Chevron and Key Proposed Most Feasible Plan for Site Evaluation and Remediation Under R.S. 30:29

Paul M. Levert et al. vs. Union Texas International Corp et al.

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1. INTRODUCTION

Environmental Resources Management Southwest, Inc. (ERM) has prepared this Chevron and Key Most Feasible Plan for Site Evaluation and Remediation Under R.S. 30:29 (Plan) pertaining to the Paul M. Levert et al. vs. Union Texas International Corp et al. matter. This Plan is submitted to the Louisiana Department of Energy and Natural Resources (LDENR) Office of Conservation in support of the March 14, 2025 Chevron U.S.A. Inc. (Chevron) and Key Production Company, Inc. (Key) joint limited admission to the court under La. R.S. 30:29. The focus of this Plan is the former Chevron and Key operations within the areas identified in the limited admission on the property at issue in the lawsuit, located in the Bayou Choctaw oil and gas field in West Baton Rouge Parish, Louisiana. The property is the subject of a lawsuit which alleges that Chevron, Key, and others caused alleged soil and groundwater contamination that the plaintiffs assert has been caused by historical oil and gas exploration and production (E&P) operations. The lawsuit was filed in the 18th Judicial District Court of West Baton Rouge Parish. The objective of this Plan is to present the results of the site investigation activities conducted to date in the vicinity of the former Chevron and Key operations and provide a Most Feasible Plan for further evaluation and remediation under La. R.S. 30:29.

1.1 OVERVIEW OF FINDINGS

An extensive investigation of the site has been conducted that has included the collection and analysis of the following:

- Soil borings;
- Electrical conductivity (EC) and hydraulic profiling tool (HPT) probes;
- Monitoring wells;
- Soil samples;
- Groundwater samples;
- Surface water samples;
- Slug tests;
- NORM surveys; and
- Site inspections, field notes, and photographs.

ERM has applied both LDENR Statewide Order 29-B (29-B) and Louisiana Department of Environmental Quality (LDEQ) Risk Evaluation/Corrective Action Program (RECAP) regulatory framework and standards to the investigation of soil and groundwater underlying the site and to determine the most feasible evaluation and remediation plan. Through the course of the investigation, ERM installed soil borings for both lateral and vertical delineation of 29-B parameters in soil. Additionally, as further described herein, ERM applied RECAP standards to evaluate the ICON reported non-29-B parameters, including total petroleum hydrocarbons (TPH) and barium, and to evaluate the soil-to-groundwater pathway for E&P-related constituents in the former Chevron and Key operational areas including salt below the effective root zone.

As part of its field investigation, ERM conducted assessment of the shallow water-bearing zone underlying the site. The groundwater assessment included an extensive investigation into the hydrogeology, usability and yield of the shallow water bearing zone, groundwater classification, and further lateral and vertical characterization of the plaintiffs' consultant's data. Through the groundwater investigation, as further described herein, ERM has demonstrated:

- Groundwater is delineated vertically, and is delineated horizontally to declining concentrations
- Groundwater to the west and south of the site has previously been evaluated and granted a No Further Action (NFA) status from LDENR
- Shallow water bearing zone groundwater concentrations are protective of the underlying Mississippi River Alluvial Aquifer
- The groundwater in the shallow water bearing zone is GW3 in accordance with LDEQ RECAP based upon the yield (slug) testing. Additionally, it is naturally non-potable due to the presence of naturally elevated concentrations of arsenic, iron, and manganese above their respective United States Environmental Protection Agency (EPA) Primary or Secondary Maximum Contaminant Level (MCL or SMCL) concentrations.

Based on the evaluation of sampling results to date, including the RECAP evaluation, Human Health Risk Assessment, Ecological Risk Assessment (ERA), Effective Root Zone (ERZ) study, ICON's NORM evaluation, and evaluation of former E&P operations herein, no active remediation of groundwater is required, and soil remediation within the limited admission areas is required at the site to comply with La. R.S. 30:29. The proposed remediation scope will result in site conditions that are protective of human health for non-industrial land use with no restrictions required. The estimated cost for soil remediation is approximately $1,324,070. An additional contingent soil remediation, dependent on composite sampling results, could be completed for approximately $115,035, if required by LDENR. The estimated cost for groundwater monitoring to confirm stable conditions is approximately $236,253. Although not proposed by ERM, a contingent active remedy to address benzene in groundwater has been prepared, with an estimated cost of approximately $128,801, if required by LDENR.

2. SITE SETTING

The plaintiffs' property is located approximately 10 miles southwest of Baton Rouge within the Bayou Choctaw Field in West Baton Rouge Parish, Louisiana (Figure 1). The property subject to this litigation encompasses approximately 160 acres located in Section 28 of Township 08 South, Range 11 East, hereinafter "the property" or "the site".

2.1 LAND USE AND GROUND SURFACE TOPOGRAPHY

The property is mostly comprised of Freshwater Forested/Shrub Wetland, with some Freshwater Emergent Wetland, with primary land uses consisting of oil and gas E&P operations, recreation (hunting), timber production, and utility rights-of-way. Large areas throughout the property are undeveloped. E&P operations were conducted using roads and pads constructed within the wetland areas. Active E&P operations are not currently being conducted on the property; however, a salt cavern brine disposal well is in active use on the property and is used for the disposal of brine generated off-site from the Bayou Choctaw salt dome. The surrounding area is also primarily a forested wetland setting with similar land uses to the property. A residential development is present to the south of the eastern portion of the property. The area beyond the property to the east is used for agricultural purposes.

Figure 2 is a USGS Topographic Map with Public Land Survey System section lines, and Figure 3 is a LiDAR site elevation model. The elevation of the property ranges from approximately +3.5 to +7.5 feet above mean sea level, with slightly higher elevations on the eastern portion of the site and along roads and other areas built up during oil and gas E&P operations.

2.2 WETLAND CLASSIFICATION

Figure 4 is a wetlands map developed by the U.S. Fish and Wildlife Service (USFWS). The map shows the following wetland categories, which are present throughout the site:

- Freshwater Forested Shrub Wetland:

  Swampland characterized by shrubby vegetation such as buttonbush, willow, dogwood, and swamp rose, and hardwood trees such as bald cypress and water tupelo. Soils are saturated year-round.
- Freshwater Emergent Wetland:

  Emergent plants (i.e., rooted aquatic plants that extend above the water's surface) are the dominant plants and are generally present throughout the growing season. Perennial plants are the dominant type of vegetation.

In the area of the site, Emergent Wetlands are mapped along a pipeline right-of-way vegetation management (i.e., mowing) is conducted. The USFWS wetland map also includes a freshwater pond in the southwest portion of the property.

The entire site is located in floodzone AE (Figure 5). Flood zone AE is considered a special flood hazard area because flood risks are very high. This is also known as the 100 year floodplain, with a 1% chance of flooding every year.

2.3 SURFACE WATER

Surface water features from the USGS National Hydrography Dataset are shown on Figure 6. Mapped surface water features on the property include shallow ponded water in the southwest corner of the property. Other surface water features in the surrounding area include Bayou Bourbeaux to the north and west of the property, and the Intracoastal Waterway (ICWW) approximately 1.3 miles west of the property. The property is located within the Louisiana Department of Environmental Quality (LDEQ) Drainage Basin Subsegment #120109 Intracoastal Waterway - From Port Allen Locks to Bayou Sorrel Locks, as shown in Figure 7. The LDEQ Numerical Criteria for chloride and total dissolved solids (TDS) for Subsegment #120109 are 60 mg/L and 300 mg/L, respectively. The Designated Uses of this Subsegment are as follows:

- A – Primary Contact Recreation
- B – Secondary Contact Recreation
- C – Fish and Wildlife Propagation
- D – Drinking Water Supply

2.4 SURFACE SOILS

Based upon the United States Department of Agriculture (USDA) soils map (Figure 8), the surface soils at the property are primarily composed of clay, with a small area of silt clay loam in the northeastern portion of the property. Descriptions of the different soil types are provided below (USDA, 1982; 2024 USDA Web Soil Survey; and Official Soil Series Descriptions accessed 2024):

Sharkey clay (Sf) –

Very deep, poorly and very poorly drained, very slowly permeable soils that formed in clayey alluvium. These soils are on flood plains and low terraces of the Mississippi River; Slope is dominantly less than 1 percent, but ranges to 5 percent. Surface runoff is negligible to very high depending on slope. Permeability is very slow. Unprotected areas typically flood for long to very long durations, most years.

Tunica clay (Tc) –

Deep, poorly drained soils that formed in clayey alluvium and the underlying loamy alluvium. These soils are on the lower parts of natural levees on the younger meander belts of the Mississippi River and its tributaries of the Lower Mississippi Valley. Slope is dominantly 0 to 3 percent but ranges to 5 percent on narrow ridges within the flood plain. These soils are frequently flooded unless protected by levees, especially during the spring and fall months.

Commerce silty clay loam (Cm) –

Deep, somewhat poorly drained, moderately slowly permeable soils that formed in loamy alluvial sediments. These soils are on level to undulating alluvial plains of the Mississippi River and its tributaries. Slope is dominantly less than 1 percent but ranges up to 5 percent.

2.5 SURFACE GEOLOGY

The property is located within the Mississippi Alluvial Valley, and the surface geology is comprised of Quaternary-age, fluvial deposited sediments (Figure 9). The majority of the property is mapped as backswamp deposits of the Mississippi River. The southeastern portion of the property is mapped as a natural levee complex of the Mississippi River meander belt.

2.6 HYDROGEOLOGY AND GROUNDWATER

The area is underlain by the Mississippi River Alluvial Aquifer (MRAA), which is present beneath a clay confining unit that is generally 75 to 125 feet thick (Whiteman, 1972). The MRAA was historically referred to as the Plaquemine Aquifer in this area, but the USGS and others use the currently accepted designation of MRAA. A regional cross section published by Whiteman (1972) runs adjacent to the site and is presented on Figure 10. The cross-section depicts approximately 100 feet of confining clay at the surface, beneath which are the upper sand and lower sand of the MRAA, which contain fresh water to a depth of approximately 500 feet below ground surface (bgs). The base of the MRAA and the underlying aquifers contain salt water in this area. This is consistent with *The Water Resources of West Baton Rouge Parish* (USGS, 2016), which depicts the base of fresh groundwater near the property at an elevation of 400 to 499 feet below sea level. The surficial clay confining unit restricts infiltration of precipitation into the groundwater system. The property is located within an area that has no potential for aquifer recharge (Figure 11).

The MRAA is in hydraulic connection with the Mississippi River near the property, and water levels in the aquifer fluctuate in response to changes in the river stage (USGS, 2016). Whiteman (1972) reports that the MRAA is at times artesian in the area (i.e., water will naturally discharge from a well at the ground surface without the use of a pump), and water levels are as much as 15 feet above ground surface. Yields of more than 1,000 gallons per minute (gpm) are common from large diameter wells in the area and yields of more than 5,000 gpm have been obtained without utilizing the full capability of the aquifer (Whiteman, 1972).

A search of the LDENR SONRIS database identified 31 registered water wells, excluding monitoring wells, within a one-mile radius of the Site (Figure 12). No registered water wells are located on the property and all are registered as being completed in the MRAA. The results of the search are as follows:

- 3 domestic (all active);
- 6 public supply, rural public supply, institution public supply, or commercial public supply (4 active; 2 P&A'd);
- 13 industrial wells (4 active; 3 P&A'd; 2 abandoned; 4 destroyed);
- 8 rig supply wells (2 active; 4 P&A'd; 2 destroyed); and
- 1 unknown well (1 P&A'd).

In addition to the 31 registered water wells, 10 other registrations were identified that are not related to water wells (1 heat pump, 2 dewatering, and 7 boreholes).

All of the wells are registered as being completed in the Mississippi River Alluvial Aquifer (if geologic unit of completion was reported), with screened intervals ranging from 72 to 305 feet below ground surface, if known. No use of the shallow water-bearing zones within the confining unit overlying the MRAA was identified on the property or within a one-mile radius. A summary of LDENR registered water wells within a one-mile radius is provided in Table 1. Water well files from the LDENR SONRIS database are provided in Appendix A.

Chloride data from the United States Geological Survey National Water Quality Monitoring database is plotted on Figure 13 and shows that groundwater is generally fresh in the MRAA near the property. Limited elevated chloride concentrations were reported above the Bayou Choctaw salt dome, which is further discussed in Section 2.8.1.

2.6.1 ARSENIC IN SOILS AND GROUNDWATER

Arsenic is naturally present in soil as well as the waters that come into contact with soil at the property and throughout Louisiana (Ori, et al., 1993). Ori, et al. (1993) has reported arsenic concentrations ranging from near zero to 73 mg/kg, with a mean concentration of 23.2 mg/kg in over 450 alluvial and other soil samples from across Louisiana. In general, finer grained soils (i.e., clays and silts) and groundwater in contact with finer grained soils tend to exhibit higher arsenic concentrations than coarser grained soils (i.e., sands) and associated groundwater.

Relevant to the Levert property and this site investigation, published studies have identified that strongly reducing aquifers often derived from alluvium tend to exhibit elevated arsenic concentrations (Smedley and Kinniburgh, 2002). These groundwater zones also tend to contain geologically young sediments and are located in flat, low-lying areas where groundwater flow is sluggish. Consistent with this characterization, Yang, et al. (2014) reported that "Aquifers with elevated groundwater As (arsenic) concentrations commonly consist of Holocene riverine and deltaic sediments that are under reducing conditions, poorly drained, and associated with high levels of organic matter content." As shown on Figure 14, the shallow water-bearing zones underlying the Levert property are susceptible to contamination from naturally-occurring arsenic containing minerals in the alluvial soils as documented by Yang, et al. (2014). The shallow water-bearing zones within the MRAA surficial confining unit beneath the property contain geologically young (Holocene) sediments and exhibit reducing conditions, and naturally elevated arsenic concentrations, consistent with both the Smedley and Kinniburgh (2002) and Yang, et al. (2014) references.

The LDENR recognized this natural condition and in 2010 issued a Memorandum and alluvial aquifer water quality summary to Louisiana Licensed Water Well Contractors that stated the following regarding the presence of arsenic in alluvial aquifers: "Louisiana alluvial aquifer groundwater quality is reported by the USGS to be primarily limited to use for industrial and agricultural purposes due to excessive concentrations of dissolved solids, hardness, iron, or localized salinity. The natural groundwater quality of these aquifer systems is generally considered not suitable for drinking water supply purposes without first undergoing appropriate water treatment. Furthermore, it is reported that other dissolved metals such as arsenic have been, and are expected to be, detected in groundwater in localized areas of these aquifers."

Site investigation activities on the property identified the presence of naturally elevated arsenic in soil and groundwater beneath the property, which is further discussed in Section 7.

2.7 UNDERGROUND PIPELINES

Figure 15 shows underground pipelines from the Rextag database. A pipeline right-of-way transects the property in a roughly north-south direction and contains ExxonMobil crude oil and natural gas pipelines. During ERM's site investigation activities, a Boardwalk brine pipeline was identified that is not mapped in the Rextag database. The brine pipeline runs near the site access road to the active brine disposal well (SN 76522), then transects the property in a northeastern direction towards an offsite active brine disposal well (SN 165353)

2.8 NEARBY INDUSTRIAL DEVELOPMENT AND DREDGING

2.8.1 BAYOU CHOCTAW STRATEGIC PETROLEUM RESERVE

The Bayou Choctaw Strategic Petroleum Reserve (SPR) is located less than ½ mile from the Levert Property (Figure 16) and was developed to store a stockpile of crude oil in salt caverns designed to provide the country with energy and economic security in the event of a disruption in supply. The SPR facility was originally reported to be capable of storing 65,000,000 barrels of crude oil (SPR Report on Capability to Distribute Oil 1984) and has the capacity to store 76,000,000 barrels of crude oil in seven storage caverns (SPR Site Environmental Report 2013).

Notable findings regarding regional surface water and groundwater impacts at the SPR, based on the Annual Environmental Reports, include the following:

- In the past, salt cavern storage operations (including the SPR) discharged water that contained elevated levels of chlorides (and Total Dissolved Solids) as a result of brine used in the process wastewater into drainage ditches or canals. Surface water monitoring has been conducted by the SPR on a periodic basis and reported annually since 1982 (SPR Site Environmental Reports). Elevated salinity is periodically detected in the monitored surface water bodies, with greater frequency and higher concentrations near the center of the SPR facility.
- Historically, the salt cavern storage operations had spills and releases of brine and hydrocarbons as would be expected from any large industrial operation. The annual environmental reports prepared by the SPR frequently included observations and findings based on the environmental assessments that included collection of surface water and groundwater data.
- Groundwater monitoring has been conducted by the SPR on a periodic basis and reported annually since 1982. Estimated chloride concentrations in monitoring wells in the shallow water-bearing zone on the SPR range from less than approximately 277 to 52,584 mg/L based on the results presented in the Site Environmental Reports.

2.8.2 INTRACOASTAL WATERWAY

The Port Allen Lock Intracoastal Waterway (ICWW) was completed by the Army Corp of Engineers in 1956 and is approximately 1.3 miles west of the Levert Property at its nearest point (Figure 16). In the immediate vicinity of the site it was dredged along the former natural course of Bayou Choctaw. The waterway runs from the Mississippi River (via the Port Allen Lock) to Morgan City serving as a significant shortcut (160 miles) for industrial barge traffic to the Gulf ICWW. The ICWW has a significant impact on surface water hydrology in the area. Approximately 20 to 40 million gallons of water per day are diverted from the Mississippi River via the ICWW into this watershed. As documented by the US Army Corp of Engineers, this serves a vital role in "freshening" this drainage basin. Transects of the ICWW performed by Michael Pisani & Associates (MP&A) while investigating an adjacent property in 2015 documented a base elevation as low as -19.4 feet (22.5-foot water depth), which is considerably deeper than bayous and other surface drainage features in the area.

2.9 NEARBY LEGACY LAWSUITS

Legacy lawsuits have been filed and assessment and remediation work has been performed on three properties in the immediate vicinity of the Levert property. The Dupont property was the subject of a lawsuit captioned *Dupont v. Metairie Energy Co., Inc. et al*. The Wilbert property was the subject of a lawsuit captioned *Mary Josephine Buquoi Primeaux et al v. Exxon Mobil Corp*., et al. The Global Marketing property, located immediately west of the Levert property, was the subject of a lawsuit captioned *Global Marketing v. Blue Mill Farms, et al*. These properties are located in the Bayou Choctaw Oil Field and are shown on Figure 17.

Each of these properties has been characterized extensively through assessment and remedial alternatives analysis processes. The remedial alternatives evaluation, planning, and remediation/monitoring implementation were performed in consultation with and under the oversight of the LDENR Office of Conservation (LDENR OC) Environmental Division. These properties are characterized by similar site settings to the Levert property, similar constituents of concern at similar concentrations to the Levert property, and all were evaluated by LDENR OC in a manner consistent with the approach that ERM has taken in the evaluation presented in this report and the remediation plan presented in Section 10. LDENR concurred that shallow groundwater at each of these properties was Class 3. A similar approach to that presented at the Levert property was utilized to demonstrate that there is no connection between shallow groundwater and the downgradient surface water body. There is consistency in the constituents of concern and the range of concentrations present for each of the sites in soil and shallow groundwater. LDENR concurred with a response action for each site that included soil remediation focused on former pits and groundwater monitoring to demonstrate stability of groundwater conditions. For each of the three nearby properties, a No Further Action (NFA) determination has been issued by LDENR OC or all measures have been implemented by the responsible parties in accordance with the LDENR-approved plans and a request for NFA by the Department is under review and pending.

Maps showing chloride concentrations in groundwater from the investigations on the adjacent properties are provided in Appendix B.

3. HISTORICAL AND CURRENT E&P OPERATIONS

The property is located within the Bayou Choctaw Oil and Gas Field, which was developed in the early 1920s through identification of the underlying salt dome, with oil and gas discovery in the early 1930s. The LDENR registered oil and gas wells within the Bayou Choctaw Oil and Gas Field, along with the extent of the underlying salt dome, are shown on Figure 18. The LDENR registered oil and gas wells on the property are shown on Figure 19; operator history is summarized in Table 2. LDENR oil and gas well files are provided in Appendix C. Historical aerial photographs of the property from 1941 through 2023 are presented in Figures 20 through 41 and show the development of oil and gas operations throughout time.

3.1 OIL & GAS WELL HISTORY

A review of the SONRIS database and historical well files downloaded from the database indicates that eleven wells have been registered on the property (eight producing or injection wells, two dry holes, and one permit expired). According to the SONRIS database, the following wells were registered on the property:

- Levert Land Co. No. 1 (SN 37734). This well was a dry hole which was drilled and plugged in 1949.
- Levert Heirs No. 1 (SN 44428). This well was spudded in November 1951 by Temple Hargrove and plugged and abandoned (P&A) in June 1966.
- Levert Heirs Brine B No. 1-D (SN 68122). This well was spudded by British-American Oil Production Company in October 1957. In 1959, SN 76522 was completed as a dual completion at this location. SN68122 was reverted to a single completion in October 1961. Subsequent operators are listed as Petrologistics Olefins, LLC (November 2004), PL Olefins, LLC (January 2009), PL Midstream, LLC (February 2012), and Boardwalk Louisiana Midstream, LLC (November 2012).
- Levert Heirs C No. 1 (SN 69635). This well was spudded by British-American Oil Producing Company in March 1958, operated by Gulf Oil Corporation beginning in August 1956, and P&A in July 1974.
- Levert Heirs C No. 1-D (SN 70947). This well was spudded by British-American Oil Producing Company in March 1958 and subsequently operated by Gulf Oil Corporation (August 1965), Precise Exploration Corp. (December 1972), and Brock Exploration Company (October 1973). The well was P&A in July 1974.
- Levert Heirs D No. 1 (SN 73467). This well was a dry hole which was spudded by British-American Oil Producing Company in January 1959 and plugged in March 1959.
- Levert Heirs B Brine Disposal No. 1 (SN 76522). This well was spudded in October 1959 by British-American Petroleum Company and was a dual completion well at the SN 68122 location. It was subsequently operated by Gulf Oil Corporation (August 1966), Precise Exploration Corp. (November 1972), and Brock Exploration Corp. (October 1973). In January 1978, the well was shut-in, and in February 1978 the well status was updated to "shut-in productive – no future utility." The operator was changed to J.H. Bible and G.M. Goldman (December 1978) and resumed operation as a producing well in December 1979. Subsequent

operators were Memaca Petroleum Corporation (March 1980), B&G Producers Inc. (September 1980), and Union Texas Petroleum Corp. (February 1981). In April, 1981, the well was converted to a brine injection well. Subsequent operators were William Olefins, LLC (September 1999), Petrologistics Olefins, LLC (November 2004), PL Olefins, LLC (December 2008), PL Midstream, LLC (May 2011), and Boardwalk Louisiana Midstream, LLC (October 2012). This well remains on the property and is an active brine disposal well.

- Levert et al No. 1 (SN 124657). This well was a dry hole which was spudded by Penton-Sohio-Southwest Gas and plugged in June 1968.
- Levert Heirs No. 2 (SN 144260). This well was spudded by Brock Exploration Corporation in March 1974 and subsequently operated by JH Bible and GM Goldman (December 1978), Memaca Petroleum Corporation (March 1980), B&G Producers Inc. (September 1980), and Liberty Oil and Gas Corp. (March 1983). This well was P&A in April 1984.
- Levert Heirs No.1 (SN 205030). This is a "permit expired" well, registered to Quality Petroleum Corp., that was not spudded.
- Levert Heirs C No. 1 (SN206248). This well was a reentry of well SN 69635 by Quality Petroleum Corp. in June 1987. In October 1991, the well was listed as "inactive well, no responsible party" and listed in LDENR's Orphan Well Program in January 1994.

3.2 SITE DEVELOPMENT

The following is a summary of the development of the property over time, based on a review of historical aerial photographs:

- 1941 – The property is undeveloped, except for a single road or other right-of-way apparently entering the southcentral boundary of the property.
- 1952 – E&P activities are apparent in the southwestern corner of the property (SN 44428 location), with an apparent tank battery and production area. The right-of-way bisecting the property from south to north is wider than the previous aerial and is cleared of trees.
- 1959-1962 – Operations are apparent along the western and southern boundaries of the property (SN 44428, SN 68122, SN 69635, and SN 73467 locations). Pits are observed at the SN 44428, SN 68122, and SN 69635 locations and a tank battery is evident northwest of SN 69635.
- 1968 – the larger pit at SN 69635 has been closed and a new smaller pit is apparent immediately to the west of the former larger pit. The right-of-way traversing the property has been more fully developed.
- 1970-1973 – SN 124657 has been completed on the eastern property boundary. The tank battery northwest of SN 69635 is no longer present in the 1973 aerial photo. Remaining operations are similar to previous.
- 1975-1978 – The area around SN 124657 and its access road appear to be little used and are returning to a more natural state. The access road and well pad for SN 144260 is apparent.
- 1983-1985 – A pit is visible near the SN 76522 location. The road that previously went to SN 124657 has been redeveloped and extended through the property to the north. The area around SN 44428 appears to be unused, although a pit is still visible.

- 1988-2009 – By 1989, the pit near SN 76522 appears to be closed and the area is leveled. SN 144260 area and access road appear to be returning to natural state. Other areas are similar to previous photos with additional signs of overgrowth.
- 2013-2023 – The only activities that are apparent on the site are in the vicinity of SN 68122/76522. The remainder of the site appears to have returned to a more natural state.

4. RECORDS REVIEW SUMMARY

The following sections summarize ERM's review of available LDENR and LDEQ records related to E&P activities conducted on the property.

4.1 LDENR RECORDS

A summary of retrieved documents accessed through the LDENR SONRIS database is presented below and includes the following – Pit Records and Inspection Reports, Lease Facility Inspection Reports (LFIR), and Compliance Orders (CO) and Notices. LDENR records are provided in Appendix C.

4.1.1 PIT RECORDS

Pit Record and Inspection reports indicating the existence of pits on the property were retrieved and are summarized in Table 3.

Well SN 76522 is referenced in a pit record dated 07/17/1986 which described the pit is used for nitrogen gas blowout. An inspection report was later issued on the same pit dated 12/11/1989 stating its closure. This pit is apparently in the vicinity of sample locations HA-8 and L-1 that are being addressed by others.

4.1.2 LEASE FACILITY INSPECTION REPORTS

Lease Facility Inspection Reports (LFIRs) for onsite wells were identified in the SONRIS database. A summary of these LFIRs is presented in Table 4 and a summary follows:

- Well SN 68122 (Operator: Petrologistics Olefins, Inc): Inspection was performed on 4 June 2008 and the operations were found to be compliant with Statewide Order 29-B.
- Well SN 76522: There were five inspections performed and documented in SONRIS, each of which noted compliance with Statewide Order 29-B. The inspection dates were 04 June 2008 and 03 March 2011 (Operator: Petrologistics Olefins, Inc), 26 April 2012 (Operator: PL Midstream, LLC), 17 May 2013 and 29 October 2014 (Operator: Boardwalk Louisiana Midstream, LLC).
- Well SN 206248 (Operator: Quality Petroleum Corporation): Inspection was performed on 17 September 1991. The only violation that was noted in the LFIR was the absence of a well sign at the well site. No follow-up inspection was found in the file database.

4.1.3 COMPLIANCE ORDERS

No Compliance Order records were identified for wells related to Chevron or Key operations. Several compliance orders/notices for minor issues were identified for brine disposal well SN 76522, which was not operated by Chevron or Key and is being addressed in the litigation by others.

4.2 LDEQ EDMS RECORDS

LDEQ Agency Interest (AI) locations in the vicinity of the property are shown on Figure 42. No AI locations were identified on the property. Indications of impacts to the property were not identified in a review of the LDEQ Electronic Document Management System (EDMS) records for nearby AI locations.

5. REGULATORY FRAMEWORK

The historical E&P operations on the property are regulated by LDENR's Office of Conservation. LDENR regulations for the assessment and cleanup of E&P sites are presented in Louisiana Administrative Code, Title 43, Part XIX (LAC 43: XIX), Subpart I, commonly referred to as Statewide Order 29-B.

In January 1986, amendments to Statewide Order 29-B required the registration of existing pits, as well as upgrading, phasing out or closure of existing pits. Prior to this, no specific or numeric LDENR standards for registration or closure of pits existed.

The Louisiana Department of Environmental Quality RECAP risk assessment regulation provides further criteria for assessment of current and historical E&P operations. RECAP was developed by LDEQ based on EPA guidance to provide a framework for evaluating risks to human health and the environment from chemical constituents in environmental media (e.g., soil and groundwater). RECAP has been used as an applicable regulatory standard by the LDENR in the approval and development of most feasible plans to address the Act 312 requirement to protect the environment, public health, safety and welfare in compliance with relevant and applicable standards promulgated by a state agency.[1] The history and application of RECAP is further discussed in Section 8.

5.1 DEFINITION OF CONTAMINATION

Environmental damage, as defined by Louisiana Revised Statute 30:29 (La. R.S. 30:29, commonly referred to as Act 312 of 2006, as amended), means:

> "any actual or potential impact, damage, or injury to environmental media caused by contamination resulting from activities associated with oilfield sites or exploration and production sites. Environmental media shall include but not be limited to soil, surface water, ground water, or sediment."

Statewide Order 29-B and Act 312, define contamination as:

> "the introduction (or presence) of substances or contaminants into a (usable) groundwater aquifer, an underground source of drinking water (USDW) or soil in such quantities as to render them unsuitable for their (reasonably) intended purposes."

The language in parentheses is included in the Act 312 definition (as amended and re-enacted by Act 400), but not in the Statewide Order 29-B definition.

[1] See MFPs issued by LDNR in the Tensas Poppadoc, Savoie, Moore, Sweet Lake, Vermillion Parish School Board, Hero Lands, LA Wetlands, Jeanerette Lumber, and Neumin Production matters, where RECAP was a component of the LDNR MFP. The MFP in the Neumin Production matter summarizes the use of RECAP in previous cases, stating "LDEQ's RECAP procedures have been recognized as containing groundwater evaluation and/or remediation standards applicable to E&P sites, and RECAP has been used as the principal regulatory standard for groundwater evaluation and/or remediation in every Act 312 [case] where groundwater has been an issue…. Use of LDEQ's RECAP, at least in part, to demonstrate compliance with Section 319.A has been proposed by responsible parties, considered and ultimately accepted by LDNR on a case-by-case basis for over 20 years beginning October 2001 with Guillory Landfarm Facility Closure, Site Code 0103, located in Eunice, Louisiana." (H.C. Drew Estate vs Neumin Production Company et al, Docket No: ENV-L-2022-01, LDNR Office of Conservation's Most Feasible Plan and Written Reasons in Support as Required by LA.R.S. 30:29, June 29, 2022).

The remediation plan provided in this report addresses soils that meet the 29-B and/or Act 312 definitions of contamination and will return the property to conditions that will allow for use without restrictions (e.g., without conveyance notice). Constituent concentrations in the groundwater do not meet these definitions because they do not render used and useable groundwater zones unsuitable for their intended purpose.

5.2 SOIL

The applicable or relevant and appropriate standards for soils are Statewide Order 29-B Chapter 3 pit closure criteria and LDEQ RECAP standards. The Statewide Order 29-B pit closure regulations establish standards for metals, salts and hydrocarbons (as oil & grease) in soils at E&P sites. ERM evaluated soil sampling results with respect to Statewide Order 29-B closure standards for land treatment in an elevated wetland environmental setting.

The soil data gathered from the property have been compared to the following Statewide Order 29-B criteria (adopted in 1986) and to RECAP standards (adopted in 2003) where appropriate:

Range of pH:	6-9
Total metals (mg/kg wet weight, unless noted):	
Arsenic:	10
Cadmium:	10
Chromium:	500
Lead:	500
Mercury:	10
Selenium:	10
Silver:	200
Zinc:	500
True Total Barium:	20,000 (dry weight)
Oil and Grease:	<1 percent (dry weight)
Electrical conductivity (EC):	<8 mmhos/cm
Sodium adsorption ratio (SAR):	<14
Exchangeable sodium percentage (ESP):	<25

Statewide Order 29-B limits for salt parameters in soil were developed for agronomic purposes to establish concentrations that promote the growth of crops and other vegetation. In addition to the promulgated LDENR salt standards, LDEQ established guidelines for salt parameters in a 2012 document entitled, "How should a release of brine (sodium chloride) be addressed under RECAP?" (Commonly referred to as the RECAP Frequently-asked-questions [FAQ] on salt). The RECAP FAQ adopts Statewide Order 29-B standards for salt parameters for soils within the effective root zone as a screening tool and utilizes a leaching test approach for determining salt concentrations in

deeper soils that are protective of groundwater, with standards for chlorides appropriate to the specific groundwater classification.

5.3 GROUNDWATER

Statewide Order 29-B does not provide any direct comparative standards for the evaluation or remediation of groundwater. Other regulations outlined within this section provide standards applicable to groundwater in the State of Louisiana.

5.3.1 RECAP

Groundwater was evaluated in accordance with LDEQ RECAP guidance. RECAP uses EPA MCLs and SMCLs, when available, as screening standards and to evaluate groundwater classified as a drinking water source. MCLs are enforceable standards established by EPA to protect the public against consumption of drinking water contaminants that may present a risk to human health. An MCL is the maximum allowable concentration of a contaminant in drinking water that can be delivered to the consumer in public water supply. SMCLs are non-enforceable standards that are used as guidelines to assist public water systems in managing their drinking water for aesthetics including taste, color, and odor. When MCLs are unavailable, risk-based standards protective of drinking water are used as screening standards. For groundwater that is not a drinking water source, the appropriate comparative standards are identified in RECAP to address other exposure pathways, where applicable.

Although Statewide Order 29-B does not provide direct comparison standards for groundwater, it does state that "Contamination of a groundwater aquifer or a USDW with E&P Waste is strictly prohibited" (LAC 43.XIX.303.C). However, LDENR and LDEQ issued a Memorandum of Understanding (MOU) between the two agencies that provides a mechanism for the use of RECAP procedures for the evaluation and/or remediation of groundwater at E&P sites (original MOU dated 2010, amended in 2011 and 2023).

5.3.2 RADIONUCLIDES RULE

The Radionuclides Rule (65 FR 76707), promulgated on December 7, 2000, specifies an MCL of 5 pCi/L for combined radium-226/-228 in Community Water Systems (CWS). The Radionuclides Rule applies to all CWSs; however, the regulations do not apply to non-community water systems (EPA, 2002, page I-4). A CWS is defined as:

> "A public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents."

The Radionuclides Rule is not applicable to the following two types of Non-Community Water Systems (NCWS) as defined in 40 CFR Part 141 – National Primary Drinking Water Regulations:

> "Non-transient non-community water system (NTNCWS) means a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year."

> "Transient non-community water system or TWS means a non-community water system that does not regularly serve at least 25 of the same persons over six months per year."

The shallow groundwater beneath the site RECAP class 3, is not used, does not meet the definition of a CWS, and the Radionuclides Rule does not apply. The Radionuclides Rule regulations are provided in Appendix D.

6. INVESTIGATION ACTIVITIES

The following sections provide information on field activities conducted on the property from March 2019 through November 2024. Soil, groundwater, and surface water sample locations are presented on Figures 43, 44, and 45, respectively. The Chevron and Key limited admission areas for soil and groundwater are shown on Figures 43 and 44, respectively. Soil limited admission areas are designated on figures as Limited Admission Areas 1 through 3 (LAA 1 through LAA 3). Information and data from field activities are provided in the following appendices:

- Appendix E – Soil boring logs and monitoring well construction diagrams
- Appendix F – Laboratory reports
- Appendix G - Field notes recorded by ERM during the site investigation activities
- Appendix H –Photo logs
- Appendix I – Survey Data

Data generated during the field activities is presented on the following tables:

- Table 5 – Soil Analytical Data
- Table 6 – Soil EDX and XRD Results
- Table 7 – Soil Geotechnical Data
- Table 8 – Groundwater Analytical Data
- Table 9 – Groundwater Field Parameters
- Table 10 – Surface Water Analytical Data
- Table 11 – Surface Water Field Parameters
- Table 12 – Survey Results and Water Elevations

The data summary tables and supporting appendices provide the comprehensive soil and groundwater data set generated by ERM and ICON for the property, including data collected within and outside of the admission areas. The analysis of regulatory compliance presented in the following sections also includes data collected within and outside of the admission areas as the basis for identification of the locations included in the admission and requiring remediation.

Soil samples at borings HA-8 and L-1 are being addressed in the litigation by others. Additionally, soil samples from boring HA-12 were collected off of the property and is not evaluated in this report. The soil sample results from these borings are presented in Appendix J.

6.1 PLAINTIFFS' INVESTIGATION ACTIVITIES

ICON conducted investigation activities on the property from March 2019 through October 2023. The defendants were not notified in advance of ICON's field activities until the August 2023 sampling event. Beginning in August 2023, ERM, observed ICON field activities and collected splits of ICON's samples, unless there was not adequate sample volume. ICON samples were submitted to Pace Analytical Services in Greensburg, Pennsylvania and Element Materials Technology in Lafayette, Louisiana. Split samples collected by ERM were submitted to Waypoint Analytical Laboratory in Marrero, Louisiana. Investigation activities conducted by ICON consisted of the following:

- March & April 2019 – Conducted a terrain conductivity survey using a Geophex GEM-2 meter on the Levert Property. Collected soil samples from twelve hand auger borings (HA-1 through HA-12) to depths ranging from approximately 3 to 8 feet below ground surface (bgs) on the property. The defendants were not notified of the event and were therefore not present to observe activities or collect split samples.
- January 2020 – Collected soil samples from two hand auger borings (SB-1 and SB-2) to depths of approximately 5 feet bgs and 8 feet bgs respectively. The defendants were not notified of the event and were therefore not present to observe activities or collect split samples.
- August through October 2023 – ICON resumed investigation activities, and ERM personnel were onsite to observe and document field activities and collect split samples. Soil and groundwater samples were collected utilizing direct push technology and included the following tasks:
  - Advanced twelve soil borings on the property (L-1 through L-12) utilizing direct push technology and collected soil samples from each soil boring.
  - Advanced EC and hydraulic profiling tool (HPT) probe at locations L-1, L-2, L-4, L-6, L-8, L-9, L-11, and L-12 to depths ranging from approximately 30 to 70 feet bgs.
  - Installed fifteen permanent monitoring wells by direct push technology, including a monitoring well screened in the shallow water-bearing zone at each boring location (L-1A, L-2, L-3, L-4A, L-5, L-6, L-7, L-8, L-9, L-10, L-11, and L-12A), and monitoring wells screened in the deep water-bearing zone at three boring locations (L-1B, L-4B, and L-12B). Groundwater samples were collected from each of the fifteen wells.
  - Slug tests were conducted on wells L-1A, L-1B, L-3, L-5, and L-9.
  - Conducted a round of water level measurements in each of the fifteen monitoring wells.
  - ICON monitoring wells were surveyed by S.J. Langlinais & Associates, Inc.
- October 2023 - A NORM Survey was performed at the site using a Ludlum Model 3 meter with 44-2 probe. No soil samples were collected during the NORM survey.

6.2 ERM INVESTIGATION ACTIVITIES

ERM conducted investigation activities on the property from September 20, 2024, through November 1, 2024. Notice was provided to the plaintiffs prior to commencing field work to provide the opportunity for observation and split sampling, and ICON was present for ERM's investigation activities. ERM contacted LA One Call prior to the start of field activities to perform a public utility locate. ERM also contracted an independent subsurface clearance contractor, Morrison Surveying, to identify and mark buried utilities near the proposed boring locations.

ERM samples were submitted to Waypoint Analytical Laboratory in Marrero, Louisiana, and geotechnical samples were submitted to Ardaman and Associates, Inc. in Baton Rouge, Louisiana. ERM's site investigation was designed to:

- Better characterize and delineate the presence of E&P-related constituents in soil and groundwater; and

- Analyze samples by rigorous analytical methods (e.g., TPH fractionation; hydrocarbon indicator PAHs; BTEX; SPLP leachate testing) to obtain the data necessary to conduct a risk assessment to support remedial decisions.

Investigation activities conducted by ERM consisted of the following:

- September 2024 – Conducted a site visit to evaluate site conditions and assess access to investigation areas. A round of water level measurements was conducted in each of the ICON monitoring wells using an electronic water level tape, with water level measurements recorded to the nearest hundredth of a foot.
- October 2024 – ERM resampled groundwater from each of ICON's existing monitoring wells. ERM used a peristaltic pump and dedicated polyethylene tubing to sample each well. Field geochemical parameters including pH, temperature, specific conductance (SC), dissolved oxygen (DO), turbidity, and oxidation reduction potential (ORP) were measured during the well purging process. After stabilization of field parameters, each groundwater sample was directly discharged to the laboratory supplied sample bottles. Each sample bottle was labelled with a unique sample number, the date and time of collection, and the samplers initials. Samples were placed on ice immediately following collection and submitted under proper chain-of-custody to Waypoint Analytical.
- Soil borings were advanced on the Levert Property with a direct push drill rig at 15 locations (B-1 through B-8, HA-3R, HA-7R, L-3R, and MW-1 through MW-4), with a vibra-core at two locations (HA-9R and HA-10R), and with a hand auger at two locations (HA-1R and HA-2R). Continuous soil cores were logged by an ERM geologist and field readings were recorded using a handheld EC pen and a photoionization detector (PID). Soil samples were collected from borings B-1 through B-8, HA-1R, HA-2R, HA-3R, HA-7R, HA-9R, HA-10R and L-3R for laboratory analysis. Geotechnical samples were collected at boring location MW-1. Soil samples collected during the ERM investigation for analysis of TPH fractions, BTEX, and/or PAHs were collected using either a direct push drill rig or vibra-core in accordance with prior sampling analysis, methods and collection that have been approved by LDENR in prior most feasible plans.
- Five monitoring wells were installed at four boring locations (MW-1 through MW-4). ERM's MW-1, MW-2, MW-3, and MW-4 were screened in the shallow water-bearing zone in the 14-24' bgs interval and MW-1D was screened in the deep water-bearing zone in the 52-62' bgs interval. Groundwater samples were collected from the newly installed wells, after development, following the methodology described above. LDENR well registration records for ERM's monitoring wells are provided in Appendix K.
- Two surface water samples were collected from Bayou Bourbeaux for laboratory analysis. A professional surveyor (M.P. Mayeux Surveying and Boundary Consulting, L.L.C.) was contracted to survey elevation transects of the bottom of Bayou Bourbeaux, measure surface water level, and survey the horizontal position, top of casing elevation, and ground surface elevation at each of the existing ERM and ICON monitoring wells. An additional round of water levels was collected on November 1, 2024 of the existing monitoring wells on the property and the surface water of Bayou Bourbeaux.

ERM personnel conducted additional field activities in support of the ecological risk assessment performed by Dr. Karen Cejas which are presented in Dr. Cejas' expert report.

Mr. Patrick Ritchie performed an effective root zone (ERZ) study on the property in October 2024 and was assisted by ERM personnel. The field activities and results of the ERZ study are presented in Mr. Ritchie's expert report (Appendix Q).

6.3 INVESTIGATION ACTIVITIES SUMMARY

During the course of the investigation activities conducted by ICON and ERM, a total of 233 soil samples (including split samples) were collected from 41 boring locations. Additionally, 72 groundwater samples (including split samples) were collected from 20 monitoring wells.

A discussion of the investigation results is presented in the subsequent sections of this report.

7. INVESTIGATION RESULTS

The shallow geology and groundwater conditions have been characterized using the available regional and site-specific data. Constituents in soil and groundwater have been identified and sufficiently delineated to support development of this remediation plan. The following sections provide a summary of investigation results. Soil boring HA-12 is not within the property boundary and is not addressed herein. Borings L-1 and HA-8 were advanced in a former E&P feature unrelated to Chevron or Key operations, and soil samples from those borings are being addressed in the litigation by others. The soil data collected in those borings are summarized in Appendix J for a complete record. Because groundwater is a dynamic medium, all groundwater sample locations on the property are evaluated herein.

7.1 SITE GEOLOGY AND HYDROGEOLOGY

7.1.1 GEOLOGY AND CROSS SECTIONS

Geologic cross-sections A-A’ and B-B’ were prepared using logs of borings advanced on the property during ICON and ERM investigation activities, as well as boring logs from the neighboring Global Marketing property, and surveyed transects of Bayou Bourbeaux. The cross-section locations are shown on Figure 46, and cross sections A-A’ and B-B’ are provided as Figures 47 and 48, respectively. The cross-sections, along with the boring logs provided in Appendix E, document that the uppermost subsurface soils beneath the site consist primarily of clay to depths of approximately 12 to 21 feet bgs. Beneath this surficial clay unit, a shallow water-bearing zone is present with grain size ranging from clayey silt to fine sand. The shallow water-bearing zone is variable in thickness and composition and has an average thickness of approximately 7 feet beneath the property. Boring logs from the adjacent Global Marketing property indicate that the shallow water-bearing zone is both thinner and deeper towards Bayou Bourbeaux. Soils beneath the shallow water-bearing zone are primarily composed of clay to a depth of approximately 45 to 50 feet below ground surface where a deep water-bearing zone is encountered. The deep water-bearing zone is approximately 5 feet thick on average and is composed primarily of silty clay and clayey silt with minor silt lenses. Clay was encountered beneath the deep water-bearing zone where borings were advanced to sufficient depth. The entirety of the shallow geology shown on cross sections A-A’ and B-B’ and described above is within the surficial confining unit overlying the MRAA.

Soil geotechnical data was collected at boring MW-1 and is presented on Table 7. The grain size analysis and soil classifications document the fine-grained nature of the water bearing zones, and in particular the deep water-bearing zone, along with the high clay content both above and below the shallow water-bearing zone. Vertical permeability samples were collected within the clay overlying the shallow water-bearing zone, and within the clay overlying the deep water-bearing zone, and results are shown on cross sections A-A’ and B-B’. The vertical permeability results were 1.9×10^{-8} and 1.5×10^{-8} cm/sec, which is consistent with the Statewide Order 29-B definition of a “Natural liner – having a hydraulic conductivity no greater than 1×10^{-7} cm/sec”. The predominantly clayey soils underlying the property preclude vertical water migration and protect the MRAA below the confining unit.

An additional regional cross section was prepared based on water well drillers logs in the vicinity of the property. The water well drillers logs cross section location is shown on Figure 49, and the cross section is shown on Figure 50. This cross section documents the presence of approximately 80 feet of confining clay overlying the MRAA. Water wells in the area are screened deep within the MRAA, and no use of the shallow water bearing zones within the surficial confining unit were identified.

7.1.2 HYDROGEOLOGY

Groundwater level data were collected on October 17, 2023, September 20, 2024, and November 1, 2024 from the monitoring wells present on the property during each event. Surface water elevations of Bayou Bourbeaux were also measured in the November 1, 2024 event. The well survey data and water elevations are provided on Table 12. Potentiometric surface maps were prepared separately for the shallow and deep water-bearing zones and are provided as Figures 51 through 59. Potentiometric maps of the shallow water-bearing zone were prepared using water elevations as measured and as density corrected (equivalent freshwater head [EFWH]). An actual representation of groundwater flow is likely somewhere between these two methodologies. Density correction was not necessary for the deep water-bearing zone due to the low total dissolved solids present. Water levels in the shallow zone are generally flat in the investigation area, indicating little lateral movement of groundwater. Water levels are typically slightly higher in the central portion of the site (i.e., near L-3, L-4A, and/or L-8), with groundwater flow moving outward from this high point. This effect is exacerbated in the density corrected maps. Water elevations in monitoring well L-12A are consistently much lower than the other wells on the property, which suggests a strong eastward gradient and rapid groundwater flow to the east. However, evidence suggests that a rapid eastward flow is not occurring (e.g., similar steep groundwater gradients are not observed elsewhere on the property or surrounding properties, and constituent concentrations indicate little migration eastward). Therefore, the lower water levels at L-12A appear to be anomalous and related to poor connection to the rest of the property due to variability in the shallow water-bearing zone or poor well installation. Groundwater flow in the deep water-bearing zone is generally to the northeast.

The water levels measured in the deep water-bearing zone were consistently higher than those measured in the shallow water-bearing zone. Although there is no connection between the two zones, this upward hydraulic gradient provides further protection from downward flow into deeper zones. Additionally, water levels in the MRAA are high and at times artesian, demonstrating a similar upward hydraulic gradient from the MRAA and protection from downward migration.

As discussed above, lateral groundwater flow in the shallow water-bearing zone is generally radially away from the central portion of the property. The groundwater flow evaluation on the west-adjacent Global Marketing property determined a generally westward groundwater flow direction. Based on the groundwater flow direction, the nearest down-gradient surface water body is Bayou Bourbeaux to the west and north. However, the surveyed elevation of the base of Bayou Bourbeaux is above the top of the shallow water-bearing zone in each of the borings on the property, demonstrating that there is no direct connection between Bayou Bourbeaux and the shallow water-bearing zone (see cross sections A-A’ and B-B’ on Figures 47 and 48). Additionally,

borings on the Global Marketing property indicate that the shallow zone becomes deeper towards Bayou Bourbeaux, providing additional separation between the bottom of the bayou and the water-bearing zone. Surface water samples collected by ERM indicated fresh conditions with no observed impacts from E&P indicator constituents (see Section 7.5), further supporting the conclusion that impacted groundwater from the shallow water-bearing zone is not discharging to Bayou Bourbeaux. Deeper surface water bodies that may be in communication with shallow groundwater are distant from the property (i.e., the ICWW over a mile west of the property and the Mississippi River over 3 miles east of the property).

ERM analyzed slug test data by uploading the water level data into AQTESOLV Version 4.5, a commercially available and widely used software program. The water level displacement data collected during the tests were plotted electronically vs. elapsed time. As specified in RECAP Appendix F, the Hvorslev (1951) curve-matching method for confined aquifers was used to calculate the hydraulic conductivity. The well yield for each well was calculated based upon LDEQ's RECAP Appendix F equations. The yield of the shallow zone was calculated as specified by RECAP by taking the geometric mean of wells screened in that zone. The estimated yield of the shallow zone based on ERM's evaluation of the slug test data is 310 gallons per day (gpd) and indicates that the zone is a Class 3 aquifer by yield. This Class 3 groundwater classification of the shallow water-bearing zone is consistent with the groundwater classifications made on the surrounding properties. A single slug test was performed in the deep zone, and an evaluation following the above-described methodology indicated an estimated yield of 7 gpd, and the deep water-bearing zone is also a Class 3 aquifer by yield. The low yield of the deep zone was also observed during sampling activities, where each of ICON's wells screened in the deep zone went dry multiple times during low-flow sampling after generating less than two gallons of water. The results of the slug test evaluation are presented in Table 13. Slug test reports are presented in Appendix L

Based on the results of the slug test evaluation and potentiometric data, groundwater flow in the shallow zone is slow and groundwater conditions are expected to be generally stable. As groundwater slowly migrates laterally, the hydrogeology of the shallow water-bearing zone provides a setting where dilution and attenuation of impacted groundwater occurs. This is evidenced in part by the concentrations of E&P constituents in groundwater (e.g., chloride) on the property, which decrease significantly with distance from former E&P features, demonstrating that dilution has taken place (see discussion of groundwater data in Section 7.4). Furthermore, the sampling locations selected on the property and on adjacent properties are biased to locations in and around potential sources of impacts, which limits data collection in unimpacted areas and under-represents locations where down-gradient fresh water is available for dilution and attenuation. Additionally, dilution occurs regionally through recharge of fresh water into the shallow zone.

7.2 SOIL DATA

Soil analytical results within the property at issue are summarized in Table 5. Laboratory reports are provided in Appendix F.

ICON advanced EC and HPT probes at eight locations to depths ranging from approximately 30 to 70 feet bgs (Figure 60). The highest EC values on the site were measured in the upper

approximately 30 feet of soil beneath the apparent closed pit at the L-3 location. Elevated EC is observed within this same interval in other EC probe locations and generally declines with distance from E&P features. Results from each EC probe indicate relatively low EC in the uppermost surface soils and show a decline to apparent unimpacted conditions at depth, demonstrating limited vertical extent of impacts and thick clay confining layers protecting the deep water-bearing zone and underlying MRAA. Results at the L-12 location, which is distant from historical E&P activities, does not have elevated EC values.

Soil analytical data from samples collected by ICON and ERM were compared in Table 5 to the Statewide Order 29-B pit closure criteria identified in Section 5. Additionally, as an initial screening comparison, soil results were compared to RECAP screening standards in Table 5. Soil data were compared to the non-industrial screening standard for direct contact (Soil_SSni) and the soil protective of groundwater screening standard (Soil_SSGW), and further RECAP evaluation is provided in Section 8 for the sample locations outside of areas proposed for remediation to comply with 29-B pit closure standards.

Where ICON metals results were presented in dry weight only, ERM converted dry weight concentrations to wet weight or "as-received" concentrations, per 29-B guidance. The results are summarized in Table 5, with concentrations reported above the 29-B limits and RECAP screening standards highlighted for further evaluation. Concentrations of salt parameters, arsenic, barium and true total barium (TTBa), oil and grease (O&G), total petroleum hydrocarbon (TPH) fractions, polycyclic aromatic hydrocarbons (PAH), and benzene, toluene, ethylbenzene, and xylenes (BTEX) in soil samples are plotted on Figures 61 through 77.

All data collected at the site were considered in the evaluation, i.e., no data were ignored. The regulatory compliance analysis provided in the following sections includes identification and discussion of locations where split and resample results are in disagreement. Where applicable, the technical rationale for reliance on one sample result over another for compliance demonstration is identified with supporting evidence. Examples of this include the use of hydrocarbon fraction data in lieu of TPH mixture data for risk assessment per RECAP and use of the resample results following well equilibration to determine potential impact to the deep water-bearing zone.

7.3 29-B EVALUATION

The following evaluation of soil data relative to the 29-B pit closure standards includes data within and outside of the limited admission areas because the property-wide soil evaluation supports the conclusion regarding which locations require remediation and demonstrates the delineation of those areas. The limited admission areas LAA 1 through LAA 3 are included on the constituent distribution figures, i.e., Figures 61 through 77. The discussion below identifies that four former pit features within the admission areas are the focus of the remediation plan to comply with 29-B standards, including two features adjacent to each other in LAA 1. The sample locations/intervals proposed for remediation are shaded gray on Table 5 to indicate that they will be removed from the site or treated during remediation activities.

7.3.1 METALS

True Total Barium: True total barium was detected above the 29-B standard, and confirmed in resample or split sample results, in four boring locations within the former large pit in LAA 1, with total depths ranging from 2 to 8 feet bgs (see Figure 61). This former pit is referenced hereafter as the L-3/L-4 pit feature. Remediation is proposed in the footprint of this former pit, determined from aerial photos, in the vicinity of these boring locations to comply with the elevated wetland standard for pit closure of 20,000 mg/kg. Boring location B-3 is not included in the remediation area identified in Figure 61 because the elevated true total barium result reported by ICON in this location was not confirmed in the split sample result reported by ERM.

One additional location on the property had a true total barium result reported above the 29-B standard as shown in Figure 62. Sample location (HA-1R) is within an apparent former pit location in the southwest corner of the property in LAA 3, and sampling results in the 0-2 ft interval included true total barium above 20,000 mg/kg. The result was not confirmed in the co-located sample from location HA-1 which identified very low true total barium. The HA-1R sample was analyzed for barium speciation, which determined that barium in this sample is present as barite, a non-toxic, stable form of barium (see Table 7). ERM proposes to perform composite sampling for true total barium and other 29-B metals within this feature to demonstrate that the apparent pit meets 29-B closure standards, after which the feature will be closed by leveling the berms and backfilling. A contingent remedy is also presented in Section 9 for this area in the event that composite sampling does not confirm compliance.

Barium results, which are addressed under RECAP and not 29-B, are presented on Figures 63 through 66. Barium is discussed in the RECAP assessment in Section 8.

Arsenic: The data set for arsenic in soil at the property identifies a sporadic distribution of concentrations reported above 10 or 12 mg/kg throughout the property, i.e., the 29-B and state-specific background value from RECAP, respectively. The distribution is characterized by relatively few exceedances, all unconfirmed where split sample results are available. Notably, the arsenic concentrations reported in the location where E&P residuals were identified (e.g., the L-3/L-4 and HA-10 former pit features in LAA 1) were unremarkable, with a maximum value of 15.4 mg/kg (and split result of 8.39 mg/kg), and do not appear indicative of arsenic-containing wastes (see Figure 67). The pattern of arsenic occurrence in soil is not limited to E&P features or well explained by migration from these features (see Figure 68). Additionally, the arsenic results across the property demonstrated high variability in many split soil samples, and such variability appears indicative of soil heterogeneity. For the sample locations in which split or resample results did not confirm an exceedance of the 29-B standard, no remediation is proposed for arsenic. Within the L-3/L-4 pit in LAA 1, remediation to meet the 29-B standard for true total barium will result in coincident removal of soil with arsenic above 10 mg/kg at locations L-3 (4-8’), HA-3 (4-6’), and B-2 (2-4’) as shown in Figure 68.

The potential correlation between arsenic and the most prevalent E&P-related COCs in site soil, barium and salt, was examined. Figures 69 (arsenic with EC) and 70 (arsenic with barium) include all sampling locations across the property and demonstrate that the concentration distributions indicate arsenic is not correlated with barium or EC (as an indicator of salt impact). This study of

arsenic occurrence suggests that arsenic at the property is not an E&P-related constituent of concern in soil and is likely naturally occurring, consistent with the literature cited in Section 2.6.1.

As noted above, arsenic concentrations detected above the 29-B standard in soil samples were not confirmed in locations where split samples were collected or resampling was performed by ERM. A total of five samples had reported concentrations of arsenic above 10 mg/kg, with results from only one sampling party. The samples include the following:

- HA-4 from 6-8′. ERM was not notified of this sampling event and did not collect a split sample. All sample intervals above this sample exhibited concentrations below the 29-B standards. No other parameters in the 6-8′ sample were above 29-B standards and no remediation is proposed.
- HA-5 from 6-8′. ERM was not notified of this sampling event and did not collect a split sample. All samples from intervals above this sample exhibited concentrations below the 29-B standards. There is no evidence of E&P impact in this sample. No remediation is proposed.
- L-4 from 48-50′. ICON did not run metals in their split of the ERM sample. All samples from intervals above this sample exhibited arsenic concentrations below the 29-B standard. There is no evidence of E&P impact in this sample, indicating that the arsenic is not E&P related. The concentration is below the RECAP statewide background value of 12 mg/kg. No remediation is proposed.
- L-8 from 2-4′. ERM was not provided a split sample due to poor recovery. With the exception of SAR at a value of 14.3 (versus the 29-B standard of 14), there is no evidence of E&P impact in this sample, suggesting that the arsenic is not E&P related. This sample is located in a heavily wooded and regularly inundated area. It is likely that this arsenic concentration is representative of natural conditions in the inundated area. No remediation is proposed.
- L-9 from 0-4′. ERM was not provided a split sample due to poor recovery. There is no evidence of E&P impact in this sample, or any sample from this boring, indicating that the arsenic is not E&P related. No remediation is proposed.

To support an exception to the 29-B standard for arsenic levels in soil samples outside of the remediation areas, arsenic concentrations that will remain on the property are evaluated for protection of human health and the environment in accordance with RECAP in Section 8.

Other Metals: Zinc was reported above the 29-B pit closure standard in samples collected by ICON in the HA-10 location within the small former pit feature in LAA 1, just west of the larger L-3/L-4 feature. The ERM resample (HA-10R) confirmed the presence of zinc and also identified lead above their respective 29-B standards in the 0 to 3 ft interval. Remediation is proposed in the footprint of this former pit, determined from aerial photos and existing berms, to comply with the 29-B standards for pit closure.

Zinc was detected slightly above the 29-B standard in sample HA-1R in LAA 3 in the 0-2 ft interval. The result was not confirmed in the co-located sample from location HA-1, which identified zinc well below the 29-B standard in both split samples. The unconfirmed zinc exceedance at HA-1R will be addressed along with true total barium, as described above (i.e.,

composite sampling for confirmation and closure of the former pit feature, with contingent remedy if composite sampling is not compliant).

No other metals were reported above 29-B standards within or outside of the limited admission areas on the property as summarized in Table 5.

7.3.2 SALTS

As discussed in Section 5, Statewide Order 29-B limits for salt parameters in soil were developed for agronomic purposes to establish concentrations which promote the growth of crops and other vegetation. Therefore, it is appropriate to apply 29-B criteria for EC, SAR and ESP to soils within the ERZ. LDENR has recognized the utility of using ERZ studies to determine the appropriate depth of soil remediation to address exceedances of 29-B salt parameter limits and has issued evaluation and remediation plans (Most Feasible Plans, MFPs) that limit remediation of salt-affected soils to the ERZ depth.

An ERZ study performed by Mr. Patrick Ritchie concludes that the ERZ on the property for trees and non-herbaceous vegetation is 16 inches. Mr. Ritchie's ERZ report indicates that 24 inches would represent a pragmatic depth to address exceedances of 29-B salt criteria. Mr. Ritchie's ERZ study is further discussed in Section 9 of this report and provided in Appendix Q. Figures 71 through 76 show 29-B salt parameter analytical results at all depths, with highlighted exceedances of 29-B standards in the upper two feet of soil.

No exceedances of the 29-B limits for salt parameters are identified in the ERZ in LAA 1 or LAA 3. Within LAA 2, an exceedance of the 29-B standard for ESP was reported in sample HA-9 0-2' within a shallow former pit feature that holds ponded water (see Figure 73). Remediation is proposed in the footprint of this former pit, determined from aerial photos and existing berms, to comply with the 29-B standards for pit closure.

Additionally, minor exceedances of the 29-B standards for SAR and ESP (unconfirmed in split sample) were reported in L-11 0-4'. Sample L-11 is located in an unvegetated drainage ditch along a former roadway, and is distant from former operational features (e.g., wells, former pits, tank batteries, etc.). Based on field observations at various times of the year, the L-11 location is alternately submerged and dry. Vegetation outside of the drainage ditch appears robust and includes mature trees. Based on the field observations, the lack of vegetation in the L-11 drainage ditch is related to surface water drainage processes, is consistent with other drainage features on the property, and is not a result of sodicity in soil. Remediating the sodicity in soil at this location would not change (i.e., promote vegetation growth in) this naturally unvegetated area, and accessing this area would damage other thriving areas of the property. Although a site-specific wetland delineation was not performed for this property, the L-11 location and vicinity is similar to features that were identified as submerged wetlands in wetlands delineations performed for the nearby properties (see Section 2.9), and consistent with Mr. Ritchie's findings regarding low-lying areas, salt standards would not be applicable. No remediation is proposed for the elevated sodicity in this drainage ditch area.

All other soil sampling locations within the ERZ on the property comply with the 29-B standards for salt parameters to support vegetative health. A discussion of the salt indicator parameters at depths below the ERZ is provided in Section 7.4, and to the extent an exception to the 29-B agronomic standards is required for soil samples outside of the remediation areas and below the root zone, reported chloride concentrations that will remain in soil on the property are evaluated for protection of groundwater in accordance with RECAP in Section 8.

7.3.3 HYDROCARBONS

Oil and grease concentrations in soil are shown on Figures 77 and 78. Oil and grease was reported above the 29-B standard (1%) in a single soil sample on the property, within the former HA-10 pit feature in LAA 1 (at HA-10 0-2'). Oil and grease at this location was sampled and analyzed by ICON without notification to ERM. This is the location and interval of elevated zinc and lead above 29-B standards and remediation is proposed in the footprint of this former pit to comply with the 29-B standards, including the standard for oil and grease.

Additional hydrocarbon-related constituents analyzed in soil samples included total petroleum hydrocarbon fractions, PAHs, and BTEX, and these constituents are regulated and evaluated under RECAP. The occurrence and distribution of these constituents is discussed in this section in relation to the areas identified for remediation to comply with the 29-B pit closure standards.

TPH fraction concentrations reported in soil are shown on Figures 79 and 80. With the exception of a single fraction (aromatic C16-C21) reported above the limiting RECAP screening standard in LAA 2 at HA-9R (0-2'), samples with reported concentrations of TPH fractions above screening standards are located within the L-3/L-4 former pit feature in LAA 1 (see Figure 79). Each sample location with a fraction concentration above a RECAP screening standard falls within the proposed remediation areas in LAA 1 and LAA 2.

PAH concentrations reported in soil are shown on Figures 81 and 82, which demonstrate that PAHs were analyzed in each soil sample location and interval where fractions were reported above screening standards. The only samples with reported concentrations of PAHs above limiting screening standards are located within the L-3/L-4 former pit feature and the adjacent HA-10 feature in LAA 1 (see Figure 82). Each sample location with a PAH concentration above a RECAP screening standard falls within the proposed remediation areas.

BTEX concentrations reported in soil are shown on Figure 83, which demonstrates that the focus of BTEX sampling was within and surrounding the large L-3/L-4 former pit feature in LAA 1. Concentrations of benzene and xylenes were reported above limiting screening standards in samples from two boring locations within the former pit feature, and these sample locations fall within the proposed remediation area.

7.4 SOIL DELINEATION

The above discussion describes the evaluation through which proposed soil remediation was determined, including the lateral and vertical extent of the remediation areas. This included an extensive sampling program in the most impacted area, LAA 1 (the L-3/L-4 area), for further characterization and delineation of the former pit features. LAA 2 and LAA 3 are impounded

features, and their lateral extent is defined by the extent of those features. Where remediation will be performed (i.e., proposed remediation at LAA 1 and LAA 2, and contingent remediation at LAA 3), confirmation sampling will be performed to confirm that the remediation achieves compliance with 29-B and RECAP requirements. Both vertical and lateral delineation has been achieved in soil to the degree needed for remedial decision making (i.e., delineation of salt parameters within the effective root zone, and metals and hydrocarbons at all depths).

Soil samples have been compared to the 29-B salt parameter standards only in the effective root zone because they are agronomic standards. However, an evaluation of these parameters below the root zone demonstrates declining salt concentrations in locations selected for deep delineation borings. Locations were selected to examine vertical delineation in recognized source areas and to represent the movement of salt at multiple locations across the property. This is most apparent in the EC probe logs (see Figure 60), which show the highest values within the former E&P features, and declining values both laterally and vertically. Salt attenuation with depth is demonstrated in the EC probe logs in the locations of highest lab-reported EC (values >20 mmhos/cm), including L-3/L-4 area, L-5/L-6 area, L-7, L-8, and L-11. The probe logs show consistent attenuation behavior across the property, with a return to baseline condition at approximately 30 to 40 feet bgs, above the second water-bearing zone. This evaluation is further supported by the lab results (see Figures 71 through 76, Table 5, and Appendix J) for representative deep boring locations L-1 and L-4, as well as field EC readings (see boring logs in Appendix E) in deep boring locations L-1, L-4, MW-1, and MW-2. Where laboratory samples were collected at sufficient depth, EC, ESP, and SAR are vertically delineated to values well below their respective 29-B standards (e.g., borings L-1 and L-4). Although these trends of declining concentration in deep delineation borings are most apparent for EC, similar trends are also present for the sodicity parameters ESP and SAR. The values for ESP and SAR are variable, and elevated values are commonly not confirmed in split samples; however, the maximum values were detected within former E&P features, and results generally decline with distance from these features. Notably, ESP and SAR results were below their respective 29-B standards at all depths sampled in borings L-12, L-9, L-2, and B-7, providing reasonable delineation around the L-3/L-4 area, where impacts are highest.

7.5 GROUNDWATER DATA

Groundwater analytical results are summarized in Table 8. Laboratory reports are provided in Appendix F. Concentrations of arsenic, barium, chloride, TDS, TPH fractions, and benzene in groundwater samples are plotted for the shallow and deep water-bearing zones on Figures 84 through 95.

To visually depict the groundwater quality, ERM has prepared both Piper and Stiff diagrams utilizing concentrations of the naturally occurring cations (sodium, potassium, calcium and magnesium) and anions (chloride, bicarbonate and sulfate) present in the groundwater (Figures 96 and 97). Piper and Stiff diagrams visually depict variations in water chemistry resulting from variable concentrations of cations and anions naturally present in groundwater. In addition to the monitoring wells sampled on the property, the Piper diagram also includes the two surface water samples collected from Bayou Bourbeaux.

An examination of the grouping of the individual sample results on the Piper diagram assists in the identification of individual water types and evaluating differences between various water types (Figure 96). Water samples that plot in the same general location on a Piper diagram indicate similar proportions of cations and anions and demonstrate a similar water quality or source. The surface water samples, shallow zone sample L-12A, and each deep zone sample, plot in the same general area of the Piper diagram which appears to be consistent with natural, unimpacted conditions. The remaining samples in the shallow zone are spread across an area along the top right portion of the diagram. This is consistent with varying degrees of impacts from produced water, which is typically high in chloride (i.e., up to and over 100,000 mg/L), and typically plots very near the right corner of the Piper diagram. The spread in these samples demonstrates varying degrees of impact and mixing with fresh groundwater and demonstrates that dilution and attenuation has occurred.

The Stiff diagrams shown on Figure 97 provide information on both the cation and anion proportions (i.e., the shape of the diagram) as well as the concentrations (i.e., the size of the diagram). The Stiff diagrams show that impacts to groundwater are highest in the shallow zone in sample L-3 beneath the apparent closed pit. Other samples in the shallow zone show a similar signature, but varying concentrations that generally decrease with distance from E&P features. Stiff diagrams of the deep zone wells and L-12A are distinct and appear to be consistent with natural, unimpacted conditions.

ICON's groundwater sampling event in September 2023 identified concentrations of various constituents (i.e., chloride, barium, and TDS) in the shallow water-bearing zone that are consistent with the distribution observed in the stiff diagrams. ERM's October 2024 groundwater sampling event included the installation of additional wells at a greater distance from E&P features, and the results from those wells indicate a general continued decline in concentrations with distance. Results from ERM's October 2024 resampling of ICON's wells showed only minor fluctuations in concentrations between sampling events and demonstrate that groundwater conditions are stable. Additionally, ICON's 2023 sampling event identified slightly elevated chloride and TDS concentrations in deep zone wells L-1B and L-4B. ERM's 2024 resamples of these wells did not confirm these concentrations, and no exceedances of screening standards for E&P-related constituents were identified in the deep zone in the resampling event. The initial slightly elevated concentrations appear to be related to poor well development due to the low yield of the zone and the wells repeatedly going dry during development and sampling.

TPH fractions and benzene in groundwater are shown on Figures 92 through 95. Two slight exceedances of RECAP screening standards for TPH fractions were identified, at L-1A and L-6, and resampling at L-6 did not confirm any detections of fractions. Benzene concentrations above the RECAP screening standard were limited to samples L-3 and L-4A, beneath the apparent closed L-3/L-4 pit feature. A RECAP evaluation of TPH fractions and benzene is included in Section 8.

7.5.1 ARSENIC IN GROUNDWATER AT THE PROPERTY

Groundwater sampling conducted on the property has confirmed that locations with no apparent impacts by E&P-related constituents contain naturally-elevated concentrations of arsenic that range to over 0.08 mg/L (i.e., MW-1D, L-12B, L-1B). This finding is consistent with other property

investigations completed adjacent to the subject property, including the Dupont and Wilbert properties studied by ERM under LDENR oversight, located south and southwest of the subject property. Samples collected on the Dupont and Wilbert properties upgradient of E&P activities and with no apparent impacts by E&P-related constituents include arsenic concentrations that range to over 0.1 mg/L (the locations identified as unimpacted are summarized in Appendix N).

Figure 98 presents scatter plots to examine the relationship between chloride and barium, as well as chloride and arsenic at the property. The chloride vs. barium plot shows a clear correlation between the two parameters, which is to be expected for these constituents which are understood to be E&P-related. In contrast, the chloride vs. arsenic plot does not demonstrate a significant correlation between arsenic and the primary indicator of E&P impact, chloride. The lack of correlation is consistent with the natural occurrence of arsenic. The reducing conditions observed during groundwater sampling on the property further support the regional data documenting naturally-elevated arsenic in groundwater (see Section 2.6.1).

In addition to arsenic, elevated iron and manganese are ubiquitous in shallow groundwater and were detected well above the EPA SMCLs in each monitoring well on the property. The natural presence of arsenic, iron, and manganese indicates the natural poor quality of the water in the low yielding, Class 3 shallow and deep water bearing zones.

7.6 GROUNDWATER DELINEATION

Groundwater in the shallow water bearing zone beneath the site has been delineated laterally to declining concentrations. Impacts are greatest beneath the L-3/L-4 former pit, and concentrations decline with distance from this feature. Although there is no downgradient surface water receptor, concentrations of chloride and TDS in the downgradient wells along the property boundary (MW-2, MW-3, and MW-4) are below the RECAP GW3DW standards with the application of a dilution attenuation factor (DAF). Concentrations of barium and hydrocarbon fractions in these wells are below the RECAP GW3DW standards prior to the application of a DAF, and benzene was not detected in these wells (see Section 8.2.2 and Appendix M for identification of these delineation standards).

As previously discussed, investigations have been conducted on the adjacent properties to the west, southwest, and south, where E&P related constituents were detected in shallow groundwater. Elevated concentrations on the adjacent properties are centered around distinct E&P features on those properties, with declining concentrations with distance, and are not directly related to impacts on the Levert property. Concentrations detected near the property boundary on the Levert property are well below the maximum concentrations on the adjacent properties. The evaluation on these adjacent properties has been completed, and no further action at this time (NFA-ATT) statuses from LDENR have been granted or are in progress (i.e., NFA-ATT granted for DuPont property to the south; NFA-ATT granted for Zig Zag Tract and investigation complete and NFA-ATT requested for Former Freeport Lease tract on the Wilbert property to the southwest; and NFA-ATT granted for the Global Marketing property to the west). Impacts to shallow groundwater on the Levert property are delineated by these adjoining properties with distinct impacts which have separately been investigated and resolved or nearing resolution.

Vertical delineation of shallow groundwater has also been demonstrated on the Levert property, with no exceedances of E&P related constituents in the deep water bearing zone.

7.7 SURFACE WATER DATA

Surface water samples were collected from Bayou Bourbeaux to the north and west of the property. Surface water analytical results are presented on Table 10. The results were consistent with typical fresh water and did not show indications of impacts from E&P activities (e.g., chloride <30 mg/L and barium ≤0.09 mg/L in both samples). Concentrations were slightly lower in the sample collected in the downstream direction, further supporting the conclusion that impacted groundwater in the shallow zone is not discharging to Bayou Bourbeaux.

8. RECAP EVALUATION

A human health risk evaluation (i.e., RECAP evaluation) was performed to confirm that the remediation plan identified to comply with Statewide Order 29-B will result in conditions that are protective of human health. Section 7 identified that remediation of soil is proposed in former pit areas, within the areas shown in the figures presented in Section 9. The soil data outside (laterally and vertically) of the proposed remediation areas are evaluated in the following quantitative RECAP assessment to address the objective that soil concentrations following remediation will be protective of human health for ongoing and potential alternative land use, including non-industrial use without restriction.

The laboratory methods used to analyze soil and groundwater samples for metals, salts, and hydrocarbon compounds are appropriate for evaluating risk in accordance with the Louisiana RECAP regulation. The site-specific data were therefore used to conduct a human health risk assessment consistent with RECAP methodology. Section 6.1 provides a Conceptual Site Model (CSM) with an exposure pathway analysis and identifies the scenarios included in the risk evaluation. Quantitative RECAP assessment is then provided for soil (Section 6.2.1) and groundwater (Section 6.2.2) in a stepwise process, using the screening step to first identify constituents of concern (COCs), followed by site-specific assessment under a Management Option where required.

8.1 CONCEPTUAL SITE MODEL

A CSM was developed based on the results of site investigations and a site-specific exposure pathway analysis. The CSM describes the potential exposures and the default scenarios used to evaluate the property under RECAP (Figure 99). The CSM discussion below confirms that screening and Management Option RECAP Standards (and their default exposure pathways/scenarios) applied to the Site are protective for the actual exposure conditions.

8.1.1 LAND AND GROUNDWATER USE

The Site setting, land use, and groundwater characteristics were presented in Section 2, and that information is used in this section in the context of an exposure assessment. Use of the sampling areas includes periodic recreation (e.g., hunting) and timber production. Exploration and production is no longer active on the property. Commercial brine injection is reported to be active at former production well location SN 76522. The property is undeveloped with no residential or other structures. Uses of neighboring properties include E&P activities, agriculture, recreation, hunting camp and rural residential use. There are no sensitive receptors such as schools, hospitals, or nursing homes within a 500-foot radius of the investigation areas.

There is no use of shallow groundwater beneath the property for any purpose. The registered water supply wells within a mile of the property, both active and plugged or abandoned, are completed to total depths of 120 feet bgs or greater, in the MRAA. There is no direct exposure to constituents in the water-bearing zones investigated at the property, which are separated from the MRAA by a significant clay confining unit.

8.1.2 EXPOSURE AND SOURCE MEDIA

Soil from the ground surface to a depth of 15 ft bgs is considered potentially available for direct human contact per RECAP definition and is evaluated as an exposure medium on the property. The soil data within this interval were evaluated relative to health-protective standards for dermal contact, soil ingestion, and inhalation. Soil is also evaluated as a potential source medium for transfer of constituents to groundwater, and soil data from all depths were included in the evaluation of this potential migration pathway.

Based on the water well survey and slug test results, shallow and deep water-bearing zones sampled beneath the property were identified as Class 3 (GW3). Future use of these zones is not reasonably anticipated due to the natural limitations of low yield and poor quality, and RECAP evaluation as an exposure medium is not applicable or required. In accordance with the RECAP requirement for Class 3 groundwater, the shallow zone was evaluated for the potential to discharge constituents to a downgradient surface water body, i.e., as a potential source medium. ERM performed an evaluation of potential hydraulic connection of the shallow zone to the nearest downgradient surface water body, Bayou Bourbeaux. No hydraulic connection is identified and the potential groundwater to surface water discharge pathway is incomplete.

Because no E&P-related constituents of concern were identified in the deep water-bearing zone, no evaluation beyond the screening analysis (i.e., as an exposure or source medium) was required.

8.1.3 SUMMARY OF EXPOSURE PATHWAY ANALYSIS AND EXPOSURE SCENARIOS

Although current uses of the sampling areas within the property are not residential, the default non-industrial (residential) exposure scenario of RECAP was used for this risk evaluation to address potential alternative (and unrestricted) use in the future. The assessment of non-industrial exposure represents the most conservative approach to assessing health risks in accordance with RECAP because it assumes the greatest amount of exposure, and it results in the selection of the broadest range of constituents for further site-specific evaluation.

The exposure scenarios and pathways that were quantitatively evaluated under the Screening Option and Management Options in accordance with RECAP include:

- *Non-industrial exposure to soil (SoilNI):* exposure pathways include ingestion, dermal contact, and inhalation of volatile emissions from soil to ambient air;
- *Soil-to-groundwater protection (SoilGW3DW):* transfer of constituents to the Class 3 shallow water-bearing zone was evaluated; and
- *Class 3 groundwater (GW3DW):* hypothetical discharge of groundwater to surface water was evaluated for delineation purposes, with use of surface water assumed to include primary and secondary contact recreation and drinking water supply.

Default exposure parameters of RECAP were used in the risk evaluation without modification.

8.2 DEVELOPMENT AND COMPARISON TO RECAP STANDARDS

The RECAP tiered framework includes a Screening Option (SO) and three Management Options (MO-1, MO-2, and MO-3) to evaluate risks posed by releases of chemical constituents to environmental media. The higher tiers of assessment offer the flexibility to derive standards more reflective of site-specific conditions. The SO, for which generic criteria are provided by LDEQ, was used to identify preliminary COCs in soil and groundwater at the property. Further evaluation was performed under a Management Option for soil and groundwater. A summary of the supporting screening and RECAP standard calculations for the risk assessment is provided in Appendix M.

8.2.1 SOIL

Shading in the soil data summary table (Table 5) identifies the samples within the proposed remediation areas, which will be excavated and removed from the property (LAA 1) or treated through chemical amendment (LAA 2) during remediation. The risk evaluation addresses the data that characterize soil to remain at the property, i.e., samples without gray shading in Table 5. The sampling locations HA-1/1R that were identified as subject to further sampling prior to a removal decision in LAA 3 are not shaded in Table 5 and are included in the risk evaluation. The soil data outside of the remediation areas both laterally and vertically are evaluated in this quantitative assessment. The data collected by both the plaintiff's and defendants' investigators were considered in the risk evaluation.

Laboratory analyses were performed using LDEQ and EPA-recommended methods and were reported with supporting QA/QC data by the laboratory, consistent with RECAP requirements. During ERM's investigation, field QA/QC sampling was performed following RECAP guidance. A review of the QA/QC data indicates that data quality objectives were met, data meet the requirements for definitive data per RECAP, and the data are useable for quantitative risk assessment.

Soil samples submitted for analysis of TPH by ICON were analyzed using the hydrocarbon mixture method (Method SW-846 8015), with the results expressed as TPH-GRO, TPH-DRO and TPH-ORO. For the ERM samples, petroleum hydrocarbon analysis was conducted using the more informative hydrocarbon fractioning method of analysis. In locations where ICON sampled for TPH mixtures during investigations without notice to ERM, ERM resampled and performed hydrocarbon fraction analyses in each location and interval where TPH mixtures were detected. Because hydrocarbon fractionation data provide more specific information than TPH mixture data and a more detailed understanding of TPH concentrations, use of fractionation data is recommended instead of TPH mixture data for conducting environmental risk assessments (LDEQ, 2003; EPA, 2022), and fraction results were used in this risk analysis in accordance with RECAP Appendix D.[2] Hydrocarbon indicator constituents for crude oil (i.e., PAHs) were also analyzed in all locations where TPH fractions were reported above screening standards. Additionally, a grid-type and step-out sampling program was performed at the large L-3/L-4 former pit feature in LAA 1 which

[2] RECAP Appendix D states: ""If TPH fractionation data and TPH mixture data have both been collected at an AOI and the two data sets yield different conclusions about management of the AOI, then management decisions shall be based on the fractionation data since the fractionation method yields more specific information regarding the TPH constituents present and thus more accurately characterizes site conditions."

included sampling for hydrocarbon fractions, PAHs, and BTEX to provide a detailed understanding of constituent distribution laterally and vertically for remedy design.

Screening Evaluation: As the first step in the RECAP risk evaluation, soil concentrations were compared to non-industrial limiting screening standards to identify constituents warranting further site-specific evaluation. Table 14 provides the comparison of maximum and average (for arsenic) reported concentrations in the surface soil interval (upper 15 ft bgs) to limiting RECAP screening standards, i.e., the lower of the screening standards for non-industrial direct contact (Soilssni) and groundwater protection (Soilssgw). Samples collected in the 14-16 ft bgs interval were included in this surface soil assessment.

Barium is the single constituent reported above the limiting screening standard outside of the remediation areas in surface soil. This finding is consistent with the fact that pit residuals were distinguishable in field observations and are reflected in chemical analytical results, and remediation of these materials in the former pit features results in soil with concentrations generally below screening levels. Other constituents detected in soil do not require further risk assessment beyond screening.

A site-specific demonstration of groundwater protection is provided in Table 14 using leachate analysis for barium and lead concentrations reported above default screening levels (Soilssgw) in soil sample locations outside of the remediation areas. Samples were analyzed for SPLP barium in the locations and intervals where the maximum concentrations of barium were reported by ICON (3510 mg/kg at B-5 0-2') and by ERM (2600 mg/kg at L-3R 0-2'). A single sample was identified with lead above the default Soilssgw by ICON (228 mg/kg at HA-1R 0-2') and ERM performed SPLP analysis for lead on the split of this sample and additional samples. The maximum SPLP results for these constituents identified in Table 14 are less than their respective leachate screening standards for protection of all classes of groundwater. The soil-to-groundwater protection pathway does not require further evaluation.

Barium is the single COC that advances to Management Option evaluation, specifically for the direct contact pathway. Figures 63 through 66 show the distribution of barium concentrations in soil compared to the RECAP screening standard. Figures 65 and 66 compare to an updated non-industrial screening standard of 1600 mg/kg that was calculated with the current EPA toxicity factor for mapping purposes.

Subsurface soil samples (greater than 16 feet bgs) were collected and analyzed for metals in two boring locations, L-4 and L-6. Table 15 provides the comparison of the maximum reported concentrations in the subsurface interval to the Soilssgw. Maximum concentrations are below the screening standards and no further risk evaluation is warranted for soil in the subsurface interval.

Management Option 2 (MO-2) Evaluation: Barium in surface soil was further evaluated under MO-2, which was selected to incorporate the current toxicity value (oral reference dose) for barium provided in the EPA Integrated Risk Information System (IRIS)[3]. The MO-2 standard for

[3] Section 2.15 of RECAP states: "If a toxicity value presented in the RECAP document is revised by the EPA: 1) the SS and MO-1 RS shall not be re-calculated using the revised toxicity value; and 2) the MO-2 and MO-3 RS shall be calculated using the revised toxicity value." The updated toxicological review with derivation of the updated oral reference dose was published for barium in the EPA's Integrated Risk Information System (IRIS) in June of 2005 following the promulgation of RECAP in 2003.

barium (Soilni) was developed using the LDEQ-provided spreadsheets (Appendix H of RECAP, 2003) and the current reference dose. No other changes to default RECAP parameters for a non-industrial scenario were made.

Table 16 provides the MO-2 evaluation and demonstrates that the maximum reported barium concentration outside of the proposed remediation areas laterally and vertically is below the MO-2 standard of 16,000 mg/kg, protective of human health for non-industrial land use with no restrictions required.

The foregoing evaluations for direct contact and groundwater protection provide conclusions of the RECAP assessment using soil concentrations expressed in wet weight (i.e., at field conditions). An assessment using dry weight concentrations confirmed no change to the conclusions provided above.

8.2.1.1 EVALUATION OF SALT IN SOIL

In accordance with RECAP guidance for the nontraditional parameter sodium chloride, the presence of salt in soil is not a concern for adverse effects to human health upon direct contact, and the evaluation of this compound is focused on vegetation health (an agronomic standard) and the potential soil to groundwater migration pathway. The evaluation related to agronomic health was provided in Section 7. Available SPLP results for chloride, as well as leachate concentrations for chlorides reported by ICON using an alternative leachate method, are less than the MO-1 GW3DW standard that incorporates the appropriate longitudinal dilution-attenuation factor (220) under RECAP, assuming hypothetically that shallow groundwater could discharge to surface water (see hypothetical calculation in Appendix M, Table M-2). The site-specific leachate testing (see Table 5) included analysis of the highest EC locations in unsaturated soil above the shallow groundwater (L-3, L-4, L-8, L-11), and the leachate results (e.g., maximum SPLP chloride of 302 mg/L) indicate that concentrations of salt in soil do not represent a residual source of contamination to shallow Class 3 groundwater above RECAP standards based on hypothetical discharge (13,200 to 55,000 mg/L).

Moreover, because the groundwater to surface water discharge pathway is incomplete, the quantitative assessment for protection of groundwater is provided solely as an example assessment for GW3 evaluation. Additionally, the chloride concentrations reported in shallow groundwater and soil are not a concern for vertical migration to the underlying MRAA. Salt was vertically delineated to baseline condition in EC probe logs at locations of elevated shallow salt occurrence, and EC values returned to baseline above the second water-bearing zone (e.g., L-1, L-3, L-11). EC less than 1 mmhos/cm was confirmed below the L-3/L-4 closed pit feature in laboratory analysis of a sample from 48-50 feet bgs at boring location L-4, collected above the second water-bearing zone. This finding is consistent with the laboratory data for the deep groundwater, which did not confirm concentrations above SMCLs, and also consistent with the geotechnical laboratory measurement of low vertical permeability (10^{-8} cm/sec) between the shallow and deep groundwater zones. The MRAA is further protected by clay-rich soil at least 30 feet thick beneath the deep groundwater zone and above the MRAA.

8.2.2 GROUNDWATER

Laboratory analyses of groundwater samples from 20 monitoring wells completed in the shallow and deep water-bearing zones included total and dissolved metals, hydrocarbons, the volatile organic constituents BTEX, chloride and other water quality indicators (Table 8). LDEQ and EPA-recommended laboratory methods were used with supporting QA/QC. Because of the fine-grained material and suspended sediment in some wells during sampling, analysis of filtered metals was performed by both parties for some samples and by ERM for all samples.[4] Both the filtered and unfiltered sample results for metals are shown in the RECAP assessment tables for complete information, however, the results for the filtered samples provide more reliable data for representative groundwater concentrations (i.e., definitive data per RECAP) where turbidity was elevated (e.g., L-1A, L-1B, L-2, L-3, L-4A, L-4B, L-12B, MW-1, MW-1D, MW-2, MW-3, and MW-4).

Similar to the soil analyses, ICON provided groundwater analyses of hydrocarbon mixtures (TPH-GRO, TPH-DRO, and TPH-ORO), and ERM provided fraction analyses for all groundwater samples. In accordance with RECAP Appendix D, the fraction analyses are used in the quantitative risk assessment.

Screening Evaluation: As a first step of RECAP evaluation, maximum reported concentrations in groundwater samples were compared to screening standards, protective for all classifications of groundwater, to identify constituents warranting further site-specific evaluation. Table 17 presents the comparison of groundwater concentrations to RECAP screening standards (GWss), with maximum concentrations identified separately for the shallow and deep zones. The table includes both total and dissolved metals data. The screening standards include MCLs, if available, and risk-based levels protective of a residential drinking scenario. RECAP identifies that SMCLs may be considered for ground water assessment on a site-specific basis, and the SMCLs for chloride, TDS, iron, and manganese were compared to the concentrations reported in groundwater for screening purposes. Following screening, the site-specific assessment under a Management Option of RECAP incorporates the appropriate classification of the groundwater.

Constituents reported above screening standards or SMCLs in shallow groundwater and subject to further evaluation include benzene and two hydrocarbon fractions, the metals barium and strontium, and salt indicators chloride and TDS. No constituents were confirmed to be above screening standards in the deeper water-bearing zone as a result of E&P activities, and no further risk evaluation is warranted for the deep zone. Figures 84 through 95 show the distribution of constituents in the shallow and deep groundwater zones. The following observations are provided for the screening assessment:

- Iron, manganese, and arsenic are naturally elevated above the SMCL/MCL regionally and locally as documented in LDEQ Triennial Reports, investigations on adjacent properties, and in unimpacted well L-12B on site. They are not identified as E&P-related constituents for further risk assessment.

[4] Incomplete removal of solids from groundwater samples is a data quality concern because acidification of suspended solids during sample collection causes dissolution of the natural matrix metals, resulting in metals present in the samples due to the mineral aquifer matrix and not groundwater contaminants.

- Benzene was reported above the screening standard in two wells completed within the former L3/L4 pit feature. Benzene was analyzed and not detected or reported below screening standards in surrounding wells and all other wells across the property (see Figure 94). This observation is consistent with the short attenuation length reported for benzene in scientific literature characterizing hundreds of hydrocarbon fuel release sites where benzene was identified (Mace, et al., 1997; Rice, et al., 1995; Happel, et al., 1997; Newell and Conner, 1998).
- The highest concentrations of barium (Figure 86), strontium, chloride (Figure 88), and TDS (Figure 90) were observed in the same locations as the benzene detections, at locations L-3 and L-4A. These constituents decline in concentration in the downgradient direction toward the western property boundary.
- The hydrocarbon fraction concentrations reported above screening levels are shown in Figure 92. The detection at the L-6 location in the southwest portion of the property was not confirmed in a second sampling event at this monitoring well, which indicated all fractions were non-detect. The detection above a screening standard at L-1A is in the active brine disposal well area being addressed in the litigation by others.

The limited admission area shown on the constituent distribution figures defines the preliminary area of investigation (AOI), which extends to the western and southern property boundaries. Shallow groundwater investigations have been completed for the Global Marketing property to the west and DuPont property to the south and received NFA-ATT determinations. The preliminary AOI is therefore defined within the Levert property boundary for this site-specific RECAP evaluation. In accordance with RECAP, the shallow Class 3 groundwater in this AOI beneath the Levert property is further evaluated for potential to discharge constituents to downgradient surface water.

Management Option Evaluation: Shallow groundwater flows predominantly west toward the Global Marketing property. Bayou Bourbeaux at the western boundary of the Global Marketing property is the nearest downgradient surface water body, other than very shallow drainage ditches (see Figure 17). The shallow water bearing zone beneath the Levert and Global Marketing properties occurs at a depth below the elevation of surface water drainage ditches and Bayou Bourbeaux. The groundwater to surface water discharge pathway is therefore incomplete. This finding is consistent with the conclusion of the Global Marketing site investigation, which was reviewed by LDENR as part of the remediation decision and closure determination for that site. Development of groundwater to surface water standards is not applicable for this incomplete pathway for the Levert property. The constituents reported in groundwater beneath the Levert property do not pose a risk of adverse effects to surface water or surface water users, and remediation of shallow groundwater is not required to protect human health and the environment.

Delineation Standards: A calculation of example Management Option 1 (MO-1) standards for the hypothetical groundwater-to-surface water pathway is provided in Appendix M for the purpose of providing delineation standards for the property. The MO-1 calculation is provided for E&P-related COCs identified in Table 17 plus arsenic. The development of example GW3DW standards includes the estimation of attenuation from the property to the potential receiving surface water body, assuming Bayou Bourbeaux as the hypothetical receiving water body. The MO-1 longitudinal

dilution-attenuation factor (DF3) was taken from Appendix H of RECAP considering migration distance (x=1751 to >2000 ft) from the western property boundary and affected saturated zone thickness (Sd=6-10 ft). The resulting values are provided in Table M-2 in Appendix M.

As shown in the COC distribution figures, concentrations are less than the example GW3DW standards in the western monitoring wells installed by ERM along the property boundary (MW-2, MW-3, MW-4) downgradient of the source areas on site. Concentrations are also below the example standards in the eastern (L-12A) and northern (MW-2, L-7, L-2) monitoring wells. A similar hypothetical calculation was provided in the closure plan for the Global Marketing property, acknowledging that no downgradient receptor was identified. The relevant table providing the development of example GW3DW values is reproduced from the Global Marketing report in Appendix M. Values were developed for arsenic and chloride, and the concentrations of these constituents beneath the Levert property along the downgradient property boundary (MW-2, MW-3, MW-4) are less than the GW3DW values developed for the Global Marketing site closure.

8.3 SURFACE WATER

Surface water of Bayou Bourbeaux west of the property was sampled by ERM and analyzed for constituents identified as the most prevalent E&P indicator constituents in site groundwater (e.g., chlorides, barium). The analyses were performed using EPA and LDEQ-recommended methods with appropriate detection limits for risk evaluation. Reported concentrations in the surface water samples are compared in Table 18 to promulgated surface water quality standards applicable to a drinking water resource (LAC 33:IX.1113) and standards specific to Subsegment 120109 (LAC 33:IX.1123). In addition, concentrations are compared for reference to RECAP health-based standards identified as protective in surface water bodies designated for recreation (primary and secondary contact and seafood ingestion) and drinking water supply, i.e., GW3DW with no DF3 applied. There is no material difference in concentrations reported in the two samples, SW-1 and SW-2, and the surface water concentrations of COCs are less than the promulgated water quality standards and health-based RECAP values in Table 18. Shallow groundwater and site soil conditions are not adversely impacting surface water quality or affecting the utility of Bayou Bourbeaux surface water for its designated uses.

8.4 CONCLUSIONS OF RECAP EVALUATION

The risk evaluation confirms that the scope of soil remediation identified to comply with Statewide Order 29-B results in soil concentrations that are compliant with RECAP non-industrial (residential) and groundwater protection standards. The remediation plan for soil provided in Section 9 includes confirmation sampling to document compliance with health-protective standards in addition to the relevant 29-B standards.

Based on the GW3 classification of groundwater sampled at the property, the potential to discharge to surface water was evaluated as required by RECAP. The study of site-specific hydrogeology completed by ERM demonstrates that groundwater to surface water discharge is an incomplete pathway, and constituents reported above screening standards in shallow groundwater beneath the property do not pose a risk to surface water or surface water users. The results of surface water sampling in Bayou Bourbeaux downgradient of the property are consistent with this

conclusion. No E&P-related impact to the deep groundwater zone was identified above screening standards. Corrective action is not required for groundwater to protect human health or comply with RECAP.

COCs in the shallow water bearing zone beneath the site have been reasonably delineated laterally to declining concentrations. A preliminary AOI specific to the Levert property has been identified because adjoining properties with distinct impacts have separately been investigated and resolved. The remediation of former pits within this AOI and specifically within LAA 1 as described in Section 9 will remove potential source material where groundwater concentrations of COCs were highest. Attenuation of COC concentrations in shallow groundwater in the vicinity of these features is expected to continue over time following soil removal and replacement. The remediation plan provided in Section 9 includes monitoring of shallow groundwater for the COCs following soil remediation.

9. SUMMARY OF FINDINGS BY OTHER EXPERTS

A summary of the additional evaluations conducted by other experts is contained in this section. The full reports prepared by these experts are included as appendices.

9.1 ECOLOGICAL RISK ASSESSMENT

Dr. Karen Cejas of ERM performed an ecological risk assessment (ERA) of the property. Dr. Cejas concluded that the site-specific ERA, prepared per EPA and LDEQ guidance, demonstrates that there are no unacceptable ecological risks for the ecological populations at the property, and that remedial actions at the property are not required for ecological reasons. The results of Dr. Cejas ERA are presented in the January 24, 2025 *Ecological Risk Assessment and Expert Report of Karen P. Cejas, PhD.*, which is provided in Appendix R.

The ERA was performed by Dr. Cejas for sampling areas within the site. These sampling areas are inclusive of samples within and outside the Chevron and Key limited admission areas (LAA) 1, 2, and 3, and the ERA and its conclusions are applicable to both the Chevron and Key LAAs and other sampling areas assessed on the site. The ERA evaluates whether oilfield E&P operations associated with Chevron and Key within the site have damaged the ecology (flora and fauna) on the site. Incidentally, the ERA also evaluates the potential impact (or lack thereof) from brine disposal operations associated with others; however, that is unrelated to the limited admission submittals for Chevron and Key and not the focus of the summary provided herein. Highlights of the ERA are summarized below.

- The ERA prepared in accordance with EPA and LDEQ guidance (EPA, 1997, 1998; LDEQ, 2003) is supported by the following information and evidence: Site inspections and evaluations performed in 2024 by Cejas, others at ERM, and ICON;
- Data from investigations performed by ERM and ICON in 2019, 2020, 2023, and 2024 of wetland soils/sediments, surface water, wildlife, and vegetation;
- A Screening-Level Ecological Risk Assessment (SLERA); and
- A site-specific Baseline Ecological Risk Assessment (BERA).

The site supports terrestrial habitats important to the Inland Swamps Ecoregion in which the site is located, including freshwater emergent and forested/shrub wetlands. Portions of the site are inundated seasonally or longer. The vegetation present on site is commonly associated with bottomland hardwood forest. The habitats on site are diverse, supporting 67 vegetative taxa, including 23 species of trees observed.

Site vegetative diversity was compared to a reference location, Sherburne Wildlife Management Area (WMA), 15 miles northwest of the site. The comparison shows that the site has a similar community structure and distribution of vegetation wetland classes to Sherburne WMA, and that the species present on site are typical and representative of the region. Representative bottomland hardwood tree species observed both on the site and Sherburne WMA include: water hickory (*Carya aquatica*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), pumpkin ash (*Fraxinus profunda*), green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*), black willow (*Salix nigra*), and American elm (*Ulmus americana*). This favorable comparison to a

protected area is a line of evidence that the site ecosystem is healthy and as expected for the region.

The site is ecologically important within the Mississippi Flyway, the Atchafalaya Basin Important Bird Area, and the EPA National Ecological Framework. The site supports an intact food web, 31 species of birds, and 30 non-avian taxa, including terrestrial invertebrates, reptiles, amphibians, and mammals. The site bird population compares favorably to the avian trophic structure at Sherburne WMA, with passerines well represented. Sixty-five percent of bird species observed on site were also observed in the reference location. Species of all levels of the terrestrial food web are represented on site.

The site is providing services that are expected for habitats in bottomland hardwood forest, including soil stabilization and provision of habitat and food. Based on observed vegetation and wildlife, and the site's ecological connectivity to the nearby WMA, the site is providing diverse, functioning habitat for flora and fauna, and is a valuable ecosystem within the larger landscape and ecoregion.

Based on the results of the Screening Level Ecological Risk Assessment (SLERA), lead, zinc, and PAHs were retained as Constituents of Potential Ecological Concern (COPECs) for a more in-depth assessment in a site-specific Baseline Ecological Risk Assessment (BERA). The BERA was completed using site-specific data and receptor factors for the ecological populations expected on site. The BERA confirms that historical E&P activities on this site do not pose an unacceptable risk to wildlife and the environment.

The following lines of evidence support the conclusion of no adverse effects to site ecology: vegetative diversity and structure is as expected for the region and comparable to reference, avian population trophic structure is as expected for the region and comparable to reference, the terrestrial food web is intact with all feeding guilds present on site, ecosystem services are functioning, and risk calculated per EPA guidance demonstrates no adverse effects to mammals and birds. Based on these data, the conclusion of the ERA is that historical E&P operations have not adversely affected site ecology, and that remediation is not required for ecological reasons.

9.1.1 EFFECTS OF REMEDIATION ON ECOLOGY AND LAND USE

Remediation is not proposed for LAA 1, 2, or 3 (or other areas) for ecological reasons, as the ecosystems in these locations were observed and documented to be without evidence of impact from former E&P operations. The effects of remediation proposed by ERM (Purdom, Levert & Wiggins) for non-ecological reasons are discussed below.

ERM is proposing remediation for 0.71 acres of wetland soils in LAA 1, 2, and 3, to meet state regulatory guidelines. Disruption to habitats and wildlife will occur in these areas of soil remediation and associated access pathways, though it will be modest in scale and limited to the implementation period. ERM's proposed actions for groundwater (monitoring, contingent in situ treatment, and plug and abandonment of wells) utilize existing wells or are within the footprint of soil remediation activities, and thus will not impose additional significant disruption to the ecology. Following the completion of these remedial activities, it is anticipated that the site will be safe for the ecology, as well as achieve the goal of meeting regulatory guidelines protective of unrestricted

land use. Soil and groundwater remediation beyond the scope proposed here is not necessary for protection of ecology and land use, and would result in prolonged, increased, and unnecessary destruction of functioning ecological communities, including excess removal of mature native forested wetlands and diminishment of ecosystem services.

9.2 EFFECTIVE ROOT ZONE STUDY

In October 2024, Mr. Patrick Ritchie of Ritchie Ecological and Environmental Solutions (REES) conducted an Effective Root Zone (ERZ) study of the Levert property. Mr. Ritchie determined that the root systems on the site are shallow with an ERZ depth between 8 to 16 inches below ground surface, and that a remediation depth of 24 inches is pragmatic and supported by site-specific conditions. The results of Mr. Ritchie's evaluation are presented in the January 24, 2025 *Effective Root Zone Determination and Ecological Assessment of the Paul M. Levert, et al. Property*, which is provided in Appendix Q.

9.3 HUMAN HEALTH TOXICOLOGICAL ASSESSMENT

Dr. John Kind and Dr. Shawn Wnek of CTEH performed a human health assessment of the Levert property. Dr. Kind and Dr. Wnek concluded that, based on a toxicological analysis of the site-specific data, the case area poses no human health risk to potential current and future users of the property. The results of the human health toxicological assessment are presented in the January 24, 2025 *Expert Report of John Kind, Ph.D., CIH, CSP, and Shawn Wnek, Ph.D., CIH, DABT*, which is provided in Appendix S.

9.4 OIL AND GAS OPERATIONS EVALUATION

An evaluation of historical oil and gas operations on the property by Chevron's predecessors was conducted by Mr. Richard Kennedy. Mr. Kennedy concluded that the oil and gas operations conducted by Chevron's predecessors were conducted in a manner that was consistent with the normal and customary way oil and gas operations were conducted in rural land operations in the region, and for the time period the operations were conducted, and that the operations were reasonable and in keeping with applicable industry standards and governmental regulations. The results of Mr. Kennedy's evaluation are presented in the February 6, 2025 *Historic Oil & Gas Operations of British American Oil Producing Company & Gulf Oil Company*, which is provided in Appendix T.

An evaluation of historical oil and gas operations on the property by Key's predecessors was conducted by Dr. L. Brun Hilbert, Jr. Dr. Hilbert concluded that Key's predecessors were prudent operators and maintained and operated oil production wells on the plaintiff's property according to good oilfield practices. The results of Dr. Hilbert's evaluation are presented in the February 6, 2025 *Expert Report of L. Brun Hilbert, Jr., PhD., P.E.*, which is provided in Appendix U.

10. PROPOSED REMEDIATION PLAN

The remediation plan proposed in this section complies with Statewide Order 29-B and RECAP, which is the State's risk-based regulatory standard for environmental evaluation and remediation. A remediation plan that fully complies with Statewide Order 29-B without exceptions (referred to as a "Hypothetical 29-B Plan" hereafter), along with a detailed discussion on why such a plan is unreasonable, infeasible, and unnecessary, is included in Appendix N.

The need for and extent of remediation will ultimately be dependent upon LDENR review of the site investigation data and the proposed plan presented below. Based upon the soil and groundwater data presented herein, the following sections outline the proposed remediation plan.

10.1 DEMONSTRATION OF PROOF OF GOOD CAUSE FOR STATEWIDE ORDER 29-B EXCEPTIONS

This Plan relies on the application of RECAP and additional lines of evidence regarding groundwater protection to address salt in soil below the effective root zone. Additionally, RECAP is used as the applicable regulatory standard for constituents in soil that do not have promulgated standards within 29-B and for constituents reported in groundwater. As stated in Section 319 of the 29-B regulations:

> "The commissioner may grant an exception to any provision of this amendment upon proof of good cause. The operator must show proof that such an exception will not endanger USDWs."

Upon demonstration of good cause, LDENR is authorized to issue exceptions to 29-B, and landowner consent is not required in the context of an Act 312 public hearing (see documentation in Appendix O).[5] Proof of good cause for the exceptions to Statewide Order 29-B requested in this Plan is demonstrated by the following lines of scientific evidence and application of additional regulatory standards that are protective of public health and the environment:

- An effective root zone study performed by Mr. Patrick Ritchie established an ERZ depth between 8 to 16 inches below ground surface, and a pragmatic remediation depth of 24 inches, if remediation were required. Application of 29B salt standards to the ERZ provides for healthy plant and tree growth consistent with the surrounding area and supports current and future use of the Property.
- Remedial action is proposed for each soil sample within the soil limited admission areas where 29-B salt parameter exceedances were observed within the ERZ. 29-B salt parameter exceedances were also observed within the ERZ outside of the soil limited admission areas at

[5] December 12, 2018, LDENR-issued memorandum (Appendix O) states: "Landowner consent has not been required by Louisiana Department of Natural Resources, Office of Conservation (hereinafter 'LDNR/OC' or 'Agency') when a case goes through an Act 312 public hearing and a Most Feasible Plan including exceptions to LAC 43:XIX.Subpart 1(29-B) is approved or developed as a result of evidence at an Act 312 public hearing."
Confirmation was provided in the June 29, 2022 MFP issued by LDENR in the H.C. Drew Estate vs. Neumin Production Company matter (Appendix O), which states: "Landowner consent is not required for a Most Feasible Plan with exceptions to Statewide Order 29-B when the plan is based on evidence at an Act 312 public hearing."

sample L-11, which is discussed in Section 7.3.2 of this report, and sample HA-8, which is addressed in the litigation by others.

- Exceedances of 29-B salt parameters in soil within the ERZ have been horizontally delineated around LAA 1, where salt impacts are highest on the site. Exceedances of ESP in LAA 2 appear to be limited to the apparent pit feature where remedial action is proposed, and confirmation sampling will be conducted after remediation. Exceedances of salt parameters were not present in the ERZ in LAA 3. Additionally, investigation results provide vertical delineation of salt in locations selected for deep delineation using EC probes and borings, in recognized source areas. These results include laboratory analytical data, SPLP data, EC probe logs, field EC data, and soil boring logs.
- Hydrocarbons are evaluated in soil under 29-B through the HEM Oil and Grease method, which only exceeded the 29-B standard in one sample (HA-10 0-2’ in LAA 1), which is delineated both vertically and horizontally. Remediation is proposed at this location. Additionally, soil samples were collected and analyzed at each location where evidence of hydrocarbons was observed in the field. TPH fractions detected above screening standards were delineated both vertically and horizontally in LAA 1, and were further addressed through additional analyses (i.e., PAHs) in all locations above screening standards. These locations fall within proposed remediation areas.
- Locations where metals were identified in soil above 29-B standards are included in proposed remediation or contingent remediation areas except for arsenic, for which a natural source is likely and RECAP evaluation demonstrates compliance with standards protective of human health and the environment.
- The shallow water-bearing zone has been determined to be RECAP Class 3 groundwater based on slug tests performed at monitoring wells appropriately distributed across the property. Slug testing is an approved method of direct measurement of aquifer properties for groundwater classification under RECAP and has been routinely used to determine groundwater classification throughout the state of Louisiana since the inception of RECAP regulations. Slug test results demonstrate the consistently low hydraulic conductivity of the shallow water bearing zone, which is consistent with evaluations performed on the neighboring properties and supported by the soil descriptions on the soil boring logs and cross-sections.
- Soil-to-groundwater protection has been demonstrated through laboratory analytical data, SPLP results for chloride and metals, soil boring logs, geotechnical data, and an evaluation of the local and regional geology and hydrogeology.
- Based on an evaluation of surveyed transects of Bayou Bourbeaux and the depth of the shallow water bearing zone, the shallow groundwater to surface water pathway is incomplete. This is supported by surface water samples collected from Bayou Bourbeaux, which did not contain elevated concentrations of E&P indicator constituents.
- Impacts to groundwater have been delineated horizontally to declining concentrations. Impacted groundwater to the west, southwest, and south of the property has already been evaluated and reviewed by LDENR, and a No Further Action At This Time status has been granted or is in progress. Impacts to groundwater have been fully delineated vertically beneath the site.

- The shallow water-bearing zone has been demonstrated to be naturally poor quality and non-potable, with arsenic, iron, and manganese naturally higher than the corresponding RECAP screening standard (for arsenic) or EPA SMCLs. The shallow water-bearing zone is naturally not potable and could not be remediated to meet potable water quality objectives.
- There is no usable aquifer underlying the property except the MRAA at depths greater than approximately 80 feet below the ground surface. The MRAA is protected by an approximately 80-foot thick predominantly clay confining unit. The water elevation of the MRAA is commonly above the ground surface in the vicinity of the property, and wells drilled in the MRAA are at times artesian. Although there is no connection between the shallow water-bearing zone and the MRAA, the MRAA is further protected from vertical migration of shallow groundwater by the hydraulic gradient, which would drive flow upwards. Furthermore, laboratory results for 29-B salt parameters in soil, EC probe logs, vertical permeability, and SPLP chloride data collected beneath the shallow water-bearing zone demonstrate that the clay confining unit is protective of vertical migration beneath the shallow water-bearing zone.
- No water wells have ever been installed in the shallow water-bearing zone underlying the property, and no shallow wells are identified within a one-mile radius of the property. This finding documents that water well drillers do not target these low-yield, shallow zones for water supplies. It is not reasonably anticipated that a water well driller would ever target such a zone instead of the first viable sand and gravel aquifer underlying the property (i.e. the MRAA) Finally, the shallow water-bearing zone does not meet the definition of an Underground Source of Drinking Water (USDW) as defined in Statewide Order 29-B Section 403.
- If requested by LDENR, additional sampling will be completed until constituents have been delineated to the satisfaction of LDENR.

10.2 PROPOSED SOIL REMEDY

Soil remediation is proposed for three areas of the site:

- Limited Admission Area 1 (LAA 1), the apparent closed pit and former pit features in the L-3/L-4 and HA-10 areas;
- Limited Admission Area 2 (LAA 2), the former pit in the HA-9 area; and
- Limited Admission Area 3 (LAA 3), the former pit in the HA-1 area.

The proposed remediation for each area is discussed in detail below.

LAA 1 (L-3/L-4 and HA-10 Areas)

The portion of the apparent closed pit feature encompassing sample locations L-3, L-3R, L-4, B-1, B-2, HA-3, and HA-3R (see Figure 100) and the former pit feature near HA-10 will be remediated to comply with Statewide Order 29-B limits and RECAP standards. The footprint of this area is approximately 14,500 square feet. ERM's sampling identified different depths of excavation for various sections of the area as shown in Figure 100. Because SONRIS shows no pit registration number for this feature, ERM will register the apparent closed pit and former pit with LDENR and then remediate the area per 29-B regulations. Remediation of the area will include:

- The former pit will be registered with LDENR.
- Preconstruction activities will be performed, including the preparation of a project-specific health and safety plan (HASP), subsurface clearance, and permitting.
- Site preparation will be performed, including access improvement (board roads) and minimal removal of trees and other vegetation to provide traffic access and to clear the surface.
- Piping, concrete slab, electrical supply materials and other debris in the vicinity of the L-3/L-4/HA-10 remediation area and the former tank battery to the northwest will be removed and transported offsite for proper disposal/reuse.
- Soil will be excavated to depths of 2 to 8 feet in subareas (as shown in Figure 100) to address true total barium-affected soil. One portion of the former pit which includes 2 feet of unimpacted overburden will be excavated and stockpiled onsite for reuse as fill.
- Affected soil will be loaded and transported to an LDENR approved E&P waste disposal facility (identified at this point as Colonial Landfill in Sorrento, Louisiana).
- Confirmation sampling will be performed upon completion of the soil removal, and samples from sidewalls and the base of the excavation will be analyzed for hydrocarbon fractions, benzene, oil and grease, salt parameters, and 29-B metals. If hydrocarbon fractions are reported above screening standards, PAHs will also be analyzed. The results will be compared to non-industrial RECAP standards and to Statewide Order 29-B pit closure standards, as applicable.
- Clean backfill will be imported, placed and compacted.
- The area will be seeded with an appropriate grass to establish vegetative ground cover.

LAA 2 (HA-9 Area)

The former pit feature encompassing sample location HA-9 will be remediated to comply with Statewide Order 29-B limits and RECAP standards. The footprint of this area is approximately 13,200 square feet. Based on the results of ERM's sampling, a remediation depth of 2 feet has been established to address ESP results above the Statewide Order 29-B standard as shown in Figure 100. Because SONRIS shows no pit registration number for this feature, ERM will register the former pit with LDENR and then close it per 29-B regulations. Remediation and closure will include the following steps:

- The former pit will be registered with LDENR.
- Preconstruction activities will be performed, including the preparation of a project-specific health and safety plan (HASP), subsurface clearance, and permitting.
- Minimal clearing will be performed to provide access to the area.
- Small quantities of piping and other debris in the vicinity of the former pit will be removed and transported offsite for proper disposal/reuse.
- Approximately 400,000 gallons (9,500 barrels) of accumulated rainwater will be pumped from the feature, transported and disposed offsite. For estimating purposes, it is assumed that this water will be pumped into vacuum trucks and transported offsite for disposal at an LDENR-permitted disposal facility.

- The upper 2 feet of soil in the apparent pit footprint will be treated to address elevated ESP. This will be accomplished by the addition of a bulking agent (hay) and gypsum and blending with the upper two feet of soil to address the ESP levels. This treatment will also address a hydrocarbon fraction reported above the screening standard in this soil interval.
- Confirmation sampling will be performed upon completion of the soil blending, with samples from the treated material analyzed for hydrocarbon fractions, and ESP. If hydrocarbon fractions are reported above screening standards, PAHs will also be analyzed. The results will be compared to non-industrial RECAP standards for TPH fractions (and potentially PAHs) and to the Statewide Order 29-B pit closure standard for ESP.
- The existing berms will then be pushed in and further blended with the upper two feet of soil.
- Clean backfill will be imported, placed and compacted.
- The area will be seeded with an appropriate grass to establish vegetative ground cover.

LAA 3 (HA-1/HA-1R Area)

The former pit feature encompassing sample location HA-1R (and HA-1) will be closed to comply with Statewide Order 29-B. The sample from the interval from 0-2 feet at HA-1R exceeded the 29-B standards for TTBa and zinc, but the sample from the same interval at the original sample location, HA-1, did not. A composite sampling program will be implemented to demonstrate that the feature meets Statewide Order 29-B closure criteria. The area will then be closed by pushing in the berms, backfilling and placing backfill to match surrounding grade.

The footprint of this area is approximately 3,100 square feet. Because SONRIS shows no pit registration number for this feature, ERM will register the former pit with LDENR and then close it per 29-B regulations. Closure will include the following steps:

- The former pit will be registered with LDENR.
- Preconstruction activities will be performed, including the preparation of a project-specific health and safety plan (HASP), subsurface clearance, and permitting.
- Minimal clearing will be performed to provide access to the area.
- A composite sampling program will be performed to characterize the pit and address inconsistencies in previous TTBa analytical data. Samples will be analyzed for 29-B metals and EPA SW-846 barium.
- The existing berms will then be pushed in, and the area will be graded to match surrounding elevations.
- Clean backfill will be imported, placed and compacted, if needed.
- The area will be seeded with an appropriate grass to establish vegetative ground cover.

The estimated cost of the proposed remediation is $1,324,070**,** as detailed in Table 19. Contractor cost estimates are provided in Appendix P.

10.3 CONTINGENT SOIL REMEDY

Cost estimates have been prepared for a contingent soil remedy in LAA 3 (the HA-1/HA-1R area) in the event that LDENR requires remediation.

In the event that composite sampling does not demonstrate compliance with the 29-B closure standard for TTBa or other metals, the pit feature encompassing sample locations HA-1 and HA-1R will be remediated to comply with the Statewide Order 29-B limits. The footprint of this area is approximately 3,100 square feet and the potential depth of exceedance is 2 feet. Because SONRIS shows no pit registration number for this feature, ERM will register the former pit with LDENR and then close it per 29-B regulations. Remediation of the pit will include:

- The former pit will be registered with LDENR.
- Preconstruction activities will be performed, including the preparation of a project-specific health and safety plan (HASP), subsurface clearance, and permitting.
- Site preparation will be performed, including access improvement (board roads) and minimal removal of trees and other vegetation to provide traffic access and to clear the surface.
- Soil will be excavated to a depth of 2 feet (as shown in Figure 96) to address TTBa and/or other metals.
- Affected soil will be loaded and transported to an LDENR approved E&P waste disposal facility (identified at this point as Colonial Landfill in Sorrento, Louisiana).
- Confirmation sampling will be performed upon completion of the soil removal, and samples from sidewalls and the base of the excavation will be analyzed for 29-B metals and EPA SW-846 barium. The results will be compared to Statewide Order 29-B pit closure standards and the RECAP standard for barium.
- Clean backfill will be imported, placed and compacted.
- The area will be seeded with an appropriate grass to establish vegetative ground cover.

The estimated cost for this contingent remedy is $115,035 as detailed in Table 20. Contractor cost estimates are provided in Appendix P.

10.4 GROUNDWATER MONITORING PLAN

Based on the evaluation of sampling results, including the RECAP analysis presented in Section 8, no active remediation of groundwater is necessary to meet risk-based standards at the property. Sampling activities on the property to date demonstrate that groundwater conditions are generally stable. To confirm that groundwater conditions are stable or improving over time, ERM recommends a monitoring plan that includes up to three years of quarterly monitoring. Eight monitoring wells within and surrounding the former E&P operational areas will be sampled for chloride, TDS, barium, arsenic, and benzene, and water levels will be measured during each monitoring event. The proposed ERM groundwater monitoring well network is shown on Figure 101 Monitoring wells within the proposed soil remediation area will be plugged and abandoned prior to remediation activities and reinstalled after remediation is complete. The estimated cost of up to three years of monitoring and reporting to the LDENR, and plugging and abandoning ERM monitoring wells is approximately $236,253 (Table 21). Contractor cost estimates are provided in Appendix P.

10.5 CONTINGENT GROUNDWATER REMEDIATION

In the event that LDENR requires active remediation of groundwater to address benzene at the L-3 location, a contingent groundwater remediation plan has been developed. This contingent plan would involve in situ treatment by injecting compounds containing activated carbon and anaerobic electron acceptors to sorb to hydrocarbon compounds and stimulate bioremediation (i.e., PetroFix). If required, the contingent groundwater remedy would be implemented within the shallow water-bearing zone around the L-3 monitoring well location after the completion of proposed soil remediation activities. The contingent groundwater remediation area is shown on Figure 102. The estimated cost to implement the contingent groundwater remediation is approximately $128,801 (Table 22). Contractor cost estimates are provided in Appendix P.

11. SCHEDULE AND REPORTING

The implementation schedule for this Plan is dependent upon LDENR approvals. The following summary identifies milestones for the implementation schedule:

1. Within 30 days of LDENR approval, initiate pit registration and USACE wetland permitting process in preparation for soil remediation activities;
2. Within 30 days of LDENR approval, initiate field activities for composite sampling at LAA 3;
3. Within 30 days after receipt of final laboratory reports, submit Site Assessment Report to LDENR. The Site Assessment Report will include:
    - Sample location maps;
    - A description of sampling methodology;
    - Updated soil analytical data tables;
    - Soil boring logs;
    - Field notes;
    - Site photographs and photo logs;
    - Copies of final laboratory reports for analyses performed;
    - ERM's recommendation, based on sample results, for remediation at LAA 3 (i.e., if the proposed or contingent remediation plan should be completed); and
    - A schedule of proposed activities to complete the subsequent phase(s) of work (i.e., soil remediation in LAA 1, LAA 2, and LAA 3. and groundwater monitoring).

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