INFORMATION ONLY

1RP-5068
DELINEATION PLAN
Jal Cooper Unit #238
Produced Water Spill
Lea County, New Mexico

Latitude: N32.192936
Longitude: W-103.226294

LAI Project No. 18-0138-01

August 31, 2018

Prepared for:
Legacy Reserves Operating, LP
303 West Wall Street, Suite 1300
Midland, Texas 79701

Prepared by:
Larson & Associates, Inc.
507 North Marienfeld Street, Suite 205
Midland, Texas 79701

Mark J. Larson, P.G.
Certified Professional Geologist #10490

Ashton Thielke
Staff Geologist

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1.0 INTRODUCTION

Larson & Associates, Inc., (LAI) has prepared this delineation plan on behalf of Legacy Reserves Operating, LP (Legacy) for submittal to the New Mexico Oil Conservation Division (OCD) District 1 for a produced water spill (Site) originating from a buried flow line associated with the Cooper Jal Unit #238 injection well located in Unit E (SW/4, NW/4) Section 25, Township 24 South, Range 36 East in Lea County, New Mexico. The Site is located in Unit A (NE/4, NE/4), Section 26, Township 24 South and Range 36 East. The geodetic position is North 32.192936° and West -103.226294. Figure 1 presents a topographic map. Figure 2 presents an aerial map.

1.1 Background

The spill occurred on May 3, 2018, due to a rupture in the buried injection line, releasing approximately 210 barrels (bbl) of produced water. Approximately 130 bbl were recovered. The fluids migrated south and southeast along the lease road for approximately 1,600 feet from the failure point, turning east and flowing approximately 700 feet before l terminating in the pasture. The spill area measures approximately 52,022 square feet. Mark Larson, on behalf of Legacy, reported the spill to the OCD (voice message communication with Maxey Brown and Olivia Yu) on May 15, 2018. The initial C-141 was submitted on May 17, 2018 and assigned remediation permit number 1RP-5068. Appendix A presents the initial C-141.

1.2 Physical Setting

The physical setting is as follows:

- The surface elevation is approximately 3,313 feet above mean sea level (msl);
- The surface topography slopes gently towards the southeast;
- There are no surface water features within 1,000 feet of the Site;
- The soil is designated as "Berino-Cacique loamy fine sands association, 0 to 3 percent slope" consisting of about 6 inches of loamy fine sand underlain by sandy clay loam to approximately five (5) feet below ground surface (bgs);
- The geology is of Eolian and Piedmont deposits (Holocene to middle Pleistocene)- interlaid eolian sands and piedmont-slope deposit of the Blackwater Draw and Ogallala formations, in descending order;
- Groundwater occurs in the Ogallala formation at approximately 100 feet bgs;
- According to the New Mexico Office of the State Engineer (NMOSE), the nearest fresh water well is located in Unit I (SE/4, NE/4), Section 24, Township 24 South, Range 36 East, approximately 1.2 miles northeast of the Site at a depth of 141 feet.

1.3 Recommended Remediation Action Levels

Recommended Remediation Action Levels (RRAL) was calculated for benzene, BTEX and TPH based on the following criteria established by the OCD in *"Guidelines for Remediation of Leaks, Spills and Releases, pp. 6-7, August 13, 1993"*:

Criteria	*Result*	*Score*
Depth-to-Groundwater	>100 Feet	0
Wellhead Protection Area	No	0
Distance to Surface Water Body	>1,000 Horizontal Feet	0

The following RRAL apply to the release for ranking score: 0

- Benzene 10 mg/Kg
- BTEX 50 mg/Kg
- TPH 5,000 mg/Kg

Depth to groundwater greater than 100 feet bgs required vertical delineation for chloride to 600 milligrams per kilogram (mg/Kg) and maintained 5 feet farther in depth.

2.0 DELINEATION PLAN

LAI proposes to collect soil samples from thirty six (36) locations along the lease road and in each cardinal direction (north, south, east and west) of the spill area.. The samples will be collected at 1 foot intervals to approximately 4 feet bgs (0-1, 1-2, etc) and 2 foot intervals to approximately 12 feet bgs (4-6, 6-8, etc) using direct push technology (DPT) depending on subsurface conditions. The soil samples will be delivered under preservation and chain of custody to Xenco Laboratories (Xenco) in Midland, Texas. The upper samples (0 to 1 foot) will be analyzed for BTEX (the sum of benzene, toluene, ethylbenzene and xylenes) and TPH (total petroleum hydrocarbons), including gasoline range organics (GRO), diesel range organics (DRO) and oil range organics (ORO) by EPA SW-846 Methods 8021B and 8015M, respectively. Additional samples will be analyzed for BTEX and TPH for vertical delineation should the initial samples report concentrations above the RRAL. All samples will be analyzed for chloride by Method 300 respectively. Pending laboratory results, further delineation will be determined to reach clean up level standards. Figure 2 presents the proposed sample locations. Appendix B presents photographs.

3.0 REMEDIATION

Legacy will include a remediation plan in the delineation report to be submitted to the OCD upon receipt of the laboratory report.

Figures

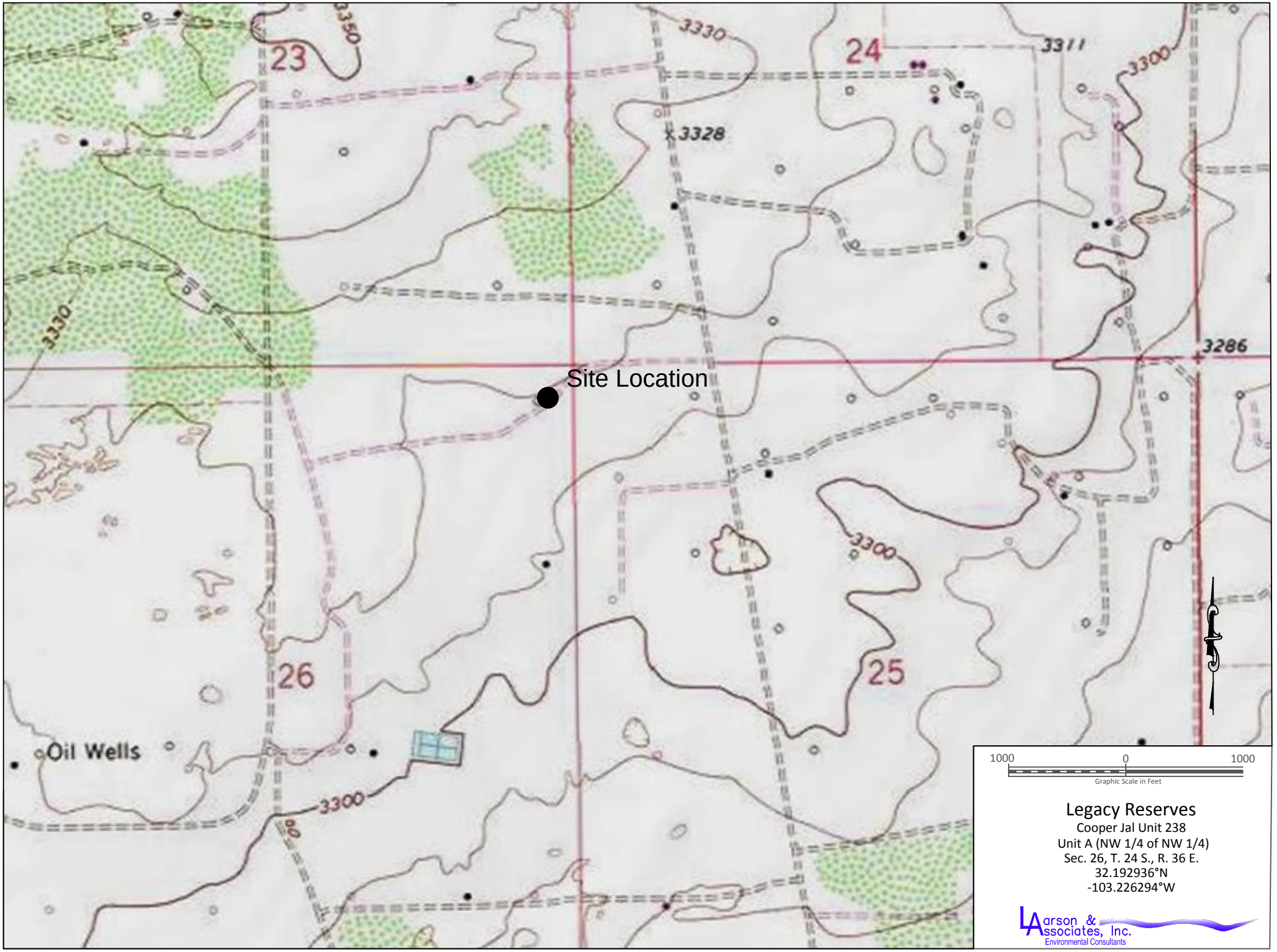

Figure 1 - Topographic Map

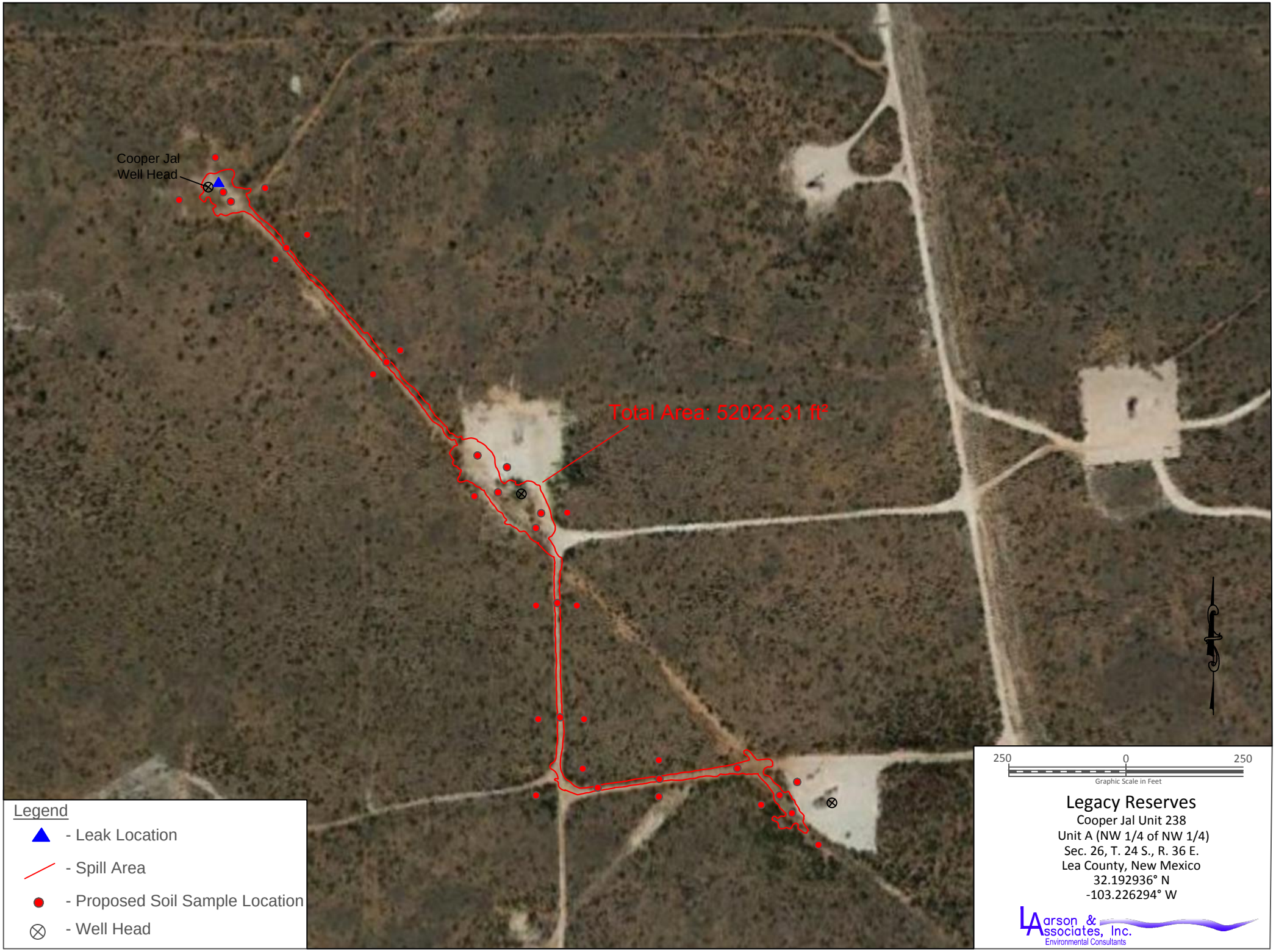

Figure 2- Aerial Map Showing Proposed Soil Sample Locations

Appendix A

Initial 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

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

Form C-141
Revised August 8, 2011

Submit 1 Copy to appropriate District Office in accordance with 19.15.29 NMAC.

Release Notification and Corrective Action

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company: Legacy Reserves Operating, LP	Contact: Clyde Wilhoit
Address: 303 W. Wall Street, Suite 1300 Midland, TX 79701	Telephone No. 432-425-4137
Facility: Cooper Jal Unit #238 Flowline	Facility Type: Flow Line

Surface Owner: Private	Mineral Owner: Federal	API No. 30-025-09659

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
A	26	24S	36E					Lea County

Latitude 32.192936° **Longitude** -103.226294°

NATURE OF RELEASE

Type of Release: Injection Water	Volume of Release: 210 bbl	Volume Recovered: 130 bbl
Source of Release: Flow Line Rupture	Date and Hour of Occurrence May 3, 2018	Date and Hour of Discovery May 3, 2018—15:00MST
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	If YES, To Whom? Verbal notification was done by voice message to Maxey Brown and Olivia Yu.	
By Whom? Mark Larson	Date and Hour 5/15/2018 at 13:10	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse.	

If a Watercourse was Impacted, Describe Fully.*
N/A

RECEIVED
By Olivia Yu at 8:40 am, May 22, 2018

Describe Cause of Problem and Remedial Action Taken.*
Approximately 210 bbl of injection water was released from a rupture in a flowline. Fluid traveled south along lease road for 1,600 feet and then turned to the east after reaching an intersection and traveled 700 additional feet. 130 bbl of fluid were recovered. The total area affected by this release is 52,022 square feet.

Describe Area Affected and Cleanup Action Taken.*
Larson & Associates, Inc. , will prepare a plan to delineate the spill for OCD approval. A delineation report with remediation plan will be submitted to the OCD for approval prior to remediation of the spill.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD 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 NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD 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.

Signature: Clyde Wilhoit	OIL CONSERVATION DIVISION
Printed Name: Clyde Wilhoit	Approved by Environmental Specialist:
Title: Maintenance Foreman	Approval Date: 5/22/2018 Expiration Date:
E-mail Address: cwilhoit@legacylp.com	Conditions of Approval: see attached directive Attached ☑
Date: 5/17/18 Phone: 432-425-4137	

1RP-5068 nOY1814231747 pOY1814232044

Operator/Responsible Party,

The OCD has received the form C-141 you provided on _5/17/2018_ regarding an unauthorized release. The information contained on that form has been entered into our incident database and remediation case number _1RP-5068__ has been assigned. **Please refer to this case number in all future correspondence.**

It is the Division's obligation under both the Oil & Gas Act and Water Quality Act to provide for the protection of public health and the environment. Our regulations (19.15.29.11 NMAC) state the following,

> *The responsible person shall complete division-approved corrective action for releases that endanger public health or the environment. The responsible person shall address releases in accordance with a remediation plan submitted to and approved by the division or with an abatement plan submitted in accordance with 19.15.30 NMAC.* [emphasis added]

Release characterization is the first phase of corrective action unless the release is ongoing or is of limited volume and all impacts can be immediately addressed. Proper and cost-effective remediation typically cannot occur without adequate characterization of the impacts of any release. Furthermore, the Division has the ability to impose reasonable conditions upon the efforts it oversees. **As such, the Division is requiring a workplan for the characterization of impacts associated with this release be submitted to the OCD District _1_ office in __Hobbs____ on or before _6/22/2018_. If and when the release characterization workplan is approved, there will be an associated deadline for submittal of the resultant investigation report. Modest extensions of time to these deadlines may be granted, but only with acceptable justification.**

The goals of a characterization effort are: 1) determination of the lateral and vertical extents along with the magnitude of soil contamination. 2) determine if groundwater or surface waters have been impacted. 3) If groundwater or surface waters have been impacted, what are the extents and magnitude of that impact. 4) The characterization of any other adverse impacts that may have occurred (examples: impacts on vegetation, impacts on wildlife, air quality, loss of use of property, etc.). To meet these goals as quickly as possible, the following items must, at a minimum, be addressed in the release characterization workplan and subsequent reporting:

● Horizontal delineation of soil impacts in each of the four cardinal compass directions. Adsorbed soil contamination must be characterized for the following constituents using the associated laboratory methods: benzene, toluene, ethylbenzene, and total xylenes by either Method 8260 or 8021, total petroleum hydrocarbons by Method 8015 extended range (GRO+DRO+MRO; C_6 thru C_{36}), and for chloride by Method 300. This is not an exclusive list of potential contaminants. Analyzed parameters should be modified based on the nature of the released substance(s). Soil sampling must be both within the impacted area and beyond.

● Vertical delineation of soil impacts. Adsorbed soil contamination must be characterized for the following constituents using the associated laboratory methods: benzene, toluene, ethylbenzene, and total xylenes by either Method 8260 or 8021, total petroleum hydrocarbons by Method 8015 extended range (GRO+DRO+MRO; C_6 thru C_{36}), and for chloride by Method 300. As above, this is not an exclusive list of potential contaminants and can be modified. Vertical characterization samples should be taken at depth intervals no greater than five feet apart. Lithologic description of encountered soils must also be provided. At least ten vertical feet of soils with contaminant concentrations at or below these values must be demonstrated as existing above the water table.

● Nominal detection limits for field and laboratory analyses must be provided.

● Composite sampling is not generally allowed.

● Field screening and assessment techniques are acceptable (headspace, titration, EC [include algorithm for validation purposes], EM, etc.), but the sampling and assay procedures must be clearly defined. Copies of field notes are highly desirable. A statistically significant set of split samples must be submitted for confirmatory laboratory analysis, including the laterally farthest and vertically deepest sets of soil samples. Make sure there are at least two soil samples submitted

for laboratory analysis from each borehole or test pit (highest observed contamination and deepest depth investigated). Copies of the actual laboratory results must be provided including chain of custody documentation.

●Probable depth to shallowest protectable groundwater and lateral distance to nearest surface water. If there is an estimate of groundwater depth, the information used to arrive at that estimate must be provided. If there is a reasonable assumption that the depth to protectable water is 50 feet or less, the responsible party should anticipate the need for at least one groundwater monitoring well to be installed in the area of likely maximum contamination.

● If groundwater contamination is encountered, an additional investigation workplan may be required to determine the extents of that contamination. Groundwater and/or surface water samples, if any, must be analyzed by a competent laboratory for volatile organic hydrocarbons (typically Method 8260 full list), total dissolved solids, pH, major anions and cations including chloride and sulfate, dissolved iron, and dissolved manganese. The investigation workplan must provide the groundwater sampling method(s) and sample handling protocols. To the fullest extent possible, aqueous analyses must be undertaken using nominal method detection limits. As with the soil analyses, copies of the actual laboratory results must be provided including chain of custody documentation.

● Accurately scaled and well-drafted site maps must be provided providing the location of borings, test pits, monitoring wells, potentially impacted areas, and significant surface features including roads and site infrastructure that might limit either the release characterization or remedial efforts. Field sketches may be included in subsequent reporting, but should not be considered stand-alone documentation of the site's layout. Digital photographic documentation of the location and fieldwork is recommended, especially if unusual circumstances are encountered.

Nothing herein should be interpreted to preclude emergency response actions or to imply immediate remediation by removal cannot proceed as warranted. Nonetheless, characterization of impacts and confirmation of the effectiveness of remedial efforts must still be provided to the OCD before any release incident will be closed.

Jim Griswold
OCD Environmental Bureau Chief
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
505-476-3465
jim.griswold@state.nm.us

From:	Mark Larson
To:	Yu, Olivia, EMNRD
Cc:	"sdittman@legacylp.com"; Ashton Thielke
Subject:	Re: Initial C-141 - Cooper Jal Unit #238 Produced Water Spill, May 3, 2018
Date:	Thursday, May 17, 2018 2:01:00 PM
Attachments:	Signed C-141, May 17, 2018.pdf

Olivia,
On behalf of Legacy Reserves, L.P. (Legacy) please find the initial C-141 for a produced water spill from a flow line connected with the Cooper Jal Unit (CJU) #283 in Lea County, New Mexico. The spill occurred on May 3, 2018, due to rupture of the buried flow line near plugged well (CJU #222) in Unit A (NE/4, NE/4), Section 26, Township 24 South, Range 36 East. Legacy attempted to verbally notify OCD but was not successful with speaking to a representative. Larson & Associates, Inc. (LAI) left voice messages with OCD representatives, Maxey Brown and Olivia Yu, on May 15, 2018, at about 1:10pm and 1:15 pm (mountain time).The spill involved approximately 210 barrels (bbl) of produced water with appproximatel130 bbls recovered. LAI will submit the delineation plan upon arrival of the initial C-141 and issuance of the remediation permit number. Please contact Steve Dittman with Legacy at (432) 312-4757, Ashton Thielke with LAI at (432) 556-5818 or me if you have questions.
Respectively,

Mark J. Larson, P.G.
President/Sr. Project Manager
507 N. Marienfeld St., Suite 205
Midland, Texas 79701
Office - 432-687-0901
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Fax - 432-687-0456
mark@laenvironmental.com

"Serving the Permian Basin Since 2000"

Appendix B

Photographs

1RP-5068
Delineation Plan
Cooper Jal Unit #238
Produced Water Spill
Lea County, New Mexico

Spill Origin East of Cooper Jal Unit #222 (P/A) Viewing East, May 4, 2018

Washout from Injection Line Rupture East of Cooper Jal Unit #222 (P/A), May 4, 2018

Washout and Spill Viewing Southeast of Cooper Jal Unit #222 (P/A), May 4, 2018

Spill Viewing South from Cooper Jal Unit #222 (P/A), May 4, 2018

1RP-5068
Delineation Plan
Cooper Jal Unit #238
Produced Water Spill
Lea County, New Mexico

Spill Viewing North to Cooper Jal Unit #222 (P/A), May 4, 2018

Spill Viewing Southeast from Cooper Jal Unit #222 (P/A), May 4, 2018

Spill Viewing Southeast from Cooper Jal Unit #222 (P/A), May 4, 2018

Spill Viewing Southeast to Road Intersection, May 4, 2018

Spill Viewing Southeast to Road Intersection, May 4, 2018

Spill Viewing Southeast to Road Intersection, May 4, 2018

Spill Viewing Southeast to Road Intersection, May 4, 2018

Spill Viewing East South of Road Intersection, May 4, 2018

Spill Viewing South of Road Intersection, May 4, 2018

Spill Viewing South of Road Intersection, May 4, 2018

Spill Viewing South of Road Intersection, May 4, 2018

Spill Viewing Southeast to Road Intersection, May 4, 2018

Spill Viewing East of Road Intersection, May 4, 2018

Spill Viewing East of Road Intersection, May 4, 2018

Spill Viewing East of Road Intersection, May 4, 2018

Spill Viewing South to Terminal End of Spill, May 4, 2018

Spill Viewing South to Terminal End of Spill, May 4, 2018

Spill Viewing North from Terminal End of Spill, May 4, 2018