CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM R5-2018-XXXX
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

This Monitoring and Reporting Program (MRP) is being required pursuant to Water Code section 13267. This MRP is for the discharge to land of produced wastewater (wastewater) from the Cymric, McKittrick, and South Belridge Oil Fields at the McKittrick 1 & 1-3 unlined disposal pond systems. The systems are interconnected, regulated as one facility, and are collectively referred to as the McKittrick 1 & 1-3 Facility or Facility. Valley Water Management Company (hereafter Discharger or Valley Water) owns and operates the Facility.

The Discharger shall not implement any changes to this MRP unless and until the Central Valley Regional Water Quality Control Board (Central Valley Water Board) adopts, or the Executive Officer issues, a revised MRP. Changes to sample location(s) shall be established with the concurrence of Central Valley Water Board staff, and a description of the revised sample location(s) shall be submitted for approval by the Executive Officer.

This MRP includes monitoring, record-keeping, reporting, and further hydrogeological investigation requirements. Monitoring requirements include monitoring of groundwater, discharges of produced wastewater, solid wastes, chemicals associated with petroleum exploration, and the application of recycled materials (wastewater and solids); to determine if the Discharger is complying with Waste Discharge Requirements Resolution No. 69-199.

BACKGROUND

Oil field produced wastewater has been discharged to the Facility since the late 1950s. .

The Facility consists of two side-by-side, interconnected pond systems used for the disposal of produced wastewater via evaporation and percolation. The McKittrick 1 pond system occupies the west side of the Facility and is slightly higher in elevation than the McKittrick 1-3 pond system that occupies the east side of the Facility. At the McKittrick 1 pond system, incoming wastewater is discharged into six netted oil/water cleaning ponds, eight pass-through ponds, and 14 evaporation/percolation ponds. Pipelines that discharge into the cleaning ponds are owned and operated by California Resources Production Corporation (CRPC) and Sentinel Peak Resources California LLC (SPR). At the McKittrick 1-3 pond system, incoming wastewater is discharged into three netted oil/water cleaning ponds, 23 pass-through ponds, and 29 evaporation/percolation ponds. A pipeline that discharges into the McKittrick 1-3 cleaning ponds is owned and operated by SPR.

The two pond systems are partially interconnected. Wastewater can gravity flow from the first two McKittrick 1 evaporation/percolation ponds to 11 evaporation/percolation ponds in the McKittrick 1-3 system. For both pond systems, wastewater usually flows through their respective evaporation/ percolation ponds in parallel. However, the pass-through ponds adjacent to the larger evaporation/ percolation ponds can control the flow into the evaporation/percolation ponds. Therefore, each evaporation/percolation pond in each pond system can be operated independently or jointly in series.

The *Water Quality Control Plan for the Tulare Lake Basin* (Revised 2016)(Basin Plan) designates the beneficial uses of local groundwater as Municipal and Domestic Supply (MUN), Agricultural Supply (AGR), and Industrial Service Supply (IND). Land used for agriculture is approximately 1,500 feet

north of the Facility. The California Aqueduct is approximately 3.3 miles northeast of the Facility. Local farmers use groundwater for AGR, particularly when surface waters are short.

Pond information follows:

Facility	Pond	Pond dimensions LxWxLxW or LxW in feet (depths were not provided)	Pass through pond LxW in feet	Contains visible oil	Active	1ST Semi-annual 2017 discharge
McKittrick 1 (west side)	CP-1	147x70	-	Yes	Yes	42,000 barrels/day
	CP-2	85x69	-			
	CP-3	109x69	-			
	CP-4	128x68	-			
	CP-5	101x63	-			
	CP-6	100x60	-			
	P-1	1540x117x1598x94	-	No	Yes	
	P-2	1608x123x1625x118	-			
	P-3	1575x88x1593x90	88x52			
	P-4	1600x86x1671x89	86x52			
	P-5	1625x100x1647x82	100x52			
	P-6	1649x87x1673x96	87x52			
	P-7	1669x89x1689x92	89x52			
	P-8	1357x93x1375x91	93x52			
	P-9	1380x83x1401x91	83x52			
	P-10	1399x83x1419x91	83x52			
	P-11	1496x87x1509x89	-			
	P-12	240x96	-			
	P-13	63x61	-			
	P-14	72x61	-			
McKittrick 1-3 (east side)	CP-1	93x74	-	Yes	Yes	
	CP-2	99x77	-			
	CP-3	97x76	-			
	P-1	1574x175x1706x102	-	No	Yes	
	P-2	1615x80x1636x88	276x92x251x96			
	P-3	1854x83x1872x96	96x48			
	P-4	1872x86x1877x90	90x48			
	P-5	1878x79x1871x92	92x48			
	P-6	1874x81x1873x91	91x48			
	P-7	1866x86x1873x92	92x48			
	P-8	1870c80x1875x89	89x48			
	P-9	1863x82x1867x89	89x48			
	P-10	1857x87x1864x91	91x48			
	P-11	1862x84x1864x92	92x48			
	P-12	1860x80x1869x89	89x48			
	P-13	1859x86x1862x90	89x48			
	P-14	1853x84x1843x101	101x48			
	P-15	1836x80x1845x85	95x48			
	P-16	1830x82x1830x94	94x48			
	P-17	1828x82x1829x92	92x48			
	P-18	1826x79x1827x91	91x48			
	P-19	1829x86x1828x92	91x48			
	P-20	1824x81x1815x91	91x48			
	P-21	1623x83x1590x96	96x48			
	P-22	1587x96x1555x91	91x48			
	P-23	1535x87x1502x91	91x48			
	P-24	1483x91x1453x86	86x48			
	P-25	1477x85x1435x93	-			
	P-26	119x118	-			
	P-27	225x119	-			
	P-28	156x84	-			

	P-29	204x84	-			

The Facility has an existing groundwater monitoring network comprised of five shallow monitoring wells and one deep monitoring well. All six groundwater monitoring wells appear to be impacted by oil field produced wastewater, as described below.

The following shows the Facility groundwater monitoring network well information:

Well ID	Installed	Ground elevation (ft-amsl)	Top of casing (ft-amsl)	Total Depth (ft-bgs)	Screen Interval (ft-bgs)	Screen Interval (ft-amsl)
CYM-17N1	Nov 2002	451.5	452.9	240	105-165	347-287
CYM-19H1	Nov 2002	469.2	471.2	245	115-155	354-314
CYM-21D1	Nov 2002	427.1	429.1	300	274-294	153-133
CYM-17K1	Aug 2006	427.9	430.9	210	150-200	278-228
CYM-17M1	Sep 2006	446.5	449.5	197	155-185	292-262
CYM-17Q1	Aug 2006	437.6	440.6	208	160-200	278-238

According to reports submitted by Valley Water, the ponds are on alluvium that extends to approximately 380 feet above mean sea level (AMSL). During the monitoring well installation hydrogeological investigation, alluvium underneath and nearest the disposal ponds appeared to be saturated with produced wastewater down to a clay layer known as the Corcoran Clay Equivalent (CCE) layer at approximately 360 to 380 AMSL. Self-monitoring reports depict a wastewater plume directly beneath the ponds percolating through the CCE. The upper Tulare sand is encountered beneath the CCE from approximately 360 to 311 feet AMSL. Data submitted indicates that the upper Tulare sand contains produced wastewater from discharges to the Facility's disposal ponds. In 2006, three sentinel wells (CYM-17K1, CYM-17M1, and CYM-17Q1) were drilled into the upper Tulare sand down structure of the produced wastewater disposal ponds and were originally reported as drilled dry.

Semiannual self-monitoring reports include sampling and analyses of the six groundwater monitoring wells and oil field produced wastewater sampling from the McKittrick 1 & 1-3 disposal ponds. Shallow groundwater monitoring wells CYM-17K1, CYM-17M1, CYM-17N1, CYM-17Q1, and CYM-19H1 are completed in the upper Tulare sand unit, and CYM-21D1 is completed in the deeper Tulare sand unit that is reportedly hydraulically separated from the upper Tulare sand unit by a clay unit called the upper Tulare clay, which is found at approximately 311 to 288 feet AMSL. The deeper Tulare sand contains the regional aquifer.

In September 2010, Valley Water submitted a self-monitoring report that indicates that sentinel wells CYM-17K1, CYM-17M1, CYM-17Q1 contained a significant amount of water, but Valley Water did not sample the wells. Subsequent reports state that sentinel well soundings are provided in field notes, but the reports do not contain field notes for the three sentinel wells. In May 2014, Valley Water sampled groundwater in sentinel wells CYM-17K1, CYM-17M1, and CYM-17Q1. The analyses indicate that the water in the wells was largely produced wastewater from the Facility ponds.

The Discharger's 30 January 2017 self-monitoring report states that "water sampled from CYM-17K1, CYM-17M1, CYM-17N1,CYM-17Q1,and CYM-19H1 plot close to pond samples with respect to the sodium and chloride ions, indicating that they are affected by the produced water but also have higher concentrations of calcium and sulfate, which is typical of the local groundwater". The report further states that "The first appearance of groundwater in wells CYM-17K1, CYM-17M1 and CYM-17Q1 also

represents a mix of native groundwater and water recharged in the ponds. Calculated groundwater velocities (0.33 ft/day) and the distances from well CYM-17N1 to these sentinel wells indicates the presence of water that was disposed of in the ponds over 40 years ago" Disposal to ponds began in the late 50s, and the sentinel wells contained water in 2010 indicating that produced wastewater has likely migrated much farther downgradient in the upper Tulare sand than implied in the Valley Water reports.

As described, the upper Tulare clay separates the upper Tulare sand groundwater zone from the deeper Tulare sand groundwater zone. The deeper Tulare sand groundwater zone extends from approximately 288 feet AMSL to at least 200 feet AMSL. Well CYM-21D1 is the only Valley Water monitoring well drilled and screened in the deeper Tulare sand. In October 2017, Valley Water submitted a technical report entitled *Valley Water Management Company, Cymric Area Sampling and Analysis Report, First Semi-Annual 2017* (October 2017 Report). Samples from each of the Valley Water wells in the upper Tulare sand were chemically similar to the produced wastewater in the ponds. Monitoring well CYM-21D1 in the deeper Tulare showed indications of produced water impacts. The October 2017 Report states, "The overall trend of increasing concentrations of chloride, magnesium, sodium, and boron at VWMC Lower Tulare Sand well CYM-21D1 continued with the June 2017 sampling event with concentrations of chloride of 2,400 mg/L and TDS of 8,500 mg/L. The boron concentration in June 2017 was 22 mg/L. These concentrations are the highest recorded and indicate influence from produced water mixing with native groundwater." The conclusions of the October 2017 Report confirm that produced wastewater has migrated through the upper Tulare clay and that it is not a reliable aquitard in the area of the Facility. The data submitted in self-monitoring reports by Valley Water also indicate that from 2002 to 2017 the TDS concentrations in CYM-21D1 have increased from about 1,200 mg/L to 8,500 mg/L, and the chloride concentrations have increased from 334 mg/L to 2,400 mg/L. The TDS and chloride concentrations now exceed State drinking water Maximum Contaminant Levels and agricultural water quality objectives, indicating that produced water from the Facility ponds have caused a condition of pollution in the deeper Tulare sand.

According to the State's database *GeoTracker Groundwater Ambient Monitoring and Assessment Program* (GeoTracker Gama), the closest groundwater well data (excluding site's groundwater monitoring wells) to the Facility ponds are monitoring wells approximately 1.98 miles (GID: 00600632 & 00600632), and 2.6 miles (GID: W0601502763) northeast on the Clean Harbors Buttonwillow, LP hazardous waste disposal facility at 2500 West Lokern Road (Clean Harbors Facility). Early operations at the Clean Harbors Facility included the use of unlined ponds for liquid waste storage and disposal. By the mid 1990's, all unlined ponds had been clean closed and the Clean Harbors Facility altered operations to utilize lined waste management units. The Clean Harbors Facility is regulated by Waste Discharge Requirements (WDRs) Order No. 96-094 and has a groundwater monitoring network that monitors three groundwater zones. The three zones are known as the Lower Water Table Zone, the Intermediate Perched Zone, and the Upper Perched Zone. The Upper Perched Zone appears to be isolated from the Intermediate Perched Zone by a clay aquitard layer. In 14 August 2017, the Upper Perched Zone groundwater flow was reported to be predominantly to the northeast: the Intermediate Perched Zone groundwater flow was reported to be predominantly to the east; and the lower water table zone groundwater flow was reported to be predominantly to the northeast.

The following table includes Clean Harbors Facility groundwater monitoring well network information dated 14 August 2017:

Groundwater Zone	Background well	Screen Interval (ft AMSL)	Groundwater elevation (ft MSL)	Point of Compliance well	Screen Interval (ft AMSL)	Groundwater elevation (ft MSL)
Upper Perched Zone	MW-QU MW-TU MW-130U MW-143U	215.2 – 205.2 210.9 – 200.9 243.8 – 223.8 237.6 – 217.6	217.2 211.78 Dry 219.42	MW-131RU MW-145U MW-146RU MW-147RU MW-158U MW-159U MW-160U MW-161U	212.6 – 182.6 228.2 – 218.2 224.6 – 194.6 217.5 – 187.5 243.9 – 213.9 238.1 – 208.1 242.6 – 222.6 242.6 – 222.6	212.97 Dry 211.68 212.74 218.26 212.75 Dry Dry
Intermediate Perched Zone	MW-148I MW-149RI	187.7 – 172.7 140.8 – 125.8	180.21 169.64	MW-137R1	183.6 – 168.6	170.27
Lower Water Table Zone	MW-PRL MW-102RL MW-119RL	101.57 – 71.57 134.7 – 104.7 127.1 – 97.1	85.91 122.8 101.16	MW-151RL MW-152RL MW-153RL MW-163L MW-164RL MW-165RL MW-166L MW-167L MW-168L MW-169L MW-170L	110.77 – 80.77 119.4 – 89.4 107.06 – 77.06 119.55 – 89.55 77.47 – 42.47 47.73 – 27.73 113.9 – 83.9 114.9 – 84.9 114.1 – 84.3 118.4 – 88.41 126.59 – 96.59	83.13 89.1* 88.38 89.58* 83.83 91.46 90.43 91.69 91.37 96.03 107.41

* This fluid level is below the base of the screened interval, and most likely represents residual groundwater trapped in the well sump. The water level in this well may not be included in site potentiometric surface maps.

Clean Harbors Facility's Quarterly monitoring report data shows monitoring well MW-148I (intermediate zone) and MW-102RL (lower zone) are increasing in TDS and chloride concentrations. MW-148I and MW-102RL are upgradient on the Clean Harbors Facility site, and down gradient/structure from the McKittrick 1 & 1-3 Facility disposal ponds. From 2011 to 2017, the TDS in MW-148I has increased from about 2,340 mg/L to 5,400 mg/L, and from 2009 to 2017 the chloride concentration has increased from about 246 mg/L to 1,200 mg/L. From 2013 to 2017, the TDS in MW-102RL has increased from about 3,040 mg/L to 3,900 mg/L, and from 2007 to 2017 the chloride concentration has increased from about 450 mg/L to 740 mg/L. The increasing TDS and chloride concentrations in these wells indicates they have been adversely influenced by the produced wastewater from Valley Water Management Company's Facility.

Valley Water owns the Facility and is responsible for the discharge from the McKittrick 1 & 1-3 Facility ponds. The discharges are migrating east and have polluted groundwater in the in the upper Tulare sand and the deeper Tulare sand, which contains the regional aquifer. These aquifers are used locally AGR. The monitoring requirements contained in the MRP are necessary to fully characterize the discharge and the lateral and vertical extent of the groundwater plume emanating from the Facility and inform an effective strategy to protect water quality. The related costs are reasonable considering the magnitude of known and potentially ongoing impacts to water quality.

MONITORING

All samples shall be representative of the volume and nature of the discharge or matrix of material sampled. All analyses shall be performed in accordance with applicable sections of ***Standard Provisions and Reporting Requirements for Waste Discharge Requirements***, dated 1 March 1991 (Standard Provisions) (Attached).

Field test instruments (such as a pH meter) may be used provided that the operator is trained in the proper use of the instrument and each instrument is serviced and/or calibrated at the recommended frequency by the manufacturer or in accordance with manufacturer instructions.

Analytical procedures shall comply with the methods and holding times specified in the following: *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater* (EPA); *Test Methods for Evaluating Solid Waste* (EPA); *Methods for Chemical Analysis of Water and Wastes* (EPA); *Methods for Determination of Inorganic Substances in Environmental Samples* (EPA); *Standard Methods for the Examination of Water and Wastewater* (APHA/AWWA/WEF); and *Soil, Plant and Water Reference Methods for the Western Region* (WREP 125). Approved editions shall be those that are approved for use by the United States Environmental Protection Agency or the State Water Board's Environmental Laboratory Accreditation Program. The Discharger may propose alternative methods for approval by the Executive Officer.

A complete list of substances which are tested for and reported on by the testing laboratory shall be provided to the Central Valley Water Board. All peaks must be reported. In addition, both the method detection limit (MDL) and the practical quantification limit (PQL) shall be reported. Detection limits shall be equal to or more precise than USEPA methodologies. Analysis with an MDL greater than the most stringent drinking water standard that results in non-detection needs to be reanalyzed with the MDL set lower than the drinking water standard, if possible, or at the lowest level achievable by the laboratory. If the regulatory limit for a given constituent is less than the RL (or PQL), then any analytical results for that constituent below the RL (or PQL), but above the MDL, shall be reported and flagged as estimated. All quality assurance/quality control (QA/QC) samples must be run on the same dates as when samples were actually analyzed. Proper chain of custody procedures must be followed and a copy of the completed chain of custody form shall be submitted with the report. All analyses must be performed by an Environmental Laboratory Accreditation Program (ELAP) certified laboratory.

If monitoring consistently shows no significant variation in magnitude of a constituent concentration or parameter after a statistically significant number of sampling events, the Discharger may request this MRP be revised by the Executive Officer to reduce monitoring frequency or minimize the list of constituents. The proposal must include adequate technical justification for reduction in monitoring frequency.

Monitoring requirements include the periodic visual inspection of the Facility to ensure continued compliance with the Order. The MRP also requires submittal of information regarding the use of all chemicals used during well drilling, installation, operation, and maintenance activities associated with each well generating waste materials (liquids and solids) that are discharged to the McKittrick 1 & 1-3 Facility Ponds and regulated under this Order.

This MRP requires the Discharger to keep and maintain records for five years from the date the monitoring activities occurred and to prepare and submit reports containing the results of monitoring specified below. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Central Valley Water Board. Except where indicated, all monitoring must begin immediately.

PRODUCED WASTEWATER MONITORING

Produced wastewater samples shall be representative of the volume and nature of the discharges. The Discharger shall maintain all sampling and analytical results: date, exact place, and time of sampling; dates analyses were performed; analyst's name; analytical techniques used; and results of all analyses.

The Discharger shall label all pipelines discharging production wastewater into the Facility. Identifying labels shall be located within five feet of the pipeline and shall include at least the following: Operator, source Oil Field, and corresponding generating leases and facilities.

If the discharge is intermittent rather than continuous, then on the first day of each such intermittent discharge, the Discharger shall monitor and record data for all of the constituents listed below, after which the frequencies of analysis given in the schedule shall apply for the duration of each such intermittent discharge.

DISCHARGE 001

The Discharger shall monitor the volume and quality of produced wastewater discharged to the disposal ponds from all sources. Produced wastewater samples shall be collected downstream from the treatment system and prior to discharge to land (roads, ponds, etc.)
(Discharge 001).

Produced wastewater monitoring for Discharge 001 shall be collected from the sample points described below and from all additional discharge points not included below and shall include at least the following:

Discharge ID	Lease	Sample point location
001a	McKittrick 1	Pipeline 1 discharge from Sentinel Peak Resources California LLC
001b		Pipeline 2 discharge from California Resources Production Corporation
001c		Pipeline 3 discharge from California Resources Production Corporation
001d	McKittrick 1-3	Pipeline 1 discharge from Sentinel Peak Resources California LLC
001x[1]	Name	Description

[1] Discharger shall label, add, monitor, and sample all existing discharge points not described in the table above which have the potential to discharge to the Facility's disposal ponds.

Constituent/Parameter	Units	Sample Type	Frequency
Flow	MGD and Barrels/day	Metered[1]	Continuous
Table I – Analytical parameters	Varies	Grab	Varies

[1] Flow may be measured with an appropriate engineered alternative if approved in writing by the Central Valley Regional Board Executive Officer.

DISCHARGE 002

Disposal pond produced wastewater samples shall be collected in the pond at the distal end of the system (Discharge 002), or if ponds are operated in parallel, in the pond that has contained produced wastewater for the longest period of time (i.e., longest retention time) (Discharge 002) from each pond system (McKittrick 1 and from McKittrick 1-3) at the Facility. Produced wastewater monitoring for Discharge 002 shall include at least the following:

Discharge ID	Lease	Sample point location
002a	McKittrick 1	Wastewater from the pond with the longest residence time
002b	McKittrick 1-3	Wastewater from the pond with the longest residence time

Constituent/Parameter	Units	Sample Type	Frequency
Table I – Analytical parameters	Varies	Grab	Varies

CHEMICAL AND ADDITIVE MONITORING

To adequately characterize discharges into, and ultimately from, the Facility, the Discharger is responsible for reporting all chemicals and additives, including those that may have entered the produced wastewater stream prior to being discharged to each pond system at the Facility. The Discharger shall obtain from oil field operators that discharge to the Facility and provide to the Central Valley Water Board the following for all chemicals and additives used at all leases and facilities that discharge produced water to each pond system at the Facility:

Requirement	Frequency
A list of all chemicals and additives used.	**Quarterly**
The volume and mass of each chemical and additive used in gallons and kilograms, respectively.	**Quarterly**
A list of the leases and facilities where the chemicals and additives are being used.	**Quarterly**
Safety Data Sheets (SDSs) or Material Safety Data Sheets (MSDSs) for each chemical and/or additive used during the year.	**Annually**

SOLID WASTE MONITORING

The Discharger shall monitor the generation and use of solid wastes, including sludges generated at the Facility from activities, such as tank, pipe, or pond maintenance. Solid waste volumes, disposal methods, disposal facilities, and analytical results from waste characterization shall be reported in the subsequent quarterly and annual monitoring reports.

The Discharger shall provide the volumes and destination, including facility permit numbers, for all solid wastes, including hazardous wastes, which are disposed of off-site.

The disposal of solid waste on-site requires the submittal of a Solid Waste Management Plan for review and approval by the Central Valley Water Board. At a minimum, the Solid Waste Management Plan shall include the following:

1. Sampling frequencies,
2. Average volume of solid waste generated annually,
3. Solid wastes criteria for on-site disposal (e.g., non-hazardous and not within 100 feet of surface waterways),
4. Disposal method(s) and procedures,
5. Disposal location(s), and
6. Reporting requirements.

Prior to the disposal of solid wastes on-site, the Solid Waste Management Plan must be approved, in writing, by the Central Valley Water Board. Modifications to the Solid Waste Management Plan need to be submitted in an addendum report that requires written approval by the Central Valley Water Board prior to implementation. On-site solid waste monitoring shall consist of the reporting requirements specified in the approved Solid Waste Management Plan.

The Discharger shall provide the volumes and locations of all solid wastes disposed on-site and include in the quarterly reports a demonstration that the applications comply with an approved solid waste management plan.

FACILITY MONITORING

Permanent markers or equivalent shall be in place with calibrations indicating the pond water level at design capacity and available operational freeboard. Freeboard shall be maintained at a two feet minimum. The freeboard shall be monitored on all ponds to the nearest tenth of a foot **monthly** and results **included in the quarterly report**.

Annually, prior to the anticipated rainy season, but **no later than 30 September**, the Discharger shall conduct an inspection of the Facility. The inspection shall assess repair and maintenance needed for: drainage control systems; slope failure; groundwater monitoring wells, oil booms, pond netting, or any change in site conditions that could impair the integrity of the waste management unit or precipitation and drainage control structures; and shall assess preparedness for winter conditions including, but not limited to, erosion and sedimentation control. The Discharger shall take photos of the Facility and of any problem areas before and after repairs. Any necessary construction, maintenance, or repairs shall be **completed by 31 October**. Annual Facility inspection reporting shall be **submitted by 30 November**.

The Discharger shall inspect all precipitation diversion and drainage facilities for damage **within 7 days** following major storm events (e.g., a storm that causes continual runoff for at least one hour) capable of causing flooding, damage, or significant erosion. The Discharger shall take photos of any problem areas before and after repairs. Necessary repairs shall be completed **within 30 days** of the inspection. Notification and reporting requirements for major storm events shall be conducted as required in the Reporting Requirements of this MRP and shall be reported in the quarterly monitoring report following the major storm event.

The Discharger shall monitor and record on-site rainfall data using an automated rainfall gauge or an acceptable alternative. Data shall be used in establishing the severity of storm events and wet seasons for comparison with design parameters used for waste management unit design and conveyance and drainage design. Daily data and on-site observation shall be used for establishing the need for inspection and repairs after major storm events. Rainfall data shall be reported in the quarterly monitoring reports, as required by this MRP.

GROUNDWATER WELL SURVEY

Within 60 days of the signature date of this MRP, the Discharger shall conduct a well survey to identify all water supply wells within two and one half-miles of the ponds that receive produced wastewater or other authorized discharges. **Within 90 days** of the signature date of this MRP, the Discharger shall sample identified domestic water supply wells and analyze the samples for the waste constituents listed in Table I of this MRP. Groundwater well survey results (including well location and designated use for all water supply wells within one mile) and analytical results shall be reported in the quarterly report following the groundwater sample collection date. If access to private property is requested and denied, a demonstration of that denial is required.

GROUNDWATER MONITORING

The Discharger shall operate and maintain a groundwater monitoring system. Field notes in Valley Water's self-monitoring reports indicate the sentinel wells CYM-17K1, CYM-17M1, and CYM-17Q1 may have contained produced wastewater from the ponds as early as 2010 and sampling in 2014 confirmed the presence of produced water from the ponds. This indicates that the plume of produced wastewater above the upper Tulare clay has reached and extended beyond the sentinel wells Valley Water's 2017 self-monitoring report demonstrates high salinity produced wastewater has migrated beyond the sentinel wells and also impacted groundwater at CYM-21D1 in the deeper Tulare sand, which contains the regional aquifer. The Discharger needs to perform additional work to delineate the lateral and vertical extent of the produced wastewater plume.

After measuring water levels and prior to collecting samples, each monitoring well shall be adequately purged to remove water that has been standing within the well screen and casing that may not be chemically representative of formation water. Depending on the hydraulic conductivity of the geologic setting, the volume removed during purging is typically from 3 to 5 volumes of the standing water within the well casing and screen, or additionally the filter pack pore volume.

The Discharger shall monitor groundwater wells for the following:

Constituent/Parameter	Units	Sample Type	Frequency
Depth to groundwater	Feet[1]	Measured	**Quarterly**
Groundwater elevation	Feet[1]	Calculated	**Quarterly**
Table I – Analytical parameters	Varies	Grab	**Quarterly**

[1] Recorded to one hundredth of a foot

Within 30 days of notification that permission to sample a well(s) is not granted or is revoked, the Discharger shall submit for review and approval by Central Valley Water staff a report that either: (1)

demonstrates that a reduction in the number of monitoring well(s) will not impair the ability to clearly and accurately assess potential groundwater impacts, or (2) proposes the installation of a new monitoring well(s) or use of another existing well to offset the well(s) no longer able to be sampled.

GROUNDWATER MONITORING WELL NETWORK INSTALLATION

The existing groundwater monitoring system has not fully delineated the lateral and vertical extent of the produced wastewater plume. A Monitoring Well Installation and Sampling Plan (MWISP) shall be submitted **within 60 days** of the signature date of this MRP. The MWISP shall provide for the installation of an appropriate number of upgradient/up-structure dip groundwater monitoring wells to identify background water quality and an appropriate number of downgradient/down-structure wells to delineate the plume of produced wastewater emanating from the Facility ponds.

At a minimum, the MWISP shall include the information below.

1. General Information:
   a. Topographic map showing any existing nearby (about 2.5 mile) domestic, irrigation, and municipal supply wells and monitoring wells known to the Discharger, utilities, surface water bodies, drainage courses and their tributaries/destinations, and other major physical and man-made features, as appropriate.
   b. Site plan showing proposed well locations, other existing wells, unused and/or abandoned wells, major physical site structures, any waste handling facilities, irrigated cropland and pasture, and on-site surface water features.
   c. Rationale for the number of proposed monitoring wells, their locations and depths, and identification of anticipated depth to groundwater.
   d. If, proposing to use existing groundwater wells as part of the MWISP, include well screen intervals in relation to groundwater levels, current well use, and rational for well selection.
   e. Local permitting information (as required for drilling, well seals, boring/well abandonment).
   f. Drilling details, including methods and types of equipment for drilling and logging activities. Equipment decontamination procedures (as appropriate) should be described.
   g. Health and Safety Plan.

2. Proposed Drilling Details:
   a. Drilling techniques.
   b. Well logging method.
   c. Proposed Monitoring Well Design - all proposed well construction information must be displayed on a construction diagram or schematic to accurately identify the following:
   d. Well depth.
   e. Borehole depth and diameter.
   f. Well construction materials.
   g. Casing material and diameter – include conductor casing, if appropriate.
   h. Location and length of perforation interval, size of perforations, and rationale.
   i. Location and thickness of filter pack, type and size of filter pack material, and rationale.
   j. Location and thickness of bentonite seal.
   k. Location, thickness, and type of annular seal.
   l. Surface seal depth and material.
   m. Type of well cap(s).
   n. Type of well surface completion.
   o. Well protection devices (such as below-grade water tight-vaults, locking steel monument, bollards, etc.).

3. Proposed Monitoring Well Development:
   a. Schedule for development (not less than 48 hours or more than 10 days after well completion).
   b. Method of development.
   c. Method of determining when development is complete.
   d. Parameters to be monitored during development.
   e. Method for storage and disposal of development water.

4. Proposed Surveying:
   a. How horizontal and vertical position of each monitoring well will be determined.
   b. The accuracy of horizontal and vertical measurements to be obtained.
   c. The California licensed professional (licensed land surveyor or civil engineer) to perform the survey.

5. Proposed Groundwater Monitoring:
   a. Schedule (at least 48 hours after well development).
   b. Depth to groundwater measuring equipment (e.g., electric sounder or chalked tape capable of ±0.01-foot measurements).
   c. Well purging method, equipment, and amount of purge water.
   d. Sample collection (e.g., bottles and preservation methods), handling procedures, and holding times.
   e. Quality assurance/quality control (QA/QC) procedures (as appropriate).
   f. Analytical procedures.
   g. Equipment decontamination procedures (as appropriate).

6. Proposed Schedule:
   a. Fieldwork.
   b. Laboratory analyses.
   c. Report submittal.

MONITORING WELL INSTALLATION COMPLETION REPORT

Within **90 days** of installation of a groundwater monitoring well(s), a Monitoring Well Installation Completion Report (MWICR) shall be submitted. At a minimum, the MWICR shall summarize the activities as described below.

1. General Information:
   a. Brief overview of field activities including well installation summary (such as number, depths), and description and resolution of difficulties encountered during field program.
   b. Topographic map showing any existing nearby domestic, irrigation, and municipal supply wells and monitoring wells, utilities, surface water bodies, drainage courses and their tributaries/destinations, and other major physical and man-made features.
   c. Site plan showing monitoring well locations, other existing wells, unused and/or abandoned wells, major physical site structures, any waste handling facilities, and on-site surface water features.
   d. Period of field activities and milestone events (e.g., distinguish between dates of well installation, development, and sampling).

2. Monitoring Well Construction:
   a. Number and depths of monitoring wells installed.
   b. Monitoring well identification (i.e., numbers).
   c. Date(s) of drilling and well installation.

d. Description of monitoring well locations including field-implemented changes (from proposed locations) due to physical obstacles or safety hazards.
e. Description of drilling and construction, including equipment, methods, and difficulties encountered (such as hole collapse, lost circulation, need for fishing).
f. Name of drilling company, driller, and logger (site geologist to be identified).
g. As-built for each monitoring well with the following details:
    i. Well identification.
    ii. Total borehole and well depth.
    iii. Date of installation.
    iv. Boring diameter.
    v. Casing material and diameter (include conductor casing, if appropriate).
    vi. Location and thickness of slotted casing, perforation size.
    vii. Location, thickness, type, and size of filter pack.
    viii. Location and thickness of bentonite seal.
    ix. Location, thickness, and type of annular seal.
    x. Depth of surface seal.
    xi. Type of well cap.
    xii. Type of surface completion.
    xiii. Depth to water (note any rises in water level from initial measurement) and date of measurement.
    xiv. Well protection device (such as below-grade water tight vaults, stovepipe, bollards, etc).
h. All depth to groundwater measurements during field program.
i. Field notes from drilling and installation activities (e.g., all subcontractor dailies, as appropriate).
j. Construction summary table of pertinent information such as date of installation, well depth, casing diameter, screen interval, bentonite seal interval, and well elevation.

3. Monitoring Well Development:
   a. Date(s) and time of development.
   b. Name of developer.
   c. Method of development.
   d. Methods used to identify completion of development.
   e. Development log: volume of water purged and measurements of temperature, pH and electrical conductivity during and after development.
   f. Disposition of development water.
   g. Field notes (such as bailing to dryness, recovery time, number of development cycles).

4. Monitoring Well Survey:
   a. Identify coordinate system or reference points used.
   b. Description of measuring points (i.e. ground surface, top of casing, etc.).
   c. Horizontal and vertical coordinates of well casing with cap removed.
   d. Name, license number, and signature of California licensed professional who conducted survey.
   e. Surveyor's field notes.
   f. Tabulated survey data.

REPORTING REQUIREMENTS

All monitoring results shall be reported in **Quarterly Monitoring Reports,** which are due by the first day of the second month after the calendar quarter. Therefore, monitoring reports are due as follows:

First Quarter Monitoring Report (January – March):	**1 May**
Second Quarter Monitoring Report (April – June):	**1 August**
Third Quarter Monitoring Report (July – September):	**1 November**
Fourth Quarter Monitoring Report (October – December):	**1 February**
Facility Inspection Report (Completed by 30 October):	**30 November**

A transmittal letter shall accompany each monitoring report. The transmittal letter shall discuss any exceedances of applicable effluent or groundwater limitations or other instances of non-compliance that occurred during the reporting period and all corrective actions taken or planned, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions or a time schedule for implementing the corrective actions, reference to the previous correspondence is satisfactory. **Reports shall be submitted whether or not there is a discharge**.

The Discharger shall **submit electronic copies** of all work plans, reports, analytical results, and groundwater elevation data via electronic mail to CentralValleyFresno@waterboards.ca.gov and over the Internet to the State Water Board Geographic Environmental Information Management System database (GeoTracker) at http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml

A frequently asked question document for GeoTracker can be found at http://www.waterboards.ca.gov/ust/electronic_submittal/docs/faq.pdf

Electronic submittals to GeoTracker shall comply with GeoTracker standards and procedures, as specified on the State Water Board's web site. All submittals including uploads to GeoTracker shall be completed on or prior to the due date.

In addition, a hardcopy of each document shall be submitted to:

California Regional Water Quality Control Board
Central Valley Region
1685 E Street, Suite 200
Fresno, CA 93706
Attn: Ronald E. Holcomb

GeoTracker Site Global ID: **WDR100037491**
CIWQS Place ID: **209130** for **BELGIAN ANTICLINE, MCKITTRICK 1 & 1-3**

The following information is to be included on all monitoring reports, as well as report transmittal letters:

Valley Water Management Company
Belgian Anticline, McKittrick 1 & 1-3
Waste Discharge Requirements 69-19901
Monitoring and Reporting Program R5-2017-0806
GeoTracker Site Global ID: WDR100037491
CIWQS Place ID: 209130

In reporting monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible for all historical and current data. The data shall be summarized in such a manner that illustrates clearly, whether the Discharger complies with waste discharge requirements.

If the Discharger monitors any constituent at the locations designated herein more frequently than is required by this Order, the results of such monitoring shall be included in the calculation and reporting of the values required in the quarterly monitoring reports. Such increased frequency shall be indicated on the quarterly monitoring reports.

All monitoring reports shall comply with the signatory requirements in Standard Provision B.3. All monitoring reports that involve planning, investigation, evaluation, or design, or other work requiring interpretation and proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code sections 6735, 7835, and 7835.1.

A. **All Quarterly Monitoring Reports shall include the following**:

Produced Wastewater reporting:

1. Tabular summary of current and historical results of produced wastewater discharges as specified on pages 7 and 8.

2. For each month of the quarter, calculation of monthly effluent flow and the historical monthly effluent flow for the last 12-months. Historical annual effluent flow data in tabular summary.
3. For each quarter, include a current and historical table of **all data** for each wastewater sample point. In addition, each quarter, include a data table for current and historical wastewater sample data for all electrical conductivity (EC), total dissolved solids (TDS), boron, dissolved sodium, potassium, dissolved calcium, dissolved magnesium, chloride, alkalinity as CaCO3, dissolved sulfate, isotopes for oxygen (^{18}O), and deuterium (Hydrogen 2, ^{2}H, or D) concentrations.

Facility reporting:
1. Monthly freeboard results as specified on MRP page 9.
2. The results of Facility inspections conducted during the quarter as specified on MRP page 9.
3. Rainfall data as specified on MRP page 9.

Chemical and Additive reporting:
1. Tabular summary of current and historical data required as specified on MRP page 7.
2. Safety Data Sheets for all chemicals and additives that are identified in quarterly monitoring reports for that respective calendar year.
3. Tabular summary of current and historical annual volume and mass for all chemicals and additives.
4. Summary that identifies if any chemicals and additives were detected in produced wastewater discharge to the Facility ponds or groundwater.

Solid Waste reporting:
1. The results of solid waste monitoring specified on MRP pages 8 and 9, including the nature, volume, and weight in dry tons of solid waste produced during the quarter.
2. Tabular summary of current and historical analytical results characterizing the solid waste, and particularly, whether the waste is hazardous as defined in Title 22, CCR, Section 66261.
3. The method of disposal and disposal locations of the solid wastes.
4. If wastes are hauled to a disposal facility, evidence that the disposal facility is properly permitted and submit copies of waste manifest.

Groundwater reporting:
1. The results of groundwater monitoring specified on page 10.
2. For each monitoring well, a table showing all constituent concentrations for current and historical concentrations. In addition, each quarter, include a data table for current and historical groundwater sample data for all electrical conductivity (EC), total dissolved solids (TDS), boron, dissolved sodium, potassium, dissolved calcium, dissolved magnesium, chloride, alkalinity as CaCO3, dissolved sulfate, isotopes for oxygen (^{18}O), and deuterium (Hydrogen 2, ^{2}H, or D) concentrations.
3. A groundwater contour map based on groundwater elevations for that quarter. The map shall show the gradient and direction of groundwater flow under/around the facility and/or effluent disposal area(s). The map shall also include the locations of monitoring wells and wastewater storage and discharge areas.

4. Provide a current isoconcentration map of groundwater data for EC, chloride, and boron concentrations.

Laboratory Reports:

1. Laboratory reports submitted in compliance with this MRP shall be accompanied by an **Excel file** that includes the analytical data found in the laboratory report. Excel files need to be generated by the laboratory, or compiled by the Discharger. At a minimum, the Excel file shall include the constituent name, sample location, sample name, sample date, analysis date, analytical method, result, unit, MDL, RL, and dilution factor. Excel files shall either be mailed to the Central Valley Water Board Office in an electronic storage device, or sent via electronic mail to CentralValleyFresno@waterboards.ca.gov. Either method of delivery needs to include, at a minimum, a copy of the transmittal letter.

B. **Fourth Quarter Monitoring Reports**, in addition to the above, by 1 February of each year, the Discharger shall submit a written report to the Executive Officer containing the following:

Facility information:

1. The names and general responsibilities of all persons employed to operate the produced water treatment systems.
2. The names and telephone numbers of persons to contact regarding the Facility for emergency and routine situations.
3. A statement certifying when the flow meters and other monitoring instruments and devices were last calibrated, including identification of who performed the calibration (Standard Provision C.4).
4. A summary of all spills/releases, if any, that occurred during the year at the facility, tasks undertaken in response to the spills, and the results of the tasks undertaken.
5. A summary of the chemical and additive volume and mass use data collected under the Chemical And Additive Monitoring section, the required Material Safety Data Sheets (MDSs) / Safety Data Sheets (SDSs) sheets, and a discussion of whether any of the chemicals or additives were found in effluent discharges.
6. Tabular summary of current and historical total annual flow for Produced Wastewater Monitoring.
7. Provide a list of oil producing leases, corresponding oil field, and operating company names whose produced wastewater is discharged to the ponds in the Facility.
8. A flow chart (i.e. diagram that clearly illustrates all processes that produced wastewater undergoes within the Facility up to discharge to the ponds) and map of the following:
    - Facility within the oil field,
    - Facility/Lease boundaries
    - Facility produced wastewater distribution network with all discharge points to the ponds or land.
    - Wastewater flow direction within the Facility's ponds.

Requesting Administrative Review by the State Water Board. Any person aggrieved by an action of the Central Valley Water Board that is subject to review as set forth in Water Code section 13320(a), may petition the State Water Board to review the action. Any petition must be made in accordance with Water Code section 13320 and California Code of Regulations, title 23, section 2050 and following. The State Water Board must receive the petition within thirty (30) days of the date the action

was taken, except that if the thirtieth day following the date the action was taken falls on a Saturday, Sunday, or state holiday, then the State Water Board must receive the petition by 5:00 p.m. on the next business day. Copies of the laws and regulations applicable to filing petitions may be found on the internet at http://www.waterboards.ca.gov/public_notices/petitions/water_quality/index.shtml or will be provided upon request.

Modifications. Any modification to this Monitoring and Reporting Program shall be in writing and approved by the Assistant Executive Officer, including any extensions. Any written extension request by the Discharger shall include justification for the delay.

This monitoring and reporting program shall be effective on the signature date below.

Ordered by: _____

PAMELA C. CREEDON, Executive Officer

_____

(Date)

Table I – Analytical Parameters

Parameters	Units	Monitoring Frequency	US EPA or other Method	Reporting Frequency
Field Parameters				
Temperature	°F[1]	Quarterly	Meter	Quarterly
Electrical Conductivity (EC)	µmhos/cm[2]	Quarterly	Meter	Quarterly
pH	pH units	Quarterly	Meter	Quarterly
Monitoring Parameters				
Total Dissolved Solids (TDS)	mg/L[3]	Quarterly	160.1	Quarterly
Total Suspended Solids (TSS)[4]	mg/L	Quarterly	160.2	Quarterly
Electrical Conductivity (EC)	µmhos/cm	Quarterly	2510B	Quarterly
Total Organic Carbon (TOC)	mg/L	Quarterly	415.3	Quarterly
Boron, dissolved	mg/L	Quarterly	6010B	Quarterly
Standard Minerals				
Alkalinity as CaCO3	mg/L	Quarterly	310.1	Quarterly
Bicarbonate Alkalinity as CaCO3	mg/L	Quarterly	310.1	Quarterly
Carbonate Alkalinity as CaCO3	mg/L	Quarterly	310.1	Quarterly
Hydroxide Alkalinity as CaCO3	mg/L	Quarterly	310.1	Quarterly
Sulfate, dissolved	mg/L	Quarterly	300.0	Quarterly
Nitrate-N, dissolved	mg/L	Quarterly	300.0	Quarterly
Calcium, dissolved	mg/L	Quarterly	6010B	Quarterly
Magnesium, dissolved	mg/L	Quarterly	6010B	Quarterly
Sodium, dissolved	mg/L	Quarterly	6010B	Quarterly
Potassium	mg/L	Quarterly	6010B	Quarterly
Chloride	mg/L	Quarterly	300.0	Quarterly
PAHs[5]	µg/L[6]	Quarterly	8270	Quarterly
Total Petroleum Hydrocarbons (TPH)	µg/L	Quarterly	418.1	Quarterly
Volatile Organic Compounds				
Full Scan	µg/L	Quarterly	8260B	Quarterly
Oil and Grease	mg/L	Quarterly	1664A	Quarterly
Stable Isotopes				
Oxygen (^{18}O)	pCi/L[7]	Quarterly	900.0	Quarterly
Deuterium (Hydrogen 2, ^{2}H, or D)	pCi/L	Quarterly	900.0	Quarterly
Radionuclides				
Radium-226	pCi/L	Quarterly	SM[8] 7500-Ra	Quarterly
Radium-228	pCi/L	Quarterly	SM 7500-Ra	Quarterly

(continued)

Table I – Analytical Parameters

Parameters	Units	Monitoring Frequency	US EPA or other Method	Reporting Frequency
Radionuclides				
Gross Alpha particle (excluding radon and uranium)	pCi/L	Quarterly	SM 7110	Quarterly
Constituents of Concern				
Lithium	mg/L	Quarterly	200.7	Quarterly
Strontium	mg/L	Quarterly	200.7	Quarterly
Iron	mg/L	Quarterly	200.8	Quarterly
Manganese	mg/L	Quarterly	200.8	Quarterly
Antimony	mg/L	Quarterly	200.8	Quarterly
Arsenic	mg/L	Quarterly	200.8	Quarterly
Barium	mg/L	Quarterly	200.8	Quarterly
Beryllium	mg/L	Quarterly	200.8	Quarterly
Cadmium	mg/L	Quarterly	200.8	Quarterly
Chromium (total)	mg/L	Quarterly	200.8	Quarterly
Chromium (hexavalent)	mg/L	Quarterly	7196A	Quarterly
Cobalt	mg/L	Quarterly	200.8	Quarterly
Copper	mg/L	Quarterly	200.8	Quarterly
Lead	mg/L	Quarterly	200.8	Quarterly
Mercury	mg/L	Quarterly	7470A	Quarterly
Molybdenum	mg/L	Quarterly	200.8	Quarterly
Nickel	mg/L	Quarterly	200.8	Quarterly
Selenium	mg/L	Quarterly	200.8	Quarterly
Silver	mg/L	Quarterly	200.8	Quarterly
Thallium	mg/L	Quarterly	200.8	Quarterly
Vanadium	mg/L	Quarterly	200.8	Quarterly
Zinc	mg/L	Quarterly	200.8	Quarterly
Oil Production and Process Chemicals and Additives[9]	µg/L	Quarterly	As Appropriate[10]	Quarterly

[1] Degrees Fahrenheit
[2] Micromhos per centimeter
[3] Milligrams per liter
[4] TSS analyses is not required for groundwater monitoring
[5] Polycyclic aromatic hydrocarbons
[6] Micrograms per liter
[7] Picocuries per liter
[8] Standard Methods
[9] The Discharger shall provide analytical results for all chemicals and additives used in the exploration, production, and or processing of all oil and the treatment of produced wastewater discharged to land (e.g. pods, roads, etc.) as described under the Chemical and Additive Monitoring section of the MRP for which there are ELAP approved analyses. For those constituents for which there are not ELAP approved analytical methods, the Discharger shall submit a technical report describing how this issue will be addressed.
[10] Alternative analytical methods may be proposed by the Discharger but are subject to the approval of the Assistant Executive Officer.