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# EAST BAY PLAIN SUBBASIN GROUNDWATER SUSTAINABILITY PLAN CHAPTER 3—SUSTAINABLE MANAGEMENT CRITERIA

PREPARED FOR

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACFCWD | Alameda County Flood Control and Water Conservation District |
| ACPWA | Alameda County Public Works Agency |
| ACWD | Alameda County Water District |
| AF | acre-feet |
| AFY | acre-feet per year |
| ASR | aquifer storage and recovery |
| B | benzene |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CASGEM | California State Groundwater Elevation Monitoring Program |
| CCR | California Code of Regulations |
| CWC | California Water Code |
| DDW | California Division of Drinking Water |
| DTSC | California Department of Toxic Substances Control |
| DWR | California Department of Water Resources |
| DWSAP | Drinking Water Source Assessment and Protection |
| EBMUD | East Bay Municipal Utility District |
| EBP | East Bay Plain |
| ft | foot, feet |
| GAMA | Groundwater Ambient Monitoring and Assessment |
| GCM | Global Climate Models |
| GW | groundwater |
| GDE | groundwater dependent ecosystem |
| GMP | groundwater management plan |
| GP | general plan |
| gpd | gallons per day |
| gpd/ft | gallons per day per foot |
| GSA | groundwater sustainability agency |
| GSP | groundwater sustainability plan |
| Hayward | City of Hayward |
| HCM | hydrogeologic conceptual model |
| LBNL | Lawrence Berkeley National Laboratory |
| LSCE | Luhdorff & Scalmanini Consulting Engineers |
| LSCE Team | GSP consultant team: LSCE, Geosyntec, ESA, BC, Dr. Moran, and Farallon Geographics |
| LUST | Leaking Underground Storage Tank |
| MCL | maximum contaminant level |
| µg/L | micrograms per liter |
| mg/L | milligrams per liter |
| MGD | million gallons per day |
| MSL | mean sea level |
| MO | Measurable Objective(s) |
| MTBE | methyl tert-butyl ether |
| MT | Minimum Threshold(s) |
| PCE | perchloroethene |
| RMS | Representative Monitoring Sites |
| RWQCB | Regional Water Quality Control Board |
| SFPUC | San Francisco Public Utilities Commission |
| SGMA | Sustainable Groundwater Management Act of 2014 |
| SMCL | secondary MCL |
| TAC | Technical Advisory Committee |
| TCE | trichloroethene |
| TDS | total dissolved solids |

| | |
|---|---|
| TM | Technical Memorandum |
| TNC | The Nature Conservancy |
| TPH | total petroleum hydrocarbons |
| USGS | United States Geological Survey |
| WCR | well completion report |

# 3. SUSTAINABLE MANAGEMENT CRITERIA

This chapter of the Groundwater Sustainability Plan (GSP or Plan) provides a discussion of the Sustainable Management Criteria (SMC), including: the sustainability goal, undesirable results, minimum thresholds, measurable objectives, interim milestones, and the monitoring networks for the six sustainability indicators within the Plan area encompassed by the two GSAs: East Bay Municipal Utility District (EBMUD) and City of Hayward (Hayward). These two GSAs (and the Plan area) comprise the entire 71,300 acres in the Subbasin. Undesirable results occur when significant and unreasonable effects for any sustainability indicator defined by the Sustainable Groundwater Management Act (SGMA) are caused by groundwater conditions occurring in the Plan area.

This chapter defines sustainability in the Plan area, and it addresses significant regulatory requirements for this GSP. The undesirable results (UR), minimum thresholds (MT), interim milestones (IM), and measurable objectives (MO) presented in this chapter define the future sustainable conditions in the Plan area and commit the associated GSAs (EBMUD and Hayward) to actions that will achieve these future conditions.

The development of and definitions for the SMC require considerable analysis and evaluation of many factors. This chapter presents the data and methods used to develop the SMC and demonstrates how they relate to beneficial uses and users. The SMC presented in this chapter are based on the best available data and science. However, due to very limited data for many of the sustainability indicators, the SMC presented in this chapter are considered "interim" while data gaps are addressed, and additional analyses are conducted during the initial five years of the GSP Implementation Period. The SMC will be revisited in the 2027 five-year update report, and SMC presented here will either be confirmed or refined based on additional data/analyses conducted during the next five years.

The EBP Subbasin has a history of consistent annual groundwater pumping volumes over the past 30 years of about 3,000 to 4,000 acre-feet per year (AFY), which is well below the initial estimate of sustainable yield of 12,500 AFY (see Section 2). The GSAs have no immediate plans to develop new groundwater supplies over the initial 10 years of the GSP Implementation Period; therefore, there is ample time to collect additional data and conduct further hydrogeologic analyses to refine the basis for long-term SMC.

As noted above and elsewhere in this GSP, data gaps and uncertainty exist in the characterization of the hydrogeologic conceptual model and groundwater conditions. Uncertainties associated with the various sustainability indicators were considered when developing the SMC; thus, the SMC presented herein are considered interim pending refinement and will be updated in 2027. The GSAs will periodically review and update this GSP, assess changing conditions in the Plan area that may warrant modifications of the GSP or management objectives, and may adjust GSP components accordingly. The GSAs will focus their evaluation on determining whether the actions under the GSP are meeting the Plan's sustainability goal.

This chapter is organized to address all the SGMA regulations regarding SMC and is organized in accordance with California Department of Water Resources (DWR) GSP annotated outline. This chapter includes a description of:

- How undesirable results were developed, including:

  - The criteria defining when and where the effect of the groundwater conditions cause undesirable results based on a quantitative description of the combination of minimum threshold exceedances
  - The potential causes of undesirable results
  - The effect of these undesirable results on the beneficial uses and users.
- How locally defined significant and unreasonable conditions were developed
- How minimum thresholds were developed, including:
  - The information and methodology used to develop minimum thresholds
  - The relationship between minimum thresholds and the relationship of these minimum thresholds to other sustainability indicators
  - The effect of minimum thresholds on neighboring basins
  - The effect of minimum thresholds on beneficial uses and users
  - How minimum thresholds are related to relevant Federal, State or local standards
  - The method for quantifying measurable minimum thresholds
- How measurable objectives were developed, including:
  - The methodology for setting measurable objectives
  - Interim milestones

The SMC presented in this chapter were developed using information from stakeholder and public input and correspondence with the GSAs, public meetings, hydrogeologic analysis, groundwater dependent ecosystem analysis, and meetings with GSA Technical Team representatives. The general process for establishing SMC included:

- GSA public meetings (i.e., Stakeholder Communication and Engagement Meetings) that outlined the GSP development process and introduced stakeholders to the SMC
- Development of draft proposed SMC by the consultant team, GSA staff, and GSA technical representatives
- Review of draft proposed SMC by GSA steering committees
- TAC meetings to review initial proposed SMC for each sustainability indicator
- Reviewing TAC input on preliminary SMC methodologies with GSA Technical Team representatives
- Conducting GSP public meetings to present proposed methodologies to establish minimum thresholds and measurable objectives and receive additional public input. Two public meetings on SMC were held in the Plan area.
- Reviewing public input on preliminary SMC methodologies with GSA Technical Team representatives
- Providing the Draft GSP for public review and comment
- Establishing and modifying MT, IMs, and MOs, and definitions for UR based on feedback from TAC meetings, public meetings, public/stakeholder review of the Draft GSP, and input from GSA Technical Team representatives.

To ensure the Plan area continues to meet its sustainability goal by 2042, the GSAs have proposed projects and management actions (MAs) described in Section 4 that are intended to avoid UR. The projects and MAs expected to be implemented will include wells for groundwater extraction and groundwater injection and various actions (e.g., collection of additional streamflow data, installation of additional representative monitoring sites (RMS)). In addition, Section 4 outlines various projects that may be considered in the future, pending development of more extensive monitoring networks and further evaluation of groundwater basin conditions that result from implementation of initial projects and MAs. The overarching sustainability goal and the absence of UR are expected to be maintained through and beyond 2042 with implementation of the projects and MAs. The sustainability goal will be maintained through proactive monitoring and management by the GSAs as described in this and the following chapters. **Table 3-1** summarizes whether each of the six UR has occurred, is occurring, or is expected to occur in the future in the Plan area without and with GSP implementation.

**Table 3-1. Summary of Undesirable Results Applicable to the Plan Area**

| Sustainable Indicator | Pre-Historical Period (1950s to 1989) | Historical Period (1990 to 2015) | Existing Conditions (2016 to 2021) | Future Conditions without GSP Implementation (after 2042) | Future Conditions with GSP Implementation (after 2042) |
|---|---|---|---|---|---|
| Chronic Lowering of Groundwater Levels | No | No | No | No | No |
| Reduction of Groundwater Storage | No | No | No | No | No |
| Land Subsidence | No | No | No | No | No |
| Seawater Intrusion | Yes[1] | No | No | No | No |
| Degraded Water Quality | Yes[2] | Yes[2] | Yes[2] | No[4] | No[4] |
| Depletion of Interconnected Surface Water | Yes[3] | No[5] | No[5] | No | No |

1 Small local areas of seawater intrusion were reported in the Shallow Aquifer Zone near the San Francisco Bay margin prior to 1930, at which time EBMUD began importation of surface water supplies from outside of the EBP Subbasin.

2 The Shallow Aquifer Zone has been impacted historically in localized areas and exhibits somewhat elevated concentrations of nitrate, chloride, and TDS.

3 There are major data gaps related to surface water/groundwater interaction and historical stream depletion. However, based on numerical model runs and available data, it is possible there may have been surface water depletion that was sufficient to constitute undesirable results in the 1950s and early 1960s in the southern portion of the EBP Subbasin.

[4] In this context, "No" means that with GSP implementation, existing degraded water quality conditions will not become worse as a result of GSP projects and MA.

[5] There are major data gaps related to surface water/groundwater interaction and historical stream depletion. However, based on numerical model runs and available data, surface water depletion since 1990 is significantly less than model results for the 1950s and early 1960s in the southern portion of the EBP Subbasin.

## 3.1. Sustainability Goal

***(California Code of Regulations [CCR] Title 23, Section 354.24)***

### 3.1.1. Sustainability Goal

The sustainability goal for the Plan area is to manage and protect the East Bay Plain Subbasin in a manner that avoids UR while continuing to collect and analyze data to support science-based decision making to evaluate new opportunities for sustainable groundwater beneficial uses. The six sustainability indicators have been assigned minimum thresholds and measurable objectives (and interim milestones) as set forth in this GSP to avoid UR and ensure continued sustainable groundwater management of the EBP Subbasin over the planning and implementation horizon.

### 3.1.2. Explanation of How the Goal Will Be Achieved in 20 Years

The sustainability goal is already being achieved, which has been the case since at least the 1970s. Over the next 20 years of the GSP implementation period, the sustainability goal will continue to be achieved by prudent and incremental use of existing approved groundwater injection and extraction facilities. At this time, the GSAs have no plans to expand groundwater injection/extraction facilities, but the GSAs will continue data collection to provide current baseline conditions and evaluate potential impacts of incremental greater use of existing facilities.

### 3.1.3. Description of Measures

Existing project facilities (e.g., EBMUD Bayside Well and Hayward Emergency Wells) are planned to continue operations in accordance with previous approval processes (e.g., Bayside 2005 FEIR) over the 20-year implementation period (2022 to 2042). The proposed projects and the MA will result in groundwater injection and net groundwater extractions consistent with existing permit conditions to maintain net groundwater pumping well below sustainable yield through and beyond 2042 and allow EBP Subbasin operations to remain sustainable over a 50-year period representing average hydrologic conditions. If actual hydrologic conditions differ from the 50-year average (plus accounting for anticipated climate change), then additional measures may be necessary. The implementation of only existing facilities/projects will maintain pumping well below the sustainable yield and allow for ongoing data collection and analysis to further evaluate the potential for increased groundwater pumping.

## 3.2. Undesirable Results

***(CCR Title 23, Section 354.26)***

The regulations define undesirable results as occurring when significant and unreasonable effects are caused by groundwater conditions occurring throughout the Subbasin for one or more sustainability indicators. This section provides a description of undesirable results for the relevant sustainability indicators, including:

- Causes of groundwater conditions that would lead to undesirable results
- Criteria used to define undesirable results based on minimum thresholds
- Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results

A summary of criteria used to define UR is provided below in **Table 3-2**, and detailed discussions of each sustainability indicator are provided in subsequent sections of this Chapter.

Locally defined significant and unreasonable conditions presented in Table 3-2 were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

**Table 3-2. Summary of MT, MOs, and Undesirable Results.**

| Sustainability Indicator | Interim Minimum Threshold | Interim Measurable Objective | Undesirable Result UR |
|---|---|---|---|
| Chronic Lowering of Groundwater Levels | Shallow Aquifer Zone: Spring groundwater level of 50 feet below ground surface; Adjustment in GDE areas to allow only a 7.5 foot decline in Water Table Aquifer Zone groundwater levels Intermediate and Deep Aquifer Zones: Spring groundwater elevation of -50 feet MSL. | Average of recent observed high and low groundwater level measurements. Where recent observed data not available – average of recent modeled high and low groundwater levels. | 25% or more RMS wells have levels below MT for two consecutive non-drought year spring measurements. |
| Reduction of Groundwater Storage | Annual pumping volume of 12,500 AFY. | Annual pumping volume of 6,250 AFY. | Five-year moving average of annual pumping volumes greater than 12,500 AFY. |
| Seawater Intrusion | Five feet groundwater elevation contour line for Water Table Aquifer Zone. | Position of Spring 2015 Water Table Aquifer Zone five feet contour line. | Inland movement of Water Table Aquifer five feet contour line by at least 25% of existing 2015 land area (for northern and/or southern areas) between Bay Margin and five feet contour line; and Cl concentration increases |

**Table 3-2. Summary of MT, MOs, and Undesirable Results.**

| Sustainability Indicator | Interim Minimum Threshold | Interim Measurable Objective | Undesirable Result UR |
|---|---|---|---|
| | | | by 25% or more in sentinel wells. |
| Land Subsidence | Spring groundwater elevation of -50 feet MSL in Intermediate and Deep Aquifer Zones in southern EBP Subbasin; Spring groundwater elevation of -20 feet MSL in Intermediate and Deep Aquifer Zones in northern EBP Subbasin. | Same as Groundwater Level MO for Intermediate and Deep Aquifer Zones. | 25% or more RMS wells below MT for two consecutive non-drought year spring measurements (applies to Intermediate and Deep Aquifer Zones only; subsidence not expected in Shallow Aquifer). |
| Degraded Water Quality | Nitrate: 10 mg/L or existing baseline level plus 20% (whichever is greater); Arsenic: 10 µg/L or existing baseline level plus 20% (whichever is greater); Chloride: 250 mg/L or existing baseline level plus 20% (whichever is greater); TDS: 500 mg/L or existing baseline level plus 20% (whichever is greater). | Current concentrations (maximum of baseline sampling results) of nitrate, arsenic, chloride, and TDS. | 25% or more RMS wells above the MT for the same constituent as a result of GSA projects or MA, based on average of most recent three-year period. |
| Depletion of Interconnected Surface Water | Two feet decline in Water Table Aquifer Zone groundwater levels beneath San Pablo or San Leandro Creeks. | Low end of range for recent observed high and low groundwater level measurements in Water Table Aquifer Zone beneath San Pablo and San Leandro Creeks. Where recent observed data not available –modeled groundwater levels were used. | 50% or more RMS wells below MT for two consecutive non-drought year spring measurements. |

[1] Interim Milestones are equal to Measurable Objectives.

### *3.2.1. Chronic Lowering of Groundwater Levels*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for chronic lowering of groundwater levels is a significant and unreasonable decline in groundwater levels caused by excessive regional groundwater pumping over an extended period of time (not due to drought) that results in existing water supply wells (drinking water, industrial, irrigation for large parcels) not being viable for intended beneficial uses due to reduction of pumping capacity, or groundwater levels exhibit ongoing lowering (not due to drought) that significantly affects other beneficial uses (e.g., GDEs). Drought years will be defined as determined by EBMUD and Hayward (through SFPUC) based on their respective annual assessments of climatic conditions and annual reservoir storage volumes. When both GSAs determine a given year as being a drought year, that year will automatically be assigned to be a drought year for evaluation of SMC in the EBP Subbasin GSP. When one GSA assigns a drought year but the other does not, the two GSAs will meet and confer to make a determination of drought-year status for the purposes of the GSP.

**Minimum Threshold:** The MT for Shallow Aquifer Zone groundwater levels is set at 50 feet below current ground surface. The MT for Intermediate and Deep Aquifer Zone groundwater levels is set at -50 feet mean sea level (MSL). Adjustments to the Shallow Aquifer Zone MT will be made at RMS wells located adjacent to GDEs that are solely dependent on groundwater levels (e.g., not located near stream or have roots extending below stream thalweg where stream is disconnected). In these areas, the initial interim MT for Shallow Aquifer Zone groundwater levels is set to 7.5 feet below existing/baseline conditions, and this will be updated (and potentially revised) pending additional hydrogeologic/biologic data collection and studies. The proposed MT requires construction of dedicated shallow wells within potential GDE areas that are planned for future installation to serve as RMS wells. Additional details on development of MT are provided in Section 3.3.

**Criteria**: An undesirable result is defined to occur when 25% or more RMS wells exceed the groundwater level minimum thresholds for the two consecutive Spring (March) readings during non-drought years, and at least one RMS well in southern EBP Subbasin and one RMS well in northern EBP Subbasin are among the RMS wells falling below the MT. The technical justification for using 25% is reasonableness. If a very small percentage of wells was used (e.g., 10% or less), it would mean that a small number of wells falling below MT (which may just be a very localized issue) would cause an undesirable result. Whereas, if a very high percentage of wells (e.g., 75%) was used, then a relatively large portion of the basin would already be impacted before an UR occur. Using a percentage in the 20 to 50% range is a reasonable balance between not letting a very localized problem drive the definition of undesirable results and not allowing most of the basin to be impacted before declaring an undesirable result has occurred. The selection of 25% is at the lower end of what is deemed a reasonable range.

### *3.2.2. Reduction of Groundwater Storage*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for reduction of groundwater storage is excessive regional groundwater pumping that causes a significant and unreasonable decrease in groundwater storage over an extended period of time that results in significant reduction of pumping capacity to the extent that existing water supply wells (drinking water, industrial, irrigation for large parcels) are no longer viable for intended beneficial uses.

**Minimum Threshold:** The MT for reduction of groundwater storage is set at an annual pumping volume of 12,500 AFY, which is the estimated Subbasin sustainable yield. The MT will be updated (and possibly refined) as more data are collected and the sustainable yield is updated. This UR encourages total basin pumping to remain less than the estimated sustainable yield, including during average hydrologic conditions over the long-term and after full implementation of GSA projects and MA. Correspondingly, over the long-term, beneficial uses and users will have access to the groundwater in storage that exists in a balanced basin where inflows remain in balance with outflows. Increased pumping within the long-term sustainable yield during dry years may temporarily lower groundwater elevations and reduce the amount of groundwater in storage. Groundwater storage would then be replenished during wet years when pumping is decreased. Additional details on development of minimum thresholds are provided in Section 3.3.

**Criteria**: An UR is defined to occur when the five-year moving average of groundwater pumping exceeds 12,500 AFY. The technical justification is that a shorter time such as one or two years does not account for the potential need for short-term greater pumping that may occur due to very extreme water shortage due to natural disasters (e.g., earthquakes) and/or extreme drought conditions. However, a longer time frame for a moving average (e.g., 8 or 10 years) is excessive and unreasonable as a duration for extreme reliance on groundwater pumping for such conditions. The use of a five-year moving average provides a good balance between accounting for short-term extreme needs versus allowing for long-term overpumping of the basin. In addition, best available data indicate the EBP Subbasin was historically pumped at levels exceeding the current initial GSP sustainable yield estimate for more than five years. Thus, the selected MT based on the five-year moving average is likely to have been exceeded historically without major reported consequences in terms of UR (i.e., the MT duration represents a conservative/low value).

### *3.2.3. Seawater Intrusion*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for seawater intrusion is excessive regional groundwater pumping that causes a significant and unreasonable inland migration of saline Bay water into existing freshwater aquifers that are or could be developed for water supply to the extent that increased groundwater salinity precludes beneficial use for drinking water.

**Minimum Threshold:** The MT is based on the position of the five-foot groundwater elevation contour for the Water Table Aquifer Zone. For the EBP Subbasin, the seawater intrusion UR is defined using groundwater levels as a proxy and maintaining the Water Table Aquifer Zone (i.e., Upper 50 feet of sediments) groundwater elevations above the MSL near the Bay margin.

**Criteria**: An UR is defined to occur when the five foot MSL groundwater elevation contour line for the Water Table Aquifer moves further inland from baseline conditions to the extent that the onshore area between the five feet MSL contour line and the Bay Margin increases by 25% or more in either the northern or southern portion of the EBP Subbasin, and chloride sentinel wells (i.e., N2S, N3S, others to be installed) show 25% or greater increases in chloride concentrations over baseline conditions. The technical justification for use of 25% is reasonableness. If a very small percentage such as a 10% increase in the area was used, it would be difficult to accurately quantify (the baseline area between 5 ft MSL and Bay Margin is relatively small portion of the Subbasin and 10% of that small area will be very small). If an increase in the area of greater than 50% was used, this would suggest a significant and unreasonable impact has already occurred. The proposed 25% increase in area represents a conservative percentage at the lower end of a reasonable range from 20 to 50%.

More refined baseline conditions will be established during the first two years of the GSP implementation. An initial interim estimate of the position of the five-foot MSL contour was developed as described in Section 3.3. However, available data will be reviewed, and additional water level measurements collected (e.g., new nested monitoring wells, possibly Port of Oakland wells) to better define the baseline conditions in 2022/2023. The proposed MT will benefit from ongoing and planned construction of additional shallow monitoring wells.

Shallow groundwater levels can serve as a good proxy for this sustainability indicator given that the Water Table Aquifer Zone is the only aquifer connected with the Bay bottom, and significant layers of clay separate the Water Table Aquifer Zone from the Intermediate and Deep Aquifer Zones. If the shallowest groundwater levels are maintained above MSL, there should be no significant incursion of saline water. This method of using shallow groundwater levels as a proxy for seawater intrusion is consistent with the DWR-approved Niles Cone Alternative (to a GSP). Supporting data related to chloride concentrations in monitoring network wells will be collected to complement the maintenance of shallow groundwater (GW) levels above MSL to prevent seawater intrusion.

### *3.2.4. Land Subsidence*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for land subsidence is excessive regional groundwater pumping that leads to the occurrence of inelastic subsidence that results in significant and unreasonable damage at a regional scale to public infrastructure critical for public health and safety (i.e., levees, flood control channels, water supply aqueducts).

**Minimum Threshold:** The MT for land subsidence is set at -50 feet MSL in Intermediate and Deep Zone Aquifers in the southern portion of the EBP Subbasin and -20 feet MSL in Intermediate and Deep Zone Aquifers in the northern portion of the EBP Subbasin. These MT apply to Spring groundwater levels and were based on evaluation of historical low groundwater elevations in the Subbasin.

**Criteria**: An UR would occur if 25% or more RMS wells fall below the MT for two consecutive non-drought years. The technical justification for use of 25% is reasonableness. If a very small percentage of RMS wells (e.g., 10% or less) was used, then a small number of RMS wells falling below the MT (which may just be a very localized issue) would result in an UR. If a very high percentage (e.g., 75%) was used, then a relatively large portion the basin would be already impacted. Using a percentage in the 20 to 50% range is a reasonable balance between not letting a very localized problem drive the definition of UR and not allowing most of the basin to be impacted before declaring an UR has occurred. The selection of 25% is at the lower end of what is deemed a reasonable range. The UR definition also includes two consecutive non-drought years to ensure that an UR is not defined from a very temporary groundwater condition, but rather the UR represents a persistent undesirable groundwater condition.

Groundwater levels serve as a good proxy for this sustainability indicator given that historical pumping stresses in EBP Subbasin resulted in much lower groundwater levels in the Intermediate and Deep Aquifer Zones. The historical low levels would generally need to be exceeded to trigger any potential for subsidence to occur. Therefore, historical low groundwater levels serve as a good proxy for the land subsidence sustainability indicator.

### *3.2.5. Degraded Water Quality*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for degraded water quality is significant and unreasonable degradation of groundwater quality to the extent of interfering with beneficial uses/users of groundwater used as drinking water that is caused by GSA-related groundwater management activities or implementation of GSA projects and MA. UR may also occur if a contaminant plume shape or migration is significantly altered by SGMA-related groundwater management activities or implementation of GSA projects and MA to the extent of interfering with beneficial uses/users of groundwater. Locally defined significant and unreasonable conditions were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

**Minimum Threshold:** The MT for key groundwater quality constituents are 500 mg/L for TDS, 250 mg/L for chloride, 10 mg/L for nitrate as N, and 10 µg /L for arsenic. In the case where the baseline concentration of a key constituent at an RMS well is close to (i.e., within 20%) or already exceeds the MCL, the MT is defined as a 20% increase in concentration from the baseline groundwater quality (for the applicable constituent(s)) for that RMS well.

**Criteria**: An UR occur when 25% or more of RMS wells in either the northern or southern portions of the EBP Subbasin exceed MT for a given key constituent, and this exceedance is a result of a GSA project or management action. The baseline concentration for each key constituent will be set as the maximum value from baseline sampling events. An exceedance of a MT at a given RMS well is defined based on the average concentration over a three-year monitoring period.

The technical justification for use of 25% is reasonableness. If a very small percentage of RMS wells (e.g., 10% or less) was used, then a small number of RMS wells exceeding MT (which may just be a very localized issue) would result in an undesirable result. If a very high percentage of RMS wells (e.g., 75%) was used, then a relatively large portion the basin is already impacted before an UR occurs. Using a percentage in the 20 to 50% range is a reasonable balance between not letting a very localized problem drive the definition of UR and not allowing most of the basin to be impacted before declaring an UR has occurred. The selection of 25% is at the low end of what is deemed a reasonable range.

Establishing baseline concentrations for key constituents requires multiple sampling events during both the wet (winter/spring) and dry seasons (summer/fall). Additional baseline sampling is needed for key constituents in the RMS wells. In general, baseline concentrations for key constituents will be established based upon a minimum of two wet and two dry season sampling events. The baseline sampling events will occur within the initial four years of GSP implementation to provide the necessary data to establish the range of baseline concentrations for each RMS well key constituent by the 5-year Update Report. Annual sampling events will be conducted thereafter to compare against baseline concentrations for each key constituent.

### *3.2.6. Depletion of Surface Water*

**Causes and Effects on Beneficial Users and Uses:** The definition of UR for depletion of interconnected surface water is excessive regional groundwater pumping that causes an increase in streamflow depletion rate that results in significant and unreasonable effects to potential beneficial uses/users (e.g., insufficient water for aquatic species, GDEs).

**Minimum Threshold:** The MT for non-drought shallow groundwater levels (as a proxy) is set at two feet below current baseline water levels in the Water Table Aquifer Zone beneath the major creeks. This is considered an interim MT, and the MT will be refined with collection of additional data to improve the understanding of stream-aquifer connectivity and potential for streamflow depletion related to groundwater pumping. The proposed MT requires future construction of dedicated shallow monitoring wells along major creeks that will serve as RMS wells. The interim MT are based on model-estimated groundwater levels and are subject to verification when the actual wells are installed and monitored for current baseline water levels.

**Criteria**: An UR will be defined to occur when 50% or more RMS levels measured in shallow RMS wells near major creeks fall below the MT for two consecutive non-drought years (e.g., three out of five wells). This is an initial interim percentage that is based on very limited data and a small number of planned RMS wells. The technical justification for the selected percentage is reasonableness. If a smaller percentage means 1 or 2 wells have levels that fall below the MT (which may just be a very localized issue), then this would be an UR. While the selection of 50% may be at the higher end of what is deemed a reasonable range, this is an initial percentage based on a small number of RMS wells anticipated to be installed to monitor this sustainability indicator (up to 10 wells).

## 3.3. Minimum Thresholds

***(CCR Title 23, Section 354.28)***

The regulations define UR as occurring when significant and unreasonable effects are caused by groundwater conditions occurring throughout the Subbasin for a given sustainability indicator. Significant and unreasonable effects occur when MT are exceeded for one or more sustainability indicators. This section describes the following for each sustainability indicator relevant to the EBP Subbasin: the methodology used to set the MT and how selected MT avoid causing UR, relationships to other sustainability indicators, impact on adjacent subbasins, impacts on beneficial uses/users, comparison to relevant federal, state, and local standards, and the measurement method.

The approach used in this GSP is to establish MT for each sustainability indicator that solely reflect that one particular indicator and that consider protection of beneficial uses/users related to that one indicator. The MT established for each indicator are then reviewed and the most constraining sustainability indicator becomes the driver for defining UR. For example, shallow groundwater levels near the Bay can be below sea level and still allow for adequate groundwater supply to be obtained from a shallow well (i.e., there is no UR for chronic lowering of groundwater levels); however, these shallow groundwater levels may not meet the seawater intrusion MT, which may then cause an UR for seawater intrusion (even though an UR for chronic groundwater level decline did not occur). This approach to establishing MT allows for clarity in identifying the cause(s) of UR should they ever occur in EBP Subbasin.

This GSP uses best available data to derive the MT, which includes using the model in some cases. Because data gaps exist for all six sustainability indicators, all the MT in this GSP are considered interim and will be refined in the first five-year Update Report in 2027 using additional data that will be collected. Development of the interim MT incorporated input received from GSA staff and technical representatives, interested stakeholders and the public through public meetings, individual stakeholder input to various GSA representatives, review of SGMA GSP regulations and DWR best management practices (BMPs), and review of DWR approval/consultation letters of four GSPs released in June 2021.

The future scenario with GSP projects and MA is described in detail in Chapter 4 of this GSP and in the groundwater model documentation included in **Appendix 6.E**. The future scenario includes injection (during wet years) and extraction (beginning with the third year of an extended drought) by the EBMUD Bayside Phase 1 Well, and operation of three of Hayward's emergency wells for short durations (two months) under assumed emergency conditions. This future scenario utilizes only the currently existing facilities for EBMUD and Hayward.

### *3.3.1. Chronic Lowering of Groundwater Levels*

The GSP regulations provide that the "minimum thresholds for chronic lowering of groundwater levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to UR." Chronic lowering of groundwater levels in the Subbasin would result in significant and unreasonable declines if they are sufficient in magnitude and duration to lower the rate of production of pre-existing groundwater wells below that necessary to meet the minimum required to support overlying beneficial use(s). In addition, groundwater levels will be managed with consideration of the MT to ensure the major aquifers in the Subbasin are not depleted in a manner to cause significant and unreasonable impacts to other sustainability indicators. At the same time, the GSAs recognize that groundwater levels may fall slightly below 2015 levels during the GSP implementation and sustainability periods because groundwater in the EBP Subbasin has been pumped at lesser amounts than the sustainable yield due to limited groundwater pumping since the 1960s. Thus, the MT have been designated with these considerations in mind.

The MT for groundwater levels and overall SMC program for this GSP are also intended to protect against significant and unreasonable impacts to groundwater storage volumes, seawater intrusion, land subsidence, groundwater quality, and surface water depletion. GDEs were also considered in setting of MT. The GDEs identified in the subbasin are dominated by terrestrial vegetation, which is susceptible to adverse impacts if groundwater levels in the underlying shallow aquifer experience chronic lowering. The development of the interim MT for chronic lowering of groundwater levels included review of the hydrogeologic conceptual model, climate, current and historical groundwater conditions including groundwater level trends and groundwater quality, seawater intrusion, land subsidence, surface water - groundwater interaction, and the water budget discussed in previous chapters.

The interim MT for chronic lowering of groundwater levels are based on selection of RMS wells from among existing and planned near-term future monitoring wells located throughout the Subbasin and screened in the Shallow, Intermediate, and Deep Aquifer Zones. The selected RMS wells are listed in **Table 3-3** and shown on **Figure 3-1**. Groundwater level hydrographs showing MT for each groundwater level RMS well are provided in **Appendix 3.A.**

The RMS wells described in **Table 3-3** and **Figure 3-1** are in locations that reflect available well locations to best represent groundwater conditions. These locations are representative of the overall Subbasin conditions because they are distributed throughout the Subbasin both vertically (in the Shallow, Intermediate, and Deep Aquifer Zones) and spatially throughout the Subbasin. Additional monitoring wells are currently being installed to fill data gaps and supplement the distribution of existing RMS wells. The GSAs have determined that use of the minimum groundwater elevation thresholds at each of the listed RMS wells will help avoid the UR of chronic lowering of groundwater levels by reducing the likelihood that access to adequate water resources for beneficial users within the Subbasin will be compromised.

**Table 3-3. Summary of Groundwater Level Minimum Thresholds for RMS**

| Well I.D. | Reference Point Elevation (ft MSL) | Well Depth (ft bgs) | Screen Top-Bottom (ft bgs) | Model Layer(s) | Aquifer Designation | MT Depth[1] (ft bgs) | MT Elevation (ft bgs) | GSA[2] |
|---|---|---|---|---|---|---|---|---|
| MW-5S | 13.88 | 210 | 200-210 | 3-4 | Shallow and Intermediate | 50 | -36 | EBMUD |
| MW-5I | 13.88 | 325 | 315-325 | 6 | Intermediate | 64 | -50 | EBMUD |
| MW-5D | 13.78 | 640 | 500-630 | 9-12 | Deep | 64 | -50 | EBMUD |
| MW-8D | 14.76 | 490 | 420-480 | 7-9 | Deep | 65 | -50 | EBMUD |
| MW-9S | 54.39 | 120 | 110-120 | 3 | Shallow | 50 | 4 | EBMUD |
| MW-9I | 54.39 | 210 | 200-210 | 5 | Intermediate | 104 | -50 | EBMUD |
| MW-9D | 54.39 | 335 | 325-335 | 6 | Intermediate | 104 | -50 | EBMUD |
| MW-10S | 11.76 | 120 | 100-120 | 3 | Shallow | 50 | -38 | EBMUD |
| MW-10I | 11.76 | 360 | 340-360 | 7 | Intermediate | 62 | -50 | EBMUD |
| MW-10D | 11.76 | 610 | 590-610 | 11 | Deep | 62 | -50 | EBMUD |
| S2-MWS1 | 6 | 85 | 50-80 | 2 | Shallow | 50 | -44 | EBMUD |
| S2-MWS2 | 6 | 205 | 140-180 | 3-4 | Shallow | 50 | -44 | EBMUD |
| S2-MWD1 | 6 | 555 | 480-500 | 7-8 | Deep | 56 | -50 | EBMUD |
| MW-N1S | 73 | TBD | TBD | TBD | Shallow | 50 | 23 | EBMUD |
| MW-N1I | 73 | TBD | TBD | TBD | TBD | 123 | -50 | EBMUD |
| MW-N2S | 19 | TBD | TBD | TBD | Shallow | 50 | -31 | EBMUD |
| MW-N2I | 19 | TBD | TBD | TBD | TBD | 69 | -50 | EBMUD |
| MW-N3S | 14 | TBD | TBD | TBD | Shallow | 50 | -36 | EBMUD |
| MW-N3I | 14 | TBD | TBD | TBD | Intermediate | 64 | -50 | EBMUD |
| MW-S1S | 27 | TBD | TBD | TBD | Shallow | 50 | -23 | Hayward |
| MW-S1I | 27 | TBD | TBD | TBD | Intermediate | 77 | -50 | Hayward |
| MW-S1D | 27 | TBD | TBD | TBD | Deep | 77 | -50 | Hayward |
| MW-S2S | 18 | TBD | TBD | TBD | Shallow | 50 | -32 | Hayward |
| MW-S2I | 18 | TBD | TBD | TBD | Intermediate | 68 | -50 | Hayward |
| MW-S2D | 18 | TBD | TBD | TBD | Deep | 68 | -50 | Hayward |
| Well D | 43 | 600 | 500-585 | 9-11 | Deep | 93 | -50 | Hayward |
| Mt. Eden Park | 24 | 550 | 460-530 | 9-10 | Deep | 74 | -50 | Hayward |

1 The actual MT is based on the groundwater elevation, but the depth to water corresponding to the surface elevation in the project database is also provided.

2 Each GSA is responsible for collecting groundwater levels for RMS within their GSA area.

### 3.3.1.1. Methodology

The methodology to develop the interim MT for chronic decline of groundwater levels involved the following steps:

1) Evaluate the DWR Well Completion Report (WCR) database for the location and construction details of wells (as described below).
2) Evaluate location of potential GDEs solely dependent on groundwater levels (as described below).
3) Review available existing and likely future RMS wells with regards to several variables/criteria (e.g., GSA ownership and/or access to well, known well construction details, preference for wells with several years of observed water levels, availability of recent water level data, good spatial distribution) and select appropriate RMS.
4) For each selected Shallow Aquifer Zone RMS hydrograph, plot a depth of 50 feet below land surface as the initial Shallow Aquifer Zone MT.
5) For each selected Shallow Aquifer Zone RMS well hydrograph, review/evaluate well location relative to potential GDEs. If the RMS well is within the designated GDE area, plot the depth of 7.5 feet below historical observed and/or baseline modeled groundwater elevations.
6) The shallowest MT at each Shallow Aquifer Zone RMS well location will serve as the interim Shallow Aquifer Zone MT for that RMS well.
7) For each selected Intermediate and Deep Aquifer Zone RMS hydrograph, plot an elevation of 50-feet MSL as the interim Intermediate/Deep Aquifer Zone MT.

DWR WCR Database Evaluation: The DWR WCR database was reviewed to evaluate the locations and construction details of various types of wells, including domestic, irrigation, industrial, and public water supply wells. Domestic wells represent the well type most likely to be impacted by declining groundwater levels, because they tend to be the shallowest wells. Additional evaluation and recategorization was needed with the DWR well log database, because the primary domestic well use in the EBP Subbasin has been for residential backyard irrigation and these wells are labeled as either domestic or irrigation wells. Labeling residential irrigation wells as irrigation instead of domestic wells causes some confusion with irrigation wells for larger non-residential parcels. Thus, domestic and irrigation wells were sorted by well diameter, with wells of 6-inch diameter or less considered to be domestic wells and wells of greater than 6-inch diameter considered to be irrigation wells. Maps were developed to show the general distribution and density of each well type (**Figures 2-2 through 2-5**) and to show minimum domestic well depth by township/range/section for all domestic wells drilled since 1970 and since 1990 (**Appendix 3.A**). These figures, combined with review of some of the associated WCRs, indicate that a relatively large number of very shallow residential backyard irrigation wells were installed in the 1970s during the 1976-1977 drought. Many of these wells appear to be hand dug (using an auger) to depths of 20 to 30 ft bgs with 4-inch PVC casing and well screen and a 10-foot sanitary seal.

A histogram for approximately 230 domestic wells installed since 1970 indicates about 45% of all wells were less than 50 feet deep and 65% were less than 100 feet deep (**Appendix 3-A**). Such shallow wells in the heavily urbanized EBP Subbasin could only reasonably be used for residential irrigation uses as opposed to drinking water, because the upper 50 to 100 feet of sediments are susceptible to contamination from fuel hydrocarbons, organic solvents, nitrate, and other contaminants. The histogram of 39 domestic wells installed since 1990 shows very few shallow wells (3 less than 50 feet and 10 less than 100 feet deep), suggesting that most of the shallow wells were installed over 30 years ago. It is not known if these very shallow backyard irrigation wells are still active.

Shallow Aquifer Zone MT Rationale: California well standards require a minimum 50-foot well seal for community water system and municipal water supply wells. Domestic and industrial wells have a 20-foot minimum well seal requirement. With respect to development of drinking water supply wells in the urban EBP Subbasin (including domestic wells that may serve as drinking water supply wells), it is reasonable to assume that drinking water supply wells of any type would have a well seal that is at least 50-feet or greater in depth (preferably at least 100 feet deep) to protect the well from potential contaminants originating at ground surface (e.g., fuel hydrocarbons, solvents, nitrate) that are known to impact the upper 100 feet of sediments in the EBP Subbasin. Thus, a conservative assumption is that drinking water supply wells are a minimum of 60 feet deep to allow for a 50-foot well seal and some intake area; it is very likely that drinking water supply wells would need to be considerably deeper than 60 feet to obtain groundwater of suitable quality and to have some protection against the most likely potential contaminants. Based on the assessment of the DWR WCR database described above, the methodology for establishing MT for the shallow (water table) zone chronic lowering of groundwater levels is based in part on an assumed minimum well depth for drinking water supply wells of 60 feet.

GDEs (Shallow Aquifer Zone) MT Rationale: A second major consideration in establishing Water Table Aquifer Zone groundwater level MT is the occurrence of GDEs (aquatic or vegetation) that are either not associated with (located along) streams or are located along streams where GDE health is directly dependent on groundwater levels (i.e., vegetation with certain rooting depths). GDEs that are directly dependent on surface water flows are addressed under the surface water depletion criterion. GDEs directly dependent on groundwater levels would not necessarily be protected by an MT that is protective of drinking water supply wells. Therefore, areas of the EBP Subbasin coinciding with known GDEs will have adjustments to the groundwater level MT established to protect drinking water supply wells. Additional work is needed in the early stages of GSP implementation to conduct further evaluation of potential GDEs, rooting depths of various species, and how declines in groundwater levels may impact various potential GDE vegetative species.

Review of best available data for depth to water across the EBP Subbasin generally indicates depths to water of less than 20 feet in the Water Table Aquifer Zone, although some smaller areas may have depths to water greater than 20 feet. Review of the initial mapping of potential GDE areas (**Appendix 2.A.b**) indicates these potential GDE areas likely have depths to water of about 20 feet or less. Some GDE species are known to have rooting depths of as much as 30 feet; thus, it was considered that shallow water table (i.e., Water Table Aquifer Zone) groundwater level declines of up to 7.5 feet may not have significant effects on health of vegetative GDEs in the EBP Subbasin solely dependent on groundwater levels. Thus, an initial interim GDE MT adjustment has been established as a decline of 7.5 feet from baseline conditions. It is recognized that additional biological and hydrogeologic studies are needed to confirm or refine this initial GDE MT adjustment for the chronic lowering of groundwater levels sustainability indicator.

Intermediate/Deep Aquifer Zone MT Rationale: The Intermediate and Deep Aquifer Zones in EBP Subbasin are confined aquifers that require a separate analysis for setting groundwater level MT. In general, these aquifers would be comprised of wells that are deeper than 200 feet, and groundwater levels in these aquifers would not directly impact GDEs. Since the depth to top of well screens in Intermediate to Deep Aquifer Zone wells generally varies from 200 to 500 ft bgs and typical depths to water in these wells are less than 50 ft bgs, there is generally between 150 and 450 feet of available drawdown in these wells. With specific capacities in the range of 5 to 20 gallons per minute per foot (gpm/ft), a typical well might use up to 100 feet of available drawdown to achieve pumping rates in the range of 500 to 2,000 gpm for the Deep Aquifer Zone. Best available data for the Intermediate Aquifer Zone (which are more limited) suggest specific capacity values of 0.5 to 8 gpm/ft, which indicates pumping rates of 50 to 800 gpm. These results indicate confined groundwater level drawdowns of 100 to 200 feet are unlikely to significantly decrease the ability of Deep Aquifer Zone wells to obtain adequate well yields, because there would still be significantly more than 100 feet of available drawdown above the top of well screen. However, a relatively shallow Intermediate Zone well may have a top of well screen depth of 200 ft bgs. Since current Intermediate Aquifer Zone groundwater levels are typically within 50 feet of ground surface and at groundwater elevations near or above MSL, maintaining a static Spring groundwater elevation no lower than -50 feet MSL generally allows for maintaining 100 feet or more available drawdown above the shallowest Intermediate well screen, which would provide for maintaining close to current pumping capacities.

Example Hydrographs with MT: Example hydrographs showing MT are provided in **Figures 3-2** through **3-4**. The hydrograph for RMS MW-5D (**Figure 3-4**) and N1I (**Figure 3-3**) demonstrate the MT for the Deep and Intermediate Aquifer Zones, respectively. Recent observed data were available for comparison for MW-5D but not N1I, which was in the planning stages for installation in 2022. An example hydrograph illustrating MT for the Shallow Aquifer Zone is provided in **Figure 3-2**. This site (S1S) is also planned for installation in 2022. Hydrographs illustrating MT for all RMS wells are provided in **Appendix 3.A**.

### 3.3.1.2. Relationship to Other Sustainability Indicators

The interim groundwater level MT were set independently of other sustainability indicators to clearly distinguish the specific sustainability indicator(s) that would be causing UR, should they ever occur in EBP Subbasin. The relationships to other sustainability indicators are described below.

1. **Reduction of groundwater storage.** The MT for reduction of groundwater storage is based on the sustainable yield of EBP Subbasin. Pumping at or less than the sustainable yield will avoid long-term and ongoing reduction of both groundwater storage and groundwater elevations in the Subbasin. However, the groundwater level MT are not based on nor correlated to a specific amount of total groundwater pumping in the EBP Subbasin. Therefore, the groundwater level MT established for this GSP will be evaluated independently from reduction of groundwater storage that is based on pumping within the sustainable yield.
2. **Seawater Intrusion.** While MT for groundwater levels have been established for all three aquifer zones where present, it is the Shallow Aquifer Zone MT that is most important to seawater intrusion because this is the only zone that has a potential connection to the San Francisco Bay. The seawater intrusion MT is designed to maintain Water Table Aquifer Zone groundwater elevations at or above mean sea level. Therefore, while the Shallow Aquifer Zone groundwater level MT established for this GSP are not necessarily set above mean sea level in some cases, groundwater level MT will not preclude finding of an undesirable result under the seawater intrusion indicator as described in Section 3.3.3.
3. **Land Subsidence.** A significant and unreasonable condition for land subsidence is measurable permanent (inelastic) subsidence that damages existing infrastructure. Inelastic subsidence is caused by reduction of pore pressure and compaction of clay-rich sediments in response to declining groundwater levels. There have not been historical reports of any significant subsidence in the

EBP Subbasin, which includes during a period of much greater groundwater pumping in the 1950s and 1960s. Therefore, no land subsidence would be expected to occur if groundwater levels remain above historical low groundwater elevations that occurred in the 1950s/1960s. If groundwater levels were to exceed historical lows, it is unknown if or at what groundwater elevations significant inelastic subsidence may occur. The MT for land subsidence use Intermediate and Deep Aquifer Zone groundwater levels as a proxy and are set at historical low groundwater levels. Most of the groundwater level MT established for this GSP are at or above historical low levels (detailed in Section 3.3.4.1), which indicates UR for subsidence would not occur without UR for groundwater levels. There are a few RMS wells for which groundwater level MT are below subsidence MT; however, groundwater level and subsidence MT were set independently of one another to clearly indicate the sustainability indictor that may be causing future undesirable conditions should they occur.

4. **Degraded water quality.** GSP projects and MA include both groundwater extraction and injection projects. Overall, it is anticipated that there will likely be an overall net benefit to groundwater quality from GSP injection projects due to injection of high-quality imported surface water; however, the overall groundwater monitoring program developed for this GSP plus any additional project-specific monitoring determined to be needed will be utilized to evaluate the need for adaptive management related to groundwater quality issues that may arise due to GSP groundwater injection projects. It is also possible that groundwater extraction projects from the Intermediate and Deep Aquifer Zones could draw shallow groundwater vertically downward in some areas where poorer water quality may be present in the shallow zone. There will be ongoing review of extraction well and nearby monitoring well water quality related to GSA projects to evaluate the need for adaptive management, as necessary.
5. **Depletion of interconnected surface waters.** The potential for impacts related to surface water depletion is a function of potential changes in shallow groundwater levels from implementation of GSA projects and MA. Most of these projects involve pumping from Intermediate and Deep Aquifer Zones, which are separated from shallow water levels by significant thicknesses of clay layers that serve to impede vertical migration of groundwater. However, the potential for groundwater pumping from deeper zones to impact shallow groundwater levels is accounted for in establishing SMC for stream depletion. In general, groundwater level MT are lower than stream depletion MT for the Shallow Aquifer Zone adjacent to major creeks. Therefore, while the Shallow Aquifer Zone groundwater elevation MT established for this GSP are not necessarily set at or above stream depletion MT, groundwater level MT will not preclude finding of an UR under the stream depletion indicator as described in Section 3.3.6.

### 3.3.1.3. Impact of Selected Minimum Thresholds to Adjacent Basins

The interim groundwater level MT established for EBP Subbasin do not provide a good indication of anticipated impacts on adjacent subbasins from implementation of the GSP. This is because the GSAs' operational plans for future groundwater pumping represent a temporary groundwater level condition (drawdowns are expected to recover within a few months) since the planned pumping occur only during short time frames. Ultimately, the potential for impacts on adjacent subbasins will be primarily a function of average water levels in EBP Subbasin. Therefore, the impact to adjacent subbasins is better described based on MO . Nonetheless, an evaluation of temporary low groundwater elevations in the EBP Subbasin and potential impacts on sustainability of Niles Cone Subbasin was conducted and is described below.

The Niles Cone Subbasin is being managed under SGMA with an Alternative (to a GSP) Plan, herein referred to as the Alternative or Niles Cone Alternative, that has been approved by DWR. The Below Hayward Fault portion of the Niles Cone Subbasin is the only area that would be potentially impacted by implementation of the EBP Subbasin GSP. The Below Hayward Fault portion of Niles Cone is separated from the southern EBP Subbasin by a transition zone described in detail in Section 2 of this GSP. In the transition zone area (see **Figure 3-5** for location), there are stratigraphic offsets of coarse-grained aquifer units that create a partial barrier that impedes horizontal groundwater flow through the transition zone. The presence and level of impedance through the transition zone is documented through a combination of geologic (e.g., stratigraphy and depositional environments), hydraulic (i.e., regional aquifer testing), and hydrochemical (i.e., isotope) data (**Appendix 2.A.b**) The EBP Subbasin Groundwater Model is calibrated to the available transition zone data (**Appendix 6.E**).

The Niles Cone Alternative measures sustainability by maintaining Shallow Aquifer Zone (Newark Aquifer) groundwater levels above sea level, and it allows for short-term declines below sea level during droughts (although the allowable duration of declines below sea level during droughts are not specified). A single sustainability indicator well (4S/1W-29A6) was selected to monitor sustainability in the Niles Cone Subbasin (see **Figure 3-5** for location of well). Management of Niles Cone Subbasin under the Alternative is based on maintaining shallow Newark Aquifer groundwater elevations above mean sea level to prevent seawater intrusion, and the Alternative states that this management approach also addresses the other sustainability criteria. The EBP GSP model scenario run for future proposed projects included inserting an observation point at the 4S/1W-29A6 location to measure estimated impacts (i.e., drawdown) from implementation of EBP Subbasin projects and MA. In addition, contour maps of drawdown were developed that extend into the Niles Cone Subbasin. Additional evaluation of potential impacts on the Niles Cone Subbasin is provided in **Appendix 6.E**.

Review of model-predicted impacts on Niles Cone Subbasin from implementation of proposed projects and MA in EBP Subbasin indicates that impacts to the Shallow Aquifer in Niles Cone Subbasin are expected to be less than 0.5 feet during years with GSA project extraction (and even less in other years). Based on how sustainability is defined for the Niles Cone Subbasin in the DWR-approved Niles Cone Alternative, the implementation of EBP Subbasin projects and MA outlined in the GSP will not impede the ability of Alameda County Water District (ACWD) to maintain sustainability in the Niles Cone Subbasin. If GSAs in the EBP Subbasin implement additional projects to increase net extraction, additional evaluation of potential impacts to neighboring subbasins will be conducted at that time.

### 3.3.1.4. Minimum Threshold Impacts on Beneficial Uses and Users

Groundwater level MT may have effects on beneficial uses, users, land use, and property owners. Those that may be impacted include other municipal users, industrial and irrigation water users, domestic water users, and ecological land uses and users. Other municipal, industrial, and irrigation water users may be impacted by temporary increases in pumping lifts/costs to pump groundwater, although benefits will be derived at other times with higher groundwater levels related to EBMUD Bayside well injection. Domestic well owners/users generally use small amounts of groundwater from the Shallow and possibly Intermediate Aquifer Zones. It is possible for the very shallow domestic irrigation wells, if they are still active, to experience temporary conditions during droughts with limited well saturation. In addition, there may be temporary increases in pumping lifts/costs to pump groundwater for domestic well owners/users, although impacts to the Shallow Aquifer Zone groundwater levels will be substantially less than in Intermediate/Deep Aquifer Zones.

Potential ecological impacts are possible in the potential GDE Units identified in the Subbasin. The potential GDE units are composed of vegetation, which may access shallow groundwater within approximately 30 feet of the surface. Modeled shallow water levels do not fluctuate very much in response to proposed groundwater pumping due to most pumping being derived from the Intermediate and Deep Aquifer Zones that are separated from the shallow Water Table Zone by multiple clay layers. If a 6-year drought and projected water level declines to MT levels were to occur, potential effects on GDEs could include short-term adverse impacts such as water stress and possibly longer-term impacts such as reduced growth and recruitment. Given the relatively low projected frequency and short duration of the shallow groundwater level declines, coupled with the inherent uncertainty in model projections and apparent resiliency of the potential GDEs to historical drought periods and times of pumping more than the sustainable yield, significant adverse impacts due to groundwater pumping are unlikely. Overall, sustainable groundwater management in the EBP Subbasin is expected to maintain the health and resiliency of the vegetation communities composing the potential GDE Units despite some potential temporary future impacts that may occur if the MT for groundwater levels are reached.

#### 3.3.1.5. Comparison of Minimum Thresholds and Relevant State, Federal, or Local Standards

There are no Federal, State, or local standards that exist for chronic lowering of groundwater levels.

#### 3.3.1.6. Minimum Thresholds Measurement Method

Groundwater levels for comparison to MT will be directly measured for existing and new monitoring wells. The groundwater level monitoring will be conducted in accordance with the monitoring plan and protocols outlined in Section 3.5. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the SGMA regulations. As noted in Section 3.5, the current groundwater level RMS monitoring network includes 10 wells in the Shallow Aquifer Zone, 9 wells in the Intermediate Aquifer Zone, and 10 wells in the Deep Aquifer Zone. EBMUD and Hayward are planning to install five new nested monitoring wells (with two or three separate wells at each site) in the Subbasin by early 2022, which are already incorporated into the RMS monitoring program. In addition, other data gaps for groundwater level monitoring are expected to be filled during the implementation period.

### *3.3.2. Reduction of Groundwater Storage*

The GSP regulations state that the "…minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to UR. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield…and projected water use in the basin." Basin groundwater conditions that involve excessive regional groundwater pumping would result in a significant and unreasonable reduction of groundwater storage. Locally defined significant and unreasonable conditions were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives. Significant and unreasonable reduction of groundwater storage occur when there is long-term reduction of groundwater storage during the sustainability period (i.e., after 2042). The MT for reduction of groundwater storage is an annual pumping volume no greater than 12,500 AFY (based on estimated sustainable yield) measured as a five-year moving average.

In evaluating this sustainable management criterion, it is noteworthy that groundwater storage as of the January 2015 SGMA benchmark reflects a groundwater basin that was experiencing substantially less groundwater pumping compared to its estimated sustainable yield. Thus, implementation of GSA projects and MA would be expected to result in some decline in groundwater storage from the 2015 SGMA baseline. However, the evaluation is based on significant and unreasonable reduction of groundwater storage, which would be reduction of storage beyond what would be expected with reasonable (i.e., within sustainable yield) additional development of groundwater supplies in EBP Subbasin.

### 3.3.2.1. Methodology

The selected methodology of annual groundwater pumping volumes involves developing a five-year moving average of annual groundwater pumping, which is to be maintained below the MT of 12,500 AFY (**Figure 3-6**). The five-year duration for the moving average is selected as a reasonable time frame, compared to a shorter or longer time frame. A shorter period such as one to two years does not account for the potential need for short-term greater pumping that may occur due to very extreme water shortages related to natural disasters (e.g., earthquakes) and/or extreme drought conditions. However, a longer time frame for a moving average (e.g., 8 or 10 years) is excessive and unreasonable as a duration for extreme reliance on groundwater pumping for such conditions. The use of a five-year moving average provides a good balance between accounting for short-term extreme needs, while not allowing for long-term overpumping of the subbasin. In addition, best available data indicates the EBP Subbasin was historically pumped at levels exceeding the current initial GSP sustainable yield estimate for more than five years. Thus, the selected MT based on the five-year moving average has been exceeded in the historical record without major reported consequences such as UR (i.e., the MT duration represents a conservative/low value).

As described in Section 2 of this GSP, there is estimated to be in excess of approximately two million acre-feet of groundwater storage in the EBP Subbasin. However, the usable storage is likely limited by maintaining a relatively full basin to prevent seawater intrusion, particularly in the Shallow Aquifer Zone. Derivation of the initial sustainable yield estimate included major constraints on pumping to ensure seawater intrusion does not occur. Therefore, pumping no more than an estimated sustainable yield that accounts for prevention of seawater intrusion is expected to maintain sufficient groundwater in storage.

One challenge in implementing this MT is the general lack of direct measurement of groundwater pumping in the basin (except for EBMUD and Hayward municipal wells). Most wells (except for municipal wells) are not metered, and indirect methods like estimating consumptive use would be primarily applicable to large, irrigated parcels known to be irrigated by groundwater. While the total water demand for residential irrigation has been (and can be) estimated, there is significant uncertainty in the total amount that may be supplied by groundwater. A portion of industrial water use is also supplied by groundwater, but industrial wells are not metered, and not all industrial well locations are known. The GSAs will be working to reduce uncertainty in groundwater pumping estimates in the future.

### 3.3.2.2. Relationship to Other Sustainability Indicators

The reduction of groundwater storage MT were set independently of other sustainability indicators to clearly distinguish the specific sustainability indicator(s) that are causing UR, should they ever occur in EBP Subbasin. The relationships to other sustainability indicators are described below.

1. **Chronic Lowering of Groundwater Levels.** Because the groundwater storage MT is based on the estimated sustainable yield and the sustainable yield is based in part on maintaining groundwater levels and groundwater outflow, it is expected that the reduction of groundwater storage MT will not cause UR for this sustainability indicator.
2. **Seawater Intrusion**. Similar to the discussion for groundwater levels above, the determination of sustainable yield, which is the basis for the reduction of groundwater storage MT, was based in part on maintaining shallow groundwater levels above sea level. Thus, use of the reduction of groundwater storage MT outlined above is not expected to have negative impacts related to seawater intrusion.
3. **Subsidence.** Because future groundwater levels in the Intermediate/Deep Zone Aquifers will be associated with groundwater pumping volumes no greater than 12,500 AFY, and historical pumping volumes in the 1950s and early 1960s were likely on the order of double the sustainable yield volume (see **Appendix 6.E**), it is expected that no subsidence will occur due to the reduction of groundwater storage MT because historical groundwater levels were lower than would occur at pumping volumes less than 12,500 AFY.
4. **Degraded Water Quality**. The MT pumping volume of 12,500 AFY for reduction of groundwater storage will not directly lead to a degradation of groundwater quality. Historical pumping volumes far more than the reduction of groundwater storage MT have occurred, and apparently did not result in any reported groundwater quality impacts with the possible exception of local areas of elevated chloride/TDS in the Shallow Aquifer Zone along the Bay margin that are more related to the seawater intrusion sustainability indicator.
5. **Depletion of Interconnected Surface Waters**. As described above in Section 3.3.1 for groundwater levels, the potential for impacts related to surface water depletion for the reduction of groundwater storage MT is a function of potential changes in shallow groundwater storage from implementation of GSA projects and MA. Most of these projects restrict pumping to the Deep or Intermediate/Deep Aquifer Zones, which are separated from Shallow Zone water levels by significant thicknesses of clay layers that serve to impede vertical migration of groundwater. While the selection of the reduction of groundwater storage MT is not expected to significantly influence depletion of interconnected surface waters, additional studies are planned to be conducted in the early years of GSP implementation to further address this criterion.

### 3.3.2.3. Impact of Selected Minimum Thresholds to Adjacent Basins

A MT for reduction of groundwater storage tied to EBP Subbasin sustainable yield over extended periods with average climatic conditions during the Sustainability Period should be protective of adjacent subbasins. Additional characterization of the potential interconnection between the EBP Subbasin and the Niles Cone Subbasin is planned in the near future. The results of that study and data collected from new wells in the southern part of the EBP Subbasin will be used to assess and potentially refine the interim MT of 12,500 AFY for reduction of groundwater storage. In addition, current plans for GSA groundwater development involve pumping no more than approximately 35% of the estimated sustainable yield. Future groundwater supply development to a greater proportion of sustainable yield would involve additional data collection, analyses, and further evaluation of adjacent basin impacts.

#### 3.3.2.4. Minimum Thresholds Impact on Beneficial Uses and Users

The interim MT of 12,500 AFY of groundwater pumping allows for some small initial decline in groundwater elevations with implementation of projects and MA resulting in increased net groundwater pumping (while remaining within basin sustainable yield) followed by maintaining stable average groundwater elevations during the Sustainability Period. The overall initial reduction of groundwater storage is not expected to significantly impact beneficial uses and users of groundwater in the Subbasin. However, it is possible for localized pumping by GSAs or other third parties to impact other beneficial uses (e.g., environmental users, irrigation uses). Such impacts to other potential beneficial users are expected to be addressed through monitoring and adaptive management, as necessary.

#### 3.3.2.5. Comparison Between Minimum Thresholds and Relevant State, Federal, or Local Standards

There are no Federal, State, or local standards that exist for reduction of groundwater storage.

#### 3.3.2.6. Minimum Thresholds Measurement Method

The minimum thresholds for groundwater storage reduction are based on various methods of measuring or estimating groundwater pumping, such as meters, remote sensing, use of crop coefficients, and personal communication with well owners. Additional discussion of quantifying groundwater pumping is provided in Section 3.5.

### *3.3.3. Seawater Intrusion*

The GSP regulations requires the use of chloride isocontour for the seawater intrusion MT, but they allow for use of groundwater levels as a proxy as long as a significant correlation exists between groundwater elevations and that indicator (CCR Title 23, Section 354.36(b)). Seawater intrusion in the Subbasin would become significant and unreasonable if excessive regional groundwater pumping causes migration of saline Bay water into existing freshwater aquifers that are or could be developed for water supply, to the extent that increased groundwater salinity precludes beneficial use of groundwater for drinking water supply.

The interim MT for seawater intrusion is based on the five foot MSL groundwater elevation contour for the Water Table Aquifer Zone. Exceedance of the MT for seawater intrusion occur when the five foot above MSL groundwater elevation contour line for the Water Table Aquifer Zone migrates further inland from baseline conditions to the extent that the onshore area between the five foot MSL contour line and Bay Margin increases by 25% in the northern and/or southern areas of the Subbasin, and chloride sentinel wells (i.e., N2S, N3S, and others to be installed) show 25% or greater increases in chloride concentrations over baseline conditions.

### 3.3.3.1. Methodology

The selected methodology of using groundwater levels in the Water Table Aquifer Zone as a proxy involves use of groundwater level data from the GeoTracker website for environmental sites combined with field measurement of groundwater levels in the RMS monitoring well network to delineate the five feet groundwater elevation contour line, and comparison of the future position of the five feet groundwater elevation contour line to the MT. A key benefit of this approach is that it is the simplest and most direct approach using available wells to evaluate seawater intrusion conditions. The five feet groundwater elevation contour was selected because it is the lowest elevation contour (closest to mean sea level, which is one foot for the NAVD 88 datum used in this GSP) that can be reasonably defined using existing data. The five feet groundwater elevation contour is a low enough elevation to be impacted by a decline in Shallow Aquifer Zone groundwater levels below sea level.

The technical justification for selecting a 25% increase in the area west of the five foot MSL contour line is reasonableness. It would be difficult to accurately quantify a smaller percentage increase (e.g., 10%) in the onshore area boundary by the five foot MSL contour line. If a percentage greater than 50% increase in area were used, this suggests a significant and unreasonable impact has already occurred. The 25% criterion represents a conservative percentage at the lower end of a reasonable range from 20% to 50%.

Shallow groundwater levels can serve as a good proxy for this sustainability indicator given that the Water Table Aquifer Zone is the only aquifer connected with the Bay bottom, and significant layers of clay separate the Water Table Aquifer Zone from the Intermediate and Deep Aquifer Zones. If the shallowest groundwater levels are maintained above mean sea level, there should be no significant inland migration of saline Bay water. This method of using shallow groundwater levels as a proxy for seawater intrusion is consistent with the DWR-approved Niles Cone Alternative (to a GSP).

Chloride concentrations in RMS monitoring network wells will also be collected to supplement and confirm the use of the five feet MSL groundwater elevation contour to maintain shallow groundwater levels above mean sea level and avoid seawater intrusion. The technical justification for selecting a 25% increase in chloride concentration in sentinel wells to confirm a seawater intrusion exceedance is reasonableness. The selected percent increase is on the lower end of the reasonable range of 20 to 50% established for other SMC as described above and below.

Updated baseline conditions will be established during the first two years of GSP implementation. An initial estimate of the position of the five feet MSL contour was developed based on the Spring 2015 Water Table Aquifer Zone Contour map (**Figure 3-7**). However, available data will be reviewed, and additional water level measurements will be collected (e.g., new nested monitoring wells, possibly Port of Oakland monitoring wells) to better define the baseline conditions in future updates of the GSP.

### 3.3.3.2. Relationship to Other Sustainability Indicators

The interim seawater intrusion MT was set independently of other sustainability indicators to clearly distinguish the specific sustainability indicator(s) that are causing UR, should they ever occur in EBP Subbasin. The relationships to other sustainability indicators are described below.

1. **Chronic Lowering of Groundwater Levels.** Because the seawater intrusion MT will maintain Water Table Aquifer Zone groundwater levels above MSL, they are not expected to have any bearing on the UR for chronic lowering of groundwater levels.
2. **Groundwater Storage.** Because the seawater intrusion MT will maintain Shallow Aquifer Zone groundwater levels above MSL, they are not expected to have any bearing on the UR for reduction of groundwater storage.
3. **Subsidence.** Seawater intrusion MT are only associated with Shallow Aquifer Zone groundwater levels, whereas subsidence MT are only associated with Intermediate and Deep Aquifer Zone MT. Therefore, MT for seawater intrusion and subsidence are not directly related to each other.
4. **Degraded Water Quality.** The MT of shallow groundwater levels at/above mean sea level will not directly lead to a degradation of groundwater quality.
5. **Depletion of Interconnected Surface Waters.** The seawater intrusion MT is generally expected to maintain existing connections and groundwater recharge/discharge from/to major creeks in proximity to the Bay margin, where the seawater intrusion MT is most applicable.

#### 3.3.3.3. Impact of Selected Minimum Thresholds to Adjacent Basins

A MT that does not allow for seawater intrusion during the sustainability period will not have negative impacts on adjacent basins and will be protective of adjacent subbasins. In particular, the EBP GSP interim seawater intrusion MT is very similar to and consistent with how ACWD manages the Niles Cone Subbasin, which should minimize any potential for adjacent basin impacts related to this key sustainability criterion.

#### 3.3.3.4. Minimum Thresholds Impact on Beneficial Uses and Users

The seawater intrusion MT of maintaining shallow groundwater levels at/above mean sea level is not expected to significantly impact beneficial uses and users of groundwater in the Subbasin. However, it may result in some restrictions for users of shallow groundwater near the Bay margin.

#### 3.3.3.5. Comparison Between Minimum Thresholds and Relevant State, Federal, or Local Standards

There are no Federal, State, and local standards for shallow aquifer groundwater levels for preventing sea water intrusion.

#### 3.3.3.6. Minimum Thresholds Measurement Method

The interim MT for seawater intrusion are based on groundwater levels being measured in shallow (Water Table Aquifer Zone) wells in the GSP monitoring network and from GeoTracker groundwater level measurements.

### *3.3.4. Land Subsidence*

The GSP regulations requires the use of a rate and extent of subsidence that, “substantially interferes with surface land uses…” for use as the MT, but they allow for use of groundwater levels as a proxy. Land subsidence in the Subbasin would become significant and unreasonable if excessive regional groundwater pumping causes significant and unreasonable damage on a regional scale to public infrastructure critical for public health and safety (i.e., levees, flood control channels, water supply aqueducts). Locally defined significant and unreasonable conditions were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

The interim MT for land subsidence are based on the Spring historical low groundwater elevations for the Intermediate and Deep Aquifer Zones: -50 feet MSL in the southern EBP Subbasin and -20 feet MSL in the northern EBP Subbasin. Documentation for historical low groundwater elevations is provided in **Appendix 3.D**. An UR for land subsidence is deemed to occur when more than 25% of RMS wells exceed the MT for two consecutive Spring measurements in non-drought years. Land subsidence generally does not occur in response to declines in shallow groundwater levels; therefore, no subsidence SMC are established for the Shallow Aquifer Zone.

### 3.3.4.1. Methodology

The methodology to develop the interim MT for land subsidence is based on historical low groundwater levels in the Intermediate and Deep Aquifer Zones. Measured/observed historical groundwater levels were described above in Section 2 and modeled historical groundwater levels are described in **Appendix 6.E**. Previous reports with groundwater elevation contour maps (from the 1950s to 1960s), previous reports with groundwater level data and narrative discussions, and hydrographs compiled for the GSP were used where available to establish historical low groundwater levels (**Appendix 3.D**). There was no reported subsidence in EBP Subbasin associated with these lower historical water level elevations. In addition, regardless of whether or not any subsidence occurred with lower historical water level elevations, the more important fact is that water levels were depressed for several years and any subsidence that could occur at those groundwater elevations would likely have occurred at that time (1950s through early 1960s). In order for subsidence to occur in the future, groundwater elevations would need to decline below historical low elevations. Therefore, historical low groundwater elevations provide any excellent proxy for land subsidence sustainable management criteria.

The selected methodology of using historical low groundwater levels as a proxy involves field measurement of groundwater levels in the RMS monitoring well network and comparison to established land subsidence minimum thresholds. To the extent that groundwater levels are maintained above land subsidence MT and collectively (on average) maintained around MO, land subsidence would not exceed its MT or display significant and unreasonable inelastic land subsidence. The subsidence MT will be supported by periodic review of extensometer data from the USGS station near the existing Bayside Well, and additional subsidence surveys would be conducted as needed in the future (e.g., benchmark surveys, InSAR surveys, etc.) to ensure no significant inelastic subsidence has occurred.

Groundwater level data for historical lows in the southern EBP Subbasin includes groundwater level contour maps from previous reports and hydrographs prepared from groundwater level data compiled for the GSP (**Appendix 3-D**). The hydrograph data show a range of historical lows from -40 to -100 ft MSL for Spring highs for several wells throughout the southern EBP Subbasin. The groundwater elevation contour maps for Spring 1958 and Spring 1961 show large areas of the southern EBP Subbasin with Spring highs lower than -50 to -70 feet MSL. These data indicate a representative (and conservative) historical Spring low for most of the southern EBP Subbasin is -50 ft MSL.

Available data for the northern EBP Subbasin are more limited; however, the best available data includes one hydrograph for an Intermediate Aquifer Zone well in the Berkeley area that reaches a low of -40 ft MSL. In addition, the report by Norfleet Consultants (1998) documents static and pumping water levels in the Richmond area and a 30-foot decline in water levels that occurred due to overpumping (3 to 4 MGD) between 1907 and 1911 (**Appendix 3-D**). These best available data indicate that use of Spring groundwater elevation MT of -20 ft MSL is a reasonably conservative value to assign for historical low levels in the northern EBP Subbasin.

The RMS wells for land subsidence listed in **Table 3-4** are in locations that reflect a wide cross section of Subbasin groundwater conditions (**Figure 3-8**). These locations are representative of the overall Subbasin conditions because they are spatially distributed throughout the EBP Subbasin. The GSAs have determined that use of groundwater level-based land subsidence MT at Intermediate/Deep Aquifer Zone wells will help avoid the UR for land subsidence because they will effectively prevent future inelastic subsidence (sufficient to impact infrastructure) that has not already occurred during the 1950s/1960s (if any). Example RMS well hydrographs with subsidence MT are provided in **Figures 3-9 and 3-10**.

**Table 3-4. Summary of Land Subsidence Minimum Thresholds for RMS Wells**

| Well I.D. | Reference Point Elevation | Well Depth | Screen Top-Bottom | Aquifer Designation | MT Depth[1] | MT Elev | GSA[2] |
|---|---|---|---|---|---|---|---|
| MW-5S | 13.88 | 210 | 200-210 | Intermediate | 64 | -50 | EBMUD |
| MW-5I | 13.88 | 325 | 315-325 | Intermediate | 64 | -50 | EBMUD |
| MW-5D | 13.78 | 640 | 500-630 | Deep | 64 | -50 | EBMUD |
| MW-8D | 14.76 | 490 | 420-480 | Deep | 65 | -50 | EBMUD |
| MW-9I | 54.39 | 210 | 200-210 | Intermediate | 104 | -50 | EBMUD |
| MW-9D | 54.39 | 335 | 325-335 | Intermediate | 104 | -50 | EBMUD |
| MW-10I | 11.76 | 360 | 340-360 | Intermediate | 62 | -50 | EBMUD |
| MW-10D | 11.76 | 610 | 590-610 | Deep | 62 | -50 | EBMUD |
| S2-MWD1 | 6 | 555 | 480-500 | Deep | 56 | -50 | EBMUD |
| MW-N1I | 73 | TBD | TBD | TBD | 93 | -20 | EBMUD |
| MW-N2I | 19 | TBD | TBD | TBD | 39 | -20 | EBMUD |
| MW-N3I | 14 | TBD | TBD | Intermediate | 34 | -20 | EBMUD |
| MW-S1I | 27 | TBD | TBD | Intermediate | 77 | -50 | Hayward |

**Table 3-4. Summary of Land Subsidence Minimum Thresholds for RMS Wells**

| Well I.D. | Reference Point Elevation | Well Depth | Screen Top-Bottom | Aquifer Designation | MT Depth[1] | MT Elev | GSA[2] |
|---|---|---|---|---|---|---|---|
| MW-S1D | 27 | TBD | TBD | Deep | 77 | -50 | Hayward |
| MW-S2I | 18 | TBD | TBD | Intermediate | 68 | -50 | Hayward |
| MW-S2D | 18 | TBD | TBD | Deep | 68 | -50 | Hayward |
| Well D | 43 | 600 | 500-585 | Deep | 93 | -50 | Hayward |
| Mt. Eden Park | 24 | 550 | 460-530 | Deep | 74 | -50 | Hayward |

[1] The actual MT is based on the groundwater elevation, but the depth to water corresponding to the surface elevation in the project database is also provided.

[2] Each GSA is responsible for collecting groundwater levels for RMS wells within their GSA area.

### 3.3.4.2. Relationship to Other Sustainability Indicators

The interim land subsidence MT was set independently of other sustainability indicators to clearly distinguish the specific sustainability indicator(s) that are causing UR, should they ever occur in EBP Subbasin. The relationships to other sustainability indicators are described below.

1. **Chronic Lowering of Groundwater Levels.** The methodology to establish MT for groundwater levels in the southern EBP Subbasin does not result in MT lower than those being established for land subsidence. Thus, the MT established for subsidence in the southern EBP Subbasin are consistent with the groundwater level MT. Groundwater level MT are lower than subsidence MT in the northern EBP Subbasin; however, they were set independently to demonstrate which sustainability indicator(s) would cause UR if they were to occur.

2. **Reduction of Groundwater Storage.** The reduction of groundwater storage MT is based on pumping volumes, whereas the land subsidence MT is based on historical low groundwater levels. Since the reduction of groundwater storage MT is based on a sustainable yield estimate of 12,500 AFY, and historical lows were generally associated with much higher pumping volumes, it is anticipated that the MT established for subsidence may be associated with an UR for reduction of groundwater storage. However, the intent of setting SMCs is to define an UR specific to each sustainability indicator independent of others.

3. **Seawater Intrusion.** The seawater intrusion MT is based on Water Table Aquifer Zone groundwater elevations, whereas the land subsidence MT is based on Intermediate and Deep Aquifer Zone groundwater elevations. Therefore, land subsidence MT do not relate to or conflict with seawater intrusion MT.

4. **Degraded Water Quality.** The land subsidence MT are consistent with historical groundwater level fluctuations in the EBP Subbasin, and they are not expected to result in a significant or unreasonable change in groundwater quality.

5. **Depletion of Interconnected Surface Waters.** The surface water depletion MT is based on Water Table Aquifer Zone groundwater elevations, whereas the land subsidence MT is based on Intermediate and Deep Aquifer Zone groundwater elevations. Therefore, land subsidence MT are not expected to conflict with surface water depletion MT.

### 3.3.4.3. Impact of Selected Minimum Thresholds to Adjacent Basins

Potential impacts of the MT established for land subsidence will be similar to those described in Section 3.3.1.3 for groundwater level MT for the southern portion of the EBP Subbasin. The northern portion of the EBP Subbasin is not adjacent to other groundwater basins.

### 3.3.4.4. Minimum Thresholds Impact on Beneficial Uses and Users

The land subsidence MT of maintaining groundwater levels at or above historical low groundwater levels to prevent future subsidence is not expected to impact other municipal, industrial, or domestic groundwater pumpers except possibly greater costs associated with increased pumping lifts. Land subsidence MT will not directly affect environmental uses/users because they are based on Intermediate and Deep Aquifer Zone groundwater levels, whereas environmental beneficial uses/users are dependent on shallow groundwater levels.

### 3.3.4.5. Comparison Between Minimum Thresholds and Relevant State, Federal, or Local Standards

There are no Federal, State, or local standards that exist for land subsidence.

### 3.3.4.6. Minimum Thresholds Measurement Method

The MT for land subsidence are based on groundwater levels measured in the RMS network for the groundwater level MT.

## *3.3.5. Degraded Water Quality*

The GSP regulations state that the "…minimum thresholds for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies…" Degraded water quality in the Subbasin would become significant and unreasonable if SGMA-related groundwater management activities or implementation of GSA projects and MA cause degradation in water quality. Locally defined significant and unreasonable conditions were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

The interim MT for degraded water quality are based on the greater of MCLs for key constituents or the baseline concentration plus 20%. The MCLs are 10 mg/L for nitrate as N; 10 µg /L for arsenic; 250 mg/L for chloride, and 500 mg/L for TDS. If the baseline concentration already exceeds the MCL or is within 20% of the MCL, the MT is set at 20% higher than the baseline. An MT exceedance for a given constituent at a given RMS well occurs when the average concentration over a 3-year period exceeds the MT. UR occur when the MT of a key constituent are exceeded at 25% or more RMS wells in the EBP Subbasin. A 3-year average is used to help ensure that a one-time concentration fluctuation does not automatically cause a MT exceedance, and allows for confirmation sampling to be conducted in subsequent sampling rounds to confirm that an MT exceedance has occurred.

In addition to setting MT for degraded water quality, Action Levels were established at 50% and 75% of the MT for key constituents at RMS wells where the baseline concentration is well below the MT. The purpose of setting these Action Levels is to require certain GSA actions to occur. At the 50% Action Level the cause of key constituent concentration increases is evaluated along with whether or not the cause is tied to GSA projects or management actions. If the 75% Action Level is exceeded, the GSA will with take action to avoid a MT exceedance (if increase in concentrations is determined to be caused by GSA projects or management actions) or report results to the appropriate agencies (if not caused by GSA projects or management actions).

The MT for degraded water quality apply to RMS wells selected from among existing and proposed future wells located throughout the Subbasin and screened in the Shallow, Intermediate, and Deep Aquifers. The RMS wells for groundwater quality include monitoring wells to be sampled and analyzed by the Subbasin GSAs. The selected RMS wells for groundwater quality are listed in **Table 3-5** and locations are shown on **Figure 3-11**. An example groundwater quality RMS wells time series for selection of SMC is provided in **Figure 3-12**.



**Table 3-5. Summary of Groundwater Quality Minimum Thresholds for RMS Wells**

| Well ID | Well Depth | Screen Top-Bottom | Aquifer Designation | MT Arsenic Concentration (µg/L)[2] | MT Nitrate Concentration (mg/L)[2] | MT Chloride Concentration (mg/L)[2] | MT TDS Concentration (mg/L)[2] |
|---|---|---|---|---|---|---|---|
| MW-5S | 210 | 200-210 | Intermediate | 10 | 10 | 250 | 551 |
| MW-5I | 325 | 315-325 | Intermediate | 23[3] | 10 | 250 | 545 |
| MW-5D | 640 | 500-630 | Deep | 10 | 10 | 250 | 550 |
| MW-8D | 490 | 420-480 | Deep | 18 | 10 | 250 | 500 |
| MW-9S | 120 | 110-120 | Shallow | 10 | 10 | 250 | 737 |
| MW-9I | 210 | 200-210 | Intermediate | 10 | 10 | 250 | 514 |
| MW-9D | 335 | 325-335 | Intermediate | 10 | 10 | 250 | 569 |
| MW-10S | 120 | 100-120 | Shallow | 10 | 10 | 250 | 500 |
| MW-10I | 360 | 340-360 | Intermediate | 10 | 10 | 250 | 558 |
| MW-10D | 610 | 590-610 | Deep | 10 | 10 | 250 | 634 |
| S2-MWS1 | 85 | 50-80 | Shallow | 10 | 10 | 18,000 | 32,400 |
| S2-MWS2 | 205 | 140-180 | Shallow | 10 | 10 | 4,200 | 7,320 |
| S2-MWD1 | 555 | 480-500 | Deep | 10 | 10 | 250 | 500 |
| MW-N1S* | TBD[1] | TBD | Shallow | 10 | 10 | 250 | 500 |
| MW-N1I* | TBD | TBD | TBD | 10 | 10 | 250 | 500 |
| MW-N2S* | TBD | TBD | Shallow | 10 | 10 | 250 | 500 |
| MW-N2I* | TBD | TBD | TBD | 10 | 10 | 250 | 500 |

**Table 3-5. Summary of Groundwater Quality Minimum Thresholds for RMS Wells**

| Well ID | Well Depth | Screen Top-Bottom | Aquifer Designation | MT Arsenic Concentration (µg/L)[2] | MT Nitrate Concentration (mg/L)[2] | MT Chloride Concentration (mg/L)[2] | MT TDS Concentration (mg/L)[2] |
|---|---|---|---|---|---|---|---|
| MW-N3S* | TBD | TBD | Shallow | 10 | 10 | 250 | 500 |
| MW-N3I* | TBD | TBD | Intermediate | 10 | 10 | 250 | 500 |
| MW-S1S* | TBD | TBD | Shallow | 10 | 10 | 250 | 500 |
| MW-S1I* | TBD | TBD | Intermediate | 10 | 10 | 250 | 500 |
| MW-S1D* | TBD | TBD | Deep | 10 | 10 | 250 | 500 |
| MW-S2S* | TBD | TBD | Shallow | 10 | 10 | 250 | 500 |
| MW-S2I* | TBD | TBD | Intermediate | 10 | 10 | 250 | 500 |
| MW-S2D* | TBD | TBD | Deep | 10 | 10 | 250 | 500 |
| Well D | 600 | 500-585 | Deep | 10 | 10 | 250 | 500 |
| Mt. Eden Park | 550 | 460-530 | Deep | 10 | 10 | 250 | 500 |

1 To Be Determined (TBD); information will be updated upon completion of well construction planned for 2022.

2 Values will be confirmed and/or adjusted as needed based on results from initial sampling for constituents.

3 MT greater than MCLs are due to baseline concentrations being greater than 80% of the MCL.

### 3.3.5.1. Methodology

The methodology to develop interim MT for groundwater quality is based on the objective of protecting beneficial uses from significant and unreasonable adverse impacts from SGMA-related groundwater management activities and implementation of GSP projects and management actions. In accordance with the Basin Plan (California Regional Water Quality Control Board, San Francisco Bay Region, 2019), groundwater in the Subbasin is considered suitable or potentially suitable for municipal and domestic water supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PRO) beneficial uses. From a groundwater quality standpoint, the municipal and domestic supply beneficial use is the most restrictive with Basin Plan water quality objectives linked to drinking water MCLs. As a result, the MT for groundwater quality set for each of the four identified key water quality constituents (nitrate, arsenic, chloride, TDS) are the respective MCL values, except for cases where existing or historical concentrations for these constituents already exceed the MCL. When baseline concentrations for the key constituents exceed 80% of the MCL, the MT is set at the current concentration plus 20 percent. When current or historical water quality for the key constituents has not been measured, the MT will be set as the MCL and adjusted as needed after water quality monitoring commences. The applicable MT for groundwater quality in the GSP apply to degraded groundwater quality as a direct result of impacts from SGMA-related groundwater management activities and implementation of projects and MA under the GSP that cause an exceedance to occur. Future exceedances of the MT may occur due to activities or conditions unrelated to implementation of the GSP, in which case they would not constitute an MT exceedance that contributes to an UR.

While GSA causation will need to be evaluated on a case-by-case basis, general procedures to be followed and considerations to be made in evaluating GSA causation for groundwater quality degradation include: review of monitoring data collected for the GSP, review work by others in/near area of concern with respect to key constituent monitoring, evaluation of whether contaminant concentration change is related to vertical or horizontal groundwater movement, evaluation of changes in groundwater levels (rise or fall) in causing increased concentrations of the key constituent, evaluation of available baseline/historical data for the key constituent in area of concern where groundwater quality degradation is occurring with respect to timing of GSA project (or management action) implementation, recommend additional monitoring steps as necessary (e.g., confirmation sampling, and review of existing wells nearby that could be added to monitoring network). Based on the assessment steps described above, a tentative conclusion regarding GSA causation will be made and supporting evidence outlined. The analysis will be presented in the Annual Report or Five-Year Update Report for DWR review.

Establishing baseline concentrations for key constituents requires multiple sampling events during both the wet (winter/spring) and dry seasons (summer/fall). Additional baseline sampling is needed for key constituents in the RMS wells. In general, baseline concentrations for key constituents will be established based upon a minimum of two wet and two dry season sampling events. The baseline sampling events will occur within the initial four years of GSP implementation to provide the necessary data to establish the range of baseline concentrations for each RMS well's key constituent(s) by the 5-year Update Report. Annual sampling events will be conducted to compare against baseline concentrations for each key constituent.

The technical justification for using a 20% increase from baseline concentrations to set the interim MT for RMS wells that already exceed the MCL for a key constituent is based on evaluation of three potential sources of fluctuations in key constituent concentrations from a series of sampling events at a given well:

1) Variability/uncertainty related to analytical lab methods/analysis;
2) Variability/uncertainty caused by slight differences in sampling methods or purge rates (this will be addressed to some extent with GSP sampling protocols, but some variability can still occur between different sampling personnel or from one sampling event to another plus existing data that may have been collected using slightly different protocols), and
3) Fluctuations/variability in constituent concentrations in the groundwater system due to the rise/fall of groundwater levels, changes in local groundwater flow directions, fluctuations in recharge rates, water year type, and other natural conditions affecting the groundwater system.

Consultation with the EBMUD analytical laboratory indicated that the margin of error associated with analytical lab measurements within a method may be set as:

a. The method reference used in the analysis.
b. Statistically calculated based on historical data of laboratory fortified blank samples or fortified matrix spikes.
c. Estimating the uncertainty of measurement by taking into consideration all sources contributing to the uncertainty but not limited to standard references, reference materials, equipment used, environmental conditions, properties and conditions of the samples being tested or calibrated, and the operator.

d. Based on The National Environmental Laboratory Accreditation Program Institute (TNI) acceptable criteria of performance testing (PT) study; these may be set by EPA or statistically calculated for the study.

**Table 3-6. Analytical Laboratory Error of Measurement for Key Constituents**

| Analyte | Method Reference | Method Reference or Laboratory Statistically Calculated Precision (% RPD[1]) | Method Acceptance Criteria for Accuracy (% Recovery) | TNI Acceptance Criteria of Performance Testing Study (% Recovery) |
|---|---|---|---|---|
| TDS | SM2540C | 10% | ±15% | ±20% |
| Nitrate | EPA 300.1 | At ≥ 10xMRL[2]xMRL[2]: ±10% RPD<br>At < 10xMRL: ±20% RPD | ±15% | ±10% |
| Chloride | EPA 300.1 | At ≥ 10xMRL: ±10% RPD<br>At < 10xMRL: ±20% RPD | ±15% | ±15% |
| Arsenic | EPA 200.8 | 20% | ±15% | ±30% |

1 Relative percent difference (RPD).

2 Minimum reporting limit (MRL) typically set by a lab as 3 x Method Detection Limit ≈ 3 x Standard Deviation.

Based on the laboratory input summarized above, the error based on the "Method Acceptance Criteria for Accuracy" may be the best reference to use since it is 15% for all the constituents and takes into consideration sources that contribute to the uncertainty.

Work being conducted for other programs, such as the Central Valley Irrigated Lands Regulatory Program (ILRP), requires extensive review of QA/QC procedures for field sampling and analytical lab analyses for various constituents of concern (including nitrate and TDS), along with quantification of the expected Relative Percent Difference (RPD) that may occur with key constituent concentrations from groundwater quality sampling events. An RPD of up to 25% constitutes the acceptance criteria for field duplicate samples, which accounts for analytical laboratory plus field sampling methods/procedures but not natural factors influencing the groundwater system. The groundwater system fluctuations/variability factor would add greater uncertainty beyond the 25% from laboratory and field sampling methods/procedures factors. Based on prior experience, the potential constituent fluctuations from various natural factors influencing the groundwater system likely exceed 5% and result in a total expected range of fluctuations from all three factors of greater than 30%. Therefore, use of a 20% increase over baseline conditions is likely a conservative (i.e., low) value relative to the reasonably expected range of fluctuations in constituent concentrations that could be expected to occur during a series of sampling events.

### 3.3.5.2. Relationship to Other Sustainability Indicators

Although there are potential relationships between groundwater quality and other sustainability indicators, setting of MT for groundwater quality does not conflict with other sustainability indicators and associated MT. Management of groundwater for other sustainability indicators and associated MT may not ensure that impacts on groundwater quality are avoided.

#### 3.3.5.3. Impact of Selected Minimum Thresholds to Adjacent Basins

The interim MT for groundwater quality established for the Subbasin are intended to protect all beneficial uses within the Subbasin, including municipal and domestic water supply uses, from groundwater quality degradation caused by projects or MA included in the GSP. Therefore, the MT to avoid degradation of water quality are not likely to impact adjacent subbasins or their ability to achieve sustainability.

#### 3.3.5.4. Minimum Thresholds Impact on Beneficial Uses and Users

Municipal and domestic supplies are the most restrictive beneficial uses for groundwater quality with water quality objectives equal to drinking water MCLs. Setting the groundwater quality MT for key constituent concentrations at respective drinking water MCLs, or within a tolerance of no more than a 20% increase above existing concentrations, is intended to limit degradation of groundwater quality caused by SGMA-related groundwater management activities, GSP projects and MA, to protect municipal and domestic supply beneficial uses. Protection of municipal and domestic beneficial uses is also protective of other groundwater beneficial uses.

#### 3.3.5.5. Comparison Between Minimum Thresholds and Relevant State, Federal, or Local Standards

The Federal and State drinking water quality standards are represented through MCLs that are applicable to public drinking water supplies and provide reasonable guidance on water quality for safe drinking water in non-public supplies. As described above, the State of California drinking water MCLs for arsenic, nitrate, chloride, and TDS are being used to define MT for groundwater quality degradation caused by GSP projects and MA, except in cases where existing baseline concentrations already exceed these levels or are already within 20% of the MCL (in which case, the MT will be baseline concentration plus 20%).

#### 3.3.5.6. Minimum Thresholds Measurement Method

Groundwater quality will be monitored on an annual basis at identified representative groundwater quality monitoring indicator wells presented in **Table 3-5** and **Figure 3-11**. Monitoring will be conducted through sampling of groundwater quality conducted for the GSP monitoring. All groundwater quality sampling and analysis will be conducted in accordance with the monitoring protocols and procedures described in the GSP. The monitoring network and monitoring protocols for groundwater quality are described in Section 3.5 (Monitoring Network and Monitoring Protocols for Data Collection).

### *3.3.6. Depletion of Surface Water*

The GSP regulations requires use of a rate or volume of surface water depletions, "caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results" to define the MT, but allows for use of groundwater levels as a proxy. Surface water depletion in the Subbasin would become significant and unreasonable if excessive regional groundwater pumping causes insufficient water to be available to support potential beneficial uses/users (e.g., aquatic species, GDEs). Locally defined significant and unreasonable conditions were determined based on discussions with GSA staff and technical representatives, input received from interested stakeholders and the public through public meetings, and through individual stakeholder input to various GSA representatives.

The interim MT for surface water depletion are average non-drought shallow groundwater levels (as a proxy) set at two feet below current baseline average water levels. This interim MT will be refined with collection of additional data to improve the understanding of stream-aquifer connectivity and potential for streamflow depletion related to groundwater pumping. The proposed MT requires use of shallow wells along major creeks, which are planned to be installed for use as RMS wells. The interim MT are based on model estimated groundwater levels. Documentation for surface water depletion MT are provided in **Appendix 3.F**. Undesirable results for surface water depletion are deemed to occur when more than 50% of RMS wells exceed MT for two consecutive Spring measurements in non-drought years.

As described in the HCM in Chapter 2, data are extremely limited for evaluation of streamflow depletion. Regional groundwater levels are generally expected to potentially be below stream thalwegs in the eastern portion of the Subbasin, and above stream thalwegs in the western portion of the Subbasin. There is very limited existing information to define gaining and losing reaches of Subbasin streams and the extent of connection between groundwater and surface water under various seasonal and water year type climatic conditions. Thus, a significant data gap exists related to depletion of surface water that will be addressed during the GSP implementation period (see Section 5).

Given the general lack of available data relating to streamflow, gaining, and losing reaches, and overall spatial/temporal connections between surface water and groundwater, initial interim MT are based on results from the EBP Subbasin groundwater model. Additional data to be collected early in GSP implementation to fill data gaps related to surface water depletion will be reviewed during the five-year Update Report, and MT for surface water depletion will be revisited at that time. The initial interim stream depletion MT are summarized in **Table 3-7** for locations shown on **Figure 3-13**. An example RMS well hydrograph with SMC is provided in **Figure 3-14**.

**Table 3-7. Summary of Surface Water Depletion Minimum Thresholds for RMS**

| Well I.D. | Reference Point Elevation | Screen Top-Bottom | Model Baseline GW Elevation (ft MSL) | Observed Baseline GW Elevation (ft MSL) | MT Depth | MT Elev | GSA |
|---|---|---|---|---|---|---|---|
| SPC-1 | 30 | TBD[1] | 27-29 | NA[2] | 5 | 25 | EBMUD |
| SPC-2 | 70 | TBD | 59-60 | NA | 13 | 57 | EBMUD |
| SPC-3 | 76 | TBD | 48-51 | NA | 30 | 46 | EBMUD |
| SLC-1 | 9 | TBD | 6-7 | NA | 5 | 4 | EBMUD |
| SLC-2 | 70 | TBD | 35-46 | NA | 37 | 33 | EBMUD |

[1] To Be Determined (TBD); information will be updated upon completion of construction planned for 2022.

[2] Not Available (NA), RMS well not yet installed.

### 3.3.6.1. Methodology

There are very limited to no data to characterize streamflow and stream-aquifer interconnections for the largest streams in the EBP Subbasin, which include San Pablo Creek, Wildcat Creek, San Leandro Creek, and San Lorenzo Creek. San Pablo Creek and San Leandro Creek are the primary streams for assignment of initial interim MT. San Lorenzo Creek was not assigned interim MT because it is lined through most of the EBP Subbasin, and the unlined portion is near San Francisco Bay where the river stage is controlled by tide levels. Wildcat Creek was not assigned an interim MT because it flows very close to San Pablo Creek, which should also be representative of conditions along Wildcat Creek. Additional information is currently being developed for San Pablo and San Leandro Creeks under a DWR Proposition 68 grant (e.g., isotope sampling; synoptic streamflow measurements), and additional data collection to characterize potential for streamflow depletion is planned for the early years (initial ten years) of GSP implementation. Therefore, due to the current lack of field data, the technical analysis to evaluate UR, using MT and MO, is based on steady-state groundwater model runs from the 1960s, the sustainability model run, and the current conditions model run. The model results related to stream depletion are summarized in **Appendix 3.F**.

Use of groundwater levels as a proxy is based on the analysis/justification using model results as summarized below. The groundwater model runs for baseline conditions (3,600 AFY), sustainability (12,500 AFY), and 1960s (23,000 AFY) pumping conditions were compared for changes in stream-aquifer connectivity, changes in average streamflow, and changes in shallow groundwater levels. The change in connectivity along each major stream reach between current baseline and sustainability model runs included no change for San Pablo, San Leandro and San Lorenzo Creeks, and a decline of 7% in connectivity for Wildcat Creek. The change in average streamflow from baseline to sustainability run conditions ranged from 0 cubic feet per second (cfs) (San Lorenzo Creek) to between 0.3 (Wildcat Creek) and 0.6 cfs (San Pablo Creek) for the other three major creeks. Changes in shallow groundwater levels along San Pablo and San Leandro Creeks ranged from 0.0 to 1.8 feet.

The change in connectivity along each major stream reach between current baseline and the 1960s run resulted in no change for San Pablo Creek, and declines ranging from 4% (Wildcat Creek) to 29% and 37% for San Leandro and San Lorenzo Creeks, respectively. However, it should be noted that the change in connectivity along San Leandro Creek has no significant effect on stream – aquifer interaction because the channel is lined. The decrease in average streamflow from baseline to the 1960s run conditions ranged from 0.1 to 0.3 cfs (Wildcat and San Pablo Creeks) to between 0.6 (San Lorenzo Creek) and 1.5 cfs (San Leandro Creek). The change in average streamflow for San Lorenzo Creek only occurs along the unlined reach of the creek within 0.75 miles of San Francisco Bay where the stream stage is primarily controlled by tidal fluctuations. Changes in shallow groundwater levels along the creeks ranged from 0.1 feet (San Pablo Creek) to 6 feet (San Leandro Creek). A decrease in shallow groundwater levels beneath/adjacent to creek channels will tend to cause a reduction of connectivity (in cases where shallow groundwater levels fall below the creek bed) and a decrease in streamflow due to either decreased groundwater flow into the creeks (stream discharge) or increased seepage of streamflow into the aquifer (stream recharge). The groundwater model helps demonstrate and quantify this relationship between shallow groundwater levels and changes in connectivity and streamflow.

Steady-state model results indicate that surface water depletion impacts were considerably greater for San Leandro Creek in the 1960s (by a factor of 3 to 4 times) compared to what would occur with pumping at sustainable yield levels, whereas impacts along San Pablo Creek are slightly less for the 1960s model run. The reason for impact differences is because pumping in the 1960s was concentrated in the southern EBP Subbasin with very limited pumping in the northern EBP Subbasin, whereas the sustainability run included evenly distributed pumping (in proportion to transmissivity) from north to south.

Overall, this analysis suggests use of an average groundwater level decline of two feet in shallow wells along major creeks (San Pablo and San Leandro Creeks) as the basis for an interim MT, which is based primarily on model results for shallow groundwater level differences between the baseline and sustainable yield model runs. This analysis does not specifically address the issue that summer baseflow periods are the most critical; such an analysis requires additional field data collection to characterize current baseflow conditions followed by model updates and revision to these interim streamflow depletion MT.

### 3.3.6.2. Relationship to Other Sustainability Indicators

The surface water depletion MT was set independently of other sustainability indicators to clearly distinguish the specific sustainability indicator(s) that are causing UR, should they ever occur in EBP Subbasin. The relationships to other sustainability indicators are described below.

1. **Chronic Lowering of Groundwater Levels.** The methodology to establish MT for groundwater levels does not account for stream depletion. Thus, circumstances may occur where declines in Water Table Aquifer Zone groundwater levels would not constitute an MT exceedance under the chronic decline in groundwater levels sustainability criteria but would be an MT exceedance under the surface water depletion sustainability indicator. The independent establishment of MT under this GSP intends to distinguish which sustainability indicator is not being met for a given set of groundwater conditions that may occur.
2. **Reduction of groundwater storage.** The reduction of groundwater storage MT is based on pumping volumes, whereas the surface water depletion MT is based on changes in shallow groundwater levels. Since most groundwater pumping is from wells screened in the Intermediate/Deep Aquifer Zones (greater than 200 ft bgs) that are separated from the Water Table Aquifer Zone (upper 50 feet) by extensive clay layers, the relationship between a specific set of pumping conditions/volumes is not necessarily known. Collection of additional data and ongoing monitoring during GSP implementation and associated with future groundwater model refinements/improvements along with additional model scenario runs will improve the understanding of the relationships between various potential future pumping scenarios, shallow groundwater levels, and surface water depletion.
3. **Seawater Intrusion.** The seawater intrusion and surface water depletion MT are both based on Water Table Aquifer Zone groundwater elevations. In general, seawater intrusion MT are likely more consistent with surface water depletion MT near the Bay margin than they are further inland. However, as described above for groundwater level MT, the intent of this GSP is to establish independent SMC for each sustainability indicator to distinguish which sustainability indicator may be violated if undesirable conditions were to occur in the future.
4. **Land Subsidence.** The surface water depletion MT is based on Water Table Aquifer Zone groundwater elevations, whereas the land subsidence MT is based on Intermediate and Deep Aquifer Zone groundwater elevations. Therefore, land subsidence MT do not directly relate to or conflict with surface water depletion MT.

5. **Degraded water quality.** The surface water depletion MT are not expected to result in a significant or unreasonable change in groundwater quality.

### 3.3.6.3. Impact of Selected Minimum Thresholds to Adjacent Basins and

The selected minimum thresholds for surface water depletion to adjacent basins will not impact the ability of adjacent basins to be sustainable.

### 3.3.6.4. Minimum Thresholds Impact on Beneficial Uses and Users

The selected MT for surface water depletion will help protect beneficial uses/users that are dependent on streamflow, which may include potential GDEs along particular reaches of some creeks. However, beneficial users (i.e., well owners) pumping shallow groundwater near creeks may potentially be impacted by having their pumping restricted (if the GSAs decided to implement policies to restrict pumping) due to the minimum thresholds for surface water depletion established under this GSP.

### 3.3.6.5. Comparison between Minimum Thresholds and Relevant State, Federal or Local Standards

There are no Federal, State, or local standards that exist for surface water depletion.

### 3.3.6.6. Minimum Threshold Measurement Method

The MT for surface water depletion will be based on measured groundwater levels in shallow wells to be installed early in GSP implementation.

### 3.3.6.7. Management Area Minimum Thresholds

No management areas were designated for the EBP Subbasin.

## 3.4. Measurable Objectives

***(CCR Title 23, Section 354.30)***

As detailed below, the MO represent the expected operating conditions for the EBP Subbasin during the sustainability period. If the GSAs successfully operate to the MO described, the Subbasin will be operating sustainably. Measurable objectives and interim milestones are detailed below. As with the interim MT, the MO developed for this GSP are also considered interim due to the data gaps that exist for the six sustainability indicators. The MO will be refined in the first five-year Update Report in 2027.

A description of the interim MO and how they were established are provided, along with recognition of the anticipated fluctuations in basin conditions around the established interim MO. This section describes how the GSP helps to meet each measurable objective, how each measurable objective is intended to achieve the sustainability goal for the Plan area for the long-term beneficial uses, and how the interim milestones are intended to reflect the anticipated progress toward the MO during the 2022 to 2042 implementation period.

The GSP regulations define MO as specific, quantifiable criteria for the maintenance or improvement of specific groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

Per GSP Regulations (354.30):

1. Measurable objectives shall be established, "…including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon." (354.30.a)
2. "Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metric and monitoring sites as are used to define the minimum thresholds." (354.30.b)
3. "Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions, which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty." (354.30.c)
4. "…a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators…" may be established where "…the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence." (354.30.d)
5. "Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years." (354.30.e)

The interim MO developed for each applicable sustainability indicator in this GSP are based on the current understanding of the Plan Area and Basin Setting as discussed in detail in Chapter 2. RMS wells are identified for monitoring of MO and interim milestones for each sustainability indicator.

### *3.4.1. Chronic Lowering of Groundwater Levels*

Measurable objectives and interim milestones for chronic lowering of groundwater levels are described below.

#### 3.4.1.1. Measurable Objectives

Interim measurable objectives for groundwater levels were established in accordance with the sustainability goal through review and evaluation of measured groundwater level data and future projected fluctuations in groundwater levels utilizing the numerical groundwater flow model (**Appendix 6.E**), which simulated implementation of projects (with existing facilities) and MA with representative long-term hydrology. This analysis provides estimates of the expected groundwater level variability due to climatic and operational variability. Both annual (year to year) and seasonal (winter/spring to summer/fall) variability were considered. Measurable objectives for groundwater levels were determined based on recent groundwater level measurements and/or model-derived groundwater levels. MO were established based on the average of recent (i.e., last ten years) observed measurements if sufficient data were available, otherwise the average of model-simulated groundwater elevations were used to determine the MO. Measurable objectives for groundwater levels for each sustainability indicator well or RMS are summarized in **Table 3-8**, and locations of groundwater level sustainability indicator wells are shown in **Figure 3-1**. Groundwater level hydrographs showing MO for each groundwater level sustainability indicator well are provided in **Appendix 3.A**, and examples are provided in **Figures 3-2 through 3-4.**

### 3.4.1.2. Interim Milestones

Interim milestones for chronic lowering of groundwater levels were established at five-year intervals over the Implementation Period from 2022 to 2042, at years 2027, 2032, and 2037. Since the MO effectively represent current conditions under which the Subbasin is already sustainable, interim milestones were set equal to the MO. Interim milestones for groundwater levels for each sustainability indicator well are summarized in **Table 3-3**, and locations of groundwater level RMS wells are shown in **Figure 3-1**.

**Table 3-8. Summary of Groundwater Level Measurable Objectives for RMS**

| Well I.D. | Reference Point Elevation | Well Depth | Screen Top-Bottom | Model Layer(s) | Aquifer Designation | MO Depth | MO Elev[1] | GSA[2] |
|---|---|---|---|---|---|---|---|---|
| MW-5S | 13.88 | 210 | 200-210 | 3-4 | Shallow/Int | 6 | 8 | EBMUD |
| MW-5I | 13.88 | 325 | 315-325 | 6 | Intermediate | 7 | 7 | EBMUD |
| MW-5D | 13.78 | 640 | 500-630 | 9-12 | Deep | 19 | -5 | EBMUD |
| MW-8D | 14.76 | 490 | 420-480 | 7-9 | Deep | 23 | -8 | EBMUD |
| MW-9S | 54.39 | 120 | 110-120 | 3 | Shallow | 21 | 33 | EBMUD |
| MW-9I | 54.39 | 210 | 200-210 | 5 | Intermediate | 34 | 20 | EBMUD |
| MW-9D | 54.39 | 335 | 325-335 | 6 | Intermediate | 48 | 6 | EBMUD |
| MW-10S | 11.76 | 120 | 100-120 | 3 | Shallow | 4 | 8 | EBMUD |
| MW-10I | 11.76 | 360 | 340-360 | 7 | Intermediate | 8 | 4 | EBMUD |
| MW-10D | 11.76 | 610 | 590-610 | 11 | Deep | 17 | -5 | EBMUD |
| S2-MWS1 | 6 | 85 | 50-80 | 2 | Shallow | 3 | 3 | EBMUD |
| S2-MWS2 | 6 | 205 | 140-180 | 3-4 | Shallow | 3 | 3 | EBMUD |
| S2-MWD1 | 9 | 555 | 480-500 | 7-8 | Deep | 12 | -3 | EBMUD |
| MW-N1S | 73 | TBD[3] | TBD | TBD | Shallow | 20 | 53 | EBMUD |
| MW-N1I | 73 | TBD | TBD | TBD | TBD | 23 | 50 | EBMUD |
| MW-N2S | 19 | TBD | TBD | TBD | Shallow | 14 | 5 | EBMUD |
| MW-N2I | 19 | TBD | TBD | TBD | TBD | 14 | 5 | EBMUD |
| MW-N3S | 14 | TBD | TBD | TBD | Shallow | 7 | 7 | EBMUD |
| MW-N3I | 14 | TBD | TBD | TBD | Intermediate | 7 | 7 | EBMUD |
| MW-S1S | 27 | TBD | TBD | TBD | Shallow | 11 | 16 | Hayward |
| MW-S1I | 27 | TBD | TBD | TBD | Intermediate | 20 | 7 | Hayward |
| MW-S1D | 27 | TBD | TBD | TBD | Deep | 30 | -3 | Hayward |
| MW-S2S | 18 | TBD | TBD | TBD | Shallow | 9 | 9 | Hayward |

**Table 3-8. Summary of Groundwater Level Measurable Objectives for RMS**

| Well I.D. | Reference Point Elevation | Well Depth | Screen Top-Bottom | Model Layer(s) | Aquifer Designation | MO Depth | MO Elev[1] | GSA[2] |
|---|---|---|---|---|---|---|---|---|
| MW-S2I | 18 | TBD | TBD | TBD | Intermediate | 12 | 6 | Hayward |
| MW-S2D | 18 | TBD | TBD | TBD | Deep | 22 | -4 | Hayward |
| Well D | 43 | 600 | 500-585 | 9-11 | Deep | 45 | -2 | Hayward |
| Mt. Eden Park | 24 | 550 | 460-530 | 9-10 | Deep | 41 | -17 | Hayward |

[1] The actual MO is based on the groundwater elevation, but the depth to water corresponding to the surface elevation in the project database is also provided.

[2] Each GSA is responsible for collecting groundwater levels for the RMS wells within their GSA area.

[3] TBD = To Be Determined; information will be updated upon completion of construction planned for 2022.

**Table 3-9. Summary of Groundwater Level Interim Milestones for RMS**

| Well I.D. | Model Layer(s) | 2027 DTW | 2032 DTW | 2037 DTW | 2042 DTW | 2027 Elev | 2032 Elev | 2037 Elev | 2042 Elev | GSA |
|---|---|---|---|---|---|---|---|---|---|---|
| MW-5S | 3-4 | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | EBMUD |
| MW-5I | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | EBMUD |
| MW-5D | 9-12 | 19 | 19 | 19 | 19 | -5 | -5 | -5 | -5 | EBMUD |
| MW-8D | 7-9 | 23 | 23 | 23 | 23 | -8 | -8 | -8 | -8 | EBMUD |
| MW-9S | 3 | 21 | 21 | 21 | 21 | 33 | 33 | 33 | 33 | EBMUD |
| MW-9I | 5 | 34 | 34 | 34 | 34 | 20 | 20 | 20 | 20 | EBMUD |
| MW-9D | 6 | 48 | 48 | 48 | 48 | 6 | 6 | 6 | 6 | EBMUD |
| MW-10S | 3 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | EBMUD |
| MW-10I | 7 | 8 | 8 | 8 | 8 | 4 | 4 | 4 | 4 | EBMUD |
| MW-10D | 11 | 17 | 17 | 17 | 17 | -5 | -5 | -5 | -5 | EBMUD |
| S2-MWS1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | EBMUD |
| S2-MWS2 | 3-4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | EBMUD |
| S2-MWD1 | 7-8 | 12 | 12 | 12 | 12 | -3 | -3 | -3 | -3 | EBMUD |
| MW-N1S | TBD | 20 | 20 | 20 | 20 | 53 | 53 | 53 | 53 | EBMUD |
| MW-N1I | TBD | 23 | 23 | 23 | 23 | 50 | 50 | 50 | 50 | EBMUD |
| MW-N2S | TBD | 14 | 14 | 14 | 14 | 5 | 5 | 5 | 5 | EBMUD |
| MW-N2I | TBD | 14 | 14 | 14 | 14 | 5 | 5 | 5 | 5 | EBMUD |
| MW-N3S | TBD | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | EBMUD |
| MW-N3I | TBD | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | EBMUD |
| MW-S1S | TBD | 11 | 11 | 11 | 11 | 16 | 16 | 16 | 16 | Hayward |
| MW-S1I | TBD | 20 | 20 | 20 | 20 | 7 | 7 | 7 | 7 | Hayward |

**Table 3-9. Summary of Groundwater Level Interim Milestones for RMS**

| Well I.D. | Model Layer(s) | 2027 DTW | 2032 DTW | 2037 DTW | 2042 DTW | 2027 Elev | 2032 Elev | 2037 Elev | 2042 Elev | GSA |
|---|---|---|---|---|---|---|---|---|---|---|
| MW-S1D | TBD | 30 | 30 | 30 | 30 | -3 | -3 | -3 | -3 | Hayward |
| MW-S2S | TBD | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | Hayward |
| MW-S2I | TBD | 12 | 12 | 12 | 12 | 6 | 6 | 6 | 6 | Hayward |
| MW-S2D | TBD | 22 | 22 | 22 | 22 | -4 | -4 | -4 | -4 | Hayward |
| Well D | 9-11 | 45 | 45 | 45 | 45 | -2 | -2 | -2 | -2 | Hayward |
| Mt. Eden Park | 9-10 | 41 | 41 | 41 | 41 | -17 | -17 | -17 | -17 | Hayward |

[1] To Be Determined (TBD); information will be updated upon completion of construction planned for 2022.

### 3.4.1.3. Achieving and Maintaining Sustainability

The combination of interim milestones and MO reflects how the basin anticipates maintaining sustainability with continued use of existing groundwater injection/extraction facilities. Future projections will require assumptions about future hydrologic conditions, including the sequence of wet, average, and dry climatic years. The future climatic assumptions for the implementation and sustainability periods used in this GSP incorporate sequences of wet, average, and dry years that represent overall long-term average historical climatic conditions over the implementation and sustainability periods, including one prolonged period of dry years. This overall pattern of anticipated fluctuations in groundwater levels reflects a slight decrease in average groundwater elevations associated with a very modest increase in overall groundwater extraction using existing facilities.

### 3.4.1.4. Impact of Selected Measurable Objectives on Adjacent Basins

The interim MO established for the EBP Subbasin Plan area provide a good basis for evaluation of anticipated impacts on adjacent subbasins from implementation of the GSP. This is because MO are set to reflect the average groundwater levels to be maintained during the sustainability period. Ultimately, the potential for impacts on adjacent subbasins will be primarily a function of average water levels in Plan area during the sustainability period, average water levels in adjacent subbasins during the sustainability period, and natural groundwater flow conditions that would be expected to occur at Plan area boundaries. The average groundwater levels expected for the Plan area are reflected in the MO. Groundwater model results indicate that the average groundwater levels reflected in the MO will result in similar groundwater elevations as in the historical period from 1990 to 2015. Therefore, the projects and MA implemented for this GSP are expected to have no significant impacts on adjacent subbasins (compared to historical conditions) and will not hinder the ability of adjacent subbasins to be sustainable.

## *3.4.2. Reduction of Groundwater Storage*

MO and interim milestones for reduction of groundwater storage are described below.

### 3.4.2.1. Measurable Objective

The interim MO for reduction of groundwater storage is based on the volume of annual groundwater pumping and is half of the estimated sustainable yield or 6,250 AFY, measured at a five-year rolling average. Available data for current groundwater pumping amounts are provided in **Appendix 3.B**.

### 3.4.2.2. Interim Milestones

The interim milestones for reduction of groundwater storage are the same as the MO.

### 3.4.2.3. Achieving and Maintaining Sustainability

The combination of interim milestones and MO reflects how the basin will maintain sustainability. Annual pumping volumes can exceed the MO while the EBP Subbasin still remains sustainable. However, additional work is needed during the early years of GSP implementation to further evaluate the sustainable yield, so the initial interim MO was set at a lower level until further analysis of the sustainable yield is conducted.

### 3.4.2.4. Impact of Selected Measurable Objectives on Adjacent Basins

Groundwater model results indicate that the average annual groundwater pumping volumes reflected in the MO will result in no significant impacts on groundwater storage in adjacent basins. Therefore, the projects and MA implemented for this GSP will not hinder the ability of adjacent basins to be sustainable with regards to groundwater storage.

## *3.4.3. Seawater Intrusion*

Information on historical seawater intrusion in the Subbasin is presented in the HCM (Chapter 2). The EBP Subbasin has not experienced significant seawater intrusion in the past, even when groundwater levels in the Intermediate and Deep Aquifer Zones were substantially lower in the 1950s and 1960s. A minor amount of seawater intrusion in the Shallow Aquifer Zone near the San Francisco Bay Margin (e.g., San Pablo Wellfield in Richmond, Alameda Island) reportedly occurred in some areas of the EBP Subbasin prior to the 1930s. Due to the potential to draw Intermediate and Deep Aquifer groundwater elevations below sea level in the future, there is at least the potential for seawater intrusion to occur. MO and interim milestones for seawater intrusion were established and are described below.

Since the San Francisco Bay is only connected to the shallow Water Table Aquifer Zone (upper 50 feet of sediments) with multiple thick clay layers between the Water Table Aquifer Zone and deeper aquifer units, shallow groundwater levels serve as a good proxy for seawater intrusion. Maintaining shallow groundwater levels above Mean Sea Level is expected to prevent seawater intrusion.

### 3.4.3.1. Measurable Objective

The interim MO for seawater intrusion is maintaining the five feet MSL groundwater elevation contour for the Water Table Aquifer Zone in its current or baseline position (or maintaining an equivalent total area between the shoreline and five foot groundwater elevation contour). The baseline position of the five feet MSL groundwater elevation contour will be developed in 2022 based on available GeoTracker data for shallow groundwater levels combined with additional nested monitoring well data for ongoing work related to the DWR Proposition 68 grant. However, an initial interim baseline for the five feet groundwater elevation contour is provided in **Figure 3-7**. Currently available data supporting proposed seawater intrusion SMC are provided in **Appendix 3.C**.

#### 3.4.3.2. Interim Milestones

The Interim Milestones for seawater intrusion are the same as the MO.

#### 3.4.3.3. Achieving and Maintaining Sustainability

The combination of interim milestones and MO reflects how the basin will maintain sustainability through 2042 and beyond. Since groundwater levels serve as a practical proxy for evaluating potential for seawater intrusion, achieving, and maintaining sustainability relative to this indicator is expected to occur with maintenance of existing conditions.

#### 3.4.3.4. Impact of Selected Measurable Objectives on Adjacent Basins

The Niles Cone Subbasin is managed on the same premise as applied in this GSP for seawater intrusion: shallow groundwater levels maintained above MSL will prevent seawater intrusion. Therefore, the MO will have no impacts on adjacent subbasins.

### *3.4.4. Land Subsidence*

Information on historical subsidence in the Subbasin is presented in the HCM (Chapter 2). The EBP Subbasin has not experienced significant subsidence or damage to infrastructure in the past, even when groundwater levels in the Intermediate and Deep Aquifer Zones were substantially lower in the 1950s and 1960s. However, due to the predominance of clay sediments and at least the potential for subsidence to occur in the future, MO and interim milestones for land subsidence were established and are described below.

#### 3.4.4.1. Measurable Objective

There is a relationship between the potential for land subsidence to occur and groundwater levels; this allows groundwater levels to serve as a proxy for the land subsidence sustainability indicator in this GSP. Therefore, the interim MO for land subsidence is based on the MO for chronic lowering of groundwater levels. Since groundwater levels in the Intermediate and Deep Aquifers were tens to hundreds of feet below sea level in the 1950s and 1960s without any apparent significant subsidence impacts, historical low groundwater levels represent a decline in groundwater levels that did not incur any significant inelastic subsidence. Even if some amount of subsidence occurred and went unreported in the 1950s and 1960s, no additional significant subsidence would be expected to occur until historical low water levels are exceeded. The interim MO for land subsidence are the same as the MO for groundwater levels in the Intermediate and Deep Aquifers. The locations of land subsidence RMS wells are provided in **Figure 3-8** Supporting data for development of land subsidence SMC are provided in **Appendix 3.D**.

### 3.4.4.2. Interim Milestones

Groundwater levels are being used as a proxy for land subsidence; therefore, the interim milestones for land subsidence are the same as the interim milestones for chronic lowering of groundwater levels in Intermediate and Deep RMS wells.

### 3.4.4.3. Achieving and Maintaining Sustainability

The combination of interim milestones and MO reflects how the basin will maintain sustainability through 2042 and beyond. Since groundwater levels serve as a practical proxy for evaluating potential for land subsidence, achieving and maintaining sustainability relative to this indicator is similar to that described above in the groundwater level Section 3.4.1.3.

### 3.4.4.4. Impact of Selected Measurable Objectives on Adjacent Basins

Groundwater model results indicate that the average groundwater levels reflected in the MO will result in groundwater levels similar to recent groundwater levels. Therefore, the projects and MA implemented for this GSP will not hinder the ability of adjacent basins to be sustainable with regards to land subsidence.

## *3.4.5. Degraded Water Quality*

Varied levels of key constituents in groundwater affect water quality considerations throughout the Subbasin (see Section 2). Elevated concentrations of naturally occurring and existing constituent concentrations resulting from historical land use practices are present in certain areas and aquifer depth zones of the basin. As noted in Section 2 (HCM), elevated concentrations of nitrate and TDS are present in some Shallow Aquifer Zone wells in the Subbasin. It is possible that increases in these concentrations may occur due to historical nitrogen and salt loading in the unsaturated zone independent of any GSP activities. The planned projects and MA are not intended to remediate these existing concentrations; however, they also are not anticipated to exacerbate these trends and conditions. Municipal and domestic supply (MUN) is a designated beneficial use for groundwater in the Subbasin; therefore, groundwater quality degradation would become significant and unreasonable based on adverse impacts to this beneficial use. This GSP intends to implement planned projects and MA in ways that do not cause or exacerbate groundwater quality impacts to beneficial uses.

### 3.4.5.1. Measurable Objective

The interim MO for groundwater quality are established to not exacerbate adverse impacts on all beneficial uses of groundwater resulting from implementation of GSP projects or MA. MO for the groundwater quality sustainability indicator are intended to assure that GSP projects and MA do not cause groundwater quality conditions to become unsuitable for any beneficial use, especially municipal and domestic supply uses since these are the most restrictive from a water quality standpoint. The groundwater quality MO are defined for individual RMS wells for key water quality constituents, including: arsenic, nitrate, chloride, and TDS. As discussed in Section 2 of this GSP, nitrate is an anthropogenic water quality constituent of concern, occurring at elevated concentrations in shallow groundwater in some areas, likely as a result of historical land use practices. The MO for arsenic, chloride, and TDS are intended to address additional potential groundwater quality impacts associated with GSP projects and MA that may result from lowered groundwater levels in some areas or altered groundwater flow dynamics.

The RMS wells represent groundwater quality conditions across the Subbasin and will be monitored by the GSAs. For all groundwater quality RMS wells, the interim MO concentrations for arsenic, nitrate, chloride, and TDS are or will be set at levels representative of recent/current baseline concentrations observed in the well with the intent to ensure that activities related to GSP projects or MA do not adversely impact groundwater quality conditions. Recent concentrations over the past 10 to 15 years (or baseline concentrations to be established from groundwater sampling early in the GSP implementation period) are used as the basis for setting the MO concentrations. The interim MO concentrations are an average of the recent (i.e., last 10 to 15 years) concentrations from baseline sampling for each of the key constituents. MO concentrations for groundwater quality for each sustainability indicator well are summarized in **Table 3-10**, and locations of groundwater quality sustainability indicator wells are shown in **Figure 3-2**. Tables and graphs of historical results for key water quality constituents in the representative groundwater quality indicator wells are presented in **Appendix 3.E.** It should be noted that many RMS wells have no or one measured value for a given constituent, and additional groundwater quality sampling is needed early in the GSP Implementation Period to establish a reliable baseline concentration.

### 3.4.5.2. Interim Milestones

The interim milestones for the groundwater quality sustainability indicator are the same as the MO and include ensuring that during the Implementation Period, GSP projects and MA do not cause degradation of existing groundwater quality that would make groundwater unsuitable for the most restrictive beneficial use of municipal and domestic supply. The groundwater quality interim milestones are maintaining existing groundwater quality concentrations for arsenic, nitrate, chloride, and TDS at each RMS well over the Implementation Period as summarized in **Table 3-11**. Consistent with the MOs, groundwater quality interim milestones also include maintaining existing or historical groundwater quality conditions over the Implementation Period for wells in which the existing or historical conditions already exceed the MCL. The GSP does not include any plan or milestones specifically intended to improve groundwater quality conditions in wells with existing or historical MCL exceedances.

**Table 3-10. Summary of Groundwater Quality Measurable Objectives for RMS**

| Well ID | Well Depth | Screen Top-Bottom | Aquifer Designation | MO Arsenic Concentration (µg/L)[1] | MO Nitrate Concentration (mg/L)[1] | MO Chloride Concentration (mg/L)[1] | MO TDS Concentration (mg/L)[1] | GSA Location | Measurement Frequency |
|---|---|---|---|---|---|---|---|---|---|
| MW-5S | 210 | 200-210 | Intermediate | 3 | 8 | 56 | 459 | EBMUD | Annual |
| MW-5I | 325 | 315-325 | Intermediate | 19 | 8 | 63 | 454 | EBMUD | Annual |
| MW-5D | 640 | 500-630 | Deep | 0.5 | 0.06 | 82 | 458 | EBMUD | Annual |
| MW-8D | 490 | 420-480 | Deep | 15 | 0.006 | 50 | 420 | EBMUD | Annual |
| MW-9S | 120 | 110-120 | Shallow | 2 | 8 | 52 | 614 | EBMUD | Annual |
| MW-9I | 210 | 200-210 | Intermediate | 2 | 8 | 47 | 428 | EBMUD | Annual |
| MW-9D | 335 | 325-335 | Intermediate | 3 | 8 | 53 | 474 | EBMUD | Annual |
| MW-10S | 120 | 100-120 | Shallow | 6 | 8 | 43 | 390 | EBMUD | Annual |
| MW-10I | 360 | 340-360 | Intermediate | 6 | 8 | 53 | 465 | EBMUD | Annual |
| MW-10D | 610 | 590-610 | Deep | 2 | 8 | 123 | 528 | EBMUD | Annual |
| S2-MWS1 | 85 | 50-80 | Shallow | 8 | 8 | 15,000 | 27,000 | EBMUD | Annual |
| S2-MWS2 | 205 | 140-180 | Shallow | 8 | 8 | 3,500 | 6,100 | EBMUD | Annual |
| S2-MWD1 | 555 | 480-500 | Deep | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N1S | TBD[2] | TBD | Shallow | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N1I | TBD | TBD | TBD | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N2S | TBD | TBD | Shallow | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N2I | TBD | TBD | TBD | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N3S | TBD | TBD | Shallow | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-N3I | TBD | TBD | Intermediate | 8 | 8 | 200 | 420 | EBMUD | Annual |
| MW-S1S | TBD | TBD | Shallow | 8 | 8 | 200 | 420 | Hayward | Annual |

**Table 3-10. Summary of Groundwater Quality Measurable Objectives for RMS**

| Well ID | Well Depth | Screen Top-Bottom | Aquifer Designation | MO Arsenic Concentration (µg/L)[1] | MO Nitrate Concentration (mg/L)[1] | MO Chloride Concentration (mg/L)[1] | MO TDS Concentration (mg/L)[1] | GSA Location | Measurement Frequency |
|---|---|---|---|---|---|---|---|---|---|
| MW-S1I | TBD | TBD | Intermediate | 8 | 8 | 200 | 420 | Hayward | Annual |
| MW-S1D | TBD | TBD | Deep | 8 | 8 | 200 | 420 | Hayward | Annual |
| MW-S2S | TBD | TBD | Shallow | 8 | 8 | 200 | 420 | Hayward | Annual |
| MW-S2I | TBD | TBD | Intermediate | 8 | 8 | 200 | 420 | Hayward | Annual |
| MW-S2D | TBD | TBD | Deep | 8 | 8 | 200 | 420 | Hayward | Annual |
| Well D | 600 | 500-585 | Deep | 1 | 8 | 52 | 412 | Hayward | Annual |
| Mt. Eden Park | 550 | 460-530 | Deep | 8 | 8 | 200 | 420 | Hayward | Annual |

[1] Values will be confirmed and/or adjusted as needed based on results from initial sampling for constituents.

[2] To Be Determined (TBD); these RMS wells have not been drilled yet but are planned for installation by mid-2022.

**Table 3-11. Summary of Groundwater Quality Interim Milestones for RMS**

| Well ID | 2027 As (µg/L)[1] | 2032 As (µg/L)[1] | 2037 As (µg/L)[1] | 2042 As (µg/L)[1] | 2027 Nitrate (mg/L)[1] | 2032 Nitrate (mg/L)[1] | 2037 Nitrate (mg/L)[1] | 2042 Nitrate (mg/L)[1] | 2027 Cl (mg/L)[1] | 2032 Cl (mg/L)[1] | 2037 Cl (mg/L)[1] | 2042 Cl (mg/L)[1] | 2027 TDS (mg/L)[1] | 2032 TDS (mg/L)[1] | 2037 TDS (mg/L)[1] | 2042 TDS (mg/L)[1] | GSA Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-5S | 3 | 3 | 3 | 3 | 8 | 8 | 8 | 8 | 56 | 56 | 56 | 56 | 459 | 459 | 459 | 459 | EBMUD |
| MW-5I | 19 | 19 | 19 | 19 | 8[†] | 8 | 8 | 8 | 63 | 63 | 63 | 63 | 454 | 454 | 454 | 454 | EBMUD |
| MW-5D | 0.5 | 0.5 | 0.5 | 0.5 | 0.06 | 0.06 | 0.06 | 0.06 | 82 | 82 | 82 | 82 | 458 | 458 | 458 | 458 | EBMUD |
| MW-8D | 15 | 15 | 15 | 15 | 0.006 | 0.006 | 0.006 | 0.006 | 50 | 50 | 50 | 50 | 420 | 420 | 420 | 420 | EBMUD |
| MW-9S | 2 |  | 2 | 2 | 0.003 | 0.003 | 0.003 | 0.003 | 52 | 52 | 52 | 52 | 614 | 614 | 614 | 614 | EBMUD |
| MW-9I | 2 | 2 | 2 | 2 | 8 | 8 | 8 | 8 | 47 | 47 | 47 | 47 | 428 | 428 | 428 | 428 | EBMUD |
| MW-9D | 3 | 3 | 3 | 3 | 8 | 8 | 8 | 8 | 53 | 53 | 53 | 53 | 474 | 474 | 474 | 474 | EBMUD |
| MW-10S | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 43 | 43 | 43 | 43 | 390 | 390 | 390 | 390 | EBMUD |
| MW-10I | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 53 | 53 | 53 | 53 | 465 | 465 | 465 | 465 | EBMUD |
| MW-10D | 2 | 2 | 2 | 2 | 8 | 8 | 8 | 8 | 123 | 123 | 123 | 123 | 528 | 528 | 528 | 528 | EBMUD |
| S2-MWS1 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 15,000 | 15,000 | 15,000 | 15,000 | 27,000 | 27,000 | 27,000 | 27,000 | EBMUD |
| S2-MWS2 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 3,500 | 3,500 | 3,500 | 3,500 | 6,100 | 6,100 | 6,100 | 6,100 | EBMUD |
| S2-MWD1 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-N1S | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-N1I | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-N2I | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-N3S | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-N3I | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | EBMUD |
| MW-S1S | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| MW-S1I | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| MW-S1D | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| MW-S2S | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| MW-S2I | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| MW-S2D | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |
| Well D | 1 | 1 | 1 | 1 | 8 | 8 | 8 | 8 | 52 | 52 | 52 | 52 | 412 | 412 | 412 | 412 | Hayward |
| Mt. Eden Park | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 200 | 200 | 200 | 200 | 420 | 420 | 420 | 420 | Hayward |

[1] Values will be confirmed and/or adjusted as needed based on results from initial sampling for constituents.

### 3.4.5.3. Achieving and Maintaining Sustainability

The combination of interim milestones and MO reflects how the basin will maintain sustainability by ensuring that GSP projects and MA do not significantly and unreasonably degrade groundwater quality conditions or exacerbate already degraded conditions. The network of groundwater quality RMS wells will enable tracking of groundwater quality conditions as they relate to GSP-related activities and activities unrelated to GSP actions. If evaluation of groundwater quality monitoring suggests that GSP projects and MA are having adverse impacts on groundwater quality affecting beneficial uses, modifications to the GSP projects and MA may be required.

### 3.4.5.4. Impact of Selected Measurable Objectives on Adjacent Basins

Groundwater quality MO are set to protect and maintain groundwater quality conditions suitable for all beneficial uses in the Subbasin, including municipal and drinking water supply, and are not anticipated to impact beneficial uses for groundwater in adjacent subbasins.

## *3.4.6. Depletion of Surface Water*

As described in the HCM in Chapter 2, regional groundwater levels are generally expected to be below stream thalwegs in the eastern portion of the Subbasin, and above stream thalwegs in the western portion of the Subbasin. There is very limited existing information to define gaining and losing reaches of Subbasin streams and the extent of connection between groundwater and surface water under various seasonal and water year type climatic conditions. Thus, a significant data gap exists related to depletion of surface water that will be addressed during the GSP Implementation Period (see Section 3.5). Supporting data available for establishing initial interim SMC for surface water depletion are provided in **Appendix 3.F**.

### 3.4.6.1. Measurable Objective

There is a general lack of available data relating to streamflow, gaining and losing reaches, and overall spatial/temporal connections between surface water and groundwater; accordingly, MO are established to maintain current conditions in the EBP Subbasin relative to shallow groundwater levels that serve as a proxy for stream depletion (see discussion in Section 3.3). The new wells to be installed at representative locations along major creeks will be used to establish baseline conditions and for future monitoring. Initial interim MO have been established at five potential shallow monitoring well sites along two major creeks: San Pablo Creek and San Leandro Creek (**Table 3-12 and Figure 3-13**). Additional data to be collected early in GSP implementation to fill data gaps related to surface water depletion will be reviewed during the five-year Update Report, and MO for surface water depletion will be updated then.

**Table 3-12. Summary of Surface Water Depletion Measurable Objectives for RMS**

| Well I.D. | Reference Point Elevation | Screen Top-Bottom | Model Baseline GW Elevation (ft MSL) | Observed Baseline GW Elevation (ft MSL) | MO Depth | MO Elevation | GSA |
|---|---|---|---|---|---|---|---|
| SPC-1 | 30 | TBD[1] | 27-29 | NA[2] | 3 | 27 | EBMUD |
| SPC-2 | 70 | TBD | 59-60 | NA | 11 | 59 | EBMUD |
| SPC-3 | 76 | TBD | 48-51 | NA | 28 | 48 | EBMUD |
| SLC-1 | 9 | TBD | 6-7 | NA | 3 | 6 | EBMUD |
| SLC-2 | 70 | TBD | 35-46 | NA | 35 | 35 | EBMUD |

[1] To Be Determined (TBD); RMS Wells not drilled yet.

[2] Not Available (NA); RMS Well not drilled yet.

### 3.4.6.2. Interim Milestones

Initial interim milestones for surface water depletion (**Table 3-13**) are the same as the MO. Additional data to be collected early in GSP implementation to fill data gaps related to surface water depletion will be reviewed during the five-year Update Report, and interim milestones for surface water depletion will be updated.

**Table 3-13. Summary of Surface Water Depletion Interim Milestones for RMS**

| Well I.D. | Model Layer | 2027 DTW[1] | 2032 DTW | 2037 DTW | 2042 DTW | 2027 Elev[2] | 2032 Elev | 2037 Elev | 2042 Elev | GSA |
|---|---|---|---|---|---|---|---|---|---|---|
| SPC-1 | 30 | 3 | 3 | 3 | 3 | 27 | 27 | 27 | 27 | EBMUD |
| SPC-2 | 70 | 11 | 11 | 11 | 11 | 59 | 59 | 59 | 59 | EBMUD |
| SPC-3 | 76 | 28 | 28 | 28 | 28 | 48 | 48 | 48 | 48 | EBMUD |
| SLC-1 | 9 | 3 | 3 | 3 | 3 | 6 | 6 | 6 | 6 | EBMUD |
| SLC-2 | 70 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | EBMUD |

[1] Depth to water.

[2] Elevation.

### 3.4.6.3. Achieving and Maintaining Sustainability

The EBP Subbasin is currently operated in a sustainable manner. The establishment of interim milestones and MO will reflect how the basin will maintain sustainability. Adhering to these interim milestones and MO will allow the EBP Subbasin to continue operating in a sustainable manner.

### 3.4.6.4. Impact of Selected Measurable Objectives on Adjacent Basins

The MO set for the EBP Subbasin will serve to maintain sustainability of the EBP Subbasin, which would also serve to maintain sustainability in adjacent subbasins. Therefore, the projects and MA implemented for this GSP are not expected to hinder the ability of adjacent basins to be sustainable. The MO set for stream depletion in EBP Subbasin will not impact adjacent basins.

## 3.5. Monitoring Network

This section describes the monitoring network and includes the following subsections:

- Description of Monitoring Network
- Monitoring Protocols for Data Collection and Monitoring
- Representative Monitoring
- Assessment and Improvement of Monitoring Network

### *3.5.1. Description of Monitoring Network*
***(CCR Title 23, Section 354.34)***

This subsection on the monitoring network is intended to:

- Describe how the monitoring network will be used to collect sufficient data about groundwater conditions to evaluate Plan implementation
- Describe monitoring network objectives
- Describe how monitoring network will be used to demonstrate progress towards achieving MO, monitor impacts to beneficial uses/users, monitor changes in groundwater conditions, and quantify annual changes in water budget components
- Describe how monitoring network allows documentation of groundwater occurrence, flow, and hydraulic gradients, calculation of annual groundwater storage change, rate and extent of subsidence, and groundwater quality trends
- Describe how monitoring network provides adequate coverage of sustainability indicators
- Describe monitoring network density and measurement frequency
- Describe monitoring network site selection rationale
- Describe data and reporting standards
- Provide map(s) with location and types of monitoring sites.

The GSP groundwater level monitoring network was initially developed using existing wells in the Subbasin and new nested monitoring wells being installed in 2022. Plans are being developed for additional monitoring wells to fill data gaps; these recommended wells will likely be installed during the initial five years of the Implementation Period. The database for existing wells was reviewed with the following criteria in mind:

- Wells owned by GSAs are preferred;
- Wells with known construction (screen intervals, depth) are preferred;
- Wells with several years of water level data history (including recent data) are preferred;
- Wells that are spatially distributed are preferred;
- Wells that provide representation of Shallow, Intermediate, and Deep Aquifer Zones (Intermediate and Deep Zones are not present in all areas of EBP Subbasin) are preferred.

To the extent possible, the network was composed of wells known to represent a specific aquifer depth zone and not screened across multiple zones. The network will enable the collection of data to assess sustainability indicators, the effectiveness of MA and projects that maintain sustainability and evaluate the MO and MT of each applicable sustainability indicator. In some cases (e.g., depletion of interconnected surface waters), available field data are insufficient to characterize groundwater conditions relative to that sustainability indicator, and additional data collection and installation of RMS wells are proposed early in the GSP Implementation Period. Therefore, this GSP uses best available data (e.g., model results only in some cases) to derive initial interim MT, which will be refined in the first five-year Update Report in 2027.

As described above, for the purposes of the GSP monitoring program, a subset of existing wells was identified that best meets certain criteria. Not all the criteria were satisfied for each well, but this effort resulted in 27 wells to represent the Subbasin, with ten wells in the Shallow Aquifer Zone, nine wells in the Intermediate Aquifer Zone, and eight wells in the Deep Aquifer Zone – referred to as the RMS wells.

These RMS wells are distributed throughout the Subbasin to provide coverage of the entire area to the extent possible. This initial RMS coverage combined with the planned overall monitoring network generally allows for the collection of data to evaluate groundwater level fluctuations over time and to calculate the annual change in storage over a significant portion of the Subbasin. The spatial coverage is currently limited primarily to the southern portion of the Subbasin due to availability of existing wells (installation of nested monitoring wells by 2022 is expected to expand the area of coverage for the northern Subbasin). Furthermore, the monitoring frequency of the RMS wells will allow for the monitoring of seasonal highs and lows. For wells that have sufficient historical data records, future groundwater data will be compared to historical data. The monitoring network is expected to evolve as new wells are drilled and water level data histories are developed. The monitoring network will be periodically reviewed, and improvements made where possible.

### 3.5.1.1. Groundwater Level Monitoring Program

The MT and MO for the chronic lowering of groundwater levels sustainability indicator are evaluated by monitoring groundwater levels. The SGMA regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow direction, and hydraulic gradients between principal aquifers and surface water features. The overall monitoring network for groundwater levels is comprised of the RMS Wells and the potential supplemental wells (**Appendix 3.A)**.

The objectives of the groundwater level monitoring program include:

- Improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify vertical hydraulic head differences in the aquifer system and aquifer-specific groundwater conditions, especially in areas where potential development of additional groundwater resources may be considered in the future;
- Detect the occurrence of, and factors attributable to, natural (e.g., direct infiltration of precipitation), irrigation, and surface water seepage to groundwater or projects and MA (e.g., injection and extraction wells) that affect groundwater levels and trends;
- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and
- Generate data to better understand groundwater basin conditions and assess current and future local water supply availability and reliability; update analyses as additional data become available.

A map of the Subbasin showing the potential supplemental monitoring network wells is provided in **Appendix 3.G**, along with a table listing each well. The current status of these wells and potential access arrangements for these supplemental wells is unknown at this time and will require further investigation. Updates on the supplemental monitoring network will be provided in future Annual Reports. **Figures 3-15** through **3-17** illustrate the locations of the wells selected as representative monitoring sites for monitoring of groundwater levels in the Shallow, Intermediate, and Deep Zone Aquifers, respectively. **Tables 3-14** through **3-16** list the well identification, location, monitoring frequency, well construction data, and measurement years, and number of measurements for the Shallow, Intermediate, and Deep Zone Aquifers, respectively.

DWR has released a series of best management practices to assist GSAs with the preparation of their GSPs. The best management practices document for monitoring networks provides guidance on determining an appropriate number of monitoring wells for a given area. The method developed by Hopkins (1984) was applied to the Subbasin. This methodology states that, for areas pumping more than 10,000 AFY per 100 square miles, they should have four monitoring wells for every 100 square miles. The Subbasin occupies an area of approximately 111 square miles, yielding 4 monitoring wells for this minimum density requirement. This number was taken to be the minimum number of monitoring wells for each aquifer in the Subbasin and several additional wells were added based on informational needs resulting from MA and historical trends in groundwater levels. This GSP includes 27 existing (plus planned to be installed by early 2022) RMS wells with a potential for additional monitoring wells to be added to the program. The selection rationale for all water level monitoring wells is summarized in **Tables 3-14 through 3-16.**

**Table 3-14. Summary of Shallow Aquifer Zone Groundwater Level RMS Monitoring Network Wells**

| Well I.D. | Latitude | Longitude | Minimum Frequency | First Year Data | Last Year Data | Years Measured | Number of Measurements | Selection Rationale |
|---|---|---|---|---|---|---|---|---|
| MW-5S | 37.67622 | -122.152 | Spring/Fall | 2009 | 2021 | 12 | 39,897 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-9S | 37.68652 | -122.113 | Spring/Fall | 2014 | 2021 | 7 | 6,362 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-10S | 37.68861 | -122.162 | Spring/Fall | 2012 | 2021 | 9 | 7,042 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| S2-MWS1 | 37.75669 | -122.21369 | Spring/Fall | 2000 | 2000 | 1 | 1 | EBMUD well; known well construction; spatial/vertical distribution |
| S2-MWS2 | 37.75669 | -122.21369 | Spring/Fall | 2000 | 2000 | 1 | 1 | EBMUD well; known well construction; spatial/vertical distribution |
| MW-N1S | NA[1] | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-N2S | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-N3S | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-S1S | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-S2S | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |

[1] Not Available (NA); RMS planned for installation in 2022.

**Table 3-15. Summary of Intermediate Aquifer Zone Groundwater Level RMS Monitoring Network Wells**

| Well I.D. | Latitude | Longitude | Minimum Frequency | First Year Data | Last Year Data | Years Measured | Number of Measurements | Selection Rationale |
|---|---|---|---|---|---|---|---|---|
| MW-5I | 37.67622 | -122.152 | Spring/Fall | 2009 | 2021 | 12 | 42,303 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-9I | 37.68652 | -122.113 | Spring/Fall | 2014 | 2021 | 7 | 5,002 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-9D | 37.68652 | -122.113 | Spring/Fall | 2009 | 2021 | 12 | 42,281 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-10I | 37.68861 | -122.162 | Spring/Fall | 2011 | 2021 | 10 | 42,263 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-N1I | NA[1] | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-2NI | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-N3I | NA | NA | Spring/Fall | Expected /2022 | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-S1I | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-S2I | NA | NA | Spring/Fall | Expected /2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |

[1] Not Available (NA); RMS wells planned for installation in 2022.

**Table 3-16. Summary of Deep Aquifer Zone Groundwater Level RMS Monitoring Network Wells**

| Well I.D. | Latitude | Longitude | Minimum Frequency | First Year Data | Last Year Data | Years Measured | Number Measurements | Selection Rationale |
|---|---|---|---|---|---|---|---|---|
| MW-5D | 37.67622 | -122.152 | Spring/Fall | 2009 | 2021 | 12 | 42,429 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-8D | 37.71761 | -122.183 | Spring/Fall | 2012 | 2021 | 9 | 6,995 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-10D | 37.68861 | -122.162 | Spring/Fall | 2009 | 2021 | 12 | 40,390 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| S2-MWD1 | 37.75688 | -122.21354 | Spring/Fall | 2000 | 2000 | 1 | 1 | EBMUD well; known well construction; spatial/vertical distribution |
| MW-S1D | NA[1] | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-S2D | NA | NA | Spring/Fall | Expected 2022 | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| Well D | 37.65332 | -122.114 | Spring/Fall | 1996 | 2003 | 7 | 4 | Hayward well; known well construction; spatial/vertical distribution |
| Mt. Eden Park | 37.63144 | -122.099 | Spring/Fall | NA | NA | 0 | 0 | Hayward Area Recreation District well; known well construction; spatial/vertical distribution |

[1] Not Available (NA); RMS wells planned for installation in 2022.

### 3.5.1.2. Reduction of Groundwater Storage Monitoring Program

The objectives of the monitoring program to calculate changes in groundwater storage based on annual groundwater pumping in the EBP Subbasin include:

- Improve the understanding of applied water rates for large, irrigated parcels (e.g., parks, golf courses, cemeteries) using groundwater as a source of supply;
- Improve the understanding of industrial water user locations and amount of groundwater use;
- Improve the understanding of groundwater use for residential irrigation; and
- Continue metering of groundwater extraction (and injection) by the GSAs.

Because changes in groundwater storage are dependent on changes in the amount of groundwater pumping, this GSP evaluates groundwater storage reduction based on total annual groundwater pumping, as described previously in this section. Due to the potential for seawater intrusion in a coastal margin aquifer like the EBP Subbasin, evaluation of total annual pumping is preferred to assess when an undesirable result may occur due to GSA projects and MA. The RMS wells and regional monitoring networks will also be used for monitoring changes in groundwater levels and storage in accordance with Annual Report requirements.

The GSAs will follow up on previous outreach work with stakeholders asking about wells and the amount of groundwater pumping they do for irrigation, industrial, and domestic uses. This outreach may include talking with selected well owners to potentially install meters to confirm existing estimates of applied water use for large irrigated parcels and industrial facilities. Other methods (e.g., remote sensing) may also be considered for estimation of pumping volumes and consumptive use to further refine the overall understanding of current and future pumping in the EBP Subbasin. The GSAs may consider a mailer insert or other outreach to residents asking for information on backyard irrigation wells and water use; possibly followed up by some outreach/interviews with residents in areas of known dense clusters of historical domestic well use (e.g., San Leandro). In addition, future GSP meetings could include discussions of this topic and requests for input from attendees on their groundwater use.

### 3.5.1.3. Seawater Intrusion Monitoring Program

The objectives of the monitoring program to calculate changes in seawater intrusion include:

- Use available GeoTracker contaminant site wells and monitor RMS and other monitoring network wells screened in the Water Table Aquifer Zone (upper 50 feet of sediments) to develop a refined baseline groundwater elevation contour map; and
- Use available wells described above to produce annual Water Table Aquifer Zone groundwater elevation contour maps to compare against the baseline map.

The connection to San Francisco Bay is limited to the Water Table Aquifer Zone; consequently, water table elevations maintained above MSL will prevent seawater intrusion into the Subbasin. This GSP adopts groundwater levels as a proxy for assessing seawater intrusion, as described previously in this GSP. The wells selected for monitoring seawater intrusion will be a combination of GeoTracker contaminant site wells, RMS monitoring wells screened in the upper 50 feet, and other monitoring network wells screened in the upper 50 feet.

### 3.5.1.4. Land Subsidence Monitoring Program

The objectives of the monitoring program to calculate changes in land subsidence include:

- Monitor groundwater levels and review extensometer data collected by the USGS at a station near the EBMUD Bayside well to improve the understanding of the relationship between groundwater levels in the Intermediate and Deep Aquifers and the potential occurrence of subsidence;
- Review periodic subsidence surveys that may be conducted by others;
- Review local groundwater levels in the Subbasin to ensure groundwater levels remain above minimum thresholds for subsidence.

Because of the dependence of land subsidence on groundwater levels (as well as soil properties), this GSP adopts groundwater levels as a proxy for assessing land subsidence (in combination with periodic review of extensometer data and subsidence surveys that may be conducted by others), as described previously in this section. The wells selected for monitoring land subsidence will be the Intermediate and Deep Aquifer wells used for groundwater level monitoring. **Figure 3-8** illustrates the locations of the wells selected for monitoring of groundwater levels to assess the potential for subsidence. **Table 3-17** lists the well identification, location, monitoring frequency, well construction data, and measurement years, and number of measurements for the subsidence RMS wells. Because the same wells for water level monitoring are being used for land subsidence monitoring, the selection process and rationale for selection are also the same (**Table 3-17**).

The land subsidence sustainability indicator will also be evaluated by annual review of extensometer data and other subsidence surveys that may be conducted. These extensometer data/subsidence surveys will be compared to groundwater level data collected in the Subbasin to verify that maintaining groundwater levels above the MT does not result in significant inelastic subsidence.

**Table 3-17. Summary of Land Subsidence RMS Monitoring Network Wells**

| Well I.D. | Latitude | Longitude | Minimum Frequency | Aquifer Designation | First and Last Year Data | Years Measured | Number Measurements | Selection Rationale |
|---|---|---|---|---|---|---|---|---|
| MW-5I | 37.67622 | -122.152 | Spring/Fall | Intermediate | 2009/2021 | 12 | 42,303 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-9I | 37.68652 | -122.113 | Spring/Fall | Intermediate | 2014/2021 | 7 | 5,002 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-9D | 37.68652 | -122.113 | Spring/Fall | Intermediate | 2009/2021 | 12 | 42,281 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-10I | 37.68861 | -122.162 | Spring/Fall | Intermediate | 2011/2021 | 10 | 42,263 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-N3I | NA[1] | NA | Spring/Fall | Intermediate | NA | NA | NA | Not yet installed; but will be/have: EBMUD well; known well construction; spatial/vertical distribution |
| MW-S1I | NA | NA | Spring/Fall | Intermediate | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-S2I | NA | NA | Spring/Fall | Intermediate | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-5D | 37.67622 | -122.152 | Spring/Fall | Deep | 2009/2021 | 12 | 42,429 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |

**Table 3-17. Summary of Land Subsidence RMS Monitoring Network Wells**

| Well I.D. | Latitude | Longitude | Minimum Frequency | Aquifer Designation | First and Last Year Data | Years Measured | Number Measurements | Selection Rationale |
|---|---|---|---|---|---|---|---|---|
| MW-8D | 37.71761 | -122.183 | Spring/Fall | Deep | 2012/2021 | 9 | 6,995 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| MW-10D | 37.68861 | -122.162 | Spring/Fall | Deep | 2009/2021 | 12 | 40,390 | EBMUD well; known well construction; recent history of WL data; spatial/vertical distribution |
| S2-MWD1 | 37.75688 | -122.21354 | Spring/Fall | Deep | 2000/2000 | 1 | 1 | EBMUD well; known well construction; spatial/vertical distribution |
| MW-S1D | NA | NA | Spring/Fall | Deep | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| MW-S2D | NA | NA | Spring/Fall | Deep | NA | NA | NA | Not yet installed; but will be/have: Hayward well; known well construction; spatial/vertical distribution |
| Well D | 37.65332 | -122.114 | Spring/Fall | Deep | 1996/2003 | 7 | 4 | Hayward well; known well construction; spatial/vertical distribution |
| Mt. Eden Park | 37.63144 | -122.099 | Spring/Fall | Deep | NA | 0 | 0 | Hayward/HARD well; known well construction; spatial/vertical distribution |

[1] Not Available (NA); RMS wells planned for installation in 2022.

### 3.5.1.5. Groundwater Quality Monitoring Program

The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of RMS wells. The objectives of the groundwater quality monitoring program for the EBP Subbasin include the following as they relate to the implementation of GSP projects and MA:

- Evaluate baseline groundwater quality conditions in the various areas of the Subbasin, and identify differences in water quality spatially between areas and vertically in the aquifer system;
- Ongoing monitoring of concentrations of key constituents of interest as represented by nitrate, arsenic, chloride, and TDS;
- Assess the changes and trends in groundwater quality; and
- Identify the natural and anthropogenic factors that affect changes in water quality.

For monitoring groundwater quality conditions and potential impacts from GSP projects and MA, a network of RMS wells has been selected from among existing and proposed future monitoring wells located throughout the Subbasin and screened in the various aquifer zones. The RMS wells for groundwater quality monitoring will be sampled and analyzed by the Subbasin GSAs. The selected RMS wells for groundwater quality are listed in **Table 3-18** and shown on **Figure 3-11**. Information on historical groundwater quality monitoring for each of these wells is included in **Appendix 3.E**.

Organic chemical (e.g., solvents such as TCE and PCE; fuel hydrocarbons) contaminant plumes tend to occur in the upper portion of the Shallow Aquifer Zone in EBP Subbasin. It is not anticipated that these contaminant plumes will interact with or be affected by GSA Projects that utilize the Intermediate and Deep Aquifer Zones due to impedance of vertical flow through intervening clay layers between the Shallow Aquifer Zone and deeper zones. However, development of new GSA Projects will include evaluation of potential contaminant plumes that may be near the project site as part of the overall project feasibility study.

The network of groundwater quality RMS wells includes 27 existing and new wells to be installed by 2022 that are also part of the water level monitoring indicator well network and will be sampled for groundwater quality by the Subbasin GSAs. As details of GSP projects and MA are refined, the groundwater quality monitoring network will be reviewed and modified if needed to ensure that the network is sufficient to monitor groundwater quality conditions and avoid impacts (or plume migration) that may potentially be caused by GSP projects and MA. Groundwater quality impacts from activities unrelated to specific GSP projects and MA are subject to oversight by other regulatory programs overseeing waste discharges to groundwater and groundwater contamination sites.

**Table 3-18. Summary of Groundwater Quality RMS Monitoring Network Wells, Constituents, and Measurement Frequency**

| Well ID | Aquifer Zone | Monitoring Entity | Field Measurements | | | | | Laboratory Measurements | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Specific Conductance | pH | Dissolved Oxygen | Oxygen Reduction Potential | Temperature | Nitrate (as nitrogen) | Arsenic | Total dissolved solids (TDS) | Carbonate | Bicarbonate | Chloride | Sulfate | Calcium | Sodium | Magnesium | Potassium |
| MW-5S | Shallow and Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-5I | Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-5D | Deep | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-8D | Deep | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-9S | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-9I | Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-9D | Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-10S | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-10I | Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-10D | Deep | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| S2-MWS1 | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| S2-MWS2 | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| S2-MWD1 | Deep | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N1S | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N1I | Intermediate | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N2S | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N2I | Shallow/Int | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N3S | Shallow | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-N3I | Shallow/Int | EBMUD | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S1S | Shallow | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S1I | Intermediate | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S1D | Deep | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S2S | Shallow | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S2I | Intermediate | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| MW-S3D | Deep | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| Well D | Deep | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |
| Mt Eden Park | Deep | Hayward | Annual | Annual | Annual | Annual | Annual | Annual | Annual | Annual | 5-Year | 5-Year | Annual | 5-Year | 5-Year | 5-Year | 5-Year | 5-Year |

### 3.5.1.6. Surface Water Depletion Monitoring Program

The objectives of the monitoring program to evaluate surface water depletion include:

- Install wells and monitor groundwater levels in the Water Table Aquifer Zone near major creeks;
- Collect additional streamflow data under different flow conditions using a combination of synoptic stream surveys (i.e., collection of streamflow measurements at multiple locations along a creek on the same day) and stream gauges;
- Review shallow groundwater levels and streamflow data to characterize stream-aquifer connection along major creeks;
- Monitor shallow groundwater levels along streams to ensure groundwater levels remain above MT for surface water depletion.

Because of the dependence of surface water depletion on shallow groundwater levels and the difficulty of accurately quantifying surface water depletion from streamflow data (due to variability in streamflow caused by variable climatic conditions, reservoir releases, and other factors), this GSP adopts shallow groundwater levels along major creeks as a proxy for assessing surface water depletion, as described previously in this GSP. The wells selected for monitoring surface water depletion will be the Water Table Aquifer Zone (i.e., upper 50 feet of sediments) wells to be installed early in GSP implementation to fill data gaps. **Figure 3-13** illustrates the approximate locations of the shallow wells being considered for monitoring of groundwater levels for surface water depletion. Final well locations may vary due to site logistics and further study regarding optimum well locations. These proposed shallow wells are expected to be up to 50 feet deep, but they could be significantly shallower depending on lithology and groundwater levels encountered during drilling at each location. The selection process and rationale for selection is based on better characterizing the primary creeks in the EBP Subbasin with priority assigned to San Pablo Creek and San Leandro Creek, which have two of the largest contributing watersheds to EBP Subbasin. Secondary creeks being considered are Wildcat Creek, Codornices Creek, and San Lorenzo Creek. Wildcat Creek flows very close to San Pablo Creek in the main part of the EBP Subbasin in the Richmond area and is likely well represented by overall conditions along San Pablo Creek. Codornices Creek has one of the smaller watersheds tributary to the EBP Subbasin, but it is representative of a creek that has been targeted for restoration activities. San Lorenzo Creek is mostly concrete-lined from the eastern EBP Subbasin boundary until it reaches about 0.75 miles from the Bay margin; therefore, it was deemed secondary in importance for stream-aquifer connection compared to San Leandro Creek (which is unlined over a greater length) even though the San Lorenzo Creek watershed is one of the major watersheds tributary to the EBP Subbasin.

## *3.5.2. Monitoring Protocols for Data Collection and Monitoring*
***(CCR Title 23, Section 352.2)***

This section provides a description of technical standards, methods, and procedures/protocols to ensure comparable data and methodologies for data collection and monitoring. All field monitoring activities will follow established monitoring protocols for the Subbasin that reflect the standards, methods, and procedures described below.

### 3.5.2.1. Groundwater Level Monitoring Program

The MT and MO for the chronic lowering of groundwater levels sustainability indicator are evaluated by monitoring groundwater levels. The SGMA regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow direction and hydraulic gradients between principal aquifers and surface water features. The overall monitoring network for groundwater levels is provided in **Appendix 3.A**.

The protocols for measuring groundwater levels include:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.01 foot (or at least to the nearest 0.1 foot at a minimum) relative to the Reference Point (RP). Measurements and RPs should not be recorded in feet and inches.
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a questionable measurement. If a well is artesian, site-specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.
- The groundwater elevation should be calculated using the following equation.

  GWE= RPE−DTW
  Where:
  GWE = Groundwater Elevation in NAVD88 datum
  RPE = Reference Point Elevation in NAVD88 datum
  DTW = Depth to Water

- The well caps or plugs should be secured following a depth to water measurement.
- Groundwater level measurements are to be made on a semi-annual basis at a minimum during periods that will capture seasonal highs and lows.
- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby pumping, flooding, or well condition. Of particular concern may be pumping of nearby supply wells or time since pumping stopped in the well being monitored (if it is a production well); such conditions should be specifically identified and noted to the extent possible. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. Standardized field forms will be used for all data collection.
- Wells containing groundwater with high salinity may occur in the shallow sediments (i.e., upper 50 to 80 feet) along the San Francisco Bay margin. Certain water level measurement devices (e.g., electronic sounder) may provide anomalous readings, and levels should be measured

multiple times to ensure a consistent depth to water is recorded. After each measurement attempt, the probe should be retrieved and rinsed with fresh water and then reinserted into the well to confirm the measurement. It is recommended that at least three attempts occur, and the same reading should be recorded to ensure accurate measurement in saline groundwater conditions.

- The sampler should have a record of previous measurements in the field for each well to compare with the current measurements being recorded. If a current measurement appears anomalous compared to previous measurements, it should be re-checked and verified.
- All data should be entered into the GSP data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person.

### 3.5.2.2. Installing Pressure Transducers and Downloading Data

The procedures below should be followed for the installation of a pressure transducer and periodic data downloads:

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated later after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment will be exercised to ensure that the data being collected is meeting the data quality objectives (DQO) and that the instrument is capable of meeting DQO. Battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Non-vented units are preferred (generally less expensive, require less maintenance than vented units, and are less prone to failure) and provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures by GSAs to coincide with measurement intervals.
    - Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
    - Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.

The transducer data should be periodically checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually to maintain data integrity. The data should be downloaded as necessary to ensure no data are lost and entered into the DMS following the QA/QC program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

### 3.5.2.3. Groundwater Storage Reduction Monitoring Program

The monitoring protocols for evaluating change in groundwater storage are related to quantification of groundwater pumping. To the extent that flow meters may be used on representative irrigation or industrial wells (in addition to GSA municipal production wells) to quantify groundwater pumping volumes from a well, the following procedures should be followed for the installation of a meter and reporting of meter reads:

- The person collecting meter reads must note the well identifier, the meter brand and model number, and meter location relative to bends in piping both up- and downstream of the meter location.
- Meters should be able to record groundwater volumes to a precision of at least 100 gallons. Professional judgment will be exercised to ensure that the data being collected meet the data quality objectives (DQO) and that the instrument is capable of meeting DQO.
- Follow manufacturer specifications for installation, calibration, recording data, correction procedure (if meter is found to be insufficiently calibrated) to assure that DQOs are being met for the GSP.

### 3.5.2.4. Seawater Intrusion Monitoring Program

The monitoring protocols for evaluating seawater intrusion are similar to the protocols described above for groundwater levels for monitoring wells being used to supplement the GeoTracker well database. While each contaminant site with monitoring wells in the GeoTracker well database may have slightly different monitoring protocols developed by the responsible parties at each site, it is expected that those protocols will be very similar to the groundwater measurement protocols developed for this GSP.

### 3.5.2.5. Land Subsidence Monitoring Program

Subsidence monitoring will include the following protocols:

- Obtain and review extensometer subsidence data collected by the USGS. This data will be input into the DMS following QA/QC.
- Obtain and review subsidence survey data that may be collected by others. This data will be input into the DMS following QA/QC.
- Groundwater level data collected as part of the subsidence monitoring program will follow the same protocols as described above for groundwater level monitoring.

### 3.5.2.6. Groundwater Quality Monitoring Program

Annual monitoring of groundwater quality will include sampling and laboratory analysis of key parameters of interest as indicated on **Table 3-18** to be conducted by GSAs as presented in **Tables 3-5, 3-10, and 3-11**. Water quality parameters may be added to the groundwater quality monitoring program in the future, if appropriate. During sampling events, measurement of select water quality parameters will take place in the field. These field parameters should be measured at an annual frequency and include electrical conductivity (EC) in µS/cm, pH, temperature (in °C), redox, and dissolved oxygen (DO) in mg/L. The annual testing is summarized in **Table 3-18.**

The GSP monitoring program will utilize the following protocols for collecting groundwater quality samples.

- Prior to sampling, the analytical laboratory will be contacted to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well used for groundwater quality monitoring will have a unique identifier. This identifier will appear on the well housing or the well casing to verify well identification.
- In the case of wells with dedicated pumps, samples should be collected at or near the wellhead following purging.
- Prior to sampling, the sampling port and sampling equipment will be cleaned of any contaminants. The equipment will be decontaminated after purging and collection of water samples at each site to avoid any cross-contamination between wells.
- The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.
- For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling.
- Field parameters of pH, electrical conductivity, pH, temperature, and turbidity should be collected periodically during purging and prior to the collection of each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to collection of the water sampling. Measurements of pH values should occur in the field since the short hold times for laboratory pH analysis are typically unachievable. Other parameters, such as oxidation-reduction potential (ORP), dissolved oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for assessing purge conditions. All field instruments should be calibrated daily and evaluated for drift throughout the day.
- Sample containers should be labeled prior to sample collection. The sample label must include sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used (if any), and analytes and analytical method(s).
- Samples should be collected under laminar flow conditions. This may require reducing pumping rates prior to sample collection. Alternatively, the flow rate from the sampling tap should correspond to laminar flow conditions when possible.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative leading to inconsistent results of dissolved analytes. Specifically, samples to be analyzed for metals should be field-filtered prior to preservation; do not collect an unfiltered sample in a preserved container.

- Samples should be chilled and maintained at 4 °C to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.
- Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.
- Ensure the laboratory uses appropriate reporting limits that are at or below levels needed for the objectives of the monitoring.
- Groundwater quality samples are to be collected annually for key constituents and every five years for all other constituents.
- For wells monitored by other entities, obtain results and associated information on sampling activities through coordination and communication directly with the monitoring entity or through public databases such as SWRCB GeoTracker where these data are available.

All groundwater quality data and other information from sampling activities should be entered into the DMS as soon as possible and in accordance with established QA/QC procedures. Care should be taken during any data entry to avoid mistakes and data entered into the database should be checked for accuracy and completeness.

### 3.5.2.7. Surface Water Depletion Monitoring Program

Stream depletion monitoring will include the following protocols:

- Obtain and review stream discharge data collected by various parties (e.g., USGS, Alameda County, EBMUD reservoir releases). This data will be input into the DMS following QA/QC.
- Obtain and review stream discharge data from synoptic studies and/or stream gauges conducted/installed by GSAs for GSP implementation. This data will be input into the DMS following QA/QC.
- Groundwater level data collected as part of the stream depletion monitoring program will follow the same protocols as described above for groundwater level monitoring.

### 3.5.2.8. GDE Monitoring Program

The GDE monitoring program will include monitoring of groundwater levels and biologic monitoring. Groundwater level monitoring being conducted for the overall GSP will include new shallow monitoring wells adjacent to selected potential GDE units. Baseline biological monitoring will be conducted within the initial five years of GSP implementation and will be conducted every five years thereafter to document ecological condition of the potential GDE units. Biological data will be analyzed in conjunction with hydrological data to assess potential ecological effects related to changes in groundwater levels and the relative degree of influence on GDE conditions exerted by streamflows (if the potential GDE unit is adjacent to a creek) and groundwater levels associated with the GDE.

### *3.5.3.* Representative Monitoring *(CCR Title 23, Section 354.36)*

This section is intended to provide the following:

- Description of representative sites
- Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators
- Adequate evidence demonstrating representative monitoring sites reflect general conditions in the area

Groundwater level data are collected from a large network of EBMUD and Hayward wells (**Appendix 3.A**). Representative monitoring sites are defined in the SGMA regulations as a subset of monitoring sites that are representative of conditions in the Subbasin. Existing wells available for use as RMS sites are primarily located in the southern EBP Subbasin due to a greater thickness of unconsolidated alluvium (and presence of all three aquifer zones) and greater well capacity production potential in this area compared to the northern EBP Subbasin (Deep Aquifer Zone generally not present, and Intermediate Aquifer Zone also not present in many areas). Additional nested monitoring wells are already in planning stages for drilling/installation at three locations (two monitoring wells at each site to different depths) in the northern EBP Subbasin to fill data gaps and provide initial RMS coverage in this area. Overall, the initial RMS network provided in this GSP makes best use of existing wells combined with using additional monitoring wells planned for installation in 2022. Data gaps in the RMS and overall monitoring network will continue to be evaluated during early years of GSP implementation and additional RMS wells may be added. Groundwater level monitoring will be used to assist in monitoring seawater intrusion, subsidence, and stream depletion.

In terms of subsidence, significant impacts to infrastructure are not known to have occurred during a time of much greater pumping in the EBP Subbasin and associated historical low groundwater levels in the 1950s and 1960s. Thus, representative Intermediate and Deep Aquifer Zone monitoring wells are included in the RMS network with MT tied to historical low groundwater levels, which greatly reduces the potential for any significant and unreasonable future inelastic subsidence. There is also ongoing extensometer monitoring near the EBMUD Bayside well to further evaluate the relationship between groundwater levels and subsidence.

San Francisco Bay is relatively shallow and only connected to the upper portion of the Shallow Aquifer Zone, which is referred to as the Water Table Aquifer Zone (i.e., upper 50 feet of sediments) in this GSP. There are thick and laterally extensive clay layers throughout the Shallow Aquifer Zone, as well as the Intermediate and Deep Aquifer Zones. Therefore, saline water from the Bay is limited to migrating horizontally inland within the shallowest sediments of the EBP Subbasin. If Water Table Aquifer Zone groundwater elevations are maintained above mean sea level, seawater intrusion would not be expected to occur in the EBP Subbasin. A very similar approach of using shallow aquifer groundwater levels to manage seawater intrusion is being followed in the Niles Cone Subbasin Alternative (to a GSP), which has been approved by DWR.

Field data (e.g., stream discharge, shallow groundwater levels near streams) are very limited for the EBP Subbasin. However, it is apparent that there is some connectivity between creeks and shallow groundwater, especially in the western to central portion of the EBP Subbasin. Significant additional work is planned to better characterize the major creeks (e.g., San Pablo Creek, San Leandro Creek) in terms of stream-aquifer connectivity, gaining and losing reaches, and typical baseflows. Even if a good historical record of streamflow were available, it is very difficult to determine if streamflow depletion is occurring related to groundwater pumping. However, establishing the relationship between shallow groundwater levels and surface water depletion using a combination of field data (shallow monitoring wells, stream discharge data) and groundwater modeling can allow for the relationship between shallow groundwater levels and surface water depletion to be established. In this manner, the change in shallow groundwater levels from baseline conditions can provide a reasonable proxy for measurement of surface water depletion.

The initial RMS wells included in this GSP, combined with additional wells in the proposed monitoring network along with shallow wells from GeoTracker, will provide adequate monitoring to reflect general conditions in the EBP Subbasin. As noted above, work to fill data gaps in the monitoring network is already underway in 2021 with a target completion date of mid-2022. In addition, an initial plan to further address data gaps identified during GSP development is provided in this GSP. The intent is to develop robust monitoring networks for the sustainability indicators for the initial five-year Update Report in 2027. Data collected and scientific analyses conducted during this period and subsequent years will be used to inform and guide plans for any additional groundwater development by the GSAs. This allows time to improve data gaps in monitoring networks and collect sufficient background/baseline data under current basin conditions and for future evaluation of potential impacts should additional development of groundwater resources in EBP Subbasin occur.

### 3.5.4 *Review and Evaluation of the Monitoring Network*
***(CCR Title 23, 354.38)***

Per Section 354.38 of the GSP Regulations, this section of the GSP is intended to provide the following:

- Review and evaluation of the monitoring network
- Identification and description of data gaps
- Description of steps to fill data gaps
- Description of monitoring frequency and density of sites

Development of this GSP included extensive review and documentation of historical data, evaluation of currently available monitoring facilities, and identification of data gaps for various data types (**Appendix 2.A**). This data gaps analysis demonstrated that historical data and currently available monitoring facilities are very limited in the northern EBP Subbasin. The southern EBP Subbasin has significantly more historical data and available monitoring facilities, but significant data gaps still remain. The results of this study were used as the basis for the DWR Proposition 68 grant application that was approved/awarded to begin filling these data gaps. The Proposition 68 grant includes drilling/installation of nested monitoring wells in both the north (three sites and six wells) and south (two sites and six wells), regional aquifer testing in both the north and south, and evaluation of streamflow and stream chemistry (isotopes) along San Pablo and San Leandro Creeks. This work is underway with a target completion date of March 2022.

A major data gap area throughout the EBP Subbasin is the understanding of stream-aquifer interconnection and potential for stream depletion from groundwater pumping. The Proposition 68 grant cited above provides some additional information, but more work has been identified to address this data gap.

The monitoring networks described above for each of the applicable sustainability indicators will be evaluated on a yearly basis. This evaluation will involve a review of the described MT and MO and their comparison to observed trends in the networks. Furthermore, a more comprehensive review of the monitoring networks will be conducted every five years. During this review, MA and projects will be evaluated and the monitoring networks will be assessed for their efficacy in tracking progress based on the actions and projects. These evaluations and assessments will also highlight any additional data gaps and recommended changes to the monitoring networks.

### 3.5.4.1. Identification and Description of Data Gaps

Identification and description of data gaps for the monitoring networks described above for each of the applicable sustainability indicators are summarized below.

### 3.5.4.2. Groundwater Elevation

Groundwater elevation data have been collected within the Subbasin over the past several decades from various sources including DWR, Alameda County, EBMUD, Hayward, USGS, and others. However, despite these data collection efforts, data gaps still exist. Specifically, the northern portion of the Subbasin and portions of the southern EBP Subbasin are lacking in historical data and existing monitoring wells. These gaps are evident in the designed monitoring network. In addition to these spatial gaps, temporal data collection gaps also exist at the monitoring network sites. Historical data are available from the early 1960s to 2000 for several wells previously monitored by Alameda County and DWR. Some groundwater elevation data from the 1990s to more recent years are available from Hayward wells. The Bayside Well monitoring network provides significant data since 2010 in the southern EBP Subbasin. Some of the spatial data gaps will be filled with installation of the nested monitoring wells by 2022, particularly for the northern EBP Subbasin where data gaps are most extensive. Temporal data gaps will begin to be filled by more regular collection of data as part of the GSP together with the installation of transducers in new nested monitoring wells.

Data gaps relative to GDEs can be characterized as a combination of groundwater levels and biological monitoring. Data gaps related to shallow groundwater levels occur in areas identified as potential GDEs in this GSP, and these will be addressed as cited above with installation of additional monitoring wells. Biological monitoring, recommended every five years, will be used to evaluate potential beneficial or adverse effects on GDEs that may be related to changes in future groundwater conditions during the Implementation and Sustainability Periods. Baseline biological monitoring will be conducted in the initial five years of GSP implementation followed by regular biological monitoring at five-year intervals.

### 3.5.4.3. Groundwater Storage

Resolving groundwater storage data gaps primarily entails developing better estimates of groundwater pumping throughout the Subbasin. The approach to improve groundwater pumping estimates will be further developed during the initial years of GSP implementation, but this may include: metering of selected production wells to better understand applied water rates for irrigation of large parcels and/or industrial sites; use of remote sensing or other technologies/methods to refine estimates of applied water for irrigation; and continued communication with basin stakeholders and well owners about groundwater use.

#### 3.5.4.4. Seawater Intrusion

As described in previous sections, hydrogeologic conditions pertaining to seawater intrusion indicate that it can best be managed by maintaining shallow Water Table Aquifer Zone groundwater elevations above mean sea level. A fairly extensive network of shallow monitoring wells with water level observations serving as a proxy and representative of the shallowest sediments are available from data collected for contaminant sites in GeoTracker. These data will be supplemented by nested monitoring wells currently under construction for a DWR Proposition 68 grant and scheduled to be completed in early 2022. Additional shallow monitoring wells planned for installation near creeks in the early years of GSP implementation will provide additional data points for use in mapping groundwater elevations in the upper 50 feet of sediments (i.e., Water Table Aquifer Zone).

#### 3.5.4.5. Subsidence

There has been no significant subsidence impacting infrastructure in the EBP Subbasin despite extensive and much greater groundwater pumping in the 1950s and 1960s. A key component of monitoring for subsidence is the extensometer station installed by USGS near the EBMUD Bayside Well. Subsidence data have been collected from this station for over 10 years to help establish background conditions, and data will continue to be collected in the future. If the Bayside Well is used more extensively in the future, the extensometer will provide a detailed record of any elastic and inelastic subsidence that may occur. In addition, extensive monitoring of groundwater levels in and around the extensometer will allow for further understanding of the relationship between groundwater levels and subsidence.

Given that groundwater levels are being used as a proxy for subsidence, the data gaps described above for groundwater levels apply for subsidence as well. However, the key areas for potential subsidence (western half of the southern EBP Subbasin) have a relatively good network of existing monitoring wells in the Intermediate and Deep Aquifers that are key to subsidence monitoring.

#### 3.5.4.6. Groundwater Quality

Considerable historical groundwater quality data exist for the Subbasin although the spatial distribution and well construction details present limitations. Several of the wells in the groundwater quality sustainability indicator monitoring network have not been historically monitored for groundwater quality or have only one measurement for a given constituent. The combination of these existing wells and the monitoring wells currently being constructed provide a sufficient initial network for monitoring of groundwater quality and impacts from GSP projects and managements actions. As GSP projects and MA are implemented and the planned locations for these activities are better known, the groundwater quality monitoring network will be reviewed and modified as needed to provide sufficient groundwater quality monitoring to meet the stated objectives.

### 3.5.4.7. Surface Water Depletion

The surface water depletion sustainability indicator has the most limited data of all the sustainability indicators in the EBP Subbasin. Data for shallow groundwater levels adjacent to/beneath creeks are generally lacking, as are detailed survey data on creek thalweg elevations along the lengths of major creeks traversing the EBP Subbasin. In addition, stream discharge data are generally lacking for the major creeks. Therefore, a preliminary plan has been developed to fill these data gaps in the initial five years of GSP implementation. Additional details of the overall plan to fill data gaps are described below in more detail and include installation of shallow monitoring wells along major creeks and potential GDE areas, conducting synoptic/hydrometric surveys, additional isotope sampling, and collection of additional stream discharge data.

Additional work during the first five years of GSP implementation will include drilling/installation of ten shallow monitoring wells up to 50 feet deep to be located along major creeks and GDEs, further synoptic surveys to collect stream discharge data and delineate gaining and losing stream reaches, and installation of stream gauges to provide for ongoing collection of stream discharge measurements.

### 3.5.4.8. Description of Steps to Fill Data Gaps

Data gaps have been presented above for the six sustainability indicators, along with details of steps to fill data gaps that are both currently in progress and planned for during the initial five years of GSP implementation. The following steps are currently in progress to address these data gaps:

- Implementation of a DWR Proposition 68 grant to drill/install nested monitoring wells at three locations (two wells at each site for a total of six new monitoring wells) in the northern EBP Subbasin, and at two locations (three wells at each site for a total of six new monitoring wells) in the southern EBP Subbasin. These new monitoring wells will allow for collection of water level and water quality data in the Water Table, Shallow, and Intermediate Aquifer Zones in the northern EBP Subbasin, and in the Shallow, Intermediate, and Deep Aquifer Zones in the southern EBP Subbasin. These new monitoring wells will help fill data gaps for the following sustainability indicators: groundwater levels, seawater intrusion, subsidence, and groundwater quality. The new wells will also provide key data points for annual calculations of groundwater storage change. All of the new wells being drilled under the DWR Proposition 68 grant are included in the list of groundwater level RMS wells.
- Implementation of the DWR Proposition 68 grant to conduct long-term (up to two weeks) aquifer tests in both the northern and southern EBP Subbasins. Regional aquifer testing will help improve the HCM in terms of developing better estimates of aquifer parameters (especially in the northern EBP Subbasin where such data are very limited), connection between deeper aquifer zones (where pumping wells are screened) and influence on shallow groundwater levels from pumping, and in the southern EBP Subbasin will enhance current understanding of connection between the EBP and Niles Cone Subbasins.
- Implementation of the DWR Proposition 68 grant to conduct synoptic stream surveys and collect stream isotope data in two major creeks (San Pablo and San Leandro) to better characterize stream-aquifer connectivity and interaction. This information will improve overall understanding of key hydrogeologic factors related to the surface water depletion sustainability indicator and relationship between groundwater levels and potential GDEs that may occur along these creeks.

In addition to these ongoing studies to fill data gaps, several additional steps to fill data gaps have been identified and outlined above and are planned to be conducted in the initial five years of GSP implementation. These additional steps include:

- Drilling and installation of ten shallow monitoring wells along major creeks and in potential GDE areas;
- Conducting periodic synoptic (hydrometric) stream surveys;
- Installing additional stream gauges;
- Better characterization of overall basin groundwater pumping;
- Biologic surveys to better characterize species and rooting depths in potential GDE areas and to provide baseline ecosystem health data.

In addition to these ongoing studies to fill data gaps, the monitoring networks will be evaluated on a yearly and five-year basis. If additional data gaps arise, the GSAs will consider the implications of these gaps, associated costs, and importance to the continued implementation of the GSP and take appropriate actions to address the gaps.

### 3.5.4.9. Description of Monitoring Frequency and Density of Sites

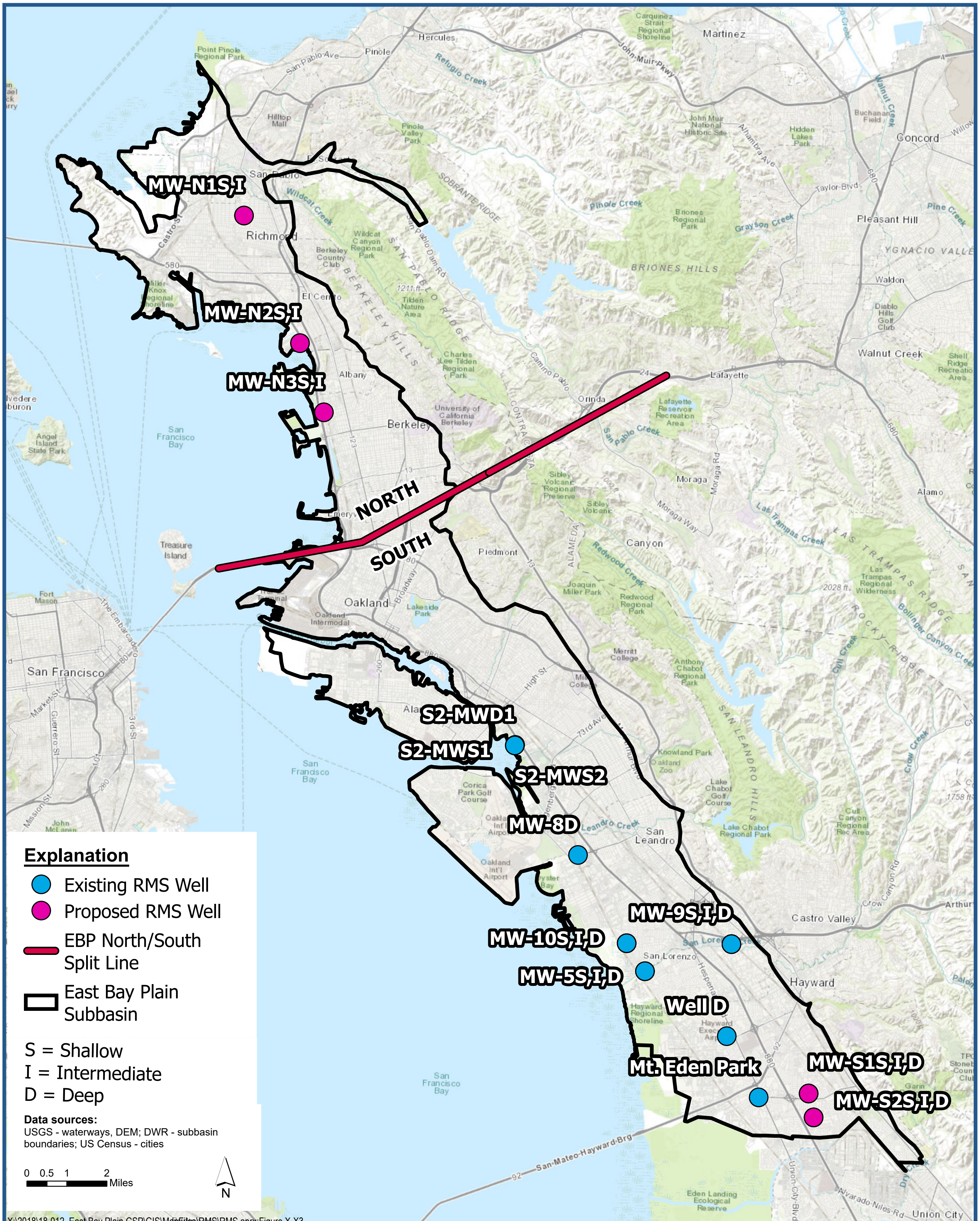
Monitoring frequency and density of sites for all sustainability indicators are described in previous sections of this report.

## 3.5 References

California Regional Water Quality Control Board, San Francisco Bay Region. 2019. *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan).*

Norfleet Consultants. 1998. *Groundwater Study and Water Supply History of the East Bay Plain, Alameda and Contra Costa Counties, California*. Prepared for The Friends of the San Francisco Estuary.

# FIGURES

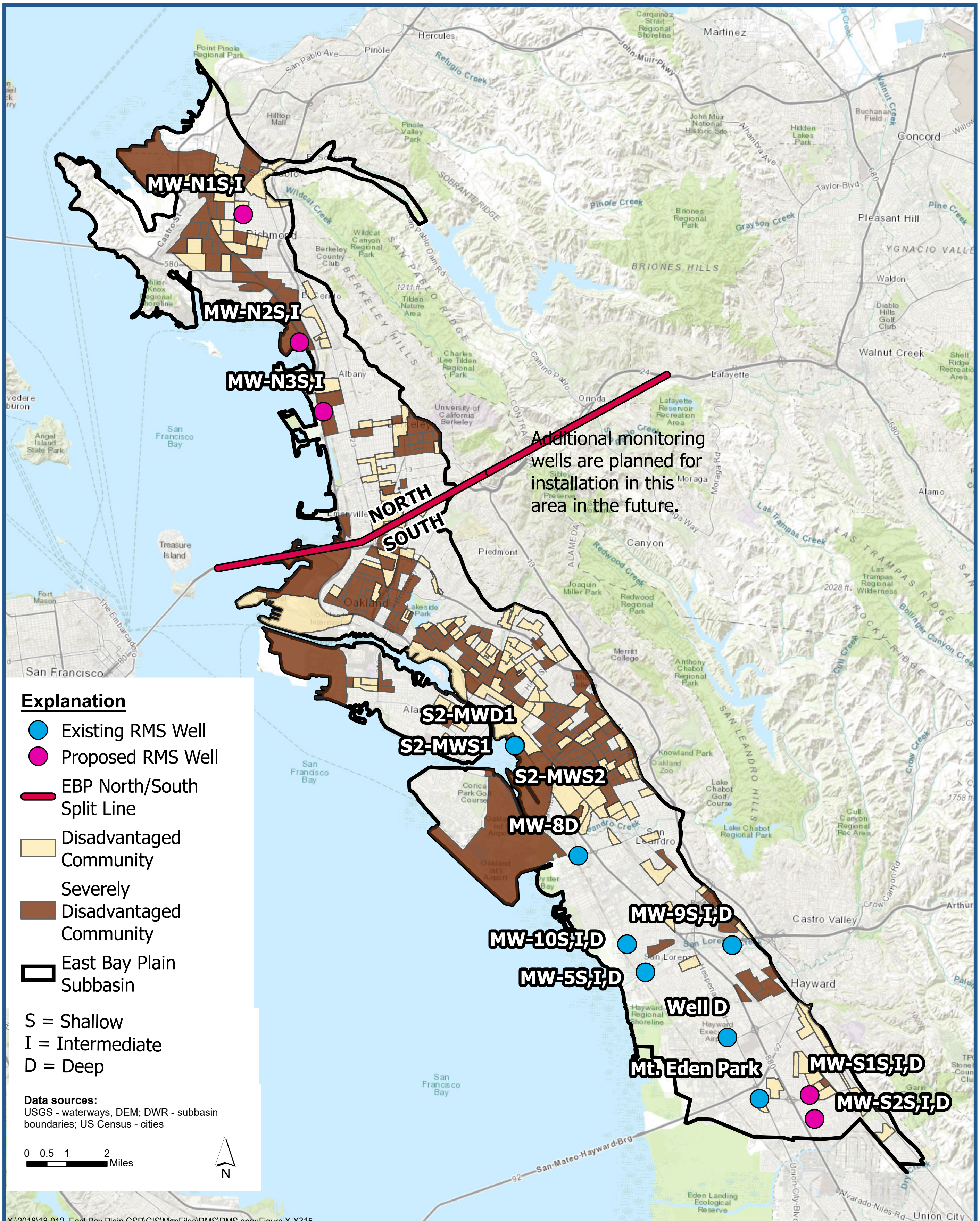



LSCE TEAM

**Groundwater Level RMS Wells**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-1A**




**Groundwater Level RMS Wells and SDACs/DACs**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

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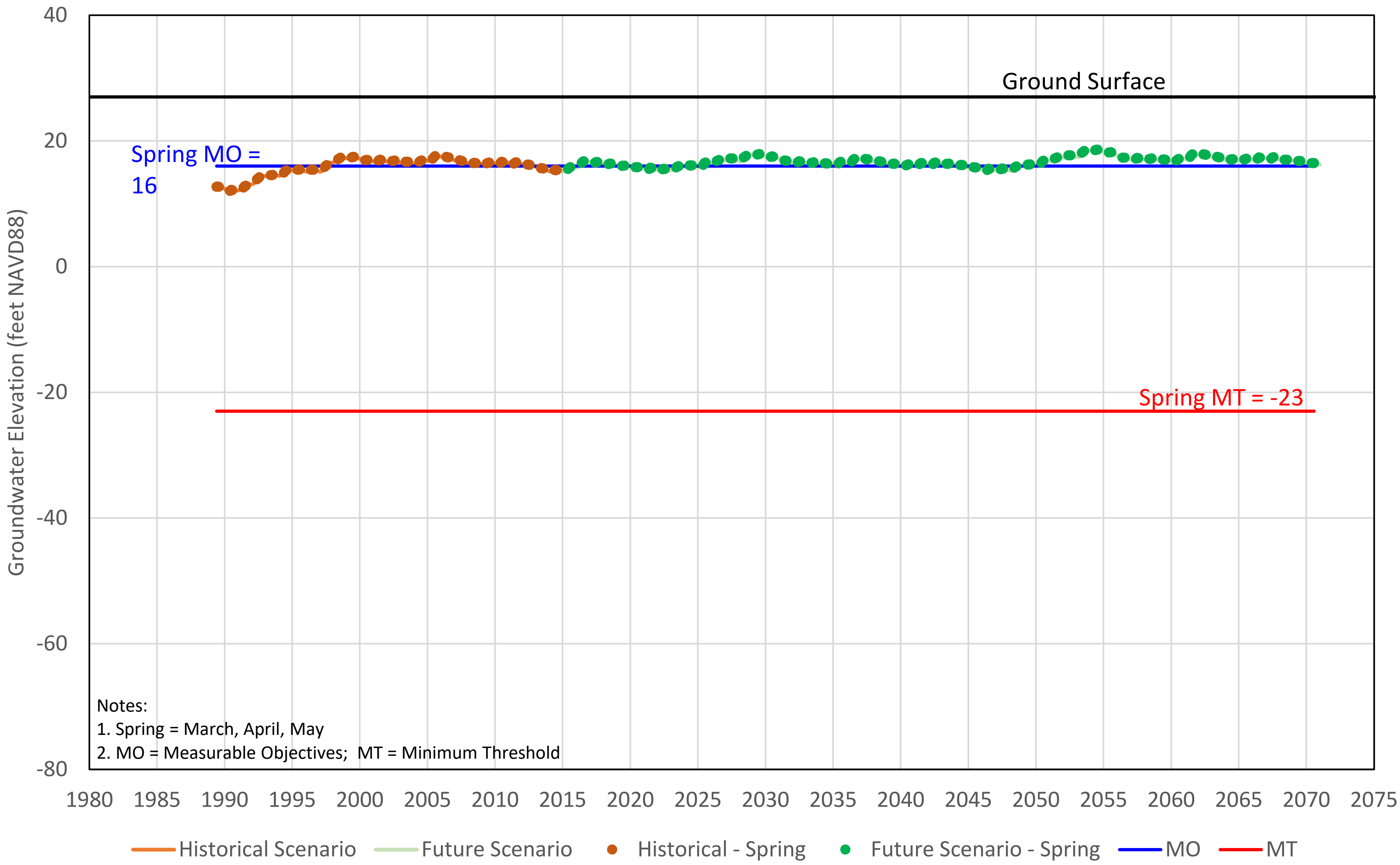
**Figure 3-1B**

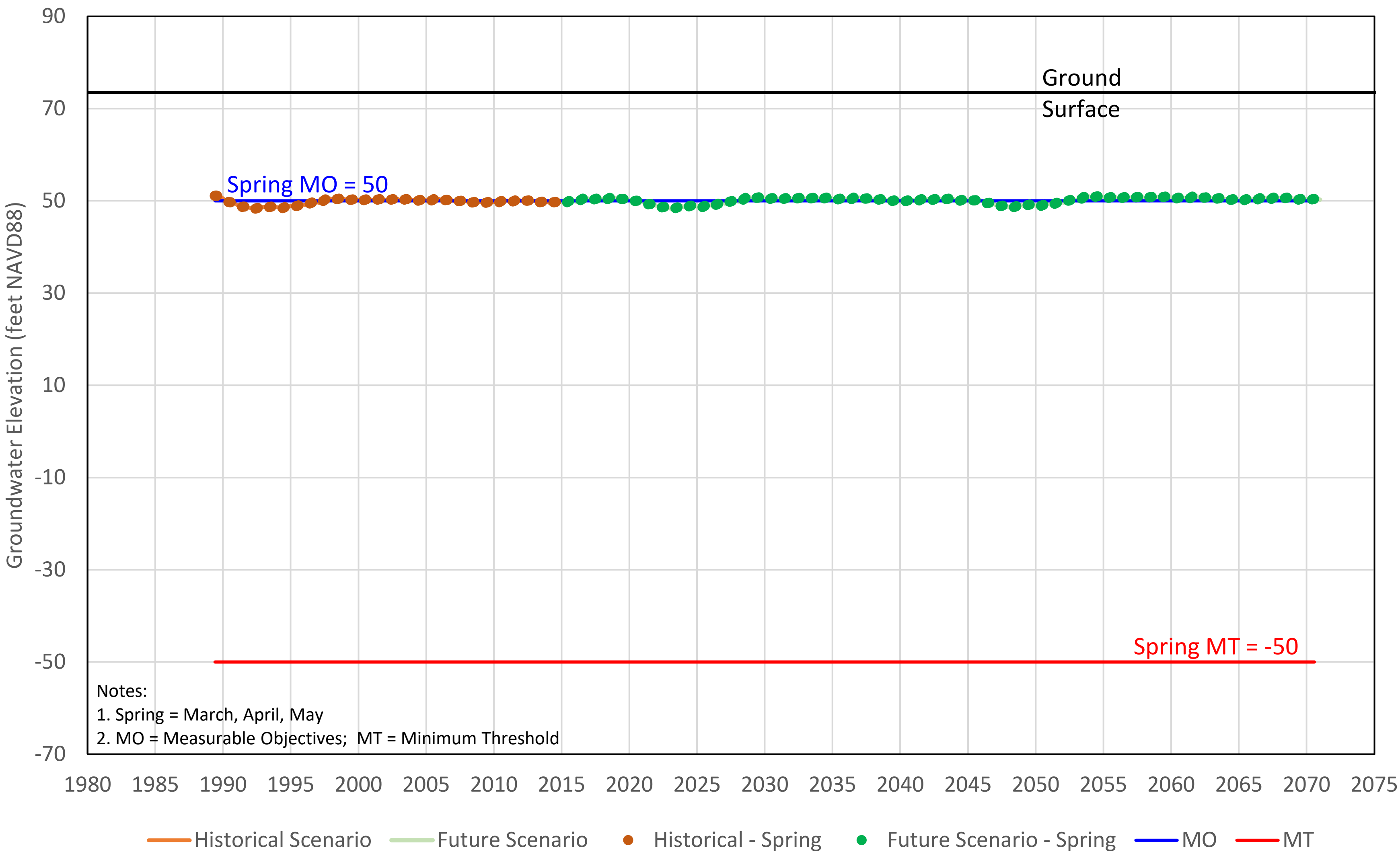



LSCE TEAM

**MW-S1S Groundwater Level SMC Hydrograph**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-2**

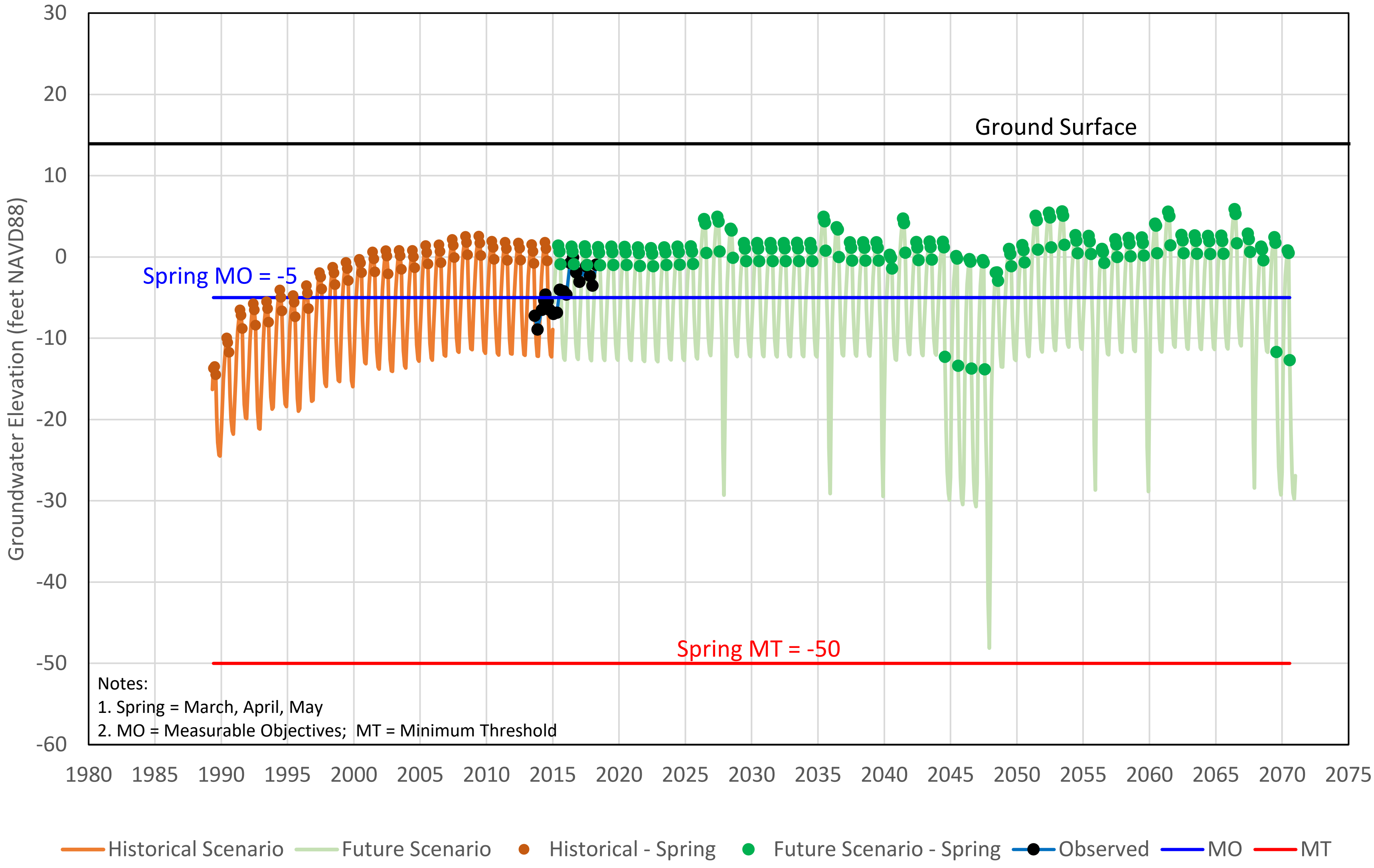



LSCE TEAM

**MW-N1I Groundwater Level SMC Hydrograph**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-3**

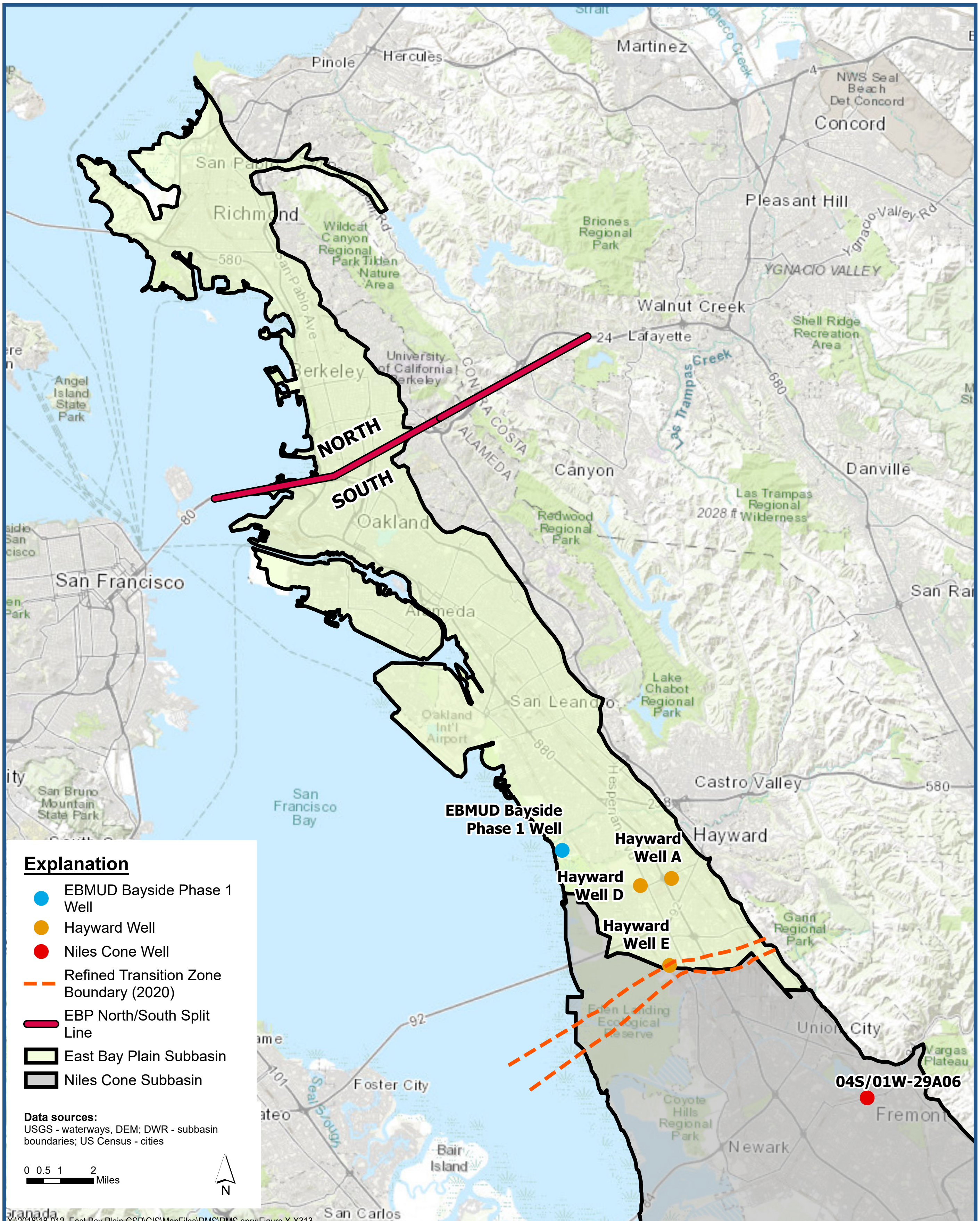



LSCE TEAM

**MW-5D Groundwater Level SMC Hydrograph**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-4**

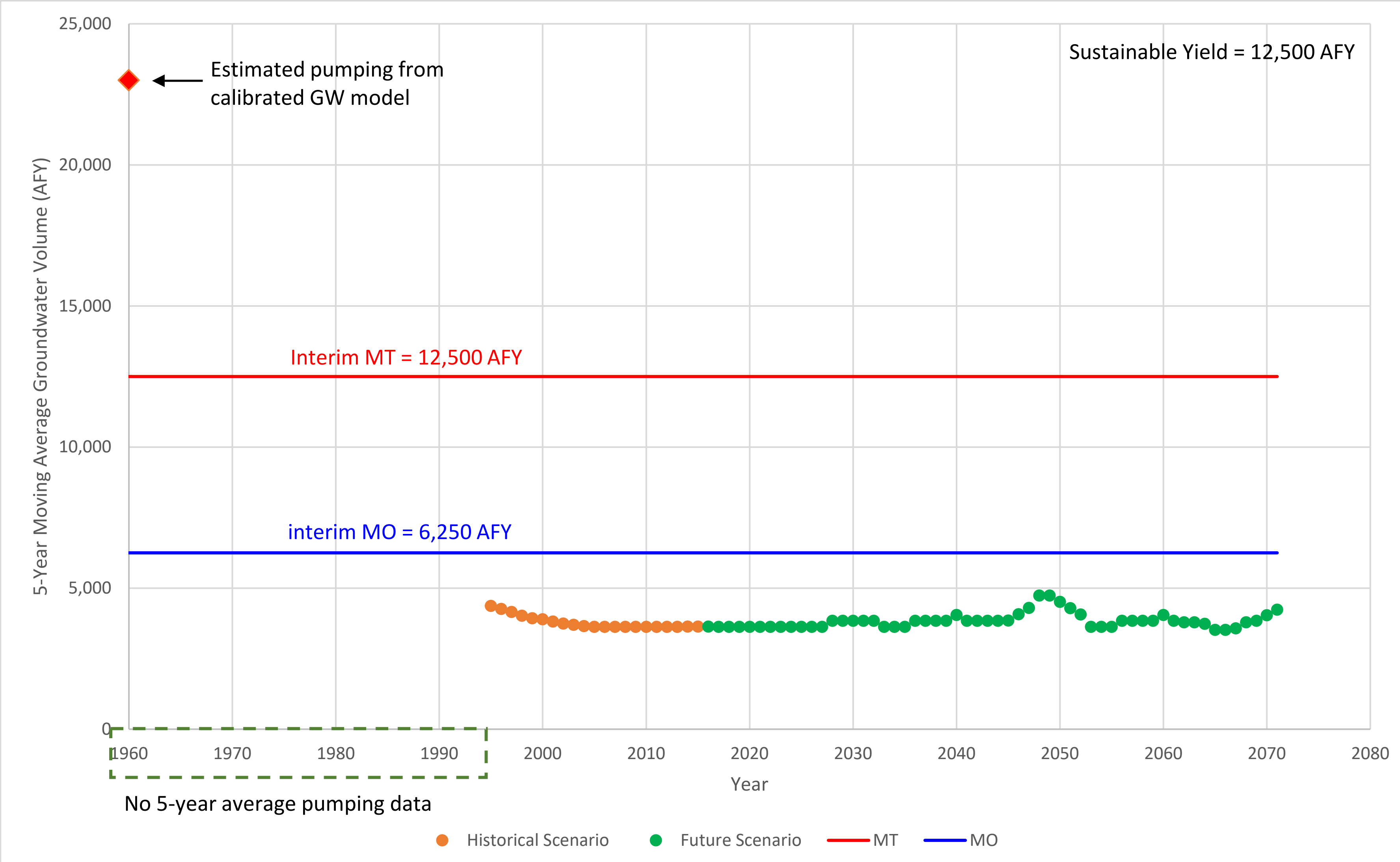



LSCE TEAM

**Potential Impacts to Adjacent Subbasins**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-5**

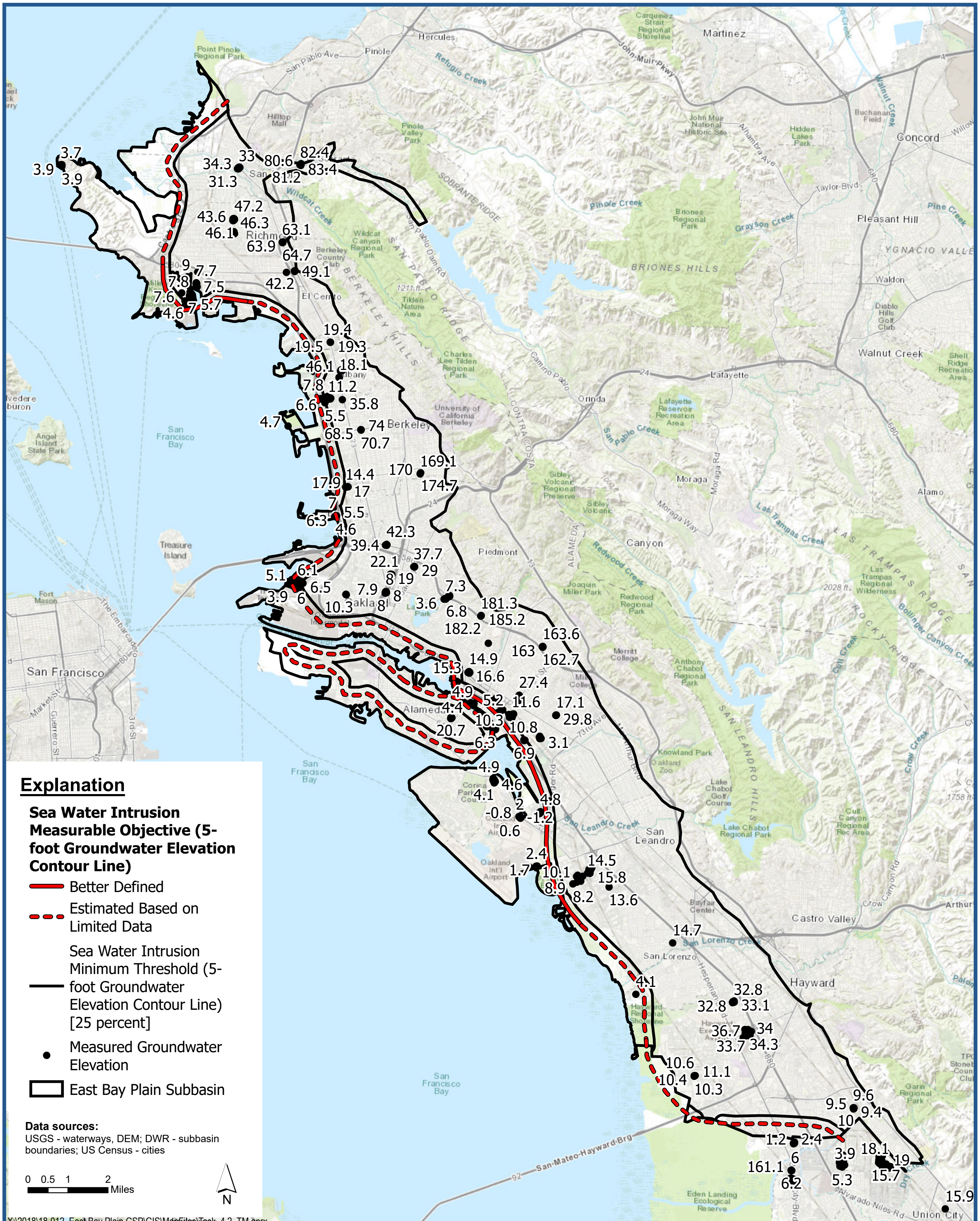



LSCE TEAM

**Groundwater Storage Minimum Threshold**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-6**




**Seawater Intrusion Minimum Threshold and Measurable Objective**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

LSCE TEAM

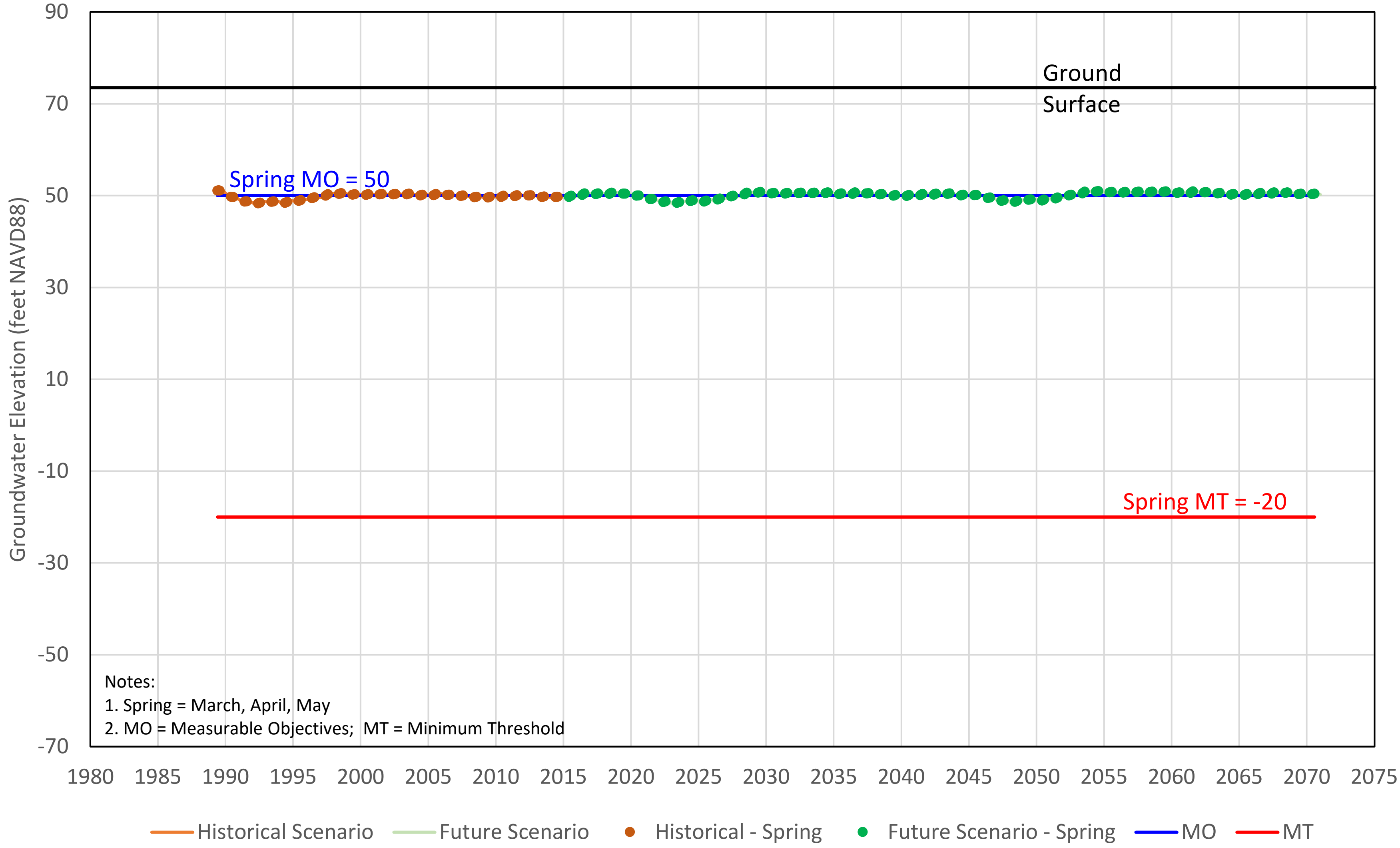
**Figure 3-7**


LSCE TEAM

**Land Subsidence RMS Wells**

**Figure 3-8**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

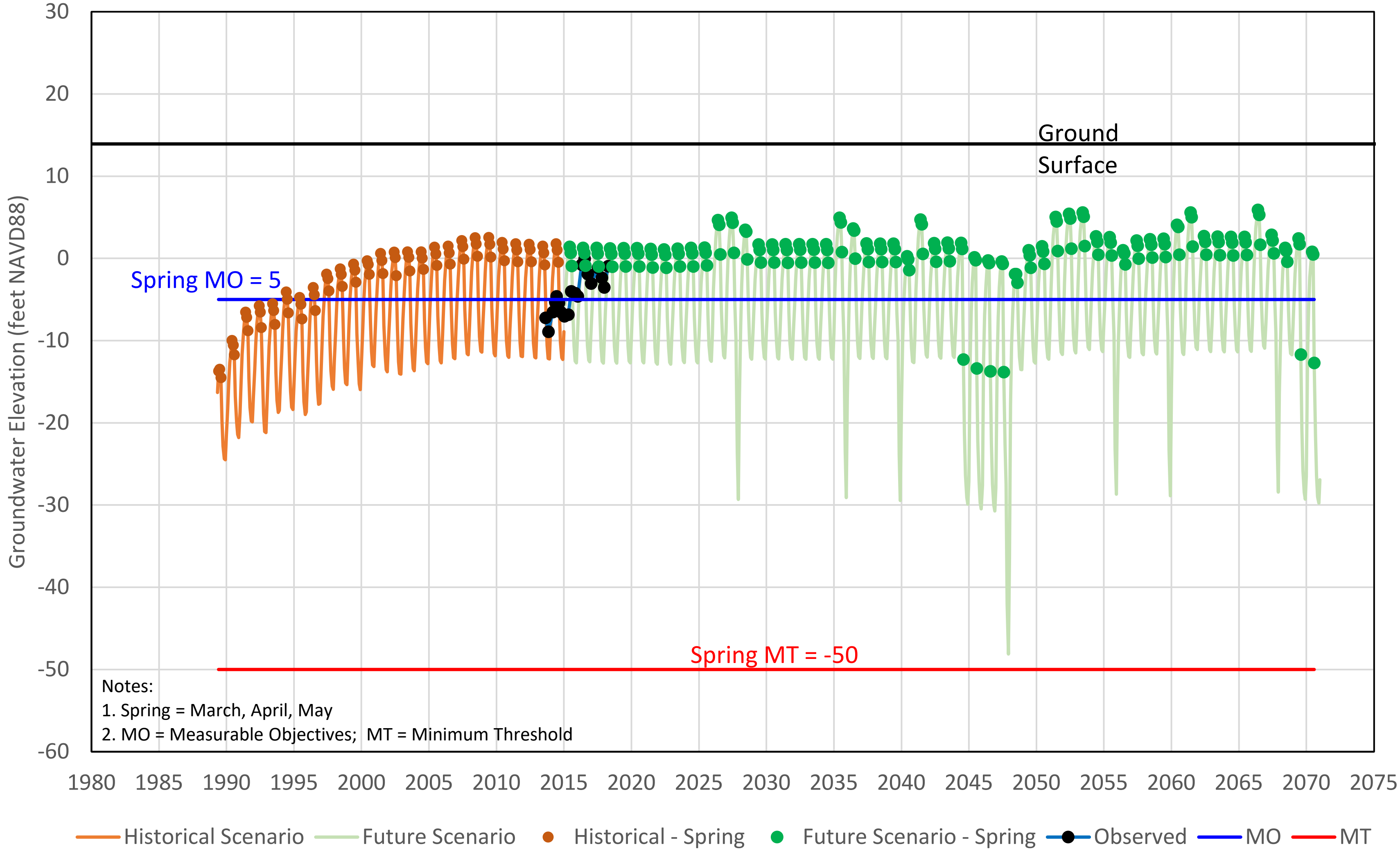



LSCE TEAM

**MW-N1I Subsidence Hydrograph**

*East Bay Plan Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-9**

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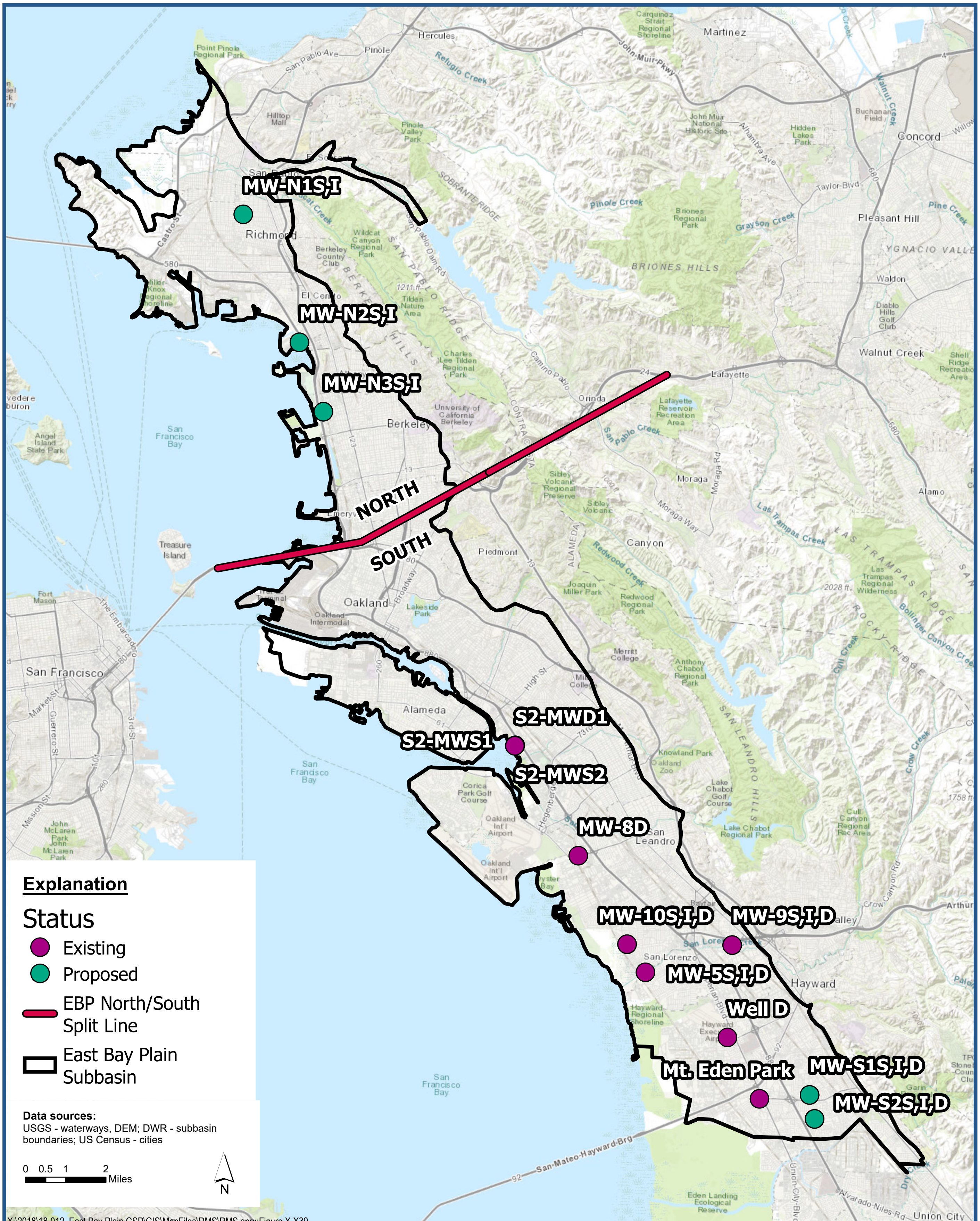
**MW-5D Subsidence Hydrograph**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-10**

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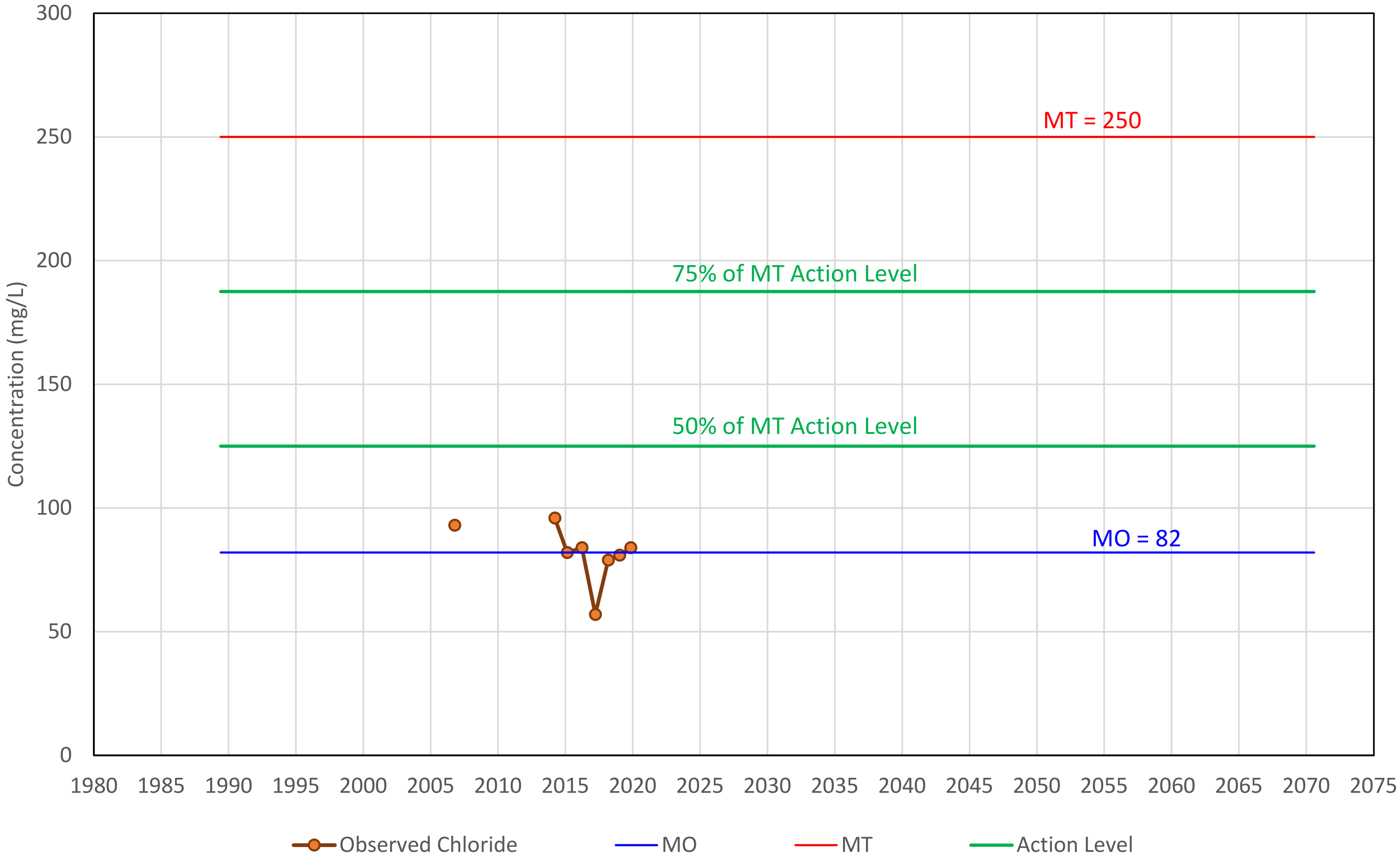
**Groundwater Quality RMS Wells**

*East Bay Plain Subbasin*
*Groundwater Sustainability Plan*

**Figure 3-11**

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**MW-5D Groundwater Quality SMC Time Series Plot for Chloride**

*East Bay Plain Subbasin*
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**Figure 3-12**


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**Stream Depletion RMS Location Map**

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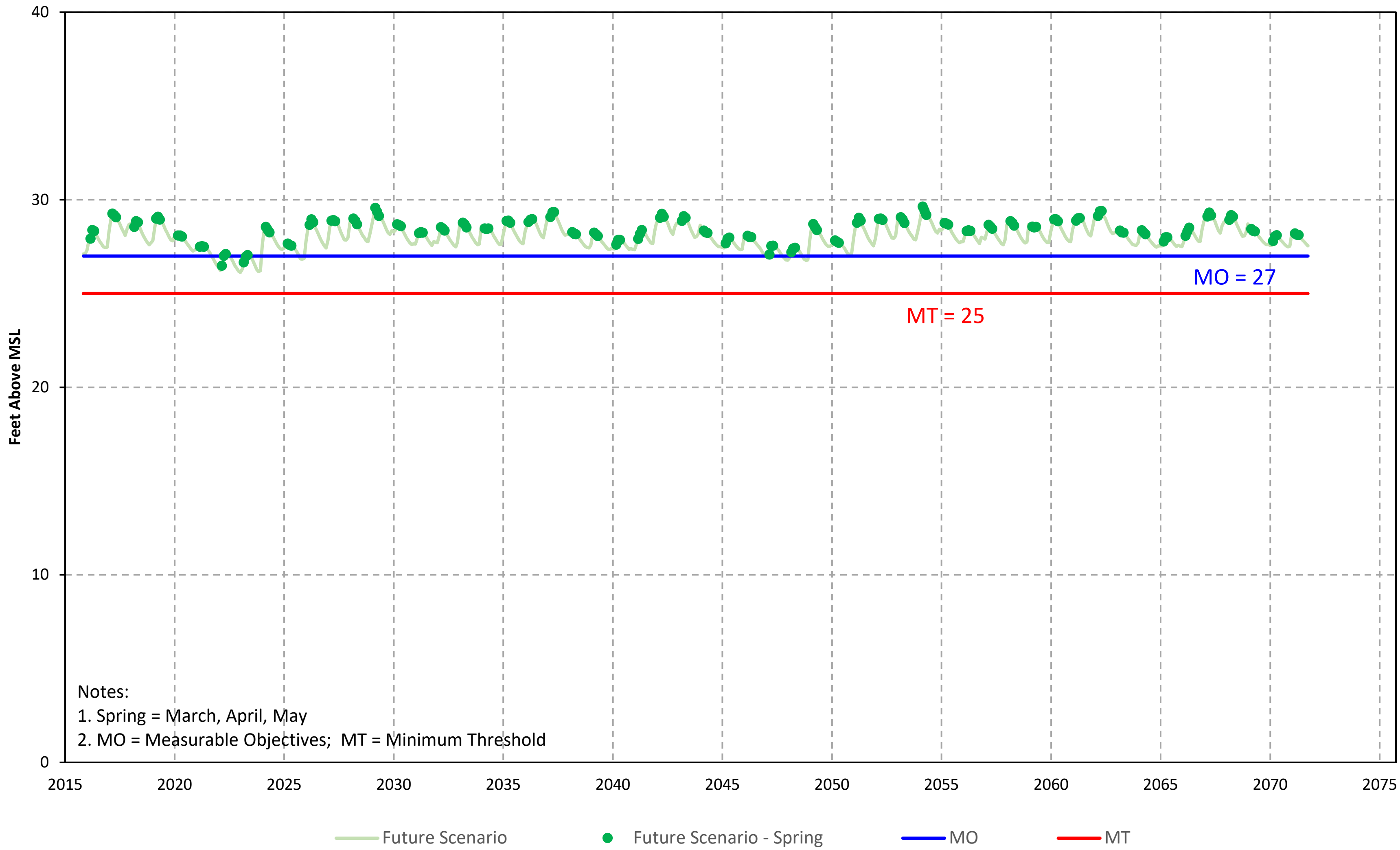
*Groundwater Sustainability Plan*

**Figure 3-13**

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**SPC-1 SMC Hydrograph**

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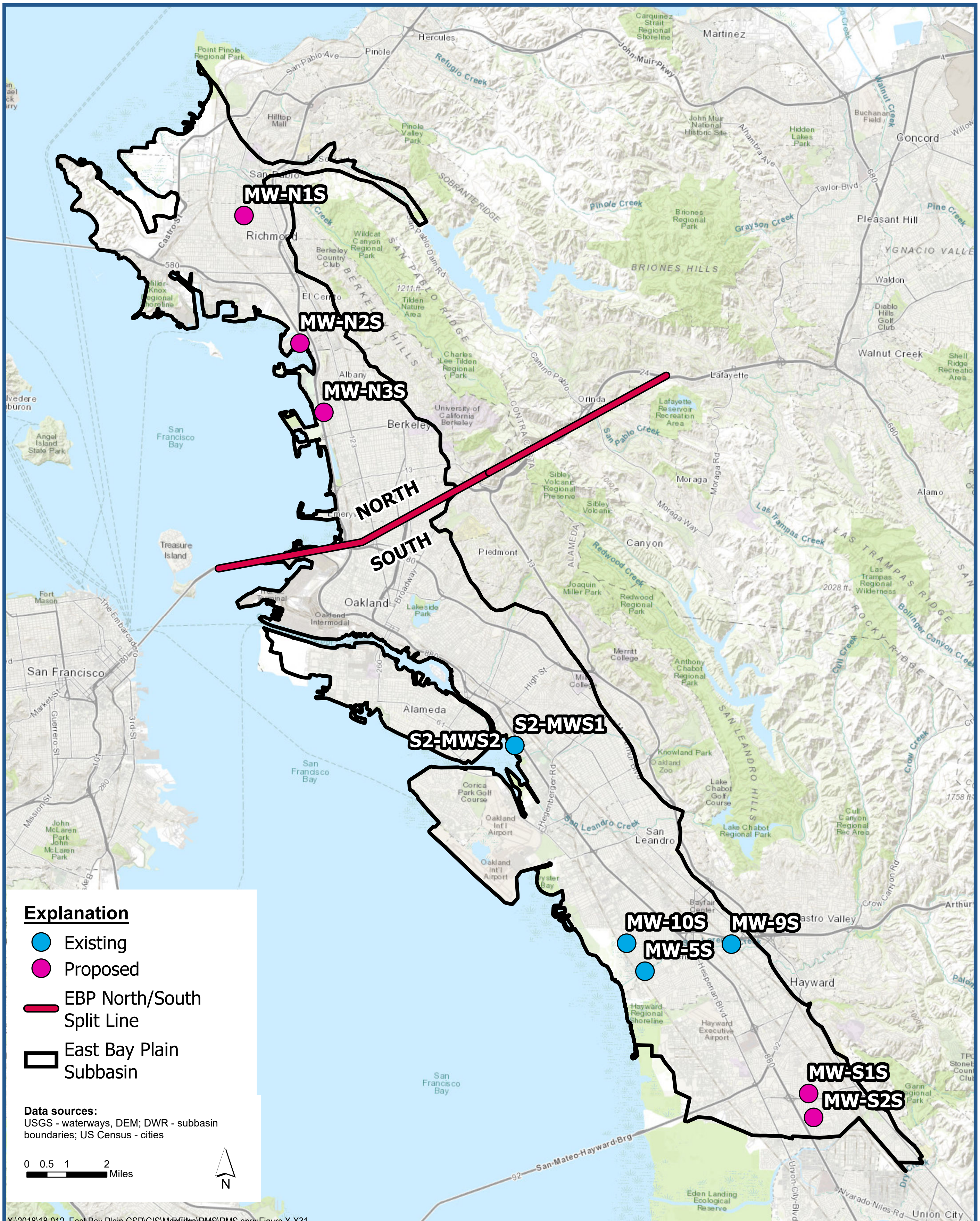
*Groundwater Sustainability Plan*

**Figure 3-14**




**Shallow Aquifer Groundwater Level RMS Wells**

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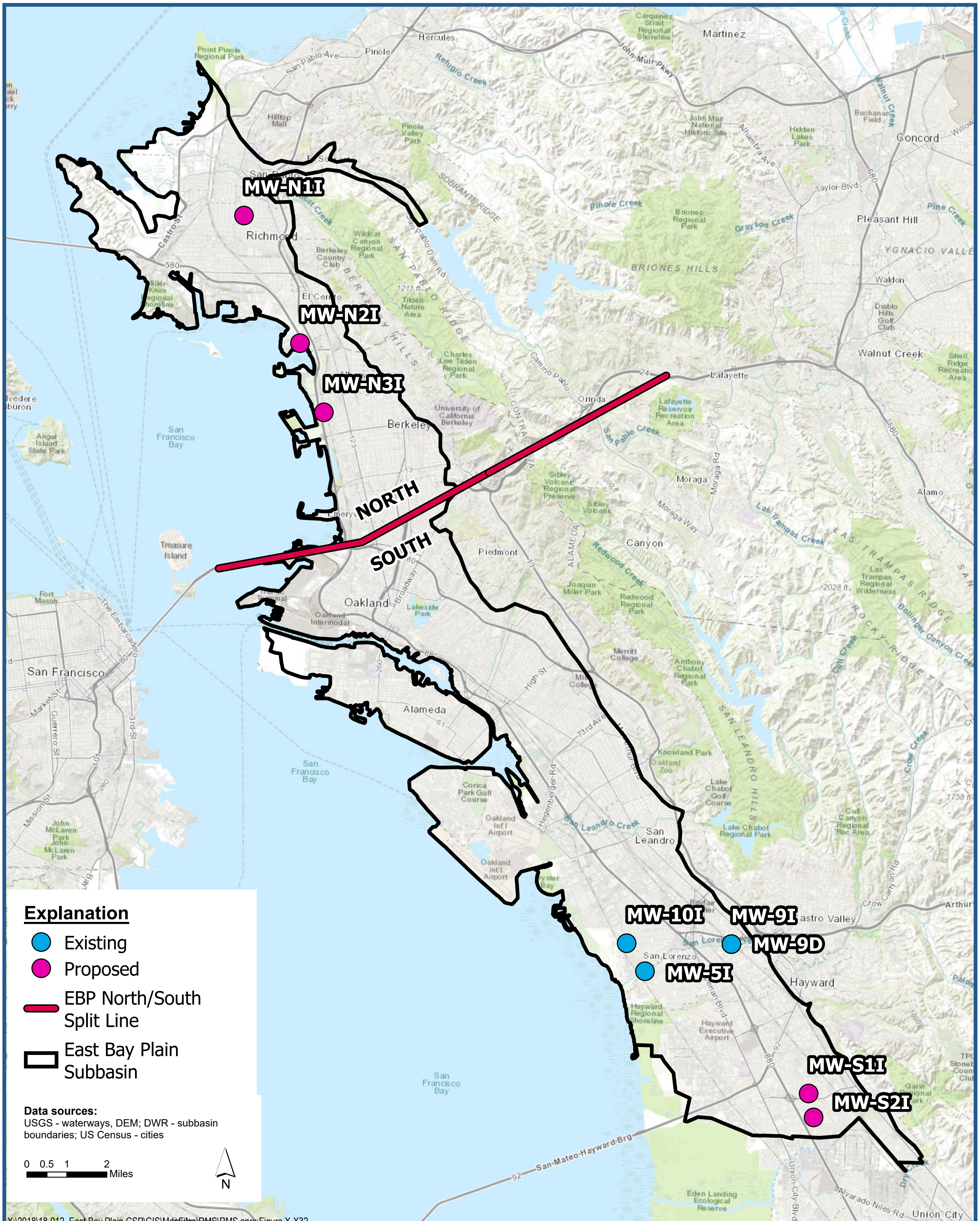
**Figure 3-15**

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**Intermediate Aquifer Groundwater Level RMS Wells**

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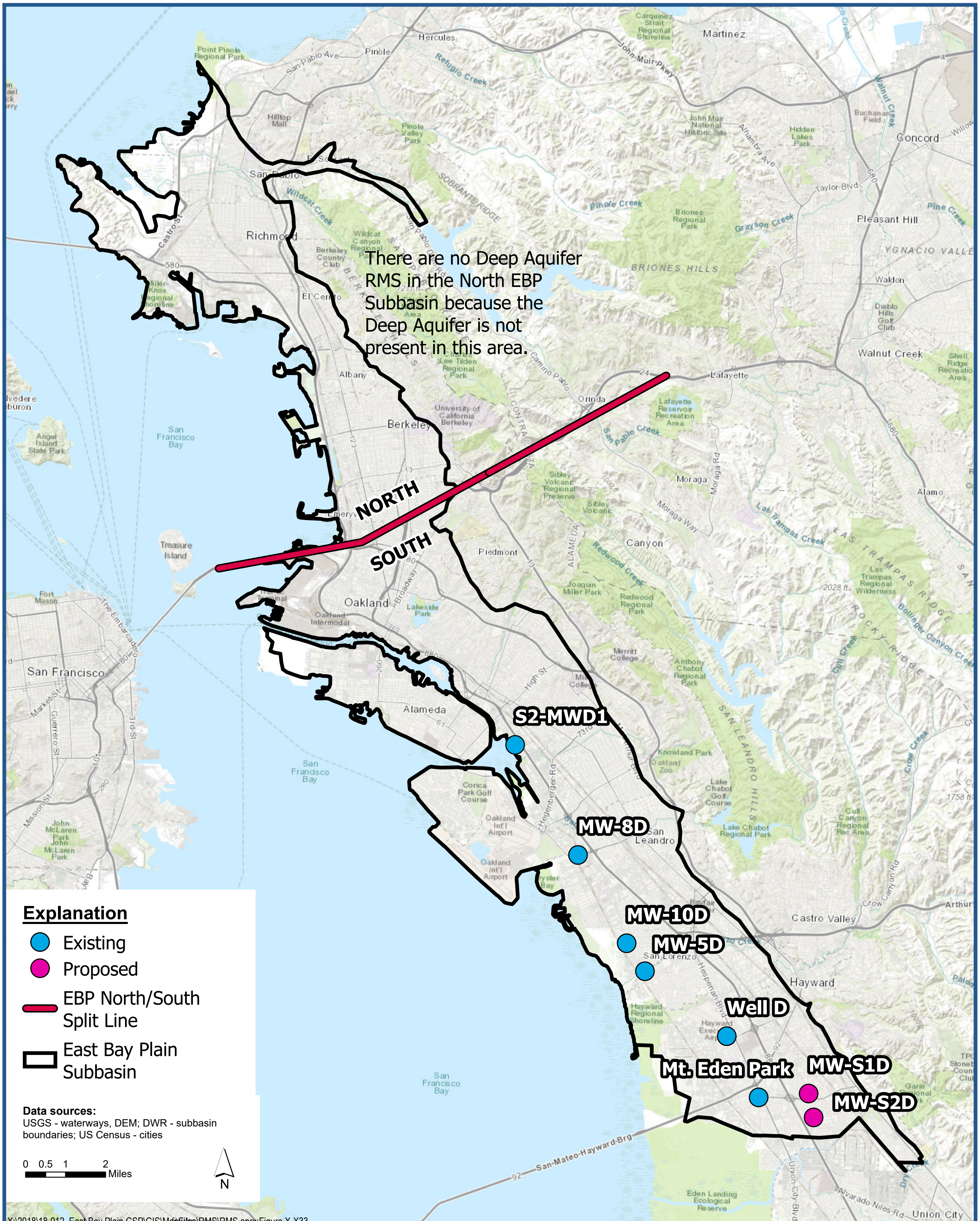
**Figure 3-16**

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**Deep Aquifer Groundwater Level RMS Wells**

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*Groundwater Sustainability Plan*

**Figure 3-17**