

CALIFORNIA REGIONAL WATER QUALITY
CONTROL BOARD CENTRAL VALLEY REGION

WATER CODE SECTION 13301
CEASE AND DESIST ORDER NO. R5-2019-0045
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

The California Regional Water Quality Control Board, Central Valley Region (hereinafter "Central Valley Water Board" or "Board"), finds that:

Facility

1. Valley Water Management Company (hereafter "Valley Water" or "Discharger"), owns and operates two interconnected systems with approximately 163 acres of unlined ponds used for the disposal of oil field produced wastewater by evaporation and percolation. The McKittrick 1 & 1-3 (Facility) is comprised of the McKittrick 1 pond system, which occupies the west side of the Facility and is slightly higher in elevation than the McKittrick 1-3 pond system, which occupies the east side of the Facility. The Facility sits at an elevation of approximately 500 feet (ft) above mean sea level (AMSL) on a 598-acre parcel (Assessor Parcel No. 099-290-19-00-1). The Facility and its monitoring well network are in Sections 17, 19, and 21 of Township 29 S, Range 22 E, Mt. Diablo Baseline and Meridian, in the southwestern San Joaquin Valley. The Facility is not within an oil field; it is just outside the boundaries of South Belridge, Monument Junction, and Cymric Oil Fields, approximately 4.5 miles north of the community of McKittrick, and approximately 8.7 miles west of the community of Buttonwillow.
2. Valley Water's February 2019 self-monitoring report (SMR) indicates produced wastewater enters the Facility through a single pipeline from producer Sentinel Peak Resources (SPR). Valley Water confirmed that California Resource Corporation (CRC) ceased discharging to the Facility approximately two years ago. About 42,000 barrels of wastewater per day (bpd) or 1.8 million gallons per day (gpd) were discharged to the 83 unlined ponds at the Facility in 2018. Reported discharge rates since 2015 through 2018 have varied from 105,000 barrels per day (bpd) (4.4 million gpd) to 38,000 bpd (1.6 million gpd) and an average of a little over 59,000 bpd (2.5 million gpd). Aerial photographs of the McKittrick 1 & 1-3 Facility are attached hereto as Attachments A and B. Attachment B is a close-up showing the Administrative Boundaries of nearby oil fields.
3. As described in the Findings below and the Staff Report, which is attached hereto and a part of this Order, the Facility discharge contains high levels of salts, boron, and some organic compounds and has created a groundwater

mound and plume that is migrating to the northeast.

Facility Regulation

4. Facility discharges are regulated under Waste Discharge Requirements (WDRs) Resolution No. 69-199, adopted by the Central Valley Water Board on 14 February 1969, which prescribes requirements for the discharge to the unlined ponds of non-hazardous produced wastewater from Belgian Anticline, Cymric, and McKittrick Oil Fields. WDRs Resolution No. 69-199 states:

“1. The Discharge shall not cause a pollution of ground or surface waters.

The Explanation of Requirements (analog to today’s Information Sheet or Fact Sheet) states:

“Pollution means an impairment of the quality of waters of the state by sewage or other waste to a degree which does adversely and unreasonably affect such waters for domestic, industrial, agricultural, navigational, recreational, or other beneficial use.”

5. Resolution No. 69-199 predates the *Water Quality Control Plan for the Tulare Lake Basin, Third Edition, May 2018* (hereafter Basin Plan) and does not contain the Basin Plan maximum effluent limits for oilfield discharges to unlined ponds of 1000 umhos/cm for electrical conductivity, 200 mg/L for chloride, and 1 mg/L for boron. The Basin Plan allows the Board to authorize discharges of oil field produced water that exceed the maximum effluent limits if the discharger successfully demonstrates in a public hearing that the proposed discharge will not substantially affect water quality nor cause a violation of water quality objectives. Exceptions from the EC and/or the chloride limit may also be permitted consistent with the Basin Plan *Program for Exception from Implementation of Water Quality Objectives for Salinity*.
6. The Facility is in Kern County Basin Hydrologic Unit, Detailed Analysis Unit (DAU) 159. The designated beneficial uses of the groundwater, as specified in the Basin Plan are municipal and domestic supply (MUN), agricultural supply (AGR), and industrial service supply (IND).
7. The Facility is in the South Valley Floor Hydrologic Unit, within the Antelope Plain Hydrologic Area (558.60), in the Tulare Lake Basin. The Basin Plan surface water beneficial uses for Valley Floor waters are: AGR, IND, industrial process supply, water contact recreation, non-contact recreational, warm freshwater habitat, wildlife habitat, rare, threatened, or endangered species habitat, and groundwater recharge.

8. On 4 April 2018, the Board's Executive Officer issued Monitoring and Reporting Program R5-2018-0808 (MRP) to Valley Water for the Facility. The MRP required Valley Water to submit by 4 June 2018 a Monitoring Well Installation and Sampling Plan (MWISP) for additional groundwater monitoring wells to fully delineate the extent of the produced wastewater mound and groundwater plume caused by discharges to the Facility's ponds.
9. On 5 April 2018, the Board adopted Resolution R5-2018-0015. Resolution R5-2018-0015 (Resolution) directed staff to take appropriate action to determine whether Valley Water's discharge should be regulated under *Order R5-2017-0035 Waste Discharge Requirements General Order for Oil Field Discharges to Land General Order Number Two*, or *Order R5-2017-0036 Waste Discharge Requirements General Order for Oil Field Discharges to Land General Order Number Three*, or whether Valley Water should be directed to submit a report of waste discharge for individual waste discharge requirements.
10. During the hearing, the Board contemplated that it would take approximately one year to obtain additional groundwater monitoring and other data required by the MRP necessary to determine an appropriate course of action to regulate the Facility. It was also expected that the two 2018 SMRs would include data from additional monitoring wells and select monitoring wells upgradient from the Clean Harbors Buttonwillow, Inc., facility (Clean Harbors), which is approximately 1.7 miles down structure and down gradient of the Valley Water Facility.
11. Valley Water submitted the MWISP to the Central Valley Water Board on 4 June 2018, and Board staff provided on 27 July 2018 conditional approval for Valley Water to implement the MWISP. Instead of implementing the conditionally approved MWISP, Valley Water submitted a modified MWISP to the Central Valley Water Board on 27 August 2018. In response, the Executive Officer issued on 13 September 2018 to Valley Water another conditional approval including a time schedule pursuant to Water Code section 13267 (13267 Order). The intent of the 13267 Order was to establish a definitive time schedule for Valley Water to complete groundwater monitoring wells to further assess the downgradient extent of its produced wastewater plume.
12. On 3 October 2018, the Discharger submitted an updated Biological Assessment (Assessment) of the proposed monitoring well locations. The Assessment states that a new biological assessment survey (Survey) is recommended and may be necessary for all proposed monitoring well locations, and the Survey would take approximately one year. The Assessment states the time required to conduct the Survey will proscribe the Discharger from complying with items in the 13 September 2018 13267 Order.
13. The two 2018 Semi-Annual SMRs for the Facility do not include groundwater

monitoring data from additional wells or from the Clean Harbors' monitoring wells. The additional monitoring wells had not been installed by the Discharger to further investigate the lateral and vertical extent of the saline plume generated by discharges to the Facility's ponds. As discussed in more detail below and in the Staff Report, the regional aquifer continues to increase in concentrations of constituents of concern associated with produced wastewater discharges to the ponds.

14. Sentinel Peak Resources (SPR) is pursuing underground injection control (UIC) projects in the South Belridge Oil Field and the Cymric Oil Field to dispose of the wastewater it generates in those fields. The projects would provide enough disposal capacity for SPR to cease its discharge to the Valley Water McKittrick 1 and 1-3 Facility ponds. SPR would need to obtain appropriate UIC permits for its projects from the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (Division). The Board, through a Memorandum of Agreement, reviews the Division's proposed permits for such projects to ensure they are protective of water quality.

LAND USE AND HYDROGEOLOGY

15. Land use near the site is a mixture of undeveloped land, oil production and industrial areas, and agricultural uses. The closest agricultural land is adjacent to Lokern Road, approximately 1,600 feet north of the Facility. The Clean Harbors' facility is approximately 1.7 miles northeast of the Valley Water Facility.
16. There is agricultural land 1,600 feet north of the Facility and several miles to the east of the Facility. Agricultural wells in the vicinity that are downgradient of the Facility have total dissolved solids (TDS) concentrations ranging from 2,300 mg/L to 6,800 mg/L. See the Staff Report for a more detailed discussion and map showing the locations and water quality of specific wells. Starrh Family Farms LP owns and operates these wells, and they are reportedly important for operations when surface water deliveries are in short supply. The use of these wells indicates that the AGR beneficial use designated in the Board's Basin Plan is also an existing use downgradient of the Valley Water Facility.
17. The hydrogeology of the Facility site is complex and described in more detail in the Staff Report for this Order. The next five findings summarize the stratigraphy and the effects of the depositional environment on the stratigraphy.
18. The Facility sits on Holocene age alluvium and is just east of the Cymric and Monument Junction oil fields and south of the South Belridge oil field, as shown on Attachment B. The topography slopes about 30 feet per mile from the west-southwest to the east-northeast. The alluvium and underlying stratigraphic intervals to be described in the following findings structurally dip from the

southwest to the northeast. The alluvium comprises alluvial fan sediments that consist of interbedded layers of poorly sorted, relatively coarse grained, subangular to angular sands with silts and clays. Subangular to angular gravelly sands also occasionally occur within the fan sediments. Due to their depositional environment, the sands are heterogenous and anisotropic, likely channelized, and considered to be highly permeable.

19. Beneath the alluvium is a silty clay to clay bed called the Corcoran Clay Equivalent (CCE) that separates the alluvium from the Pleistocene age Tulare Formation. As described in Valley Water's hydrogeologic reports, the CCE in the vicinity of the Facility does not act as a significant barrier to the downward migration of produced wastewater. Valley Water's SMRs depict a wastewater plume directly beneath the ponds that has migrated below the CCE and into underlying Tulare Formation sediments.
20. Beneath the CCE is the upper Tulare or upper Tulare sand. The upper Tulare interval is comprised of deposits that vary greatly from fine grained lacustrine (lake) deposits to coarser-grained channel deposits. The deposits are comprised of fine-grained sands with interbedded silt and clay layers and gravels.
21. Beneath the upper Tulare interval is the dense and stiff upper Tulare clay bed, which separates the upper Tulare from the deeper Tulare interval. The deeper Tulare interval is composed primarily of fine-grained to medium-grained sands. Groundwater within this zone is part of the regional aquifer that supplies water supply wells to the east.
22. The upper Tulare clay and, where present, the CCE, may not be laterally continuous layers as they appear in the Valley Water cross sections. The upper Tulare clay and CCE may be erosionally cut by overlying fluvial channels that contain permeable coarse sands and gravels deposited during high energy storm events. These repeated depositional events, typical for alluvial fan systems underlain by lacustrine (lake deposits) sediments, would compromise the integrity of the upper Tulare clay bed and prevent it from being an effective aquitard.

WASTE DISPOSAL OPERATIONS AND GROUNDWATER CONDITIONS

23. Table 1 presents self-monitoring data submitted by the Discharger from November 2002 through November 2018 characterizing the discharge and compares it to Basin Plan effluent limits for oil field discharges and State drinking water Maximum Contaminant Levels.

Table 1 Produced Wastewater Discharge Quality

Parameters (units)	Wastewater Discharge Range	Basin Plan Limits	MCLs ¹
Electrical Conductivity (EC) @ 25°C ² (µmhos/cm ³)	11,000 - 41,000	1000	900/1600/2200
Total Dissolved Solids (TDS) (mg/L ⁴)	11,000 - 26,000	- - -	500/1000/1500
Chloride (mg/L)	3,600 - 11,000	200	250/500/600
Boron (mg/L)	53 – 94	1	- - -
Benzene (µg/L ⁵)	0.46 – 400 ^{6,7}	- - -	1
Toluene (µg/L)	0.31 – 1000 ^{6,7}	- - -	150
Ethylbenzene (µg/L)	0.75 – 120 ^{6,7}	- - -	300
Total-Xylenes (µg/L)	1.2 – 550 ^{6,7}	- - -	1750

¹ MCLs = state drinking water maximum contaminant level. The MCLs for benzene, toluene, ethylbenzene, and total xylenes (BTEX) are Primary MCLs and have one numerical limit. The MCLs for electrical conductivity, chloride, and total dissolved solids are Secondary MCLs or “Consumer Acceptance Contaminant Level Ranges” and three different values are shown as the limits. The first number is the “Recommended” MCL, while the second number is the “Upper” MCL, and the third number is the “Short term” MCL

² °C = degrees Celsius.

³ µmhos/cm = micromhos per centimeter.

⁴ mg/L = milligrams per liter.

⁵ µg/L = micrograms per liter.

⁶ Includes data from samples collected by Board staff during field inspections.

⁷ BETX are not detected in groundwater or, if they are detected, are below MCLs. See Finding 28.

24. As shown in Finding 22, the EC, chloride, and boron concentrations in the discharge significantly exceed the numerical limits set for oil field discharges to land contained in the Basin Plan. The Basin Plan also contains a narrative water quality for chemical constituents which requires, in part, that groundwater not contain chemical constituents in concentrations that adversely affect any beneficial use. For groundwater that is designated for use as domestic and municipal supply, such as DAU 159, the Basin Plan incorporates by reference drinking water maximum contaminant levels (MCLs) promulgated in Chapter 15 of Title 22 of the California Code of Regulations. The discharges from the Facility exceed the MCLs, which the Basin Plan establishes as levels protective of the groundwater’s MUN beneficial use.
25. Agricultural water quality objectives for salinity and boron vary due to crop tolerances. Water Quality for Agriculture, FAO Irrigation and Drainage Paper 29 Rev. 1 (1994) indicates that irrigation water use is severely restricted when the EC is greater than 3000 umhos/cm, the TDS is greater than 2000 mg/L, the chloride is greater than 350 mg/L (surface irrigation), or the boron is greater than 3 mg/L. As shown in Finding 22, the EC, TDS, chloride and boron concentrations of the discharge exceed these agricultural water quality criteria by orders of magnitude.

26. To characterize groundwater impacts from the Facility's ponds, Valley Water installed three groundwater monitoring wells in 2002. The monitoring well locations are shown on Attachment C. CYM-17N1, CYM-19H1 are considered shallow wells and are screened in the upper Tulare. CYM-21D1 is considered a deeper well and is screened in the deeper Tulare. In 2006, Valley Water installed three more shallow wells farther downgradient of the Facility (CYM-17K1, CYM-17M1, and CYM-17Q1). CYM-17K1, CYM-17M1, and CYM-17Q1 did not encounter groundwater during drilling and were installed as dry sentinel wells. Valley Water's consultant interpreted the results as delineating the horizontal extent of Valley Water's plume.
27. In February 2015, Valley Water submitted a self-monitoring report indicating that CYM-17M1 had 26.56 feet of water, CYM-17K1 had 48.99 feet of water, and CYM-17Q1 had 6.93 feet of water at the time of sampling. The self-monitoring report acknowledged that produced wastewater had migrated past the sentinel wells.
28. Attachment C depicts the locations of the Valley Water's ponds and groundwater monitoring wells. CYM-19H1 is approximately 1,500 feet northwest and down structure and down gradient of the ponds. CYM-17N1 is about 3,600 feet northwest and down structure and down gradient of the ponds. CYM-17K1 is about 5,800 feet northwest and down structure and down gradient of the ponds. The Attachment indicates that the predominate direction of groundwater flow is to the northeast. The Attachment also shows the mound is large. In November 2018, the mound gradient is about 153 feet (500 ft AMSL – 346.78 ft AMSL) from the ponds to CYM-19H1, another 25 feet (346.78 ft AMSL – 321.60 ft AMSL) from CYM-19H1 to CYM-17N1, and about another 49 ft (321.60 ft AMSL – 272.48 ft AMSL) from CYM-17N1 to CYM-17K1. Finally, the Attachment shows the mound remains undefined to the north, northeast, northwest, west, south, and southeast.
29. Constituent ranges for Valley Water groundwater monitoring data from 2002 through 2018 are summarized in Table 3 along with the Basin Plan effluent limits for oil field discharges to land and the State drinking water MCLs.

Table 3 Groundwater Quality Data

Well ID	EC (µmhos/cm) Range	TDS (mg/L) Range	Chloride (mg/L) Range	Boron (mg/L) Range	BTEX (µg/L)			
					Benzene	Toluene	Ethylbenzene	Xylenes
CYM-19HI	8500-23000	10500-14000	4120-5700	30-41	0.65-0.79	ND ¹	ND	ND
CYM-17N1	10900-33000	7450-18000	2700-8000	20-76	0.53	ND	ND	ND
CYM-17K1	18000-28000	16000-18000	6000-8000	55-68	ND	ND	ND	ND
CYM-17M1	15840-24350	12000-16000	4900-7000	40-55	0.27	ND	ND	ND
CYM-17Q1	13000-22600	13000-16000	4800-5900	45-60	ND	ND	ND	ND
CYM-21D1	1970-11000	1200-10000	334-2900	2.5-22	0.62	ND	ND	ND
Basin Plan limits ²	1000	-	200	1	-	-	-	-
MCLs ³	900/1600/2200	500/1000/1500	250/500/600	-	1	150	300	1750

1. ND = not detected above laboratory reporting limit. Prior to 2018, reporting limits for benzene, toluene, ethylbenzene, and total xylenes (BTEX) was 2.0 ug/L. Subsequently, reporting limit has been 0.5 ug/L.
2. Basin Plan = Water Quality Control Plan for the Tulare Lake Basin, Third Edition which sets limits for oil field discharges to land.
3. MCLs = maximum contaminant level. The MCL's for benzene, toluene, ethylbenzene, and total xylenes (BTEX) are Primary MCLs and have one numerical limit. The MCLs for electrical conductivity, chloride, and total dissolved solids are Secondary MCLs or "Consumer Acceptance Contaminant Level Ranges" and three different values are shown as the limits. The first number is the "Recommended" MCL, while the second number is the "Upper" MCL, and the third number is the "Short term" MCL.

30. Valley Water's SMRs indicate produced wastewater discharged to the Facility ponds has elevated sodium, chloride, and TDS concentrations and low sulfate, calcium, and magnesium concentrations. According to Valley Water's consultant, groundwater samples collected in November 2018 from monitoring wells CYM-19H1, CYM-17N1, and sentinel wells CYM-17K1, CYM-17M1, and CYM-17Q1 plot close to the Facility discharges with respect to sodium and chloride ions, indicating that they are impacted by discharges from the ponds. The presence of significant volumes of groundwater in CYM-17K1, CYM-17M1, and CYM-17Q1 also indicates the produced wastewater plume has migrated beyond the Facility's monitoring well network which extends to more than 1.1 miles northeast of the Facility's ponds.
31. Groundwater concentrations in TDS, chloride, boron are increasing in two of Clean Harbors' background groundwater monitoring wells. MW-148I is screened in the upper Tulare, and MW-102RL is screened in the deeper Tulare. These wells are part of the background monitoring network for the Clean Harbors Facility, and as such the increasing groundwater concentrations reflect an upgradient source. The TDS in MW-148I has increased from 2,340 mg/L in 2011

to 6,600 mg/L in 2018. The chloride in MW-148I has increased from 246 mg/L in 2009 to 1,800 mg/L in 2018. The boron in MW-148I has increased from 4.9 mg/L in 2015 to 9.5 mg/L in 2018. The TDS in MW-102RL has increased from 3,040 to 4,000 umhos/cm (high of 4,300 in 1Q2018 to 3,800 in 4Q2018). The chloride in MW-102RL has increased from 450 mg/L in 2007 to about 750 to 780mg/L in 2018. The increases in constituent concentrations in MW-102RL indicate the that the produced wastewater from the Valley Water ponds is adversely affecting the regional aquifer. There is some variability in the trends. Graphs of the described trends for MW-148I and MW-102RL are included in the Staff Report.

32. Valley Water data for deeper monitoring well CYM-21D1 continues to show increasing EC, TDS, chloride, and boron concentrations, indicating that produced wastewater discharged to the ponds is migrating through the upper Tulare clay layer and also adversely affecting the regional aquifer. From 2002 to 2018, monitoring well CYM-21D1 has increased in TDS from 1,200 mg/L to about 8,000 mg/L, chloride from 334 mg/L to about 2,700 mg/L, and boron from 2.5 mg/L to 22 mg/L. Graphs of CYM-21D1 constituent concentration trends are included in the Staff Report.
33. The information summarized in Findings 14 through 31 demonstrate that produced wastewater discharged to the Facility's disposal ponds has generated a plume that has traveled beyond Valley Water's monitoring wells appear to be affecting groundwater in wells at Clean Harbors facility to northeast of the disposal ponds in two groundwater zones (upper Tulare and deeper Tulare which are part of the regional aquifer supplying beneficial use water for agriculture down gradient). The produced wastewater discharged to the Facility ponds and the resulting plume exceeds water quality objectives associated with MUN for EC, TDS, and chloride, and AGR for TDS, EC, chloride, and boron. Based on the EC, TDS, chloride and boron concentrations in monitoring CYM-21D1, MW-148I, and MW-102RL; in the early 2000's, water in the wells was potentially suitable for AGR. More recent increases in these constituents render the groundwater in these wells unsuitable for irrigation of most, if not all crops

COMPLIANCE ISSUES

34. As described in Finding 4, WDRs Resolution No. 69-199 prohibits the discharge from causing pollution of ground or surface waters. The Discharger has generated an oil field produced wastewater plume that is migrating to the northeast. The groundwater in the plume greatly exceeds the quality with respect to EC, TDS, chloride and boron required to support the Basin Plan designated beneficial uses of MUN and AGR. The plume has migrated at least 2.2 miles northeast of the Facility's disposal ponds in the upper Tulare and in the deeper regional aquifer. The plume has caused a condition of pollution in CYM-21D1, as

water in it is no longer likely suitable for AGR. The water in monitoring wells MW-102RL is approaching concentrations of salinity and boron that will render it unsuitable for irrigation of most crops while water in MW-148I already has become unsuitable. The plume has adversely impacted and/or threatens to adversely impact the beneficial uses of groundwater currently being used for AGR in violation of the Resolution 69-199 and the Basin Plan.

35. On 13 September 2018, the Central Valley Water Board issued a 13267 Order to Valley Water Management Company. The Order required the completion and sampling of all MWISP proposed and conditionally approved monitoring wells and the submittal of a technical report, by 1 March 2019. On 3 October 2018, the Central Valley Water Board received correspondence from the Discharger that stated that no additional monitoring wells could be installed prior to the completion of a new Biological Assessment which would take approximately a period of one year, and thus, the Discharger will not be able to comply with the 13267-time schedule Monitoring Well Installation Completion Report required by the 1 March 2019 due date.

REGULATORY CONSIDERATIONS

36. Section 13301 of the California Water Code states in part:

When a Regional Board finds that a discharge of waste is taking place or threatening to take place in violation of requirements or discharge prohibitions prescribed by the regional board or the state board, the board may issue an order to cease and desist and direct that those persons not complying with the requirements or discharge prohibitions (a) comply forthwith, (b) comply in accordance with a time schedule set by the board, or (c) in the event of a threatened violation, take appropriate remedial or preventive action. Cease and desist orders may be issued directly by a board, after notice and hearing, or in accordance with the procedure set forth in Section 13302.

37. Section 13267(b) of the California Water Code states, in relevant part:

(a) A regional board, in establishing or reviewing any water quality control plan or waste discharge requirements, or in connection with any action relating to any plan or requirements or authorized by this division, may investigate the quality of any waters of the state within this region.

(b)(1) In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having

discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports and shall identify the evidence that supports requiring that person to provide the reports.

38. Valley Water owns and operates the Facility that discharges the waste subject to this Order. These discharges have degraded/polluted and/or threaten to degrade/pollute groundwater down gradient of the Facility. The reports and actions required by this Order are necessary to define the lateral and vertical extent of the plume migrating from the Facility, to ensure the Discharger complies with the requirements of this Order; and to ensure that Valley Water brings the Facility into compliance with WDRs Resolution No. 69-199, MRP Order R5-2018-808, the Basin Plan, and the Water Code to assure protection of waters of the state.
39. This Order will require the Valley Water Management Company to cease discharging in violation of existing permit requirements and to develop either a proposal for a new permit or plans for the orderly wind-down of operations at the Facility. While the Board may need to evaluate potentially significant environmental impacts associated with a new permit or the implementation of a closure workplan (CEQA, Pub. Resources Code, § 21000 et seq.), the Board is not required to engage in speculation about what those impacts would be before remedial action plans and/or a report of waste discharge is submitted to the Board and thus environmental review of those options is not required at this time. Further, this action may also be considered exempt from the provisions of CEQA because it is an enforcement action to address a violation of a permit requirement (Cal. Code Regs., tit. 14, § 15321.), an action by a regulatory agency for the protection of natural resources (Cal. Code Regs., tit. 14, § 15307.), and an action by a regulatory agency for the protection of the environment (Cal. Code Regs., tit. 14, § 15308.). Should additional environmental review be required in connection with future discretionary regulatory actions, the Board may recover the costs associated with preparing and processing environmental documents. (Pub. Resources Code, § 21089.)
40. If the Central Valley Water Board determines that implementation of any plan required by this Cease and Desist Order will have a significant effect on the environment, the Board will conduct the necessary and appropriate environmental review prior to the Executive Officer's approval of the applicable

plan. The Discharger will bear the costs, including the Board's costs, of determining whether implementation of any plan required by this Cease and Desist Order will have a significant effect on the environment and, if so, in preparing, handling and providing any documents necessary for environmental review. If necessary, the Discharger and a consultant acceptable to the Board shall enter into a memorandum of understanding with the Board regarding such costs prior to undertaking any environmental review.

41. As a result of the events and activities described in this Order, the Central Valley Water Board finds that a discharge of waste in violation of the Basin Plan has polluted groundwater. This Order requires Valley Water to take appropriate remedial action and to comply in accordance with the time schedule set forth below.
42. On 6/7 June 2019, in Rancho Cordova, California, after due notice to the Discharger and all other interested persons, the Central Valley Regional Board conducted a public hearing at which evidence was received to consider an Order under Water Code section 13301 to establish a time schedule to achieve compliance with the Basin Plan or cease discharge.

IT IS HEREBY ORDERED THAT, pursuant to Sections 13301 and 13267 of the California Water Code, Valley Water Management Company, its agents, successors, and assigns, shall implement the following at the McKittrick 1 & 1-3 Facility:

1. Cease and desist from discharging produced wastewater in violation and threatened violation of WDR Resolution No. 69-199 and the *Water Quality Control Plan for the Tulare Lake Basin* in accordance with the following tasks and dates.
2. On the first of each month, commencing with 1 August 2019, Valley Water Management Company shall submit a written update to the Executive Officer detailing their progress towards completing the requirements of the Cease and Desist Order.
3. By **1 January 2020**, Valley Water Management Company shall implement the already approved Work Plans for the McKittrick 1 and 1-3 Facility. Work to be completed shall include:
 - a. Completion and submittal of a technical report of the results of the hydrogeological investigation to fully characterize the nature and lateral and vertical extent of the release of waste constituents from the Facility ponds consistent with the evaluation monitoring program requirements contained in California Code of Regulations, Title 27, section 20005 et seq. (Title 27).

- b. Preparation and submittal of a Water Quality Protection Standard Report identifying each potential Constituent of Concern in the discharges to the Facility ponds and proposing statistical data analysis methods to calculate concentration limits for each Constituent of Concern.
 - c. Identify and sample water supply wells located within 2.5 miles of the Facility and analyze the samples for Constituents of Concern.
4. **By 1 March 2020**, Valley Water Management Company shall:
 - a. Submit a complete Report of Waste Discharge based on the information acquired during the Work Plan implementation for the McKittrick 1 and 1-3 Facility that will ensure that future discharges at the McKittrick 1 and 1-3 Facility will be in compliance with the *Water Quality Control Plan for the Tulare Lake Basin*. The Report of Waste Discharge may propose a reasonable time schedule to come into compliance with applicable requirements of the *Water Quality Control Plan for the Tulare Lake Basin*.
 - b. Submit a **Closure Plan and Closure Time Schedule** for the wind-down and closure of any portions of the McKittrick 1 and 1-3 Facility that Valley Water Management Company determines are no longer to be used. The Closure Plan and Time Schedule shall specify the dates by which Valley Water Management Company will remove the residual liquid waste and close the ponds in accordance with applicable regulatory requirements.
 - c. Submit a **McKittrick 1 and 1-3 Facility Remediation Workplan** based on the hydrogeological investigation that describes a time schedule under which Valley Water Management Company will conduct groundwater, surface water, and/or soil remediation consistent with the corrective action program requirements of Title 27. This will entail the preparation of an engineering feasibility study followed by a proposed corrective action program.
5. **On 1 September 2020**, Valley Water is prohibited from discharging to the McKittrick 1 and 1-3 Facility unless those discharges are in compliance with waste discharge requirements issued by the Central Valley Water Board.
6. If SPR has submitted to the Division complete UIC permit applications for the projects described in Finding No. 14 prior to 1 September 2020, demonstrates that the proposed UIC wells are intended to be used for the disposal of the produced wastewater currently being discharged to the Facility, and demonstrates all due diligence to complete the projects and cease discharges to the Facility, then the prohibition from discharging to the McKittrick 1 and 1-3 Facility described in Item 5 may be extended by the written approval of the Executive Officer to a

date no later than **1 September 2021**.

All technical reports required herein 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 supervision of persons registered to practice in California pursuant to California Business and Professions Code, Sections 6735, 7835, and 7835.1. As required by these laws, completed technical reports must bear the signatures(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work.

Signatory Requirements. All documents required under this Cease and Desist Order shall be signed and certified by Valley Water or by a duly authorized representative and submitted to the Central Valley Water Board. A person is a duly authorized representative only if: 1) The authorization is made in writing by Valley Water; and 2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity. (A duly authorized representative may be either a named individual or any individual occupying a named position.)

With each document required by this Cease and Desist Order, Valley Water shall provide under penalty of perjury under the laws of California a "Certification" statement to the Central Valley Water Board. The "Certification" shall include the following signed statement:

"I certify under penalty of perjury of law that I have personally examined and am familiar with the information submitted in this documents and all attachments and that, based on my knowledge and on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

All documents submitted in compliance of this Order shall be submitted 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.

In addition to pdf documents, all analytical laboratory data shall be uploaded by the

CEASE AND DESIST ORDER NO. R5-2019-0045
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

-15-

Discharger or on behalf of the discharger as an Electronic Deliverable Format (EDF) submittal into GeoTracker for Global ID: **L10007494132**

If in the opinion of the Executive Officer, the Discharger violates this Order, the Executive Officer may refer this matter to the Attorney General for judicial enforcement or may issue a complaint for Administrative Civil Liability.

Failure to comply with this Order, Resolution 69-199 or MRP R5-2018-0808, may result in the assessment of Administrative Civil Liability of up to \$10,000 per violation, per day, depending on the violation, pursuant to the Water Code, including sections 13268, 13350 and 13385. The Central Valley Water Board reserves its right to take any enforcement actions authorized by law.

Any person aggrieved by this action of the Central Valley Water Board may petition the State Water Board to review the action in accordance with Water Code section 13320 and California Code of Regulations, title 23, sections 2050 and following. The State Water Board must receive the petition by 5:00 p.m., 30 days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at: http://www.waterboards.ca.gov/public_notices/petitions/water_quality_ or will be provided upon request.

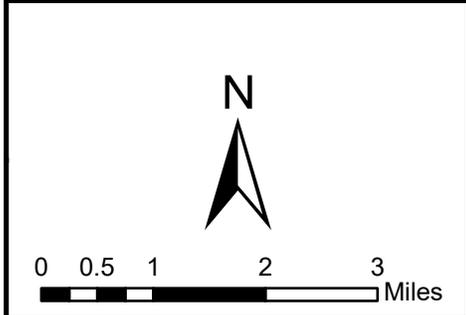
I, PATRICK PULUPA, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region on 7 June 2019.



PATRICK PULUPA, Executive Officer

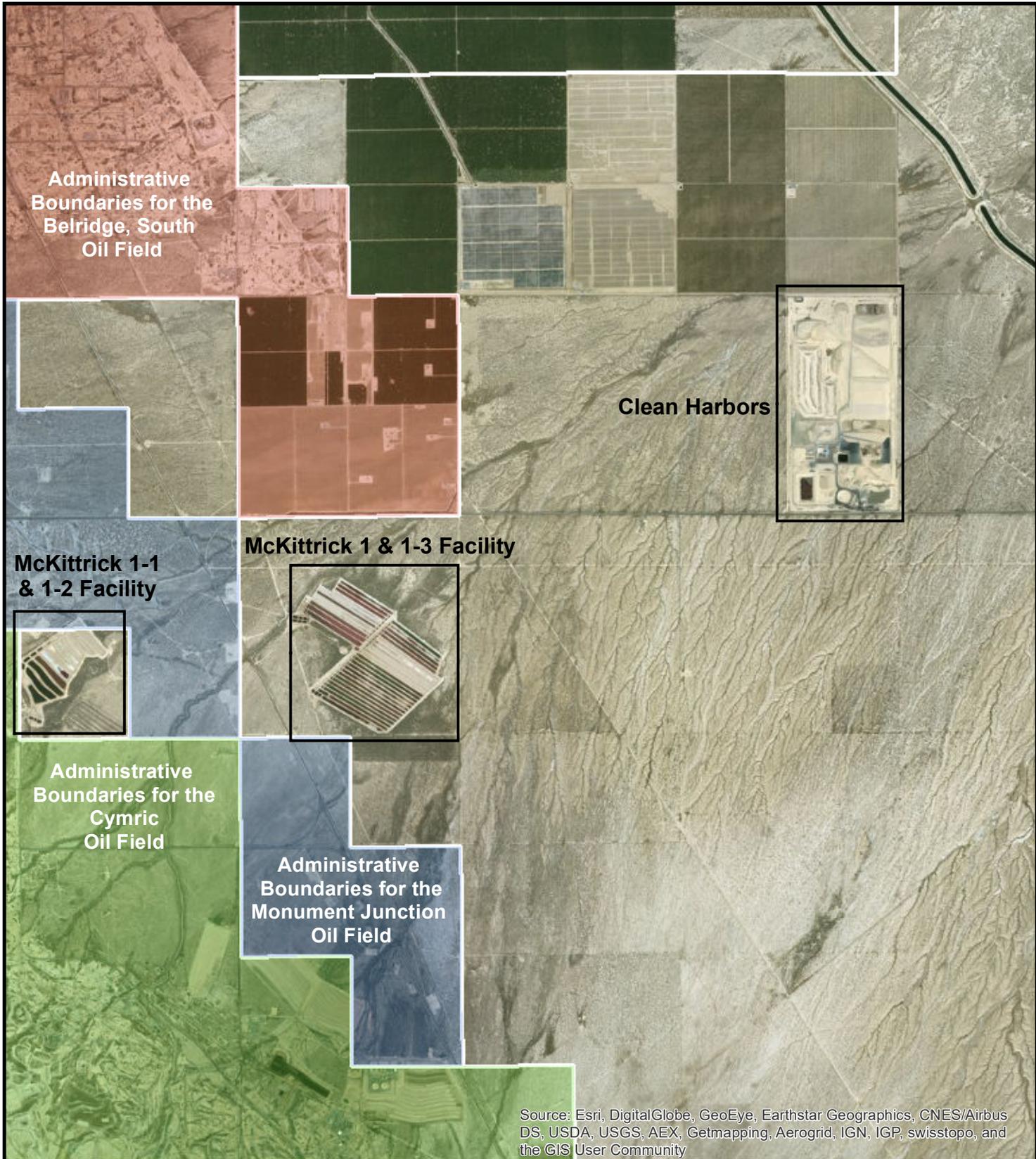


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

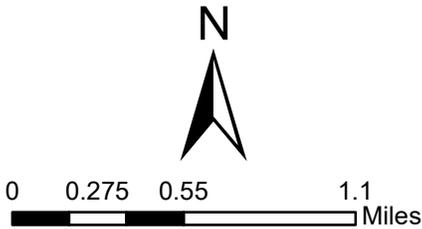


EXTENDED VIEW OF THE MCKITTRICK 1 & 1-3 FACILITY
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VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT A



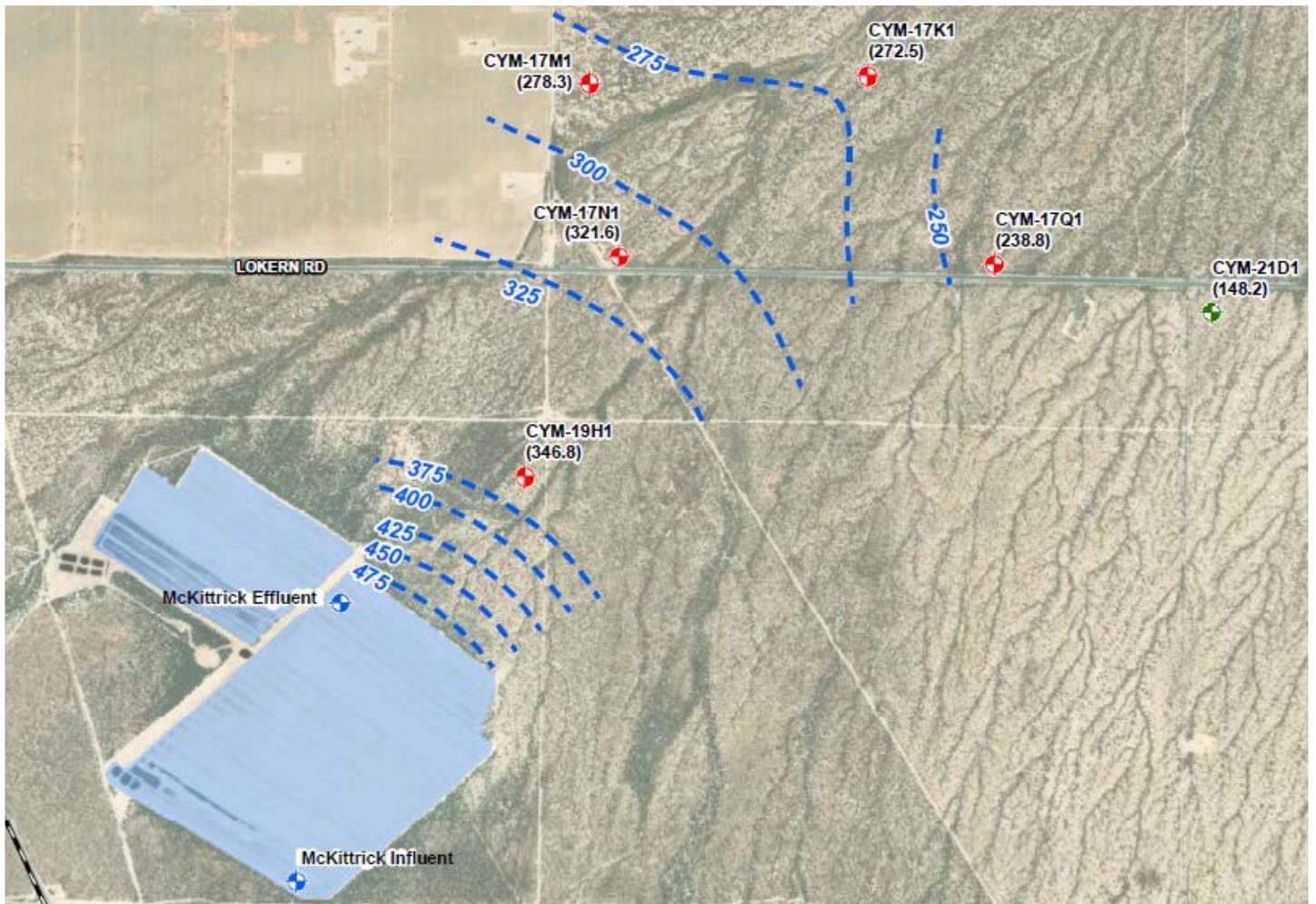
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



SITE MAP OF THE MCKITTRICK 1 & 1-3 FACILITY AND PROXIMITY TO OIL FIELDS

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MCKITTRICK 1 & 1-3 FACILITY
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ATTACHMENT B



Explanation

- — GROUNDWATER ELEVATION, ft amsl
- + POND SAMPLE POINT
- + MONITORING WELL SCREENED IN THE UPPER TULARE SAND (GROUNDWATER ELEVATION, ft amsl)
- + MONITORING WELL SCREENED IN THE LOWER TULARE SAND (GROUNDWATER ELEVATION, ft amsl)



**UPPER TULARE
POTENTIOMETRIC SURFACE MAP
CEASE AND DESIST ORDER NO. R5-2019-0045
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**

Source of Map:
Valley Water Management Company
(Second Semi-Annual 2018)
By Golder Associates Inc

ATTACHMENT C

STAFF REPORT
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INTRODUCTION

Valley Water Management Company (Valley Water) owns and operates oil field produced wastewater disposal pond systems named the McKittrick 1 ponds and McKittrick 1-3 ponds. The systems are interconnected, regulated as one facility, and collectively referred to herein as the “McKittrick 1 & 1-3 Facility” or “Facility.” The Facility is approximately 8.7 miles west of the community of Buttonwillow, as shown on Attachment A.

Oil field produced wastewater from various operators has been discharged to the Facility’s approximately 163 acres of ponds for disposal by percolation and evaporation since the late 1950s. Produced wastewater comes from the South Belridge, Cymric, and McKittrick oil fields and is high in salinity and boron. The Facility is not within an established oil field (Attachment B).

Discharges to the ponds are regulated under Resolution No. 69-199 (Permit) and Monitoring and Reporting Program R5-2018-0808 (MRP). The Permit was adopted by the Central Valley Water Board (Board) on 14 February 1969 and regulates Valley Water discharges in the Belgian Anticline, Cymric, and McKittrick Oil Fields. The MRP was issued by the Central Valley Water Board’s Executive Officer on 4 April 2018 to require monitoring of Facility discharges and expansion of Valley Water’s groundwater monitoring network. The Permit prohibits the discharges from creating pollution or nuisance. “Pollution,” by definition, occurs when there are unreasonable impacts to designated beneficial uses in groundwater or surface water. The *Water Quality Control Plan for the Tulare Lake Basin, Third Edition, Revised May 2018* (Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, including plans and policies specific to oilfield discharges, and incorporates by reference plans and policies adopted by the State Water Board.

In 2002, at the request of Board staff, Valley Water began to voluntarily investigate groundwater down-structure of its Facility. In June 2010, at the request of Board staff, Valley Water began voluntarily monitoring its discharge and groundwater down-structure of the Facility. As discussed in detail below, groundwater monitoring revealed the presence of a highly saline produced wastewater plume originating from the Facility ponds and migrating to the northeast beyond the Valley Water groundwater monitoring well network. MRP R5-2018-0808 requires the submission and implementation of a Monitoring Well Installation and Sampling Plan (MWISP) that provides for the installation of an appropriate number of upgradient/up-structure groundwater monitoring wells to identify background water quality and an appropriate number of down gradient/down-structure wells to fully delineate the produced wastewater plume.

On 5 April 2018, the Board adopted Resolution No. R5-2018-0015, which directed Staff to determine whether Valley Water's discharge may be regulated under *Order R5-2017-0035 Waste Discharge Requirements General Order for Oil Field Discharges to Land General Order Number Two (Oil Field General Order Two)*, *Order R5-2017-0036 Waste Discharge Requirements General Order for Oil Field Discharges to Land General Order Number Three (Oil Field General Order Three)*, or whether Valley Water should be directed to submit for a report of waste discharge for individual waste discharge requirements. Oil Field General Order Two and Oil Field General Order Three are hereafter referred to collectively as "Oil Field General Orders." The determination process was to take approximately one year. The one-year time frame was selected so that Staff could evaluate two additional and complete semiannual monitoring reports, which were to include groundwater data from an expanded groundwater monitoring network. As of January 2019, no additional monitoring wells have been installed to delineate the plume.

The Facility discharge exceeds Basin Plan oil field effluent limits for salt and boron, state drinking water standards for salinity, and agricultural water quality objectives for salinity and boron. The plume and groundwater affected by the plume exceeds water quality objectives for Basin Plan designated beneficial uses of Municipal and Domestic Supply (MUN) and Agricultural Supply (AGR).

This Staff Report describes why regulatory coverage under one of the Oil Field General Orders is inappropriate and why coverage under individual WDRs would only be appropriate with significant Facility modifications. It also describes why a Board issued Cease and Desist Order (CDO) is appropriate. Specifically, this Staff Report describes the Facility, the discharges to the Facility, the local geology and hydrogeology, the results of groundwater monitoring conducted to date, and why additional monitoring is necessary to define the extent of the impacts. In preparing this Staff Report, Board staff reviewed the Board files for the Facility, including, but not limited to, those documents listed in Attachment C.

FACILITY

The Facility is constructed on alluvial fan deposits just east of the Cymric and Monument Junction oil fields as shown on Attachment B. These fan deposits are discussed in more detail below but are generally considered to be coarse grained and highly permeable. Structurally, the sediments dip from the southwest to the northeast. Similarly, topography in the area slopes at about 30-feet-per-mile from the west-southwest to the east-northeast, as shown by the surface water channels depicted on Attachment D. The Clean Harbors Buttonwillow, LLC, Class I waste facility (Clean Harbors) is about 1.7 miles to the east-northeast, as shown on Attachment D, and sits at an elevation that is about 100 feet lower than the Facility.

Table 1 below presents the range of analytical results for various constituents associated with samples of produced wastewater discharged to the ponds from

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November 2002 through November 2018. These analytical results are from samples collected by Board staff during field inspections or submitted by, or on behalf of, Valley Water.

Table 1. *Range of Select Constituents in McKittrick 1 & 1-3 Ponds*

Parameter (units)	Concentration	State MCL ⁵
Electrical Conductivity (EC) @ 25°C ¹	11,000 - 41,000	1,600/2,200 ⁶
Total Dissolved Solids (TDS) (mg/L)	11,000 - 26,000	1,000/1,500 ⁶
Chloride (mg/L)	3,600 - 11,000	500/600 ⁶
Boron (mg/L)	53 - 94	
Benzene (µg/L ³)	0.46 - 400 ⁴	1.0 ⁷
Toluene (µg/L)	0.31 - 1000 ⁴	100 ⁷
Ethylbenzene (µg/L)	0.75 - 120 ⁴	300 ⁷
Xylenes (µg/L)	1.2 - 550 ⁴	1750 ⁷

1. °C = Celsius.

2. µS/cm = microsiemens per centimeter which is equivalent to micromhos per centimeter.

3. µg/L = micrograms per liter.

4. Includes data from samples collected by Board staff during field inspections.

5. State of California drinking water Maximum Contaminant Level (MCL)

6. Secondary MCL, upper limit/short term limit.

7. Primary MCL.

The State drinking water Maximum Contaminant Levels (MCLs) are presented for comparison purposes. Oil field produced wastewater discharged to the Facility is from the more saline marine diatomite formations and the relatively less saline, non-marine Tulare Formation. The large range in produced wastewater constituent concentrations discharging to the ponds depends on the number of wells producing and the corresponding zone of production. The electrical conductivity (EC), chloride, and boron concentrations in the produced wastewater greatly exceed the numerical limits set for oil field discharges to land in the Basin Plan of 1,000 umhos/cm, 200 mg/L, and 1.0 mg/L, respectively. The discharges to the ponds also greatly exceed the MCL for EC, TDS, chloride, benzene, toluene, ethylbenzene, and xylenes. *Water Quality for Agriculture, FAO Irrigation and Drainage Paper 29 Revision 1* (Ayers and Westcot) indicates that severe restrictions on irrigation may occur when the applied irrigation water exceeds an EC of 3000 umhos/cm, a TDS of 2000 mg/L, the chloride exceeds about 350 mg/L (surface irrigation; much less for sprinkler irrigation), and boron exceeds about 3 mg/L. The discharge exceeds these agricultural criteria by orders of magnitude.

The discharge flows to the McKittrick 1 & 1-3 ponds were not metered until recently. Reported flows and their sources are shown in Attachment E and have ranged from 7000 barrels (bbls) per day (~ 294,000 gallons per day 'gpd') to 115,000 bbls per day (4.83 million gpd). The average of the reported flows is approximately 67,000 bbls per day or 2.8 million gpd. Based on the average flows, the volume of produced water discharged to the ponds from 1960 to 2018 is about 1.4 billion barrels (60 billion

gallons).

GENERAL HYDROGEOLOGY AND GROUNDWATER MONITORING RESULTS

Several general studies of the hydrogeology in the area that encompasses the Valley Water facilities that serve the Cymric and Monument Junction Oil Fields have been conducted. At Board staff's request, Valley Water has also conducted hydrogeology studies in the area of the McKittrick 1 & 1-3 ponds and installed a groundwater monitoring network. Similarly, Clean Harbors, has conducted local hydrogeology studies and installed a groundwater monitoring network for its facility. The following describes the depositional environment of the local sediments and salient information in those reports and studies. As previously mentioned, the reports and studies consulted are listed in Attachment C.

Depositional Environment

Within the Cymric area, the Quaternary stratigraphic depositional environment generally consists of uplifted arid alluvial fan systems underlain by lacustrine (lake deposits) silts, sands, and clays. Alluvial fan systems are formed from the release of water-borne sediments from mountainous catchments into an adjacent valley or basin. Sediments are deposited to the fan by sheet flow and an incised channel that is an extension of the catchment feeder channel. The incised channel will usually end short of the distal portion of the fan. At the end of the channel, flows expand laterally onto the fan surface. Headward-eroding gullies are common on the distal fan either as single channels or as a downward-converging network. These gullies may eventually intersect the incised channel which could result in changing the active portion of the fan to another direction. Alluvial fan systems can transition to an alluvial plain and then on to a lacustrine environment. Alluvial plain deposits are typically well sorted, fine to medium-grained sands. Lacustrine deposits are formed by sedimentation in a lake. These deposits are characterized by well-sorted, fine-grained sediments, such as clays and silts, which formed in a low-energy environment. The edges of lacustrine deposits may have alluvial delta or fluvial deposits.

Stratigraphy

The following describes the general stratigraphy underlying the McKittrick 1 & 1-3 Facility and the Clean Harbors facility. The nomenclature is generally consistent with that provided in Valley Water technical reports and self-monitoring reports. Attachment F.1 and F.2 provide general cross sections.

Alluvium

The first layer underlying the McKittrick 1 & 1-3 Facility is comprised of Holocene age alluvial fans consisting of sediments transported eastward from the Coast Ranges. These sediments are in interbedded layers of poorly sorted relatively coarse-grained,

subangular to angular sands with silts and clays. Angular to subangular gravelly sands occasionally occur in the interbedded sequence.

Geomega's report (17 October 2003) documenting the initial hydrogeologic investigation said "Silty clay layers within the shallower alluvial fan sequence act to perch groundwater in the Cymric area. Multi-perched water zones in the alluvial fan sequence encountered in borehole/monitoring wells CYM-17N1 and CYM-19H1 are apparent from air rotary drilling and geophysical log interpretation." The alluvium is saturated to the east and serves as an aquifer for water supply wells.

"Corcoran Clay Equivalent" or basal alluvial clay

Under the alluvium is a silty-clay to clay bed probably deposited in an alluvial plain to lacustrine (lake) environment transition. This bed separates the alluvium from the Tulare Formation. As described in the studies and reports provided by Valley Water, this bed does not act as a significant aquitard; i.e. it does not act as a significant barrier to the downward migration of produced wastewater discharged from the McKittrick 1 & 1-3 Facility ponds.

Upper Tulare

Below the Corcoran Clay Equivalent (CCE) is what is called the upper Tulare or upper Tulare sand. It consists of Pleistocene age deposits that vary greatly from lacustrine delta deposits to braided stream, and meandering stream deposits. The deposits are comprised of fine-grained sands with interbedded silt and clay layers and gravels. The upper Tulare sand serves as an aquifer to the east that supplies water supply wells.

Regionally extensive clay layer

The upper Tulare sand is separated from what is called the deeper Tulare or deeper Tulare sand by a dense, stiff clay bed approximately 70 feet thick. This is sometimes called the upper Tulare clay.

Deeper Tulare

The deeper Tulare or deeper Tulare sand is composed primarily of fine-grained to medium-grained well-sorted sands. Valley Water documents indicate the deeper Tulare contains the "regional aquifer." The deeper Tulare serves as an aquifer for water supply wells to the east.

Effects of Depositional Environment on Stratigraphy

Potentially significant consequences of the stratigraphy and above described depositional environment include:

1. What may appear to be homogenous (uniform) and isotropic (similar in all

directions) deposits in cross-section may actually be heterogeneous (varied) in nature due to fluvial channel cutting and deposition of higher energy (coarser) sediments deposited during higher energy storm events.

2. What may appear to be continuous confining layers in cross section, such as the CCE and the clay layer that separates the upper Tulare from the deeper Tulare may be riddled with more permeable channel deposits that compromise the layers' integrity, preventing them from serving as effective aquitards.
3. Intersecting the more permeable channel deposits with monitoring wells is difficult without detailed subsurface information. Groundwater typically flows preferentially much faster through channel deposits.

Groundwater Monitoring Networks and Results

The locations of the Valley Water McKittrick 1 & 1-3 Facility groundwater monitoring wells and select Clean Harbors facility groundwater monitoring wells are shown in Attachment F.1. Valley Water's groundwater monitoring well network does not have any upgradient or up-structure wells.

As part of the initial hydrogeologic investigation in 2002, Valley Water installed monitoring wells CYM-19H1 and CYM-17N1 in the upper Tulare and monitoring well CYM-21D1 in the deeper Tulare. The borings for the monitoring wells were drilled using air rotary drilling until groundwater was encountered. At that point, the drilling method was switched to mud rotary.

Analysis of groundwater samples obtained in 2002 contained elevated concentrations of EC, TDS, chloride, and boron. Valley Water's consultant Geomega, Inc., concluded in its September 2003 report titled *Hydrogeologic Characterization Report Valley Waste Disposal Company, Cymric Field Study (Phase I Study)* that produced wastewater from the ponds had infiltrated the upper Tulare at least as far as 0.75 miles from the Facility. The Phase I Study also concluded that groundwater samples from well CYM-21D1 indicated that produced wastewater had not reached groundwater in the deeper Tulare at that point at that time.

In 2006, Valley Water completed monitoring wells CYM-17K1, CYM-17M1, and CYM-17Q1 in an unsaturated portion of the upper Tulare down-structure from the wells installed in 2002. The well locations are also shown in Attachment F.1. These wells were positioned as "sentinel wells" that would indicate whether and when the plume of produced water reached those points in the upper Tulare downgradient from the ponds. Geomega, Inc., submitted an April 2007 report titled *Phase II Hydrogeologic Characterization Report Valley Waste Disposal Company, Cymric Field Study (Phase II Study)* including results from samples obtained in 2006. The Phase II Study concluded that produced wastewater was present in the upper Tulare, but the sentinel wells were

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dry. Well CYM-21D1, in the deeper Tulare, reportedly did not show any indication of a produced wastewater impact at the time of sampling.

Borehole/Monitoring well details are presented in Table 2 below.

Table 2. *Valley Water McKittrick 1 & 1-3 Groundwater Monitoring Well Information.*

Well	Distance to VWMC ¹ ponds	Well total depth (ft bgs ²)	Surface Elevation (ft AMSL ³)	Screen interval (ft AMSL ³)	Screen interval (ft bgs)	11/12/2018 Water elevation (ft AMSL ³)
CYM-19H1	1,500 feet (0.28 miles)	245	469.2	354-314	115-155	346.78
CYM-17N1	3,300 feet (0.62 miles)	240	451.5	347-287	105-165	321.60
CYM-17M1	4,300 feet (0.81 miles)	197	446.5	292-262	155-185	278.30
CYM-17Q1	5,438 feet (1.03 miles)	208	437.6	278-238	160-200	238.802
CYM-17K1	5,861 feet (1.11 miles)	210	427.9	278-228	150-200	272.48
CYM-21D1	6,700 feet (1.27 miles)	300	427.1	274-294	274-294	148.24

¹ VWMC = Valley Water Management Company

² ft bgs = feet below ground surface

³ AMSL = feet above mean sea level

In June 2014, Valley Water submitted a self-monitoring report titled *Valley Water Disposal Company, 2010 Semi-Annual Sampling and Analysis Report, McKittrick 1 & 1-3 Ponds Cymric Area* prepared on its behalf by Schlumberger Water Services. The report 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 sentinel wells.

In March 2015, Valley Water submitted a self-monitoring report titled *Valley Water Management Company, 2014 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 & 1-3 Ponds Cymric Area* prepared by Schlumberger Water Services and summarizing data collected in November 2014. The report indicates that CYM-17M1 had 26.56 feet of water, CYM-17K1 had 48.99 feet of water, CYM-17Q1 had 6.93 feet of water at the time of sampling demonstrating that produced wastewater was present in the sentinel wells (CYM-17K1, CYM-17M1, and CYM-17Q1), and that these wells were hydraulically downgradient from the wells installed in 2002. The report also concluded that there were no indications of a produced water impact on the groundwater monitored by well CYM-21D1 in the deeper Tulare, even though chemical constituent concentrations associated with produced wastewater (e.g. TDS, chloride, and boron) had been increasing in well CYM-21D1 since about 2002, and more significantly since 2010, as shown in Attachment G.

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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). The report was prepared by WSP USA on behalf of Valley Water and includes data from Valley Water’s June 2017 monitoring event including sampling results from the Facility ponds and groundwater monitoring wells. Samples from each of the Valley Water wells in the upper Tulare 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 report states, “The overall trend of increasing concentrations of chloride, magnesium, sodium, and boron at VWMC Deeper 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 data submitted in self-monitoring reports by Valley Water also indicate that from 2002 to 2018 the TDS concentrations in CYM-21D1 have increased from about 1,200 mg/L to about 8,000 mg/L, and the chloride concentrations have increased from 334 mg/L to about 2,700 mg/L. Table 3 summarizes the Valley Water groundwater monitoring data. As previously mentioned, the TDS, chloride, and boron trends are presented in Attachment G. This information along with the increasing water levels in CYM-21D1 indicates the mound of produced wastewater emanating from the Facility ponds is continuing to expand. Attachments H1 and H.2 present salient water level data. The direction of groundwater flow is predominantly to the northeast as shown on Attachment I.

Table 3. *Valley Water McKittrick 1 & 1-3 Facility Groundwater Monitoring Well Water Quality.*

Well ID	Distance from ponds (ft ¹)	No. of results & (date range)	EC (umhos/cm ²)	TDS (mg/L ³)	Boron (mg/L ³)	Chloride (mg/L ³)
CYM-19H1	1,500	20 (2002 – 2018)	8,500 – 23,000	10,500 – 14,000	30 – 41	4,120 – 5,700
CYM-17N1	3,500	20 (2002 – 2018)	10,900 – 33,000	7,450 – 18,000	20 – 76	2,700 – 8,000
CYM-17M1	4,400	11 (2014 – 2018)	15,840 24,350	12,000 – 16,000	40 – 55	4,900 – 7,000
CYM-17Q1	5,300	11 (2014 – 2018)	13,000 – 22,600	13,000 – 16,000	45 - 60	4,800 – 5,900
CYM-17K1	5,900	11 (2014 – 2018)	18,000 – 28,000	16,000 – 18,000	55 - 68	6,000 – 8,000
CYM-21D1	6,850	20 (2002 – 2018)	1,970 – 11,000	1,200 – 10,000	2.5 - 22	334 - 2,900

¹ ft = feet.

² umhos/cm = micromhos per centimeter.

³ mg/L = milligram per liter.

Table 4. *Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) Concentrations in Valley Water Facility Groundwater Monitoring Wells.*

Well ID	BTEX (µg/L)			
	Benzene	Toluene	Ethylbenzene	Xylenes
CYM-19HI	0.65-0.79	ND ¹	ND	ND
CYM-17N1	0.53	ND	ND	ND
CYM-17K1	ND	ND	ND	ND
CYM-17M1	0.27	ND	ND	ND
CYM-17Q1	ND	ND	ND	ND
CYM-21D1	0.62	ND	ND	ND
MCLs ²	1	150	300	1750

¹ ND = not detected above laboratory reporting limit. Prior to 2018, reporting limits for benzene, toluene, ethylbenzene, and total xylenes (BTEX) was 2.0 ug/L. Subsequently, reporting limit has been 0.5 ug/L.

² MCLs = maximum contaminant level. The MCL's for benzene, toluene, ethylbenzene, and total xylenes (BTEX) are Primary MCLs.

Groundwater sample results from Valley Water's monitoring wells show that BTEX constituents have generally been not detected. Where there have been detections, the results have been below the State drinking water MCLs.

Central Valley Water Board staff have reviewed the self-monitoring reports for the Clean Harbors Class I landfill facility. As described previously, the Clean Harbors facility is about 1.7 miles to the east-northeast, as shown on Attachment B. The Clean Harbors facility is also down structure and down gradient of the McKittrick 1 & 1-3 Facility ponds. In its hydrogeological investigations, Clean Harbors has differentiated three zones that contain groundwater: 1. Perched zone, 2. Intermediate zone, and 3. Lower zone. These zones generally correspond to the Alluvium, upper Tulare, and deeper Tulare.

Valley Water obtained split samples during the May 2017 sampling of the Clean Harbors groundwater monitoring wells. In part, the samples were analyzed for general minerals and stable isotopes of oxygen and hydrogen. Generally, the native groundwater in the Cymric area is enriched in sodium, calcium, and sulfate, likely due to the abundance of gypsum present throughout the sediments of the Tulare formation. In contrast, the produced wastewater discharged to Valley Water's ponds are marine waters from deeper zones that occur with petroleum and, as such, are enriched with sodium and chloride.

Clean Harbors' groundwater monitoring wells MW-148I and MW-102RL are on the upgradient side of the Class I facility (i.e., the side closest to the McKittrick 1 & 1-3 Facility) (Attachment F.1). MW-148I is screened in the upper Tulare and MW-102RL is screened in the deeper Tulare. Groundwater sample analyses from monitoring well MW-148I and MW-102RL indicate that TDS and chloride concentrations in these wells have been increasing from as early as 2007, as shown on Attachments J.1 and J.2.

From 2011 to 2018, the TDS in MW-148I has increased from about 2,340 mg/L to 6,600 mg/L, from 2009 to 2018 the chloride concentration has increased from about 246 mg/L to 1,800 mg/L, and from 2015 to 2018 the boron in MW-148I has increased from about 4.9 mg/L to 9.5 mg/L. From 2013 to 2018, the TDS in MW-102RL has increased from about 3,040 mg/L to about 4,000 mg/L (high of 4,300 in Q1 2018, 3,800 for Q4 2018), and from 2007 to 2018 the chloride concentration has increased from about 450 mg/L to about 750 to 780 mg/L. The data suggest that groundwater at the Clean Harbors location has been adversely impacted by produced wastewater.

Stable isotopes of oxygen and hydrogen can be used to help differentiate between wastewaters discharged to ponds and native groundwaters, or a combination thereof. The ratios of H^2 to H^1 and O^{18} to O^{16} are measured in each sample and are expressed as parts-per-thousand differences from that of Vienna Standard Mean Ocean Water. They are then plotted with δ^2H on the y-axis and $\delta^{18}O$ on the x-axis, as shown on Attachment K. The plotted points are compared to the Global Meteoric Water Line or a Local Meteoric Water Line (LMWL). Native groundwater that has not been significantly evaporated plots below, but near the LMWL, as shown on Attachment K. Wastewater that has been subject to significant evaporation in ponds plots farther to the right side of the graph, and farther from the LMWL. Mixtures plot in between the two, with those containing more pond water plotting farther to the right than those containing less pond water.

Attachment K shows isotopic results for water sampled from Clean Harbors MW-170L and Kern County Water Well 23. These wells are below and slightly to the right of the LMWL, and probably do not represent groundwater that has been mixed with any significant volume of produced wastewater from ponds. There are only single sample results for Clean Harbors MW-102RL and MW-148I, but these wells plot farther from the LMWL indicating possible mixing with produced wastewater from the McKittrick 1 & 1-3 ponds. MW-148I plots still farther to the right of the LMWL. From 2006 to 2018, data for CYM-21D1 shows consistent movement away from the LMWL and towards the data associated with the Valley Water McKittrick 1 & 1-3 upper Tulare wells CYM-19H1, CYM-17N1, CYM-17K1, CYM-17M1, and CYM-17Q1. The quality of groundwater in these wells reflects primarily the quality of produced wastewater discharged to the McKittrick 1 & 1-3 Facility ponds. Isotope data for the produced wastewater from the McKittrick 1 & 1-3 Facility ponds are included in Attachment K for reference. As expected, the data are generally farther to the right and away from the LMWL. The isotope results of the groundwater samples CYM-21D1 and from Clean Harbors' wells MW-102RL, MW-148I, and MW-149I show that produced wastewater is mixing with groundwater in the upper Tulare and deeper Tulare, at least as far down gradient as the Clean Harbors facility.

The ionic composition of the minerals dissolved in a water (wastewater, unaffected groundwater, or a combination of both) can be used to classify the water based on the dominant dissolved anions (negatively charged) and cations (positively charged). The ionic composition of the water is expressed in milliequivalents per liter (meq/L). A

milliequivalent is a measurement of the molar concentration of the ion, normalized by the ionic charge of the ion. The dominant dissolved ion must be greater than 50 percent of the total. For example, water classified as a sodium-bicarbonate-type water contains more than 50 percent of the total cation milliequivalents as sodium and more than 50 percent of the total anion milliequivalents as bicarbonate. If no cation or anion is dominant (greater than 50 percent), the water is classified as mixed and the two most common cations or anions in decreasing order of abundance are used to describe the water type. For example, a water containing 45 percent sodium, 35 percent calcium, and 20 percent magnesium, and 55 percent bicarbonate, 30 percent sulfate, and 15 percent chloride would be classified as a sodium-calcium-bicarbonate-type water. Stiff and Piper diagrams can be used to illustrate the ionic composition of water samples (e.g., wastewater, unaffected groundwater, or a combination of both.) and, with sufficient data, how the composition changes over time.

Stiff diagrams provide a graphical representation of geochemical data and are often used when a qualitative comparison of many analyses is needed. A polygonal shape is created by plotting major cation and anion concentrations in milliequivalents on parallel horizontal lines with anions plotted to the right of a vertical zero line and cations plotted to the left.

Stiff diagrams presented on Attachments L.1 – L.4 show recent water quality of the Facility produced wastewater, water quality of wells that appear to be unaffected by the produced wastewater (which is date dependent), and water quality in Valley Water and Clean Harbors groundwater monitoring wells that have been impacted by produced wastewater. The Stiff diagrams indicate that the Valley Water monitoring wells between the Facility ponds and the Clean Harbors groundwater monitoring wells have been affected by produced wastewater when compared to the unaffected water quality. Well CYM-21D1 (Attachment L.4) has shown a steady increase in some cations and anions and primarily sodium and chloride, indicative of increasing impacts over time from produced wastewater. Significant impacts are also appearing in some of the Clean Harbors facility monitoring wells down gradient of the Valley Water groundwater monitoring well network. The primary source of produced wastewater appears to be discharges from the Facility ponds.

For the attached Piper diagrams, cation and anion concentrations for each of the produced wastewater and groundwater samples have been converted to total milliequivalents of solute per liter of solution (meq/L) and plotted as percentages of their respective totals in two triangles (Attachments M.1-M.4). The cation and anion relative percentages in each triangle are then projected into a quadrilateral polygon that describes the water type. The attached Piper diagrams provide graphical representations of the major cations and anions for Valley Water's produced wastewater ponds, waters that appear to be unaffected by infiltrated produced wastewater, and waters that have been impacted by produced wastewater over time appear to show a progressive mixing over time between the two types (CYM-21D1).

These diagrams show that the Valley Water produced wastewater is dominated by sodium and chloride (Attachment M.1). Better quality water that appears to be largely unaffected by the produced wastewater is more sulfate-rich, consistent with groundwater typical of the west side of the San Joaquin Valley, and here represented by wells MW-170L, MW-149I, Belridge 16, and CYM-21D [in 2006] on Attachment M.2. Piper diagrams for several wells show mixing of produced wastewater with better quality water (Attachment M.3), or in the case of well CYM-21D1, increasing impacts over time from produced wastewater (Attachment M.4), which clearly shows a shift from a sulfate type water to a chloride type water with time.

Notwithstanding the above, the October 2017 Report concludes that Valley Water's discharges from its McKittrick 1 & 1-3 Facility ponds have not impacted groundwater in Clean Harbors' upgradient monitoring wells and proffers the following arguments:

- Groundwater levels in the Clean Harbors' wells have been decreasing while levels in the Valley Water wells are increasing. The report states, therefore, the wells are not hydraulically connected.
- Boron concentrations have been increasing in the Valley Water monitoring wells and show no trends in Clean Harbors' wells.
- The calculated groundwater flow velocity shows that the produced water constituents could not have reached the Clean Harbors' wells at this time.
- The pH of the water from the Valley Water monitoring well CYM-21D1 is more acidic (6.6 to 6.8) than the groundwater from the nearest Clean Harbors groundwater monitoring wells, which are more alkaline (7.5 to 8.1). The report states, therefore, the wells are not hydraulically connected.

The arguments posited by WSP USA on Valley Water's behalf are not persuasive. Valley Water has provided no evidence of a geologic structure that would impede or isolate the produced wastewater discharged into and from the McKittrick 1 & 1-3 Facility ponds from the Clean Harbors' facility monitoring wells. Further, the Clean Harbors' facility is down structure from and much closer to large areas of irrigated agriculture than the McKittrick 1 & 1-3 Facility ponds. The decrease in the Clean Harbors' groundwater monitoring well water levels is likely due to increased pumping of groundwater for irrigation during the recent drought conditions. The increases in the groundwater levels in the Valley Water monitoring wells are probably due to continued discharge to the Facility ponds and the large volume of percolated produced wastewater that is moving through the formations tapped by the groundwater monitoring wells.

Relatively stable boron concentrations in samples from the Clean Harbors' groundwater monitoring well MW-102RL are not unexpected. Boron tends to be mobile in sands and gravels but can adsorb to finer grained soils such as silts and clays. The ability of boron in a plume to migrate through the subsurface at rates similar to or slower than TDS and

chloride depends on many factors, including but not limited to, the pH and the salinity of the discharge, the pH of the groundwater with which the discharge is mixing; and the pH, buffering capacity, and composition of the soils through which the discharge/groundwater mixture is migrating. Therefore, the boron front of a plume can move slower through the subsurface than more conservative constituents, such as chloride. As shown in Attachment J.1, boron is increasing in MW-148I.

The groundwater flow velocity calculations presented in the October 2017 Report, and more recently in the February 2019 monitoring report submitted by Golder Associates Inc., likely underestimate the actual groundwater flow velocities as they assume a consistent flow gradient, employ a hydraulic conductivity value derived from the analysis of one fine grained soil sample, and use an assumed effective porosity. The report gives no consideration to the heterogeneous nature of the local hydrogeology. For example, produced wastewater that finds its way into a subterranean channel comprised of coarse sand or gravel will travel much faster than calculated.

Lastly, regarding pH, the pH in CYM-21D1 has ranged from 7.10 to 10.4 pH units. The pH in the Clean Harbors wells historically ranged from 7.5 to 8.2 pH units. The pH range for CYM-21D1 overlaps the pH range reported for the Clean Harbors wells, which contradicts the assertion made in the October 2017 Report.

Downgradient Groundwater Quality and Beneficial Uses

The beneficial uses of groundwater in the Cymric area designated by the Basin Plan are: Municipal and Domestic Supply (MUN), Agricultural Supply (AGR), and Industrial Service Supply (IND). In many instances, the quality of groundwater to the east of the McKittrick 1 & 1-3 Facility ponds is of sufficient quality to meet water quality objectives for MUN, AGR, and IND.

Attachment N shows the locations of select Clean Harbors monitoring wells and existing water supply wells, mostly agricultural wells, downgradient of the McKittrick 1 & 1-3 ponds. Attachment P also shows TDS concentrations in the wells. As described above, TDS and chloride concentrations in MW-148I and MW-102RL have increased over time. The historical quality in MW-148I was suitable for MUN and AGR. It now appears to be unsuitable for both.

Attachment N shows several agricultural wells operated primarily by Starrh Family Farms, LP (Starrh Farms) to the north of the McKittrick 1 & 1-3 Facility and the Clean Harbors facility. Starrh Farms well Belridge 7 had a TDS of 2,700 mg/L in 2013 when it was last sampled by AMEC, Foster, Wheeler. The sampling notes indicate that at the time of sample collection the well was actively pumping, and presumably irrigating crops. Other agricultural wells in the area have TDS values ranging from 2,300 mg/L to 6,800 mg/L. The agricultural well closest to the Valley Water Facility had a TDS of 18,000 mg/L. The better quality wells contain TDS and chloride concentrations that do not require dilution prior to use on salt-tolerant crops. The wells with higher TDS

concentrations can be blended with higher quality surface water to irrigate a variety of crops. On 26 January 2018, Starrh Farms communicated to Board staff that these wells are very important to its operations when surface water allocations are short.

Attachment N also shows that to the east McKittrick 1 & 1-3 Facility and Clean Harbors, groundwater from agricultural wells in the area have had TDS values ranging from 391 mg/L to 5,952 mg/L. Data for these wells is old, but do demonstrate that high quality groundwater has existed, and presumably exists today, down gradient of the McKittrick 1 & 1-3 Facility.

Additional Groundwater Monitoring Well Work Plans

On November 2014, Kennedy/Jenks Consultants and Schlumberger Water Services, on behalf of Valley Water submitted a report titled, *Monitoring Well Installation Work Plan for the McKittrick Ponds, Cymric Oil Field, California* (2014 Work Plan). Kennedy/Jenks then met with Board staff on 6 January 2015 to discuss the Work Plan. On January 2015, Kennedy/Jenks submitted a proposed modification to the Work Plan. The Work Plan proposed to drill three to four borings and install at least two, and possibly four monitoring wells to further characterize the vadose zone and groundwater. The work plan proposed to drill in two phases. In the first phase, two wells would be drilled "soon" (CYM-19H2 and CYM-21D2) and two borings (CYM-17H1 and CYM-17H2) would be drilled later because they were proposed in an area of protected species habitat. CYM-19H2 would be installed as a deep groundwater monitoring well. CYM-21D2 would be installed as a shallow monitoring well or if water was not encountered, as a sentinel well. If groundwater quality changed in the CYM-21D1 well (CYM-21D1 is now impacted), then CYM-17H2 would be installed as a deep groundwater monitoring well.

On January 2015, Board staff issued a letter to Valley Water generally concurring with the Work Plan. Staff requested a second monitoring well be installed above the Upper Tulare Clay, and that CYM-17H1 be installed.

On April 2016, Valley Water submitted a report titled *Biological Report for the Valley Water Management Cymric Water Monitoring Well Project* (Biological Report). The Biological Report concluded that well 17H1 and well 17H2 could be installed but that the other proposed wells were in endangered species habitat. It also stated that there is enough room near a Clean Harbors monitoring well location for a drilling rig. Further, the Biological Report stated, "As for the other monitoring wells that were proposed near the McKittrick pond facility, it appears that we will have to obtain a "take" in permit prior to the installation of those wells. A "take" permit currently requires at least six months and more likely one year to obtain a permit."

As of February 2019, Valley Water has not implemented the proposed 2014 Work Plan, nor has Valley Water provided a formal update on whether it sought or acquired a "take" permit (or whether one was denied) for the installation of CYM-19H2 and CYM-21D2

monitoring wells. Wells 17H1 and 17H2 have not been installed, as proposed in the 2014 Work Plan and approved in the January 2015 Board staff letter.

In June 2018, Kennedy/Jenks Consultants, on behalf of Valley Water submitted a report titled, *Monitoring Well Installation and Sampling Plan for the Valley Water Management Company*

McKittrick Ponds Facility, Cymric Oil Field (2018 Work Plan). The Monitoring Well Installation and Sampling Plan (MWISP or Work Plan) was submitted in response to the requirements of Monitoring and Reporting Program Order R5-2018-0808. The Work plan proposed the installation of six additional monitoring wells to extend the existing groundwater monitoring network and delineate the plume of produced wastewater emanating from the Facility ponds.

On 27 July 2018, Board staff issued a letter to Valley Water conditionally concurring with the 2018 Work Plan. Staff requested Valley Water incorporate three recommendations into a revised MWISP: 1. Monitoring well CYM-17A1 be installed whether or not well CYM-17H1 is completed in unsaturated sediments; 2. All new monitoring wells are logged using geophysical methods; and 3. The process for determining the screened interval for a well is included in the MWISP.

In August 2018, Kennedy/Jenks Consultants, on behalf of Valley Water submitted a report titled, *Revised Monitoring Well Installation and Sampling Plan for the Valley Water Management Company McKittrick Ponds Facility, Cymric Oil Field* (Revised 2018 Work Plan). The Revised 2018 Work Plan did not contain an implementation schedule with specific dates for any proposed activities, but rather stated that, "No site work will be scheduled until habitat and endangered species restrictions for well locations have been satisfactorily addressed." The Revised 2018 Work Plan did not include a proposed date for the initiation of site biological review and/or assessment, any documentation of efforts Valley Water had taken to date, and when site work was expected to commence.

On 13 September 2018, Board staff issued to Valley Water an Order pursuant to Water Code section 13267 (September 13267 Order). The September 13267 Order stated the number of proposed monitoring wells that would be added to the six existing wells would likely be inadequate to define the lateral and vertical extent of wastewater constituents in the groundwater. However, in the interest of moving forward expeditiously, September 13267 Order conditionally approved the Revised MWISP contingent upon Valley Water:

1. Installing proposed monitoring well CYM-17A1 in first encountered groundwater regardless of whether well CYM-17H1 is completed in unsaturated sediments. The July 13267 Order noted Valley Water could move CYM-17A1 north towards Delfern Road to minimize disturbance to habitat during installation and monitoring;

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2. Installing a shallow well at the proposed site of CYM-25B1 if the geophysical logging of the well showed the presence of perched water in the upper Tulare sands;
3. Providing with each monitoring report a demonstration that specific low-flow pumping and sampling method parameters are stable, recorded, and reported each time;
4. Sampling and analyzing the selected Clean Harbors monitoring wells MW-148I, MW-149RI, MW-102RL, MW-170L, and MW-PRL as part of its obligations to comply with Order No. R5-2018-0808; and
5. Proceeding forthwith with the installation of all proposed wells that are at existing well sites and that do not need additional biological review for endangered species issues.

To address the vagueness of the schedule proposed in the MWISPs, the July 13267 Order required Valley Water Management Company to provide technical and monitoring reports as follows:

<u>Item</u>	<u>Description</u>	<u>Due Date</u>
1.	Updated Biological assessment report of proposed monitoring well locations.	3 October 2018
2.	Demonstration that monitoring well drilling has begun for clear monitoring well locations.	28 November 2018
3.	Monitoring well installation report for new wells.	90 days after monitoring well installation
4.	A demonstration that additional biological assessment has begun for proposed monitoring well sites that require it. A time schedule that includes obtaining required "take" permits where necessary.	28 November 2018
5.	Monthly biological review activities progress reports.	By the 10 th day of each month
6.	Technical Report of monitoring well installation, completion, and sampling as required by MRP.	1 March 2019

On 3 October 2018, Valley Water submitted a report prepared by McCormick Biological, Inc., and titled *Biological Evaluation for Proposed Valley Water Management Cymric Well Locations, Kern County, California* (Updated Biological Assessment Report). The report stated that all Revised 2018 Work Plan proposed monitoring well locations required further Biological assessment and that installation of monitoring wells could not begin. It stated that a complete Biological Assessment for the Blunt Nose Leopard Lizard was necessary and that it would take approximately one year to complete (by 15 September 2019). McCormick Biological, Inc., recommended that "Valley Water

Management should consider pursuing take authorization/permitting under the state and federal Endangered Species Acts with the CDFW and the USFWS for this project."

During a conference call on 10 December 2018, Board staff and Valley Water's representatives stated that two additional monitoring wells (CYM-17E1 and CYM-20A1) could potentially be installed without additional biological assessment. Board staff replied that Valley Water that the two proposed well locations were within the extent of the plume, and that Board staff would also like to see monitoring wells between the existing Valley Water and the Clean Harbors monitoring wells. Board staff directed Valley Water to continue to address biological and access issues and to install upgradient and additional downgradient monitoring wells. Board staff advised Valley Water to collect as much data as feasible from all additional monitoring wells and for selected Clean Harbors monitoring wells.

As of February 2019, no additional monitoring wells have been installed, nor have any of the selected Clean Harbors monitoring wells been added to Valley Water's monitoring network.

Groundwater Modeling

Valley Water contracted with Catalyst Environmental (Consultant) to use MODFLOW-SURFACT modeling software to model the subsurface migration of the produced wastewater plume from the Facility. Staff met with Valley Water and its Consultant on 9 October 2017 and 10 January 2018 to discuss the various data inputs in the model, the assumptions of the model, and the preliminary results. The modeling effort assumes that, beginning in the late 1950's, the plume migrated to the northeast and that by 2014 it reached the three sentinel wells approximately one mile down gradient from the Facility ponds. Another assumption is that infiltrated wastewater is restricted to migration in sands in the upper Tulare interval and that no wastewater is leaking through the underlying upper Tulare clay. Two key general assumptions for the model are that the sediments are homogeneous and isotropic.

Two scenarios were proposed for the modeling effort. Both scenarios assumed that Valley Water ceases discharge to the Facility ponds in 2050. The first scenario (Scenario 1) ramps up the discharge rate to 45,000 barrels per day from 1957 to 1992 and then employs a steady 45,000 barrel per day discharge rate to 2050. The second scenario (Scenario 2) ramps up the discharge rate to 75,000 barrels per day from 1957 to 2002 and then employs a steady 75,000 barrel per day discharge rate to 2050. The model was run for both scenarios to year 2117 to allow for plume expansion after the cessation in discharge.

Staff has not evaluated the model and any results because Valley Water has not presented the model and results in a technical report. However, preliminary results for the two scenarios were provided at the 10 January 2018 meeting with Staff. Valley Water indicated that by 2050 the plume would migrate nearly $\frac{3}{4}$ mile to the northeast of

well CYM-17K1; and that by 2117 the plume would reach its maximum downgradient extent at approximately 1-mile northeast of well CYM-17K1, which is to the west of the northwestern corner of the Clean Harbors facility. Valley Water indicated for Scenario 2 that by 2050 the plume would migrate approximately 1.1 miles to the northeast of well CYM-17K1; and that by 2117 the plume would reach its maximum downgradient extent at approximately 1.5 miles northeast of well CYM-17K1, which is about ½ mile to the north of the northwestern corner of the Clean Harbors facility with the leading edge of the plume near to and south of the Belridge 7 irrigation supply well (See Attachment N).

The Consultant presented some model results at the 4/6 April 2018 Board hearing for Resolution R5-2018-0015. The Consultant stated that initial model results indicate that over the next 30 years the plume would migrate another ¾ mile downgradient (this appears to be Scenario 1 in 2050). Not mentioned by the Consultant is that the plume will continue to migrate further downgradient even after wastewater discharge ceases in 2050 (the second part of Scenario 1). Also, not mentioned were the results for Scenario 2 discussed above.

Board staff expressed its concerns with the modeling effort during its meetings with Valley Water and its Consultant. The primary concerns were that: 1. The model assumes the sediments are homogenous and isotropic whereas site sediments are heterogenous and anisotropic, 2. The model does not address potential preferential flow pathways, and 3. The model does not address fluid migration in the deeper Tulare.

Board staff concerns have not been adequately addressed, and the predictive ability of the model is questionable given that contemporary groundwater monitoring data indicates that the plume has already migrated past the terminal downgradient edge predicted by the Scenario 1 model result for the year 2117.

Groundwater Monitoring Conclusions

Several pieces of information, including but not limited to the following, support the conclusion produced wastewater from the Valley Water McKittrick 1 & 1-3 ponds has migrated and continues to migrate down-structure through the sediments of the upper Tulare and has also impacted groundwater quality in the regional aquifer in the deeper Tulare:

1. Valley Water has discharged large volumes of poor-quality produced wastewater to the Facility Ponds since the late 1950s, estimated at 60,000,000,000 gallons.
2. Valley Water's Facility ponds sit upgradient and upstructure of agricultural land and the Clean Harbors facility, which is 2.2 miles northeast of the ponds.
3. Groundwater elevation data and contour maps provided by Valley Water indicate that the groundwater direction of flow and gradient is to the northeast towards the agricultural land and the Clean Harbors facility.

4. Valley Water's technical reports and self-monitoring reports have acknowledged that there is a plume of poor-quality produced wastewater migrating from the ponds to the east, and the plume has migrated beyond its sentinel wells and CYM-21DI, about 1.11 and 1.27 miles downgradient, respectively.
5. Groundwater levels continue to increase in in Valley Water's downgradient groundwater monitoring wells.
6. TDS, chloride, and boron concentrations continue to increase in Valley Water's CYM-21D1 and Valley Water's consultants have stated, in multiple reports, that this is due to mixing with produced wastewater.
7. TDS, chloride, and boron concentrations continue to increase in Clean Harbors' MW-148I.
8. TDS and chloride concentrations continue to increase in Clean Harbors' MW-102RL.
9. Isotope data analyses indicate that the groundwater in Valley Water's CYM-21D1 is continuing to mix with produced wastewater and move closer to the isotopic signature of water in Valley Water's ponds. The isotope results of the groundwater samples CYM-21D1 and from Clean Harbors' wells MW-102RL, MW-148I, and MW-149I show that produced wastewater is mixing with groundwater in the upper Tulare and deeper Tulare, at least as far down gradient as Clean Harbors.
10. Stiff diagrams show that Well CYM-21D1 has shown a steady increase in sodium and chloride, indicative of increasing impacts over time from produced wastewater. Significant impacts are also appearing in some of the Clean Harbors facility monitoring wells down gradient of the Valley Water groundwater monitoring well network. The primary source of produced wastewater is discharges from the Facility ponds.
11. Piper diagrams for several wells show mixing of produced wastewater with better quality water, or in the case of well CYM-21D1, increasing impacts over time from produced wastewater, which clearly shows a shift from a sulfate type water to a chloride type water with time.

This information indicates the waste constituents have migrated at least 2.2 miles (to well MW-148I) downgradient from the Facility in the upper Tulare and 1.9 miles (to well MW-102RL) down gradient in the deeper Tulare, which is part of the regional aquifer.

MONITORING AND REPORTING PROGRAMS (MRP) R5-2018-0808

Water Code section 13267 authorizes the Central Valley Water Board to require monitoring and technical reports as necessary to investigate the impact of a waste

discharge on waters of the State.

Pursuant to Water Code section 13267, on 4 April 2018, and under authority delegated to the Executive Officer by the Board, the Executive Officer issued to Valley Water MRP Order R5-2018-0808 which requirements include: Facility inspections, maintenance requirements, effluent monitoring, and groundwater monitoring. The MRP requires Valley Water to report on the quantity and quality of produced wastewater before it is discharged to the ponds, the quality of produced wastewater while it resides in the ponds, and the quality of monitoring well water.

The MRP requires Valley Water to install additional monitoring wells to delineate the vertical and lateral extent of the produced wastewater plume to help to ensure the protection of designated beneficial uses of groundwater.

The MRP requires wastes (solids, liquid, and semi-solids) and groundwater to be analyzed for a wide range of constituents that are defined in MRP Table 1. Monitoring reports are required to include full laboratory reports.

Some of the more important MRP requirements are outlined below:

- The 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.
- The submittal of a Monitoring Well Installation and Sampling Plan (MWISP) within 60 days of MRP issuance. The MWISP would 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 and cross gradient/cross-structure dip wells to delineate the plume of produced wastewater emanating from the Facility ponds in both the shallow and deep groundwater zones.
- The submittal of a Monitoring Well Installation Completion Report (MWICR) within 90 days of installation of a groundwater monitoring well(s).
- The submittal of Quarterly monitoring reports whether or not there is a discharge.

The MRP issued on 4 April 2018 is very similar to those in Oil Field General Order One and Oil Field General Order Two. With respect to Water Code section 13267(b)(1) requirements, Valley Water owns and operates the Facility. Facility discharges have migrated and continue to migrate to the northeast and are adversely affecting groundwater in the regional aquifer, which is designated for MUN, AGR, and IND, and is used nearby for 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 similar to those carried by other dischargers under Oil Field General Order One and Oil Field General Order Two and are reasonable considering the magnitude of known and potentially ongoing impacts to water quality.

As of February 2019, Valley Water has failed to install additional monitoring wells proposed and approved to date and as far back as October 2014 and January 2015 respectively. Valley Water has failed to delineate the vertical and lateral extent of the produced wastewater plume generated by discharges to the Facility through the installation and sampling of additional monitoring wells to help ensure the protection of designated beneficial uses of groundwater as required by MRP R5-2018-0808.

RESOLUTION R5-2018-0015

As described above, on 5 April 2018, the Board adopted Resolution R5-2018-0015 Central Valley Water Board staff to take appropriate action to determine whether Valley Water's discharge may be regulated under Oil Field General Order Two or Oil Field General Order Three, or whether Valley Water should be directed submit for the Board's consideration a report of waste discharge to be regulated under an updated set of individual waste discharge requirements.

The following evaluation is based on an extensive amount of historic hydrogeologic and monitoring information provided by Valley Water, Clean Harbors' groundwater monitoring data, information compiled by Board staff, and other information related to oil field operations. The evaluation also included the relatively small amount of new information collected and submitted by Valley Water since the April 2018 meeting of the Board.

Regulation under Oil Field General Orders

Valley Water has suggested the Facility discharge could be covered under Oil Field General Order Three. Oil Field General Order Three does not require groundwater monitoring. This Order requires dischargers to either demonstrate that there is no groundwater beneath the discharge areas, that produced wastewater will not migrate into areas with groundwater with designated beneficial uses, or if there is groundwater underlying the discharge location, demonstrate that the current Basin Plan groundwater beneficial uses are eligible for de-designation.

The groundwater directly under the Facility appears to be primarily produced water from the Facility ponds and possibly other Valley Water facilities. This groundwater may be suitable for dedesignation. However, this water is migrating to the northeast into areas where groundwater not suitable for dedesignation, because it is of higher quality and is being beneficially used.

Oil Field General Order Three also includes Groundwater Limitations that proscribe discharges from causing groundwater to contain constituents in concentrations that adversely affect beneficial uses. Valley Water's monitoring reports indicate that its discharges are polluting groundwater in the first encountered groundwater (MW-148I) and the deeper regional aquifer (CYM-21D1 and MW-102RL), both of which have active beneficial uses of AGR. Additionally, the produced wastewater has migrated to the northeast and beyond the Facility groundwater monitoring well network. To date, the extent of plume migration has not been fully characterized, but given the local hydrogeology, it is expected to remain uncontained and continue to migrate northeastward. Therefore, the discharge cannot comply with Oil Field General Order Three.

Like Oil Field General Order Three, Oil Field General Order Two proscribes discharges from causing groundwater to contain constituents in concentrations that adversely affect beneficial uses. Therefore, it would seem that regulating the facility under Oil Field General Order Two would likewise be inappropriate. In addition, Oil Field General Order Two requires that the discharges from the regulated facility comply with State Water Board Resolution 68-16, the Statement of Policy with Respect to Maintaining High Quality of Waters in California (*State Antidegradation Policy*). The *State Antidegradation Policy* requires, among other things, that the discharger employ best practicable treatment or control (BPTC) to minimize degradation; and that any degradation be consistent with the maximum benefit to the people of the State. Given the high salinity of the discharge, the large volume of the discharge, the location of the discharge upgradient and upstructure of groundwater that is beneficially used for AGR, the evidence demonstrating that the discharge is migrating downgradient and down structure to the northeast and adversely impacting groundwater beneficially used for AGR, it may be unreasonable to conclude that the discharge should be considered BPTC and that the degradation is to the maximum benefit to the people of the state.

Individual Waste Discharge Requirements

Another option would be for Board staff to require Valley Water to submit a report of waste discharge supporting an updated set of individual waste discharge requirements (WDRs) pursuant to Water Code section 13263. Individual WDRs would require Facility discharges to comply with the requirements of the Basin Plan and the *State Antidegradation Policy*. As mentioned above, due to the high salinity and boron of the discharge and local hydrogeology, the existing discharge configuration may not be considered BPTC. Valley Water would need time to modify its treatment and/or control practices to ensure compliance with the Basin Plan. Some potential modifications could include improved treatment to remove salts and boron, the implementation of plume management to contain the plume, or changes in disposal practices, including discharge to underground injection control wells to put the discharge into deeper, unusable aquifers. Underground injection control is widely used in oil field disposal operations, and Valley Water has experience operating UIC wells.

The proposed Cease and Desist Order ultimately requires Valley Water to either submit a report of waste discharge (along with a supporting technical report) that would describe facility improvements needed to comply with all applicable regulatory requirements, or that discharges at the facility cease.

PROPOSED CEASE AND DESIST ORDER

The information above indicates that the Valley Water Facility discharges have violated and/or threatened to violate Resolution 69-1999 by causing a condition of pollution or threatening to cause a condition of pollution.

Water Code section 13301 states in part:

When a Regional Board finds that a discharge of waste is taking place or threatening to take place in violation of requirements or discharge prohibitions prescribed by the regional board or the state board, the board may issue an order to cease and desist and direct that those persons not complying with the requirements or discharge prohibitions (a) comply forthwith, (b) comply in accordance with a time schedule set by the board, or (c) in the event of a threatened violation, take appropriate remedial or preventive action. Cease and desist orders may be issued directly by a board, after notice and hearing, or in accordance with the procedure set forth in Section 13302.

Water Code section 13267(b) of the states, in relevant part:

(a) A regional board, in establishing or reviewing any water quality control plan or waste discharge requirements, or in connection with any action relating to any plan or requirements or authorized by this division, may investigate the quality of any waters of the state within this region.

(b)(1) In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region ... shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

As instructed by Board adopted Resolution R5-2018-0015, Board staff has taken action to determine whether Valley Water's discharge may be regulated under Oil Field General Order Two, Oil Field General Order Three, or individual waste discharge requirements. These actions include review of Valley Water and Clean Harbors historic

groundwater monitoring data and more recent data collected since April 2018. This review does not include any groundwater monitoring data from new groundwater monitoring wells, as Valley Water has not installed any new wells. Nonetheless, based on the review, staff have determined the following:

1. The Facility discharge does not meet the criteria to obtain coverage under Oil Field General Order Two or Oil Field General Order Three.
2. Valley Water would likely need to significantly modify its discharge to comply with waste discharge requirements implementing the Basin Plan, which would require regulation under an individual order.

If Valley Water could not demonstrate to the Board that it would be able to comply with applicable requirements to be sufficiently protective of groundwater beneficial uses, it lies within the Board's discretion to order that discharges from the Facility cease and desist. Board staff have therefore prepared for Board consideration a Cease and Desist Order pursuant to Water Code section 13301. The Cease and Desist Order requires Valley Water to:

1. Cease and desist from discharging produced wastewater in violation and threatened violation of WDR Resolution No. 69-199 and the *Water Quality Control Plan for the Tulare Lake Basin* according to a specific schedule.
2. Submit by **1 October 2019**, implement work plans already approved by Board staff and to:
 - a. complete the ongoing hydrogeological investigation to fully characterize the nature and lateral and vertical extent of the release of the plume;
 - b. identify each potential Constituent of Concern in the discharges to the Facility ponds and propose concentration limits in groundwater for each Constituent of Concern; and
 - c. identify and sample water supply wells located within 2.5 miles of the Facility and analyze the samples for Constituents of Concern.
3. Submit by **1 January 2020**:
 - a. a complete Report of Waste Discharge based on the information acquired during the *Work Plan for the McKittrick 1 & 1-3 Facility* that will ensure that future discharges at the McKittrick 1 & 1-3 Facility will be in compliance with the *Water Quality Control Plan for the Tulare Lake Basin*;
 - b. a **Closure Plan and Closure Time Schedule** for the wind-down and closure of any portions of the McKittrick 1 & 1-3 Facility that Valley Water Management Company determines are no longer to be used;

- c. a ***McKittrick 1 & 1-3 Facility Remediation Work Plan*** based on the hydrogeological investigation that describes a time schedule under which Valley Water Management Company will conduct groundwater, surface water, and/or soil remediation consistent with the corrective action program requirements of Title 27. This will entail the preparation of an engineering feasibility study followed by a proposed corrective action program.
4. Cease discharge to the McKittrick 1 & 1-3 facility on **1 July 2020** unless those discharges are in full compliance with waste discharge requirements issued by the Central Valley Water Board.

Valley Water owns and operates the Facility. These discharges have degraded/polluted and/or threaten to degrade/pollute groundwater downgradient of the Facility. The reports and actions proposed by the Cease and Desist Order are necessary to define the lateral and vertical extent of the plume migrating from the Facility, to ensure the Discharger complies with the requirements of this Order; and to ensure that Valley Water brings the Facility into compliance with WDRs Resolution No. 69-199, MRP Order R5-2018-808, the Basin Plan and the Water Code to assure protection of waters of the state.

CONCLUSIONS AND RECOMMENDATIONS

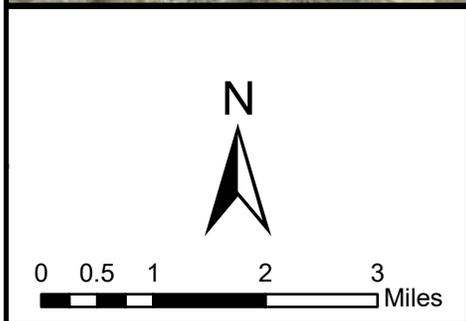
Valley Water's McKittrick 1 & 1-3 Facility ponds are the source of a plume of highly saline produced wastewater that exceeds for several constituents water quality objectives necessary to support locally designated beneficial uses of MUN and AGR. AGR is an existing beneficial use in the area, and more importantly, immediately downgradient of the Facility. Staff believes the plume has migrated beyond Valley Water's groundwater monitoring well network and downgradient and down-structure at least 2.2 miles (to well MW-148I) in the upper Tulare and 1.9 miles (to well MW-102RL) in the deeper Tulare. The plume has caused the water in MW-148I to exceed MUN and AGR water quality objectives for TDS and chloride and water in MW-102RL to exceed MUN water quality objectives for chloride. These wells are screened in aquifers that supply local agricultural wells a short distance from the Facility. Staff believes there is a good chance that produced wastewater traveling through channels of coarse grained materials has migrated from the Valley Water Facility far beyond the Clean Harbors facility, but it has not been detected due to limitations associated with the existing groundwater monitoring network. Progress on the expansion of Valley Water's groundwater monitoring network has not proceeded according to anticipated timeframes, though endangered species issues are partially responsible for the delays.

Given the close proximity of groundwater down-structure with an existing AGR beneficial use, the depositional environment of underlying sediments, the high salinity and boron of the produced wastewater, and the unknown limits of the expanse of the plume migrating to the northeast, Board staff do not believe the Facility discharge meets the requirements to be regulated under any of the Oil Field General Orders for Oil Field

STAFF REPORT
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

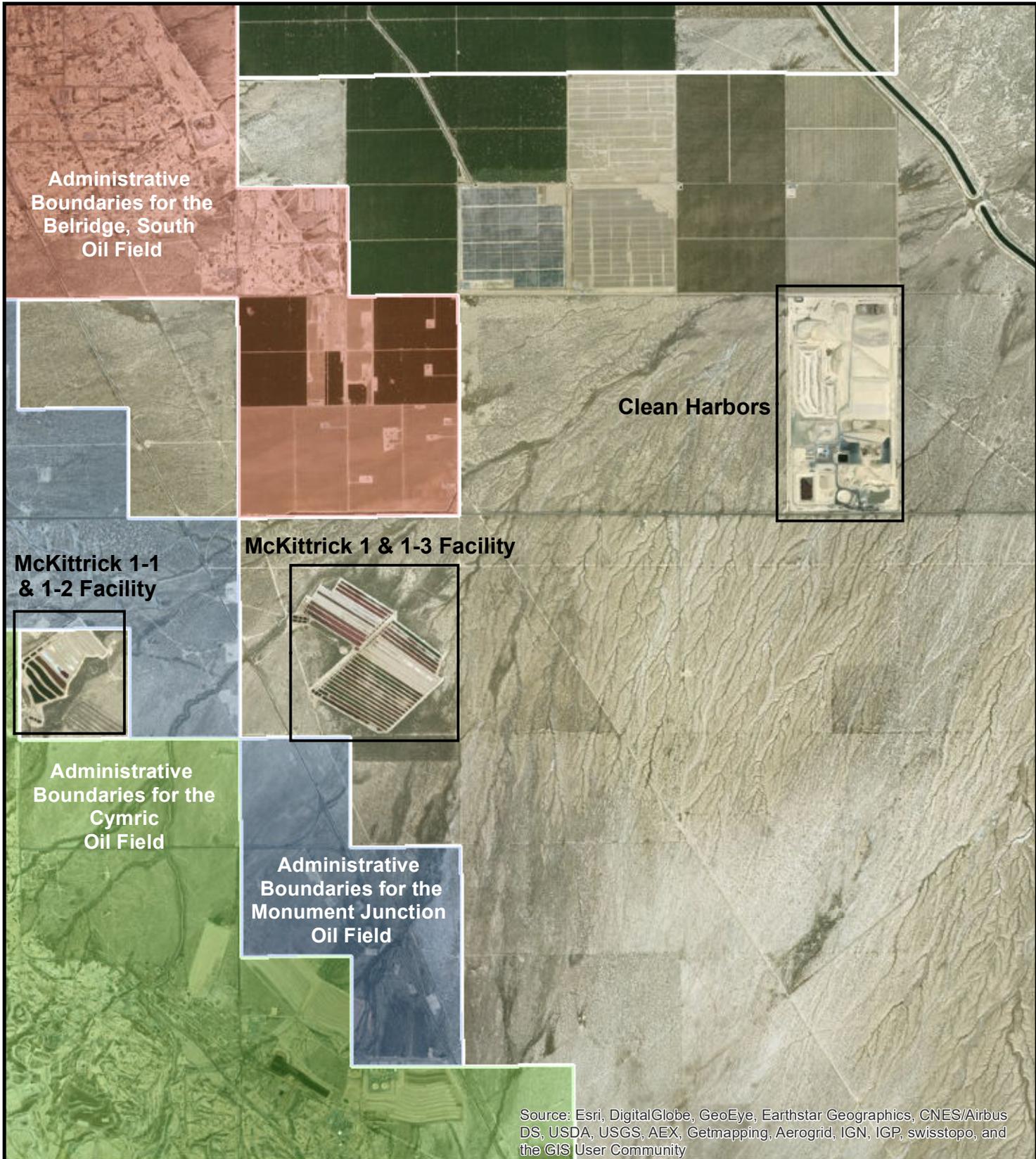
-26-

Discharges to Land. However, discharges from the facility may be permitted under a set of individual waste discharge requirements, provided that Valley Water takes adequate measures to ensure the protection of groundwater beneficial uses. This would likely include the modification and upgrading of Valley Water's wastewater discharge infrastructure. The proposed Cease and Desist Order is necessary to ensure that Valley Water completes the characterization of the plume and modifies its discharge so that it complies with the Water Quality Control Plan for the Tulare Lake Basin and protects the beneficial uses of groundwater downgradient of the Facility.



EXTENDED VIEW OF THE MCKITTRICK 1 & 1-3 FACILITY
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT A

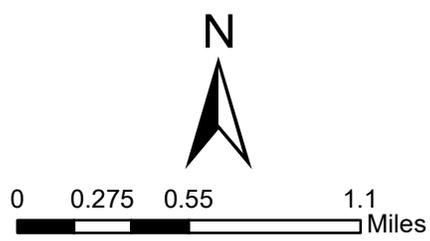


SITE MAP OF THE MCKITTRICK 1 & 1-3 FACILITY AND PROXIMITY TO OIL FIELDS

STAFF REPROT
FOR

VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT B



- a. Golder Associates Inc. February 2019. Valley Water Management Company, McKittrick 1 and 1-3 Second Semi-Annual Monitoring Report 2018.
- b. Golder Associates Inc. November 2018. VWMC McKittrick Q3 Sampling Event file 3– GeoTracker Electronic Deliverable Format (EDF).
- c. Golder Associates Inc. November 2018. VWMC McKittrick Q3 Sampling Event file 2 – GeoTracker EDF.
- d. Golder Associates Inc. November 2018. VWMC McKittrick Q3 Sampling Event – GeoTracker EDF.
- e. McCormick Biological, Inc. November 2018. Biological Evaluation for Newly Proposed Alternative Well Locations for Valley Water Management Cymric Well Expansion, Kern County, California.
- f. McCormick Biological, Inc. October 2018. Biological Evaluation for Proposed Valley Water Management Cymric Well Locations, Kern County, California.
- g. Central Valley Water Board Staff. September 2018. Order Pursuant to California Water Code Section 13267.
- h. Kennedy/Jenks Consultants. August 2018. Revised Monitoring Well Installation and Sampling Plan for the Valley Water Management Company McKittrick Ponds Facility, Cymric Oil Field, California.
- i. Golder Associates Inc. August 2018. Valley Water Management Company McKittrick 1 and 1-3 First Semi-Annual Monitoring Report 2018.
- j. Central Valley Water Board Staff. July 2018. Review of Monitoring Well Installation and Sampling Plan
- k. Kennedy/Jenks Consultants. June 2018. Monitoring Well Installation and Sampling Plan for the Valley Water Management Company McKittrick Ponds Facility, Cymric Oil Field, California.
- l. Central Valley Water Board, April 2018. Resolution R-5-2018-0015
- m. Audio of Central Valley Water Board Meeting, 5 April 2018. Valley Water Management Presentation for Resolution R-5-2018-0015
- n. Central Valley Water Board Staff, April 2018. 13267 Monitoring and Reporting Program No. R5-2018-0808
- o. Catalyst Environmental Solutions. January 2018. Presentation meeting handout. Valley Water Groundwater Infiltration Modeling Preliminary Results January 10, 2018.
- p. WSP USA. October 2017. Valley Water Management Company, Cymric Area Sampling and Analysis Report, First Semi-Annual 2017.
- q. Valley Water Management Company. July 2017. Request for Rescission of Monitoring and Reporting Program Order No. R5-2017-0806.
- r. WSP | Parsons Brinckerhoff. January 2017. Valley Water Management Company, 2016 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- s. Schlumberger Water Services. September 2016. Valley Water Management Company, 2016 First Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- t. Schlumberger Water Services. April 2016. Valley Water Management Company, 2015 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- u. Schlumberger Water Services. August 2015. Valley Water Management Company, 2015 First Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- v. South Valley Biological Consulting LLC. January 2016. Biological Report for the Valley Water Management Cymric Water Monitoring Well Project.
- w. Valley Water Management Company. December 2015. Letter: Response to Notice of Violation (NOV) regarding the 13267 Order.
- x. Central Valley Water Board Staff. November 2015. Notice of Violation - Failure to Furnish Complete Technical Report, Valley Water Management Company.

	<p>DOCUMENTS LIST STAFF REPORT FOR VALLEY WATER MANAGEMENT COMPANY MCKITTRICK 1 & 1-3 FACILITY KERN COUNTY</p> <p style="text-align: right;">ATTACHMENT C</p>
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- y. Valley Water Management Company. June 2015. Technical report a summary table presenting analytical data as required by Central Valley Regional Water Quality Control Board's order (Order) under the California Water Code Directive Pursuant to Section 13267, dated April 1, 2015 and received by Valley Water Management Company on April 6, 2015.
- z. Central Valley Water Board Staff. April 2015. California Water Code Directive Pursuant to Section 13267.
- aa. Schlumberger Water Services. February 2015. Valley Water Management Company, 2014 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- bb. Central Valley Water Board Staff, January 2015. Review of Modified Monitoring Well Installation Work Plan.
- cc. Kennedy/Jenks Consultants. January 2015. Proposed Modifications to the McKittrick Ponds – Cymric Oil Field Work Plan.
- dd. Kennedy/Jenks Consultants and Schlumberger Water Services. November 2014. Monitoring Well Installations Work plan for the McKittrick Ponds, Cymric Oil Field. California.
- ee. Schlumberger Water Services. February 2014. Valley Water Management Company, 2013 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- ff. Schlumberger Water Services. October 2013. Valley Water Management Company, First Semi-Annual 2013 Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- gg. Schlumberger Water Services. October 2012. Valley Water Management Company, 2012 Second Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- hh. Schlumberger Water Services. August 2012. Valley Water Management Company, First Semi-Annual 2012 Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- ii. Schlumberger Water Services. October 2011. Valley Waste Disposal Company, Second Semi-Annual 2011 Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- jj. Schlumberger Water Services. July 2011. Valley Waste Disposal Company, 2011 Semiannual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- kk. Schlumberger Water Services. September 2010. Valley Water Waste Disposal Company, 2010 Semi-Annual Sampling and Analysis Report, McKittrick 1 and 1-3 Ponds Cymric Area.
- ll. Central Valley Water Board Staff, December 2009. Review of Sampling and Analysis for Pond Water and Groundwater Monitoring Wells Located at the Cymric Study area.
- mm. Schlumberger Water Services. February 2010. Sampling and Analysis Plan for Pond water and Groundwater Monitoring Wells Located at the Cymric Study Area, Operated by Valley Waste Disposal Company.
- nn. Central Valley Water Board Staff, August 2009. Review of Phase II Hydrogeologic Characterization Report.
- oo. Geomega Inc. April 2007. Phase II Hydrogeologic Characterization Report Valley Waste Disposal Company, Cymric Field Study area.
- pp. Central Valley Water Board Staff, March 2005. Review of Phase II Hydrogeologic Characterization work plan.
- qq. Geomega Inc. March 2005. Revised Borehole/ Monitoring Well Locations, Valley Waste Disposal Company, Cymric Field Phase II Hydrogeologic Investigation.
- rr. Geomega Inc. February 2005. Workplan – Phase II Hydrogeologic Characterization Valley Waste Disposal Company, Cymric Field (Phase II Workplan).
- ss. Central Valley Water Board Staff, August 2004. Review of Hydrogeologic Characterization Report.
- tt. Geomega Inc. September 2003. Hydrogeologic Characterization Report Valley Waste Disposal Company, Cymric Field Study area (Phase I).

DOCUMENTS LIST
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT C

- uu. RWQCB Staff. August 2001. Review of: Hydrogeologic Characterization Workplan, Valley Waste Disposal Company, Cymric Field
- vv. Geomega Inc. June 2001. Hydrogeologic Characterization Workplan, Valley Waste Disposal Company, Cymric Field (Phase I Workplan).
- ww. Valley Waste Disposal Company. April 2001. Fax Re: Cymric / McKittrick Plots
- xx. RWQCB Staff. April 2001. Review memo of: Surface Geophysical Survey Report – McKittrick 1 & 1-3, Ponds (Sec. 19/R29S/T22E), Kern County, California.
- yy. Strata Geophysical, Inc. November 2000. Electrical Geophysical Survey, Valley Waste Disposal Company, Percolation Ponds McK 1 & McK 1-3, Kern County, California.

OTHER DOCUMENTS EVALUATED FOR THIS PROJECT WERE:

- zz. Clean Harbors Buttonwillow, LLC. Quarterly Monitoring reports from third quarter 2005 through fourth quarter 2018 prepared by Cameron-Cole.
- aaa. GeoTracker GAMA (Groundwater Information System), Water Supply Well KERN-23, USGS Data Display.
- bbb. Aera Energy LLC
 Belridge Area, Structure Map, Top of 22K Sand (Color, 32" x 38")
 Belridge Area, Structure Map, Base of Upper Tulare Clay (Color, 24" x 32")
 Southern Belridge Area, Structure Map, Top of 22K Sand (Color, 18" x 30")
 Geophysical Logs from Starrh and Starrh Cotton Growers (SSCG) water supply wells WW-1, WW-2, WW-3, WW-4, WW-6, WW-7, and WW-9
 Geophysical Log for monitoring well MW-2
 Table of SSCG Well Completions Information [DLW's approx. Lat/Long and Ground Elevation of the SSCG wells determined using Google Earth Pro has been added to the Table because the surveyed location and elevation coordinates for the SSCG wells are not available]
- ccc. California Department of Water Resources
 Well Completion Reports for SSCG wells WW-1, WW-2, WW-3, WW-4, WW-6, WW-7, and WW-9
- ddd. Belridge Water Storage District
 Table 2 (Wells Sampled in May 2013) from *Westside Districts Groundwater Study*
- eee. Westside Water Quality Coalition
 Table 4 (Historical Analytical Results for Mineral/Metal Constituents in Unconfined/Semi-Confined Groundwater) from *Basin Plan Amendment Work Plan*
- fff. Defendant's Exhibit from Kern County Superior Court, SSCG versus Aera Energy LLC
 Defendant's Exhibit # 2001 (SSCG Irrigation and Monitoring Wells – Summary of 2003-2004 Analytical Results)
- ggg. Clean Harbors, Buttonwillow
 Figure W-1 (Facility Map with well locations) 1987 Hydro-Geologic Assessment Report
 Geophysical Logs for wells MW-S, MW-P, MW-G, West Side Water Well V, MW-F, MW-J, and MW-A (the approx. location of MW-S is on Figure 4 below)
 Plate 2 (Facility Map with well locations) 1991
 Plate 3 (Cross Sections B-B' and C-C') 1991
 Figure 4 (Cross Sections Location Map) 1991
 Geophysical Logs for wells/borings P-101, B-114, P-154L, P-156L, and MW-149I
 Color Soil Boring/Well Construction Log for well MW-PRL, drilled in 2010

DOCUMENTS LIST

STAFF REPORT

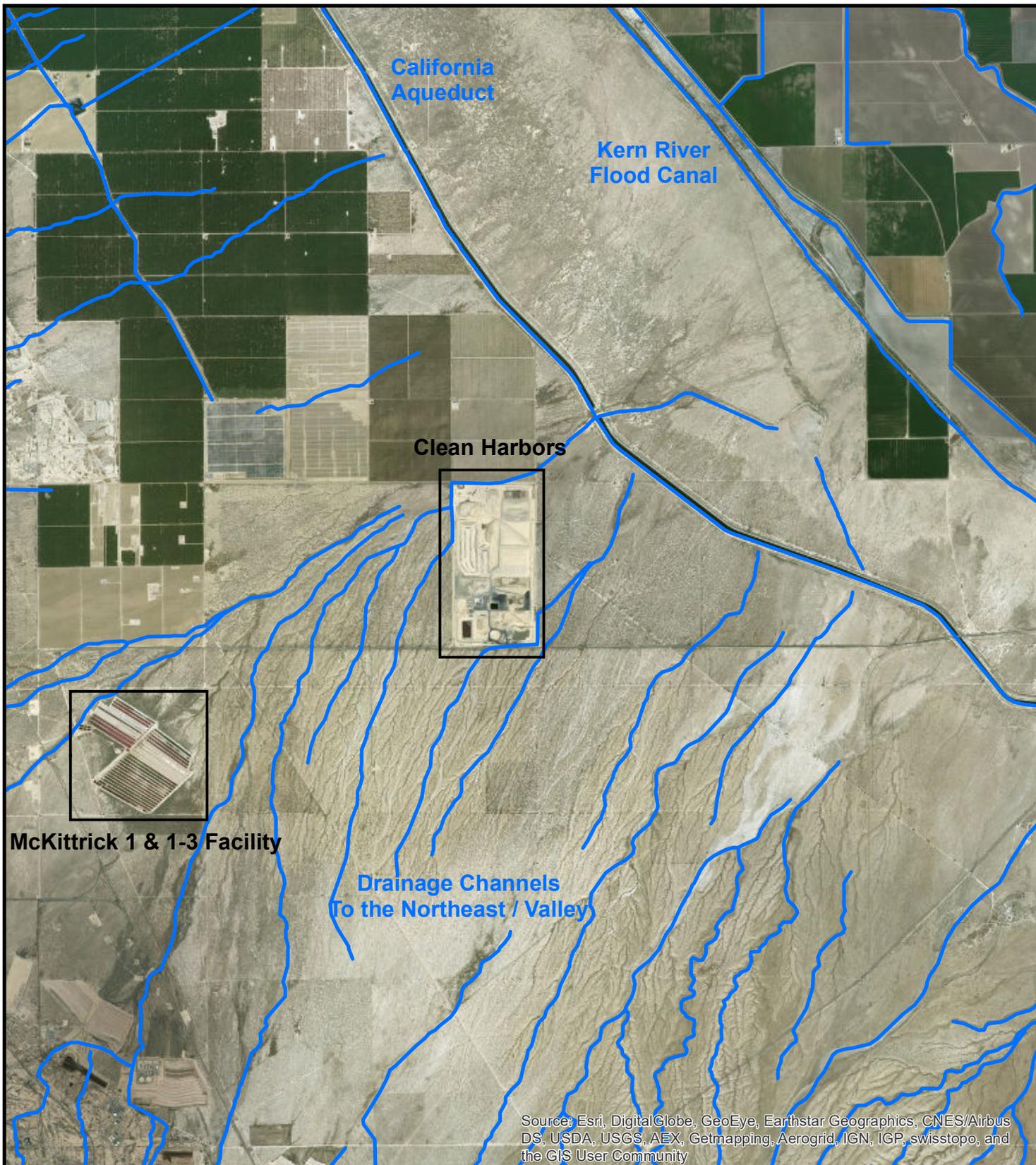
FOR

VALLEY WATER MANAGEMENT COMPANY

MCKITTRICK 1 & 1-3 FACILITY

KERN COUNTY

ATTACHMENT C



Drainage Data Originates From The Department of Water Resources



0 0.375 0.75 1.5 Miles

MAP OF SURFACE DRAINAGE CHANNELS TO THE VALLEY

STAFF REPORT

FOR

VALLEY WATER MANAGEMENT COMPANY

MCKITTRICK 1 & 1-3 FACILITY

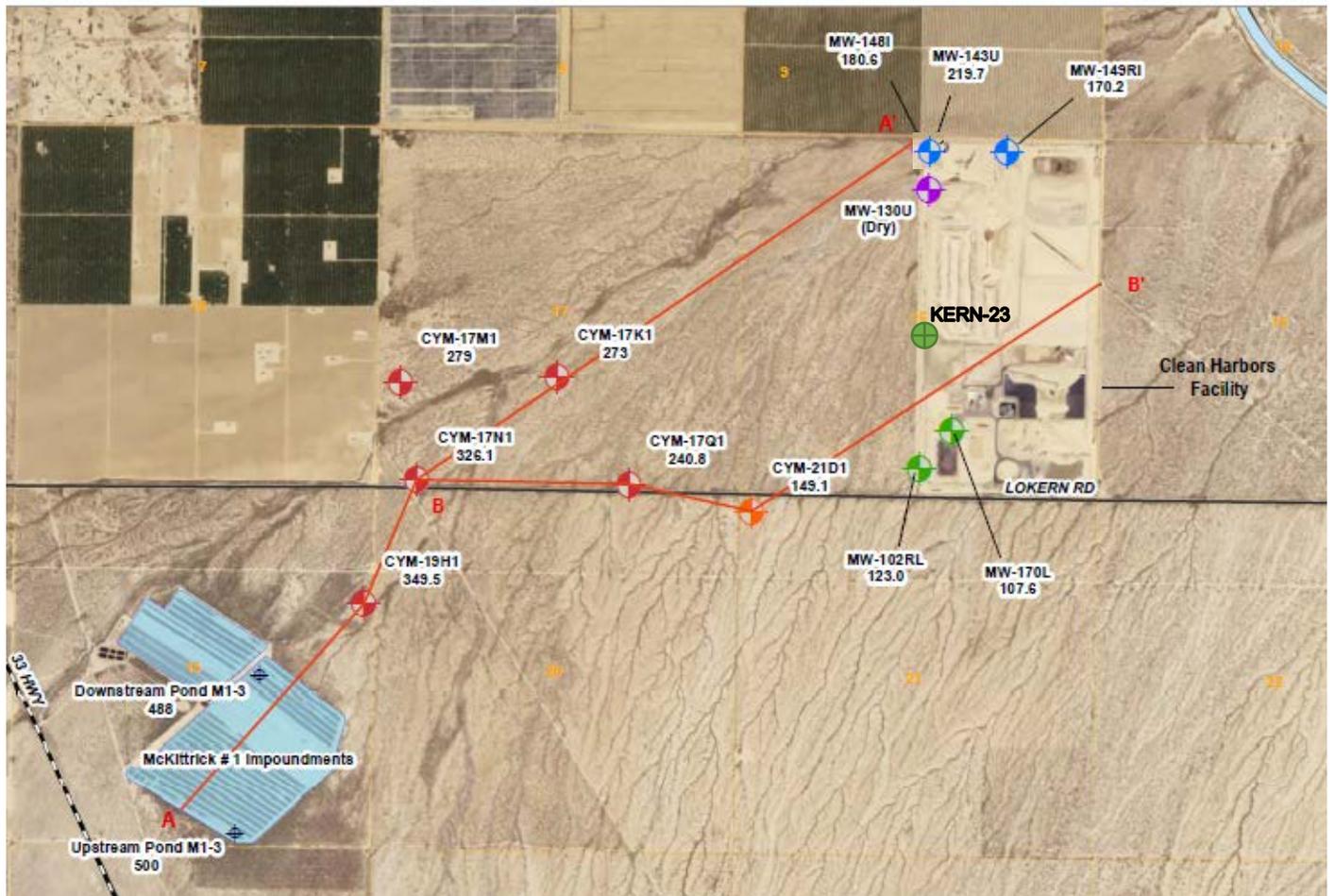
KERN COUNTY

ATTACHMENT D

Facility	Data Source	Document Date	Volumes (barrels / day)
McKittrick 1 & 1-3	Valley Water Management Company Second Semi-Annual Monitoring Report (2018)	February 2019	47,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2018)	August 2018 Corrected February 2019	38,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2017)	March 2018	58,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2017)	October 2017	42,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2016)	January 2017	66,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2014)	February 2015	105,000
	Central Valley Water Board Inspection Report	May 16, 2014	101,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2013)	February 2014	60,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2013)	October 2013	60,000
	Central Valley Water Board Inspection Report	April 6, 2012	60,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2012)	October 2012	60,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2012)	August 2012	60,000
	Central Valley Water Board Inspection Report	April 8, 2011	60,000
	Valley Water Management Company Second Semi-Annual Monitoring Report (2012)	October 2011	50,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2011)	July 2011	50,000
	Central Valley Water Board Inspection Report	March 26, 2010	65,000
	Valley Water Management Company First Semi-Annual Monitoring Report (2010)	September 2010	65,000
	Central Valley Water Board Inspection Report	March 27, 2009	115,000
	Central Valley Water Board Inspection Report	April 11, 2008	100,000
	Central Valley Water Board Inspection Report	March 30, 2007	100,000
	Central Valley Water Board Inspection Report	April 21, 2006	100,000
	Central Valley Water Board Inspection Report	May 13, 2005	100,000
	Central Valley Water Board Inspection Report	March 23, 2004	45,000
	Central Valley Water Board Inspection Report	April 11, 2003	65,000
Central Valley Water Board Inspection Report	May 10, 2002	65,000	
Valley Water Management Company Fax to the Central Valley Water Board	April 19, 2001	70,000	
Central Valley Water Board	June 19, 1998	7,000	

FACILITY REPORTED FLOWS AND SOURCES
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT E



Explanation

Facility Monitoring Wells

- Upper Tulare
- Deeper Tulare

Clean Harbors Monitoring Wells

- Upper Perched Zone
- Intermediate Perched Zone
- Lower Water Tabled Zone



Pond Sample Points (WL elevation)



State Highway



Cross Sections

Cross sections A – A' and B – B' are presented in Attachment F.2



PLSS Sections



Lower Water Table Water Supply Well

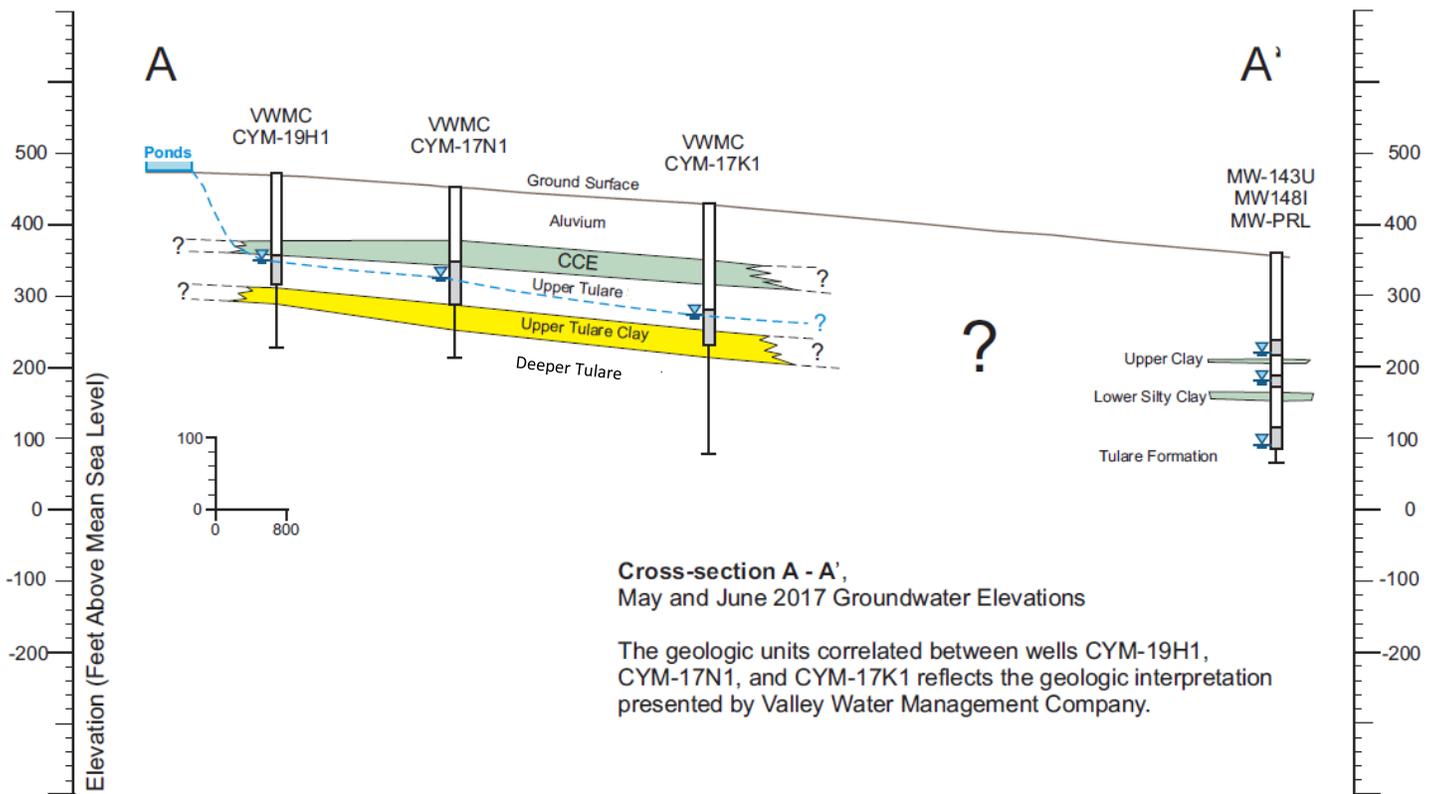
Source of Map:
Cymric Area Sampling and Analysis
Report (First Semi-Annual 2017)
By WSP USA



0 0.1 0.2 0.4 0.6 0.8
Miles

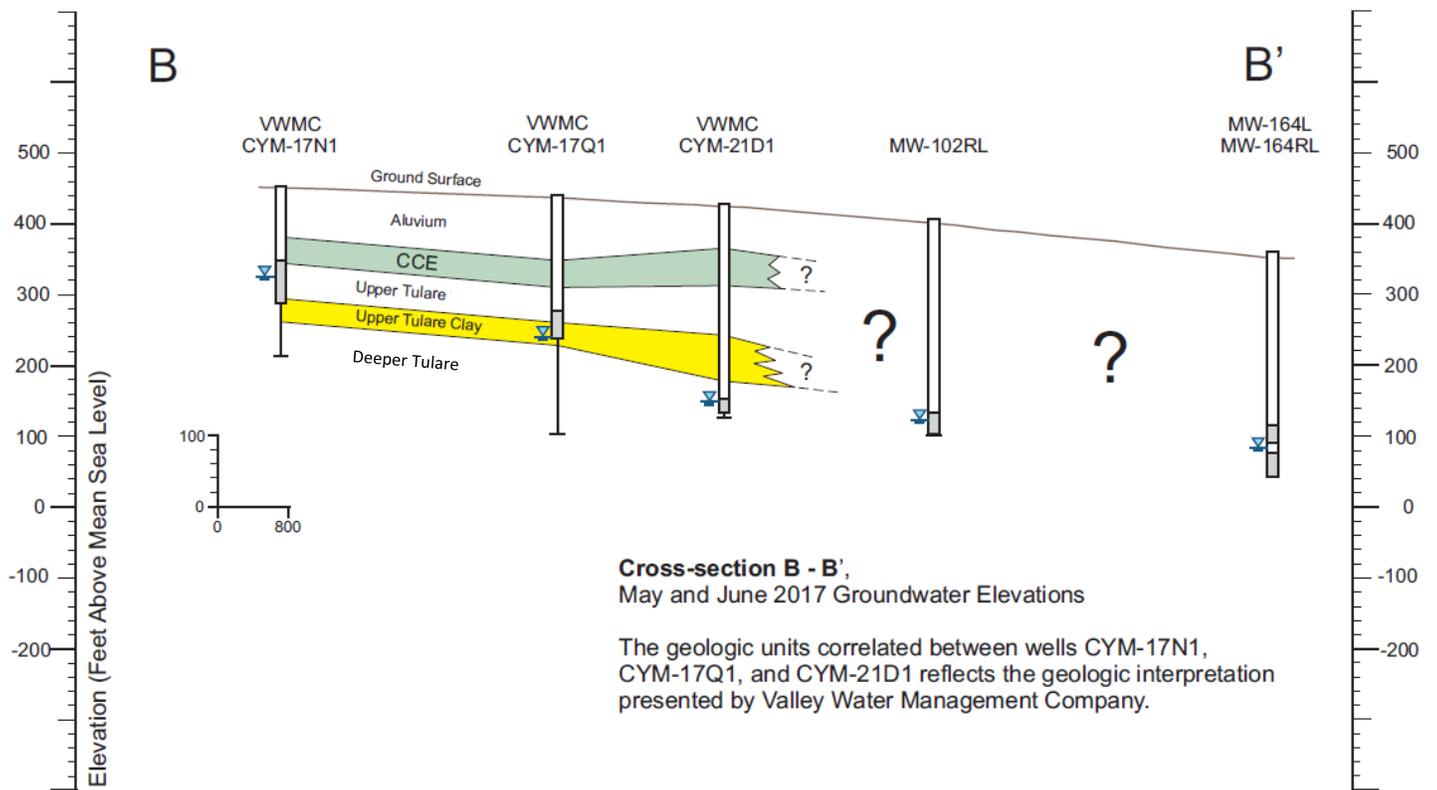
**SITE PLAN OF WELLS DOWNSTREAM
OF THE MCKITTRICK 1 & 1-3 FACILITY**
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

ATTACHMENT F.1



Cross-section A - A',
May and June 2017 Groundwater Elevations

The geologic units correlated between wells CYM-19H1, CYM-17N1, and CYM-17K1 reflects the geologic interpretation presented by Valley Water Management Company.



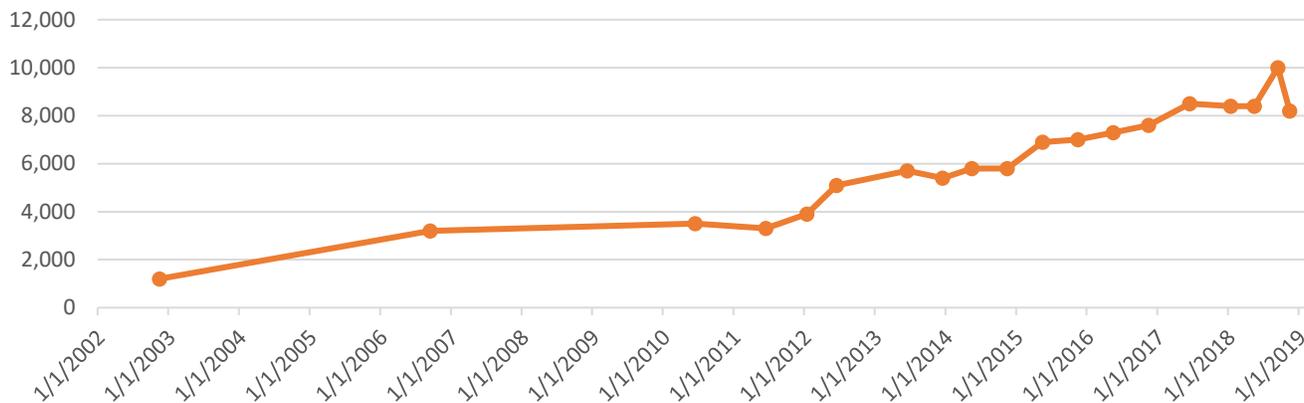
Cross-section B - B',
May and June 2017 Groundwater Elevations

The geologic units correlated between wells CYM-17N1, CYM-17Q1, and CYM-21D1 reflects the geologic interpretation presented by Valley Water Management Company.

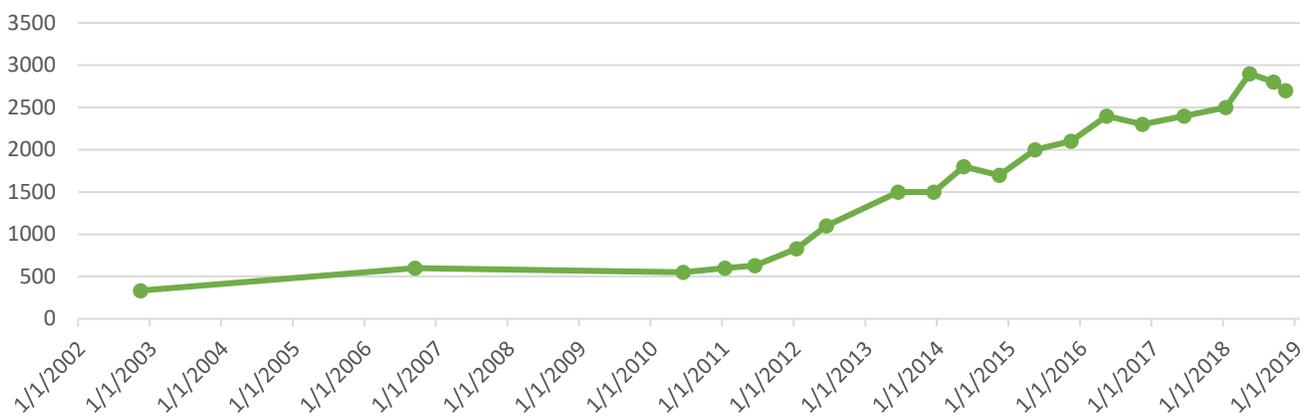
Data Originates From Groundwater
Self-Monitoring Reports
Prepared By WSP USA
On Behalf Of
Valley Water Management
Company

CROSS SECTION OF THE MCKITTRICK 1 & 1-3 FACILITY
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

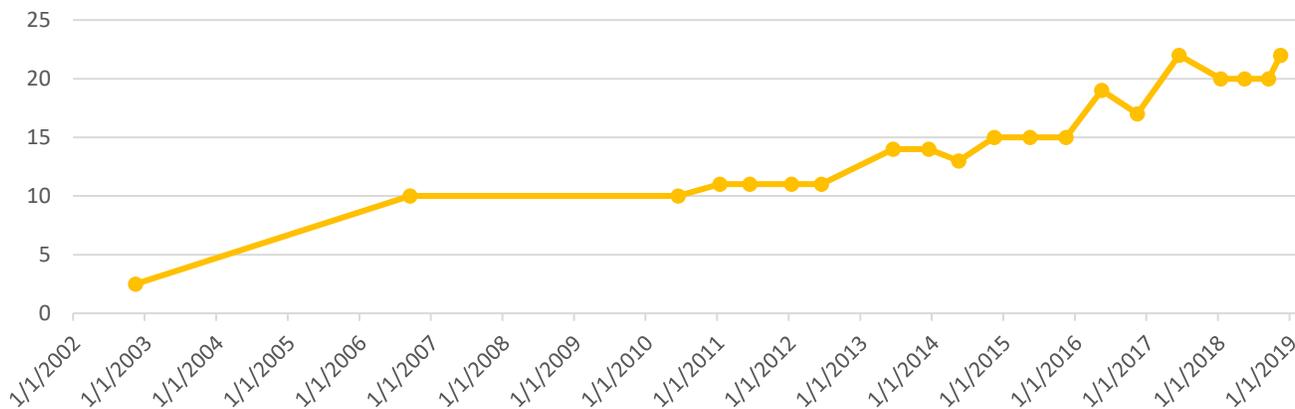
CYM-21D1 Total Dissolved Solids (mg/L)



CYM-21D1 Chloride (mg/L)



CYM-21D1 Boron (mg/L)

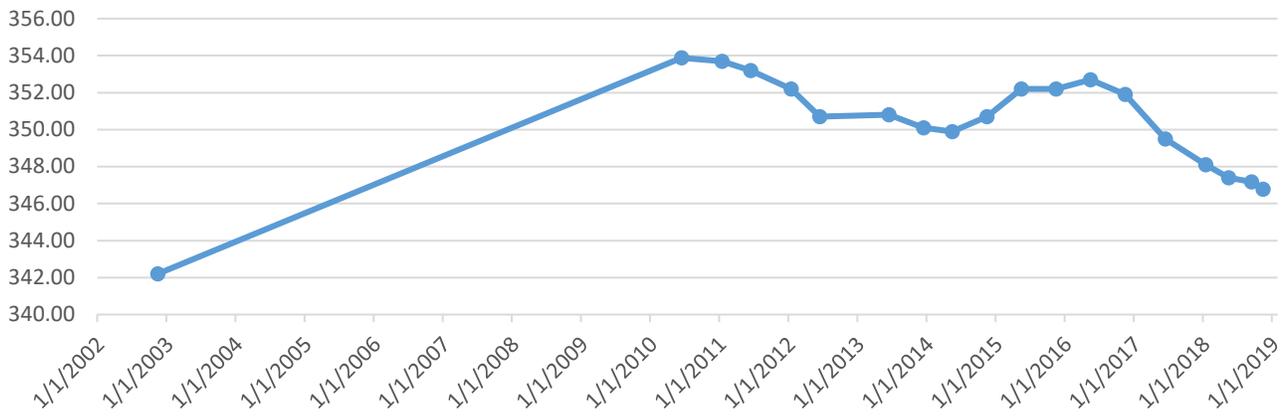


Data Originates from
Self-Monitoring Reports
submitted by or on behalf of
Valley Water Management
Company
2002 through February 2019

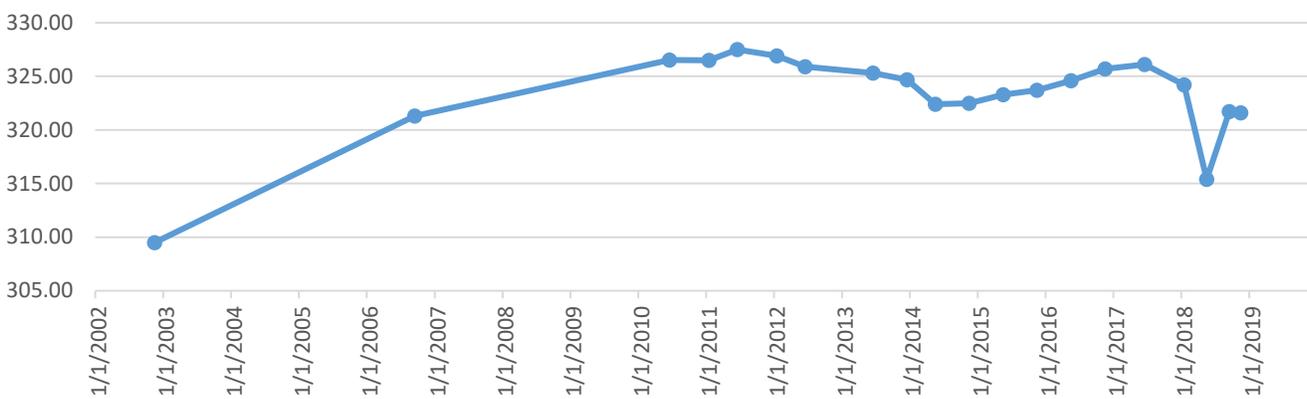
**TOTAL DISSOLVED SOLIDS, CHLORIDE, AND BORON
CONCENTRATION TRENDS
FOR CYM-21D1 (REGIONAL AQUIFER)
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**

ATTACHMENT G

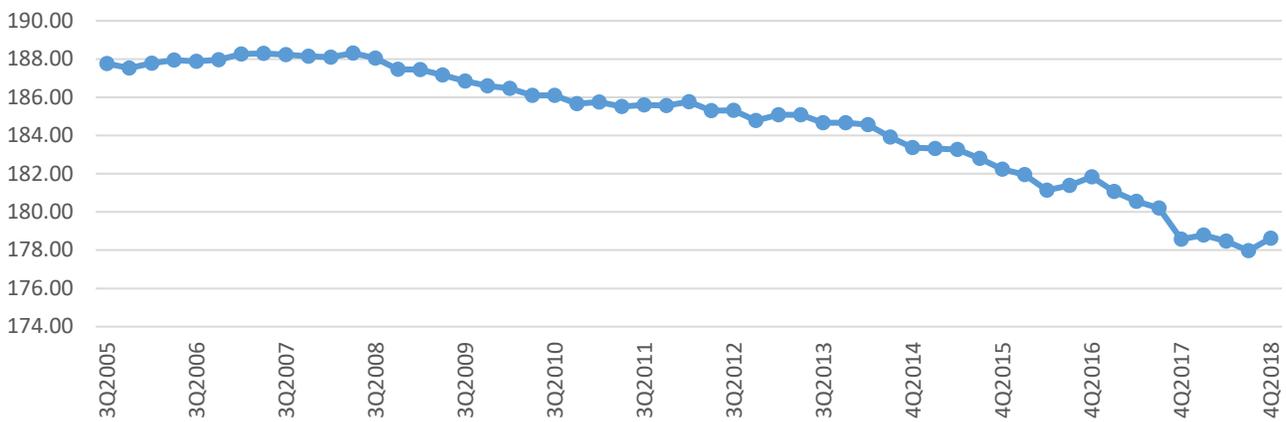
CYM-19H1 Groundwater Elevation in Feet Above Mean Sea Level



CYM-17N1 Groundwater Elevation in Feet Above Mean Sea Level



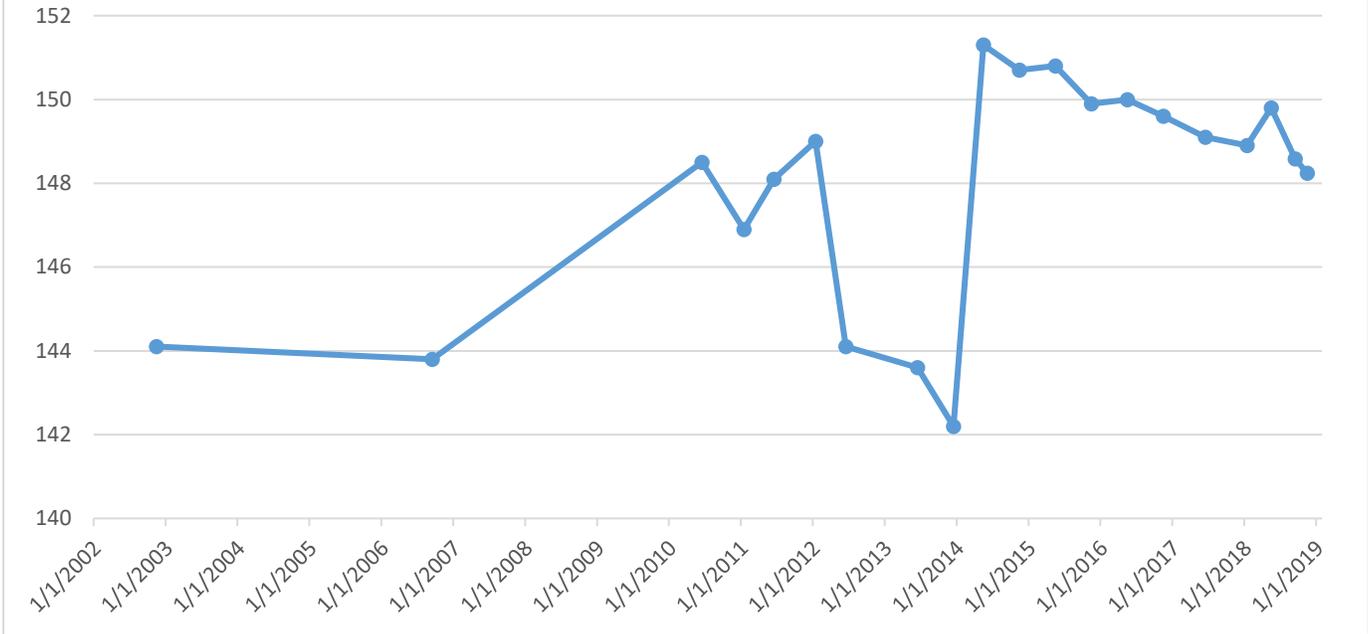
MW-148I GW Elevation in Feet Above Mean Sea Level



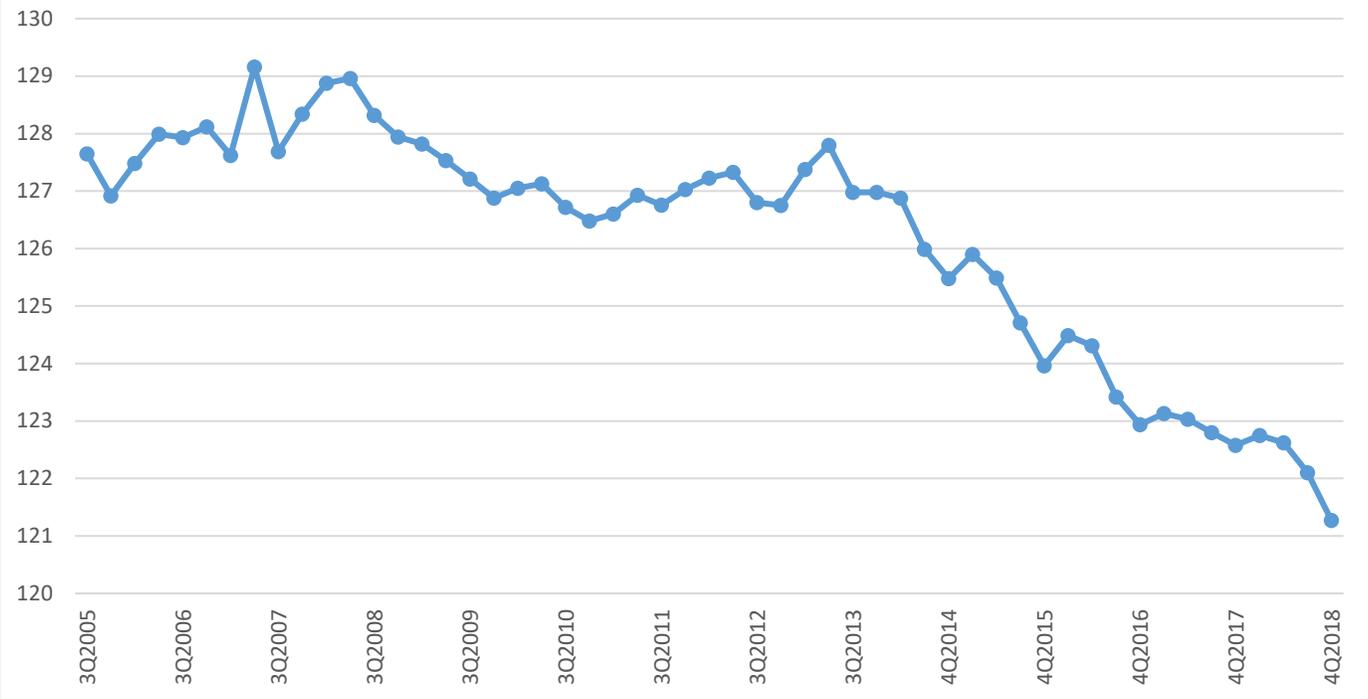
Data Originates From
Self-Monitoring Reports
Prepared by or on Behalf of
Valley Water Management Company
or Clean Harbors Buttonwillow, LLC.

**SHALLOW GROUNDWATER DEPTH TRENDS
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**

CYM-21D1 Groundwater Elevation in Feet Above Mean Sea Level

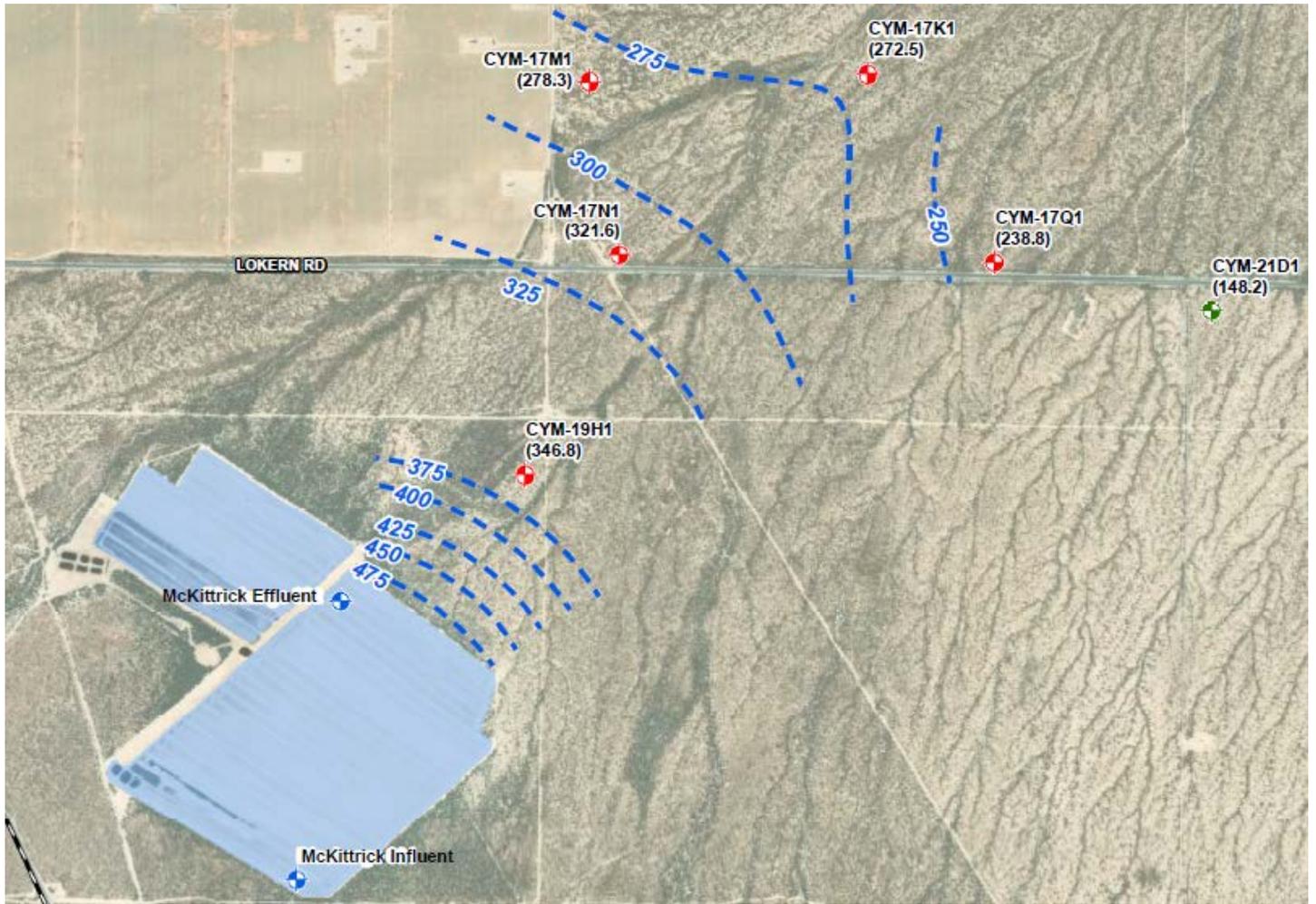


MW-102RL Groundwater Elevation in Feet Above Mean Sea Level



Data Originates From
Self-Monitoring Reports
Prepared by or on Behalf of
Valley Water Management
Company
or Clean Harbors Buttonwillow, LLC.

**DEEP GROUNDWATER DEPTH TRENDS
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**



Explanation

- GROUNDWATER ELEVATION, ft amsl
- + POND SAMPLE POINT
- + MONITORING WELL SCREENED IN THE UPPER TULARE SAND (GROUNDWATER ELEVATION, ft amsl)
- + MONITORING WELL SCREENED IN THE LOWER TULARE SAND (GROUNDWATER ELEVATION, ft amsl)

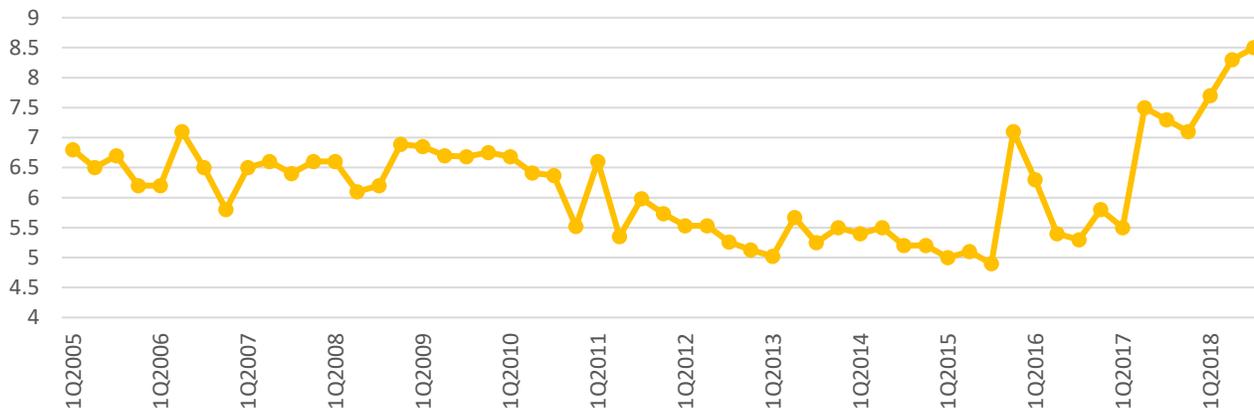


Source of Map:
Valley Water Management Company
(Second Semi-Annual 2018)
By Golder Associates Inc

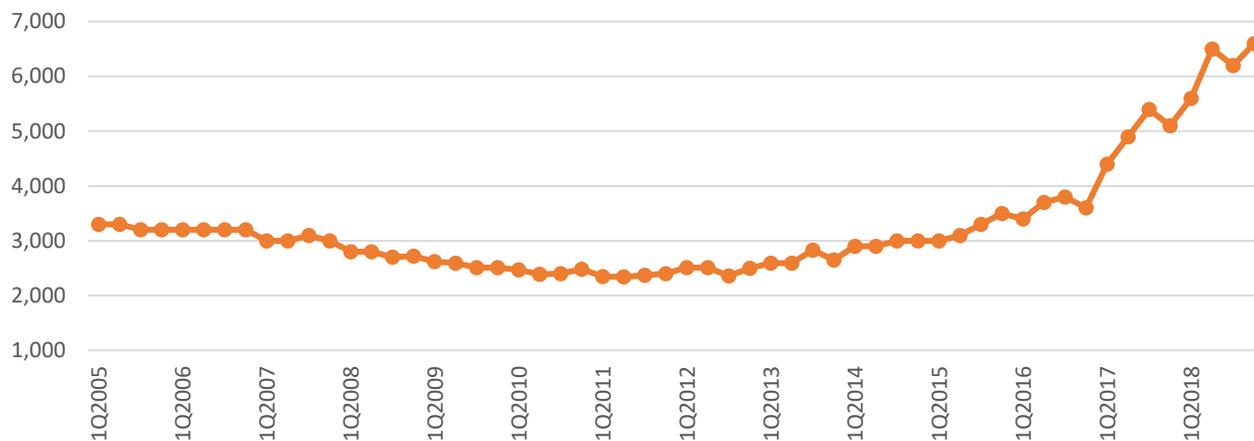
**UPPER TULARE
POTENTIOMETRIC SURFACE MAP
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**

ATTACHMENT I

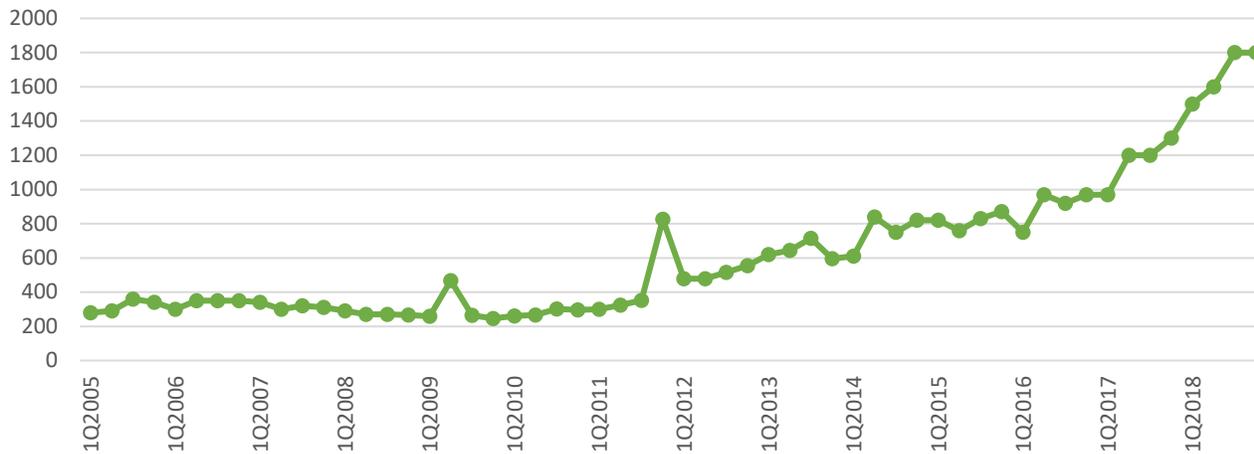
MW-148I Boron (mg/L)



MW-148I Total Dissolved Solids (mg/L)

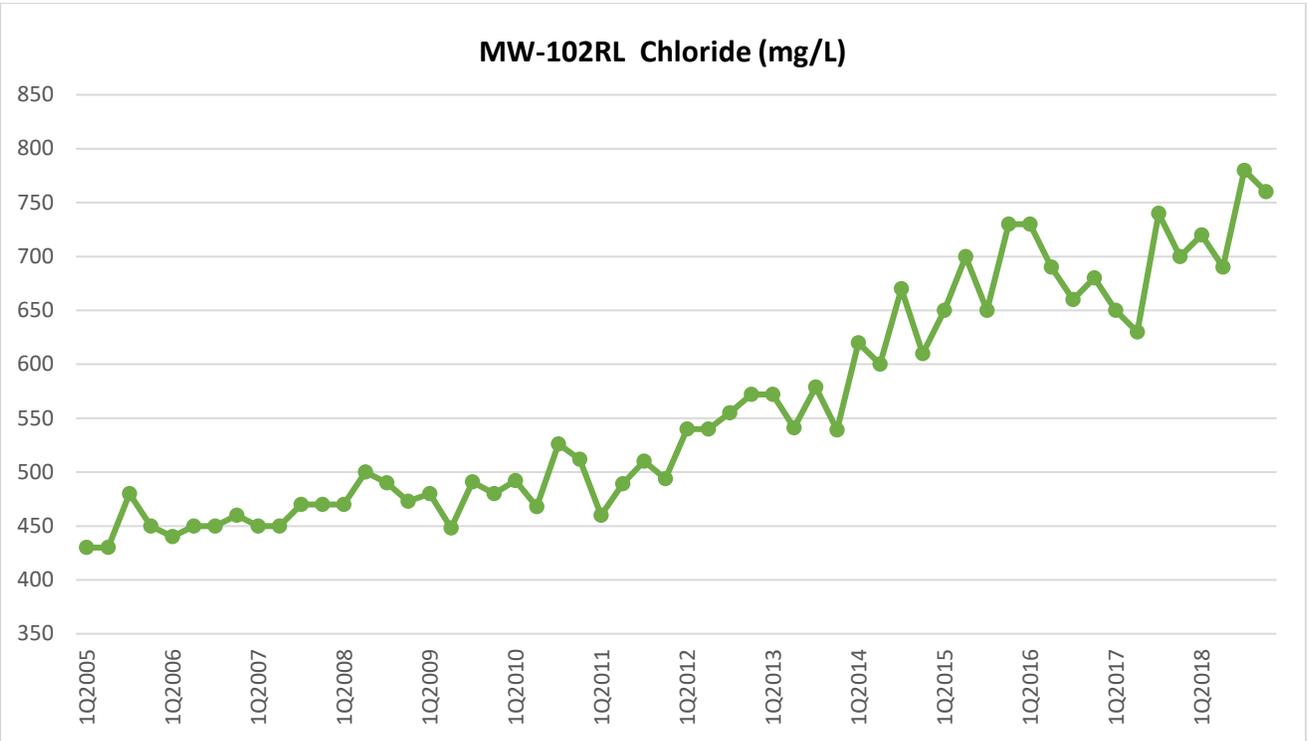
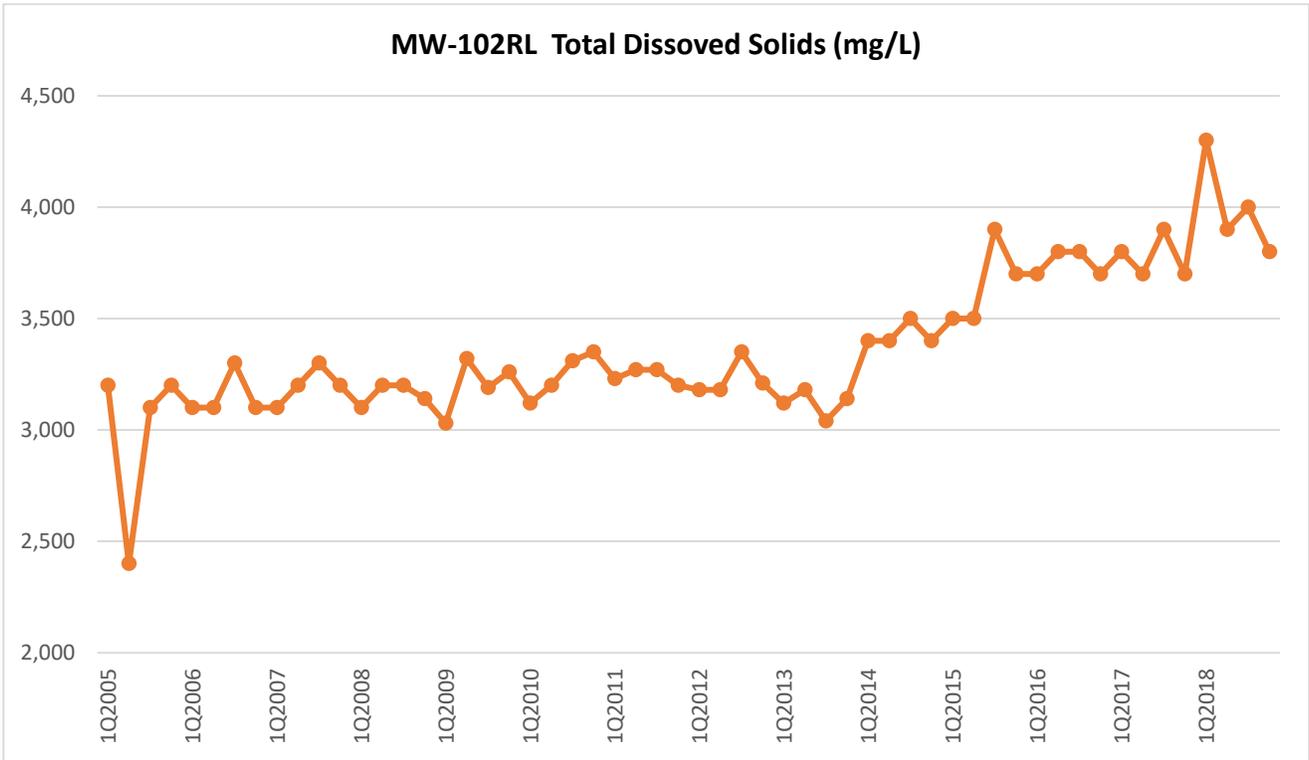


MW-148I Chloride (mg/L)



Data Originates From
Self-Monitoring Reports
Prepared by Cameron-Cole
on Behalf of
Clean Harbors Buttonwillow, LLC.
2005 through 2018

**CLEAN HARBORS CHEMICAL CONCENTRATION
TRENDS FOR MW-148I
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY ATTACHMENT J.1**

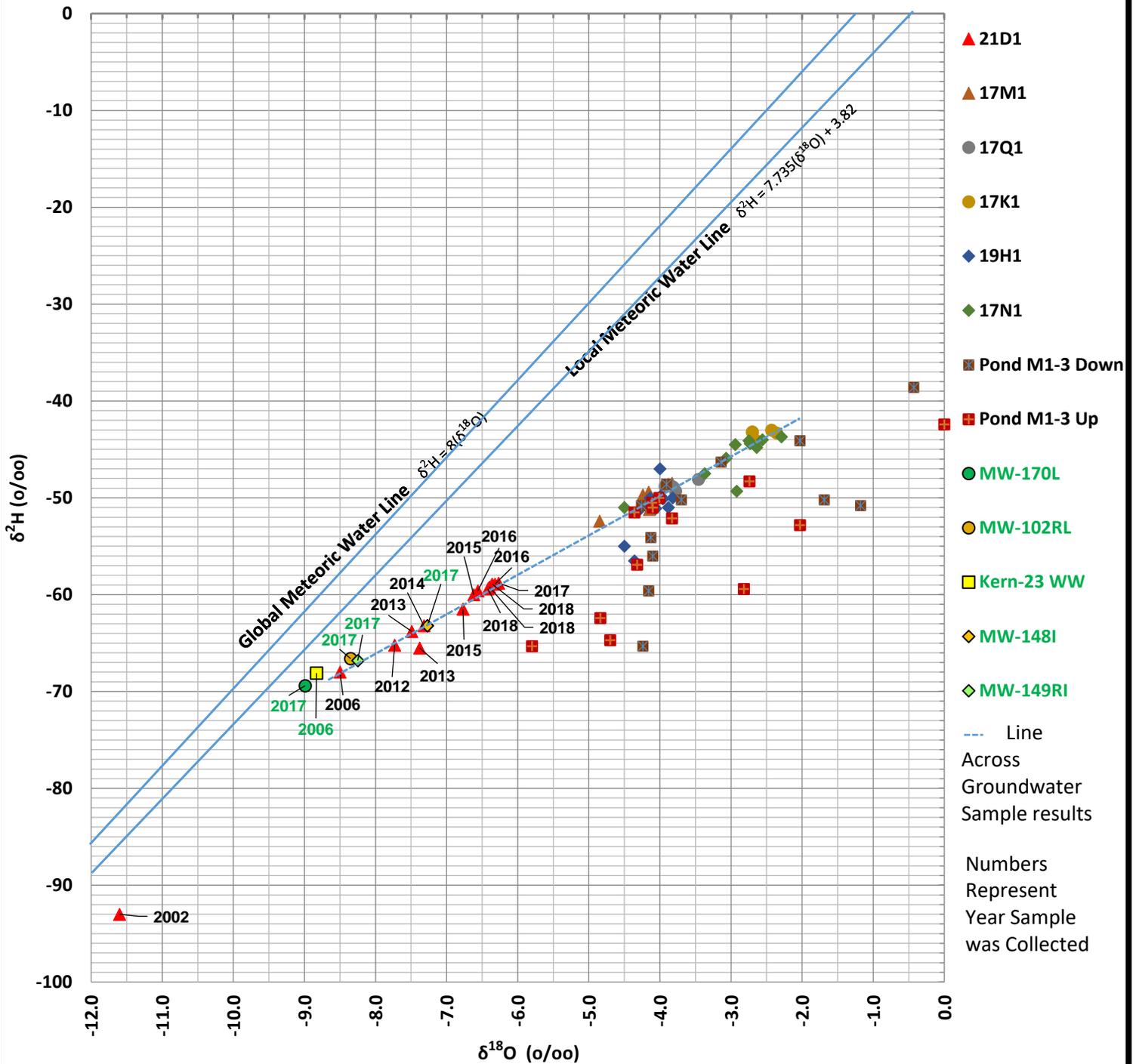


Data Originates From
 Self-Monitoring Reports
 Prepared by Cameron-Cole
 on Behalf of
 Clean Harbors Buttonwillow, LLC
 2005 through 2018

**CLEAN HARBORS CHEMICAL CONCENTRATION
 TRENDS FOR MW-102RL
 STAFF REPORT
 FOR
 VALLEY WATER MANAGEMENT COMPANY
 MCKITTRICK 1 & 1-3 FACILITY
 KERN COUNTY**

ATTACHMENT J.2

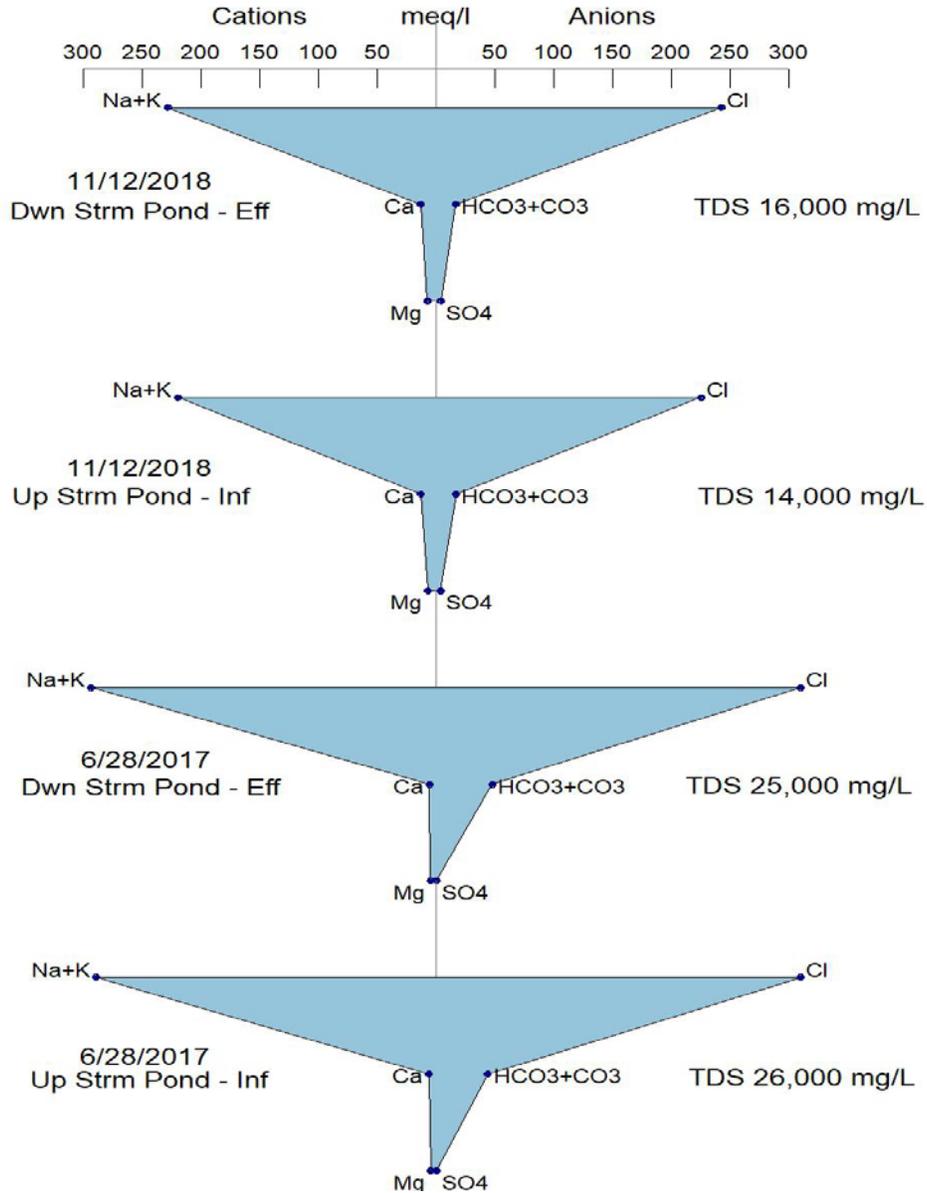
Valley Water Management Company, McKittrick 1 and 1-3 Ponds
 Oxygen and Hydrogen Stable Isotopes for Ponds and Six Monitoring Wells
 with Five Clean Harbors Wells



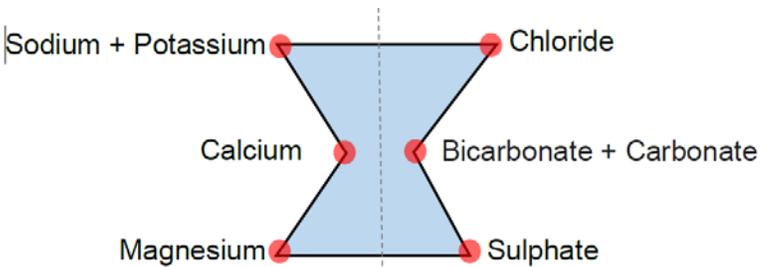
Local Meteoric Water Line determined from stable isotope data from 47 wells in *Ground-Water Quality Data in the Kern County Sub-Basin Study Unit, 2006-Results from the California GAMA Program: US Geological Survey Data Series 337*

STABLE ISOTOPE FIGURE OF PRODUCED WASTEWATER AND GROUNDWATER WELLS
 STAFF REPORT
 FOR
 VALLEY WATER MANAGEMENT COMPANY
 MCKITTRICK 1 & 1-3 FACILITY
 KERN COUNTY **ATTACHMENT K**

Stiff Diagram Valley Water Management Company Produced Wastewater



Explanation



STIFF DIAGRAMS OF VALLEY WATER MANAGEMENT COMPANY PRODUCED WASTEWATER

STAFF REPORT

FOR

VALLEY WATER MANAGEMENT COMPANY

MCKITTRICK 1 & 1-3 FACILITY

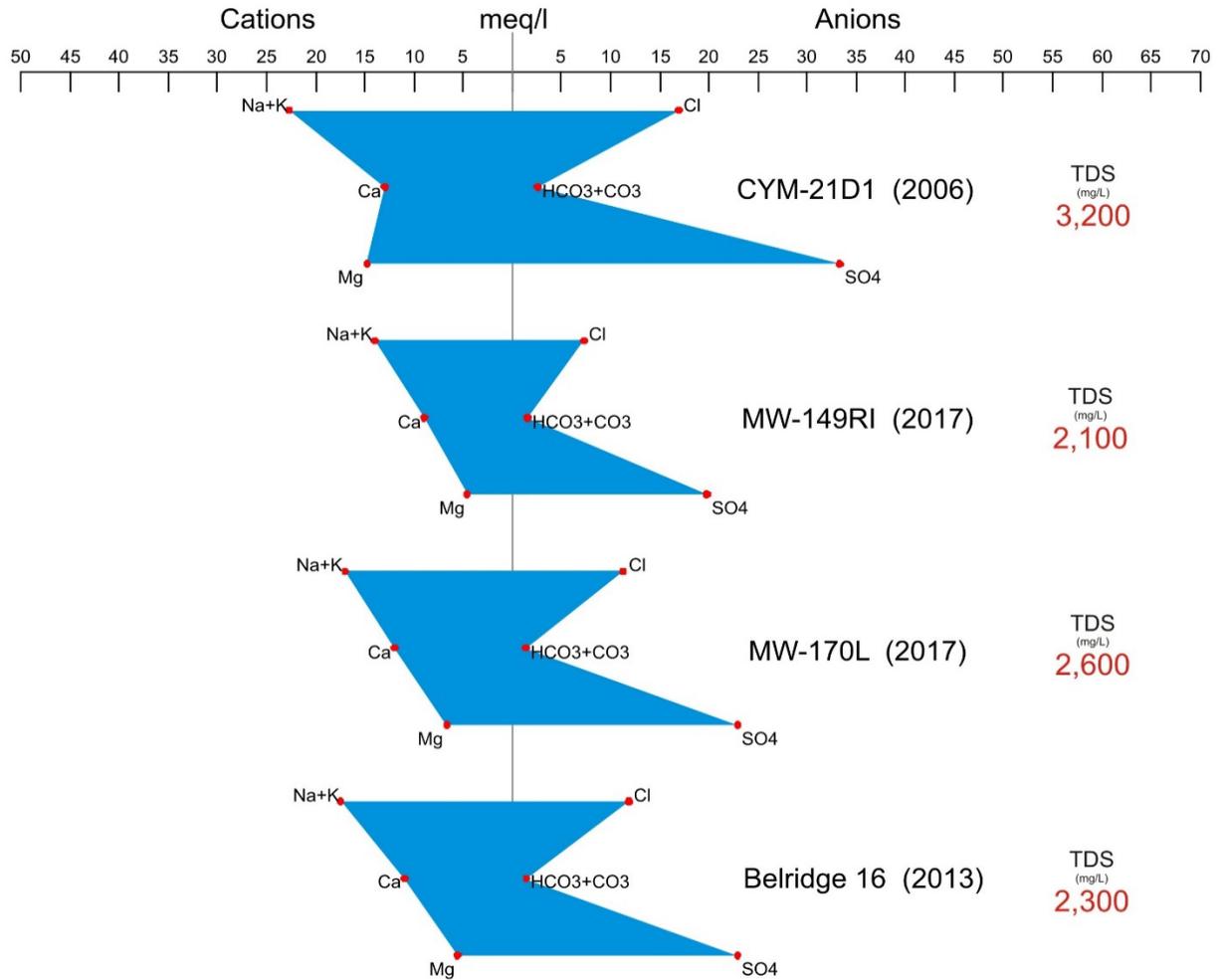
KERN COUNTY

ATTACHMENT L.1

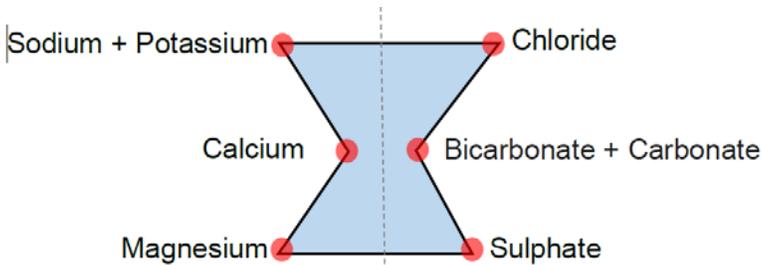
Stiff Diagrams

Wells that appear to be unaffected or minimally affected by produced wastewater

Sample dates range 2006 - 2017



Explanation



CYM-21D1 appeared to be unaffected in 2006, but is now affected by produced wastewater

STIFF DIAGRAMS ON UNAFFECTED OR MINIMALLY AFFECTED MONITORING WELLS

STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

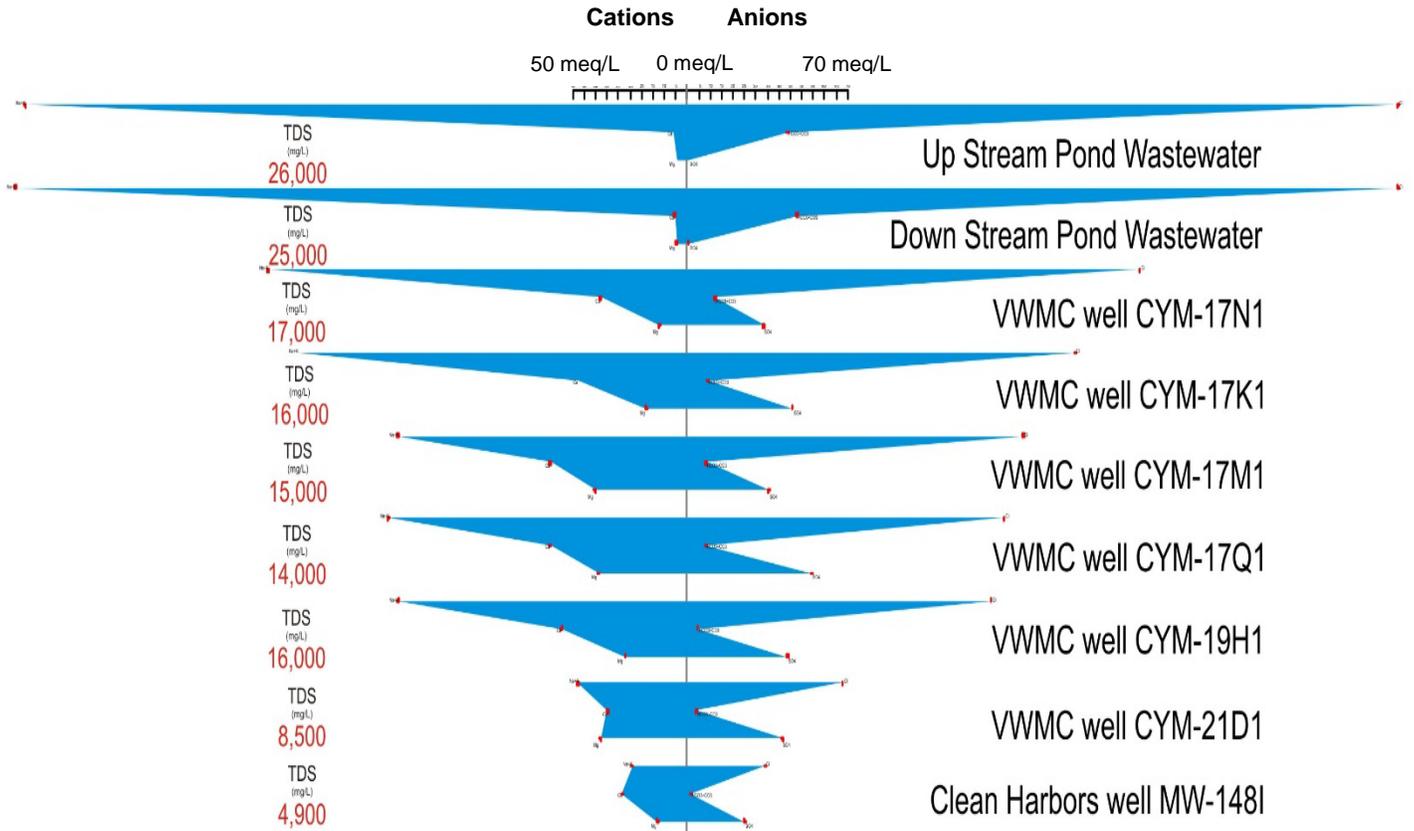
ATTACHMENT L.2

Stiff Diagrams

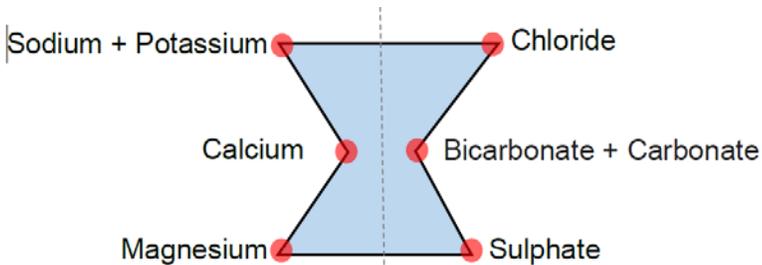
Valley Water Management Company and Clean Harbors Facility

Produced Wastewater and Well Water

Sample Dates: May and June 2017



Explanation



STIFF DIAGRAMS OF PRODUCED WASTEWATER AND GROUNDWATER FROM VALLEY WATER MANAGEMENT COMPANY AND CLEAN HARBORS FACILITY

STAFF REPORT

FOR

VALLEY WATER MANAGEMENT COMPANY

MCKITTRICK 1 & 1-3 FACILITY

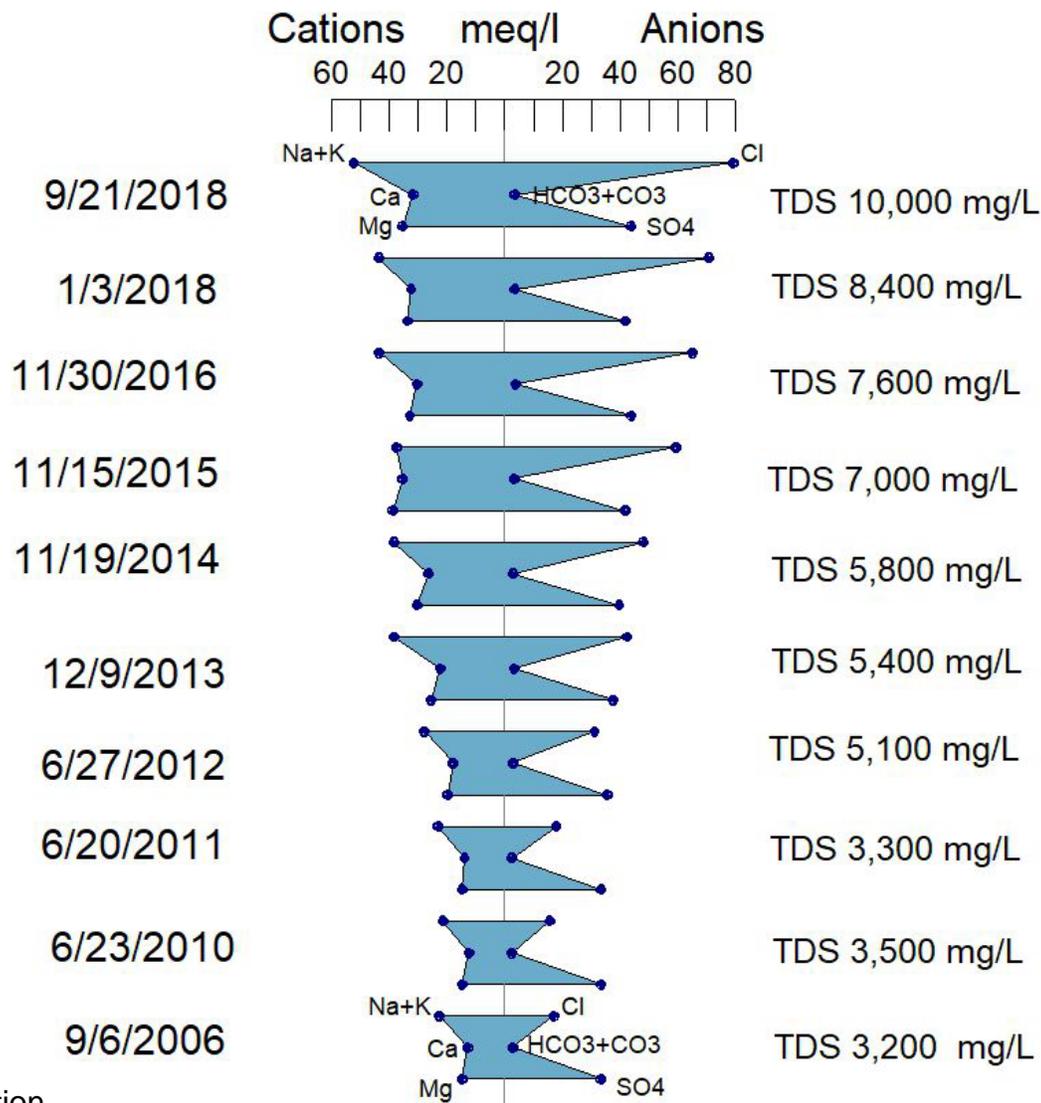
KERN COUNTY

ATTACHMENT L.3

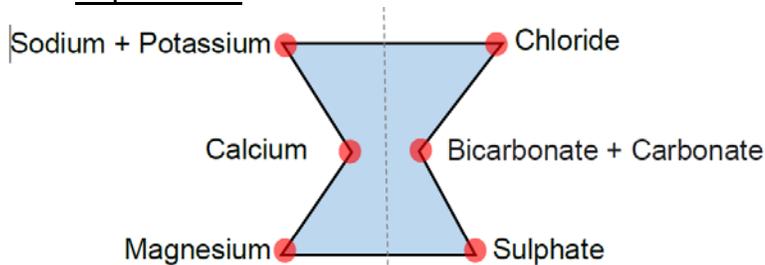
Stiff Diagram

Valley Water Management Company, Progressive Mixing of CYM-21D

Sample dates: September 2006 through September 2018



Explanation



STIFF DIAGRAMS OF GROUNDWATER RESULTS FROM MONITORING WELL CYM-21D1

STAFF REPORT

FOR

VALLEY WATER MANAGEMENT COMPANY

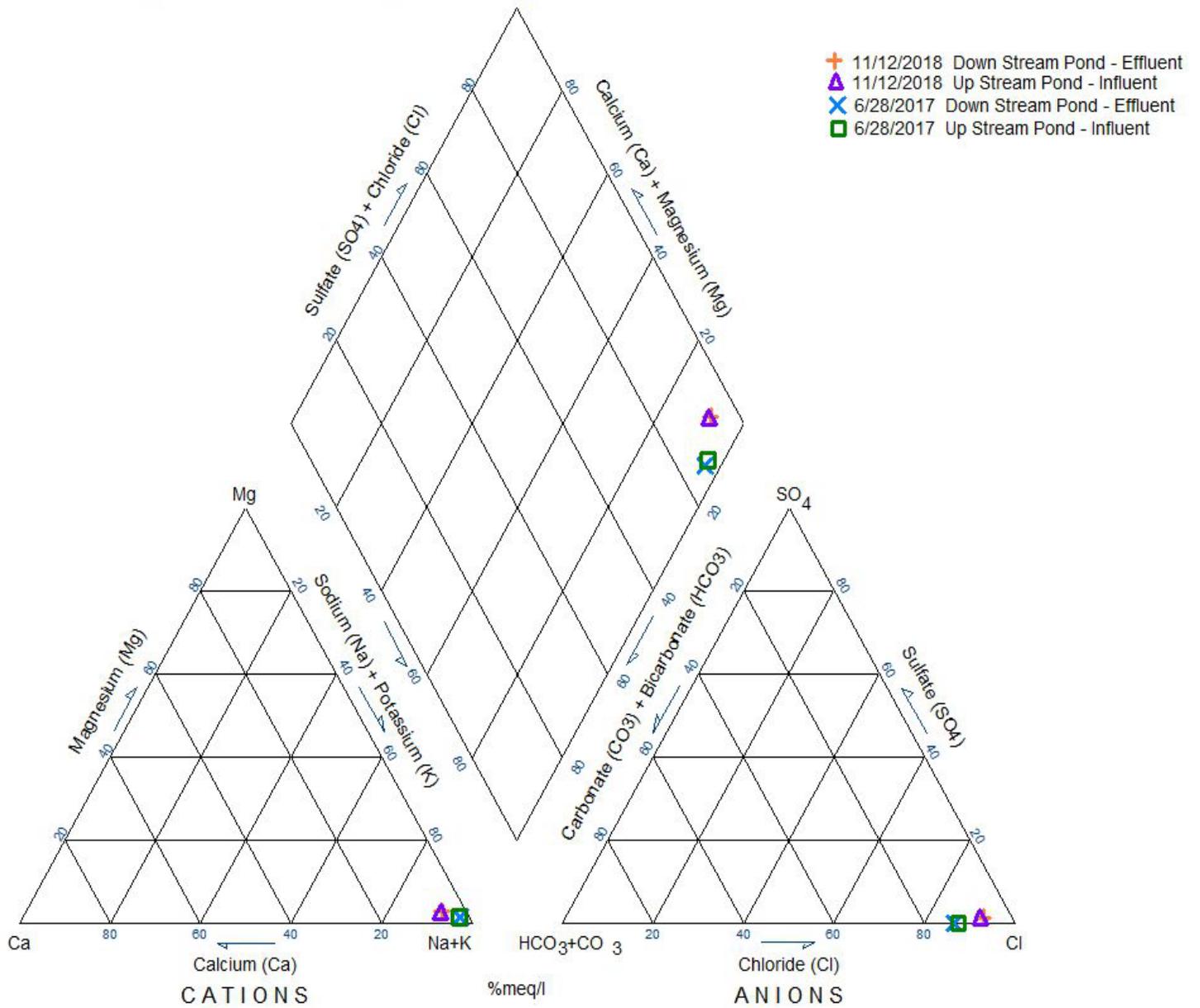
MCKITTRICK 1 & 1-3 FACILITY

KERN COUNTY

ATTACHMENT L.4

Piper Diagram

Valley Water Management Company Produced Wastewater



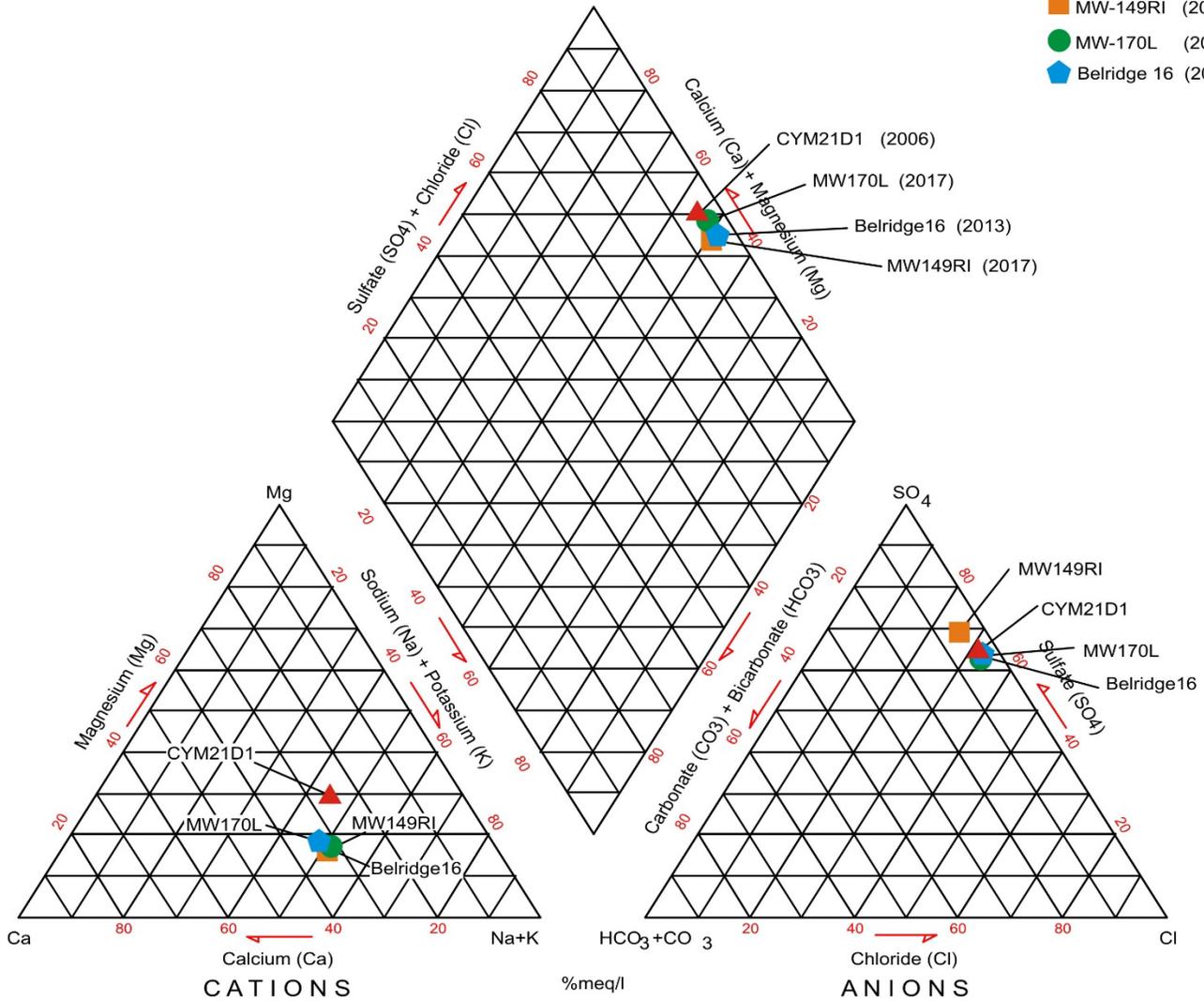
**PIPER DIAGRAM OF VALLEY WATER MANAGEMENT COMPANY
 PRODUCED WASTEWATER**
 STAFF REPORT
 FOR
 VALLEY WATER MANAGEMENT COMPANY
 MCKITTRICK 1 & 1-3 FACILITY
 KERN COUNTY

Piper Diagram

Wells that appear to be unaffected or minimally affected by produced wastewater

Sample dates range 2006 - 2017

- ▲ CYM-21D1 (2006)
- MW-149RI (2017)
- MW-170L (2017)
- ◆ Belridge 16 (2013)

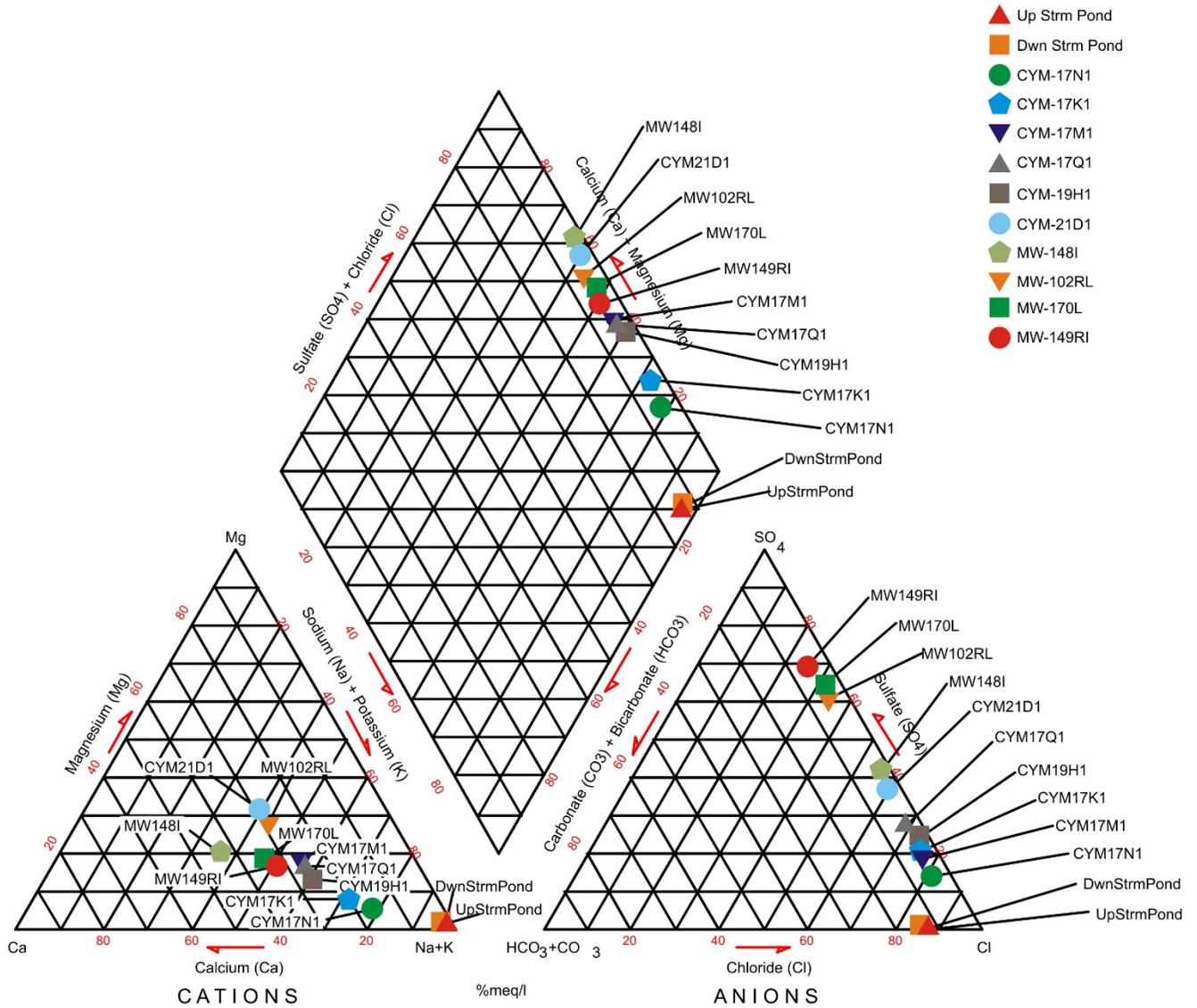


CYM-21D1 appeared to be unaffected in 2006, but, is now affected by produced wastewater.

PIPER DIAGRAM ON UNAFFECTED MONITORING WELLS
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY

Piper Diagram

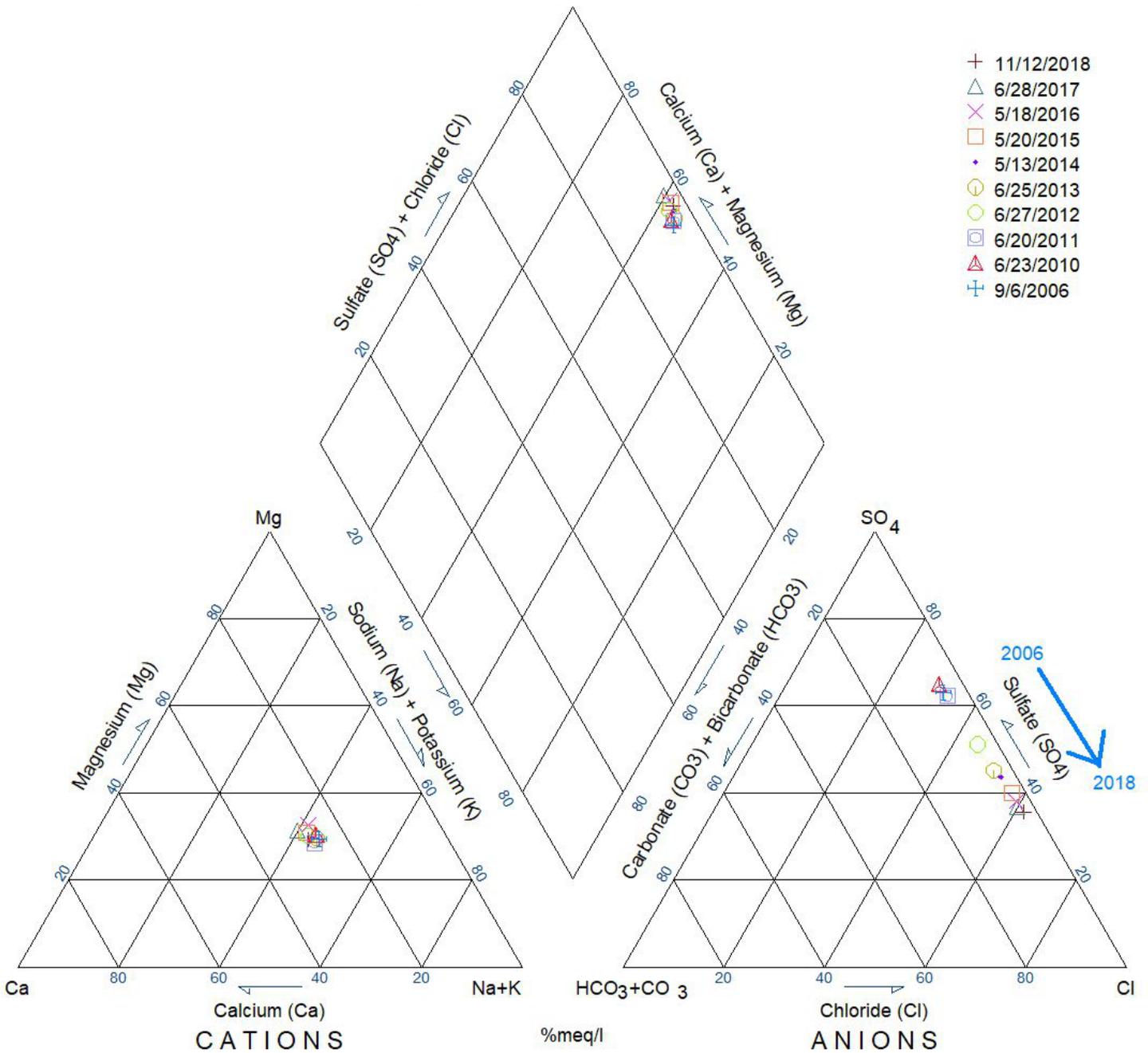
Valley Water Management Company and Clean Harbors Facility
 Produced Wastewater and Well Water
 Samples Dates: May and June 2017



**PIPER DIAGRAM OF PRODUCED WASTEWATER AND
 GROUNDWATER FROM VALLEY WATER MANAGEMENT
 COMPANY AND CLEAN HARBORS FACILITY
 STAFF REPORT
 FOR
 VALLEY WATER MANAGEMENT COMPANY
 MCKITTRICK 1 & 1-3 FACILITY
 KERN COUNTY**

ATTACHMENT M.3

Piper Diagram
Valley Water Management Company Groundwater from Well CYM-21D
Selected sample dates 2006 - 2018



**PIPER DIAGRAM OF GROUNDWATER RESULTS
 FROM MONITORING WELL CYM-21D1**

STAFF REPORT

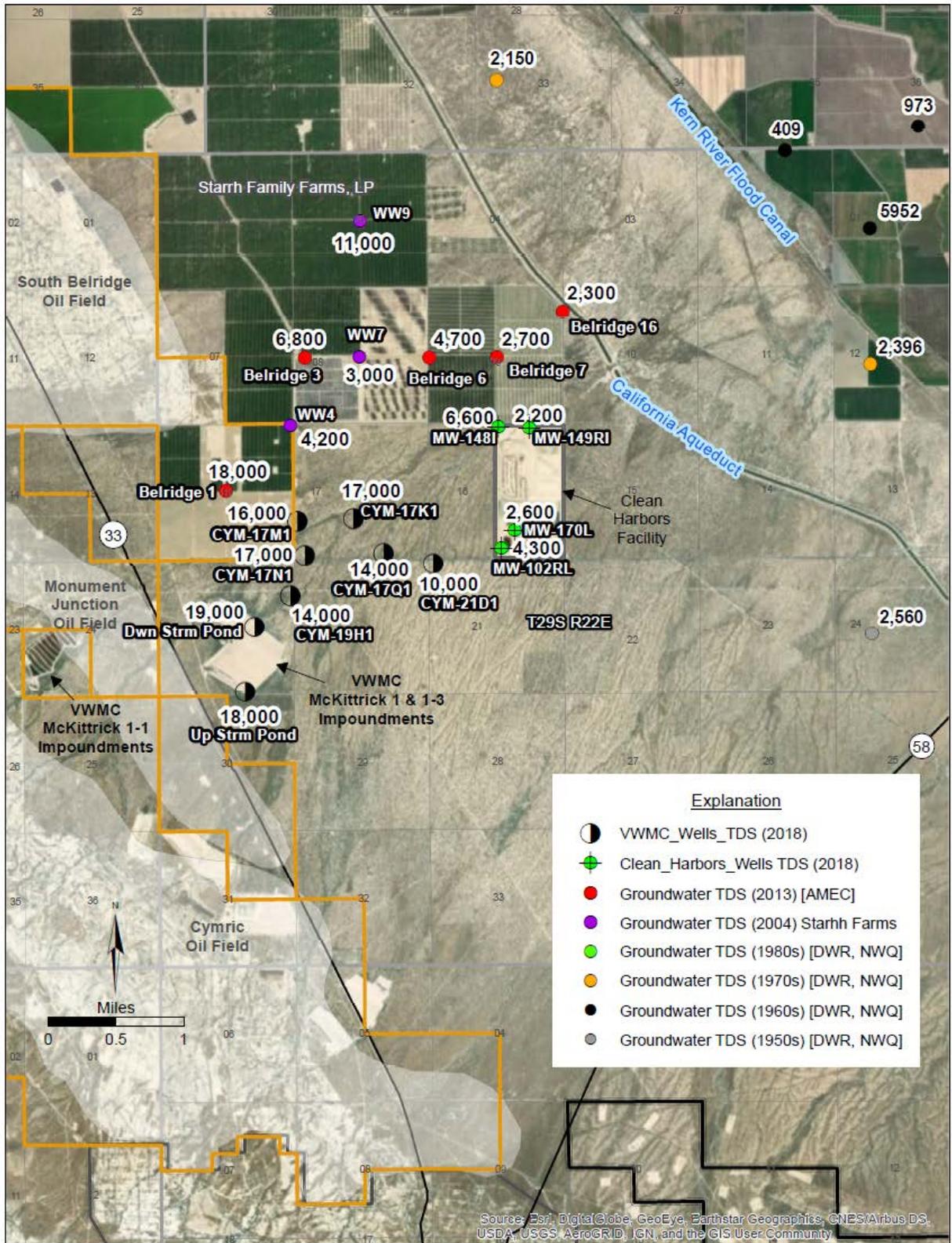
FOR

VALLEY WATER MANAGEMENT COMPANY

MCKITTRICK 1 & 1-3 FACILITY

KERN COUNTY

ATTACHMENT M.4



**PRODUCED WASTEWATER AND GROUNDWATER WELL
RESULTS FOR TOTAL DISSOLVED SOLIDS
STAFF REPORT
FOR
VALLEY WATER MANAGEMENT COMPANY
MCKITTRICK 1 & 1-3 FACILITY
KERN COUNTY**

ATTACHMENT N