedial activities, as a result of this inspection, may include recharging of fire extinguishers, replacement of personal protective gear, restocking of disposable items, etc. The EC will verify that response equipment has been properly decontaminated and returned to its original location and is fit for future use.

6.0 STORAGE AND TREATMENT OF RELEASED MATERIALS

Spilled or otherwise contaminated material approved for disposal at the Lea Land Landfill will be managed in accordance with standard operating practices. Other hazardous spilled materials will be containerized, stored and disposed of in accordance with applicable local, state and federal regulatory requirements; potentially including third-party services (i.e., Southwest Environmental, Hobbs, NM). No oil field waste, which may be incompatible with the released material, will be treated, stored, or disposed of until cleanup procedures are complete (19.15.36.13.N.(12) and (13) NMAC).

7.0 EMERGENCY EQUIPMENT

The following sections describe emergency equipment that is available at Lea Land for responding to emergency situations. An Emergency Response Equipment List describing the equipment, quantity, location, and uses is provided as **Table II.5.5**.

7.1 Internal Communications

Communications at the Lea Land SWMF will be accomplished via cellular telephones, land lines, two-way radios, etc. These systems provide Facility personnel with immediate and redundant emergency notification capabilities, and the opportunity to receive instructions in the event of an emergency incident. Mechanical difficulties with the communications equipment will be promptly addressed. Internal communication devices are listed on **Table II.5.5**.

7.2 External Communications

The telephones located at Lea Land will have outside access in the event that notification of the local emergency response authorities is required (i.e., EMS, fire department, ambulance, etc.). In addition, key Facility personnel including the ECs, General Manager, etc., will carry cellular telephones for contacting each other, Lea Land Headquarters and outside agencies. The cellular telephones will also provide a backup means for contacting emergency authorities in the event they cannot be reached by conventional (hard-line) telephone. Emergency phone numbers will be posted in the Facility Scalehouse and provided to employees and key customers on laminated pocket cards. External communication devices are also included on **Table II.5.5**.

7.3 Fire Prevention

Portable ABC-type fire extinguishers will be located in Facility vehicles and mobile equipment, as well as within the Facility Scalehouse, and tank areas. Fire extinguishers will be maintained in accordance with state and local fire codes and regulations, and routinely serviced. On-site earthmoving equipment will be available to move and apply cover material for control of smoldering loads. Cover material will be readily available throughout the site.

7.4 Personnel Protection, First Aid, and Safety Equipment

Personal protective equipment (PPE) necessary for preliminary response to a release of hazardous materials will be maintained in on-site buildings (Facility Scalehouse, etc.) and/or issued to each employee (**Table II.5.5**). These items may include Tyvek suits, gloves, safety glasses, hearing protection, etc.

First aid and safety equipment will be maintained at various locations at the Lea Land SWMF (**Table II.5.5**). Safety equipment located at the Facility will include industrial first aid kits, emergency shower/eye wash station, etc. First aid kits will be placed in the Facility Scalehouse and the Produced Water Facility. An emergency shower and eye wash station will also be located at the Produced Water Facility. In addition, first aid kits will be maintained in Facility vehicles, including heavy equipment. Prominent signs will be placed identifying the location of health and safety equipment, and emergency response items (e.g., fire extinguishers).

7.5 Spill Response Equipment

Spill response equipment, including heavy equipment and hand-gear, will be stored at specific locations around the Facility (**Table II.5.5**).

8.0 RECORDKEEPING

The EC will be responsible for ensuring that emergency response actions are fully documented. The Incident Report Form (**Attachment II.5.B**) illustrates the information that will be recorded as a result of an emergency incident and related response action. This form will be signed by both the EC and the Facility Manager. Copies of the form filed for each incident will be retained as part of the Lea Land SWMF Operating Record.

In addition, in the case of an unauthorized release at the Lea Land SWMF, the OCD will be notified pursuant to 19.15.29 NMAC. As defined by OCD in **Table II.5.3**, a "*release*" is "*breaks, leaks, spills, releases, fires or blowouts involving crude oil, produced water, condensate, drilling fluids, completion fluids or other chemical or contaminant or mixture thereof, including oil field wastes and natural gases to the environment*" (19.15.2.7.R(4) NMAC). A major release (19.15.29 NMAC; **Table II.5.7**) includes *an unauthorized release of a volume in excess of 25 barrels; or of any volume which results in a fire, will reach a water course, may with reasonable probability endanger public health or results in substantial damage to property or to the environment, cause detriment to water or exceed the standards in 19.15.30 NMAC*. A major release requires both immediate verbal or e-mail notification (within 24 hours) as well as timely written notification to OCD (within 15 days) using OCD Form C-141 (**Attachment II.5.C**) relating to *Release Notification and Corrective Action*. A minor release (**Table II.5.7**) is an unauthorized release of greater than 5 barrels but less than 25 barrels.

A minor release requires timely written notice within 15 days of discovery. A copy of OCD Form C-141 is provided as **Attachment II.5.C**. Copies of the form filed for each incident will be retained as part of the Lea Land SWMF Operating Record.

9.0 COORDINATION AGREEMENTS

A copy of the Contingency Plan will be made available to the organizations identified in **Table II.5.2**. The Contingency Plan serves to familiarize each of the identified organizations with the operations of the Facility and types of emergencies and responses that may be required. Each agency will be encouraged to visit the Facility for purposes of assessing site operations and providing input regarding emergency response procedures (19.15.36.13.N.(2)-(7) NMAC).

10.0 PLAN AMENDMENT

The EC will be responsible for assuring updates to or amendments of the Contingency Plan. Amendments to the Contingency Plan will be made within five working days in the event of the following (19.15.36.13.N(8) NMAC):

1. The Facility Permit is revised or modified.
2. The Plan fails in an emergency.
3. Modification to the Facility design, construction, operation, maintenance or other circumstances that changes the potential for fires, explosion, or releases of hazardous oil field waste constituents; or related changes in the appropriate emergency response.
4. The list of EC's changes.
5. The list of emergency equipment changes significantly.

The Contingency Plan amendments will be distributed to OCD and made available to each of the organizations identified in **Table II.5.2** with a cover letter highlighting substantive changes. Proposed changes will be accomplished in compliance with 19.15.36.13.N NMAC.

ATTACHMENT II.5.A

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE

OCD FORM C-138

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-138
Revised August 1, 2011

*Surface Waste Management Facility Operator and Generator shall maintain and make this documentation available for Division inspection.

REQUEST FOR APPROVAL TO ACCEPT SOLID WASTE

1. Generator Name and Address:

2. Originating Site:

3. Location of Material (Street Address, City, State or ULSTR):

4. Source and Description of Waste:

Estimated Volume ___________ yd^3 / bbls Known Volume (to be entered by the operator at the end of the haul) ___________ yd^3 / bbls

5. GENERATOR CERTIFICATION STATEMENT OF WASTE STATUS

I, ___________________________, representative or authorized agent for ____ do hereby certify that according to the Resource Conservation and Recovery Act (RCRA) and the US Environmental Protection Agency's July 1988 regulatory determination, the above described waste is: (Check the appropriate classification)

☐ RCRA Exempt: Oil field wastes generated from oil and gas exploration and production operations and are not mixed with non-exempt waste. *Operator Use Only: Waste Acceptance Frequency* ☐ *Monthly* ☐ *Weekly* ☐ *Per Load*

☐ RCRA Non-Exempt: Oil field waste which is non-hazardous that does not exceed the minimum standards for waste hazardous by characteristics established in RCRA regulations, 40 CFR 261.21-261.24, or listed hazardous waste as defined in 40 CFR, part 261, subpart D, as amended. The following documentation is attached to demonstrate the above-described waste is non-hazardous. (Check the appropriate items)

☐ MSDS Information ☐ RCRA Hazardous Waste Analysis ☐ Process Knowledge ☐ Other (Provide description in Box 4)

GENERATOR 19.15.36.15 WASTE TESTING CERTIFICATION STATEMENT FOR LANDFARMS

I, ___________________________, representative for ____ do hereby certify that representative samples of the oil field waste have been subjected to the paint filter test and tested for chloride content and that the samples have been found to conform to the specific requirements applicable to landfarms pursuant to Section 15 of 19.15.36 NMAC. The results of the representative samples are attached to demonstrate the above-described waste conform to the requirements of Section 15 of 19.15.36 NMAC.

5. Transporter:

OCD Permitted Surface Waste Management Facility

Name and Facility Permit #:

Address of Facility:

Method of Treatment and/or Disposal:

☐ Evaporation ☐ Injection ☐ Treating Plant ☐ Landfarm ☐ Landfill ☐ Other

Waste Acceptance Status:

☐ **APPROVED** ☐ **DENIED** (Must Be Maintained As Permanent Record)

PRINT NAME: ______________________________ TITLE: ________________________ DATE: __________

SIGNATURE: ___________________________________ TELEPHONE NO.: ______________________
Surface Waste Management Facility Authorized Agent

ATTACHMENT II.5.B

INCIDENT REPORT FORM (TYPICAL)

INCIDENT REPORT FORM

Facility Information

Facility Name: ____

Location: ____

Permit No: ______________________ Phone No: ______________________

Type of Incident and General Information

- ❑ Work Related Injury/Illness
- ❑ Property Damage
- ❑ Vehicular Accident
- ❑ Unsafe Act/Near Miss
- ❑ Vandalism/Criminal Activity
- ❑ Other _______________ (i.e., spill, release, fire, explosion, hot load, etc.)

Employee Name: ______________________ Job Title: ______________________

Phone No: _____________ Date of Incident: __________ Time of Incident: _______ AM/PM

Location of Incident: ____

Start of Shift:______________________ Weather:______________________

Date and Time Reported to Management: Date: _____________ Time: __________ AM/PM

Reported to: ______________ Title: ______________ Reported by: ______________

What was the injury category of incident at the time it was first reported to management?

[ ] N/A. Employee does not claim an injury associated with this incident
[ ] Notice Only of Injury, Declined Medical Treatment at this time
[ ] First Aid done on site, Declined Medical Treatment at this time
[ ] Medical Treatment. Transported by ________________ to ________________
[ ] Fatality, employee

THIS SECTION FILLED OUT BY **EMPLOYEE**

Employee's Description of Incident / Declaración del empleado de los hechos

Were you injured? *(Ud. se lastimó ?)* **Yes [ ]** **No [ ]**

Type of Injury: *(Tipo de lesión)* ____

Part of Body: ______________________ Left __________ Right __________
(Parte del cuerpo) *(Izq)* *(Der)*

Explain in your own words what happened. *(Explique en sus propias palabras lo que sucedió)*

____

____

____

____

____

Employee Signature: (*Firma del empleado*) ____

Date: (*Fecha*) ____

INCIDENT REPORT FORM

TO BE FILLED OUT BY EMERGENCY COORDINATOR

Describe in order of occurrence the events leading to the incident and/or injury. Reconstruct the sequence of events that led to the incident. ______________________________

Identify possible hazards to human health or the environment: ______________________________

Identify name and quantity of material(s) involved: ______________________________

CORRECTIVE ACTIONS. (Equipment, Practices, Environment, Retraining) Steps that have been, or will be taken to prevent recurrence: ______________________________

Date Corrective Action Completed: ______________________________

- I have been briefed on the corrective actions outlined above
- *Estoy consciente de las acciones correctivas mencionadas anteriormente en esta hoja*

____
Employee's Signature

____
Date

Report Reviewed and Concluded By:

____
Emergency Coordinator's Signature

____
Date

ATTACHMENT II.5.C

RELEASE NOTIFICATION AND CORRECTIVE ACTION

OCD FORM C-141

District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-141
Revised August 24, 2018
Submit to appropriate OCD District office

Incident ID	
District RP	
Facility ID	
Application ID	

Release Notification

Responsible Party

Responsible Party	OGRID
Contact Name	Contact Telephone
Contact email	Incident # *(assigned by OCD)*
Contact mailing address	

Location of Release Source

Latitude ______________________________ Longitude ______________________________
(NAD 83 in decimal degrees to 5 decimal places)

Site Name	Site Type
Date Release Discovered	API# *(if applicable)*

Unit Letter	Section	Township	Range	County

Surface Owner: ☐ State ☐ Federal ☐ Tribal ☐ Private (*Name:* ______________________________)

Nature and Volume of Release

Material(s) Released (Select all that apply and attach calculations or specific justification for the volumes provided below)

☐ Crude Oil	Volume Released (bbls)	Volume Recovered (bbls)
☐ Produced Water	Volume Released (bbls)	Volume Recovered (bbls)
	Is the concentration of dissolved chloride in the produced water >10,000 mg/l?	☐ Yes ☐ No
☐ Condensate	Volume Released (bbls)	Volume Recovered (bbls)
☐ Natural Gas	Volume Released (Mcf)	Volume Recovered (Mcf)
☐ Other (describe)	Volume/Weight Released (provide units)	Volume/Weight Recovered (provide units)
Cause of Release		

State of New Mexico
Oil Conservation Division

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Was this a major release as defined by 19.15.29.7(A) NMAC? ☐ Yes ☐ No	If YES, for what reason(s) does the responsible party consider this a major release?
If YES, was immediate notice given to the OCD? By whom? To whom? When and by what means (phone, email, etc)?	

Initial Response

The responsible party must undertake the following actions immediately unless they could create a safety hazard that would result in injury

☐ The source of the release has been stopped.

☐ The impacted area has been secured to protect human health and the environment.

☐ Released materials have been contained via the use of berms or dikes, absorbent pads, or other containment devices.

☐ All free liquids and recoverable materials have been removed and managed appropriately.

If all the actions described above have <u>not</u> been undertaken, explain why:

Per 19.15.29.8 B. (4) NMAC the responsible party may commence remediation immediately after discovery of a release. If remediation has begun, please attach a narrative of actions to date. If remedial efforts have been successfully completed or if the release occurred within a lined containment area (see 19.15.29.11(A)(5)(a) NMAC), please attach all information needed for closure evaluation.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: ____________

email: ______________________________ Telephone: ______________________

<u>OCD Only</u>

Received by: ______________________________ Date: ____________

State of New Mexico
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Site Assessment/Characterization

This information must be provided to the appropriate district office no later than 90 days after the release discovery date.

What is the shallowest depth to groundwater beneath the area affected by the release?	_________ (ft bgs)
Did this release impact groundwater or surface water?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a continuously flowing watercourse or any other significant watercourse?	☐ Yes ☐ No
Are the lateral extents of the release within 200 feet of any lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark)?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of an occupied permanent residence, school, hospital, institution, or church?	☐ Yes ☐ No
Are the lateral extents of the release within 500 horizontal feet of a spring or a private domestic fresh water well used by less than five households for domestic or stock watering purposes?	☐ Yes ☐ No
Are the lateral extents of the release within 1000 feet of any other fresh water well or spring?	☐ Yes ☐ No
Are the lateral extents of the release within incorporated municipal boundaries or within a defined municipal fresh water well field?	☐ Yes ☐ No
Are the lateral extents of the release within 300 feet of a wetland?	☐ Yes ☐ No
Are the lateral extents of the release overlying a subsurface mine?	☐ Yes ☐ No
Are the lateral extents of the release overlying an unstable area such as karst geology?	☐ Yes ☐ No
Are the lateral extents of the release within a 100-year floodplain?	☐ Yes ☐ No
Did the release impact areas **not** on an exploration, development, production, or storage site?	☐ Yes ☐ No

Attach a comprehensive report (electronic submittals in .pdf format are preferred) demonstrating the lateral and vertical extents of soil contamination associated with the release have been determined. Refer to 19.15.29.11 NMAC for specifics.

Characterization Report Checklist: ***Each of the following items must be included in the report.***

☐ Scaled site map showing impacted area, surface features, subsurface features, delineation points, and monitoring wells.
☐ Field data
☐ Data table of soil contaminant concentration data
☐ Depth to water determination
☐ Determination of water sources and significant watercourses within ½-mile of the lateral extents of the release
☐ Boring or excavation logs
☐ Photographs including date and GIS information
☐ Topographic/Aerial maps
☐ Laboratory data including chain of custody

If the site characterization report does not include completed efforts at remediation of the release, the report must include a proposed remediation plan. That plan must include the estimated volume of material to be remediated, the proposed remediation technique, proposed sampling plan and methods, anticipated timelines for beginning and completing the remediation. The closure criteria for a release are contained in Table 1 of 19.15.29.12 NMAC, however, use of the table is modified by site- and release-specific parameters.

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I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: __________

email: ______________________________ Telephone: ______________________________

OCD Only

Received by: ______________________________ Date: ______________

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Remediation Plan

Remediation Plan Checklist: ***Each of the following items must be included in the plan.***

☐ Detailed description of proposed remediation technique
☐ Scaled sitemap with GPS coordinates showing delineation points
☐ Estimated volume of material to be remediated
☐ Closure criteria is to Table 1 specifications subject to 19.15.29.12(C)(4) NMAC
☐ Proposed schedule for remediation (note if remediation plan timeline is more than 90 days OCD approval is required)

Deferral Requests Only: ***Each of the following items must be confirmed as part of any request for deferral of remediation.***

☐ Contamination must be in areas immediately under or around production equipment where remediation could cause a major facility deconstruction.

☐ Extents of contamination must be fully delineated.

☐ Contamination does not cause an imminent risk to human health, the environment, or groundwater.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Printed Name: ____ Title: ____

Signature: ____ Date: ____________

email: ____ Telephone: ______________________________

OCD Only

Received by: ____ Date: ________________

☐ Approved ☐ Approved with Attached Conditions of Approval ☐ Denied ☐ Deferral Approved

Signature: ____ Date: ______________________

State of New Mexico
Oil Conservation Division

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District RP	
Facility ID	
Application ID	

Closure

The responsible party must attach information demonstrating they have complied with all applicable closure requirements and any conditions or directives of the OCD. This demonstration should be in the form of a comprehensive report (electronic submittals in .pdf format are preferred) including a scaled site map, sampling diagrams, relevant field notes, photographs of any excavation prior to backfilling, laboratory data including chain of custody documents of final sampling, and a narrative of the remedial activities. Refer to 19.15.29.12 NMAC.

Closure Report Attachment Checklist: ***Each of the following items must be included in the closure report.***

☐ A scaled site and sampling diagram as described in 19.15.29.11 NMAC

☐ Photographs of the remediated site prior to backfill or photos of the liner integrity if applicable (Note: appropriate OCD District office must be notified 2 days prior to liner inspection)

☐ Laboratory analyses of final sampling (Note: appropriate ODC District office must be notified 2 days prior to final sampling)

☐ Description of remediation activities

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to OCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the OCD does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to groundwater, surface water, human health or the environment. In addition, OCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations. The responsible party acknowledges they must substantially restore, reclaim, and re-vegetate the impacted surface area to the conditions that existed prior to the release or their final land use in accordance with 19.15.29.13 NMAC including notification to the OCD when reclamation and re-vegetation are complete.

Printed Name: ______________________________ Title: ______________________________

Signature: ______________________________ Date: ________________

email: ___________________________ Telephone: ______________________

OCD Only

Received by: ______________________________ Date: ____________

Closure approval by the OCD does not relieve the responsible party of liability should their operations have failed to adequately investigate and remediate contamination that poses a threat to groundwater, surface water, human health, or the environment nor does not relieve the responsible party of compliance with any other federal, state, or local laws and/or regulations.

Closure Approved by: ______________________________ Date: ____________

Printed Name: ______________________________ Title: ______________________________

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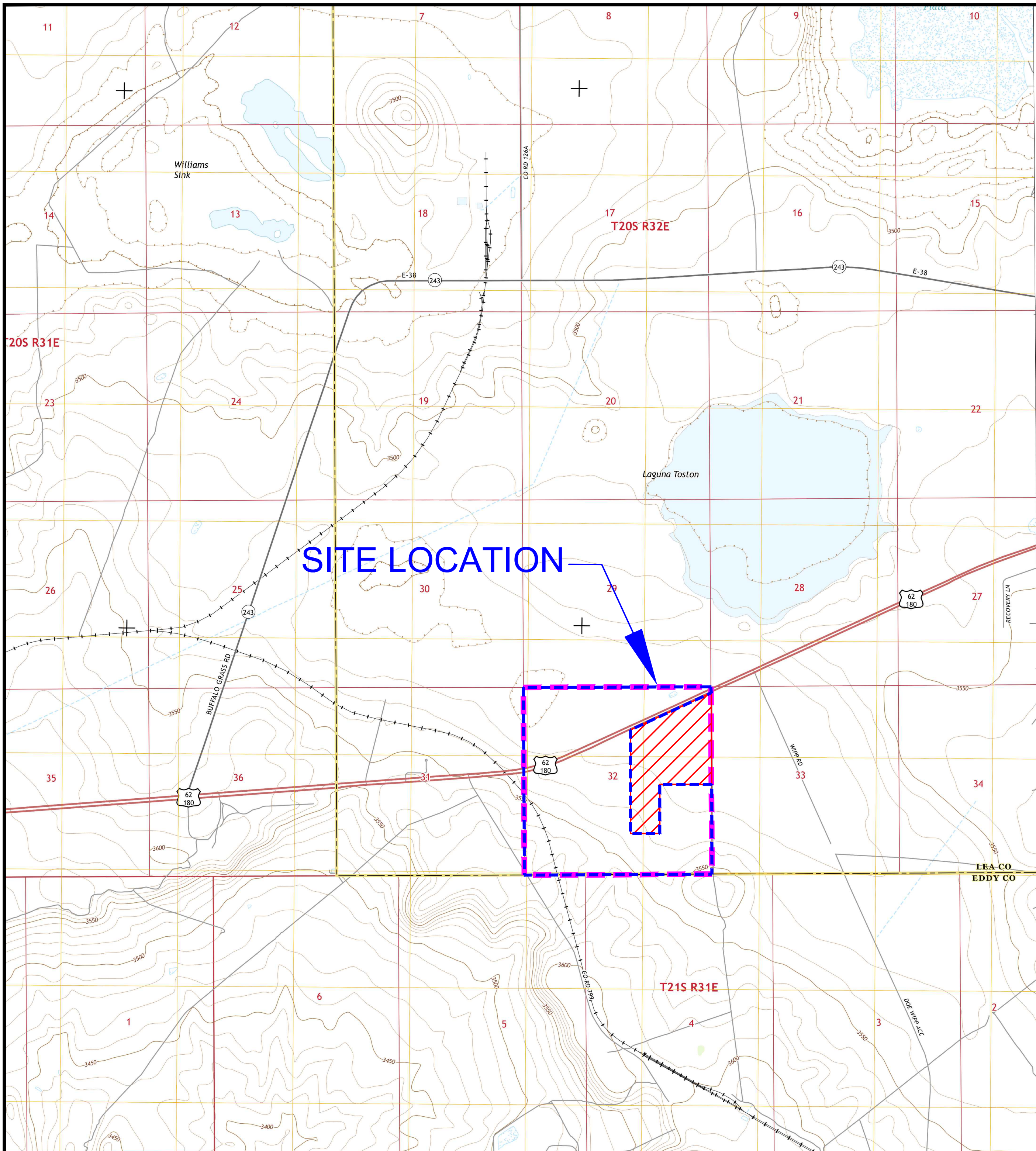
1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.6.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".



LEGEND

PROPERTY BOUNDARY

LEA LAND LLC FACILITY BOUNDARY

INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE LOCATION.dwg
Date/Time:May. 31, 2019-06:22:15 ; LAYOUT: A (P)

SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.6.1
APPROVED BY: CWF	www.team-psc.com	

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The **Permit Plans** (**Volume III.1**) identify the locations of the Processing Area and Landfill facilities.

1.3 Purpose

This Migratory Bird Protection Plan (the Plan) for the Lea Land Facility has been prepared in accordance with requirements of 19.15.36.13.I and 19.15.36.17.C(3) NMAC. This Plan describes the procedures for migratory bird protection at Lea Land. Lea Land is not proposing to install screening, netting or covering over the evaporation ponds. Instead, Lea Land is proposing alternate procedures that have proven historically effective in discouraging bird propagation; and which fulfill the requirements of 19.15.36.13.I and 19.15.36.17.C(3) NMAC for comparable protection of migratory birds. Current installations at Lea Land include stormwater management ponds and a leachate pond.

This Plan may be modified by Lea Land to address changes in site conditions following OCD review and approval of the proposed change. This Plan may also be amended at the request of OCD should conditions warrant. Lea Land will coordinate with USEPA Region 6 regarding this Plan if so directed by OCD.

2.0 MIGRATORY BIRD PREVENTION

2.1 Siting Perspective

Lea Land proposes an exception to the screening/netting requirements of 19.15.36.17.C(3) NMAC, although Lea Land plans to meet the requirements of this Rule through an alternative monitoring method described herein. Additionally, Lea Land does not anticipate that the ponds will be potentially hazardous to migrating birds as oil will be removed from the water prior to discharge into ponds. There is a significant absence of habitat for migratory birds congregating around, or landing in, the vicinity of the Lea Land Facility. This is due primarily to the lack of an organic food source at the Facility that limits avian sustainability, and the lack of other nearby suitable habitat. In addition, as documented in **Volume IV.1** (Siting Criteria), no evidence of wetlands are documented at the site, despite the National Wetlands Institute's wetland designation of a portion of a depressional feature located in the northeast corner of the facility, which is inundated only intermittently based on site reconnaissance and shows no wetland characteristics.

2.2 Human and Mechanical Intervention

Lea Land Processing Area operations, as proposed in this Application, have been designed to eliminate oil from accumulation on the evaporation ponds (**Volume II.1**). This will be accomplished utilizing tanks and equipment that separate the oil from the water prior to discharge into the evaporation ponds. The anticipated absence of oil in the evaporation ponds eliminates the concerns typically associated with migratory birds being endangered if they land on the evaporation surface. In the unlikely event that oil is found on an evaporation pond, the following actions will be implemented:

- Operations at the Processing Area Facility will be manned by at least two employees.
- The Facility Manager, operators and employees will conduct routine inspection rounds making note of migratory bird activity in or surrounding the evaporation ponds.
- Should migratory bird activity be discovered at the Facility, inspection and scare tactic frequency will be increased to alleviate the roosting of the birds.

In order to prevent oil sheen accumulation on the surface of the ponds (19.15.36.17.C(1) NMAC), Facility personnel will work continually throughout each day to ensure the Produced Water Settling Tanks are functioning properly, removing the oil from the water prior to discharging to the evaporation ponds. If oil is observed on the evaporation ponds, efforts will be made to remove the visible oil layer from the evaporation ponds immediately. This will be accomplished by using booms to bring the oil sheen to the banks of the ponds where the oil will be removed by vacuum trucks and returned to the Produced Water Receiving Tanks.

Operations will not lend the Facility to migratory bird congregation, with proposed operations 24 hours per day, 7 days per week, and 365 days per year. During this time, the mechanical evaporation systems will be in full operation, truck traffic will be consistently entering and leaving the Facility, and pumps will be transferring waters to and from the evaporation ponds. General activities at the site will involve human and truck motion, a natural deterrent to wildlife.

3.0 MIGRATORY BIRD LANDING CONTINGENCY

3.1 Migratory Bird Rescue

In the unlikely event that a bird lands on a pond and becomes contaminated, Facility employees will immediately utilize a boat and side ropes to retrieve the bird. Upon retrieval, Facility employees will transport the bird to a local veterinary clinic for treatment. Bird rescue procedures adapted from those of the International Bird Rescue Research Center (www.bird-rescue.org) are provided in **Table II.6.1**.

TABLE II.6.1 - Bird Rescue Protocol (Typical)

a. The bird's entire body is immersed in a one percent solution of Dawn and warm water (warm enough to approximate the bird's internal body temperature. Once wet, the bird is unable to thermo regulate) by one person while a second vigorously agitates the water into the bird's feathers.
b. A WaterPik® filled with the same solution is used to clean the head.
c. A soft toothbrush and cotton swabs are used to loosen dried oil around the head and eye area.
d. When the water becomes dirty, the bird is moved to a second pan. The washing process is repeated as often as necessary.
e. The bird is considered clean when the tub of water is clear and free of oil.
f. The bird is moved to another pan of clean warm water for rinsing.
g. A WaterPik filled with the warm water is used to clean the head.
h. When the water becomes soapy, the bird is moved to a second pan. The rinsing process is repeated as often as necessary to remove the remaining soap.
i. The bird is considered rinsed when no soap is visible in a fresh pan of water.
j. After wash and rinse, the cleaned bird is placed in a protective net-bottomed pen. As it rests, the bird will begin to preen its own feathers back into place. The complete realignment of feathers in a tight overlapping pattern creates a waterproof seal.
k. The bird is fed a nutritious food mixture to assure proper nourishment, plenty of fluids, as well as vitamins and medications, and is allowed free access to food.
l. The bird is released when it is stable, healthy, and completed preening. The bird shall be taken to a local veterinary clinic for examination prior to release.

3.2 Screening and Netting

Although it is highly unlikely the Lea Land Facility will have a migratory bird issue based on the described preventative methodology and lack of suitable habitat and food, Lea Land is committed to the protection of migratory birds. Should migratory bird landings become an ongoing concern, Lea Land will implement more aggressive techniques, such as netting or screening, after review and discussion with OCD and qualified wildlife experts.

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1.0 PROJECT OBJECTIVES

The Construction Quality Assurance (CQA) Plan has been developed to document the measures that will be used to ensure that the environmental control systems will be constructed in compliance with:

- 19.15.36.14.D NMAC – Liner Specifications
- 19.15.36.14.E NMAC – Soil Liners
- 19.15.36.17.A and B NMAC – Processing Design and Construction
- The approved Permit Plans
- The Permit and any Permit Conditions
- This CQA Plan
- Industry standards and other applicable technical criteria
- The Construction Plans and Technical Specifications for each new Unit.

The sequence of development is prescribed in this Application for Permit. While operations continue in Stages 1 – 12, Lea Land LLC will extend stormwater controls, liner systems, roadways monitoring networks, etc., in advance of need. Much of the infrastructure that is in-place and proven effective at its designated purpose will be maintained, such as the current scale plaza.

The Engineering Design is the core of project plans, as summarized in the Permit Plans. Major and/or sophisticated components (e.g., liners, leachate collection, waste processing units) are then detailed on "Construction Plans" that are submitted for OCD review prior to engaging specialized Contractors. The bulk of the permitting effort is devoted to Landfill engineering, where designs are subjected to site-specific calculations, in which materials are matched with loads and compatibility demonstrations.

The Landfill Operating Plans are then derived from these designs, as well as established and proven operational techniques, equipment needs, personnel requirements, etc. It is anticipated that preparation of the Landfill Engineering Plans, calculations, Management Plans, etc., will require at least six months from the time of achieving general concurrence with OCD on Lea Land's plans moving forward (i.e., early 2019 deadline).

One of the key outputs of the iterative Landfill Engineering calculations is the site-specific "Materials Balance" (**Volume III.1**) is the template that will be developed for the Lea Land LLC Landfill to demonstrate that there are adequate volumes of specifics soil types for each engineering application:

- Protective soil (i.e., drainage) Layer (PSL)
- Final Cover Barrier Layer
- Final Cover Vegetative (i.e., infiltration) Layer
- Daily and Intermediate Cover Soils
- Berms, Access Roads, Cell Subgrade
- Aggregate for Sump Applications (likely imported)

The generation of these soil types will be matched with the estimated waste receipts to maintain an orderly site development sequence. The on-site soils are then strategically teamed with the various geosynthetic tools available to the design engineer for liners, covers, drainage features, etc.

- Geomembranes (typically 60 mil HDPE)
- Composite Clay-Liners (GCL's)
- Geopipes
- Geotextiles
- Geogrids
- Geonets

This CQA Plan establishes the quantitative criteria that will be used in the field and laboratory to measure the quality of the installed infrastructure including but not limited to disposal landfill cells, evaporation ponds, operational facilities requiring geosynthetic liner containment, and any other geosynthetic liner components as shown in approved construction plans. Specific construction elements that are addressed in this Plan includes:

1. Landfill liner:
   - Inspection and compaction of the subgrade and liner foundation (6-inch)
   - Installation of the geosynthetic clay liner
   - Installation of the secondary containment geomembrane (60-mil smooth and textured HDPE)
   - Installation of the leak detection layer (200-mil geonet)
   - Installation of the primary containment geomembrane (60-mil smooth and textured HDPE)
   - Installation of the leachate drainage layer and collection system (6-inch SDR 13.5 HDPE collection and cleanout pipe; 24-inch SDR 17 HDPE riser pipe; 10 oz/yd^2 geotextile; course aggregate)
   - Installation of the liner protection/drainage enhancement geocomposite (12 oz/yd^2 – 200 mil – 12 oz/yd^2)
   - Installation and specifications for the protective soil layer
   - Ancillary installations as needed to complete the above (40-mil smooth HDPE stormwater rain flap)
2. Evaporation pond liner:
   - Inspection and compaction of the subgrade and liner foundation (6-inch)
   - Installation of the secondary containment geomembrane (60-mil smooth HDPE)
   - Installation of the geonet leak detection layer (200-mil geonet)
   - Installation of the primary containment geomembrane (60-mil smooth conductive HDPE)
   - Installation of the leak detection sump and riser system (GCL; 4-inch SDR 17 HDPE riser pipe; 10 oz/yd^2 geotextile; course aggregate)
   - Ancillary installations as needed to complete the above (60-mil single-sided texture HDPE pond surrounds; 60-mill smooth HDPE overspray containment)
3. Process storage tank liner; produced water load out island liner; and washout/jet out island liner:
   - Inspection and compaction of the subgrade and liner foundation
   - Installation of the containment geomembrane (30-mil smooth reinforced polyester)
   - Installation of basecourse (12-inch)
   - Ancillary installations as needed to complete the above (4-inch SDR 17 HDPE leak detection riser pipe)
4. Stabilization and solidification pad liner:
   - Inspection and compaction of the subgrade and liner foundation
   - Installation of the secondary containment geomembrane (60-mil smooth HDPE)
   - Installation and compaction of structural granular fill and basecourse (24-inch and 12-inch) (concrete serves a primary containment)
   - Ancillary installations as needed to complete the above (4-inch SDR 17 HDPE leak detection riser pipe)
5. Landfill run-off retention pond liner:
   - Inspection and compaction of the subgrade and liner foundation
   - Installation of the containment geomembrane (60-mil smooth HDPE)
   - Ancillary installations as needed to complete the above

This CQA Plan is a quality control plan meeting the specifications of 19.15.36.14.D NMAC, 19.15.36.14.E NMAC, and 19.15.36.17.B NMAC. No revisions to the technical specifications should be allowed without the express approval of the Engineer. The Engineer is a registered professional engineer in New Mexico with applicable experience in soils and geosynthetics design and construction.

This Plan may be updated to address changes in materials, technologies, test methods, etc. in consultation with the New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division; and more specifically revisions will be made to the applicable geosynthetics testing standards as implemented. Additionally, the Oil Conservation Division shall be notified at least 72 hours prior to primary liner installation so the leak detection layer may be inspected.

Table II.7.1 lists the applicable testing required for each construction element. The Table identifies:

- Key property being evaluated
- The appropriate type of test procedure and method
- The sampling strategy and frequency

2.0 PROJECT ORGANIZATION

2.1 Project Organization

The Project Team shall be identified in advance of construction, and each Team member will be assigned specific responsibilities as discussed in this section.

2.2 Authority and Responsibilities

2.2.1 Owner

The Owner has the responsibility for scheduling and administration, which may include, but not be limited to:

- Contractor procurement.
- Some or all of the construction tasks (e.g., mass excavation).
- Assignments of duties of Project Team and orientation of the Project Staff to the needs and requirements of the project.
- Approval of project-specific procedures and internally prepared plans, drawings, and reports.
- Serving as the "Collection point" for Project Staff reporting project documents and activities.
- Point of collection for archived destruction test (DT) samples.

2.2.2 Site CQA Engineer

The Site CQA Engineer shares responsibilities with the Owner/Operator for addressing technical and administrative issues. The Site CQA Engineer must be present at the outset of major undertakings and at critical times during the construction. The Site CQA Engineer's staff shall be on-site continually for construction activities. The Site CQA Engineer will also be on-site, as necessary, to perform the following:

- Periodic review of submittals from the Site CQA Manager.
- Approval of any CQA Plan revisions.
- Administrative functions as necessary to staff and maintain personnel for the CQA activities.
- Periodic review and assessment of the CQA Plan as implemented to determine completeness and compliance.
- Spot-checking of field and laboratory methods and results for accuracy.
- Acceptance and approval of materials and workmanship.
- Compilation and submission of Certification Reports and other project deliverables.
- Design and certification responsibilities mandate that this site CQA Engineer must be a Professional Engineer properly registered in the State of New Mexico; who possesses demonstrated competence and experience in waste containment engineering.

2.2.3 Site CQA Manager

- Review moisture-density curves correlated to compaction specifications for the borrow source or in-situ subgrade.
- Review Field Grain Size Analyses of materials to confirm suitability.
- Perform nuclear density testing as necessary for in-place compaction confirmations.
- Conduct verification testing for thickness and placement of materials.
- Perform inspection and documentation of synthetic materials installation.
- Review of documentation from contractors as enumerated in this CQA Plan.
- Review daily CQA activities.
- Notification to appropriate personnel of nonconformance, or changes in CQA procedures.
- Completion of Project CQA audits.
- Scheduling, at regular intervals, CQA meetings with project staff and Subcontractors.
- Reporting, on a regular basis, to the Site CQA Engineer the results of reviews, inspections, and audits.
- Identifying for the Site CQA Engineer project issues, which require his direct involvement.
- Maintaining records of reviews, inspections, audits, and their results.
- Collection of Daily Field Reports from Contractor, which are to be provided no later than 24 hours after each shift has ended.
- Maintenance of calibration records of the instrumentation used on-site in the implementation of this plan.
- Other duties as directed by the Site CQA Engineer.

2.2.4 Contractor

Responsibilities of the Contractor may include:

- Management of daily field operations (labor and equipment allocation), in collaboration with Site CQA Manager.
- Submission of Daily Field Progress Reports to the Site CQA Manager.
- Implementation of tasks relative to this CQA Plan specific to his assigned construction activities per contract.
- Submittal of required as-built drawings and certificates to the Site CQA Manager.
- Submittal of required work plans to the Site CQA Engineer.

Work installed by the Contractor shall be guaranteed for at least two (2) years from date of completion. Materials shall be warranted per manufacturer standards.

The Contractor/Installer must construct this project in a workmanlike manner, in conformance with the plans and specifications. The purpose of the CQA Program is to provide independent confirmation of compliance with the plans and specifications for the Owner's benefit.

2.3 Documentation

1. Data will be gathered or developed in accordance with procedures appropriate for the intended use of the data and will be of significant or greater quality to stand up to scientific and regulatory scrutiny.
2. Data will be of known or acceptable precision, accuracy, representatives, completeness, and comparability within the limits of the project.

The quality of the measurement data can be defined in terms of the following elements:

1. Completeness - the adequacy in quantity of valid measurements to reduce the potential for misinterpretation.
2. Representativeness - the extent to which discrete measurements accurately describe the greater picture of which they are intended to represent. Good representativeness is achieved through careful, informed selection of sampling site.
3. Accuracy and Precision - the agreement between a measurement and the true value and the degree of variability in this agreement, respectively. Accuracy and precision of data collected in the investigation will depend upon the measurement standards used and the competent use of them by qualified personnel.
4. Comparability - the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. Comparability among measurements will be achieved through the use of standard procedures and standard field data sheets.
5. Traceability - the extent to which data can be substantiated by hard-copy documentation. Traceability documentation exists in two essential forms: that which links quantitation to authoritative standards, and that which explicitly describes the history of each sample from collection to analysis.

The fundamental mechanisms that will be employed to achieve these quality goals can be categorized as prevention, assessment and correction, as follows:

1. Prevention of defects in the quality through planning and design, documented instructions and procedures, and careful selection and training of skilled, qualified personnel;
2. Quality assessment through a program of regular audits and inspections to supplement continual informal review;
3. Permanent correction of conditions adverse to quality through a closed-loop corrective action system.

The Site CQA Manager shall maintain current records, on appropriate CQA forms, of quality control operations, inspections and tests performed relative to the work of suppliers and contractors. Below is an index of CQA Forms which are typically used for the Liner CQA program (**Attachment II.7.A**):

Form No.	**Title**
1.	Liner Quality Control Project Specifications
2.	Approval/Authorization to Proceed Form
3.	Field Observation Report
4.	Field Compaction Testing Form
5.	GCL Inventory Control Log
6.	FML Inventory Control Log
7.	Geonet Inventory Control Log
8.	Geotextile Inventory Control Log
9.	Geocomposite Inventory Control Log
10.	Leachate Collection and Extraction Pipe Inventory Control Log
11.	FML Trial Seaming Test Log
12.	FML Seaming Log
13.	FML Seam Pressure Test Log
14.	FML Destructive Field Test Record
15.	FML Seam Vacuum Test/Repair Log
16.	GCL Deployment Log
17.	FML Deployment Log
18.	Geonet Deployment Log
19.	Geotextile Deployment Log
20.	Geocomposite Deployment Log

Photographs will also be used to document the progress and acceptability of the work and may be incorporated into the Daily Summary Report; if photographic documentation is used, each photo shall be identified with the following information:

- Date
- Time of Day
- Location/Orientation

Originals of the photographs will be retained electronically at the offices of the Site CQA Engineer. Select photographs will be submitted with Engineering Certification Reports as applicable.

3.0 CONSTRUCTION QUALITY ASSURANCE OBJECTIVES

3.1 Allowable Variations

It is the objective of this CQA Plan that test results must meet the applicable specified values in compliance with 19.15.36.14.C, D, E, and F NMAC. Should a test result not achieve the specified value for a material, it must be replaced or repaired; or for operation, the operation must be repeated until it is acceptable. However, as stated by Daniel and Koerner, *"it is unrealistic to think that 100 percent of all CQA tests will be in compliance with specifications."* Variations due to isolated anomalies in material, sample disturbance, human testing errors, or other factors may result in failing tests, yet these tests are not indicative of the general quality of the construction. For this reason, the Site CQA Engineer may accept a small percentage of outliers. The total number of outliers will not exceed the maximum allowable number as defined in Waste Containment Facilities – Guidance for Construction Quality Assurance and Construction Quality Control of Liner and Cover Systems 2nd Edition (Daniel, D.E. and Koerner, R.M.), 2007.

4.0 SITE PREPARATION

4.1. General

The following is a list of the work to be included in site preparation by the Contractor:

1. Field check utilities and groundwater monitoring well locations, as appropriate.
2. Mark survey hub markers and permanent benchmarks.
3. Strip topsoil and any other material deemed unsuitable by the Engineer, or his representative, and stockpile at designated location.
4. Strip or remove brush, and non-mowable vegetation, surface debris and similar materials from existing surface and relocate to a designated area on the site. Stumps, logs, roots, etc. will be completely removed.
5. Excavate to design grade at the direction of the Site CQA Manager.
6. The existing surfaces will be proof rolled to check stability conditions of existing surface and to provide a trafficable, reasonably smooth, working surface for construction equipment.
7. Contractor will be responsible for costs associated with repairing and/or replacement of the ground surface utilities, and appurtenant facilities damaged by the Contractor, to the satisfaction of the Owner. Any damage resulting from unauthorized intrusion upon or use of off-site areas will be completely and immediately repaired, solely at the expense of the Contractor.

The following is a list of requirements related to site grading:

1. Relocate exposed debris outside the limits of the construction area to locations as directed by Owner.
2. Remove and dispose of coarse vegetation. Vegetation removal will be accomplished in such a manner as to minimize the amount of bare soil exposed at any given time.
    a. Stripped vegetation may be stockpiled temporarily at the site, provided that it is stockpiled in a manner, which prevents movement of the material off-site due to wind, water, or other

factors.

b. Residual vegetative matter, such as stumps, will be transported to the designated on-site area or removed off-site by the Contractor under authorization by the Owner.

4.2. Survey Coordinate System

The site will be surveyed and integrated into a grid system so that locations of sample and testing points made during construction can be readily discernible by the CQA personnel. This grid system should consist of equidistant spaced parallel lines, l00-feet (ft) on center, projecting north to south and east to west within the limits of the site. In addition, permanent project benchmarks will be placed by the Owner or his representative in the vicinity of the site for correlation of lift thickness, site liner construction, etc. This grid system will be coincident with the existing and former site coordinate system for future reference. The project limits will be staked out by the Owner or his representative based on record drawings.

4.3. Subgrade Development

Subgrade development will be required prior to landfill, evaporation pond, process equipment, stabilization and solidification, run-off retention pond, and other containment liner construction. The existing topography will be contoured to the subgrade elevations shown on the drawings identified by the Site CQA Manager. The subgrade will be constructed, prepared and protected in accordance with the procedures stated below.

4.3.1 Subgrade Preparation

1. Establish required lines, levels and contours. Use survey control model and/or place grade stakes as required by Contractor's methods at a minimum 100-feet on center.
2. Before grading commences, adjust monitoring wells and piezometer heights in the area to be graded in accordance with details shown on the drawings if applicable. Such adjustments will be made under direct surveillance of the Site CQA Manager. Any wells adjusted without the Site CQA Manager being present will be re-established at the Contractor's expense.
3. No subgrading will begin in a given area prior to approval of the area by the Site CQA Manager.

4.3.2 Excavating to Subgrade Elevation

1. Excavated material will be placed on-site as directed by Owner.
2. Adequate grade control during subgrade preparation/construction is imperative. Should insufficient grade control during this phase occur, the Site CQA Manager may stop work until the situation has been rectified.

4.3.3 Filling to Subgrade Elevation and Berm Construction

1. Engineer will collect samples of proposed in-situ or borrow fill material in advance of construction for determination of soil characteristics (e.g. Standard Proctor)
2. Materials will be obtained from designated in-situ areas, borrow sources, or stockpiles.
3. No fill will be used for subgrade or berm construction without approval of the Site CQA Manager.
4. Place fill material to the required elevations as shown on the drawings.
5. Place suitable fine-grained subgrade soils in 9-inch thick loose lifts, 6-inch thick compacted finshed lifts and compact to 90-percent of the maximum dry density unless otherwise specified, as determined by the Standard Proctor Compaction Test (ASTM D698).
6. Place berm material in maximum 12-inch thick loose lifts, 9-inch thick compacted finished horizontal lifts over the prepared surface. Compact to not less than 90-percent of the maximum dry density unless otherwise specified, as determined by the Standard Proctor Compaction Test (ASTM D698).

7. The surface of each lift will be scarified prior to placing the next lift, if applicable.
8. The moisture content of fill material will be adjusted in the stockpile, borrow area, and/or other approved areas to maintain uniform moisture content of fill. Uniform moisture distribution will be obtained by mixing with disc, harrow, and pulverizers or by otherwise manipulating the soil prior to compaction.
9. The final surface of subgrade and berms will be rolled smooth, free of protrusions and will contain no lumps, angular materials or large rocks. Roll the exposed surface transverse to slopes.

4.4. Final Subgrade Inspection and Protection

The final subgrade lift will conform to the following specifications:

1. The upper 6-inches shall be comprised of suitable fine-grained soils and compacted to a minimum 90-percent of the maximum dry density unless otherwise specified, as determined by the Standard Proctor Test (ASTM D698)
2. The surface of the final lift of subgrade will be free of angular material or stones greater than one-half inch in diameter.
3. The final lift will be wetted and smooth rolled. Abrupt changes of grade will be regraded.
4. Completed subgrade will be protected from traffic, erosion and damage of any kind.
5. Completed subgrade will be kept free of trash and debris.
6. Prior to placement of liner system, any areas of subgrade damaged by traffic, erosion, settlement, or another cause, will be repaired and the grades shown on the drawings will be re-established. Exposed subgrade, which has significantly dried or exhibits desiccation will be wetted and compacted prior to fill placement. Disturbed areas will be reshaped, scarified, recompacted and rolled prior to further work.
7. The condition of the subgrade will be approved by the Site CQA Manager prior to placement of any additional layers or liner system materials immediately in advance of installation.

4.5. Subgrade and Berm Testing

The following tests will be performed during construction:

1. One field compaction test will be performed at a frequency of a minimum 4 tests per acre per 6-in lift for confirmation of density of the subgrade soils and 12-in for confirmation of density of soils used in berm construction.
2. The subgrade will be required to meet an elevation tolerance of 0.20 ft±; and the sidewalls a vertical tolerance of 0.50 ft± based on a regular grid established by site survey.

5.0 ANCHOR TRENCH

1. Anchor trenchs shall be constructed as shown on the construction drawings and as specified in the CQA Plan. The anchor trench shall be backfilled and compacted by the Contractor as approved by the Site CQA Manager. Trench backfill material shall be placed and compacted by rolling with a rubber-tired wheel or mechanical tampers. Approval of compaction equipment shall be obtained from the Site CQA Manager before any compaction begins.
2. Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment make direct contact with geosynthetic materials.
3. Anchor trench backfill shall be compacted to 90% Standard Proctor Dry Density.

6.0 GEOSYNTHETIC CLAY LINER (GCL)

6.1 GCL Properties

1. Reinforced GCL shall be installed directly in contact with the landfill subgrade material and in evaporation pond leak detection sump subgrade material or as otherwise specified in the construction drawings. GCL shall comply with the requirements listed in **Table II.7.2** or approved by Engineer as equivalent.
2. The primary component in the GCL is high-quality sodium bentonite (montmorillonite). The bentonite used in the manufacture of the GCL must be demonstrated to meet the testing and acceptance criteria listed in **Table II.7.2**. The testing shall be performed on the bentonite obtained from the finished GCL product.
3. Bentonite Sealing Compound (BSC) and Granular Bentonite (GB) shall be applied to ensure tightness at penetrations and structures. The BSC and GB shall be supplied by the manufacturer and shall be comprised of the same bentonite used in the manufacturing of the GCL. The BSC shall be a mixture of non-aqueous liquid suspension agent, which creates a paste-like texture. The suspension agents used in the manufacture of the BSC shall be non-toxic, water- soluble and shall not restrict the bentonite's ability to swell and absorb water upon hydration.
4. Longitudinal seams can also be sealed using the Winning Edge™ which eliminates the need for free bentonite on those seams.

6.2 Delivery, Storage and Handling

1. The GCL rolls shall be packaged and shipped by appropriate means to prevent damage of the geomembrane rolls. Off-loading and storage of the GCL is the responsibility of the Contractor/Installer. The Contractor shall be responsible for replacing any damaged or unacceptable material discovered upon arrival at no cost to the Owner.
2. The GCL storage area will be designated by the Site CQA Manager/Owner. No off-loading shall be performed unless the Site CQA Manager is present. Damage during off-loading shall be documented by the Site CQA Manager. Any damaged rolls must be separated from the undamaged rolls until the proper disposition of that material has been determined by the Site CQA Manager.
3. A steel support pipe shall be inserted through the roll core. Slings or lifting chains shall be attached at the ends of the support pipe to the bucket of a front-end loader or lifting device. A spreader bar, which is used to support the pipe, must be long enough to prevent damage to the edges of the GCL during hoisting.
4. The rolls of GCL shall be stored in their original, unopened, wrapped cover in a clean, dry area, stacked no higher than three rolls high. The material shall be stored off the ground on pallets and shall be covered with a heavy, protective tarpaulin or enclosed within a storage facility. Care shall be used to keep the bentonite clean and free from debris prior to installation.
5. The installer shall be responsible for the transportation of each roll of GCL from the storage area to its proposed panel location. The contractor shall not drive upon the GCL panels with equipment exceeding 6 psi and shall be responsible for replacing any material damaged during installation until the GCL is accepted by the Site CQA Manager/Owner.

6.3 Manufacturer Quality Control Documentation

Prior to installation commencement of any GCL material, the Contractor shall provide the following information to the Site CQA Manager, certified by the manufacturer for the delivered GCL.

1. Manufacturer's certification verifying that the quality of the raw materials used to manufacture the GCL meets the Manufacturer specifications.
2. Each roll delivered to the project site shall have the following identification information:
   - Manufacturer's name

- Product identification
- Roll number
- Roll dimensions

3. Quality control certificates signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency and test results. At a minimum, the following results shall be provided in accordance with test requirements specified in **Table II.7.2:**
   - Free swell (ASTM D5890)
   - Fluid loss (ASTM D5891)
   - Bentonite mass/unit area (ASTM D5993)
   - Grab strength (ASTM D4632)
   - Permeability (ASTM D5887)

6.4 Conformance Testing

6.4.1 Conformance Testing – Sampling at Manufacturer's Plant

The Owner, Manufacturer and/or independent Quality Assurance Laboratory (QAL) will determine the suitability of either sampling at the Manufacturer's production plant or sampling at the delivered on-site location. Should the parties agree that the independent QAL will collect test samples from the Manufacturer's plant, the following sampling and testing criteria apply:

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory (QAL) approved by the Site CQA Engineer at a minimum frequency of one (1) test per 100,000 ft^2. The sampling frequency may be increased as deemed necessary by the Site CQA Engineer. A representative of the designated QAL shall take samples at the manufacturer's plant location; across the entire roll width and shall not include the first three (3) feet. The following conformance tests shall be conducted at the QAL:
   - Mass per Unit Area (ASTM D 5993)
   - Free Swell (ASTM D 5890)
   - Fluid Loss (ASTM D 5891)
   - Hydraulic Conductivity (ASTM D 5887)
2. These conformance test shall be performed in accordance with test requirements specified in **Table II.7.2**.
3. All conformance tests shall be reviewed by the Site CQA Engineer and accepted or rejected, prior to the deployment of the GCL. All tests results shall meet, or exceed, the property values listed in **Table II.7.2**. In case of failing test results for any individual lot sample, the lot shall be resampled and retested. This retesting shall be at the expense of the Installer or Manufacturer. If all test values from the resamples pass the acceptable certified values listed in **Table II.7.2**.

6.4.2 Conformance Testing – Sampling On-site

The Owner, Manufacturer and/or independent Quality Assurance Laboratory (QAL) will determine the suitability of either sampling at the Manufacturer's production plant or sampling at the delivered on-site location. Should the parties agree that the independent QAL will collect test samples from delivered products, i.e., on-site sampling, the following sampling and testing criteria apply:

1. The Site CQA Manager will group the documentation of the delivered rolls into the Manufacturer's listed lot numbers. The Site CQA Manager may, at his/her discretion, subdivide the Manufacturer's listed lots into smaller lots for purposes of conformance testing.
2. Based on the requirements outlined in ASTM D4354, the Site CQA Manager will determine the number of sampling units within each lot; or at a minimum, one (1) test per one hundred thousand (100,000) square feet (ft^2) of GCL material delivered to the site.
3. The Site CQA Manager shall cut or observe the sampling (i.e. if Contractor is responsible for conformance samples) from randomly selected rolls which have been delivered to the site.

Sampling Units shall be one (1) ft wide by roll width, which shall be used for field and Engineer approved Quality Assurance Laboratory (QAL) testing as described below. A measuring device and straight edge shall be used to ensure uniformity of length and width. Mass per unit area, free swell and fluid loss testing shall be performed on delivered rolls by an approved laboratory. The method used for determining specification conformance shall be in accordance with ASTM D4759.

a. The entire sample unit will be loosely rolled, and the width of each sample shall also be measured and recorded.
b. The sample shall then be unrolled and spread out on a clean, dry area at the site. The Site CQA Manager (or Contractor) shall randomly cut five (5) twelve (12)-inch by six (6)-inch specimens from varying places across the sample. Each specimen will be immediately packaged up in a "zip-lock" bag marked with the project name, roll number, lot number, and specimen number.
c. The five specimens shall be sent to an independent QAL for mass per unit area, free swell (bentonite content) and fluid loss testing (ASTM D5993, ASTM D5890 and ASTM D5891, respectively).
   1) The average of the mass per unit area, free swell and fluid loss of the five specimens will be provided by the independent QAL in accordance with ASTM D4643.
   2) If any two samples from a given lot being tested for free swell falls below the specified values, the entire lot shall be rejected.
   3) If any one of the samples from a given lot being tested for free swell falls below the specified values, an additional set of samples shall be taken from the lot (the number of samples taken for the second set shall be equal to that taken from the first set). If any one of the samples from the second set fails to meet the specified criteria, the entire lot shall be rejected.

4. Conformance test results shall be reviewed by the Site CQA Manager and Site CQA Engineer. All lots shall be accepted or rejected, prior to the final placement of the GCL. All test results shall meet, or exceed, the certified values listed in **Table II.7.2**. In case of failing test results for any given lot sample, the lot shall be resampled and retested. This retesting shall be paid for by the Manufacturer. If all of the test values from the resamples pass the acceptable specification values listed in **Table II.7.2**, then the lot shall be accepted.

6.5 GCL Placement

1. As each roll is moved from the storage area by the Installer, the labels shall be removed by the installer and submitted to the Site CQA Manager. The rolls of GCL shall be brought to the area to be lined with a front-end loader and support pipes set up such that the GCL roll is fully supported across its length. A spreader bar or similar device shall be used to prevent the lifting chains or slings from damaging the edges. Dragging of the GCL panels over the surface shall be minimized. Travel on the GCL is permissible if low-ground pressure equipment (6 psi or less) is used. The Site CQA Manager shall be informed as to the equipment to be used and shall approve same.
2. The flexible membrane liner shall be placed over the GCL during the same day as the placement of the GCL. Only those GCL panels which can be anchored and covered the same day shall be placed in position.
3. The GCL shall not be installed in standing water or during rain. The GCL must be dry when installed and must be dry when covered.
4. In areas where wind is prevalent, GCL installation should be started at the upwind side of the project and proceed downwind. The leading edge of the GCL shall be secured at times with sandbags or other means sufficient, and approved by the Site CQA Manager, to secure it down during high winds.

5. The GCL shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. Stretching of the GCL to fit will not be allowed. The GCL shall be straightened to smooth out creases or irregularities in the runs.

6.6 Field Seams

1. Longitudinal seams shall be a minimum of 9 inches overlap on the cell floor (up to 10% slope); and 12 inches overlap for sideslopes (>10%).
2. Soil, gravel, or other debris shall be removed from the overlap area.
3. Seam overlap shall be placed such that the direction of flow is from the top sheet to the bottom sheet to form a shingle effect.
4. On slopes, runs shall be from crest to toe with the GCL machine direction running perpendicular to the base. On slopes greater than or equal to 20%, the number of seams will be minimized, and end seam overlap will be increased to a minimum of 36 inches overlap.
5. If the temperatures are higher than 85°F and humidity is low, contraction may occur soon after placement when no confining stress or soil cover is placed. In order to account for the possibility of contraction under these conditions, the seam overlap shall be increased to a minimum of twelve inches on longitudinal seams and 36 inches on end seams, or 4% of the distance to the next parallel seam, whichever is greater. Free bentonite shall be used to seal seam. Free bentonite is not necessary on longitudinal seams if the Winning Edge™ seam is used.
6. Once the first run has been laid, adjoining runs shall be laid with 9-inch minimum overlap or use of the Winning Edge™, on the longitudinal seams and 12 inches on end seams.

6.7 Field Quality Control

1. The Installer shall provide the Site CQA Manager with daily reports addressing the following:
   a. subgrade approval for areas expected to be covered by GCL
   b. the total amount and location of panels placed
   c. total amount and location of seams completed
   d. location of repairs
   e. weather conditions
2. The Installer's Superintendent and the Site CQA Manager shall provide 100% inspection of the installation to ensure compliance with the construction drawings, technical specifications, and manufacturer recommended procedures.
   a. The surface of the GCL shall be clean and free of debris at the time of inspection.
   b. The Installer and the Site CQA Manager shall record each roll number and lot number as panels are deployed and a general description of the location of each panel.
   c. The Installer and the Site CQA Manager shall inspect the overlap for each panel.
   d. The Installer and the Site CQA Manager shall inspect the anchoring and sealing around penetrations and structures.
   e. The Installer and the Site CQA Manager shall inspect the geotextile quality, bentonite uniformity, and degree of hydration on the GCL. Areas requiring repair shall be marked and subsequently repaired in accordance with the Repair Procedures listed in this CQA Plan.
   f. The Installer and the Site CQA Manager shall re-inspect areas previously marked as requiring repair.

6.8 Repair Procedures

1. Seam and non-seam areas of the GCL shall be inspected for identification of defects, holes, and any sign of contamination by foreign matter in accordance with the Field Quality Control procedures listed in this CQA Plan.
2. Any defects shall be repaired by the Installer, by placing a GCL patch with a minimum 12-inch overlap in all directions.

3. Horizontal patch seams shall be secured with adhesive glue as approved by the Site CQA Manager and manufacturer's recommendations.
4. Patches and repairs shall not be allowed on slopes greater than 5H:1V, unless they are securely anchored with an adhesive or other approved method. Alternatively, the patches can be placed under the defective liner in order to prevent slippage of the patch.
5. For any repair method, surfaces shall be clean and dry at the time of the repair.
6. Each completed repair shall be inspected in accordance with the Field Quality Control procedures listed in this CQA Plan.

6.9 GCL Acceptance

1. The GCL shall be accepted by the Site CQA Manager when the installation is complete, and documentation of installation is completed and verification of the adequacy of field seams and repairs, are complete.
2. Approval of any subsequent post-liner construction, as well as payment requests of the same, will not be granted until required documentation is provided by the Installer and approved by the Site CQA Officer.

7.0 FLEXIBLE GEOMEMBRANE LINER (FML)

1. The flexible membrane (FML) used for landfill liner installation shall be double-sided textured 60-mil HDPE for landfill sideslopes, smooth 60-mil HDPE for the landfill floor, and smooth 40-mil for stormwater rain flaps. The FML used for the evaporation ponds liner installation shall be smooth 60-mil HDPE for secondary containment and overspray containment; smooth conductive 60-mil HDPE for primary containment; and single-sided textured 60-mil HDPE for pond separation berm caps and pond surrounds. FML used for operational facilities liner installation, i.e., process storage tanks, produced water load out islands, and washout/jet out islands, shall be reinforced 30-mil polyester. FML used for stabilization and solidification pads and run-off retention pond liner installations shall be smooth 60-mil HDPE. Additional liner systems shall be as specified or shown on approved drawings.
2. The geomembrane shall be manufactured of new, prime first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures and chemically resistant to leachate.
3. The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.
4. The sheets shall be manufactured in a minimum 15-foot seamless width. Labels on the roll shall identify the thickness, length, width and manufacturer's lot number.
5. The geomembrane rolls shall meet the minimum properties listed in **Table II.7.3** for single-sided and double sided textured 60-mil HDPE liner, **Tables II.7.4a** and **II.7.4b** for smooth 40-mil and 60-mil HDPE liner**,** and **Table II.7.5** for reinforced 30-mil polyester liner.
6. Extrudate welding rods shall be of the same compound as the geomembrane and supplied by the manufacturer and shall be delivered in the original sealed containers. Each container shall have a label bearing the brand name, manufacturer's lot number and complete directions as to proper storage.

7.1 Manufacturer Quality Control Documentation

Prior to installation commencement of any geomembrane material, the Contractor shall provide to the Site CQA Manager the following information certified by the manufacturer for the delivered geomembrane.

1. Origin, identification and production of the resin (supplier's name, brand name and production plant).
2. Copies of quality control certificates issued by the resin supplier.

3. Manufacturer's certification verifying that the quality of the resin used to manufacture the geomembrane meets the resin specifications fingerprint properties shown in **Table II.7.3** for single-sided and double-sided textured 60-mil HDPE liner, **Tables II.7.4a** and **II.7.4b** for smooth 40-mil and 60-mil HDPE liner, and **Table II.7.5** for the reinforced 30-mil polyester liner.
4. Each roll delivered to the project site shall have the following identification information:
   - Manufacturer's name
   - Product identification
   - Thickness
   - Roll number
   - Roll dimensions
5. Quality control certificates, signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency, and test results. At a minimum, the following test results shall be provided in accordance with applicable test requirements specified in **Tables II.7.3** and **II.7.4** for the HDPE liner:
   - Thickness (smooth, ASTM D 5199; textured, ASTM D5994)
   - Density (ASTM D1505)
   - Tensile properties (ASTM D 6693 Type IV)
   - Tear properties (ASTM D 1004)
   - Carbon black content (ASTM D 4218)
   - Carbon black dispersion (ASTM D 5596)
   - Puncture Resistance (ASTM D 4833)
   - Notched constant tensile load (ASTM D 5397, Appendix)
   - Interface Friction Angle (Textured Geomembrane) [GRI - GS -7]
6. Quality control certificates, signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency, and test results. At a minimum, the following test results shall be provided in accordance with applicable test requirements specified in **Table II.7.5** for the reinforced polyester liner:
   - Thickness (ASTM D751, Optical Method)
   - Weight (ASTM D751)
   - Break strength (ASTM D751 Grab Tensile Method, Procedure A)
   - Break elongation (ASTM D751)
   - Tear strength (ASTM D751)
   - Puncture Resistance (ASTM D4833)
   - Hydrostatic resistance (ASTM D751, Procedure A)
   - Bursting strength (ASTM D751, Ball Tip)

7.2 Conformance Testing

7.2.1 Conformance Testing – Sampling at Manufacturer’s Plant

The Owner, Engineer, Manufacturer and/or independent Quality Assurance Laboratory (QAL) will determine the suitability of either sampling at the Manufacturer’s production plant or sampling at the delivered on-site location. Should the parties agree that the independent QAL will collect test samples from the Manufacturer’s plant, the following sampling and testing criteria apply:

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory (QCL) approved by the Site CQA Engineer at a minimum frequency of one (1) test per 100,000 ft^2. The sampling frequency may be increased as deemed necessary by the Site CQA Engineer. A representative of the designated QAL shall take samples at the manufacturer’s plant location; across the entire roll width and shall not include the first three (3) feet. The following conformance tests shall be conducted at the QAL:
   - Thickness (ASTM D 5199)
   - Density (ASTM D 1505/0792)

- Tensile properties (ASTM D 6693)
- Tear resistance (ASTM D 1004)
- Carbon black content (ASTM D 4218)
- Carbon black dispersion (ASTM D 5996)
- Puncture resistance (ASTM D 4833)

2. These conformance test shall be performed in accordance with test requirements specified in **Tables II.7.4a**, **II.7.4b and II.7.5**.
3. All conformance tests shall be reviewed by the Site CQA Engineer and accepted or rejected, prior to the deployment of the HDPE FML. All tests results shall meet, or exceed, the property values listed in **Tables II.7.4a, II.7.4b and II.7.5**. In case of failing test results for any individual lot sample, the lot shall be resampled and retested. This retesting shall be at the expense of the Installer or Manufacturer. If all test values from the resamples pass the acceptable certified values listed in **Tables II.7.4a, II.7.4b and II.7.5**.

7.2.2 Conformance Testing – Sampling On-site

The Owner, Manufacturer and/or independent Quality Assurance Laboratory (QAL) will determine the suitability of either sampling at the Manufacturer's production plant or sampling at the delivered on-site location. Should the parties agree that the independent QAL will collect test samples from delivered products, i.e., on-site sampling, the following sampling and testing criteria apply:

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory (QAL) [previously approved by the Site CQA Engineer] at a minimum of one (1) per one hundred thousand (100,000) ft^2 of each type of HDPE FML material delivered to the site; or one (1) sample per lot, whichever results in the greater number of conformance tests. As stated in the Project Technical Specifications, the Site CQA Manager or Installer shall obtain the samples from the HDPE FML roll, mark the machine direction, lot number and roll number. The minimum number of conformance samples shall meet the requirements outlined in ASTM D 4354. The following conformance tests shall be conducted at the QAL:
   - Thickness (ASTM D 5199)
   - Density (ASTM D 1505/0792)
   - Tensile properties (ASTM D 6693)
   - Tear resistance (ASTM D 1004)
   - Carbon black content (ASTM D 4218)
   - Carbon black dispersion (ASTM D 5596)
   - Puncture resistance (ASTM D 4833)
2. These conformance tests shall be performed in accordance with **Tables II.7.4a, II.7.4b** and **II.7.5**.
3. All conformance test results shall be reviewed by the Site CQA Manager and Site CQA Engineer; and all lots shall be accepted or rejected, prior to the placement of the HDPE FML. All test results shall meet, or exceed, the property values listed in **Tables II.7.4a, II.7.4.b,** and **II.7.5**). In case of failing test results for any individual lot sample, the lot shall be resampled and retested. This retesting shall be at the expense of the Installer or the Manufacturer. If all of the test values from the resamples pass the acceptable certified values listed in **Tables II.7.4a**, **II.7.4b** and **II.7.5,** the lot shall be accepted.

7.3 Delivery, Storage and Handling

1. The geomembrane rolls shall be packaged and shipped by appropriate means to prevent damage of the geomembrane rolls. Off-loading and storage of the geomembrane is the responsibility of the Installer. The Installer shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner.

2. No off-loading shall be performed unless the Site CQA Manager is present. Damage during off-loading shall be documented by the Site CQA Manager. Damaged rolls must be separated from the undamaged rolls until the proper disposition of that material has been determined collectively by the installer and Site CQA Manager.
3. The geomembrane rolls shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions and excessive heat that may damage the geomembrane material. The rolls shall be stored on a prepared surface (not wooden pallets) and shall not be stacked more than two rolls high.

7.4 Guarantee

1. The Contractor shall guarantee the HDPE and reinforced polyester geomembrane against defects in installation and workmanship for the period of two years commencing with the date of final acceptance by the Owner. The guarantee shall include the services of qualified service technicians and materials required for the repairs at no expense to the Owner.

7.5 Quality Assurance

1. In addition to manufacturer and installer requirements for qualifications and certification specified in submittals, the Quality Assurance consists of conformance testing of the material delivered to the site and field quality control during installation.
2. Conformance testing requirements are listed in this CQA Plan. The purpose of conformance testing is to assure that the supplied material conforms to the specifications and to the manufacturer's quality control certificates.
3. Field quality control requirements are specified in this CQA Plan. The purpose of field quality control procedures is to assure that the geomembrane has been installed in accordance with the specifications and manufacturer's recommendations.
4. Quality control forms for geomembrane installation documentation are used for field installation documentation. Sample project forms are listed below:
   - Liner Quality Control Project Specifications
   - Approval/Authorization to Proceed Form
   - Field Observation Report
   - FML Inventory Control Log
   - FML Trial Seaming Test Log
   - FML Seaming Log
   - FML Seam Pressure Test Log
   - FML Destructive Field Test Record
   - FML Seam Vacuum Test/Repair Log
   - FML Deployment Log

Photo-documentation will be also used to record the cell construction. Select photographs shall include date, time, location, and Site CQA Manager; and shall be included in the Liner Certification Report submitted to OCD.

7.6 Geomembrane Placement

1. Weather Conditions
   Geomembrane placement shall not proceed at an ambient temperature below 40 degrees F or above 104 degrees F unless otherwise authorized, in writing, by the Site CQA Manager. Geomembrane placement shall not be performed during precipitation, excessive moisture, in an area of ponded water, or excessive winds. Observation of temperature, humidity,

precipitation, and wind shall be noted on CQA forms to ensure that weather conditions are acceptable prior to geomembrane placement.

2. Method of Placement
   a. No more material than can be seamed on that same day shall be deployed.
   b. Each panel of the geomembrane shall be rolled out and installed in accordance with the approved construction drawings. The layout shall be designed to keep field joining of the HDPE geomembrane to a minimum and consistent with proper methods of HDPE geomembrane installation, seaming, etc.
   c. Geomembrane rolls shall be placed using proper spreader and rolling bars with cloth slings.
   d. The Site CQA Manager shall inspect each panel, after placement and prior to seaming, for damage and/or defects. Defective or damaged panels shall be replaced or repaired, as approved by the Site CQA Manager.
   e. The installer shall avoid dragging the geomembrane sheets on rough soil subgrades.
   f. Geomembranes shall be anchored as shown on the construction drawings and consistent with manufacturer's recommendations.
   g. Personnel working on the geomembrane shall not smoke, wear damaging shoes or involve themselves in any activity that may damage the geomembrane.
   h. Vehicular traffic across the geomembrane shall not be allowed on the liner material.
   i. Damage shall be recorded and located on the as-built drawings.
   j. When tying into existing geomembrane, final excavation to previously installed liner segments shall be performed by hand to prevent damage. Damaged sections of previously installed liner at the boundary zone shall be removed and replaced. New liner segments shall be seamed only to competent segments of previously installed liner as approved by the Site CQA Manager.
   k. The geomembrane shall be kept free of debris, unnecessary tools and materials. In general, the geomembrane area shall remain neat in appearance.
   l. The method used to unroll the panels shall neither score, scratch or crimp the geomembrane, nor damage the underlying liner system components or subgrade.
   m. Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind. In cases of high wind, continuous loading is recommended along edges of panels to minimize wind flow under the panels.
   n. Direct contact with the geomembrane shall be minimized; i.e., the geomembrane under traffic areas shall be protected by geotextile, extra geomembrane, or other suitable materials.
   o. Sufficient slack shall be placed in the geomembrane to compensate for the coldest temperatures envisioned so that no tensile stresses are generated in the geomembrane or in its seams either during installation or subsequently after the geomembrane is covered.
   p. The geomembrane shall have adequate slack such that it does not lift up off of the subgrade or substrate material at any location within the facility, i.e., no "trampolining" of the geomembrane shall be allowed to occur at any time.
   q. The geomembrane shall not have excessive slack to the point where creases fold over upon themselves either during placement and seaming, or when the protective soil or drainage materials are placed on the geomembrane.
   r. Permanent (fold over type) creases in the covered geomembrane shall not be permitted. Creases shall be repaired in accordance with this CQA Plan and manufacturer’s recommendations.
   s. The amount of slack to be added to the deployed and seamed geomembrane should be carefully considered and calculated, taking into account the type of geomembrane and the geomembrane's temperature during installation versus its final temperature in the completed facility.

3. Field Seams
   a. Individual panels of geomembrane shall be laid out and overlapped by a minimum of 4 inches (or three inches for extrusion fillet welding) but no more than 6 inches prior to welding. The area to be welded shall be cleaned and prepared in accordance with the quality control welding procedures.
   b. If the overlap is too wide to contain the hot wedge welding machine, "float" the liner into better position by lifting it high enough to draw air beneath it, guiding it upon the air to an improved position. Avoid dragging the liner, particularly across rough soil subgrades.
   c. If overlap between the placed liners is excessive, the excess must be trimmed away. This should be done by trimming the lower sheet. If this is not possible and the upper sheet must be trimmed, use a knife with a shielded or hook blade.
   d. Cutting and preparation of odd-shaped sections or small fitted pieces should be completed at least 50 feet ahead of the seaming operation, so that seaming may be conducted with the fewest interruptions.
   e. Liner panel overlaps shall be shingled so the upper panel is hydraulically upgradient of lower panel.
   f. Sheets which are overlapped and ready for seaming must be clean. If dirty, they must be wiped clean with dry rags.
   g. The seam area must be completely free of moisture before the overlapping sheets can be properly seamed. Dry rags should be used to wipe any such moisture up from the seam surface. Air blowers may also be used.
   h. Seaming is not to be performed when the soil surface beneath the liners is saturated, because the hot seaming apparatus will draw moisture into the ongoing seam. Seaming activity on frozen soil is unacceptable for the same reason.
   i. Double track hot wedge fusion welder shall be used for straight welds.
   j. Extrusion welder shall be used for cross seam tees, patches and repairs and penetration boots.
   k. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the geomembrane material so as to ensure that changes in environmental conditions will not affect the integrity of the weld.
   l. No “fish mouths” will be allowed within the seam area. Where “fish mouths” occur, the material shall be cut, overlapped and a patch fusion weld shall be applied. Welds upon completion of the work shall be tightly bonded. Any geomembrane area showing damage due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of geomembrane. The number of patches per 100-foot length shall not exceed five. If more than five patches per 100-foot length are necessary, then the entire 100-foot length of seam shall be removed. Further welding will cease at this time and the Site CQA Manager shall be notified.
   m. Seams shall have a seam number that corresponds with the panel layout numbers. The numbering system shall be used in the development of the as-built drawings. Seam numbers shall be derived from the combination of the two panel numbers that are to be welded together.
   n. Fusion welded “T” seams (i.e., the result of the geomembrane panels placed perpendicular to each other) shall be double welded where possible. Extrusion welding shall be used for the second weld.
   o. Extrudate shall be free of debris, dry and protected from damage.
   p. If an extrusion welder is stopped for longer than one minute, it shall be purged to remove heat-degraded extrudate. Purged extrudate shall be placed on a sacrificial sheet and disposed of.
   q. No horizontal seams shall be constructed on slopes greater than or equal to 5H:1V and no

horizontal seams shall be located within 5 feet of the sideslope toe.

r. Vertical panels placed on sloped surfaces shall extend 10 feet inward from the toe of slope and 3 feet from the edge of the trench.
s. In the anchor trench, seams shall extend a minimum 12 inches.
t. Factory seams, field seams and repair welds shall meet seam strength requirements specified in **Tables II.7.3, II.7.4,** and **II.7.5.**
u. For geomembrane installation in geometrically unique areas, the number of field seams shall be minimized.
v. No solvent or adhesive may be used unless the product is approved by the Site CQA Officer.

7.7 Hot Wedge Fusion Welding

The objective of hot wedge seaming is to heat two facing liner surfaces to their melting point before forcing them together and creating a permanent bond. The wedge is situated between the overlap of the two liners; it reduces the surface tension of the viscous polymer sheets and acts as a scraper and mixer, so that the nip rollers can pressure the two liners together. The result is that the two facing surfaces are bonded into one continuous molecular structure. Types of thermoplastic liners can be seamed by the hot wedge method, but temperature settings will vary according to their specific polymer components. Typical wedge temperature ranges for hot wedge seaming is specified on **Table II.7.6**.

1. The hot wedge system should be properly positioned for completing the desired single or dual (split) seam.
2. Ambient variables such as temperature, cloud cover, and wind speed may make it necessary to vary the temperatures used successfully in a variety of ambient conditions, so that the hot wedge can be more accurately adjusted if new conditions are met, or if personnel changes are necessary.
3. The drive motor should be off when positioning the welding machine to seam. Place the machine where the sheets overlap. Guide the overlapped material between the idlers and the wedge, and into the drive/nip rollers. When continuing a weld that has been abandoned mid-seam, the liners must be spread where the seam leaves off and loaded into the respective sides of the machine. Raise the machine a few inches, load the bottom sheet first, and then load the top sheet. When the nip rollers engage, and the wedge is in position, turn on the drive motor. Immediately engage the sheets when they are between the nip rollers to prevent an imminent melt-through. Move the hot wedge into position and lock it.
4. The Operator must constantly monitor the temperature controls, as well as the completed seam passing out of the machine. Occasional adjustments in temperature or speed will be necessary to maintain a consistent weld. Visual inspection and constant hand testing by the peel method (or other) is also recommended.
5. On some soils, the device tends to "bulldoze" into the ground as it travels, causing soil to enter the weld. A seam with soil trapped in its weld is unacceptable. To keep this from happening, the operator should lift the front of the machine slightly. Alternatively, a moveable base for the machine to travel on can be used. Scrap strips of geotextile or geomembrane have proven to be effective materials upon which the welder can maintain traction. It may also be necessary to change the size of the rollers in loose soils.
6. A small amount of "squeeze-out" or "flashing" is a reliable indication that proper temperatures have been achieved. The melted polymer will laterally extrude, or squeeze-out of the seam zone in properly welded seams, but not to excess. An excessive amount of extruded hot melt indicates that excessive heat or pressure, or both, was applied. Reduce the temperature and/or pressure to correct the situation.
7. The hot wedge device has just a few adjustable parts, but it is critical that they be checked after a day of seaming. The machine should be cleaned daily.

7.8 Extrusion Welding

1. The upper sheet's leading edge must be ground to a 45º bevel. It is imperative that the sheet be lifted up and away from the lower sheet during the beveling so that no deep gouges are cut in the lower sheet. Grinding should therefore be done before tack welding.
2. After beveling, the upper sheet is lowered and laid flat against the lower sheet. The horizontal surface grinding across the interface of both sheets is completed. Surface sheen in the area to be seamed must be removed. Material dust generated by grinding the liner sheets must be wiped or blown away from the seaming zone.
3. Grinding marks should run perpendicular to the seam. Though this process is slower than grinding parallel to the seam, it does not create the deep parallel grooves that significantly decrease the thickness of the parent material that can lead to seam failure. Parallel grinding marks can also initiate stress cracking.
4. Grind marks should never be deeper than 10% of the sheet thickness. Optimally, they should be about 5% of the sheet thickness. The only purpose of grinding is the removal of oxide layers and dirt from the liner surfaces, and the roughening of their interface for extrudate.
5. Grinding marks should not extend beyond 1/4 inch of either side of the extrudate after its placement. For example, if the final extrudate bead width is 1-1/2 inches, the width of the grinding trail should not exceed 2 inches.
6. Seaming must take place no more than one (1) hour after grinding, so that surface oxide layers do not reappear where the extrudate must be placed.
7. The hand grinder should never be left running when it is not in use. If it makes contact with the liner while running it will cause serious damage.
8. A hot air gun may be used to "tack" the two sheets together, ahead of the extrusion welder. The hot air gun prepares the seam for the extrusion welder by heating the ground surface and by creating a light bond between the two sheets, securing their position. The hot air gun is not meant to create a primary seam. No heat distortion should be evident on the surface of the upper sheet.
9. The extrusion welder's barrel shall be purged of heat-degraded extrudate before starting a seam. This must be done every time the extruder is restarted after one or more minutes of inactivity. The purged extrude shall not be discharged onto the surface of previously placed liner, or onto prepared subgrade, where it would eventually form a hard lump under the liner and cause stress concentrations and possibly premature failure.
10. Molten, highly viscous extrudate is deposited along the overlapped seam. The center of the extrudate pass directly along the edge of the upper liner, at sufficient width to completely cover the edge and most of the outlying grind marks, at least to within 1/4 inch of their extremity.
11. The extrudate should be approximately twice the specified sheet thickness, measured from the top of the bottom sheet to the top or "crown" of the extrudate. Excessive "squeeze out" is acceptable, if it is equal on both sides and will not interfere with subsequent vacuum box testing. If, however, the extrudate can be pulled by its squeeze-out off the seam, the extrudate is unacceptable. The presence of squeeze-out may indicate that the extrusion die was not riding directly against the liner, that the extrudate temperature was improper for adequate flow, or that the seaming rate was too slow.
12. Where possible, inspect the underside of the lower for heat distortion. This can be done at the end of seams, and wherever samples are cut out of the seam. A slight amount of thermal "puckering" on relatively thin liners (less than 50 mil) is acceptable. It indicates that heat penetrated entirely through the sheet. However, if the underside is greatly distorted, either lower the temperature or increase the rate of seaming.
13. If the seaming process must be interrupted at mid-seam, the extrudate should trail off gradually, not terminate in a large mass of solidified extrudate. Where such welds are abandoned long enough to cool, they must be ground prior to continuing with new extrudate over the remainder

of the seam. Grind where the extrudate trail-off begins. This restart procedure must be followed for patches, pipes, fittings, appurtenances and "T" and "Y" shaped items.

14. The extrudate bead should be visually inspected. Look to see that its alignment is straight, its height is appropriate, and its surface texture is uniform. No bubbles or pock marks should appear in the extrudate, which indicate the undesirable presence of air, water or debris within the extrudate rod or pelletized polymer.
15. Grind marks should not be visible more than 1/4 inch beyond the extrudate. These should be very light and not contain heavy gouges. As stated previously, grinding is considered excessive when it is deeper than 10% of the liner thickness. It is unacceptable to apply additional extrudate over the original extrusion fillet seam in an area of excessive grinding. A cap strip shall be placed over the entire portion of the seam where excessive grinding is seen.

7.9 Field Quality Control

1. Start-up Testing
   A trial weld, 10 feet long for hot wedge welding and 3 feet long for extrusion welding, from each welder/welding machine shall be run upon the beginning of each shift, every four hours thereafter and at the discretion of the Site CQA Manager, under the same conditions that exist for the geomembrane welding. The trial weld shall be marked with date, ambient temperature, welder's name, and welding machine number. A tensiometer provided by the Installer shall be required to be on-site before and during geomembrane installation for the purpose of testing samples. Specimens of weld 1-inch wide shall be cut from the trial weld and tested on site for shear and peel strength in accordance with **Tables II.7.3, II.7.4,** and **II.7.5**. No welder may start work until the trial weld has been approved by the Site CQA Manager.
2. Nondestructive Seam Testing
   a. The installer shall perform nondestructive tests on field seams over their full length. The purpose of this test is to assure continuity and integrity of the seams. Vacuum and air pressure tests shall be used for nondestructive testing. The vacuum test shall be used for extrusion welds and single-track hot wedge welds. The air pressure test shall be used for double track hot wedge welds.
   b. Vacuum Testing
      Equipment for testing single wedge fusion seams and extrusion seams shall be comprised of the following:
      1) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, porthole or valve assembly and a vacuum gauge.
      2) A vacuum tank and pump assembly equipped with a pressure controller and pipe connections.
      3) A rubber pressure/vacuum hose with fittings and connections.
      4) A plastic bucket and wide paintbrush.
      5) A soapy solution.
   c. The following procedures shall be followed by the installer:
      1) Excess sheet overlap shall be trimmed away.
      2) Clean the window, gasket surfaces and check for leaks.
      3) Energize the vacuum pump and reduce the tank pressure to approximately 5 psi.
      4) Wet a strip of geomembrane approximately 12 inches by 48 inches (length of box) with the soapy solution.
      5) Place the box over the wetted area and compress.
      6) Close the bleed valve and open the vacuum valve.
      7) Ensure that a leak-tight seal is created.

8) For a minimum period of ten seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
9) If no bubbles appear after ten seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum of 3-inch overlap and repeat the process.
10) Areas where soap bubbles appear shall be marked and repaired in accordance with the Repair Procedures contained in this CQA Plan.

d. If the seam cannot be tested prior to final installation, the seaming operations shall be observed by the Site CQA Manager for uniformity and completeness.

3 Air Pressure Testing (for double track fusion seams only)
The following procedures are applicable to those processes which produce a double seam with an enclosed space. Equipment for testing double fusion seams shall be comprised of the following:

a. An air pump equipped with pressure gauge capable of generating and sustaining a pressure of 35 psi and mounted on a cushion to protect the geomembrane.
b. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.
c. The following procedures shall be followed by the installer:
   1) Seal one end of the seam to be tested.
   2) Insert needle or other approved pressure feed device through the sealed end of the channel created by the double wedge fusion weld.
   3) Energize the air pump to verify the unobstructed passage of air through the channel.
   4) Seal the other end of the channel.
   5) Energize the air pump to a pressure of 35 psi, close valve, and sustain pressure for at least 5 minutes.
   6) If loss of pressure exceeds 1% ±, or pressure does not stabilize, locate faulty area, repair and retest.
   7) Remove needle or other approved pressure feed device and seal.

7.10 Destructive Seam Testing

The purpose of the destructive testing is to evaluate seam strength properties. An average minimum of one test sample shall be obtained per 500 feet of performed seam length. The location of samples shall be determined by the Site CQA Manager. Selection of such locations may be prompted by suspicion of overheating, contamination, or other potential cause that may adversely impact the welds. This may result in more than one sample per 500 feet of seam length. Sampling shall be performed by the installer. Testing of field samples shall be performed by the installer in the presence of the Site CQA Manager as described below.

1. Sampling Procedures
   a. Samples shall be cut by the installer at locations chosen by the Site CQA Manager as the seaming progresses.
   b. The seams shall not be covered by another material before they have been tested and accepted by the Site CQA Manager.
   c. Upon obtaining each sample, assign a number to the sample and mark it accordingly.
   d. Record sample location on layout drawing.
   e. Record purpose of the sample, statistical routine or suspicious weld area.
   f. Record date, time, location, roll, seam number, master seamer, welding apparatus, and ambient temperature.
   g. Holes in the geomembrane resulting from destructive seam testing shall be immediately repaired in accordance with the Repair Procedures contained in this CQA Manual.

2. Size and Disposition of Samples
   a. The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three pieces of equal length and distributed as follows:
      1) One portion to the Installer for field testing; 12 inches by 12 inches.
      2) One portion for the independent geosynthetic laboratory quality assurance testing; 12 inches by 12 inches.
      3) One portion to the Landfill Manager for archive storage in the Site Operating Record; 12 inches by 12 inches.
   b. The portion of the seam samples for geosynthetic laboratory quality assurance testing will be packed and shipped to an independent lab for testing by the Installer.
3. Field Testing
   a. The following shall be performed by the Installer in the presence of the Site CQA Manager for samples designated for field sampling.
      1) The Installer shall cut ten 1-inch wide replicate specimens from the sample to be tested for shear and peel strength, in accordance with the criteria set in **Tables II.7.3, II.7.4,** and **II.7.5**.
      2) Any specimen that fails through the weld or by fusion at the weld sheet interface is a non-FTB (Film Tearing Bond) break and shall be considered a failure.
      3) The Installer shall test five specimens for shear seam strength and five for peel strength. Four out of the five replicate test specimens shall pass for the seam to be acceptable. A specimen must pass both Sections 1 and 2 above to be acceptable.
4. Quality Assurance Laboratory Test
   a. The Installer shall package and ship destructive test samples designated for laboratory testing to the independent Quality Assurance Laboratory. The laboratory must be approved by the Site CQA Officer.
   b. Laboratory tests shall include shear and peel strength tests. The minimum acceptable values obtained in these tests shall be in accordance with **Tables II.7.3, II.7.4,** and **II.7.5**.
   c. At least five specimens shall be tested each for shear and peel strength. A passing test shall meet the minimum required values in at least four of the five specimens tested for each method.
   d. Any specimen that fails through the weld or by fusion at the weld sheet interface is a non-FTB (Film Tearing Bond) break and shall be considered a failure.
   e. The Independent Laboratory shall provide verbal test results to the Site CQA Manager no more than 24-hours after they receive the samples. The Site CQA Manager shall review the laboratory results as soon as they become available.
5. Procedures for Destructive Test Failure
   a. The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted in the field or by the laboratory. The Installer has two options:
      1) The installer can repair the seam between any two passing test locations.
      2) The installer can retrace the welding path to an intermediate location 10 feet (on both sides) from the location of the failed test and take a sample for an additional field test. If these tests pass, then the seam shall be repaired. If the test fails, then the process is repeated to establish the zone in which the seam should be repaired. This process may only be repeated twice. After the third failed test, the entire seam must be repaired.
   b. Acceptable repaired seams shall be bound by two locations from which sample passing destructive tests have been taken. In cases where repaired seam exceeds 150 feet, a sample taken from the zone in which the seam has been repaired must pass destructive testing. Repairs shall be made in accordance with this CQA Plan.
   c. The Installer shall document actions taken in conjunction with destructive test failures.

7.11 Repair Procedures

1. Any portion of the geomembrane exhibiting signs of defect, failing a destructive or a nondestructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be made by the Site CQA Manager.
2. The repair procedures available include:
   a. Defective seams shall be restarted/reseamed as described in this CQA Plan.
   b. Small holes shall be repaired by extrusion cap welding. If the hole is larger than 1/4 inch, it shall be patched with a piece of material extending six inches out from the damaged area.
   c. Tears shall be repaired by patching. The sharp end of a tear on a slope, or in an area of particular stress, must be rounded prior to patching.
   d. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.
   e. HDPE surfaces to be patched shall be abraded and cleaned no more than one hour prior to the repair. No more than 10% of the thickness shall be removed.
   f. Patches shall be round or oval in shape, made of the same geomembrane, and extend to a minimum of six inches beyond the edge of defects. Patches shall be of the same compound and thickness as the geomembrane specified. Patches shall have their top edge beveled prior to placement on the geomembrane in accordance with this CQA Plan. Patches shall be applied, and the repair made using methods discussed in the CQA Plan.
3. Restart/Reseaming Procedures - Fillet Extrusion Welds
   The Fillet Extrusion Welds process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted.
4. Restart/Reseaming Procedures - Hot Wedge Welds
   Over the length of the seam failure, the Installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip, as required by the Site CQA Manager.
5. For any repair method, the following provisions shall be satisfied:
   a. Surfaces of the geomembrane which are to be repaired using extrusion methods shall be abraded no more than one hour prior to the repair.
   b. Surfaces shall be clean and dry at the time of the repair.
6. Repair Verification
   a. Each repair shall be numbered and logged by the installer and the Site CQA Manager. Each repair shall be nondestructively tested using the methods described in Section 7.9, Subsection 2 “Nondestructive Testing” as appropriate. Repairs which pass the nondestructive test shall be taken as an indication of an adequate repair. Repairs more than 150 feet long may be of sufficient length to require destructive test sampling, at the discretion of the Site CQA Manager. Failed tests indicate that the repair shall be redone and retested until passing test results are achieved. The Site CQA Manager shall observe nondestructive testing of repairs. The installer shall record the number of each repair, date and test outcome.
7. Disposal of Waste Material
   Upon completion of installation, the Installer shall dispose of trash, waste material, etc., and shall leave the premises in a neat and acceptable condition.

7.12 Geomembrane Acceptance

The Installer shall retain ownership and responsibility for the geomembrane until acceptance by the Owner. The geomembrane liner shall be accepted by the Owner when the following conditions are met:

1. Installation is finished.
2. Verification in the form of a certificate of acceptance of the adequacy of field seams and repairs, including associated testing, is complete.
3. Certification by the Site CQA Manager that the geomembrane was installed in accordance with the Construction Drawings, this CQA Plan and manufacturers recommendations.
4. Certification, including "as built" drawing(s) and installation documentation, is provided by the Installer to the Site CQA Manager.

8.0 GEOCOMPOSITE

8.1. Geocomposite Properties

Gecomposite is proposed as a cushion layer to protect the FML and as a drainage enhancement layer to help convey liquids that pass throuth the PSL to the leachate collection system of the landfill. Double-sided 10 oz/yd^2 – 200-mill geocomposite has been specified for landfill sidewalls and single-sided 10 oz/yd^2 – 200-mil geocomposite has been specified for the landfill floor.

1. The geocomposite shall be manufactured of new, prime first-quality materials designed and manufactured specifically for the purpose of planar drainage of liquid and chemically resistant to leachate.
2. Geocomposites are unitized sets of parallel ribs positioned in layers to form a three-dimensional structure such that liquid can be transmitted within their open spaces, bound to a geotexite on one or both sides.
3. The geocomposite material shall meet the minimum properties listed in **Table II.7.7.**

8.2 Manufacturer Quality Control Documentation

Before shipment to site of any geocomposite material, Manufacturer provides certified information for geocomposite before shipment to landfill. Each roll delivered to Project site shall the following identification information:

- Manufacturer's name.
- Product identification.
- Thickness.
- Roll number.
- Roll dimensions.

Quality control certificates, signed by manufacturer quality assurance manager certificate shall each have roll identification number, sampling procedures, frequency, and test results. At minimum, these test results provided per applicable test requirements specified In **Table II.7.7**.

8.3 Conformance Testing

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory at a minimum of 1 per 100,000 ft^2. The Site CQA Manager or Installer shall obtain the samples from the roll, mark the machine direction and identification number.
2. These conformance tests shall be performed in accordance with **Table II.7.7.**
3. Conformance test results shall be reviewed by the Site CQA Officer, and lots shall be accepted or rejected prior to the placement of the geocomposite. Test results shall meet, or exceed, the property values listed in **Table II.7.7.** If the sampling results do not meet property values for any individual lot sample, the lot shall be resampled and retested. This retesting shall be paid for by

the manufacturer or installer. If of the test values from the resamples pass the acceptable specification values listed in **Table II.7.7,** the lot shall be accepted.

8.4 Delivery, Storage and Handling

1. The geocomposite rolls shall be packaged and shipped by appropriate means to prevent damage of the geocomposite rolls. Off-loading and storage of the geomembrane is the responsibility of the Installer. The Installer shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner.
2. No off-loading shall be performed unless the Site CQA Manager is present. Damage during off-loading shall be documented by the Site CQA Manager. Damaged rolls must be separated from the undamaged rolls until the proper disposition of that material has been determined collectively by the installer and Site CQA Manager.
3. The geocomposite rolls shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions and excessive heat that may damage the geocomposite material. The rolls shall be stored on a prepared surface (not wooden pallets) and shall elevated from the ground (a minimum of 3 inches) to protect the geocomposite from standing water.

8.5 Guarantee

1. The Contractor shall guarantee the geocomposite against defects in installation and workmanship for the period of two years commencing with the date of final acceptance by the Owner. The guarantee shall include the services of qualified service technicians and materials required for the repairs at no expense to the Owner.

8.6 Geocomposite Installation

8.6.1 Geocomposite Placement

1. As each roll is moved from the storage area by the Installer, the labels shall be removed by the Installer and submitted to the Site CQA Manager. The rolls of geocomposite shall be brought to the area to be lined with a front-end loader and support pipes set up such that the geocomposite roll is fully supported across its length. A spreader bar or similar device shall be used to prevent the lifting chains or slings from damaging the edges.
2. Care shall be taken to keep the geocomposite clean and free from debris prior to installation
3. Each panel of the geocomposite shall be rolled out and installed in accordance with the approved shop drawings prepared by the Installer. The layout shall be designed to keep field joining of the geocomposite to a minimum and consistent with proper methods of geocomposite installation.
4. On slopes, the geocomposite shall be secured and rolled down the slope in such a manner as to continually keep the geocomposite panel in tension. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.
5. In areas where wind is prevalent, geocomposite installation should be started at the upwind side of the project and proceed downwind. The leading edge of the geocomposite shall be secured at times with sandbags or other means sufficient to hold it down during windy conditions.
6. Do not remove sandbags until replaced by PSL.
7. The geocomposite shall not be welded to the geomembrane.
8. The geocomposite shall only be cut using scissors or other cutting tools approved by the Manufacturer that will not damage the underlying geosynthetics. Care shall be taken not to leave tools on the geocomposite.
9. Necessary precautions shall be taken to prevent damage to underlying layers during placement of the geocomposite.
10. During placement of geocomposite, care shall be taken not to entrap dirt or excessive dust within the geocomposite that could cause clogging of the drainage system or bonded geotexitile and/or

stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geocomposite, it should be hosed clean prior to placement of the next material on top of it.

8.6.2 Field Seams

The following requirements shall be met during installation of the geocomposite:

1. Adjacent rolls shall be overlapped by a minimum of 4 inches.
2. End seams shall be overlapped by a minimum of 8 inches.
3. On sideslopes, upper geocomposite panel overlaps down slope panel.
4. Overlaps shall be secured by tying. Tying can be achieved by HDPE fasteners or polymer braids. Tying devices shall be white or yellow for easy inspection. Metallic devices will not be permitted.
5. Tying shall be every 5 feet along the slope and base, every 6 inches in the anchor trench, and every 6 inches along end-to-end seams on the floor of the landfill.
6. In the corners of the side slopes where overlaps between perpendicular geocomposite panels are required, an extra layer of geocomposite shall be unrolled along the slope, on top of the previously installed geocomposite from top to bottom of the slope.

8.7 Field Quality Control

1. The Installer shall provide the Site CQA Manager with Daily Summary Reports addressing the following:
   a. Underlying geomembrane approval for areas anticipated to be covered by geocomposite
   b. The total number and location of panels placed
   c. Location of repairs
2. Before placing protective soil cover, Site CQA Manager inspects geocomposite installation and related Work. All Work in system inspected shall be complete, clean, and ready for use. All Work to meet requirements as to line, grade, cleanliness, and workmanship. Note all discrepancies and repair at no additional expense to Owner. Final acceptance of system contingent upon approval of Owner and Site CQA Manager. Final acceptance shall address the following:
   a. The surface of the geocomposite shall be clean and free of debris at the time of inspection.
   b. The Field Installation Manager shall record each roll number and lot number as panels are deployed, and a general description of the location of each panel.
   c. The Field Installation Manager and the Site CQA Manager shall inspect the overlap for each panel.
   d. The Field Installation Manager and the Site CQA Manager shall inspect the anchoring of the geocomposite.
   e. The Field Installation Manager and the Site CQA Manager shall inspect the geocomposite for any signs of defects or holes. Any areas requiring repair shall be marked and subsequently repaired in accordance with the Repair Procedures listed in these specifications.
   f. The Field Installation Manager and the Site CQA Manager shall reinspect, verify, and approve repairs and patches.
3. Repair Procedures
   a. Seams and non-seam areas of the geocomposite shall be inspected for defects, holes, and any sign of contamination by foreign matter in accordance with the Field Quality Control procedures listed in these specifications.
   b. Any defects shall be repaired by the Installer by placing a geocomposite patch with a minimum 12-inch overlap in all directions.
   c. The patch shall be secured to the original geocomposite panel by placing HDPE fasteners or polymer braids every 6 inches along the perimeter of the patch.

d. If hole/tear width across roll is greater than 50 percent of roll width, repair damage to geocomposite as follows:
    a. On floor of cell, cut out damaged area and replace with new geocomposite.
    b. On sideslopes, remove and replace damaged geocomposite panel.
e. For any repair method, surfaces shall be clean and dry at the time of the repair.
f. Each completed repair shall be inspected and approved in accordance with the Field Quality Control procedures listed in this CQA Plan.
g. Cover installed geocomposite by operations layer (PSL) no more than 15 days from date of geocomposite installation to minimize potential for ultraviolet ray degradation of geotextile material properties.
h. Protect installed geocomposite from elements, traffic, and damage of any type.
i. Keep installed geocomposite free of all trash and debris.

9.0 GEONET

9.1. Geonet Properties

Geonet is proposed as the leak detection layer for the landfill evaporation pond liner systems.

1. The geonet shall be manufactured of new, prime first-quality materials designed and manufactured specifically for the purpose of planar drainage of liquid and chemically resistant to leachate.
2. Geonets are unitized sets of parallel ribs positioned in layers to form a three-dimensional structure such that liquid can be readily transmitted within their open spaces.
3. The geonet material shall meet the minimum properties listed in **Table II.7.8.**

9.2 Manufacturer Quality Control Documentation

Prior to installation commencement of any geonet material, the Contractor shall provide to the Site CQA Manager the following information certified by the manufacturer for the delivered geomembrane.

1. Origin, identification and production of the resin (supplier's name, brand name and production plant).
2. Copies of quality control certificates issued by the resin supplier.
3. Manufacturer's certification verifying that the quality of the resin used to manufacture the geonet meets the resin specifications fingerprint properties shown in **Table II.7.8**.
4. Each roll delivered to the project site shall have the following identification information:
    - Manufacturer's name
    - Product identification
    - Thickness
    - Roll number
    - Roll dimensions
5. Quality control certificates signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency, and test results. At a minimum, the following test results shall be provided in accordance with applicable test requirements specified in **Table II.7.8.**

9.3 Conformance Testing

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory at a minimum of 1 per 100,000 ft^2. The Site CQA Manager or Installer shall obtain the samples from the roll, mark the machine direction and identification number. The number of lots and samples will be determined in accordance with ASTM D4354. The following conformance tests shall be conducted at the independent laboratory:
    - Thickness (ASTM D 5199)
    - Density (ASTM D 792 Method B)

- Wide width tensile properties (ASTM D 7179)
- Mass per unit area (ASTM D 5261)
- Carbon black (ASTM D 4218)
- Melt Index (ASTM D 1238)

2. These conformance tests shall be performed in accordance with **Table II.7.8.**
3. Conformance test results shall be reviewed by the Site CQA Officer, and lots shall be accepted or rejected prior to the placement of the geomembrane. Test results shall meet, or exceed, the property values listed in **Table II.7.8.** If the sampling results do not meet property values for any individual lot sample, the lot shall be resampled and retested. This retesting shall be paid for by the manufacturer or installer. If of the test values from the resamples pass the acceptable specification values listed in **Table II.7.8,** the lot shall be accepted.

9.4 Delivery, Storage and Handling

1. The geonet rolls shall be packaged and shipped by appropriate means to prevent damage of the geonet rolls. Off-loading and storage of the geomembrane is the responsibility of the Installer. The Installer shall be responsible for replacing any damaged or unacceptable material at no cost to the Owner.
2. No off-loading shall be performed unless the Site CQA Manager is present. Damage during off-loading shall be documented by the Site CQA Manager. Damaged rolls must be separated from the undamaged rolls until the proper disposition of that material has been determined collectively by the installer and Site CQA Manager.
3. The geonet rolls shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions and excessive heat that may damage the geonet material. The rolls shall be stored on a prepared surface (not wooden pallets) and shall elevated from the ground (a minimum of 3 inches) to protect the geonet from standing water.

9.5 Guarantee

1. The Contractor shall guarantee the HDPE geonet against defects in installation and workmanship for the period of two years commencing with the date of final acceptance by the Owner. The guarantee shall include the services of qualified service technicians and materials required for the repairs at no expense to the Owner.

9.6 Geonet Installation

9.6.1 Geonet Placement

1. As each roll is moved from the storage area by the Installer, the labels shall be removed by the Installer and submitted to the Site CQA Manager. The rolls of geonet shall be brought to the area to be lined with a front-end loader and support pipes set up such that the geonet roll is fully supported across its length. A spreader bar or similar device shall be used to prevent the lifting chains or slings from damaging the edges.
2. Care shall be taken to keep the geonet clean and free from debris prior to installation. If the geonet is not clean, it should be washed using a high-pressured hose prior to installation.
3. Each panel of the geonet shall be rolled out and installed in accordance with the approved shop drawings prepared by the Installer. The layout shall be designed to keep field joining of the geonet to a minimum and consistent with proper methods of geonet installation.
4. On slopes, the geonet shall be secured and rolled down the slope in such a manner as to continually keep the geonet panel in tension. If necessary, the geonet shall be positioned by hand after being unrolled to minimize wrinkles.
5. In areas where wind is prevalent, geonet installation should be started at the upwind side of the project and proceed downwind. The leading edge of the geonet shall be secured at times with sandbags or other means sufficient to hold it down during windy conditions.

6. The geonet shall not be welded to the geomembrane.
7. The geonet shall only be cut using scissors or other cutting tools approved by the Manufacturer that will not damage the underlying geosynthetics. Care shall be taken not to leave tools on the geonet.
8. Necessary precautions shall be taken to prevent damage to underlying layers during placement of the geonet.
9. During placement of geonet, care shall be taken not to entrap dirt or excessive dust within the geonet that could cause clogging of the drainage system and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, it should be hosed clean prior to placement of the next material on top of it. In this regard, care shall be taken in handling the sandbags to prevent rupture or damage of the sandbag.
10. Once the geonet is removed from the storage area by the Installer, it becomes the responsibility of the Installer.

9.6.2 Field Seams

The following requirements shall be met during installation of the geonet:

1. Adjacent rolls shall be overlapped by a minimum of 4 inches.
2. Overlaps shall be secured by tying. Tying can be achieved by HDPE fasteners or polymer braids. Tying devices shall be white or yellow for easy inspection. Metallic devices will not be permitted.
3. Tying shall be every 5 feet along the slope and base, every 6 inches in the anchor trench, and every 6 inches along end-to-end seams on the floor of the landfill and pond.
4. No horizontal seams shall be allowed on side slopes.
5. In the corners of the side slopes where overlaps between perpendicular geonet panels are required, an extra layer of geonet shall be unrolled along the slope, on top of the previously installed geonet from top to bottom of the slope.
6. When more than one layer of geonet is installed, joints shall be staggered.

9.7 Field Quality Control

1. The Installer shall provide the Site CQA Manager with Daily Summary Reports addressing the following:
   a. Underlying geomembrane approval for areas anticipated to be covered by geonet
   b. The total number and location of panels placed
   c. Location of repairs
2. The Field Installation Team Manager and the Site CQA Manager shall provide 100% inspection of the installation to ensure compliance with these technical specifications and Manufacturer recommended procedures.
   a. The surface of the geonet shall be clean and free of debris at the time of inspection.
   b. The Field Installation Manager shall record each roll number and lot number as panels are deployed, and a general description of the location of each panel.
   c. The Field Installation Manager and the Site CQA Manager shall inspect the overlap for each panel.
   d. The Field Installation Manager and the Site CQA Manager shall inspect the anchoring of the geonet.
   e. The Field Installation Manager and the Site CQA Manager shall inspect the geonet for any signs of defects or holes. Any areas requiring repair shall be marked and subsequently repaired in accordance with the Repair Procedures listed in these specifications.
   f. The Field Installation Manager and the Site CQA Manager shall reinspect, verify, and approve repairs and patches.
3. Repair Procedures

a. Seams and non-seam areas of the geonet shall be inspected for defects, holes, and any sign of contamination by foreign matter in accordance with the Field Quality Control procedures listed in these specifications.
b. Any defects shall be repaired by the Installer by placing a geonet patch with a minimum 12-inch overlap in all directions.
c. The patch shall be secured to the original geonet panel by placing HDPE fasteners or polymer braids every 6 inches along the perimeter of the patch.
d. For any repair method, surfaces shall be clean and dry at the time of the repair.
e. Each completed repair shall be inspected and approved in accordance with the Field Quality Control procedures listed in this CQA Plan.

10.0 PROTECTIVE SOIL LAYER AND SELECT AGGREGATE

10.1 Protective Soil Layer

1. Protective soil layer (PSL) material is proposed for use in the landfill and shall be comprised of readily available on-site materials free from organic substance and other deleterious matter typically comprised of materials from the unconsolidated formation at the surface of the site (sometimes referred to as “OAG”).
2. PSL shall be free of organic materials, contain fines < 30% by dry weight, and have a uniformity coefficient (Cu) less than 10 (see permit HELP Model **Volume III, Section III.4**).
3. Protective soil layer material will be placed uncompacted in direct contact with the geocomposite and shall have rounded particle shapes to avoid potential for damage to the FML.

10.2 Select Aggregate

<u>*Leachate Collection System Bedding Layer and Sumps*</u>

1. Washed select aggregate, shall be used for bedding material around the leachate collection pipes and sumps for the landfill; in leak detection sumps for the evaporation ponds; and other locations as shown in the approved construction drawings. The select aggregate shall be durable, resistant to weathering and shall be free organic material, and fines < 2% by dry weight.
2. The bedding aggregate shall have particle sizes that range from ¾ inch minimum diameter to 2.0 inch maximum diameter in accordance with ASTM C136.
3 The select aggregate shall have particle shapes that will not damage the FML with the use of a 10 oz/yd^2 non-woven geotextile cushion layer. The select aggregate shall be approved by the Engineer.

10.3 Conformance Testing

<u>*Protective Soil Layer*</u>

1. Conformance testing shall be performed on samples from each source of protective soil layer to assure compliance with the specifications. The following tests shall be performed on the samples:
   a. Permeability (ASTM D2434 or Falling Head) [min. 1 test per 2 acres]
   b. Total Thickness Test (survey or direct test) [min. 5 per acre]

<u>*Select Aggregate.*</u>

1. Gradation analysis shall be performed on samples from each source of the select aggregate to assure compliance with the project specifications.

10.4 Delivery, Storage and Handling

If protective soil/select aggregate materials are delivered to the site prior to approval, materials shall be stockpiled on-site in areas as dictated by the Owner to facilite approval by the Engineer. Provision shall be implemented to minimize surface water or dust impacts on the stockpile. Removal and placement of the materials shall be conducted in a manner to minimize intrusion of soils adjacent to and beneath the stockpile.

10.5 Protective Soil Layer Placement

1. After the completion of installation and acceptance of the liner system and related work activities, placement of the minimum uncompacted 24-inch thick protective soil layer will be initiated following approval by the Engineer.
2. During the placement of the protective soil layer material, no construction equipment shall be allowed directly on the geosynthetic liner system and any damage shall be repaired immediately by the Contractor in accordance with this CQA Plan.
3. Care shall be taken to protect the geosynthetic liner system. Ramps shall be provided at down slopes and in other heavily traveled areas. Heavily traveled areas shall have a minimum of 3 feet of protective soil layer material above the geosynthetic liner system.
4. Protective soil layer shall not be placed over folds in the geocsynthetics.
5. Protective soil material shall be placed on the side slopes starting at the toe of the slope and working toward the top of the slope/berm.
6. The protective soil layer should be spread when the geosynthetics are taut or stretched evenly over the base of the landfill. The protective soil layer material shall not be spread when the geosynthetics are elongated due to higher daytime temperatures and/or exposure to sun.
7. Protective soil layer shall not be placed while the soil is frozen or thawing, or during unfavorable weather conditions.

10.6 Select Aggregate Placement

Leachate Collection System Bedding Layer and Sump Select Aggregate

After geosynthetic placement has been approved, placement of non-woven geotextile in the floor of the leachate collection system trench, leachate collection sump and leak detection sump will ensure protection of the geosynthetics from the overlying select aggregate layer.

1. Leachate Collection System Bedding Layer
   a. Placement of a 3 inch bedding layer in the bottom of the trench and on top of the geotextile consisting of select aggregate, 0.75 inch minimum diameter to 2.0 inch maximum diameter (maximum 2% fines by dry weight).
   b. Backfilling of the leachate pipe will be allowed only after placement and workmanship have been approved by the Site CQA Manager.
   c. Backfilling around the leachate pipe will be with the select aggregate to the depth and width shown on the construction drawings.
   d. Haunching of the select aggregate will provide stability to the pipe from the sides and from underneath.
   e. Placement of the select aggregate should be in gradual 4 inch to 6 inch lifts and tamped simultaneously with a blunt tamping tool to ensure the material is well consolidated under and around the pipe.
   f. Backfilling, with the select aggregate, should be brought up to a height of a minimum of 12 inches above the top of the pipe.
2. Leachate Collection Sump and Leachate Detection Sump Select Aggregate Placement
   a. Placement of a 2 foot layer in the sumps and on top of the geotextile consisting of select aggregate, 0.75 inch minimum diameter to 2.0 inch maximum diameter (maximum 2% fines by dry weight).
   b. Backfilling of the leachate collection and riser pipes will be allowed only after placement and workmanship have been approved by the Site CQA Manager.

c. Backfill around the leachate collection and riser pipes will be with the select aggregate to the depth and width shown on the construction drawings.
d. Placement of the select aggregate should be in gradual 4 inch to 6 inch lifts and teamped simultaneously with a blunt tamping tool to ensure the aggregrate is well consolidated under the sides of the pipes as well as around it.
e. Care shall be taken during backfilling such that damage to the leachate collection and riser pipes is avoided.

10.7 Field Quality Control

1. The protective soil layer thickness shall be verified by survey on a minimum frequency of 5 survey points per acre.
2. The protective soil layer thickness may be measured by survey or manually periodically throughout the day during construction to confirm that the thickness of the installed material is in accordance with the Engineering Drawings.
   a. Protective Soil Layer Thickness (i.e., Survey 5/acre, Test Probe, Calibrated cones).

10.8 Protective Soil Layer - Thickness Confirmation Procedure

Due to the effects of wind and stormwater, the protective soil may not maintain a full 24 inch thickness at locations over time. The following procedure has proven effective at confirming protective layer thickness at the most important point in time when the protective soil layer is being covered with waste.

1. Prior to advancing the fill face over new sections of the liner, the protective soil cover in these areas may be tested to confirm a thickness not less than 24 inches.
2. The area that may be tested will include the footprint where the next lift of waste will be placed over the protective cover; plus a buffer zone at least 50 feet ahead of the advancing fill face.
3. Add select protective soil material from the designated stockpile in the area to be tested if additional thickness is required.
4. Perform protective cover depth probe by field survey, with a <u>blunt</u> instrument or construction cones (i.e., no shovels) on a spacing not to exceed 100 feet. The instrument shall have a smooth rounded or flat tip, and it shall be advanced carefully until contact with the geosynthetic surface is confirmed. Care must be taken not to damage the geosynthetic surface.
5. The probes or traffic cones shall be calibrated such that the 24 inch length is visible and prominently marked. Record probe test results (both passing and failing) in the Site Log Book and/or on forms provided specifically for this purpose.
6. In sections where the protective cover is less than 24 inches thick, add additional protective soil to the area and retest. Continue this procedure until test locations meet the 24 inch thickness criterion, and the intervening protective cover layer surface appears level and smooth.
7. PSL thickness verified shall be establed by suvery provided by a New Mexico registered professional land surveyror (PLS).
8. Maintain records regarding the protective soil layer on-site at all times for review by OCD inspectors, and by landfill management and engineering personnel.

11.0 GEOTEXTILE

11.1 Geotextile Properties

1. The 10 oz/yd^2 non-woven geotextile is specified for the landfill leahate collection pipe aggregate cushion wrap; leak detection sump aggregate cushion wrap; and leachate sump aggregate cushion wrap. Additionally, 10 oz/yd^2 non-woven geotextile is specified for the evaporation pond leak detection sump aggregate cushion wrap. The geotextile shall meet the specifications provided in **Table II.7.9**.
2. The minimum roll width shall be 15 feet, and the maximum roll length shall be 300 feet.

11.2 Manufacturer's Quality Control Documentation

Prior to installation commencement of any geonet composite material, the Contractor shall provide to the Site CQA Manager the following information certified by the manufacturer for the delivered geotextile.

1. Each roll delivered to the project site shall have the following identification information:
   - Manufacturer's name
   - Product identification
   - Thickness
   - Roll number
   - Roll dimensions
2. Quality control certificates, signed by the manufacturer's quality assurance manager. Each certificate shall have roll identification number, sampling procedures, frequency, and test results. At a minimum, the following test results/certifications shall be provided in accordance with applicable test/certification requirements specified in **Table II.7.9**:
   - Thickness (ASTM D5199)
   - Weight (ASTM D5261)
   - Tensile strength (ASTM D4632)
   - Elongation (ASTM D4632)
   - CBR puncture strength (ASTM D6241)
   - Trapezoidal tear strength (ASTM D4533)
   - Coefficient of permeability (ASTM D4491)
   - Permittivity (ASTM D4491)
   - Flow rate (ASTM D4491)
   - UV resistance (ASTM D4355)
   - Apparent opening size (ASTM D4751)

11.3 Conformance Testing

1. Conformance testing shall be performed by an independent Quality Assurance Laboratory approved by the Engineer at a minimum of one (1) per 100,000 ft^2. The Site CQA Manager or Installer shall obtain the samples from the roll, mark the machine direction and identification number. The number of lots and samples will be determined in accordance with ASTM D4354. The following conformance tests shall be conducted at the independent laboratory:
   - Weight (ASTM D5261)
   - Tensile strength (ASTM D4632)
   - CBR puncture strength (ASTM 6241)
   - Trapezoidal tear strength (ASTM D4533)
   - Apparent opening size (ASTM D4751)
2. These conformance tests shall be performed in accordance with **Table II.7.9.**
3. Conformance test results shall be reviewed by the Site CQA Officer, and lots shall be accepted or rejected prior to the placement of the geotextile. Test results shall meet, or exceed, the property values listed in **Table II.7.9.** If the sampling results do not meet property values for any individual lot sample, the lot shall be resampled and retested. This retesting shall be paid for by the manufacturer or installer. If the test values from the resamples pass the acceptable specification values listed in **Table II.7.9,** the lot shall be accepted.

11.4 Installation

1. Leachate Trench/Sump Preparation
   a. Before the geotextile is placed into position in the leachate collection pipe trench, leachate collection sumps, and leak detection sumps, the following procedures will be completed.
      1) The subgrade at the bottom and sides of the trench and sumps shall be carefully prepared in accordance with this CQA Plan.
      2) Underlying geosynthetics have been installed in accordance with this CQA Plan.
2. Geotextile Installation
   a. After geosynthetic placement has been approved by the Site CQA Manager, the Geotextile Installer shall place the non-woven geotextile in the bottom of the trench, leachate collection and leachate detection sumps to ensure protection of the underlying geosynthetics from the overlying select aggregate layer.
      1) Exposure of the geotextiles to the elements between lay down and cover shall be a maximum of 14 days.
      2) The 10 oz/yd^2 non-woven geotextile shall be placed atop the underlying geosynthetics in the trenches, leak detection sump and leachate collection sump. The geotextile shall be placed such that the centerline of the geotextile lines up with the centerline of the trench. The geotextile shall be joined by overlapping with heat bond or sewing. Overlapped seams shall have a minimum overlap of 24 inches.
      3) The Installer shall take care not to damage the underlying geosynthetic materials. The Installer is responsible for any damage to the geotextile and underlying geosynthetics caused during geotextile installation.
3. Field Quality Control
   a. The Site CQA Manager shall inspect the installation for proper placement, sufficient overlap and damaged material. Damaged areas will be repaired in accordance with the Repair Procedures of this CQA Plan.
4. Repair Procedures
   a. A geotextile patch shall be placed over the damaged area and extend three feet beyond the perimeter of the tear or damage.
   b. The Site CQA Manager shall verify repairs.
5. Select Aggregrate Installation
   a. Placement of a 3 inch bedding layer in the bottom of the leachate collection pipe trench and on top of the geotextile will be performed by the Contractor.
   b. Placeement of the 2 feet of select aggregrate in the leachate collection and leak detection sumps shall be performed by the Contractor.
6. Leachate Pipe Installation (landfill)
   a. Installation of the slotted or perforated SDR 13.5 HDPE leachate collection pipe onto the bedding layer will be performed in accordance with the Geopipe Specifications.
   b. Installation of the SDR 17 HDPE sump riser pipes will be performed in accordance with the Geopipe Specifications.
7. Select Aggregate Backfill
   a. Backfill of completed sections of the leachate trench shall be completed only after placement and workmanship have been approved by the Site CQA Manager and the top of leachate pipe has been surveyed to verify grade.
   b. Backfill of the leachate collection and leak detection sumps shall be completed only after placement and workmanship of the riser pipes has been approved by the Site CQA Manager.

12.0 GEOPIPE

12.1 General

The design of the landfill employs 6-inch perforated SDR 13.5 leachate collection pipe; 6-inch solid-walled SDR 17 leachate cleanout pipe; and 24-inch both perforated/solid-walled SDR 17 leachate and leak detection extraction riser pipes. Additionally, the design of the evaporation ponds employ a 4-inch partial perforated/partial solid-walled SDR 17 leak detection sump riser pipe.

The landfill design employs a leachate collection system atop the primary composite liner that includes leachate collection piping and leachate extraction piping. The leachate collection system is comprised of slotted or perforated geopipes which collect leachate seepage through the drainage layer directing it to the permanent or temporary leachate collection sumps where leachate extraction piping is installed. These geopipes are placed within select aggregate and wrapped with a non-woven geotextile material and covered by the granular protective soil drainage layer. At the end of each slotted or perforated permanent leachate collection geopipe, a solid geopipe is attached which rises up along the landfill or evaporation pond sideslope to allow cleanout of the pipe. The sump extraction geopipes rise along the landfill and evaporation pond sideslope to allow extraction of liquid from the leachate collection and leak detection sumps. Leachate collection and leak detection piping design is shown on Engineering Drawings.

12.2 HDPE Geopipe Material Properties

1. High Density Polyethylene (HDPE) Pipe is the preferred material utilized for the leachate collection pipe and leachate extraction pipe will be manufactured in accordance with ASTM D714 and have the following physical characteristics:
   a. Perforated and solid wall 6-inch diameter HDPE Driscopipe as manufactured by Phillips 66, or approved equal, with a standard dimension ratio (SDR) of 13.5 as shown on the Engineering Drawings. The Construction Plans and Technical Secifications for each unit may specify a different SDR wall thickness (e.g., SDR 11, SDR 17, etc.).
   b. Solid wall 12-inch diameter HDPE Driscopipe as manufactured by Phillips 66, or approved equal, with a standard dimension ratio (SDR) of 17 as shown on the Engineering Drawings.
   c. Solid wall 4-inch diameter HDPE Discopipe as manufactured by Phillips 66, or approved equal, with a standard dimension ratio (SDR) of 17 as shown on the Engineering Drawings.
   d. HDPE pipe shall meet the requirements of cell classification PE 445574C or higher cell classification in accordance with ASTM D3350.
   e. The slots or perforations must conform with the Engineering Drawings.
   f. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
   g. Apart from structural voids and hollows associated with some profile wall designs, the pipe fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other defects.
2. HDPE Pipe Fittings
   a. HDPE fittings shall be manufactured in accordance with the requirements of ASTM E714.
   b. End caps for the clean-out risers will be of low pressure type HDPE, or similar with stainless steel hardware.

12.3 Manufacturer's Quality Control Documentation

Prior to installation of the geopipe, the Contractor shall provide the following information certified by the manufacturer for the delivered geopipe:

1. Manufacturer's certification verifying that the quality of the raw materials used to manufacture the geopipe meets the Manufacturer specifications.

2. Each geopipe length delivered to the project site shall have the following identification information:
   - Manufacturer's name
   - Pipe size
   - Ring stiffness constant classification or SDR number
   - Production code designating plant location, machine, and date of manufacture.

12.4 Delivery, Storage and Handling

1. Off-loading and storage of the geopipe shall be performed by the Contractor.
2. Storage of the geopipe shall not exceed 17 rows high, as per Manufacturer's recommendation.
3. The Contractor shall be responsible for moving the pipes and fittings from the storage area to the area of pipe installation. The Contractor shall be responsible for replacing any material damaged during transport or installation.

12.5 Quality Assurance

1. Finished Product Evaluation
   a. Each length of pipe produced shall be checked by production staff for the items listed below. The results of measurements shall be recorded on production sheets which become part of the Manufacturer's permanent records.
      1) Pipe in process shall be checked visually, inside and out for cosmetic defects (grooves, pits, hollows, etc.).
      2) Pipe outside diameter shall be measured using a suitable periphery tape to ensure conformance with ASTM D1785.
      3) Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with the Manufacturer’s specifications.
      4) Pipe length shall be measured.
      5) Pipe marking shall be examined and checked for accuracy.
      6) Pipe ends shall be checked to ensure they are cut square and clean.

12.6 Installation

12.6.1 Leachate Collection Pipe

1. Leachate Collection Trench Preparation
   a. Before the geopipe is placed into position in the trench, the following procedures will be completed:
      1) The subgrade at the bottom and sides of the trench shall be carefully prepared as shown on the Engineering Drawings by the Contractor.
      2) The subgrade will be covered by a composite liner by the Liner Installer according to the Engineering Drawings.
2. Geotextile Installation
   a. After composite liner placement has been approved, the Liner Installer shall place the non-woven geotextile in the bottom of the leachate trench to ensure protection of the composite liner from the overlying select aggregate layer in accordance with the Geotextile Cushioning Fabric specifications.
3. Bedding Layer Installation
   a. Placement of a three 3-inch bedding layer in the V-notch trench and above the geotextile consisting of select aggregate, 0.75 inch minimum diameter to 2.0 inch maximum diameter (maximum 2% fines by dry weight) will be performed.
      1) "Spading" with shovels or any other activities which could jeopardize the underlying liner's integrity will not be allowed.

2) The three (3) inch bedding layer is discussed in more detail under Protective Soil Layer and Select Aggregate (Section 10.0).

4. Leachate Collection Pipe Installation
   a. High Density Polyethylene (HDPE) Leachate Collection Pipe Installation
      1) Installation of the 6-inch diameter perforated SDR 13.5 HDPE pipe onto the bedding layer will be performed in such a manner as not to jeopardize the integrity of the pipe.
      2) Trenches shall be kept free from any deleterious material, water or backfill to prevent damage to the pipe. The Contractor shall provide means and devices to remove promptly and dispose of any deleterious material, or water entering the area of pipe laying.
      3) Installation practices shall conform with ASTM D2321 and any specific manufacturer's recommendations.
      4) HDPE pipe joints shall be butt fused in the field in accordance with the manufacturer's instructions. Fused joints, when tested for tension and pressure, shall be stronger than the pipe itself.
      5) As many sections of pipe as practical shall be fused together outside of the lined landfill cell to minimize damage to the liner system during pipe fusion.
      6) No connection shall be made where joint surfaces and joint materials have been soiled until such surfaces are thoroughly cleaned.
      7) As the work progresses, the interior of pipes shall be kept clean. After each line of pipe has been laid, it shall be carefully inspected and earth, trash, rags, and other foreign matter removed from the interior.
      8) Slots/perforations on adjoining sections of pipe shall remain in alignment after fusion welding.
      9) Two sets of pipe slots/perforations shall be facing vertically down after pipe placement in the trench.
5. Field Quality Control
   a. After completion of any section of geopipe; the grades, joints, and alignment shall be true to line and grade.
   b. The leachate collection pipe grade shall be surveyed on maximum 50 foot centers for compliance with the approved design.
   c. The Site CQA Manager shall inspect the installation. The pipe shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, dirt, debris or other materials on the inside.
6. Leachate Trench Backfill
   a. The Contractor shall backfill completed sections of pipe trench with additional select aggregate (0.75 inch to 2.0 inch diameter) around and above the pipe to a minimum thickness of 12 inches above the pipe as shown on the Engineering Drawings. Backfilling over the pipe trench will be allowed only after placement and workmanship have been approved by the Site CQA Manager.
   b. Placement of a geotextile layer will be completed as shown on the Engineering Drawings.

12.6.2 Leachate Collection and Leak Detection Sumps

1. Leachate Collection and Leak Detection Sump Preparation
   a. Before the leachate collection and leak detection riser geopipe is placed into position in the sumps, the following procedures will be completed:
      1) The subgrade at the bottom and sides of the sumps shall be carefully prepared as shown on the Engineering Drawings by the Contractor.
      2) The subgrade will be covered by a composite liner by the Liner Installer according to the Engineering Drawings.

2. Geotextile Installation
   a. After composite liner placement has been approved, the Installer shall place the non-woven geotextile in the bottom of the leachate collection and leak detection sumps to ensure protection of the composite liner from the overlying select aggregate layer in accordance with the Geotextile Cushioning Fabric specifications.
3. Select Aggregate Installation
   a. Placement of 2 feet of select aggregate in the sumps and above the geotextile consisting of 0.75 inch minimum diameter to 2.0 inch maximum diameter (min 2% fines by dry weight) will be performed."Spading" with shovels or any other activities which could jeopardize the underlying composite liner's integrity will not be allowed.
4. Leachate Extraction and Leak Detection Pipe Installation
   a. High Density Polyethylene (HDPE) Leachate Collection and Leak Detection Pipe Installation
      1) Installation of the 12-inch or 4-inch diameter SDR 17
      HDPE pipe in the leachate collection and leak detection sumps will be performed in such a manner as not to jeopardize the integrity of the pipe.
      2) Each pipe section shall be accurately placed to the line and alignment called for on the Engineering Drawings.
      3) The leachate collection and leak detection sumps shall be kept free from any deleterious material, water or backfill to prevent damage to the pipe. The Contractor shall provide means and devices to remove promptly and dispose of any deleterious material, or water entering the area of pipe laying.
      4) Installation practices shall conform with ASTM D2321 and any specific manufacturer's recommendations.
      5) HDPE pipe joints shall be butt fused in the field in accordance with the manufacturer's instructions. Fused joints, when tested for tension and pressure, shall be stronger than the pipe itself.
      6) As many sections of pipe as practical shall be fused together outside of the composite lined area to minimize damage to the composite liner during pipe fusion.
      7) No connection shall be made where joint surfaces and joint materials have been soiled until such surfaces are thoroughly cleaned.
      8) As the work progresses, the interior of pipes shall be kept clean. After each line of pipe has been laid along the side slope, it shall be carefully inspected and earth, trash, rags, and other foreign matter removed from the interior.
      9) Slots/perforations on the bottom 6 feet of the leachate extraction and leak detection riser pipes shall be as shown on the Engineering Drawings.
5. Field Quality Control
   a. After completion of each section of the leachate collection and leak detection geopipe; the joints and alignment along the side slopes shall be true to line and alignment.
   b. The Site CQA Manager shall inspect the installation. The pipe shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, dirt, debris or other materials on the inside.
   c. Placement of a geotextile layer will be completed as shown on the Engineering Drawings.

13.0 ENGINEERING CERTIFICATION

Construction tasks, other than mass excavation and general earthmoving, will be subject to OCD notification and submittal of sealed Construction Plans and Technical Specifications. An Engineering Certification Report, incorporating the laboratory and field data, shall be submitted by Engineer to the New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division confirming that the subgrade, liner, leak detection system and leachate collection system have been installed in compliance with the project specifications and the CQA Plan. The Engineering Certification Report shall be sealed by a Professional Engineer registered in good standing with New Mexico; and who has applicable expertise in landfill liner and geosynthetics engineering.

TABLES

TABLE II.7.1 – Summary of Required CQA Standards (Sheet 1 of 2)

Element	Key Property	CQA/CQC Test	Sampling Plan	Sampling Frequency (Minimum)	Standard Test Method
Excavation Required: Subgrade Layer Material Evaluation	Maximum Density	Proctor Test	Judgmental	1 per 5,000 cy or soil material change	ASTM D698
Fill Required: Subgrade Layer Material Evaluation	Maximum Density	Proctor Test	Judgmental	1 per 5,000 cy or soil material change; 4 per acre per 6-inch lift	ASTM D698
Subgrade Layer & Structural Fill Construction Quality Evaluation	In-Place Density	Nuclear Density Test	Random within the grid	4 per acre per 6-inch thick lift	ASTM D6938
	Surface of final lift to be free of stones greater than 1/2".	Visual	Judgmental	100%	NA
Geosynthetic Clay Liner Material	Conformance	Mass per unit area, Free Swell, Fluid Loss, Peel Strength, Hydraulic Conductivity, Index Flux	Systematic	1 per 100,000 sf	ASTM D5261, D5890, D5891, D5887, D6496, D5587
	Surface Defects	Visual	100%	100%	NA
Liner Geomembrane Material	Conformance	Thickness, Density, Tensile properties, Tear resistance, Carbon black content, Carbon black dispersion, Puncture resistance, Mass/unit area	Systematic	1 per 100,000 sf	ASTM D5994, D1505/0792, D6693, D1004, D4218, D5996, D4833, D5261, D4751, D4632, D4833
	Surface Defects	Visual	100%	100%	NA
Liner Geomembrane Seaming Procedures	Subgrade	Visual	100%	100%	NA
	Anchor Trench	Visual	100%	100%	NA
	Temporary Anchor	Visual	100%	100%	NA
	Sheet Placement	Visual	100%	100%	NA
	Overlap of Sheets	Measurement	100%	100%	NA
	Cleanliness of Seam	Visual	100%	100%	NA
	Extent of Grinding	Measurement	100%	100%	NA

Note: Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

TABLE II.7.1 – Summary of Required CQA Standards (Sheet 2 of 2)

Element	Key Property	CQA/CQC Test	Sampling Plan	Sampling Frequency (Minimum)	Standard Test Method
Liner Geomembrane Seams	Test Seams	Tensiometer	Systematic	In accordance with specifications	NA
	Field Hot Wedge Seams	Non-Destructive Tests (Pressure Dual Seam)	100%	100%	NA
		Destructive Tests (peel & shear strength)	Random within the grid and Judgmental	1 per 500 linear feet	ASTM D6392
	Field Extrusion Fillet Seams	Non-Destructive Tests (Vacuum Box Testing)	100%	100%	ASTM D4437
		Destructive Tests (peel & shear strength)	Random within the grid and Judgmental	1 per 500 linear feet	ASTM D6392
Geonet	Conformance	Thickness, Density, Wide width tensile properties, Mass per unit area, Carbon black, Melt index	Systematic	1 per 100,000 sf	ASTM D4354, D1777, D1505, D7179, D5261, D4218, D1238
	Anchor Trench	Visual	100%	100%	NA
	Temporary Anchor	Visual	100%	100%	NA
	Sheet Placement	Visual	100%	100%	NA
	Overlap and Tying of Sheets	Measurement	100%	100%	NA
Protective Soil Layer	Permeability	Lab Permeability	Random	1 per Source	ASTM D2434 or Falling Head
	Particle Size	Gradation of Soil	Random	1 per 1,500 cy	ASTM C136
	Thickness of Protective Soil Layer	Surveying or Direct Test	Within the grid	5 per acre	NA
Geotextile	Conformance	Mass per unit area, Trapezoidal tear strength, Puncture strength, Grab tensile strength, Apparent opening size	Systematic	1 per 100,000 sf	ASTM D5261, D4533, D6241, D4632, D4751
	Overlap	Measurement	100%	100%	NA
	Seams	Visual Observation	100%	100%	NA
Leachate Collection System	Grade	Surveying	NA	1 per 50 lf	NA
	Product specs, placement and workmanship	Visual Observation	100%	100%	NA
Leachate Pipe Envelope	Minimize clogging, facilitate flow	Gradation of Aggregate	Random	1 per Source	ASTM C136
	Placement and workmanship	Visual Observation	100%	100%	NA

Note: Where reference is made to one of the above standards, the revision in effect at the time of construction shall apply.

TABLE II.7.2 - Technical Specifications: Geosynthetic Clay Liner (GCL)

MATERIAL	PROPERTY	QUALIFIER	UNIT	VALUE	TEST METHOD	MANUFACTURER QC TEST FREQUENCY (MINIMUM)	CONFORMANCE QA TEST FREQUENCY (MINIMUM)
Nonwoven Cover Geotextile	Mass/Unit Area	Minimum	$^{oz}/_{yd^2}$	6.0	ASTM D5261	200,000 ft^2	100,000 yd^2
Bentonite	Free Swell	Minimum	ml	24/2g	ASTM D5890	100,000 lb	100,000 yd^2
	Fluid Loss	Maximum	ml	18	ASTM D5891	100,000 lb	100,000 yd^2
	Moisture Content	Maximum	%	35	ASTM D5993	100,000 lb	NA
Woven Base Fabric	Mass/Unit Area	Minimum	$^{oz}/_{yd^2}$	3.2	ASTM D5261	200,000 ft^2	NA
GCL (as manufactured)	Mass of GCL[2]	Minimum	lbs/ft^2	0.81	ASTM D5993	40,000 ft^2	100,000 yd^2
	Tensile Stress (Machine Direction)	Minimum	lbs/in	30	ASTM D6768	40,000 ft^2	NA
	Peel Strength	Minimum	lbs/in	3.5	ASTM D6496	40,000 ft^2	100,000 yd^2
	Permeability[3]	Maximum	cm/sec	$5x10^{-9}$	ASTM D5887	30,000 yd^2	100,000 yd^2
	Flux	Maximum	$cm^3/sec-cm^2$	$1x10^{-8}$	ASTM D5887	30,000 yd^2	100,000 yd^2
	Shear Strength[4]	Minimum @ 200 lbs/ft^2	lbs/ft^2	500	ASTM D6243	Periodic	NA
Geotextile and Reinforcing Yarns	% Strength Retained[5]	Minimum	%	65	ASTM D6768	Yearly	NA

Notes:
1. *Standard test methods updated to reflect most current industry standards.*
2. *Mass of GCL and bentonite measured after oven drying per stated test method at 0% moisture content.*
3. *Value represents GCL permeability after permeation with deaired, deionized water @ 5 psi maximum effective confining stress and 2 psi head pressure. See GRI-GCL3 for termination criteria.*
4. *Value represents minimum percent retained from manufactured value after oven aging at 60^0C 50 days.*
5. *Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf normal stress.*

TABLE II.7.3 - Technical Specifications: 60-mil HDPE Single-Sided and Double-Sided Textured Geomembrane

PROPERTY	QUALIFIER	UNIT	VALUE	TEST METHOD	MANUFACTURER QC TEST FREQUENCY (MINIMUM)	CONFORMANCE QA TEST FREQUENCY (MINIMUM)
Thickness	Min Average Lowest individual for 8 of 10 values Lowest individual for any 10 values	mils mils mils	60 54 51	ASTM D5994	Per Roll	100,000 ft^2
Density	Minimum	g/cc	0.94	ASTM D792 or D1505	100,000 ft^2	100,000 ft^2
Tensile Properties (each direction): Break Strength Yield Strength Elongation - break Elongation - yield	 Min Average Min Average Min Average Min Average	 lb/in lb/in % %	 228 126 700 12	ASTM D6693, Type IV	100,000 ft^2	100,000 ft^2
Tear Resistance	Min Average	lbs	42	ASTM D1004	20,000 lbs	100,000 ft^2
Puncture Resistance	Min Average	lbs	108	ASTM D4833	20,000 lbs	100,000 ft^2
Carbon Black Content	Min Range	%	2.0 – 3.0	ASTM D4218	20,000 lbs	100,000 ft^2
Carbon Black Dispersion	Rating	NA	Note 1	ASTM D5596	20,000 lbs	100,000 ft^2
Stress Crack Resistance	Minimum	hours	500	ASTM D5397 Appendix	Per GRI GM 10	NA
Asperity Height	Min Average	mils	20	ASTM D7466 GRI GM 13	every second roll	100,000 ft^2
Standard Oxidation Time	Min Average	minutes	100	ASTM D3895	200,000 lbs	NA
Oven Aging at 85ºC Standard Oxidation Time - % Retained after 90 days	Min Average	%	55	ASTM 3895	Each Formulation	NA
UV Resistance High Pressure Oxidation Induction Time - % Retained after 1,600 hours	Min Average	%	50	ASTM D5885	Each Formulation	NA

Notes:

1. *Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.*
2. *Standard test methods will be updated to reflect the most current industry standards.*

SEAM PROPERTIES HDPE GEOMEMBRANE				
PROPERTY	**QUALIFIER**	**UNIT**	**VALUE**	**TEST METHOD**
Thickness	Minimum	mils	60	ASTM D5994
Bonded Seam Strength (1) [Shear Strength]	Minimum	lb/in	121	ASTM D6392
Tensile Properties (1)(2) [Peel Strength]: • Hot Wedge Fusion Weld • Fillet Extrusion Weld	 Minimum Minimum	 lb/in lb/in	 98 78	 ASTM D6392 ASTM D 6392
Air-Pressure (3)(4)	Minimum	psi	3	GRI GM6
Vacuum (3)	Minimum	psi	3	NA

Seam Notes:

1. *Value listed for shear and peel strengths are for four out of five test specimens. Fifth specimen can be as low as 80 percent listed values.*
2. *Break, when peel testing, occurs in liner material itself, not through peel separation (FTB).*
3. *See Section 7.9 for Field Quality Control requirements and testing extrusion and fusion welds.*
4. *Initial pressure 27-37 psi for 5 minutes.*

TABLE II.7.4a - Technical Specifications: 60-mil HDPE Smooth Geomembrane and 60-mil HDPE Smooth Conductive Geomembrane

PROPERTY	QUALIFIER	UNIT	VALUE	TEST METHOD	MANUFACTURER QC TEST FREQUENCY (MIN)	CONFORMANCE QA TEST FREQUENCY (MIN)
Thickness	Min Average Min Individual Lowest individual for any 10 values	mils mils mils	60 54 51	ASTM D5199	Per Roll	100,000 ft^2
Density	Minimum	g/cc	0.94	ASTM D792 or D1505	100,000 ft^2	100,000 ft^2
Tensile Properties (each direction): Break Strength Yield Strength Elongation - break Elongation - yield	 Min Average Min Average Min Average Min Average	 lb/in lb/in % %	 228 126 700 12	ASTM D6693, Type IV	100,000 ft^2	100,000 ft^2
Tear Resistance	Min Average	lbs	42	ASTM D1004	20,000 lbs	100,000 ft^2
Puncture Resistance	Min Average	lbs	108	ASTM D4833	20,000 lbs	100,000 ft^2
Carbon Black Content	Min Range	%	2.0 – 3.0	ASTM D4218	20,000 lbs	100,000 ft^2
Carbon Black Dispersion	Rating	NA	Note 1	ASTM D5596	20,000 lbs	100,000 ft^2
Stress Crack Resistance	Minimum	hours	500	ASTM D5397 Appendix	Per GRI GM 10	NA
Standard Oxidation Time	Min Average	minutes	100	ASTM D3895	200,000 lbs	NA
Oven Aging at 85°C Standard Oxidation Time - % Retained after 90 days	Min Average	%	55	ASTM D3895	Each Formulation	NA
UV Resistance High Pressure Oxidation Induction Time - % Retained after 1,600 hours	Min Average	%	50	ASTM D5885	Each Formulation	NA

Notes:

1. *Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.*
2. *Standard test methods will be updated to reflect the most current industry standards.*

SEAM PROPERTIES HDPE GEOMEMBRANE				
PROPERTY	**QUALIFIER**	**UNIT**	**VALUE**	**TEST METHOD**
Thickness	Minimum	mils	60	ASTM D5199
Bonded Seam Strength (1) [Shear Strength]	Minimum	lb/in	121	ASTM D6392
Tensile Properties (1)(2) [Peel Strength]: • Hot Wedge Fusion Weld • Fillet Extrusion Weld	 Minimum Minimum	 lb/in lb/in	 98 78	 ASTM D6392 ASTM D 6392
Air-Pressure (3)(4)	Minimum	psi	3	GRI GM6
Vacuum (3)	Minimum	psi	3	NA

Seam Notes:

1. *Value listed for shear and peel strengths are for four out of five test specimens. Fifth specimen can be as low as 80 percent listed values.*
2. *Break, when peel testing, occurs in liner material itself, not through peel separation (FTB).*
3. *See Section 7.9 for Field Quality Control requirements and testing extrusion and fusion welds.*
4. *Initial pressure 27-37 psi for 5 minutes.*

TABLE II.7.4b - Technical Specifications: 40-mil HDPE Smooth Geomembrane

PROPERTY	QUALIFIER	UNIT	VALUE	TEST METHOD	MANUFACTURER QC TEST FREQUENCY (MIN)	CONFORMANCE QA TEST FREQUENCY (MIN)
Thickness	Min Average Min Individual Lowest individual for any 10 values	mils mils mils	40 36 51	ASTM D5199	Per Roll	100,000 ft^2
Density	Minimum	g/cc	0.94	ASTM D792 or D1505	100,000 ft^2	100,000 ft^2
Tensile Properties (each direction): Break Strength Yield Strength Elongation - break Elongation - yield	 Min Average Min Average Min Average Min Average	 lb/in lb/in % %	 152 84 700 12	ASTM D6693, Type IV	100,000 ft^2	100,000 ft^2
Tear Resistance	Min Average	lbs	28	ASTM D1004	20,000 lbs	100,000 ft^2
Puncture Resistance	Min Average	lbs	72	ASTM D4833	20,000 lbs	100,000 ft^2
Carbon Black Content	Min Range	%	2.0 – 3.0	ASTM D4218	20,000 lbs	100,000 ft^2
Carbon Black Dispersion	Rating	N	Note 1	ASTM D5596	20,000 lbs	100,000 ft^2
Stress Crack Resistance	Minimum	hours	500	ASTM D5397 Appendix	Per GRI GM 10	NA
Standard Oxidation Time	Min Average	minutes	100	ASTM D3895	200,000 lbs	NA
Oven Aging at 85°C Standard Oxidation Time - % Retained after 90 days	Min Average	%	55	ASTM D3895	Each Formulation	NA
UV Resistance High Pressure Oxidation Induction Time - % Retained after 1,600 hours	Min Average	%	50	ASTM D5885	Each Formulation	NA

Notes:

1. *Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.*
2. *Standard test methods will be updated to reflect the most current industry standards.*

SEAM PROPERTIES HDPE GEOMEMBRANE				
PROPERTY	**QUALIFIER**	**UNIT**	**VALUE**	**TEST METHOD**
Thickness	Minimum	mils	40	ASTM D5199
Bonded Seam Strength (1) [Shear Strength]	Minimum	lb/in	121	ASTM D6392
Tensile Properties (1)(2) [Peel Strength]: • Hot Wedge Fusion Weld • Fillet Extrusion Weld	 Minimum Minimum	 lb/in lb/in	 98 78	 ASTM D6392 ASTM D 6392
Air-Pressure (3)(4)	Minimum	psi	3	GRI GM6
Vacuum (3)	Minimum	psi	3	NA

Seam Notes:

1. *Value listed for shear and peel strengths are for four out of five test specimens. Fifth specimen can be as low as 80 percent listed values.*
2. *Break, when peel testing, occurs in liner material itself, not through peel separation (FTB).*
3. *See Section 7.9 for Field Quality Control requirements and testing extrusion and fusion welds.*
4. *Initial pressure 27-37 psi for 5 minutes.*

TABLE II.7.5 - Technical Specifications: 30-mil Reinforced Polyester Geomembrane

PHYSICAL PROPERTIES				
PROPERTY	**QUALIFIER**	**UNIT**	**VALUE**	**TEST METHOD[1]**
Thickness	Minimum Average	mils	30	ASTM D5199
Density	Minimum	oz/yd^2	30 ± 2	ASTM D1505
Break Strength	Minimum	lb	550	ASTM D751 Grab Test Method Procedure A
Break Elongation	Minimum	%	20	ASTM D751
Tear Strength	Minimum	lb	40	ASTM D751
Puncture Resistance	Minimum	lb	275	ASTM D4833
Hydrostatic Resistance	Minimum	psi	800	ASTM D751, Procedure A
Bursting Strength	Minimum	lb	750	ASTM D751, Ball Tip

SEAM PROPERTIES				
PROPERTY	**QUALIFIER**	**UNIT**	**VALUE**	**TEST METHOD[1]**
Bonded Seam Strength	Minimum	lb	575	ASTM D751 Grab Test Method Procedure A
Peel Adhesion	Minimum	lb/2 in	40	ASTM D413

Notes:

1. *Standard test methods will be updated to reflect the most current industry standards.*

TABLE II.7.6 - Typical Wedge Temperature Ranges for Hot Wedge Seaming of Thermoplastic Liners

Liner Type	Fahrenheit (°F)	Celsius (°C)
HDPE		
Minimum[1] Temperature	600	320
Maximum[2] Temperature	750	400

Notes:
[1] For dry, warm weather seaming conditions
[2] For damp, cold weather seaming conditions

TABLE II.7.7 - Technical Specifications: 10 oz/yd^2 Single-Sided and Double-Sided 200 mil Geocomposite

PROPERTY	QUALIFIER	UNIT	VALUE	TEST[4] METHOD	MANUFACTURER QC TEST FREQUENCY	CONFORMANCE QA TEST FREQUENCY
Geocomposite						
Transmissivity[2] Double-Sided Single-Sided	MARV	gpm/ft (m^2/sec)	0.4 (9x10^{-5}) 4.3 (9x10^{-4})	ASTM D4716	540,000 ft^2	1 per project
Ply Adhesion	MARV	lb/in	1.0	ASTM D7005	50,000 ft^2	100,000 ft^2
Geonet Core[1,3]						
Thickness	MARV	mil	200	ASTM D5199	50,000 ft^2	100,000 ft^2
Transmissivity[2]	MARV	gpm/ft (m^2/sec)	9.6 (2x10^{-3})	ASTM D4716	NA	NA
Density	MARV	g/cm^3	0.94	ASTM D1505	50,000 ft^2	100,000 ft^2
Tensile Strength	MD	lb/in	45	ASTM D7179	50,000 ft^2	100,000 ft^2
Carbon Black Content	MinARV	%	2.0	ASTM D4218	50,000 ft^2	1 per lot
Geotextile[1,3]						
Mass per Unit Area		oz/yd^2	10	ASTM D5261	90,000 ft^2	100,000 ft^2
Grab tensile strength	MARV	lbs	260	ASTM D4632	90,000 ft^2	100,000 ft^2
Grab elongation	MARV	%	50	ASTM D4632	90,000 ft^2	100,000 ft^2
CBR Puncture strength	MARV	lbs	725	ASTM D6241	540,000 ft^2	1 per project
Trapezoidal tear strength	MARV	lbs	100	ASTM D4533	90,000 ft^2	NA
Apparent opening size (AOS)[1]	MaxARV	US Sieve	100	ASTM D4751	540,000 ft^2	1 per project
Permittivity	MARV	sec^{-1}	1.0	ASTM D4491	540,000 ft^2	1 per project
Water flow rate	MARV	gpm/ft^2	75	ASTM D4491	540,000 ft^2	1 per project
UV resistance	MARV	% retained @ 500 hours	70	ASTM D4355	Per Formulation	NA

Notes:

1. *All geotextile properties are minimum average roll values except AOS which maximum roll value and UV resistance is typical value, Geonet thickness is nominal value.*
2. *Gradient of 0.1 normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes.*
3. *Component properties prior to lamination.*
4. *Standard test methods will be updated to reflect the most current industry standards.*

TABLE II.7.8 -Technical Specifications: HDPE Geonet

PROPERTY	QUALIFIER	UNIT	VALUE	TEST METHOD	MANUFACTURER QC TEST FREQUENCY	CONFORMANCE QA TEST FREQUENCY
Thickness	Minimum	mils	200	ASTM D5199	50,000 ft^2	100,000 ft^2
Density	Minimum	g/cm^3	0.94	ASTM D1505 ASTM D792	50,000 ft^2	100,000 ft^2
Melt Index	Range	g/10 min	≤ 1.0	ASTM D1238	Per Lot	NA
Carbon Black Content	Range	%	2.0 - 3.0	ASTM D4218	50,000 ft^2	100,000 ft^2
Tensile Strength (Machine Direction)	Minimum	lb/in	45	ASTM D5035 ASTM D7179	50,000 ft^2	100,000 ft^2
Mass Per Unit Area	Minimum	lb/ft^2	0.16	ASTM D5261	50,000 ft	100,000 ft^2
Transmissivity (loaded)	Minimum	m^2/sec	$1x10^{-3}$	ASTM D4716	500,000 ft^2	100,000 ft^2

Notes:

1. *Standard test methods will be updated to reflect the most current industry standards.*

TABLE II.7.9 - Technical Specifications: 10 oz/yd^2 and 12 oz/yd^2 Non-Woven Geotextile[1]

PROPERTY	QUALIFIER	UNIT	VALUE		TEST METHOD	MANUFACTURER QC TEST FREQUENCY	CONFORMANCE QA TEST FREQUENCY
Mass per unit area	MARV	oz/yd^2	10	12	ASTM D5261	90,000 ft^2	100,000 ft^2
Grab tensile strength	MARV	lbs	260	320	ASTM D4632	90,000 ft^2	100,000 ft^2
Grab elongation	MARV	%	50	50	ASTM D4632	90,000 ft^2	100,000 ft^2
CBR Puncture strength	MARV	lbs	725	925	ASTM D6241	540,000 ft^2	1 per project
Trapezoidal tear strength	MARV	lbs	100	125	ASTM D4533	90,000 ft^2	NA
Apparent opening size (AOS)	MaxARV	US Sieve	100	100	ASTM D4751	540,000 ft^2	1 per project
Permittivity	MARV	sec^{-1}	1.0	0.8	ASTM D4491	540,000 ft^2	1 per project
Water flow rate	MARV	gpm/ft^2	75	60	ASTM D4491	540,000 ft^2	1 per project
UV resistance	MARV	% retained @ 500 hours	70	70	ASTM D4355	Per Formulation	NA

Notes:

1. *Values reported in weaker principal direction.*
2. *All values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as typical -2 standard deviations.*
3. *MaxARV represents typical +2 standard deviations.*
4. *Geotextiles with greater or equivalent properties may be used for select application.*
5. *Standard test methods will be updated to reflect the most current industry standards.*

ATTACHMENT II.7.A

CQA FORMS

Form No.	Title
1.	Liner Quality Control Project Specifications
2.	Approval/Authorization to Proceed Form
3.	Field Observation Report
4.	Field Compaction Testing Form
5.	GCL Inventory Control Log
6.	FML Inventory Control Log
7.	Geonet Inventory Control Log
8.	Geotextile Inventory Control Log
9.	Geocomposite Inventory Control Log
10.	Leachate Collection and Extraction Geopipe Inventory Control Log
11.	FML Trial Seaming Test Log
12.	FML Seaming Log
13.	FML Seam Pressure Test Log
14.	FML Destructive Field Test Record
15.	FML Seam Vacuum Test/Repair Log
16.	GCL Deployment Log
17.	FML Deployment Log
18.	Geonet Deployment Log
19.	Geotextile Deployment Log
20.	Geocomposite Deployment Log

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LINER QUALITY CONTROL PROJECT SPECIFICATIONS

1. Project Data

Site Name: ______________________________ Date Prepared: ____________

Project/Cell: ______________________________

Project Number: ______________________________ Project Start Date: ____________

Project Size: ____________ Acres or ft^2

Location: ______________________________

____

Client Contact: ______________________________

Phone: ______________________________

Site Phone: ______________________________

		Initials
Project Manager:	______________________________	________
CQA Officer:	______________________________	________
CQA Technicians:	______________________________	________
	______________________________	________
	______________________________	________

Project Documentation Available

CQA Plan: ______ Construction Drawings: ______ Health and Safety Plan: ______

Other: ______________

Comments: ______________________________

____

____

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LINER QUALITY CONTROL PROJECT SPECIFICATIONS

2. Subgrade/Soil Liner

2.1 Grade Control (Survey) Area: ______ Acres or ft^2

Performed By: ________________________ Date Performed: ________

Tolerance (vert): ________ feet or inches As-Built Drawing(s) Available? Y or N

____

Thickness: ________ feet or inches **NMED Standard = 1 per acre**

2.2 Compaction

		Sample ID	Maximum Density	Optimum Moisture
Reference Proctor(s):	________ lb/ft^3			
Standard (ASTM D698):	________			
Modified (ASTM D1557):	________			

Specifications:

Density: ________ % of Optimum Moisture: ________ lb/ft^3

________ lb/ft^3

Number of Lifts: ________ Lift Thickness (inches):

Loose: ______ Compacted: ________

Field Test Frequency: ________ per: acre/lift yd^3 other units: ________

Compaction Test Method: Nuclear Density Meter or Other: ________

Total Number of Density Tests Required: ______________ **NMED Standard = 4/acre/lift**

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LINER QUALITY CONTROL PROJECT SPECIFICATIONS

2.3 Soil Classification Standards

Acceptable USCS: (circle or box)

GW	SW	ML	MH
GP	SP	CL	CH
GM	SM	OL	OH
GC	SC		

Subgrade/Liner Material Testing:

in situ ________ borrow source: ____________

Testing Frequency		Quality Requirements	
Project	NMED	Project	NMED

Grain Size:

#200 Sieve ________________________ (percent passing)

C_u (D_{60}/D_{10}) ________________________

Other ________________________

Atterberg Limits: P.I.

Liquid Limit ________________

Plastic Limit ________________

Other ________________

Laboratory Permeability: ________________

2.4 Surface Preparation Y or N

_______ smooth surface

_______ remove angular material

_______ remove organic material

_______ remove rocks greater than ______ inches

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LINER QUALITY CONTROL PROJECT SPECIFICATIONS

3.0 Geosynthetics

Conformance Tests

3.1 GCL

Area: ________ Acres or ft^2

Specifications:

collected by: ________
performed by: ________
frequency: ________
total number: ________

3.2 FML

collected by: ________
performed by: ________
frequency: ________
total number: ________

Specifications: ________ 60 mil
________ other

HDPE Smooth: Area: ________ Acres or ft^2

HDPE Textured: Area: ________ Acres or ft^2

Other: ________ Area: ________ Acres or ft^2

3.3 Geotextile (not including leachate system)

Specifications: oz
Woven or Nonwoven

Area: ________ Acres or ft^2

collected by: ________
performed by: ________
frequency: ________
total number: ________

3.4 Geonet

Area: ________ Acres or ft^2

Specifications: ________ thickness

with Geotextile:
upper ________ lower ________

collected by: ________
performed by: ________
frequency: ________
total number: ________

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LINER QUALITY CONTROL PROJECT SPECIFICATIONS

4.0 Leachate Collection System — Conformance Tests

4.1 Piping

Collection System — Specifications: ____________
Linear Quantity — Material: ____________
Diameter: ____________

____

Risers — Specifications: ____________
Linear Quantity — Material: ____________
Diameter: ____________

4.2 Aggregate

Specifications:
greater than
smaller than

collected by: ________
performed by: ________
frequency: ________
total number: ________

4.3 Geotextile

Specifications: oz
Woven or Nonwoven

Area: ________ Acres or ft^2

collected by: ________
performed by: ________
frequency: ________
total number: ________

4.4 Sump

Design volume: ________ yd^3 or gallons
Double Lined? Y or N
Area of double liner: ________ ft^2

5.0 Protective Soil Layer — Conformance Tests

Area: ________ Acres or ft^2

Thickness (inches): ________

Volume: ________ yd^3

performed by: ________
frequency: ________
total number: ________

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APPROVAL/ AUTHORIZATION TO PROCEED

TO:

FROM:

PROJECT NAME:

PROJECT NO.:

DATE:

The following liner system surface is deemed acceptable on a visual inspection by Liner Contractor Representative:

LAYER:
1. Subgrade ______________________
2. Geosynthetic Clay Liner (GCL) ______________________
3. HDPE Geomembrane (FML) ______________________
4. Geocomposite ______________________

LOCATION: ______________________to______________________

______________________to______________________

REMARKS: ____

____

____

Authorized By: ______________________
(Liner Contractor Representative)

____
(Authorized Signature)

____
(Date)

Accepted By: ______________________
(CQA Manager)

____
(Authorized Signature)

____
(Date)

☐ Attachments

Copies: ☐ Owner ☐A/E ☐Contractor ☐ Consultants ☐________ ☐ ________ ☐ File

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FIELD OBSERVATION REPORT

TO:

FROM:

PROJECT NAME:

PROJECT NO.:

DATE: **TIME:** **EST. % COMPLETE:**

Weather
☐ Clear ☐ Snow ☐ Warm
☐ Overcast ☐ Foggy ☐ Hot
☐ Rain ☐ Cold ☐ ___________

Site Conditions
☐ Clear ☐ Dusty
☐ Muddy ☐ __________
Temperature Range _______

Day
☐ Monday ☐ Thursday
☐ Tuesday ☐ Friday
☐ Wednesday ☐ ____________

Persons Contacted/Present at Site:

Work Observed/In-Progress:

Items Discussed/Observations:

Materials Delivered to Site:

Requested Revisions or Interpretations:

Items to Verify:

Information or Action Required:

☐ Attachments

Copies: ☐ Owner ☐A/E ☐ Contractor ☐ Consultants ☐______ ☐ __________ ☐ File

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FIELD COMPACTION TESTING RESULTS

PROJECT INFORMATION	
PROJECT TITLE:	**PROJECT NO.:**
OWNER:	**DATE:**
PROJECT LOCATION:	**PAGE NO.: of**
Testing Instrument:	**Technician:**
Reference Density (pcf):	**Reference Moisture (%):**

Test Number	Dry Density (pcf)	% Proctor	% Moisture	Test Number	Dry Density (pcf)	% Proctor	% Moisture

Note: *See Figure for test locations*

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GCL INVENTORY CONTROL LOG

PROJECT NAME: ______________ **PROJECT NUMBER:** ______________
CLIENT: ______________ **CONTRACTOR:** ______________
PROJECT LOCATION: ______________ **SHEET NUMBER:** ______________

MATERIAL TYPE: ______________ **DATE OF INVENTORY:** See Below
MATERIAL IDENTIFICATION: ______________ **INVENTORY MONITOR:** ______________
MATERIAL MANUFACTURER: ______________ **UNLOADING METHOD:** ______________

	ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	CONFORMANCE SAMPLE (Y/N)	DATE OF INVENTORY
			LENGTH (FT)	WIDTH (FT)	WEIGHT (LBS)			
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5								
6								
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FML INVENTORY CONTROL LOG

PROJECT NAME: ____________ PROJECT NUMBER: ____________
CLIENT: ____________ CONTRACTOR: ____________
PROJECT LOCATION: ____________ SHEET NUMBER: ____________

MATERIAL TYPE: ____________ DATE OF INVENTORY: ____________
MATERIAL IDENTIFICATION: ____________ INVENTORY MONITOR: ____________
MATERIAL MANUFACTURER: ____________ UNLOADING METHOD: ____________

	ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	CONFORMANCE SAMPLE (Y/N)	REMARKS
			LENGTH (FT)	WIDTH (FT)	THICKNESS OR WEIGHT			
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5								
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GEONET INVENTORY CONTROL LOG

PROJECT NAME: ____________________ PROJECT NUMBER: ____________
CLIENT: ____________________ CONTRACTOR: ____________
PROJECT LOCATION: ____________________ SHEET NUMBER: ____________

MATERIAL TYPE: ______________ DATE OF INVENTORY: ____________
MATERIAL IDENTIFICATION: ______________ INVENTORY MONITOR: ____________
MATERIAL MANUFACTURER: ______________ UNLOADING METHOD: ____________

	ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	CONFORMANCE SAMPLE (Y/N)	REMARKS
			LENGTH (FT)	WIDTH (FT)	THICKNESS OR WEIGHT			
1								
2								
3								
4								
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GEOTEXTILE INVENTORY CONTROL LOG

PROJECT NAME: ______ PROJECT NUMBER: ______
CLIENT: ______ CONTRACTOR: ______
PROJECT LOCATION: ______ SHEET NUMBER: ______

MATERIAL TYPE: ______ DATE OF INVENTORY: ______
MATERIAL IDENTIFICATION: ______ INVENTORY MONITOR: ______
MATERIAL MANUFACTURER: ______ UNLOADING METHOD: ______

	ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	CONFORMANCE SAMPLE (Y/N)	REMARKS
			LENGTH (FT)	WIDTH (FT)	THICKNESS OR WEIGHT			
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GEOCOMPOSITE INVENTORY CONTROL LOG

PROJECT NAME: ____________ PROJECT NUMBER: ____________
CLIENT: ____________ CONTRACTOR: ____________
PROJECT LOCATION: ____________ SHEET NUMBER: ____________

MATERIAL TYPE: ____________ DATE OF INVENTORY: ____________
MATERIAL IDENTIFICATION: ____________ INVENTORY MONITOR: ____________
MATERIAL MANUFACTURER: ____________ UNLOADING METHOD: ____________

	ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	CONFORMANCE SAMPLE (Y/N)	REMARKS
			LENGTH (FT)	WIDTH (FT)	THICKNESS OR WEIGHT			
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LEACHATE COLLECTION AND EXTRACTION GEOPIPE INVENTORY CONTROL LOG

PROJECT NAME: ____________ **PROJECT NUMBER:** ____________
CLIENT: ____________ **CONTRACTOR:** ____________
PROJECT LOCATION: ____________ **SHEET NUMBER:** ____________

MATERIAL TYPE: ____________ **DATE OF INVENTORY:** See Below
MATERIAL IDENTIFICATION: ____________ **INVENTORY MONITOR:** ____________
MATERIAL MANUFACTURER: ____________ **UNLOADING METHOD:** ____________

	TYPE	QUANTITY	MATERIAL DIMENSIONS			MANUF. QC CERT. (Y/N)	TOTAL LENGTH	DATE OF INVENTORY
			LENGTH (FT)	DIAM. (IN)	PIPE SDR			
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FML TRIAL SEAMING TEST LOG

PROJECT INFORMATION	
PROJECT NAME:	PROJECT NUMBER:
OWNER:	CONTRACTOR:
PROJECT LOCATION:	SHEET NUMBER:

PROJECT SPECIFICATIONS					
FUSION	TEXTURED:	PEEL	91 lbs/in	SHEAR	120 lbs/in
	SMOOTH:	PEEL	91 lbs/in	SHEAR	120 lbs/in
EXTRUSION	TEXTURED:	PEEL	78 lbs/in	SHEAR	120 lbs/in
	SMOOTH:	PEEL	78 lbs/in	SHEAR	120 lbs/in

DATE	TIME	QC INITIALS	WELDER'S INITIALS	MACHINE NUMBER	WEDGE WELDS		EXTRUSION WELDS		PULL	FIELD TEST RESULTS				
					Temperature	Speed	Barrel Temp	Pre-Heat Temp		Test #1	Test #2	Test #3	Test #4	Test #5
									P					
									P					
									S					
									P					
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FML SEAMING LOG

PROJECT NAME: ______________________ PROJECT NUMBER: ______________________
OWNER: ______________________ CONTRACTOR: ______________________
PROJECT LOCATION: ______________________ SHEET NUMBER: ______________________

	DATE	PANEL #/PANEL #	APPROX. LENGTH WELDED	START TIME	SEAMER INITIALS	MACHINE #	TEMP SETTING	SPEED SETTING	DESTRUCTIVE TEST	MONITORED BY
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FML SEAMING PRESSURE TEST LOG

PROJECT INFORMATION		PROJECT SPECIFICATIONS
PROJECT NAME:	PROJECT NUMBER:	MIN START PSI:
OWNER:	CONTRACTOR:	TEST DURATION:
PROJECT LOCATION	SHEET NUMBER:	MAX PSI DROP:

	DATE	PANEL #/PANEL #	TESTER	TIME		PRESSURE		MONITORED BY	PASS/FAIL
				START	FINISH	INITIAL	FINAL		
1									
2									
3									
4									
5									
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FML DESTRUCTIVE FIELD TEST RECORD

PROJECT INFORMATION		PROJECT SPECIFICATIONS					
PROJECT NAME:	PROJECT NUMBER:	FUSION	TEXTURED:	PEEL	90	SHEAR	120
CLIENT:	CONTRACTOR:		SMOOTH:	PEEL	90	SHEAR	120
PROJECT LOCATION:	SHEET NUMBER:	EXTRUSION	TEXTURED:	PEEL	78	SHEAR	120
			SMOOTH:	PEEL	78	SHEAR	120

DATE	DT #	QC INITIALS	WELDER'S INITIALS	MACHINE NUMBER	WEDGE WELDS		EXTRUSION WELDS		PULL	FIELD TEST RESULTS					COMMENTS
					Temperature	Speed	Barrel Temp	Pre-Heat Temp		Test #1	Test #2	Test #3	Test #4	Test #5	
									P						
									P						
									S						
									P						
									P						
									S						
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333 Rio Rancho Blvd. NE, Suite 400
Rio Rancho, New Mexico 87124
505.867.6990

FML SEAM VACUUM TEST/REPAIR LOG

PROJECT NAME: ______________________ **PROJECT NUMBER:** __________
OWNER: ______________________ **CONTRACTOR:** __________
PROJECT LOCATION: ______________________ **SHEET NUMBER:** __________

	REPAIR DATE	PANEL	TYPE OF REPAIR	REPAIR TECH	NUMBER OF LEAKS	TESTING TECH ID	DATE ACCEPTED	COMMENTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
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45								

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505.867.6990

GCL DEPLOYMENT LOG

PROJECT NAME: ______________________ **PROJECT NUMBER:** __________
CLIENT: ______________________ **CONTRACTOR:** __________
PROJECT LOCATION: ______________________ **SHEET NUMBER:** __________

PANEL NUMBER	ROLL NUMBER	APPROXIMATE LENGTH (FT)	APPROXIMATE WIDTH (FT)	APPROXIMATE AREA (FT^2)	DATE INSTALLED
TOTAL LINER PLACED (FT^2):				0.0	

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FML DEPLOYMENT LOG

PROJECT NAME: ______________________ **PROJECT NUMBER:** __________
CLIENT: ______________________ **CONTRACTOR:** __________
PROJECT LOCATION: ______________________ **SHEET NUMBER:** __________

PANEL NUMBER	ROLL NUMBER	APPROXIMATE LENGTH (FT)	APPROXIMATE WIDTH (FT)	APPROXIMATE AREA (FT^2)	DATE INSTALLED
		TOTAL LINER PLACED (FT^2):		0.0	

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GEONET DEPLOYMENT LOG

PROJECT NAME: ____________________ **PROJECT NUMBER:** __________
CLIENT: ____________________ **CONTRACTOR:** __________
PROJECT LOCATION: ____________________ **SHEET NUMBER:** __________

PANEL NUMBER	ROLL NUMBER	APPROXIMATE LENGTH (FT)	APPROXIMATE WIDTH (FT)	APPROXIMATE AREA (FT^2)	DATE INSTALLED
			TOTAL LINER PLACED (FT^2):	0.0	

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GEOTEXTILE DEPLOYMENT LOG

PROJECT NAME: ______________________ PROJECT NUMBER: __________
CLIENT: ______________________ CONTRACTOR: __________
PROJECT LOCATION: ______________________ SHEET NUMBER: __________

PANEL NUMBER	ROLL NUMBER	APPROXIMATE LENGTH (FT)	APPROXIMATE WIDTH (FT)	APPROXIMATE AREA (FT^2)	DATE INSTALLED
TOTAL LINER PLACED (FT^2):				0.0	

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GEOCOMPOSITE DEPLOYMENT LOG

PROJECT NAME: ____________________ **PROJECT NUMBER:** __________
CLIENT: ____________________ **CONTRACTOR:** __________
PROJECT LOCATION: ____________________ **SHEET NUMBER:** __________

PANEL NUMBER	ROLL NUMBER	APPROXIMATE LENGTH (FT)	APPROXIMATE WIDTH (FT)	APPROXIMATE AREA (FT^2)	DATE INSTALLED
TOTAL LINER PLACED (FT^2):				0.0	

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1.0 INTRODUCTION

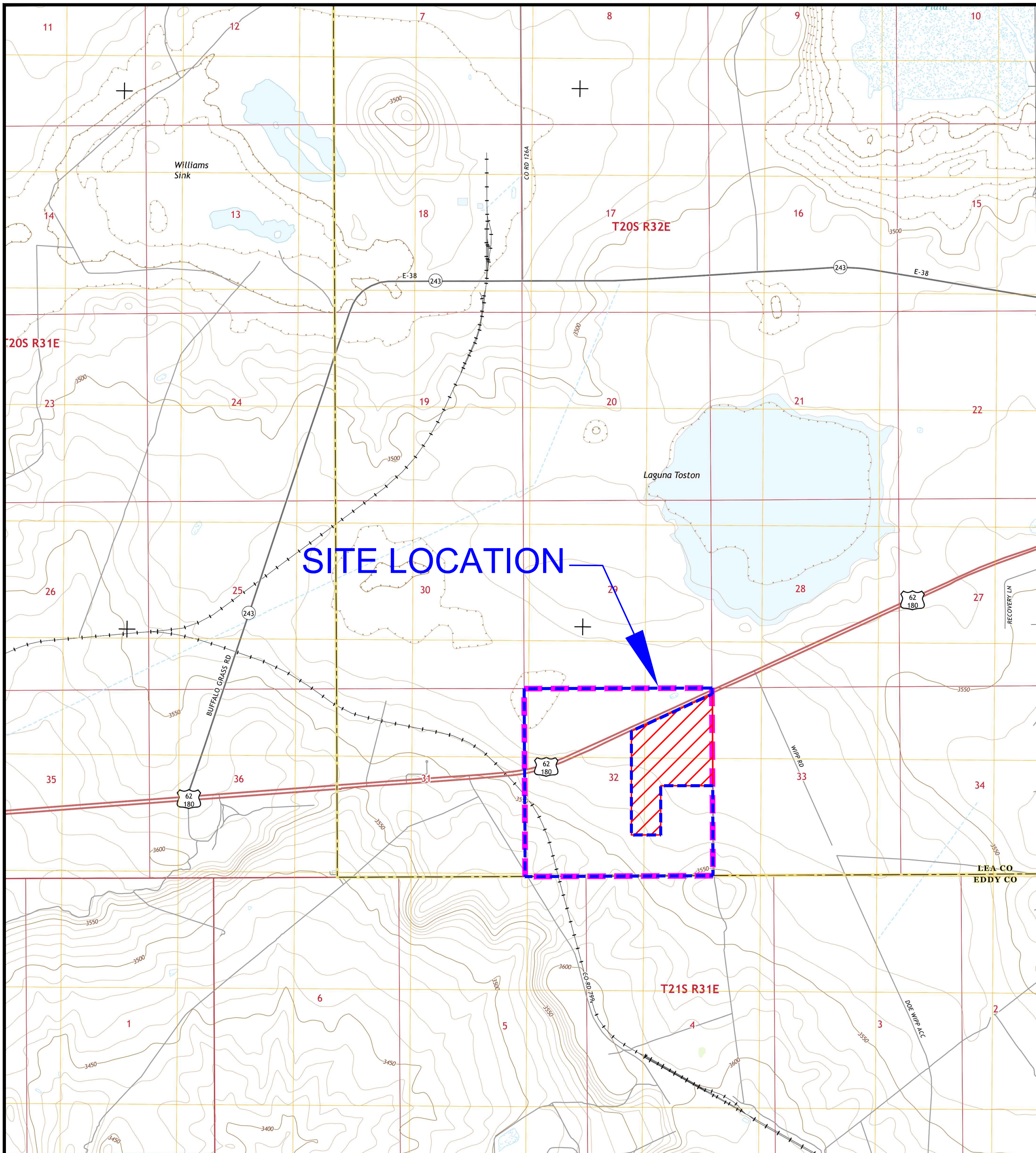
Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

The existing Lea Land Landfill is equipped with a composite liner design with an inclined leachate collection geopipe system and extraction point in the northeast corner. Liner Installation Records and Engineering Certification/CQA Reports document that the liner segments were constructed in compliance with current industry and engineering standards. Routine attempts to monitor and collect leachate flow from "Unit I" have demonstrated that oil field waste solids do not generate fluids, as no free liquids are allowed, and does not produce water.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM (**Figure II.8.1**). Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".



LEGEND

PROPERTY BOUNDARY

LEA LAND LLC FACILITY BOUNDARY

INDUSTRIAL SOLID WASTE MANAGEMENT FACILITY

NORTH

0 2000' 4000'

NOTES:

1. GEOGRAPHIC CENTER 32° 31'46.77 -103° 47' 18.25 MAP REFERENCE: WILLIAMS SINK, NM. 2017 USGS 7.5 MIN QUAD

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\RAI1\SITE LOCATION.dwg
Date/Time:May. 31, 2019-06:23:04 ; LAYOUT: A (P)

SITE LOCATION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/11/2019	CAD: SITE LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.8.1
APPROVED BY: CWF	www.team-psc.com	

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The Site Plan provided as **Figure II.1.2** (**Volume II.1**) identify the locations of the Processing Area and Land Disposal facilities, which are further detailed on the **Permit Plans** (**Volume III.1**).

1.3 Purpose

This “Leachate Management Plan” must be developed per 19.15.36.8.C(12) NMAC that describes the anticipated amount and quality of fluids collected, along with the proposed management, storage and disposal technologies. This Leachate Management Plan (the Plan) details the procedures that will be used to manage contact waters generated at the Lea Land Facility Landfill during the permit period and following closure. This Plan has been developed to address the design and performance requirements of 19.15.36.14 NMAC, and addresses the following items:

1. Projected amounts and rates of leachate generation
2. Expected duration of leachate generation
3. Leachate disposal options
4. Proposed treatment and disposal methods

2.0 LEACHATE COLLECTION SYSTEM

The leachate collection system designed for the Lea Land Landfill meets or exceeds the minimum design and performance standards specified in 19.15.36.14 NMAC, specifically:

1. The minimum design slope on the landfill liner is 3.4%; and the minimum slope on the leachate piping system is 2.5%.
2. The leachate piping system will consist of perforated and solid pipe with a minimum diameter of 6 inches.
3. Standard dimension ratio (SDR) 13.5 (or as otherwise specified in the Construction Plans and Technical Specifications for each Unit), high density polyethylene (HDPE) piping is demonstrated to meet the site-specific performance standards.
4. The protective soil layer (minimum 24 inches of pervious soil) with a minimum permeability of 2×10^{-4} cm/sec will provide both protection for the liner, and promote leachate flow to the piping and extraction system.
5. There is a geonet leak detection layer and secondary composite 60 mil HDPE/GCL below the primary liner and leak collections system.

Each new cell will be outfitted with perforated leachate collection piping that is enveloped in aggregate and geotextile to promote flow while minimizing the intrusion of fines. The cell floor and liner system will be sloped at 45º to each pipe, and leachate will flow readily through the protective soil layer (PSL).

Permanent leachate sumps are designed for each Unit at the Lea Land Landfill. Temporary sumps and cleanout risers may also be installed as filling progresses in each cell. Therefore, each cell is designed with its own collection piping. Two solid pipe risers will provide access to each permanent leachate sump at the toe of the slope:

- The leachate extraction riser will be used to measure leachate levels in the leachate sump, and to provide access for a submersible pump to remove accumulated fluids.
- A cleanout riser is connected with a pipe elbow to the collection pipe to facilitate cleaning or flushing if necessary.

In addition, each of the four new cells will be equipped with a permanent solid pipe riser at the upgradient terminus for leachate piping cleanout.

Compliance with the design standards of 19.15.36.14 NMAC is demonstrated in the **Permit Plans** (**Volume III.1**). The performance standards specified in the same subsections are addressed as follows:

1. The Liner Construction Quality Assurance (CQA) Plan (**Volume II.7**) specifies the materials and installation techniques which will be used for construction of the leachate collection system and protective soil layer.
2. The performance of the design and the specified materials are documented to meet OCD requirements in the following Landfill Engineering Calculations:
    - Pipe Loading Calculations (**Volume III.5**)
    - Geosynthetic Applications and Compatibility Documentation (**Volume III.6**)
    - Settlement Calculations (**Volume III.7**)

3.0 LEACHATE GENERATION

Leachate in the permanent extraction risers will be measured monthly and after significant rainfall events. The fluid storage capacity in each sump is approximately 1,500 gallons. The maximum fluid accumulation on the liner is designed to maintain leachate "head" well below the performance standard of 12 inches per 19.15.36.14.F NMAC. Fluid levels on the cell floor will be maintained below the regulatory threshold through regular pumping as recorded and reported to OCD. Lea

Land will maintain a record of actual leachate generation and management volumes, using a form similar to the one provided as **Attachment II.8.A** to track the amount of leachate removed from the sumps throughout a given year at the Facility.

Leachate production is projected to approach zero because of the solid and dry nature of the waste and the paint filter restriction. Therefore, most leachate generation is attributable solely to precipitation; and particularly fluids from precipitation in the very early stages of cell development immediately following liner installation.

The leachate generation rate decreases to nearly zero following the placement of the first lift of waste on the liner. This assumption has been calculated in the HELP Model (**Volume III.4**) and confirmed through experience at other facilities. As demonstrated in the HELP Model, the field capacity of the waste and the local evaporation rate far exceed the volume of rainfall experienced at the site, and therefore liquids are not generated and thus do not typically reach the leachate collection system. As discussed in detail in the Operations, Inspection, and Management Plan (**Volume II.1**), routine site operation procedures will dictate that a loose ("fluff") lift of waste (approximately 5 feet thick) be placed over the entire floor of a newly constructed cell as soon as practical. This process will protect the liner and leachate collection system; and reduce the generation of contact water, which is stormwater collected within the cell footprint. During the post-closure care period, the site will have been capped and stabilized (**Permit Plans**); and leachate production is modeled to decline to near zero.

4.0 LEACHATE MONITORING

Routine monitoring of leachate levels and extraction of leachate from primary liner leachate collection sumps and leak detection sumps will ensure that the fluid accumulation on the liner will be maintained well below the regulatory 12-inch threshold measured from the liner at the top of the edge of the sump. Procedures to ensure leachate does not accumulate on the liner will include the following:

- The level of the leachate in the sumps will be monitored at least monthly, and leachate will typically be extracted on a minimum quarterly basis; or as needed to maintain <12 inches of head on the liner.
- The leachate will be extracted from the sumps with portable submersible pumps, vacuum trucks, or other suitable devices.

- In the future, the leachate sumps may be equipped with remote level sensors and/or dedicated submersible pumps, if routine leachate removal is required.

The Leachate Monitoring Form provided as **Attachment II.8.A** is a template for recording monitoring levels and extraction data, as well as the disposal technique used.

5.0 LEACHATE DISPOSAL

Lea Land is requesting approval to recirculate leachate over lined areas of the landfill during the active life of the Lea Land Facility. The following procedures will be adhered to when performing recirculation of leachate at Lea Land:

- On an as-needed basis (initially anticipated to be quarterly), leachate will be pumped from the sump(s) with a portable or permanent submersible pump or vacuum to a tank truck, equipped with appropriate fluid transfer hoses, and will be transported to the active cell(s). Prior to applying daily cover to the cell, the leachate will be sprayed onto the exposed waste. Cover will be placed after the recirculation activities are complete.
- For the most effective recirculation, and to avoid short-circuiting, the leachate will be applied only in areas where the cell surface is at least 10 feet above the liner system. In addition, the leachate will be applied on cells upgradient in the collection system whenever possible. No leachate recirculation will be conducted within 50 feet of the solid waste boundary.
- Monitoring and recirculation activities will be documented on the Leachate Monitoring Form (**Attachment II.8.A**). The information will be maintained in the Facility Operating Record.

Leachate recirculation will be accomplished via similar collection, transport, and application methods in future cells. Alternatively, leachate may be applied directly to waste deposits in lined cells with pumps and hoses attached directly to the collection system. Lea Land is seeking OCD's approval of additional leachate management alternatives that include, but are not limited to:

- disposal onsite through the Produced Water processing/evaporation process
- use of dilute leachate for dust control over lined cells and temporary roadways over lined areas
- disposal offsite at an OCD-approved facility

Disposal of leachate onsite through the Produced Water evaporation process will be accomplished by pumping leachate directly from the sump with a submersible pump or extraction hose to a tanker truck, equipped with appropriate fluid transfer hoses. The leachate will be transferred to the Produced Water Load-Out Station and unloaded into the Produced Water Receiving tanks for processing with the routine waste processing stream.

The use of dilute leachate for dust control over lined cells will be accomplished as follows:

- Leachate will be diluted with collected stormwater to minimize the potential for odors.
- The leachate application method will consist of spraying the dilute leachate with the site's water wagon, or similar type vehicle.
- The application of leachate will be conducted only in lined cell areas or future areas to be lined and yet to be excavated.
- Leachate will be sprayed evenly and thinly over lined cell areas to provide for effective dust control and evaporation, and to minimize the potential of recirculation through the waste. No ponding will be allowed.
- To enhance safety, leachate will be sprayed only when personnel are restricted from the spray surface. In addition, leachate will not be sprayed on windy days.
- If there are any issues regarding the potential composition of the leachate (for example, leachate being generated by some means other than heavy rainfall on a new cell), leachate may be analyzed prior to beneficial use in consultation with OCD.

Disposal of leachate offsite at a POTW or OCD-permitted liquids processing facility following closure may be conducted by pumping leachate directly from the sump with a submersible pump or extraction hose to a tanker truck, equipped with appropriate fluid transfer hoses. If the leachate is required to be sampled and analyzed by the disposal facility, the parameters to be tested will be determined in consultation with the POTW. Prior to transport, leachate samples will be collected and analyzed to demonstrate compliance with the disposal facility's leachate acceptance criteria for analytical parameters and concentrations.

Prior to disposal, the Leachate Management Plan may be updated with OCD approval to reflect the analytical parameters and concentrations, as well as transport methods specified by the selected disposal facility. The updated Plan will be submitted to OCD for approval as an administrative change to the existing Plan prior to implementation of disposal activities. The analytical test results for leachate disposal at the off-site Facility will be maintained in the Facility Operating Record.

Following closure, the most effective treatment and disposal technology for leachate (if produced) will be determined and implemented with the approval of OCD. This disposal technology may include spray irrigation, or hauling off-site for treatment at an OCD-approved facility. Leachate monitoring during post-closure will be conducted at least annually. Leachate management information will continue to be documented and maintained in the Facility Operating Record. Historical leachate production, and generation following closure is calculated to approach zero.

6.0 LEAK DETECTION MONITORING

Routine inspection of the leak detection system and sump in each of the Landfill cells and evaporation ponds will be conducted on at least a monthly basis; and documented on the Leachate Monitoring Form (**Attachment II.8.A**), or the Pit/Pond Integrity/Leak Detection Inspection Form (**Attachment II.8.B**). At a minimum, the following items will be documented:

- Inspection date, time, and conditions
- Inspector identification
- Depth of liquids in sump
- Sump and piping condition and status
- Volume collected

A thorough inspection of the leak detection system and sump will be conducted on a weekly basis and documented on the Pond Integrity/Leak Detection Inspection Form included in **Attachment II.1.D**. At a minimum, the items listed in **Table II.1.10** will be documented. Prior to placing a newly constructed landfill cell or evaporation pond (or an evaporation pond that has undergone repair or cleaning) into service, liquids will be removed from above the primary liner and from the leak detection system. Once in service, it is anticipated liquid may be present at all times in the leak detection system due to condensation and nominal flow through the primary liner. The leak detection sumps are 2 feet deep and have a capacity of approximately 1,200 gallons (gal) using a porosity of 0.35 for the granular material.

Attachment II.8.C is a summary table from an authoritative publication on potential geomembrane liner leakage for 40 mil HDPE lined ponds. As shown on the table, the combined projected permeation/pinhole leakage rate ranges from 1.5 to 130 gal/acre/day. Using a very conservative value of 8 gal/acre/day for the combined leakage/permeation rate (**Attachment II.8.C**), this provides 16 days of storage at a depth of 2 ft in the sump. The rate of 8 gal/acre/day is considered very conservative as it is based on 40 mil HDPE (vs. the actual 60 mil); a fluid depth of 10 ft; and a high number of large pin-holes. Considering that the Landfill leachate collection system is designed to maintain less than 1 ft of liquid on the liner, and a rigorous proposed CQA Plan (**Volume II.7**) this is an extremely conservative analysis for the Landfill.

The liquid levels in the leak detection sumps will be monitored at least monthly and immediately after the cells or ponds are put into service and documented. Should the lack of liquids become apparent after a series of inspections, the monitoring frequency will be extended to quarterly; and semi-annual or annual thereafter. In the event an excessive liquid level (i.e., > corrective action level of more than 1 ft of liquid) is observed in a leak detection system, OCD will be notified within 24 hours. If this liquid level is observed in a Landfill cell the Facility will initiate corrective action which may include but is not limited to:

- Additional sump liquid level monitoring and pumping frequencies
- Liquids analytical testing and submittal of results of OCD
- Enhanced vadose zone monitoring (as applicable)

If this liquid level is observed in an evaporation pond, the affected pond area will be drained. Prior to placing the pond back into service, the Facility will initiate corrective action which may include but is not limited to:

- Actions undertaken to locate source of leakage
- Repair procedures
- Additional sump liquid level monitoring and pumping frequencies
- Liquids testing and submittal of results to OCD
- Groundwater monitoring (if required)

Any liquids recovered from the Leak Detection Sump will be disposed of in the same manner as leachate generated from the landfill cells.

ATTACHMENT II.8.A

LEACHATE MONITORING FORM (TYPICAL)

ATTACHMENT II.8.A - Leachate Monitoring Form (Typical)

Leachate Level Data				Pumping Data			Notes
Date	Sump I.D.	Time	Monitored By	Date	Company	Volume Pumped (gal)	

ATTACHMENT II.8.B

PIT/POND INTEGRITY/LEAK DETECTION INSPECTION FORM (TYPICAL)

ATTACHMENT II.8.B - Pit/Pond Integrity/Leak Detection Inspection Checklist (Typical)

Page _____ of _____

Date: ____________________ **Inspector(s):**

Time: ____________________ ____

Weather:

Temperature ____________________ deg. F Precipitation (last 24 hours) _____________ inches

Skies ____________________

Wind Speed ____________________ mph

Wind Direction ____________________ *(direction blowing from)*

NOTES:
"X" indicates that a Deficiency has been noted. "P" indicates that a Photograph has been taken. "S" indicates that a Sample has been collected. Complete descriptions of Deficiencies, Photographs, and Samples are provided on attached pages. Items are referenced by Location.

POND CONDITION

Location	Item			
	Erosion	Slopes	Vectors	Sample

LEAK DETECTION SYSTEM

Riser #	Deficiency	
	Depth of H_2O	Structural Defect

NOTES: ____

____

____

ATTACHMENT II.8.C

POTENTIAL GEOMEMBRANE LINER LEAKAGE

Title: **Leakage Through Liners Constructed with Geomembranes - Part 1. Geomembrane Liners**

Written by: J.P. Giroud and R. Bonaparte
Published in: Geotextiles and Geomembranes **Volume:** 8 **Issue:** 2 **Pages:** 27 to 67
Phone: +31 20-485-3757 ~ **Web Site:** http://www.elsevier.com

How impermeable are 'impermeable liners'? All liners leak, including geomembranes, but how much? What are the mechanisms of leakage through liners constructed with geomembranes? To answer these questions, a detailed review of leakage mechanisms, published and unpublished data, and analytical studies has been carried out with the goal of providing practical design recommendations. In particular, it appears that a composite liner (i.e. geomembrane on low-permeability soil) is more effective in reducing the rate of leakage through the liner than either a geomembrane alone or a soil liner (low-permeability soil layer) alone. However, the paper shows that the effectiveness of composite liners depends on the quality of the contact between the geomembrane and the underlying low-permeability soil layer.

Table 1
Calculated Leakage Rates Due to Pinholes and Holes in a Geomembrane

	Water depth on top of the geomembrane, h_w					
	Defect Diameter	0.003 m (0.01 ft)	0.03 m (0.1 ft)	0.3 m (1 ft)	3 m (10 ft)	30 m (100 ft)
Pinholes	0.1 mm (0.004 in)	0.006 (0.0015)	0.06 (0.015)	0.6 (0.15)	6 (1.5)	60 (15)
	0.3 mm (0.012 in)	0.5 (0.1)	5 (1)	50 (13)	500 (130)	5000 (1 300)
Holes [a]	2 mm (0.08 in)	40 (10)	130 (30)	400 (100)	1300 (300)	4000 (1 000)
	11.3 mm (0.445 in)	1 300 (300)	4 000 (1 000)	13 000 (3 000)	40 000 (10 000)	130 000 (30 000)
Values of leakage rate in liters/day (gallons/day)						

Table 2
Calculated Unitized Leakage Rates Due to Permeation of Water Through an HDPE Geomembrane

	Water depth on top of the geomembrane, h_w					
	0 m (0 ft)	*0.003 m (0.01 ft)*	*0.03 m (0.1 ft)*	*0.3 m (1 ft)*	*3 m (10 ft)*	*>10 m (>30 ft)*
Coefficient of migration, m_g(m^2/s)	0	9×10^{-20}	9×10^{-18}	9×10^{-16}	9×10^{-14}	3×10^{-13}
Unitized leakage rate, q_q (m/s)	0	9×10^{-17}	9×10^{-15}	9×10^{-13}	9×10^{-11}	3×10^{-10}
(lphd)	0	8×10^{-5}	0.008	0.8	80	260
(gpad)	0	8×10^{-6}	0.0008	0.08	8	28

Notes: These values of utilized leakage rates were calculated using eqn (5) and assuming a geomembrane thickness of 1 mm (40 mils). The coefficients of migration used to calculate the unitized leakage rates in this table were obtained from eqns (19) and (20), with
$C_1 = 1 \times 10^{-22}$ m^4 $kg^{-2}s^3$, $n = 2$, and $m_{gmax} = 3 \times 10^{-13}$ m^2/s.

The water depths used here correspond to the typical values defined in Section1.3.6. (To use eqn (19), it is necessary to know the pressure difference, Δp. According to eqn (1), water depths, h_w, are approximately equal to hydraulic head differences, Δh, which are related by eqn (12) to pressure differences, Δp.)

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1.0 INTRODUCTION

Lea Land LLC (the Facility) is an existing Surface Waste Management Facility (SWMF) providing oil field waste solids (OFWS) disposal services. The existing Lea Land SWMF is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.9.711 and 19.15.36 NMAC, administered by the Oil Conservation Division (OCD) of the NM Energy, Minerals, and Natural Resources Department (NMEMNRD). This document is a component of the "Application for Permit Modification" that proposes continued operations of the existing approved waste disposal unit; lateral and vertical expansion of the landfill via the construction of new double-lined cells; and the addition of waste processing capabilities. The proposed Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, Lea Land LLC.

The Lea Land SWMF is one of the most recently designed facilities to meet the new more stringent standards that, for instance, mandate double liners and leak detection for land disposal. The new services that Lea Land will provide needed resources to fill an existing void in the market for technologies that exceed current OCD requirements.

Lea Land, LLC proposes to modify existing OCD Permit NO. NM-01-0035 to expand and operate the "Surface Waste Management Facility" for oil field waste processing and disposal services. The Facility was originally permitted in 2001 and was designed and operated subject to regulation under the New Mexico (NM) Oil and Gas Rules, specifically OCD Part 711 [19.15.9.711 NMAC, 11-30-00]. The original permit area was 72.69 acres; the proposed new Facility footprint will be enhanced to 463 ± acres.

1.1 Site Location

The Lea Land site is located approximately 27 miles northeast of Carlsbad, straddling US Highway 62-180 (Highway 62) in Lea County, NM. The Lea Land site is comprised of a 642-acre ± tract of land encompassing Section 32, Township 20 South, Range 32 East, Lea County, NM. Site access is currently provided on the south side of US Highway 62. The coordinates for the approximate center of the Lea Land site are Latitude 32°31'46.77" and Longitude -103°47'18.25".

1.2 Facility Description

The Lea Land SWMF comprises approximately 463 acres ± of the 642-acre ± site, and will include two main components: an oil field waste Processing Area and an oil field waste solids Landfill, as well as related infrastructure (i.e., access, waste receiving, stormwater management, etc.). Oil field wastes are delivered to the Lea Land SWMF from oil and gas exploration and production operations in southeastern NM and west Texas. The Permit Plans (**Attachment III.1.A**) identify the locations of the Processing Area and Landfill Disposal facilities. The proposed facilities are detailed in **Table II.1.2** (**Volume II.1**), and are anticipated to be developed in four primary phases as described in **Table II.1.3** (**Volume II.1**).

1.3 Purpose

The purpose of this Vadose Zone Monitoring Plan is to provide the technical rationale and environmental benefits for a Request for Groundwater Monitoring Suspension and plans for alternative Vadose Zone Monitoring at the Facility. The Request for Suspension of Groundwater Monitoring and Vadose Zone Monitoring Plan are based upon regional hydrogeology and detailed site-specific investigations

A permit for major modification of the Surface Waste Management Facility for oil and gas waste is sought under provisions set forth in 19.15.36 NMAC. Provisions of 19.15.36.13 NMAC include facility siting criteria that no landfill shall be located where ground water is less than 100 feet below the lowest elevation of the design depth and that no other surface waste management facility shall be located where ground water is less than 50 feet below the lowest elevation at which the operator will place oil field waste. 19.15.36.14.B NMAC includes requirements for groundwater monitoring at facilities where "fresh groundwater" exists, unless "otherwise approved by the division". Fresh water is defined in 19.15.2.7.F(3) NMAC as water that contains less than 10,000 milligrams per liter (mg/l) of total dissolved solids (TDS). Groundwater is defined in 19.15.2.7.G(10) NMAC as *"interstitial water that occurs in saturated earth material and is capable of entering a well in sufficient amounts to be used as a water supply"*.

The Lea Land SWMF is located in an area where few shallow groundwater resources are known to exist. Information obtained from 10 soil borings and 5 groundwater monitoring wells that were drilled on the Lea Land SWMF, as well as several other groundwater monitoring wells in the vicinity of the site, provide ample demonstration that the minimum depth to the shallowest saturated zone on the property exceeds 150 ft below ground surface (bgs); and more than 100 ft below projected landfill basegrade levels.

Depth to water-bearing zones in the Dewey Lake Redbeds, which is the shallowest saturation in the vicinity of the site, ranges from 173 ft to 198 ft bgs and ranges between 122 ft and 149 ft below the deepest proposed basegrade in the facility**.** Saturated zones at the site are vertically separated from the proposed facility by approximately 125 ft of dense non water-bearing Dewey Lake Redbed shale deposits. Saturated zones in the Dewey Lake Redbeds are hydraulically tight and highly confined. Monitoring wells at the site will not sustain adequate yields for well purging for groundwater sample collection, and well recharge is near zero. Therefore, saturation in the Dewey Lake Redbeds beneath the site does not qualify as groundwater, according to 19.15.2.7.G(10) NMAC.

The proposed facility design includes a double geomembrane clay liner (GCL) and two high density polyethylene (HDPE) liners below a leak detection layer, as well as installation of technology and operational provisions for leachate monitoring and collection. Based upon shallow stratigraphy in the vicinity of the proposed facility, it is anticipated that in the unlikely event that leakage were to occur through two composite liner systems, the leachate would migrate vertically through Santa Rosa Sandstone and pool on the upper surface of the laterally extensive and dense Dewey Lake Redbed shales that are present at an average depth of 50 ft bgs at the site. Subsurface stratigraphic information for the site and surrounding area indicates that potential leakage would migrate downslope above the sandstone-shale interface and likely move to the east.

The proposed Facility design includes double HDPE lined waste cells and provisions for leachate monitoring, and since the facility is underlain by laterally extensive dense shale and projected depth to the shallowest water bearing zone is significant. Therefore, vadose zone monitoring at the interface at the Dewey Lake Redbeds/Santa Rosa Sandstone interface is proposed as the most appropriate detection zone for the site. Due to the exceptional depth to a water-bearing zone at the site, as well as the low hydraulic conductance of the Dewey Lake Redbeds shale bedrock, it is anticipated that properly positioned and completed vadose zone monitoring wells at the site would detect leakage from the facility long before monitoring wells completed in deeper, hydraulically tight and confined horizons in the Dewey Lake Redbeds. This strategy provides a greater level of protection to environmental resources at the facility through early detection.

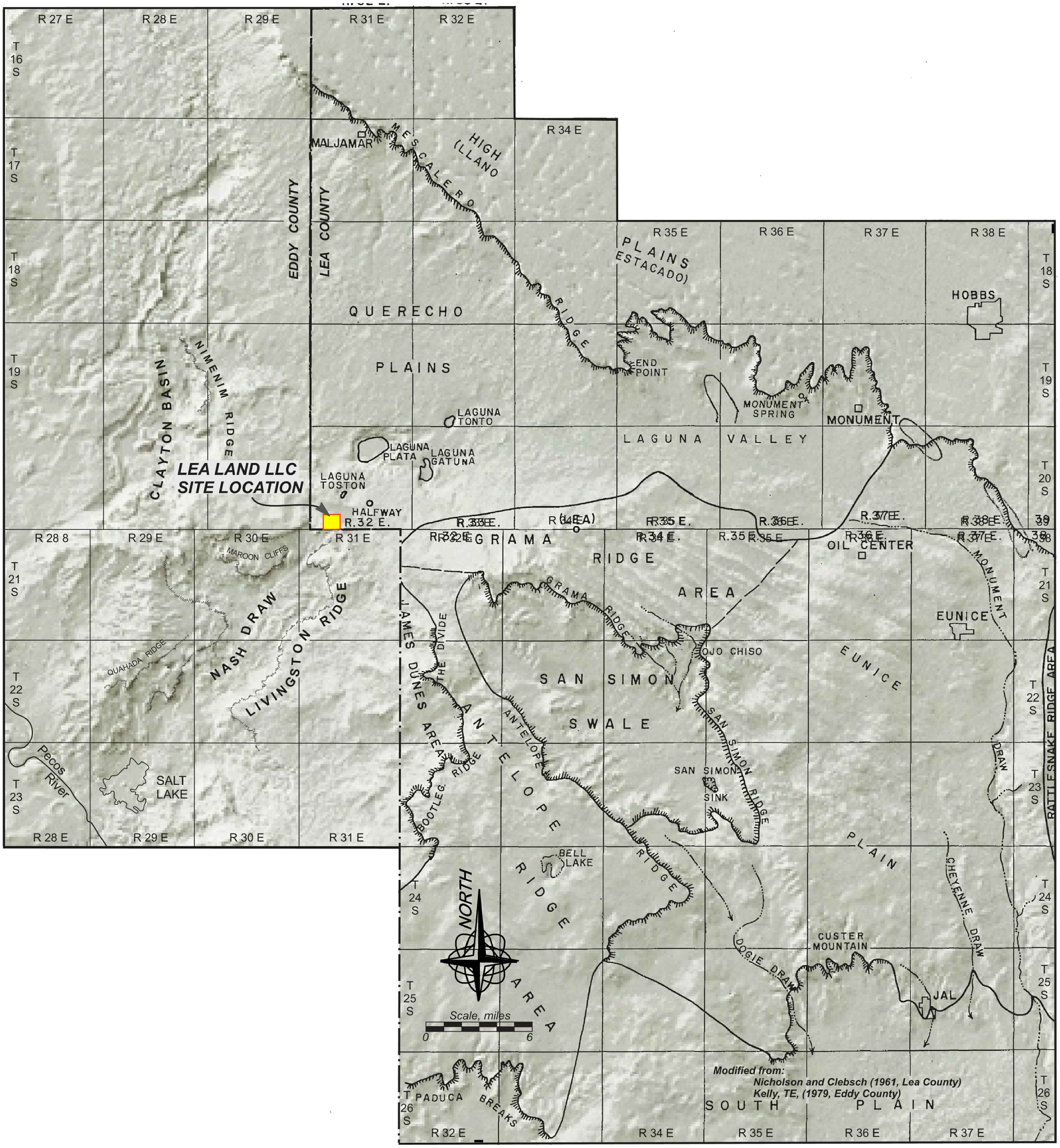
The following sections provide specific descriptions of the subsurface stratigraphy and water-bearing zones in the vicinity of the proposed facility, as well as proposed design, installation methods and operational strategy for the proposed vadose zone monitoring network at the site. **Volume IV.2** provides the results of numerous hydrogeologic and geotechnical investigations conducted to gather pertinent site-specific subsurface data.

2.0 HYDROGEOLOGIC SETTING

The Lea Land SWMF is located near the boundary between the Southern High Plains Section (Llano Estacado) and the Pecos Valley Section of the Great Plains Physiographic Province (Hawley, 1993). The Great Plains Physiographic Province is characterized by low relief and lightly deformed Permian and Triassic sedimentary bedrock units overlain by variable thicknesses of late Tertiary and Quaternary age layers. These consist of unconsolidated to semi-consolidated deposits of sand, silt, clay, gravel and calcrete (caliche) of the Ogallala Formation and younger Quaternary deposits of unconsolidated or aeolian sands and silts.

Physiography of the vicinity of the Lea Land SWMF in western Lea County and eastern Eddy County was described by Nicholson and Clebsch (1961) and Kelly (1979) and is summarized in the physiographic map in **Figure II.9.1**. The site is situated in the Upper Pecos-Black watershed (USGS cataloging Unit 1306011).

The Lea Land SWMF is located near the southwestern terminus of the Querecho Plains, which is a broad and relatively flat terrain that slopes gently from Mescalero Ridge at the western terminus of the Llano Estacado toward the Pecos River, approximately 80 miles to the west of Mescalero Ridge. The Querecho Plains are generally underlain by thin accumulations of unconsolidated sand, silt, gravel and caliche that mantle Triassic age redbeds and sandstones. The Tertiary Ogallala Formation, which is a thick sequence of unconsolidated to semi-consolidated sand, silt and gravel forms the caprock on Mescalero Ridge. Ogallala sediments were deposited on an erosional surface foot incised into Triassic Chinle Formation in much of southeastern New Mexico. The Ogallala has been removed by erosion and is absent west of Mescalero Ridge



REGIONAL PHYSIOGRAPHY

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

NOTES:

1.) GEOGRAPHIC COORDINATES FOR THE CENTER OF THE SITE:
32° 31' 46.77 N, -103° 47' 18.25 W

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\PHYSIOGRAPHY.dwg
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GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: PHYSIOGRAPHY.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.1
APPROVED BY: CWF	www.team-psc.com	

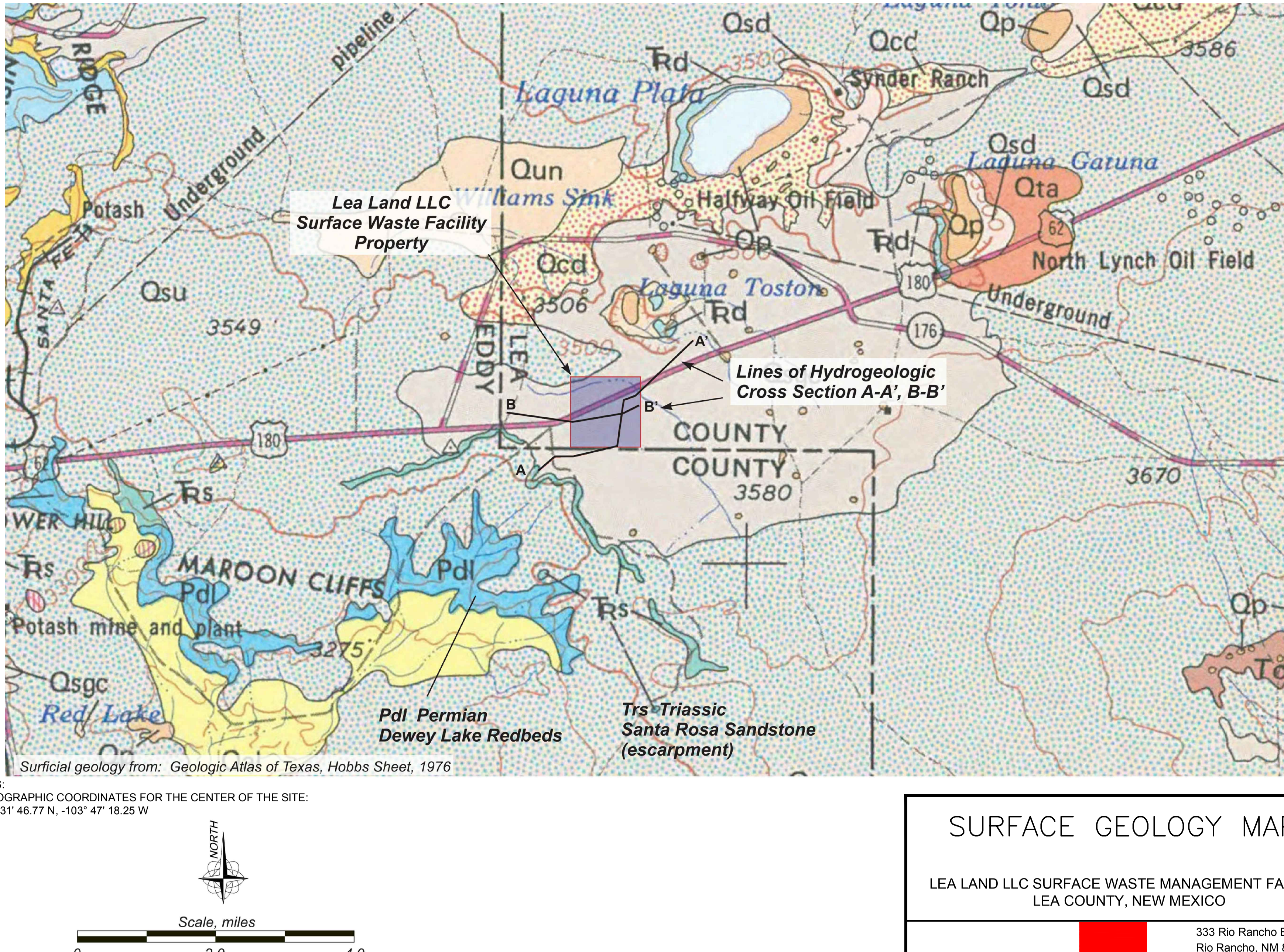
Surface geology of the vicinity of the Lea Land SWMF was mapped by the Texas Bureau of Economic Geology (1954) and is shown in **Figure II.9.2**. The Lea Land SWMF is situated east of the northernmost extension of Livingston Ridge, which is a west-facing escarpment formed by ledge-forming sandstone beds of the Triassic Santa Rosa Sandstone. The Facility rests on thinly alluvium-mantled beds of the Santa Rosa Sandstone, which dip gently to the northeast. Near surface stratigraphic units in the subsurface at the Lea Land SWMF include, Quaternary alluvium, Triassic Santa Rosa Sandstone, Permian Dewey Lake Redbeds, and Permian Rustler and Salado Formations.

Potential subsidence features are present in eastern Eddy County and Western Lea County. (**Figure II.9.1**). The most notable of these are Nash Draw and Clayton Basin. Several large playas, including Williams Sink, Laguna Plata, Laguna Gatuna, Laguna Tonto and Laguna Toston are present in the vicinity of the Lea Land SWMF. These features are believed to have formed from a combination of dissolution of deep-seated soluble substrates (Rustler and Salado) and more significantly wind deflation (Nicholson and Clebsch, 1961).

2.1 Groundwater Occurrence and Site Conditions

Shallow saturation at the Lea Land SWMF is present in hydraulically tight and confined zones in the Dewey Lake Redbeds unit. The top of the Dewey Lake Redbeds is present at an average depth of approximately 50 ft bgs at the Lea Land SWMF. Based upon data obtained from numerous geotechnical borings and groundwater monitoring wells that were drilled at the facility, the shallow saturated zones are present at depths ranging from 123 ft and 148 ft below the top of the Dewey Lake Redbeds; and ranging from 173 ft and 198 ft bgs. Water levels in the completed groundwater monitoring wells at the Lea Land SWMF rose between approximately 20 and 48 ft above the zones where water was initially noted during air rotary drilling of the wells (i.e., artesian conditions).

The Dewey Lake Redbeds are overlain by the Santa Rosa Sandstone, which consists of Triassic fine-grained silty sandstone and interbedded siltstone. The Santa Rosa Sandstone produces modest quantities of reasonably good quality water to wells further east in Lea County and West Texas; however this unit is above the water table and is not water-bearing at the Lea Land SWMF.



Surficial geology from: Geologic Atlas of Texas, Hobbs Sheet, 1976

NOTES:
1.) GEOGRAPHIC COORDINATES FOR THE CENTER OF THE SITE:
32° 31' 46.77 N, -103° 47' 18.25 W

SURFACE GEOLOGY MAP

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
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DATE: 01/08/2019	CAD: SURF GEO.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.2
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:Mar. 25, 2019-11:59:25 ; LAYOUT: A (LS)

Wells and borings in the vicinity of the Lea Land SWMF that yielded data of significance with regard to water-bearing occurrence or potential are plotted on the well location map presented as **Figure II.9.3**. The geometry of land surface and underlying geologic units, as well as water saturations near the Lea Land SWMF are depicted in hydrogeologic cross-section A-A' shown as **Figure II.9.4**. This diagram indicates that the shallowest saturated zone at the Facility is well below the top of the Dewey Lake Redbeds, at an average depth of approximately 185 ft below land surface, and water is slow to recharge.

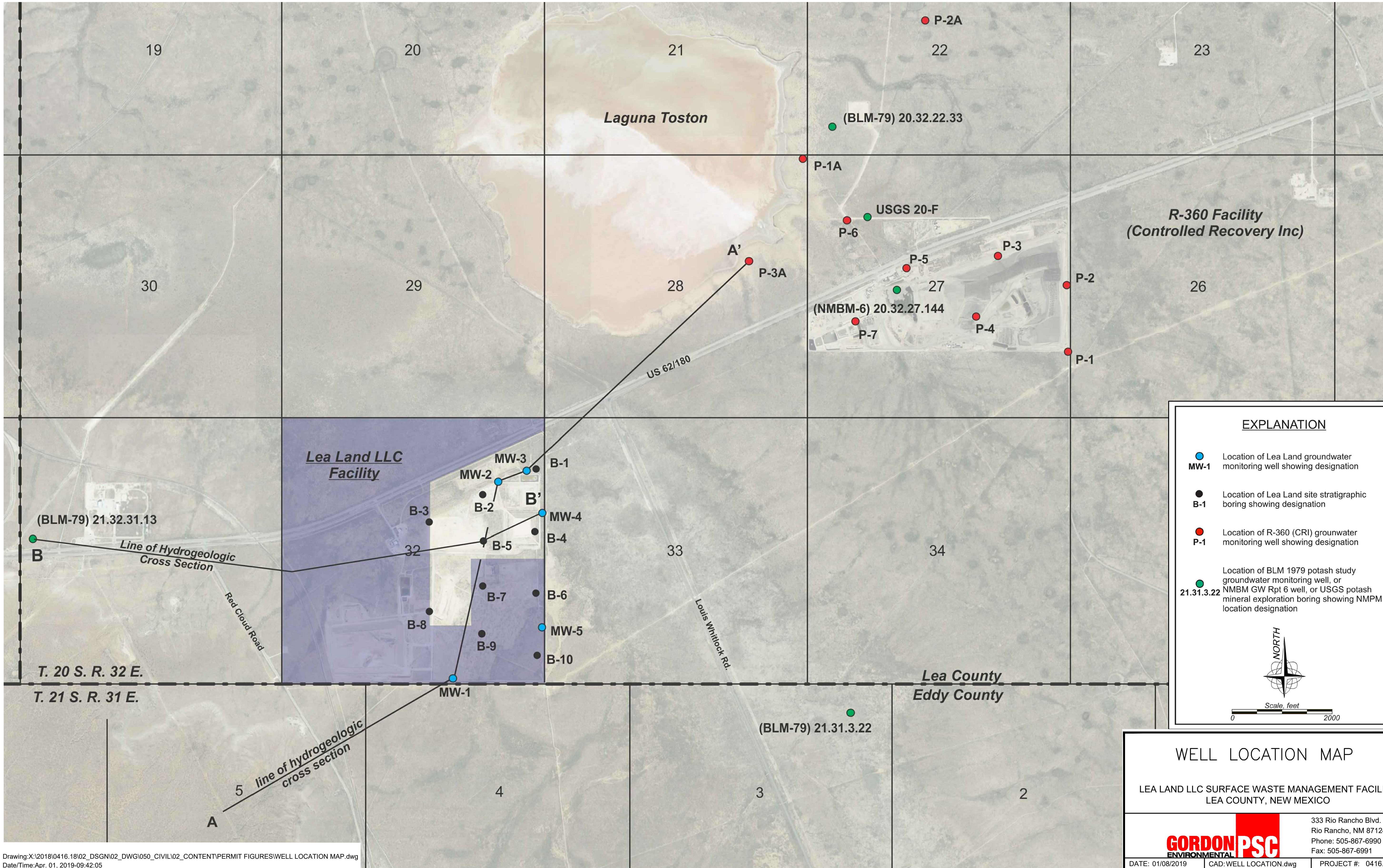
Table II.9.1 provides a summary of information from site characterization borings, groundwater monitoring wells, mineral exploration wells and/or other borings in the vicinity of the Lea Land SWMF. Data included in **Table II.9.1** were obtained from the following sources:

- Logs from groundwater monitoring wells at the Lea Land site **(Volume IV.2, Attachment IV.2.D)**
- Logs from geotechnical borings at the Lea Land site (**Volume IV.2, Attachment IV.2.E**)
- Logs from Controlled Recovery Inc. monitoring wells **(Volume IV.2, Attachment IV.2.B)**
- Well logs and supporting data from BLM monitoring wells (Geohydrology Associates Inc.,1979; **Volume IV.2, Attachment IV.2.A)**
- USGS Potash Log Hole F-20-1956 **(Volume IV.2, Attachment IV.2.C)**
- Water well data from Nicholson and Clebsch (1961)

The potentiometric surface gradient at the Lea Land SWMF was mapped using information from the Lea Land SWMF groundwater monitoring wells, as well as from other vicinity wells, as summarized in **Table II.9.1**. Local gradient is toward the southwest at a rate of approximately 100 ft per mile, as shown in **Figure II.9.5**.

No water production wells are present in the vicinity of the Lea Land SWMF. Soil borings and monitoring wells drilled at the Facility found dry alluvium and Santa Rosa Sandstone on top of the Dewey Lake Redbeds, and no saturation in approximately the upper 123-148 ft of the redbeds beneath the site.

Available water quality data taken from samples collected from wells completed in the Dewey Lake Redbeds at the Lea Land SWMF and other vicinity wells is summarized in **Table II.9.2**. Analyses of water samples taken from Lea Land SWMF wells in March 2010 and June 2018 indicate that the water is of fairly good chemical quality, with Total Dissolved Solids (TDS) ranging from 778



WELL LOCATION MAP

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
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DATE: 01/08/2019	CAD: WELL LOCATION.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.3
APPROVED BY: CWF	www.team-psc.com	

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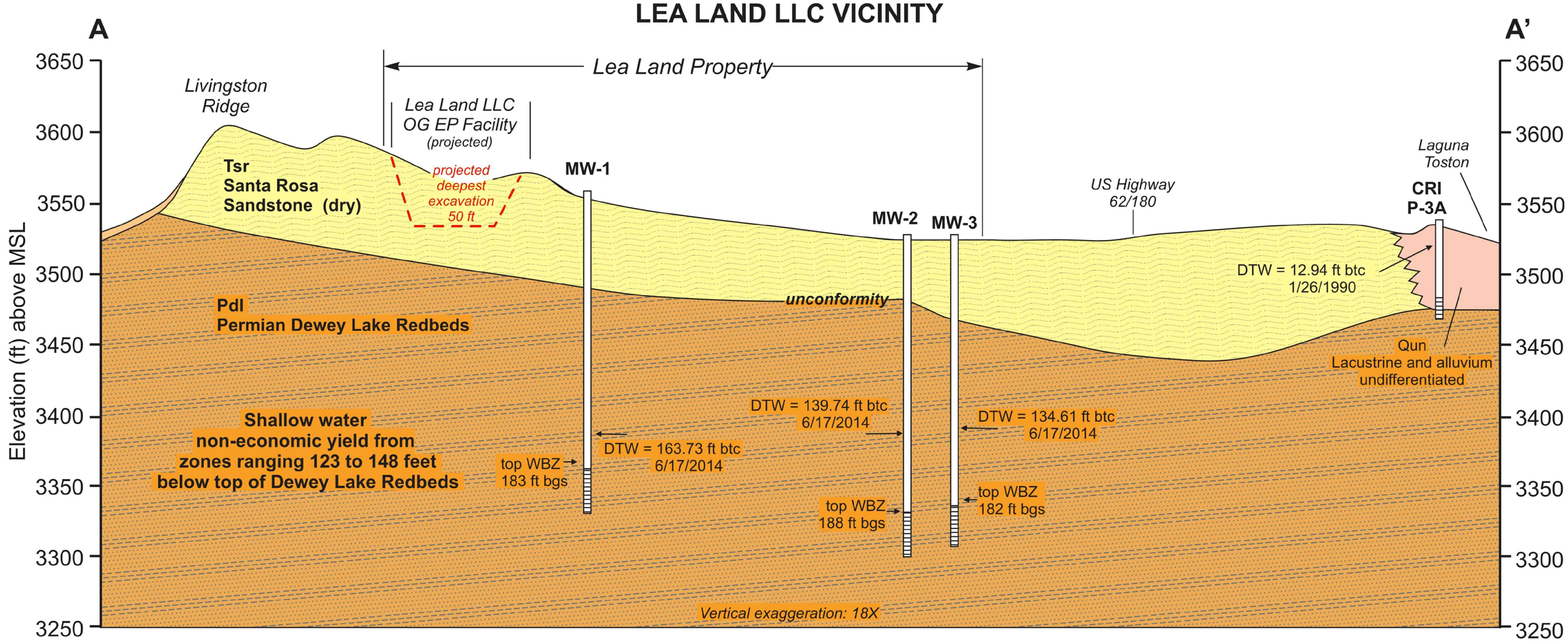
HYDROGEOLOGIC CROSS SECTION
LEA LAND LLC VICINITY



EXPLANATION

- Qun — Quaternary alluvium and lacustrine deposits, undifferentiated
- Tsr — Triassic Santa Rosa Sandstone
- Pdl — Permian Dewey Lake Redbeds

Notes: btc: below top of casing
bgs: below ground surface

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Date/Time:Mar. 25, 2019-12:32:19 ; LAYOUT: A (LS)

HYDROGEOLOGIC CROSS–SECTION A–A'

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

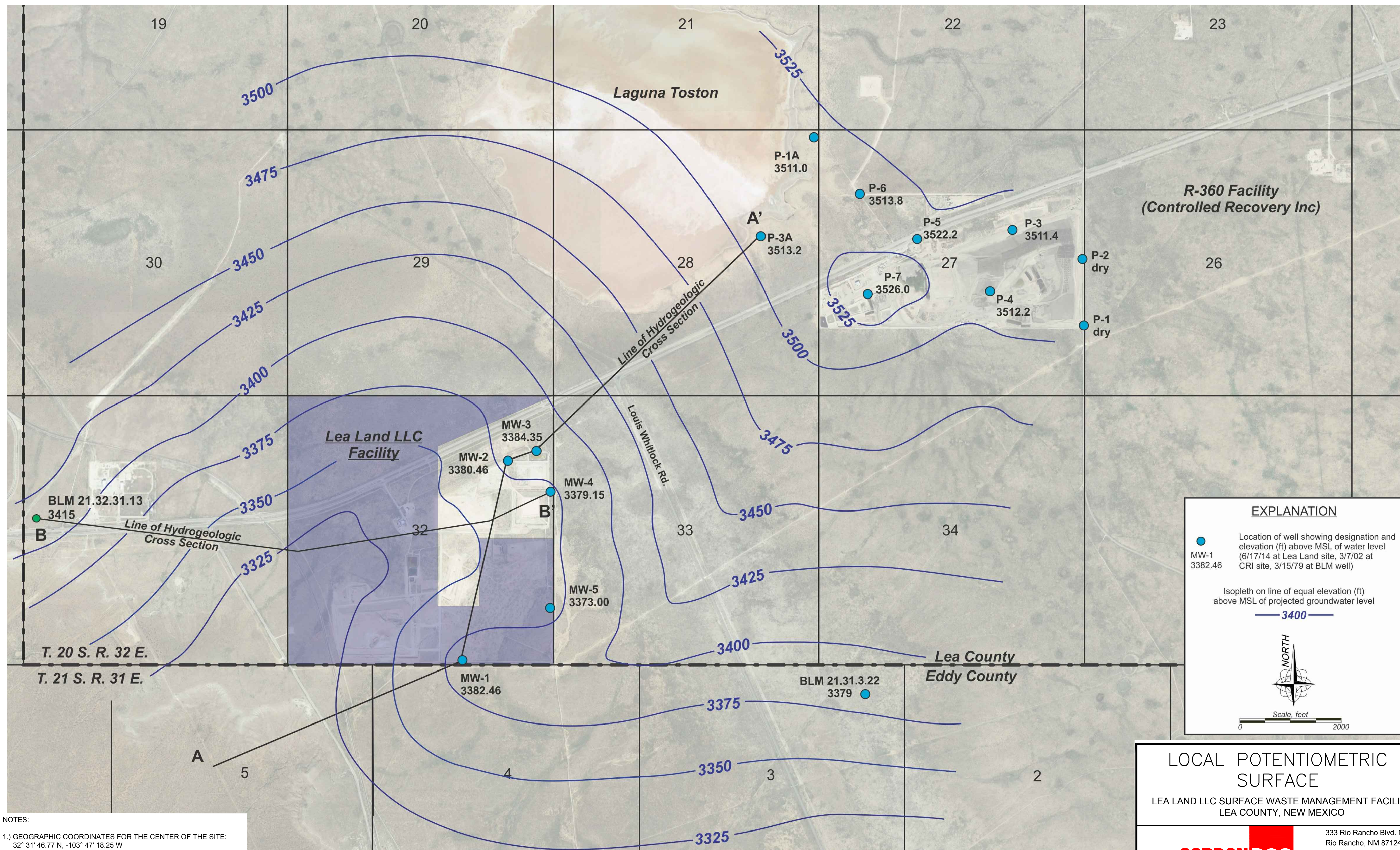
GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: HYDRO GEO X-SEC.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.4
APPROVED BY: CWF	www.team-psc.com	

TABLE II.9.1 - Summary Data from Wells and Borings in the Vicinity of the Lea Land SWMF

Well or Boring	Latitude	Longitude	Owner	Completion Date	[1]LS Elev (ft)	Water Bearing Zone	Top Casing Elev (ft)	Depth (ft)	WL (ft) Below Top Casing	WL (ft) Below Land Surface	WL Date	WL Elev (ft) above MSL	Top Screen Elev (ft) Above MSL	Bottom Screen Elev (ft) Above MSL	Depth to Top of Water-Bearing Zone (ft)	Depth to Top of Pdl Dewey Lake Redbed (ft)	Elev Top of Pdl Dewey Lake Redbeds (ft)	Source of Data
Lea Land Facility Groundwater Monitoring Wells																		
MW-1	32.522613	-103.78581	Lea Land	Jun-96	3543.79	Pdl	3546.29	215.0	163.73		6/17/2014	3382.56	3361	3329	183	50	3493.79	LL Permit Doc, GW Monitoring Reports
MW-2	32.533437	-103.78285	Lea Land	Jun-96	3517.70	Pdl	3520.20	220.0	139.74		6/17/2014	3380.46	3330	3298	188	40	3477.70	LL Permit Doc, GW Monitoring Reports
MW-3	32.533989	-103.78099	Lea Land	Jun-96	3516.46	Pdl	3518.96	214.0	134.61		6/17/2014	3384.35	3335	3303	182	50	3466.46	LL Permit Doc, GW Monitoring Reports
MW-4	32.531736	-103.78001	Lea Land	Jun-96	3517.71	Pdl	3520.21	203.5	141.06		6/17/2014	3379.15	3347	3315	171.5	48	3469.71	LL Permit Doc, GW Monitoring Reports
MW-5	32.525402	-103.78000	Lea Land	Jun-97	3523.03	Pdl	3525.53	210.0	152.53		6/17/2014	3373.00	3346	3314	178	30	3493.03	LL Permit Doc, GW Monitoring Reports
Lea Land Facility Soil Borings																		
B-1	32.535111	-103.780339	Lea Land	11/8/1993	3515.5	Pdl	not cased	126		125		3390.50				60	3455.5	Lea Land Boring Logs-Permit Document
B-2	32.533001	-103.783891	Lea Land	11/8/1993	3516.6	dry	not cased	155		dry						45	3471.6	Lea Land Boring Logs-Permit Document
B-3	32.531446	-103.787568	Lea Land	11/8/1993	3519.2	dry	not cased	150.0		dry						45	3474.2	Lea Land Boring Logs-Permit Document
B-4	32.531098	-103.780226	Lea Land	11/8/1993	3517.3	dry	not cased	148.0		dry						45	3472.3	Lea Land Boring Logs-Permit Document
B-5	32.530447	-103.783806	Lea Land	11/8/1993	3519.5	Pdl	not cased	201.0		199		3320.50				45	3474.5	Lea Land Boring Logs-Permit Document
B-6	32.527602	-103.780036	Lea Land	11/8/1993	3520.9	dry	not cased	165.0		dry						30	3490.9	Lea Land Boring Logs-Permit Document
B-7	32.527902	-103.783752	Lea Land	11/8/1993	3524.4	dry	not cased	184		dry						35	3489.4	Lea Land Boring Logs-Permit Document
B-8	32.526431	-103.787421	Lea Land	11/8/1993	3536.4	dry	not cased	166		dry						95	3441.4	Lea Land Boring Logs-Permit Document
B-9	32.525223	-103.783718	Lea Land	11/8/1993	3530.1	dry	not cased	160		dry						75	3455.1	Lea Land Boring Logs-Permit Document
B-10	32.524025	-103.779907	Lea Land	11/8/1993	3548.2	dry	not cased	178		dry						50	3498.2	Lea Land Boring Logs-Permit Document
Controlled Recovery Inc. Monitoring Wells																		
P-1	32.540629	-103.745681	CRI	10/31/1989	3553	dry	3554.9	97.95	dry		3/7/2002					45	3508	Safety-Environmental Solutions 2003
P-2	32.544247	-103.745751	CRI	10/31/1989	3546	dry	3556.6	59.28	dry		3/7/2002					40	3506	Safety-Environmental Solutions 2003
P-3	32.545867	-103.750232	CRI	10/31/1989	3542	Qal	3543.4	46.8	31.98		3/7/2002	3511.4				40	3502	Safety-Environmental Solutions 2003
P-4	32.542550	-103.751759	CRI	10/31/1989	3550	Qal	3551.2	58.6	39.01		3/7/2002	3512.2				50	3500	Safety-Environmental Solutions 2003
P-5	32.545331	-103.756278	CRI	10/31/1989	3539	Qal	3541.0	48.57	18.85		3/7/2002	3522.2				50	3489	Safety-Environmental Solutions 2003
P-6	32.547877	-103.760023	CRI	10/31/1989	3529	Qal	3531.8	50.21	18.00		3/7/2002	3513.8				40	3489	Safety-Environmental Solutions 2003
P-7	32.542377	-103.759548	CRI	10/31/1989	3541	Qal	3543.7	42.04	17.74		3/7/2002	3526.0				35	3506	Safety-Environmental Solutions 2003
P-1A	32.551305	-103.762889	CRI	1/26/1990	3519	Qal	3522.9	31.26	11.86		3/7/2002	3511.0				30	3489	Safety-Environmental Solutions 2003
P-2A	32.558896	-103.75490	CRI	1/26/1990	3527	Qal	3529.3	47.41	37.14		3/7/2002	3492.2				45	3482	Safety-Environmental Solutions 2003
P-3A	32.545635	-103.76645	CRI	1/26/1990	3522	Qal	3526.1	55.45	12.94		3/7/2002	3513.2	3482	3467		50	3472	Safety-Environmental Solutions 2003
BLM 1978 Potash Environmental Study Wells																		
BLM 20.32.17.13	32.575143	-103.79470	BLM	11/8/1978	3460.5	Qplaya	3450.35	100	9.90		3/15/1979	3440.45	20	40	18	35	3425.5	Geohydrology 1979
BLM 20.32.22.33	32.553150	-103.76076	BLM	11/8/1978	3527	Tr undiff	3512.52	170	29.65		3/15/1979	3482.87	150	179	35	30	3497.0	Geohydrology 1979
BLM 20.32.31.13	32.531335	-103.81209	BLM	11/8/1978	3553	Pdl	3549.95	250	135.12		3/15/1979	3414.83	240	250	unknown	23	3530.0	Geohydrology 1979
BLM 21.31.3.22	32.520657	-103.75978	BLM	11/9/1978	3523	Pdl	3519.59	200	140.81		3/15/1979	3378.78	140	160	150	30	3493.0	Geohydrology 1979
NMBM GW-6																		
20.32.18.233	32.573908	-103.804859	Freeport	1954	3450	Tr		400		89.2	3/24/1954	3360.8	WBZ 215-243 ft					Nicholson-Clebsch, 1961
20.32.27.144	32.544000	-103.756733	Joel Frey		3545	Qal		25		12.3	6/11/1954	3532.7						Nicholson-Clebsch, 1961
20.32.30.142	32.546506	-103.806406			3530	Pdl				9.9	6/11/1954	3520.1						Nicholson-Clebsch, 1961
NMOSE Permitted Water Wells and Monitoring Wells																		
CP-00368	32.533577	-103.81851	Ballard-Bonfield	6/9/1966	3573		not cased	303		dry			not cased			9	3564	NMOSE WATERS DATABASE
CP-00370	32.535000	-103.82900	Ballard-Bonfield	7/14/1966	3549		not cased	120		80	7/14/1966		not cased			80	3469	NMOSE WATERS DATABASE
C-02953 EXPL	32.481000	-103.79000	DOE WIPP	4/7/2004	3500				630									NMOSE WATERS DATABASE
C-03233 EXPLORE	32.458000	-103.79300	DOE WIPP	6/19/2006	3349			566										NMOSE WATERS DATABASE
C-03151	32.491000	-103.71100	DOE WIPP	8/23/2005	3433			1352										NMOSE WATERS DATABASE
C-02727	32.440000	-103.79000	DOE WIPP	8/27/2000	3440	Pr		913										NMOSE WATERS DATABASE
Mineral Exploration Wells																		
USGS 20-F	32.54044	-103.758712	FM Coop.	3/6/1953	3532		not cased	1273								40	3492.0	Mineral Expl Hole



NOTES:

1.) GEOGRAPHIC COORDINATES FOR THE CENTER OF THE SITE:
32° 31' 46.77 N, -103° 47' 18.25 W

NOT FOR CONSTRUCTION

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\LOCAL POTENTIOMETRIC SURFACE.dwg

SIZE: ANSI-B Date/Time:Mar. 25, 2019-12:23:17 ; LAYOUT: B (LS)

LOCAL POTENTIOMETRIC SURFACE

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

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333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: LOCAL POTENT.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.5
APPROVED BY: CWF	www.team-psc.com	

TABLE II.9.2 - Water Quality Data Summary

Volatile Organic Compounds

Well Location	Sample Date	Chloromethane	Vinyl chloride	Bromomethane	Chloroethane	Trichlorofluoromethane	1,1-Dichloroethene	Methylene chloride	trans-1,2-Dichloroethene	1,1-Dichloroethane	cis-1,2-Dichloroethene	Chloroform	Carbon tetrachloride	1,1,1-Trichloroethane	Benzene	1,2-Dichloroethane	Trichloroethene	1,2-Dichloropropane	Bromodichloromethane	cis-1,3-Dichloropropene	Tetrachloroethene	trans-1,3-Dichloropropene	1,1,2-Trichloroethane	Dibromochloromethane	Chlorobenzene	Bromoform	1,1,2,2-Tetrachloroethane	1,4 Dichlorobenzene	1,2-Dichlorobenzene
	Lab Method	EPA Method 8260B - (all units in micrograms per liter)																											
	NMWQCC Standard	100	1.0	--	--	--	25	5	100	--	5	100	--	100	5	5	5	5	--	--	5	--	5	--	100	--	10	75	600
Lea Land Monitoring Wells Completed in Dewey Lake Redbeds																													
Lea Land MW-2	6/13/18	<0.2	<0.1	<0.3	<0.2	<0.1	<0.2	<0.09	<0.2	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1	<0.08	<0.03	<0.08	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1
Lea Land MW-4	6/13/18	<0.2	<0.1	<0.3	<0.2	<0.1	<0.2	<0.09	<0.2	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1	<0.08	<0.03	<0.08	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1
Lea Land MW-5	6/13/18	<0.2	<0.1	<0.3	<0.2	<0.1	<0.2	<0.09	<0.2	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1	<0.08	<0.03	<0.08	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1

Inorganic Compounds

All units are milligrams per liter (mg/L) except conductivity (micromhos/cm3) and pH (standard units).

Well Location	Sample Date	Chloride	Nitrate as N	Nitrate+Nitrite as N by IC	Nitrite as N	Sulfate	Ammonia	Total Dissolved Solids	Calcium	Iron	Magnesium	Manganese	Potassium	Sodium	Alkalinity, Bicarbonate	Alkalinity, Carbonate	Alkalinity Total	Total Organic Carbon	Conductivity mS/cm	pH	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver	Boron	Chromium, total	Chromium +6
	Lab Method	300.0					350.1	160.1	200.7						310.1			5310C	120.1	150.1	6010B								1	1	1
	NMWQCC Standard	250	10.0	--	10.0	600	--	1,000	--	1.0	--	0.2	--	--	--	--	--	--	--	6-9	0.01	1.0	0.01	0.05	0.05	0.0020	0.05	0.05		0.05	
Lea Land Monitoring Wells Completed in Dewey Lake Redbeds																															
Lea Land MW-2	6/13/18	79.8	3.36	3.36	<0.02	462	0.09	818	50.6	<0.05	40.1	<0.02	5.33	224	205	<1.0	168	1.36	1510	7.72											
	3/19/10																				<0.005	0.033	<0.00209	0.0030	<0.005	<0.0002	0.069	<0.005			
Lea Land MW-3	3/19/10																				<0.005	0.017	<0.00209	<0.005	<0.005	<0.0002	0.075	<0.005			
Lea Land MW-4	6/13/18	62.5	3.32	3.32	<0.02	361	0.05	778	48.4	<0.05	43.2	<0.02	4.92	170	190	<1.0	156	<0.05	1280	7.74											
	3/19/10																				<0.005	0.025	<0.00209	0.004	<0.005	<0.0002	0.087	<0.005			
Lea Land MW-5	6/13/18	54.0	3.15	3.15	<0.02	412	0.07	886	58.6	<0.05	42.0	<0.02	4.14	176	224	<1.0	184	0.501	886	7.70											
	3/19/10																				<0.005	0.023	<0.00209	<0.005	<0.005	<0.0002	0.068	<0.005			
BLM 1979 Potash Area Groundwater Monitoring Wells Completed in Dewey Lake Redbeds																															
[1]BLM 20.32.22.33	Jan 1979	75.0				550		3136	105																				0.3	<0.02	<0.02
[1]BLM 21.31.3.22	Jan 1979	18.0				20.0		424.0	19.9																				<0.05	<0.02	<0.02

Notes:

All units are milligrams per liter (mg/L) except conductivity (micromhos/cm^3) and pH (standard units).

[1] Methods undetermined

to 886 milligrams per liter (mg/L). The water was found to contain no Volatile Organic Compounds (VOCs) and meets New Mexico Water Quality Control Commission (NMWQCC) standards for tested inorganic compounds, and slightly exceeds the NMWQCC standard for selenium of 0.05 mg/L, ranging in selenium concentration from 0.069 mg/L to 0.09 mg/l.

2.2 Dewey Lake Redbed Shale Aquiclude

The vicinity of the Lea Land SWMF is underlain by thick and laterally extensive deposits of shale in the Permian age Dewey Lake Redbeds. Saturated zones within the Dewey Lake Redbeds range from 123 ft and 148 ft below the top of the redbeds; and from 173 ft to 198 ft bgs at the Lea Land SWMF.

A summary of geotechnical testing data obtained from samples of soil media at the Lea Land SWMF and in the vicinity is presented in **Table II.9.3**. Media tests included extensive geotechnical laboratory tests of soil samples taken from soil borings and surficial samples, and in-situ hydraulic tests of saturated zones penetrated by groundwater monitoring wells at the Lea Land SWMF and other nearby wells.

Estimates of hydraulic conductance of the samples from the Santa Rosa Sandstone made from sample texture ranged from 10^{-3} centimeters per second (cm/s) to 10^{-8} cm/s. Texture-based estimates of hydraulic conductance of boring samples taken from the Dewey Lake Redbeds yielded a similar range of conductance. Hydraulic conductance of the saturated zones in the Dewey Lake Redbeds was measured during well tests. Well MW-4 was slug-tested in 1997 (Intera), yielding a hydraulic conductivity value of 4.19×10^{-9} cm/s and a storativity value of 3.71×10^{-9} (dimensionless), indicating very low conductance and confined, or artesian conditions. Tests of other vicinity wells completed in the Dewey Lake Redbeds were conducted by BLM (Geohydrology, 1979); these tests yielded hydraulic conductance values ranging from 1.33×10^{-6} cm/s to 3.15×10^{-7} cm/s. Well tests yield results that are indicative of **horizontal** hydraulic conductance, which is multiple orders of magnitude greater than **vertical** hydraulic conductance in highly stratified geologic units such as the Dewey Lake Redbeds. Therefore, we conclude that these test results are conservative and that the Dewey Lake Redbeds present high impedance to vertical fluid flow at the Lea Land SWMF.

TABLE II.9.3 - Soil Laboratory Analysis Summary
(Page 1 of 3)

Boring, Well or Source	Depth Top Sample (Top Tested Interval)	Depth Bottom Sample (Bottom Tested Interval)	Work Completed By	Date	USCS	Sieve - % Passing		Atterberg Limits		Carbonate %	[1]Permeability Range Based on Texture (cm/sec)	Ksat, (cm/sec) [Constant Head]	Ksat, (cm/sec) [Falling Head]
						No. 40	No. 200	Liquid Limit	Plasticity Index				
Tests of Borehole Media from Santa Rosa Sandstone and Alluvial Veneers													
B-1	5	6	STEC	11/8/1993	SM	71.6%	32.4%	NP	NP	100	10-3 to 10-6		
B-1	35	36	STEC	11/8/1993	SM	67.8%	23.4%	NP	NP	100	10-3 to 10-6		
B-1	45	46	STEC	11/8/1993	SM	82.2%	38.6%	NP	NP	24	10-3 to 10-6		
B-2	10	11	STEC	11/8/1993	SM	90.9%	30.4%	NP	NP	17	10-3 to 10-6		
B-2	25	26	STEC	11/8/1993	SM	82.2%	38.5%	NP	NP	24	10-3 to 10-6		
B-3	15	16	STEC	11/8/1993	SM	93.6%	30.5%	28	NP	8	10-3 to 10-6		
B-4	40	41	STEC	11/8/1993	SM	90.2%	38.0%	NP	NP	18	10-3 to 10-6		
B-5	35	36	STEC	11/8/1993	SM	89.9%	35.1%	NP	NP	18	10-3 to 10-6		
B-7	25	26	STEC	11/8/1993	SM	59.0%	19.1%	NP	NP	77	10-3 to 10-6		
B-8	0	1	STEC	11/8/1993	CL	85.4%	54.4%	NP	NP	4	10-6 to 10-8		
B-8	5	6	STEC	11/8/1993	SM	69.7%	33.4%	29	NP	77	10-3 to 10-6		
B-8	15	16	STEC	11/8/1993	SM	59.0%	19.1%	NP	NP	77	10-3 to 10-6		
B-8	85	86	STEC	11/8/1993	SM	95.4%	30.5%	NP	NP	18	10-3 to 10-6		
B-9	0	1	STEC	11/8/1993	ML	97.8%	53.9%	24	NP	5	10-3 to 10-6		
B-9	30	31	STEC	11/8/1993	SM	71.6%	32.4%	NP	NP	100	10-3 to 10-6		
B-9	35	36	STEC	11/8/1993	SM	93.6%	30.5%	28	NP	8	10-3 to 10-6		
B-9	50	51	STEC	11/8/1993	SM	95.4%	30.5%	NP	NP	18	10-3 to 10-6		
B-10	10	11	STEC	11/8/1993	SM	69.7%	33.4%	29	NP	77	10-3 to 10-6		
B-10	15	16	STEC	11/8/1993	SM	83.3%	37.8%	NP	NP	40	10-3 to 10-6		
Tests of Borrow Material Samples (Santa Rosa Sandstone and Alluvial Materials)													
Onsite Stockpile Soil 1			DBSA	7/19/2016								3.40E-04	N/A
Onsite Stockpile Soil 2			DBSA	7/19/2016								1.40E-04	N/A

Note:
[1] Permeability range estimates from Engineering document FM-5-47/NAVFAC MO 330/AFJMAN 32-1221(1)

TABLE II.9.3 - Soil Laboratory Analysis Summary
(Page 2 of 3)

Boring, Well or Source	Depth Top Sample (Top Tested Interval)	Depth Bottom Sample (Bottom Tested Interval)	Work Completed By	Date	USCS	Sieve - % Passing		Atterberg Limits		Carbonate %	[1]Permeability Range Based on Texture (cm/sec)	Ksat (cm/sec) (Horizotal)	Coefficient of Storage (dimensoinless)	Comments
						No. 40	No. 200	Liquid Limit	Plasticity Index					
ehole Media from Dewey Lake Redbeds														
B-1	75	76	STEC	11/8/1993	CL	85.4%	54.4%	25	8	4	10-6 to 10-8			
B-1	90	91	STEC	11/8/1993	SC	78.9%	49.2%	31	14	19	10-6 to 10-8			
B-2	65	66	STEC	11/8/1993	CL	85.4%	54.4%	25	8	4	10-6 to 10-8			
B-4	50	51	STEC	11/8/1993	SM	92.3%	40.9%	NP	NP	16	10-3 to 10-6			
B-4	140	141	STEC	11/8/1993	SC	78.9%	49.2%	31	14	19	10-6 to 10-8			
B-6	30	31	STEC	11/8/1993	CL	96.5%	73.8%	27	11	27	10-6 to 10-8			
B-6	40	41	STEC	11/8/1993	SM	83.3%	37.8%	NP	NP	40	10-3 to 10-6			
B-6	55	56	STEC	11/8/1993	SM	90.0%	30.4%	NP	NP	17	10-3 to 10-6			
B-6	110	111	STEC	11/8/1993	SM	90.2%	38.0%	NP	NP	18	10-3 to 10-6			
B-8	105	106	STEC	11/8/1993	ML	97.8%	53.9%	24	NP	5	10-3 to 10-6			
B-8	120	121	STEC	11/8/1993	ML	97.8%	53.9%	24	NP	5	10-3 to 10-6			
B-9	65	66	STEC	11/8/1993	SM	85.9%	28.6%	NP	NP	24	10-3 to 10-6			
B-10	60	61	STEC	11/8/1993	SM	92.3%	40.9%	NP	NP	18	10-3 to 10-6			
B-10	70	71	STEC	11/8/1993	CL	96.5%	73.8%	27	11	27	10-6 to 10-8			
ells Completed in the Dewey Lake Redbeds														
Lea Land MW-4	170	203	Intera	2/27/1997								4.17E-09	3.71E-09	Slug test
BLM 20.32.22.33	150	179	Geohydrology	11/8/1978								3.15E-07		Pump Test
BLM 21.31.3.22	140	160	Geohydrology	11/8/1978								1.33E-06		Pump Test

Note:
[1] Permeability range estimates from Engineering document FM-5-47/NAVFAC MO 330/AFJMAN 32-1221(1)

TABLE II.9.3 - Soil Laboratory Analysis Summary
(Page 3 of 3)

Boring, Well or Source	Work Completed By	Date	USCS	Sieve - % Passing	Max Density (pcf)	Optimum Moisture (%)	Atterberg Limits			ASTM D-2922		Ksat, (cm/sec) [Constant Head]	Ksat, (cm/sec) [Falling Head]	Ksat, (cm/sec) (Corrected) [Constant Head]	Ksat, (cm/sec) (Corrected) [Falling Head]	Cu	Cc	Calculated Porosity (%)
				No. 200			Liquid Limit	Plastic Limit	Plasticity Index	Dry Density % Maximum	Moisture Content %							
unicipal Cell Closure (Santa Rosa Sandstone and Alluvial Materials)																		
Sample 1.0	DBS&A	8/7/20014	SC	45.8%	116.12	13.9	28	18	10	80.5%	13.5%	4.4E-03		4.1E-03		326	0.84	44.8
Sample 1.1	DBS&A	8/7/20014	SC		116.12	13.9				95.2%	17.4%		5.7E-07		5.3E-07			34.7
Sample 2.0	DBS&A	8/7/20014	SC	42.8%	117.99	12.7	28	17	11	80.4%	12.3%	4.1E-03		3.8E-03		205	0.48	44.3
Sample 2.0	DBS&A	8/7/20014	SC		117.99	12.7				95.3%	15.7%		3.0E-06		2.7E-06			33.9
Sample 3.0	DBS&A	8/7/20014	SC	44.4%	114.87	14.0	27	17	10	80.1%	13.7%	6.6E-03		6.1E-03		183	0.43	45.8
Sample 3.1	DBS&A	8/7/20014	SC		114.87	14.0				94.8%	17.4%		3.9E-06		3.5E-06			35.9
Sample 4.0	DBS&A	8/7/20014	SC	43.4%	114.87	14.0	28	17	11	80.3%	13.5%	4.9E-03		4.6E-03		211	0.39	45.5
Sample 4.1	DBS&A	8/7/20014	SC		114.87	14.0				95.1%	17.0%		1.0E-06		9.4E-07			35.5
Sample 5.0	DBS&A	8/7/20014	SC	48.4%	114.87	13.6	30	18	12	80.0%	13.0%	4.4E-03		4.1E-03		176	0.21	45.2
Sample 5.1	DBS&A	8/7/20014	SC		114.87	13.6				95.2%	16.3%		1.1E-06		1.0E-06			34.8
Sample 6.0	DBS&A	8/7/20014	SC	45.2%	115.49	13.6	29	19	10	80.0%	13.4%	5.2E-03		4.7E-03		195	0.23	45.6
Sample 6.1	DBS&A	8/7/20014	SC		115.49	13.6				94.9%	16.8%		8.2E-07		7.5E-07			35.4
Sample 7.0	DBS&A	8/7/20014	SC	43.7%	114.24	13.4	27	16	11	79.9%	12.9%	6.0E-03		5.6E-03		190	0.32	45.8
Sample 7.1	DBS&A	8/7/20014	SC		114.24	13.4				95.1%	16.4%		5.6E-06		5.3E-06			35.4
Sample 8.0	DBS&A	8/7/20014	SC	47.0%	115.49	14.4	30	18	12	80.1%	13.8%	5.3E-03		5.0E-03		184	0.13	45.2
Sample 8.1	DBS&A	8/7/20014	SC		115.49	14.4				95.3%	17.1%		4.4E-07		6.4E-07			34.8
Sample 9.0	DBS&A	8/7/20014	SC	44.8%	115.49	14.1	28	18	10	80.0%	13.8%	7.8E-03		7.4E-03		170	0.40	45.2
Sample 9.1	DBS&A	8/7/20014	SC		115.49	14.1				95.2%	16.8%		1.4E-06		1.3E-06			34.9
Sample 10.0	DBS&A	8/7/20014	SC	44.5%	114.24	14.3	29	17	12	80.1%	13.8%	7.5E-03		7.0E-03		214	0.52	45.9
Sample 10.1	DBS&A	8/7/20014	SC		114.24	14.3				94.9%	17.2%		1.3E-06		1.2E-06			35.8

Note:
[1] *Permeability range estimates from Engineering document FM-5-47/NAVFAC MO 330/AFJMAN 32-1221(1)*

Elevations of the upper surface of the Dewey Lake Redbeds determined from site borings and monitoring wells at the Lea Land SWMF and a BLM monitoring well to the west of the Facility are presented in **Figure II.9.6**. The excavation envelope for the proposed Lea Land Facility is also shown, indicating that the excavation for disposal cells at the Lea Land SWMF will approach within a few feet of the Dewey Lake Redbeds. Geometries of land surface, the Dewey Lake Redbed surface and the projected facility excavation are depicted on the "shallow" local hydrogeologic cross-section B-B' in **Figure II.9.7**.

3.0 PROPOSED VADOSE ZONE MONITORING PROGRAM

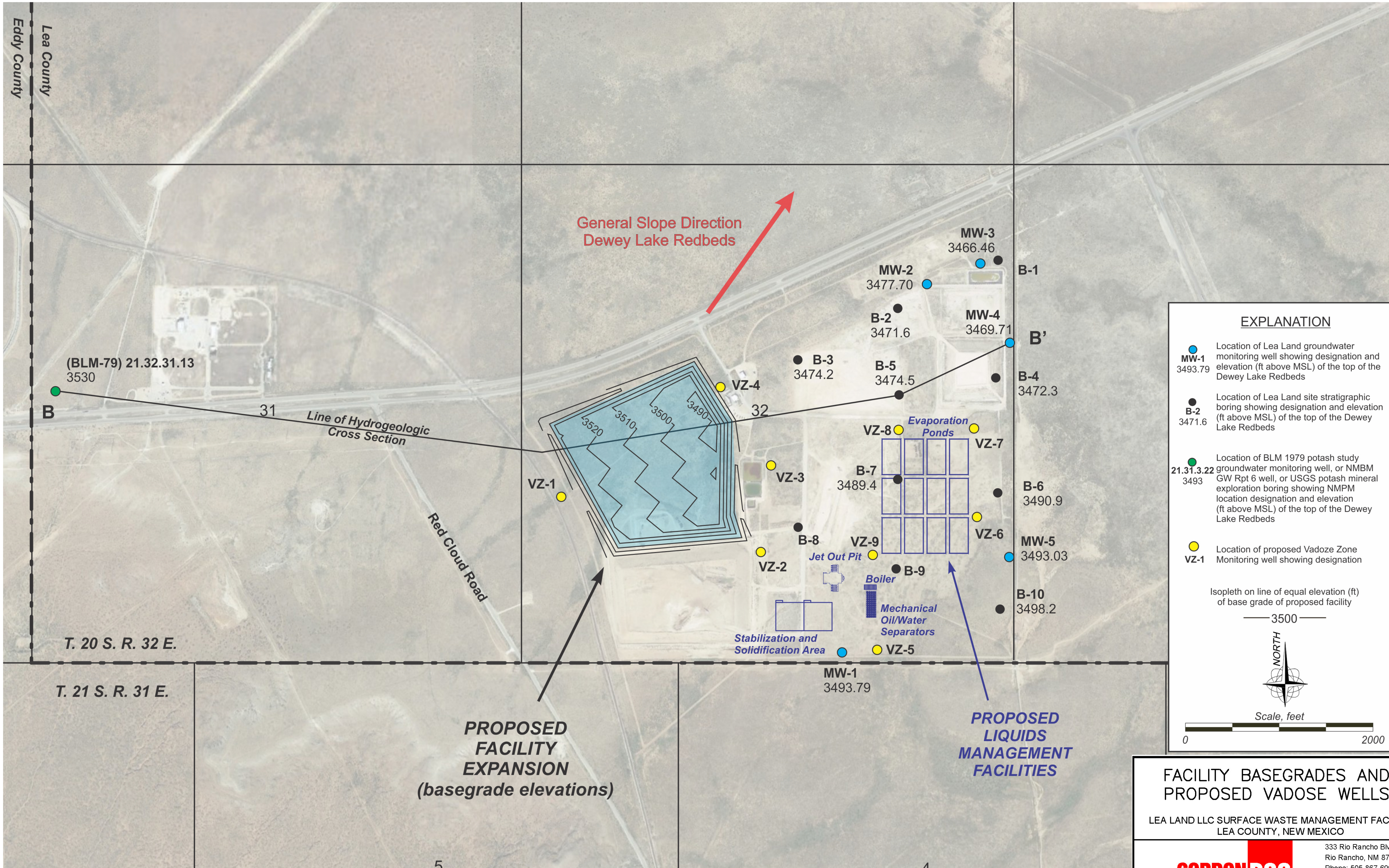
Due to the anticipated significant depth to the limited shallowest saturated zones in the Dewey Lake Redbeds, as well as high impedance to vertical water flow posed by the redbeds at the Lea Land SWMF, vadose zone monitoring is proposed as the most appropriate early detection technology for the site. The proposed vadose zone monitoring network wells would be positioned along the western and eastern boundary of the disposal cells immediately upslope and downslope on the upper Dewey Lake Redbed surface and screened across the Santa Rosa Sandstone and Dewey Lake Redbed interface, where leachate from a potential leak from the facility would be detected before approaching the saturated zones in the Dewey Lake Redbeds, more than 125 ft below.

3.1 Proposed Monitoring Well Locations

Locations of the proposed vadose zone monitoring wells for the facility are shown on the map in **Figure II.9.6.** Four wells are proposed along the western and eastern boundaries of the facility disposal cells. Based upon projection of the Dewey Lake Redbed structure, there is a high confidence level that proposed vadose zone monitoring wells will be positioned directly upgradient and downgradient from the proposed waste disposal cells.

3.2 Proposed Well Drilling and Completion

Proposed vadose zone monitoring wells would be installed using hollow-stem auger drilling methods; such that no fluids would be introduced into the borings during drilling. Drilling equipment would be equipped to switch to air rotary, should auger refusal be reached before adequate depth is reached for each vadose zone well. Undisturbed, depth-referenced samples will be collected on five-foot intervals using split spoon sampling equipment. Drive blow counts will be noted during



NOTES:

1.) GEOGRAPHIC COORDINATES FOR THE CENTER OF THE SITE:
32° 31' 46.77 N, -103° 47' 18.25 W

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Date/Time:Apr. 01, 2019-06:57:58 ; LAYOUT: B (LS)

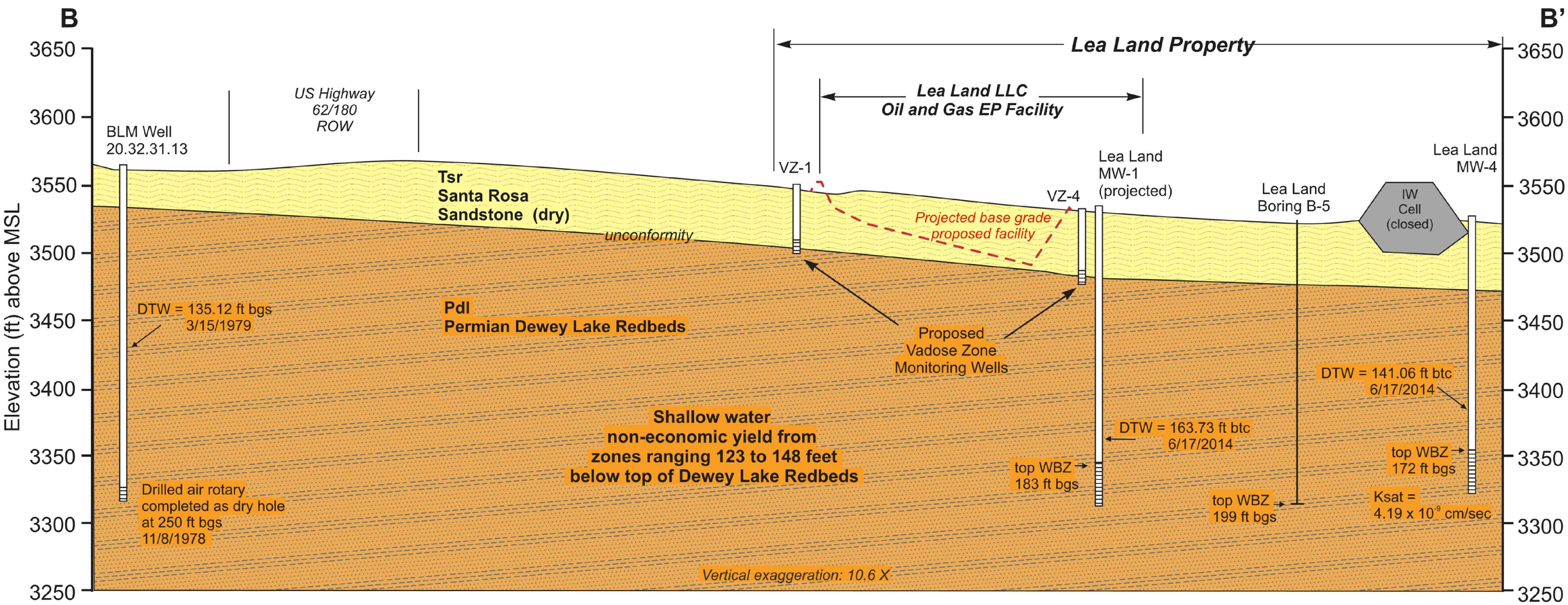
FACILITY BASEGRADES AND PROPOSED VADOSE WELLS

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 03/20/2019	CAD: PROPOSED VADOSE.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.6
APPROVED BY: CWF	www.team-psc.com	

SHALLOW LOCAL HYDROGEOLOGIC CROSS SECTION LEA LAND LLC FACILITY



EXPLANATION

- Qun — Quaternary alluvium and lacustrine deposits, undifferentiated
- Tsr — Triassic Santa Rosa Sandstone
- Pdl — Permian Dewey Lake Redbeds

Notes: btc: below top of casing
bgs: below ground surface

Drawing:X:\2018\0416.18\02_DSGN\02_DWG\050_CIVIL\02_CONTENT\PERMIT FIGURES\LOCAL HYDROGEOLOGIC CROSS-SECTION B B'.dwg
Date/Time:Mar. 29, 2019-09:09:24 ; LAYOUT: A (LS)

SHALLOW LOCAL HYDROGEOLOGIC CROSS–SECTION B–B'

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC
333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: HYDRO GEO X-SEC.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.7
APPROVED BY: CWF	www.team-psc.com	

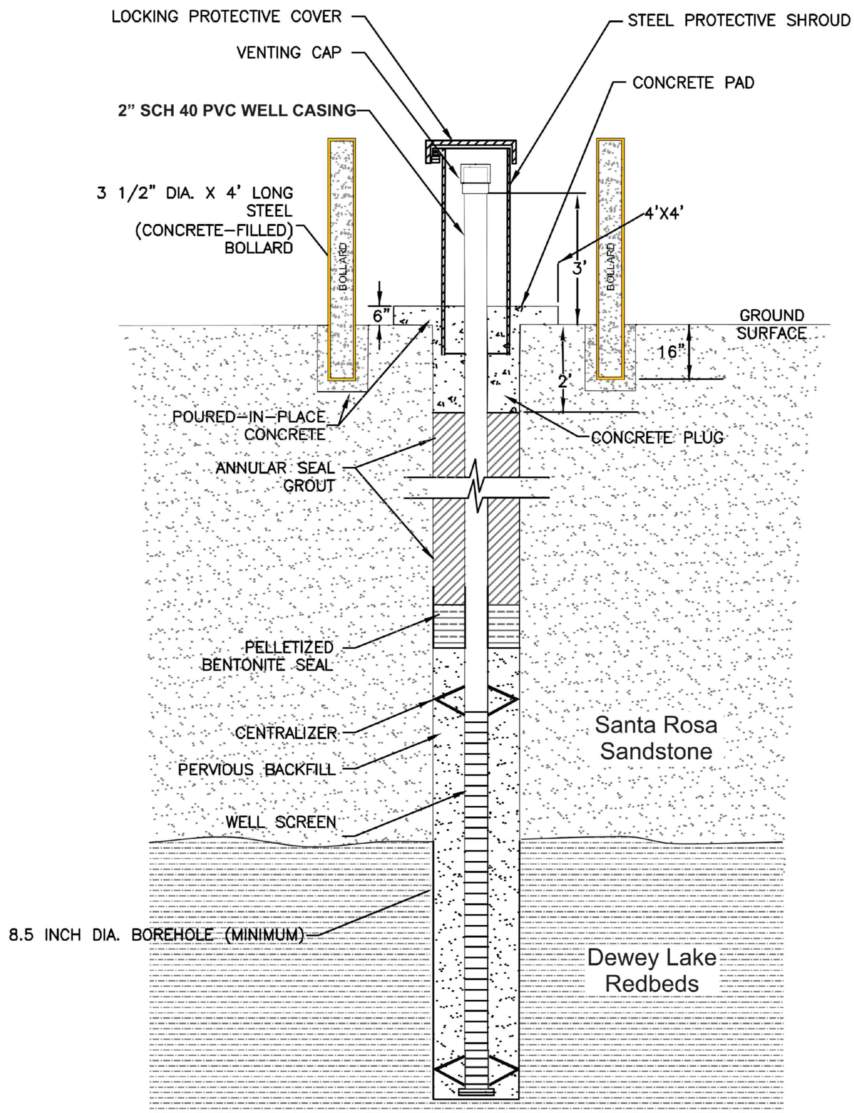
each sampling event and logged to allow precise determination of the upper redbed surface in each boring. A qualified hydrogeologist will be present on location during drilling, and will prepare detailed descriptions of the lithology, texture, sorting, rounding, color, plasticity, degree of lithification, moisture content, etc. for each sample and stratigraphic unit that is penetrated.

Each boring will be advanced into indurated Dewey Lake Redbeds to an adequate depth to reach an elevation of 3485 ft above MSL, or to a depth of five feet lower than the deepest penetration of the adjacent waste cell basegrades. Although split spoon sampling offers ample opportunity to identify saturated sediments with a high degree of confidence, each boring will be further evaluated for the presence of free water. Upon reaching total depth, the rig will be placed on standby for at least two hours, during which time soundings will be made inside the augers to check for accumulating fluid in the augers.

Vadose zone monitoring wells will be completed in accordance with specifications set forth on the well design sheet provided as **Figure II.9.8**. Each well will be completed using 2-inch schedule 40 flush joint casing, and completed with a 10-foot length of 0.010-inch slotted well screen, positioned with the lowermost end extending below the upper redbed surface to a depth adequate to reach an elevation of 3485 ft above MSL; or to a depth of five feet lower than the deepest penetration of waste cell basegrades. Well screens would span the vertical distance from approximately five feet above the Dewey Lake Redbeds and Santa Rosa Sandstone interface to total well depth. Each well annulus will be backfilled with a 10/20 grade silica sand pack extending two feet above the screen, with an annular seal consisting of bentonite grout or equivalent extending to land surface. Each well would be equipped with a radially sloped concrete surface pad with locking steel shroud extending approximately 3 ft above grade (**Figure II.9.8**).

3.3 Proposed Monitoring Program

The proposed vadose zone monitoring program would include monthly inspection of each well for the presence of fluid as with leak detection sumps in accordance with provisions set forth in 19.15.36.13.L.(1). Results of fluid detection measurements would be submitted with related leachate monitoring results in normal facility operations reporting to the OCD. If fluids are noted in any of the monitoring wells, fluid will be sampled and tested in accordance with 19.15.30.9.and



TYPICAL VADOSE ZONE MONITORING WELL

NOT TO SCALE

LEGEND

CASING: 2" DIA. SCH 40 PVC

SCREEN: 2" DIA. 0.10" MACHINE SLOT SCH 40 PVC

PEVIOUS ANNULAR FILL: 10-20 COLORADO SILICA SAND OR EQUIVALENT

ANNULAR SEAL: NEAT CEMENT WITH 2% BENTONITE OR EQUIVALENT

NOTE:

SPECIFIC VERTICAL DIMENSIONS FOR EACH NEW WELL WILL BE INCLUDED IN NMOSE AND NMOCD PERMITTING AND AS-BUILT SUBMITTALS

PROPOSED VADOSE ZONE MONITORING WELL COMPLETION

LEA LAND LLC SURFACE WASTE MANAGEMENT FACILITY
LEA COUNTY, NEW MEXICO

GORDON ENVIRONMENTAL PSC

333 Rio Rancho Blvd. NE
Rio Rancho, NM 87124
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 01/08/2019	CAD: PHYSIOGRAPHY.dwg	PROJECT #: 0416.18
DRAWN BY: DMI	REVIEWED BY: CRK	FIGURE II.9.8
APPROVED BY: CWF	www.team-psc.com	

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Date/Time:Mar. 29, 2019-09:17:16 ; LAYOUT: Layout A (P)

20.6.2.7 NMAC; and a reporting of findings will be transmitted to the division in accordance with requirements for groundwater monitoring and reporting set forth in 19.15.14.B.

4.0 CONCLUSIONS

Regional, vicinity and site characterization boring and testing data indicates that the shallowest saturated zones beneath the Lea Land SWMF are within hydraulically tight shale of the Dewey Lake Redbeds, at a depth of approximately 175 ft below land surface. Water within these beds is under confined conditions. Small non-sustainable quantities of water are present in groundwater monitoring wells at the Facility. These occurrences of groundwater are not regarded to be protectable as resources as defined by the Oil and Gas Rules:

19.15.2.7G(10) NMAC
> ***"Ground water" means interstitial water that occurs in saturated earth material and can enter a well in sufficient amounts to be used as a water supply.***

Due to the depth of the saturated zones within the Dewey Lake Redbeds and the fact that they are generally under confined conditions, a potential release from the Lea Land SWMF would not be expected to migrate readily into these confined groundwater zones through the 124-148 ft of overlying Dewey Lake redbed deposits. Therefore, groundwater monitoring wells completed in the shallow saturated zones in the Dewey Lake Redbeds at the Lea Land SWMF would not be expected to provide a high level of environmental protection as sentinel wells.

Based upon shallow stratigraphy at the site, as well as the geometry of the proposed waste disposal cells, it is concluded that vadose zone monitoring wells completed to communicate with more permeable basal Santa Rosa Sandstone sediments at the contact with underlying dense shale in the Dewey Lake Redbeds would provide the most effective early leak detection system and the greatest level of environmental protection for the site. These wells would be placed strategically at the downgradient east side of the Facility to optimize detection of potentially contaminated fluids.

This site has the advantage that the local subsurface conditions have been significantly characterized during subsurface investigations conducted at the Facility, as well as the CRI site and the 1979 BLM potash study monitoring well installation and testing. No additional reconnaissance drilling is recommended to augment the hydrogeologic or geotechnical database; however emergent subsurface data that is obtained during installations of proposed vadose zone monitoring wells will be used to update subsurface mapping and adjust well locations as appropriate. Detailed logs will be prepared for the four proposed vadose zone monitoring wells (see **Volume II.9**, Vadose Zone Monitoring Plan) and will be provided to OCD. OCD will be notified of the proposed well installation program in advance and invited to observe.

5.0 REFERENCES

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