EXECUTIVE SUMMARY

EAST BAY PLAIN SUBBASIN
GROUNDWATER SUSTAINABILITY PLAN



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GROUNDWATER SUSTAINABILITY PLAN

The Sustainable Groundwater Management Act allows local water agencies to form a groundwater sustainability agency that will develop, adopt, and implement a groundwater sustainability plan.

This plan is the coordinated plan for the East Bay Plain Subbasin, as prepared by East Bay Municipal Utility District and the City of Hayward, the exclusive groundwater sustainability agencies for the subbasin.

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East Bay Municipal Utility District GSA and
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EAST BAY PLAIN SUBBASIN GSP OVERVIEW

The East Bay Plain (EBP) Subbasin Groundwater Sustainability Plan (GSP) creates the framework for sustainable management of groundwater in the EBP Subbasin. East Bay Municipal Utility District (EBMUD) and the City of Hayward (Hayward) are the water providers that lie atop the subbasin and became the exclusive groundwater sustainability agencies (GSAs) for the portions of the EBP Subbasin located beneath their service areas, and have jointly prepared the GSP. This GSP was written to meet the regulatory requirements listed in California Code of Regulations Title 23, Section 354 (Groundwater Sustainability Plans, Plan Contents). It is organized as follows:

CHAPTER 1

Introduction

Provides an overview of the EBP Subbasin GSAs and the development of the GSP for the EBP Subbasin, including how the GSAs are organized, their legal authority, and the estimated costs in implementing the plan.

CHAPTER 2

Plan Area and Basin Setting

Describes the plan area for the EBP Subbasin GSP and development of the basin setting, including the conceptual model of the subbasin's hydrogeology; current and historical conditions, such as groundwater elevations, seawater intrusion, and groundwater quality issues; water budgets (total annual volumes of groundwater and surface water entering and leaving the EBP Subbasin); and management areas, as applicable.

CHAPTER 3

Sustainable Management Criteria

Establishes the EBP Subbasin's sustainability goal, explaining the criteria used for defining sustainable groundwater management for the subbasin, describing measurable objectives, minimum thresholds, undesirable results for each indicator of groundwater sustainability, and proposed monitoring to track and verify progress toward the sustainability goal.

CHAPTER 4

Projects and Management Actions to Achieve Sustainability Goal

Describes projects and management actions for achieving and maintaining the EBP Subbasin's sustainability goal.

CHAPTER 5

Plan Implementation

Proposes the plan's implementation strategy, costs, and schedule.

CHAPTER 6

References and Technical Studies

Lists references and technical studies consulted for preparation of the EBP Subbasin GSP.

Appendices

The appendices include additional information related to the GSP.

CHAPTER 1: INTRODUCTION

Groundwater Management in California

In September 2014, Governor Jerry Brown signed three bills into law that together became known as the Sustainable Groundwater Management Act (SGMA). The law created a statewide framework for sustainable management of groundwater on the local level throughout California.

The Sustainable Groundwater Management Act allows local water agencies to form a groundwater sustainability agency (GSA) that will develop, adopt, and implement a groundwater sustainability plan (GSP). East Bay Municipal Utility District (EBMUD) and the City of Hayward (Hayward) lie atop a groundwater subbasin known as the East Bay Plan (EBP) Subbasin. In 2016 and 2017, respectively, EBMUD and Hayward became the exclusive GSAs for the portions of the EBP Subbasin located beneath their service areas.

Sustainability Goal

The sustainability goal for the EBP Subbasin is to manage and protect the Subbasin in a manner that avoids the six undesirable results listed below while continuing to collect and analyze data to support science-based decision making to evaluate new opportunities for sustainable groundwater beneficial uses:

- Chronic lowering of groundwater levels, indicating a significant and unreasonable depletion of supply.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality.
- Significant and unreasonable land subsidence.
- Depletions of interconnected surface water and groundwater that have significant and unreasonable reductions in beneficial uses of surface water, including beneficial use by ecosystems that depend on groundwater.

The purpose of this GSP is to characterize groundwater conditions in the EBP Subbasin, establish a sustainability goal and sustainable yield, and describe projects and management actions the GSAs will implement to maintain sustainable groundwater management through 2042 and beyond. The information in Chapter 1 complies with the following California Code of Regulation (CCR) requirements:

- **Sustainability Goal (CCR Title 23, Section 354.24)**
- **Groundwater Sustainability Plan Organization (CCR Title 23, Section 354)**

Map at Left
East Bay Municipal Utility District (EBMUD) and the City of Hayward (Hayward) lie atop a groundwater subbasin known as the East Bay Plan (EBP) Subbasin.

Agency Information

EBMUD and Hayward have each formed GSAs as required by law, and the EBMUD and Hayward GSAs combine to cover the entirety of the EBP Subbasin. The **Steering Committee** included senior GSA staff who oversaw and guided the **Technical Team** during development of the GSP. The Technical Team consisted of GSA staff members who developed and managed the GSP and associated projects, oversaw the consultants, and engaged with stakeholders.

They are also supported by **EBP Subbasin GSP Interested Parties**, which participated in public meetings and provided input on the GSP, the **EBP Subbasin GSP Technical Advisory Committee (TAC)**, which reviewed technical work products and provided comments and recommendations on the GSP, and the **EBP Subbasin GSP Interbasin Working Group**, which met quarterly during development of the GSP with participants from neighboring groundwater subbasins. The GSAs retained a team of private consultant firms (Consultants) to support preparation of the GSP. EBMUD and Hayward held six TAC meetings, eight interested party meetings, and seven interbasin working group meetings.

EAST BAY MUNICIPAL UTILITY DISTRICT GROUNDWATER SUSTAINABILITY AGENCY

The EBMUD GSA incorporates all or portions of the cities of San Pablo, Richmond, El Cerrito, Albany, Berkeley, Emeryville, Alameda, Oakland, Piedmont, San Leandro, and other unincorporated areas including the community of San Lorenzo.

Area covered: 61,000 acres
Annual groundwater pumping: Approx. 3,100 acre feet
Primary sources of water supply: Mokelumne River reservoirs, East Bay Hills reservoirs

CITY OF HAYWARD GROUNDWATER SUSTAINABILITY AGENCY

The Hayward GSA covers the portion of the City of Hayward located within the EBP Subbasin. Other portions of the City of Hayward are located in the East Bay Hills located east of EBP Subbasin and within the Niles Cone Subbasin to the south of EBP Subbasin.

Area covered: 10,300 acres
Annual groundwater pumping: Approx. 500 acre feet
Primary sources of water supply: San Francisco Public Utilities Commission Hetch Hetchy Reservoir

EAST BAY PLAIN SUBBASIN GSP TECHNICAL ADVISORY COMMITTEE

The EBMUD and Hayward GSAs jointly formed the EBP Subbasin GSP Technical Advisory Committee, which helped guide the agencies through development of the GSP. Committee members included representatives from the Cities of Richmond, Berkeley, San Pablo, and Alameda; Lawrence Berkeley National Laboratory; the Alameda County Department of Public Works; the San Francisco Bay Regional Water Quality Control Board; the Sierra Club; Contra Costa College; and Grolutions Horticultural Landscaping.

INTERESTED PARTIES

The following state agencies and non-governmental organizations also contributed to the GSP: The Nature Conservancy, Sierra Club, Clean Water Action, California Dept of Fish and Wildlife.

EAST BAY PLAIN SUBBASIN GSP INTERBASIN WORKING GROUP

The GSAs for the EBP Subbasin participated in an Interbasin Working Group with representatives from neighboring groundwater subbasins. The working group met quarterly during development of this GSP. Members included one or more representatives each from EBMUD, Hayward, and

Legal Authority of the Groundwater Sustainability Agencies

EBMUD and Hayward are the local agencies overlying the EBP Subbasin, as defined in the Sustainable Groundwater Management Act (SGMA); this makes them eligible to serve as separate GSAs within the EBP Subbasin (Water Code Section 10723[a]). Under the California Water Code, neither Alameda County nor Contra Costa County serves as a GSA, because all areas within the EBP Subbasin are covered by either EBMUD or Hayward.

Consequently, EBMUD and Hayward each held public hearings regarding the establishment of a GSA in accordance with Water Code Section 10723(b). Each agency's governing board then adopted a resolution to establish the GSA. On November 6, 2017, EBMUD and Hayward filed a notification letter with the California Department of Water Resources of their intent to jointly develop a single GSP for the EBP Subbasin. The California Department of Water Resources recognizes the intent to develop a single GSP as shown on their online SGMA Portal for the East Bay Plan profiles for the EBMUD GSA and the City of Hayward GSA.

As GSAs for the EBP Subbasin, EBMUD and Hayward have the legal authority to prepare a GSP and are pursuing the financial resources necessary to implement the plan.

Hayward Shoreline, City of Hayward Groundwater Sustainability Agency
Source: https://www.hayward-ca.gov/shoreline-master-plan

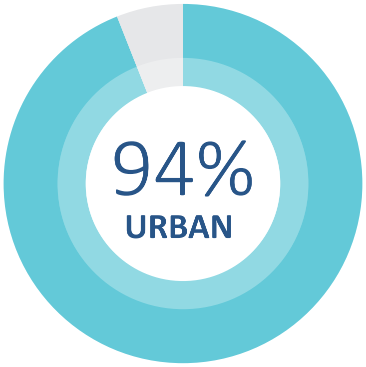
CHAPTER 2: PLAN AREA AND BASIN SETTING

Description of the Plan Area

The Plan Area lies within the boundaries of Contra Costa and Alameda counties, including all or portions of the cities of Alameda, Albany, Berkeley, El Cerrito, Emeryville, Hayward, Oakland, Piedmont, Richmond, San Leandro, and San Pablo. Unincorporated areas (including San Lorenzo) within the subbasin are covered by the respective county general plans (GPs), and various city GPs cover the other portions of the Subbasin. The Subbasin does not contain federal or state lands, but does include Lytton Tribal lands.

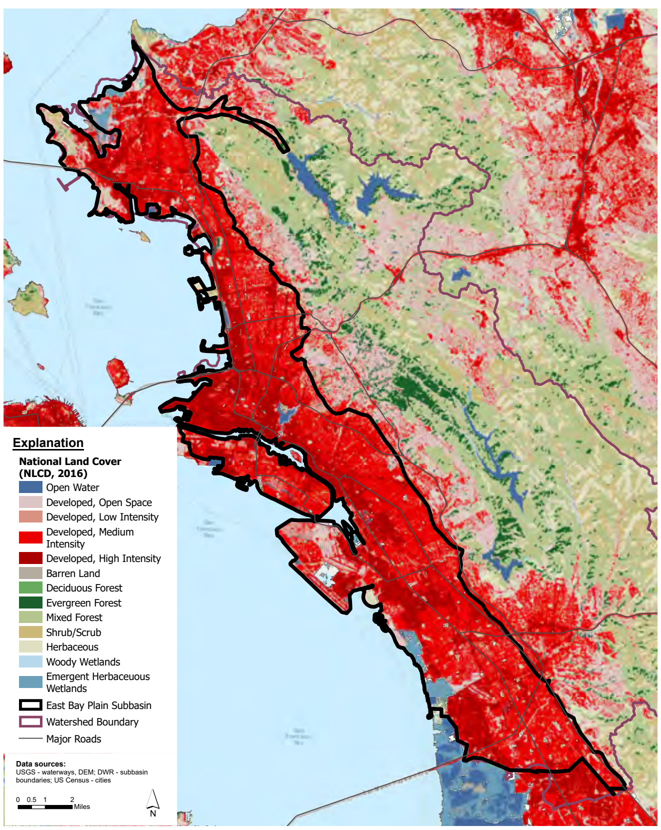
Land Use Overview

USE TYPE	% OF EBP SUBBASIN AREA
Urban	94%
Open Water	1%
Barren Land	1%
Vegetation	4%



LAND USE

While the area is primarily urban (94%), it does have some areas with vegetation and open water.



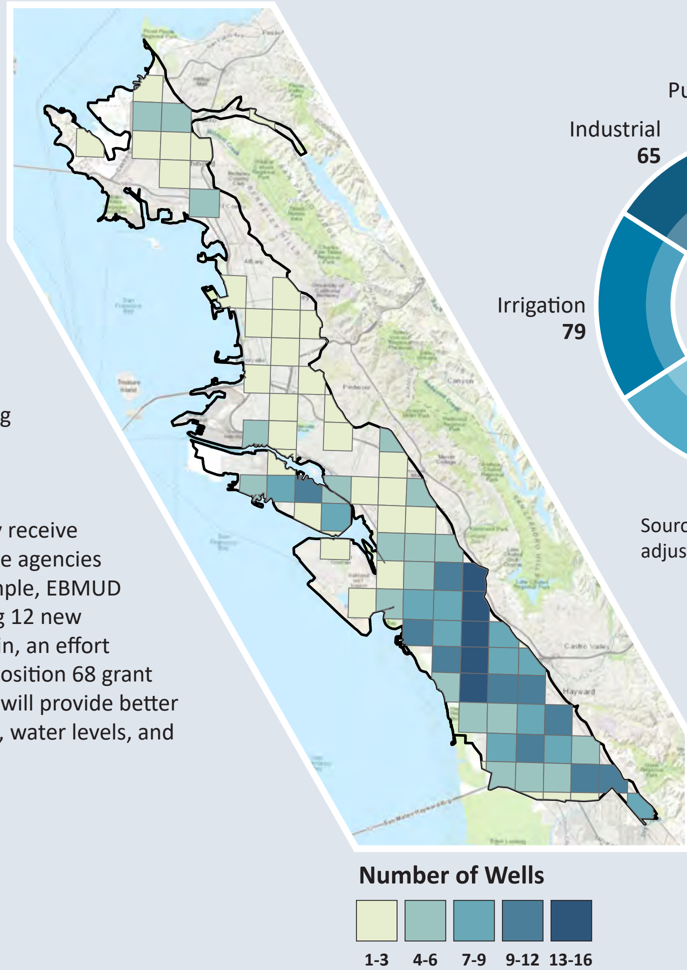
A comprehensive understanding of the plan area is important in developing the groundwater sustainability plan. Chapter 2 addresses the following California Code of Regulation (CCR) requirements:

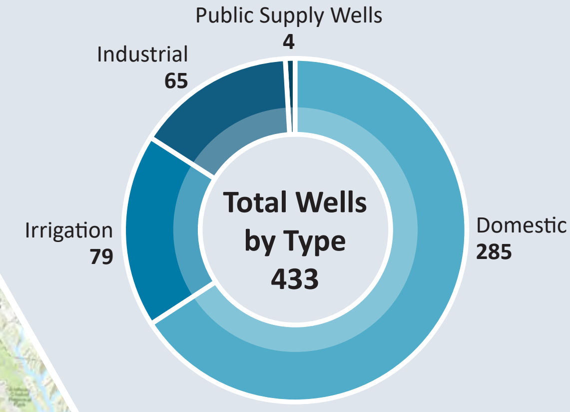
- ☑ Description of the Plan Area (CCR Title 23, Section 354.8)
- ☑ Summary of Jurisdictional Areas and Other Features (CCR Title 23, Section 354.8[b])
- ☑ Water Resources Monitoring and Management Programs (CCR Title 23, Sections 354.8 [b], 354.8 [d], and 354.8 [e]
- ☑ Land Use Elements or Topic Categories of Applicable General Plans (CCR Title 23, Section 354.8[f])
- ☑ Additional GSP Elements (CCR Title 23, Section 354.8[g])
- ☑ Notice and Communication (CCR Title 23, Section 354.10)
- ☑ Hydrogeologic Conceptual Model (CCR Title 23, Section 354.14)
- ☑ Current and Historical Groundwater Conditions (CCR Title 23, Section 354.16)
- ☑ Water Budget Information (CCR Title 23, Section 354.18)
- ☑ Management Areas (CCR Title 23, Section 354.20)

WELLS AND THEIR EFFECT ON GROUNDWATER

A system of domestic, irrigation, and industrial wells are located throughout the EBP Subbasin. As part of GSP implementation, well permitting agencies will be asked to consult with GSAs prior to issuing permits to ensure the groundwater basin's sustainability. The GSAs will also work with existing well owners to collect and analyze pumping data.

The GSAs apply for and occasionally receive grants from various federal and state agencies for water-related projects. For example, EBMUD and Hayward are currently installing 12 new monitoring wells in the EBP Subbasin, an effort that is being funded through a Proposition 68 grant awarded to EBMUD. The new wells will provide better definition of the Subbasin's geology, water levels, and water quality.





Source: DWR Well Completion Report Database adjusted for known public supply wells

WATER RESOURCES PLANNING, MONITORING, AND MANAGEMENT PROGRAMS

To develop a comprehensive GSP and as stewards of water resources, the EBP Subbasin GSAs and corresponding local agencies have prepared and adopted regional, local, urban, groundwater management, and general plans. Each of these plans coordinate water resources for the region across a number of agencies and county lines.

Information in these plans regarding GSA surface water and groundwater supplies, distribution infrastructure, and monitoring programs has contributed to the development of this GSP.

LAND USE ELEMENTS OR TOPIC CATEGORIES OF APPLICABLE GENERAL PLANS

General plans have been prepared for Alameda County and Contra Costa County and several cities within the EBP Subbasin, which the GSP thematically characterizes by the following topics:

- Buildout
- Vacant land and infill/recharge potential
- Additional housing development and other future development
- Green infrastructure
- Creek protection
- Water supply sources
- Groundwater as a water supply

Generally, implementation of general plan policies aligns with GSP planning efforts and supports the sustainability of the EBP Subbasin. The GSP uses conservative assumptions (Chapter 4: Projects and Management Actions to Achieve Sustainability Goal) to develop a future scenario where there is a net decrease in groundwater recharge.

Notice and Communication Regarding the GSP

The GSAs in the EBP Subbasin created a communication and engagement plan that includes a stakeholder engagement chart. Beneficial users are stakeholders in the EBP Subbasin who use or consume groundwater, including environmental uses, such as groundwater dependent ecosystems (GDEs). Other stakeholders include those with an interest in groundwater use and management.

The GSAs convened a EBP Subbasin GSP Technical Advisory Committee with technical experts and/or representatives associated with the various Subbasin stakeholders. An email distribution list of stakeholders and beneficial users was developed. Before public meetings for development of the GSP, the GSAs emailed a meeting agenda to the list of interested parties.

Public engagement opportunities during GSP development included:

- Eight general meetings for stakeholders and the public to learn about the SGMA process and Plan components, receive updates about planning activities, and provide input.
- SGMA webpages maintained by each GSA (EBMUD and Hayward), containing calendars of public meetings and other events; information about past meetings, including relevant presentation materials; links to external sites and resources; information about the GSAs and EBP Subbasin technical meetings; GSP documents; and subbasin maps.
- Email/telephone availability of the GSAs' SGMA staff.

PUBLIC ENGAGEMENT PROCESS

Stakeholder Engagement Plan created

Stakeholder Group convened, including EBP Subbasin GSP Technical Advisory Committee, Interbasin Working Group, and Interested Parties

The **Technical Advisory Committee** reviewed and commented on the consultants' deliverables and provided input for GSP development

The Draft GSP was made available for a **45-day public review** in September 2021, which was announced via email and social media. Hard copies were also made available at several public libraries.

Comments received during public review of the Draft GSP were reviewed and considered by the GSAs, the Technical Team, and consultants; the final GSP was submitted to DWR with responses to comments

Basin Setting

HYDROGEOLOGIC CONCEPTUAL MODEL

The geologic history of the EBP Subbasin over the past 800,000 years involves the rise and fall of sea level, which resulted in deposits of different types of sediments/soils from streams (e.g., clay, sand, gravel), wind (e.g., sand dunes), and the Bay (e.g., Bay Mud, silt). These sediments were laid down in different places at different times, thereby resulting in alternating sequences of clay, silt, sand, and gravel within each aquifer zone. Aquitard layers consist primarily of fine-grain materials (clay, silt). This depositional history resulted in more coarse-grained material (sand, gravel) in the Deep Aquifer Zone in the southern EBP Subbasin compared to shallower zones or more northerly locations. The transition zone is a hydrogeologic boundary between the EBP and Niles Cone Subbasins related to vertical offsets of coarse-grained layers that restrict groundwater flow between the two subbasins.

The EBP Subbasin extends across multiple jurisdictions and consists of three major aquifer zones across the area. Most high-yield production wells have been developed within the Deep Aquifer Zone and lower portion of the Intermediate Aquifer Zone in the southern EBP Subbasin. The Shallow Aquifer Zone and upper to middle portions of the Intermediate Aquifer Zone have geologic conditions that tend to result in lower yielding wells.

Based on recharge mechanisms, soil types, and surface geologic data, it has been found that groundwater recharge has the potential to occur throughout the EBP Subbasin.

CURRENT AND HISTORICAL GROUNDWATER CONDITIONS

Groundwater pumping is much lower today (3,600 AF) than in the 1960s (>20 TAF), and groundwater levels are stable and the basin is sustainable.

Overall groundwater quality in the intermediate and deep aquifer is good, with contamination limited to the shallow aquifer.

Extensive water supply development and groundwater pumping from the Intermediate and Deep Aquifer Zones occurred in the southern EBP Subbasin during the 1950s and 1960s, resulting in Intermediate/Deep Zone groundwater levels that ranged from 10s of feet (ft) to well over 100 ft below sea level. However, no seawater intrusion problems were reported during this time.

Land subsidence is a decline in ground surface elevation, which can occur from natural or human-induced causes. Since 2008, two deep extensometers have continually measured the aquifer system compaction (elastic and inelastic subsidence) and expansion (uplift) in the southern portion of EBP subbasin area. The extensometer monitoring (done in coordination with USGS) is a key ongoing program that collects subsidence data on a continuous basis and no land subsidence has been reported to date.

Groundwater Quality

Overall groundwater quality in the EBP Subbasin has been evaluated in detail for several major constituents. Where appropriate, the minimum threshold is based on the maximum containment level (MCL), which is defined as "the highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the MCL goal as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water" (California Code of Regulations, 2019).

Total Dissolved Solids (TDS)

TDS has secondary MCLs of 500 mg/L (recommended) and 1,000 mg/L (maximum). Average concentrations are generally less than 1,000 mg/L except in localized areas near San Francisco Bay (primarily in the Shallow Aquifer Zone).

Chloride

Chloride has secondary MCLs of 250 mg/L (recommended) and 500 mg/L (maximum). The distribution of chloride concentrations, which can serve as a potential indicator for seawater intrusion, generally have concentrations less than 500 mg/L except near San Francisco Bay in the Shallow Aquifer Zone.

Nitrate

Available data for wells known to be screened in the Intermediate and Deep Aquifer Zones indicate that nitrate concentrations are below the primary MCL of 10 mg/L for nitrate as nitrogen. However, there are a limited number of Shallow Aquifer Zone wells distributed throughout the EBP Subbasin that have elevated nitrate concentrations exceeding the MCL.

Arsenic

Arsenic is a commonly occurring natural constituent in groundwater. Most wells with data have arsenic concentrations below the arsenic primary MCL of 10 ug/L; however, there are one or more wells in each depth zone with an average arsenic concentration above the MCL.

Manganese

Manganese is a commonly occurring natural constituent in groundwater, and the majority of wells tested in the EBP Subbasin have manganese concentrations exceeding the secondary MCL (no primary MCL has been established for manganese since it is not a health concern) in all three aquifer depth zones.

GROUNDWATER POLLUTANTS

Historical commercial and industrial activities in the EBP Subbasin have resulted in release of pollutants to the soil and groundwater system.

The pollutants selected for more detailed analysis were based on the need to establish current baseline conditions for the most common and potentially impactful contaminants. Environmental (i.e., contaminant) sites were reviewed using the State Water Resources Control Board's GeoTracker database; the review focused on perchloroethene (PCE), trichloroethene (TCE), total petroleum hydrocarbons, benzene, toluene, ethylbenzene, xylenes, methyl tert-butyl ether, and hexavalent chromium (generally considered a naturally occurring constituent, but included here to account for potential industrial sources).

A total of fourteen sites with existing PCE, TCE, and/or hexavalent chromium concentrations above the MCL were identified at locations throughout the EBP Subbasin from Richmond to Hayward.

The depth of contamination was limited to the upper 50 feet below ground surface (bgs) at all sites except one (located in Richmond), where monitoring well depths extended to 120 feet bgs. Other sites with minor contamination are present throughout the Subbasin; review of these sites generally indicated environmental site contamination is limited to the upper portion (i.e., upper 120 feet) of the Shallow Aquifer Zone.

A review of available information on PFAS contaminants in the EBP Subbasin as of August 2021 revealed three reported sites located adjacent to San Francisco Bay in the EBP Subbasin: West Contra Costa Landfill (Richmond area), Oakland Airport, and West Winton Landfill (Hayward area). The West Contra Costa Landfill is located adjacent to biosolids drying lagoons for a wastewater treatment plant, and had perfluorooctanoic acid (PFOA) detected in shallow brackish groundwater from six wells (up to 47 feet deep) and perfluorooctane sulfonate (PFOS) detected in four of six wells (up to 21 feet deep) at concentrations consistent with the range expected in municipal solid waste leachate. No additional sampling was recommended as of July 2020 (Geosyntec, 2020). The Oakland Airport site report indicated detection of PFAS compounds in soil and groundwater (in monitoring wells up to nine feet deep) in four different areas of the site. Additional investigation was ongoing at the time of the latest available report (CH2M Hill, December 2020). The West Winton Landfill site has been evaluated under a SWRCB order for PFAS sampling of landfill leachate and groundwater. Relatively low concentrations of PFAS compounds were detected in shallow brackish groundwater from monitoring wells up to 27 feet deep (Wood, April 2020).

The overall results of this review indicate that the Intermediate and Deep Aquifer Zones (depth intervals greater than 200 ft bgs) are generally not impacted by contaminants attributed to environmental sites, which are subject to clean up orders from the RWQCB and DTSC and are not the responsibility of the GSAs.

Water Budget

A water budget is a tabulation of all the components of inflow (recharge) and outflow (discharge) from the groundwater basin. Primary components of recharge in the EBP Subbasin that require quantification are rainfall infiltration, excess infiltration of applied irrigation water, streamflow infiltration, pipe leakage, bedrock inflow, and lateral subsurface inflows. Primary discharge components include groundwater pumping, lateral subsurface outflows, discharge to streams, and sewer pipe outflow.

CLIMATE CHANGE

The anticipated effects of future climate change were reviewed both in terms of expected sea level rise and relative to expected changes in hydrology (i.e., precipitation, evapotranspiration (ET), and streamflow) using DWR's SGMA Guidance for Climate Change and several local studies. Overall, these studies indicate a tendency towards greater precipitation and streamflow along with higher ET.

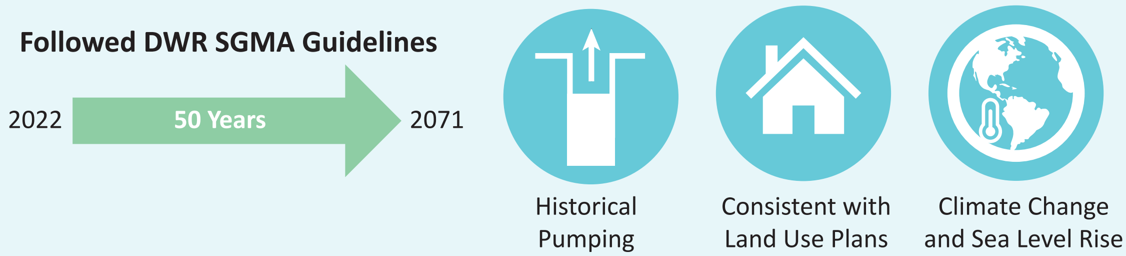
There is significant uncertainty with regard to total sea level rise expected by 2070, with estimates ranging from 1.5 to 3.5 feet by 2070. While DWR (2018) estimates sea level rise of 1.5 feet by 2070, this GSP uses a sea level rise estimate of 2.0 feet by 2070 to accommodate other studies indicating somewhat higher estimates of sea level rise.

The change factors defined in DWR's SGMA Guidance documents indicate expectations are for a higher percentage increase in precipitation than for ET, especially in the key months of December to March when most groundwater recharge occurs. In addition, streamflow is expected to be greater than historical amounts. However, due to significant uncertainty associated with these change factors and in order to be more conservative in the future hydrology used in this GSP, it was assumed that groundwater recharge and streamflow do not increase in the future and are the same as historical levels.

FUTURE SCENARIO

Looking ahead, it is reasonable to expect that existing groundwater facilities for public water supply (EBMUD's Bayside Phase 1 well for supplemental drought supply and the City of Hayward's emergency wells) will provide additional resilience to the overall water supply portfolio for the East Bay.

Pumping from the projects results in short-term drawdown that is not expected to produce undesirable results, and no significant change in stream connectivity or decrease in streamflow is expected. The recharge of the basin will slightly outpace discharge from the basin, resulting in a net benefit increase in basin storage.



SUSTAINABLE YIELD

The estimate of sustainable yield is based on previous studies (Muir; 1996; Norfleet, 1998), the water balance analysis provided in the GSP HCM, and the groundwater model developed for this GSP. Muir conducted studies in the 1990s on the Alameda County portion of EBP Subbasin from Berkeley in the north to Hayward in the south.

Muir defined the "yield of the groundwater reservoir" in the East Bay Plain to be based on the amount of groundwater that could be pumped "…year after year without decreasing groundwater in storage to the point where the intrusion of seawater from San Francisco Bay would occur."

The EBP Subbasin groundwater model developed for this GSP used a steady-state groundwater model run to evaluate sustainable yield for the EBP Subbasin. It was estimated with data from previous studies, the water balance analysis provided in the GSP hydrogeologic conceptual model, and the groundwater model used for the GSP.

This analysis resulted in an initial estimated sustainable yield of approximately 12,500 AFY for the entire EBP Subbasin.

Based on best available data at this time, this estimated sustainable yield represents a maximum amount that assumes approximately evenly spaced pumping throughout the Subbasin. This initial estimate of sustainable yield will be refined in the future with collection of additional field data, refinement of the water balance, development of a better understanding of surface water depletion, updates to the groundwater model, and additional model simulations of transient model runs with specific proposed projects and management actions.

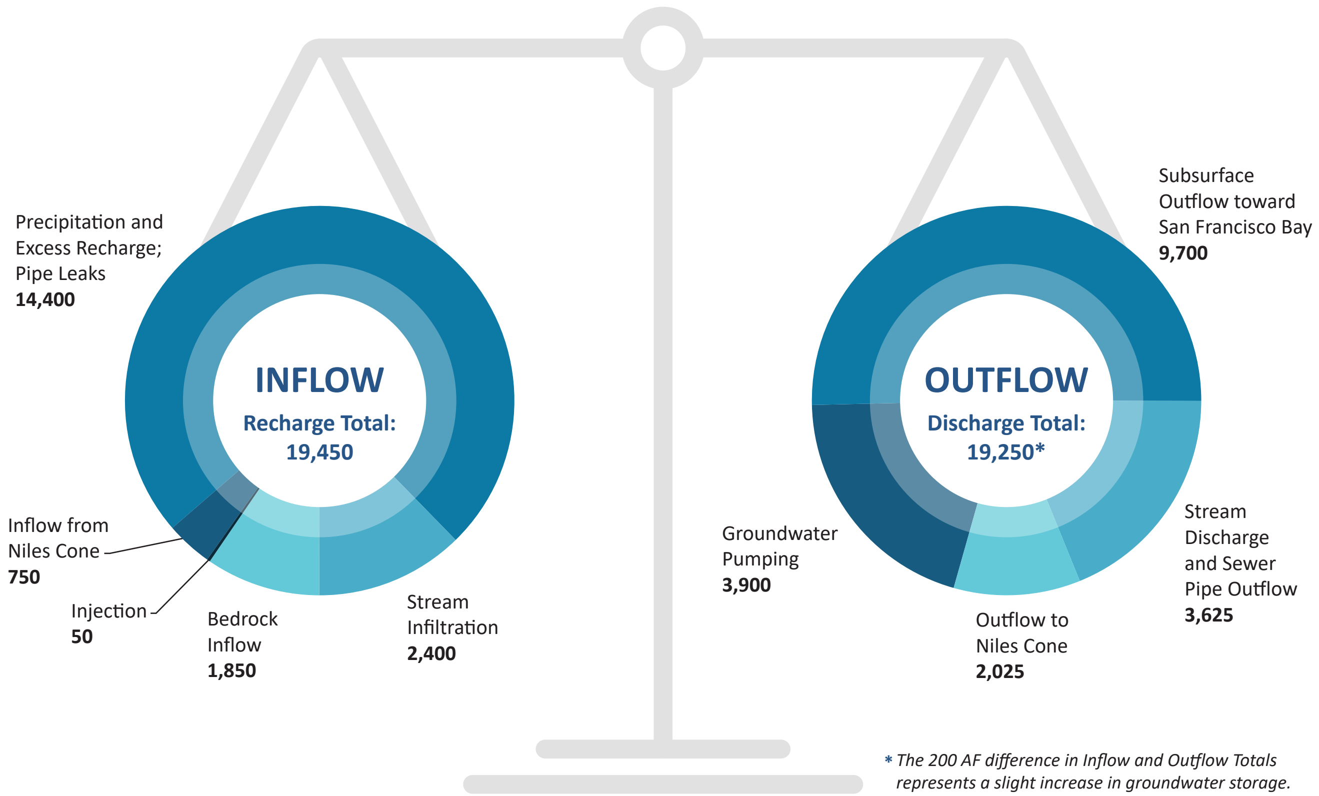
PROJECTED FUTURE WATER BUDGET

The future projected water budget includes anticipated impacts of climate change, land use changes, and changes related to implementation of GSA projects and management actions. Based on these forecasts, the recharge and discharge elements are balanced with an accounting for a small groundwater storage change component.

While total recharge to the EBP Subbasin is slightly reduced under the projected future water budget with sea level rise, comparison of total recharge to total discharge indicates an overall groundwater storage increase averaging 200 AFY.

Water Balance

RECHARGE (AFY)				DISCHARGE (AFY)			
Historical	**Current**	**Future Baseline**	**Future with Projects**	**Historical**	**Current**	**Future Baseline**	**Future with Projects**
19,700	19,475	19,300	19,450	17,550	19,000	19,025	19,250



** The 200 AF difference in Inflow and Outflow Totals represents a slight increase in groundwater storage.*

CHAPTER 3: SUSTAINABLE MANAGEMENT CRITERIA

Sustainable Management Criteria

This fundamental chapter of the Groundwater Sustainability Plan (GSP) defines sustainability in the Plan area, and addresses significant regulatory requirements. The undesirable results, minimum thresholds, and measurable objectives 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.

SUSTAINABILITY GOAL

The sustainability goal for the Plan area is to manage and protect the East Bay Plain Subbasin in a manner that avoids undesirable results while continuing to collect and analyze data to support science-based decision making to evaluate new opportunities for sustainable groundwater beneficial uses.

SGMA requires that the GSAs consider six sustainability indicators in the GSPs. Each have been assigned minimum thresholds and measurable objectives as set forth in this GSP to avoid undesirable results and ensure continued sustainable groundwater management of the EBP Subbasin over the planning and implementation horizon. Interim milestones were set equal to measurable objectives because the basin is sustainable under current conditions.

Interim sustainable management criteria (metrics defining when undesirable results occur and when the sustainability goal is maintained/achieved) for each indicator were developed with stakeholder input and using best available science and data with the caveat that major data gaps need to be addressed.

LOOKING AHEAD 20 YEARS

The sustainability goal and the absence of undesirable results are expected to be maintained through and beyond 2042 with implementation of the projects and management actions (MAs). The sustainability goals will be maintained through proactive monitoring and management by the GSAs.

Chapter 3 defines what sustainability looks like for the plan area considering a number of specific indicators, and addresses the following California Code of Regulation (CCR) requirements:

- **Sustainability Goal (CCR Title 23, Section 354.24)**
- **Undesirable Results (CCR Title 23, Section 354.26)**
- **Minimum Thresholds (CCR Title 23, Section 354.28)**
- **Measurable Objectives (CCR Title 23, Section 354.30)**
- **Description of Monitoring Networks (CCR Title 23, Section 354.34)**
- **Monitoring Protocols for Data Collection and Monitoring (CCR Title 23, Section 352.2)**
- **Representative Monitoring (CCR Title 23, Sections 354.36 and 354.38)**

A Network of Monitoring Wells

By establishing the GSP groundwater level monitoring network, the GSAs are able to collect data to assess sustainability indicators, the effectiveness of management actions and projects that maintain sustainability and evaluate each applicable sustainability indicator.

Monitoring protocols include specifics like frequency to 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.

A network of groundwater quality representative monitoring sites 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.

The RMS monitoring network is expected to evolve as new wells are drilled and water level data histories are developed, and will be periodically reviewed for potential improvements. Additional non-RMS monitoring wells are being considered for a broader monitoring network (Appendix 3.G).

Monitoring wells shown in the map at left are intended to fill the following data gaps:

- Limited historical groundwater level data
- Limited wells in the North
- Limited data on groundwater dependent ecosystems
- Lack of direct measurements of pumping
- Lack of chloride measurements and shallow wells near Bay margin
- Lack of historical concentration data to establish baseline concentrations
- Subsidence has only been directly measured in the EBP Subbasin using the extensometers near EBMUD's Bayside well
- Limited to no data on streamflow and stream-aquifer interconnection for major streams

SUSTAINABILITY INDICATOR:

Chronic Lowering of Groundwater Levels

EBP Subbasin is not experiencing a chronic lowering of groundwater levels and is currently in a sustainable condition.

UNDESIRABLE RESULTS

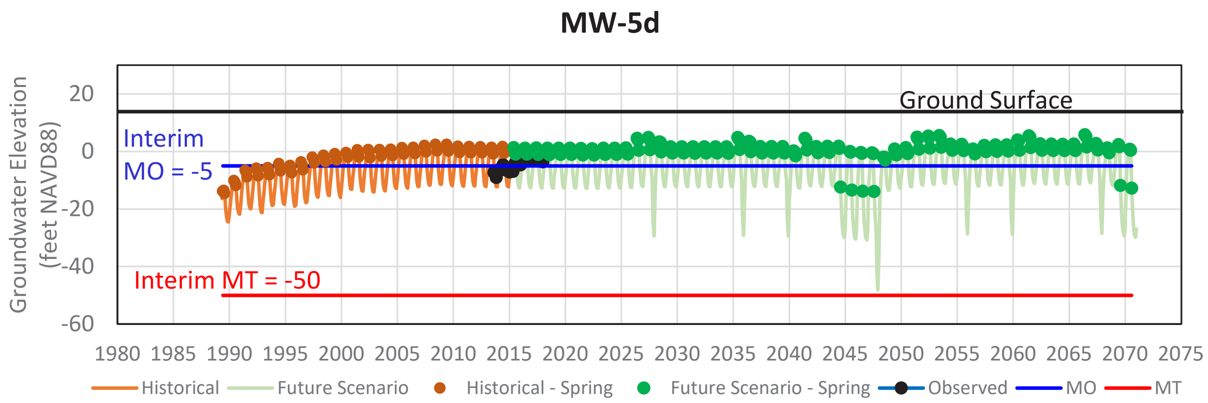
Declining groundwater levels unrelated to drought resulting in water supply wells no longer providing enough groundwater for beneficial uses or users resulting in:

- Reduction in well capacity
- Impacts to groundwater dependent ecosystems (GDEs)

INTERIM CRITERIA		
UNDESIRABLE RESULTS (UR)	**MINIMUM THRESHOLDS**	**MEASURABLE OBJECTIVES & INTERIM MILESTONES**
• **25% of Spring Representative Monitoring Sites (RMS) well levels below minimum threshold** *25% is at the lower end of a reasonable range from 20-50% and provides a balance to avoid URs* • **Two consecutive Spring measurements (March) on non-drought years** *Spring water levels are less influenced by localized pumping*	• **Shallow Aquifer: 50' below ground surface** *Based on minimum well seal depth requirement for water supply and industrial wells* • **Intermediate/Deep Aquifer: 50' below mean sea level** *Allows for sufficient available drawdown in deeper wells to maintain their capacity* • **Groundwater Dependent Ecosystems: 7.5' below baseline conditions in shallow wells** *30' maximum rooting depth for most plants used per The Nature Conservancy guidance; 25% of maximum rooting depth*	• **Average of historical data, when recent data (<10 years) is available** • **If no data or recent data is unavailable, groundwater model results are used**

SAMPLE MONITORING WELL DATA

See Appendix 3 for all locations



This hydrograph depicts observed and modeled deep aquifer zone groundwater elevations at MW-5 over time with associated groundwater level minimum thresholds and measurable objectives. Similar groundwater level hydrographs with sustainable management criteria for other RMS wells are presented in Appendix 3.A.

SUSTAINABILITY INDICATOR:

Reduction of Groundwater Storage

EBP Subbasin groundwater storage is stable because estimated groundwater pumping from the 1990s to present is well below the estimated sustainable yield of the Subbasin.

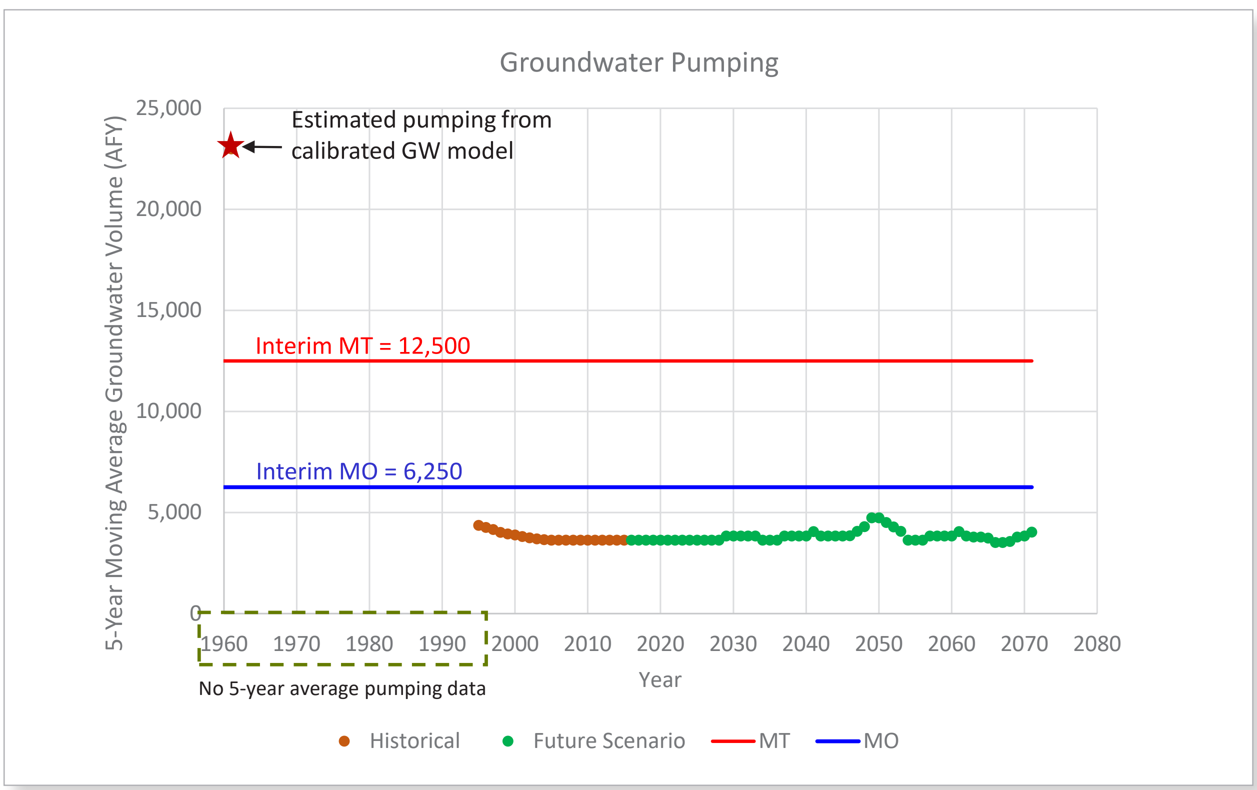
UNDESIRABLE RESULTS

Excessive regional groundwater pumping that results in significant and unreasonable long-term reduction in groundwater storage, resulting in:

- Reduction in well capacity

INTERIM CRITERIA

UNDESIRABLE RESULTS (UR)	MINIMUM THRESHOLDS	MEASURABLE OBJECTIVES & INTERIM MILESTONES
• **Average annual subbasin pumping exceeds sustainable yield for five-year period** *Five years balances short-term extreme needs while not allowing for long-term overpumping*	• **12,500 AFY over five-year period** *Initial sustainable yield estimate; two million AF of excess storage estimated in EBP Subbasin*	• **Reasonable range would be 20 to 50% less than MT** *A 20-50% range is a reasonable balance between not letting a very localized problem define undesirable results and not allowing most of the basin to be impacted before declaring an undesirable result has occurred.* • **Use 50% to be conservative = 6,250 AFY** *The selection of 50% results in lowest MO of 6,250 AFY.*



This figure presents the historical and projected future five-year moving average of annual groundwater pumping with implementation of GSA projects.

SUSTAINABILITY INDICATOR:

Seawater Intrusion

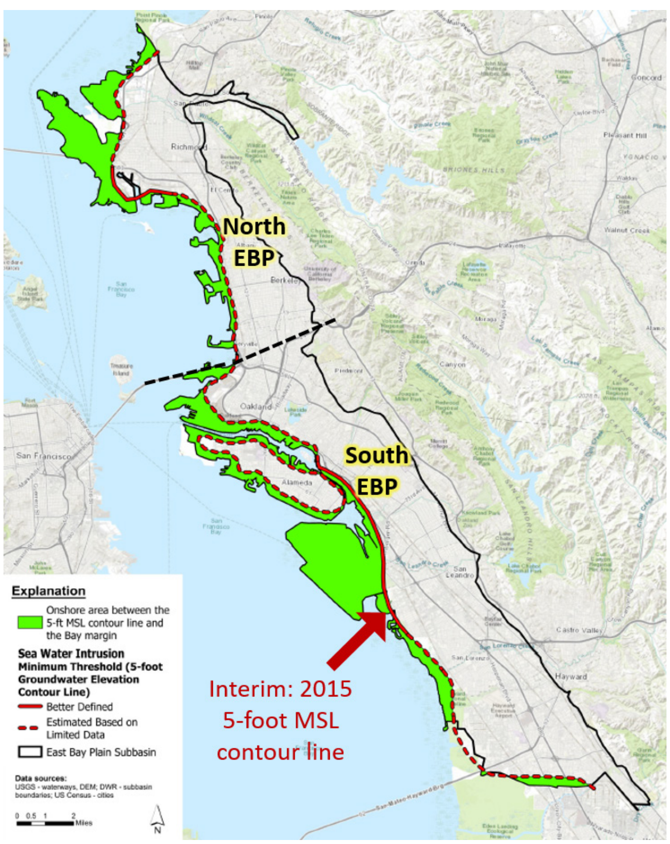
UNDESIRABLE RESULTS

Migration of saline Bay water into existing fresh water aquifers that are or could be developed for water supply, resulting in:

- The preclusion of beneficial use for drinking water

EBP Subbasin has not experienced significant seawater intrusion even during historical periods of much greater groundwater pumping than is occurring today.

INTERIM CRITERIA		
UNDESIRABLE RESULTS (UR)	**MINIMUM THRESHOLDS**	**MEASURABLE OBJECTIVES & INTERIM MILESTONES**
• **GW levels in Water Table Aquifer Zone (upper 50 feet) used as a proxy** *Water Table Aquifer is the only aquifer connected to the Bay with significant clay layers below* • **GW elevations exceed MSL near the Bay margin** *Seawater intrusion is not expected if shallow GW levels are maintained above MSL* • **Segmented into the north and south**	• **25% increase in onshore area between the 5 ft MSL contour line and Bay margin** *25% is at the lower end of a reasonable range from 20 to 50%* **AND** • **25% increase in chloride concentration in sentinel wells** *25% is at the lower end of a reasonable range from 20 to 50%*	• **Position of 5-foot MSL contour line based on 2015 Spring GW levels** *Current MSL is 1-foot; 5-foot MSL is lowest contour line that can be reasonably defined by available data and expected to adequately reflect inland movement of 1-foot MSL contour.*



The seawater intrusion sustainable management criteria are based in part on monitoring potential inland movement of the shallow aquifer five feet groundwater elevation contour (i.e., inland expansion of green area on this figure, which represents the area between San Francisco Bay margin and the five-foot groundwater elevation contour).

SUSTAINABILITY INDICATOR:

Land Subsidence

UNDESIRABLE RESULTS

Inelastic subsidence due to excessive groundwater pumping that causes impacts at a regional scale, resulting in:

- Damage to critical public infrastructure such as levees, flood control channels, water supply aqueducts

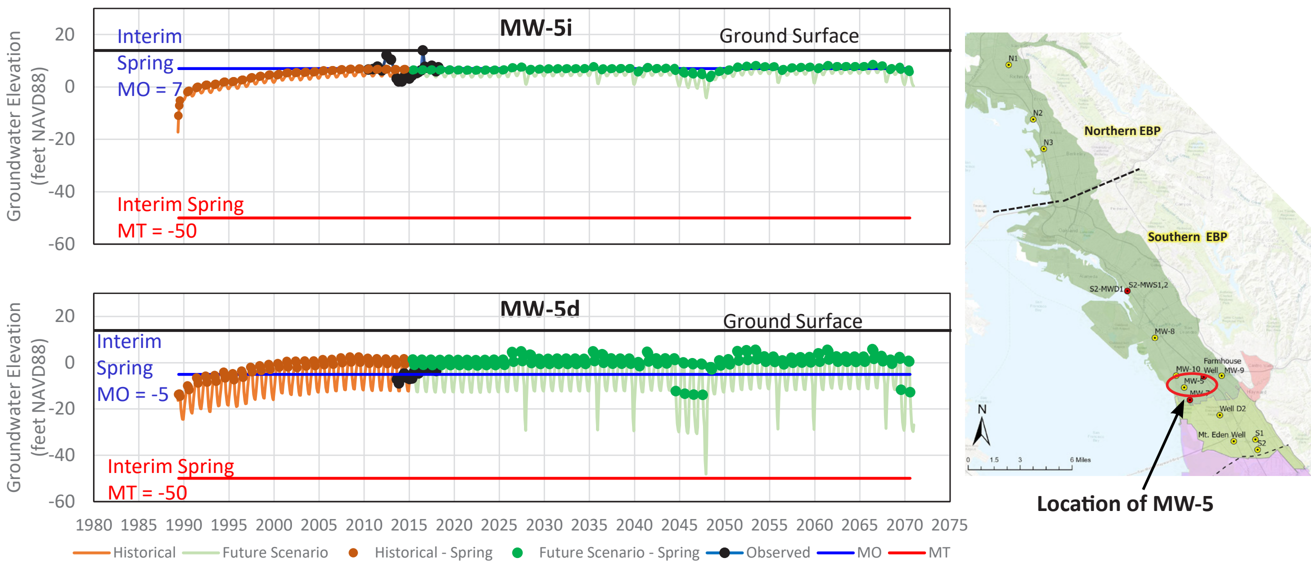
EBP Subbasin has no observed inelastic land subsidence even during historical periods of much greater groundwater pumping and much lower confined aquifer groundwater elevations than are occurring today.

INTERIM CRITERIA

UNDESIRABLE RESULTS (UR)	MINIMUM THRESHOLDS	MEASURABLE OBJECTIVES & INTERIM MILESTONES
• **GW levels used as a proxy; based on historical spring lows** • **Better data for historical spring water levels compared to fall** • **25% of RMS wells fall below MT for two consecutive non-drought years** *25% is at the lower end of a reasonable range from 20 to 50%* • **Intermediate / Deep Aquifer only; subsidence not expected in Shallow Aquifer**	• **South EBP -50 feet MSL (Spring)** *Observed / modeled historical lows in Intermediate and Deep Aquifer Zones* • **North EBP -20 feet MSL (Spring)** *Observed historical low for one well in Intermediate Zone* *Water levels and narrative from Richmond wellfield pumping*	• **Average spring groundwater levels in intermediate and deep aquifers when recent data (<10 years) is available** • **If data is unavailable, groundwater model results are used**

SAMPLE MONITORING WELL DATA

See Appendix 3 for all locations



These hydrographs depict observed and modeled intermediate and deep aquifer zone groundwater elevations at MW-5 over time with associated land subsidence minimum thresholds and measurable objectives, based on using groundwater levels as a proxy for land subsidence. Similar land subsidence hydrographs with sustainable management criteria for other RMS wells are presented in Appendix 3.D.

SUSTAINABILITY INDICATOR:

Degraded Water Quality

UNDESIRABLE RESULTS

Significant and unreasonable degradation of groundwater quality caused by GSA projects and management actions, resulting in:

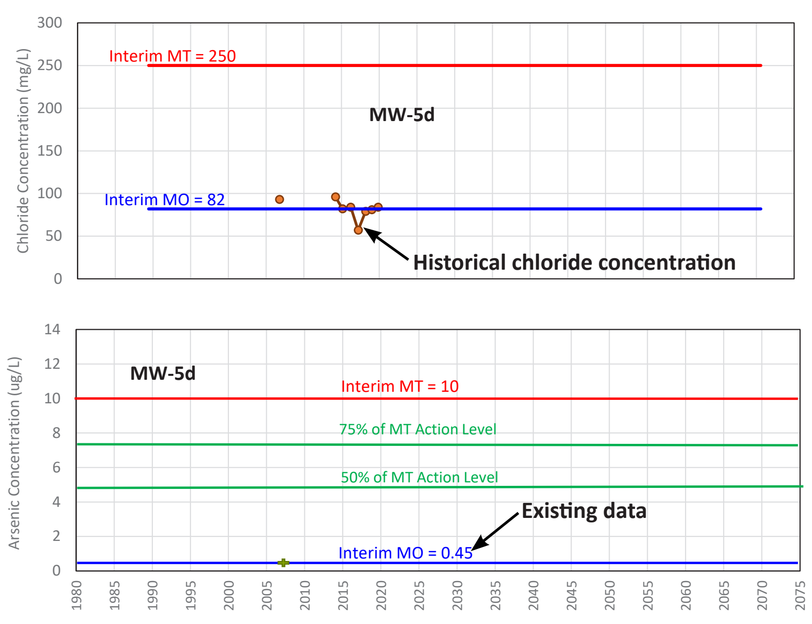
- The preclusion of beneficial use for drinking water

Overall groundwater quality in the EBP Subbasin is good; key constituents for monitoring degraded water quality are total dissolved solids, chloride, nitrate, and arsenic.

INTERIM CRITERIA		
UNDESIRABLE RESULTS	**MINIMUM THRESHOLDS**	**MEASURABLE OBJECTIVES & INTERIM MILESTONES**
• **25% of RMS wells exceed MT** *25% is at the lower end of a reasonable range from 20 to 50%* • **If concentrations exceed 50% of MT for a constituent with Primary MCL (i.e., nitrate and arsenic) conduct additional investigation of cause(s); 50% Action Level corresponds to notifications required in Drinking Water Regulations** • **If concentrations exceed 75% of MT for a constituent with Primary MCL (i.e., nitrate and arsenic) GSA acts to avoid undesirable result (if caused by GSA activity) or reports to appropriate agencies (if not caused by GSA activity); 75% Action Level corresponds to SWRCB/RWQCB Basin Plan Amendments for Region 5**	• **MCLs:** • Nitrate – 10 mg/L (primary) • Arsenic – 10 ug/L (primary) • TDS – 500 mg/L (secondary) • Chloride – 250 mg/L (secondary) *GW quality is generally acceptable if below an established MCL* • **If baseline concentration already exceeds MCL (e.g., naturally occurring constituents or pre-existing conditions), set MT at baseline concentration plus 20%** *20% increase is based on evaluation of 3 potential sources of fluctuations:* *(1) analytical lab methods* *(2) sampling methods* *(3) variability in GW system*	• **Average baseline concentrations where data is available**

SAMPLE MONITORING WELL DATA

See Appendix 3 for all locations



These time-series plots of chloride (secondary MCL) and arsenic (primary MCL) show historical baseline concentrations with associated minimum thresholds and measurable objectives. In addition, key constituents with primary MCLs such as arsenic have been assigned Action Levels set at 50% and 80% of the MT. Time-series plots for other RMS wells are provided in Appendix 3.E.

SUSTAINABILITY INDICATOR:

Depletion of Interconnected Surface Water

While significant data gaps currently exist for characterization of groundwater – surface water interaction, best available data indicates current pumping has minimal impacts on interconnected surface water.

UNDESIRABLE RESULTS

Increase in streamflow depletion rate that results in significant and unreasonable effects to potential beneficial uses/users, resulting in:

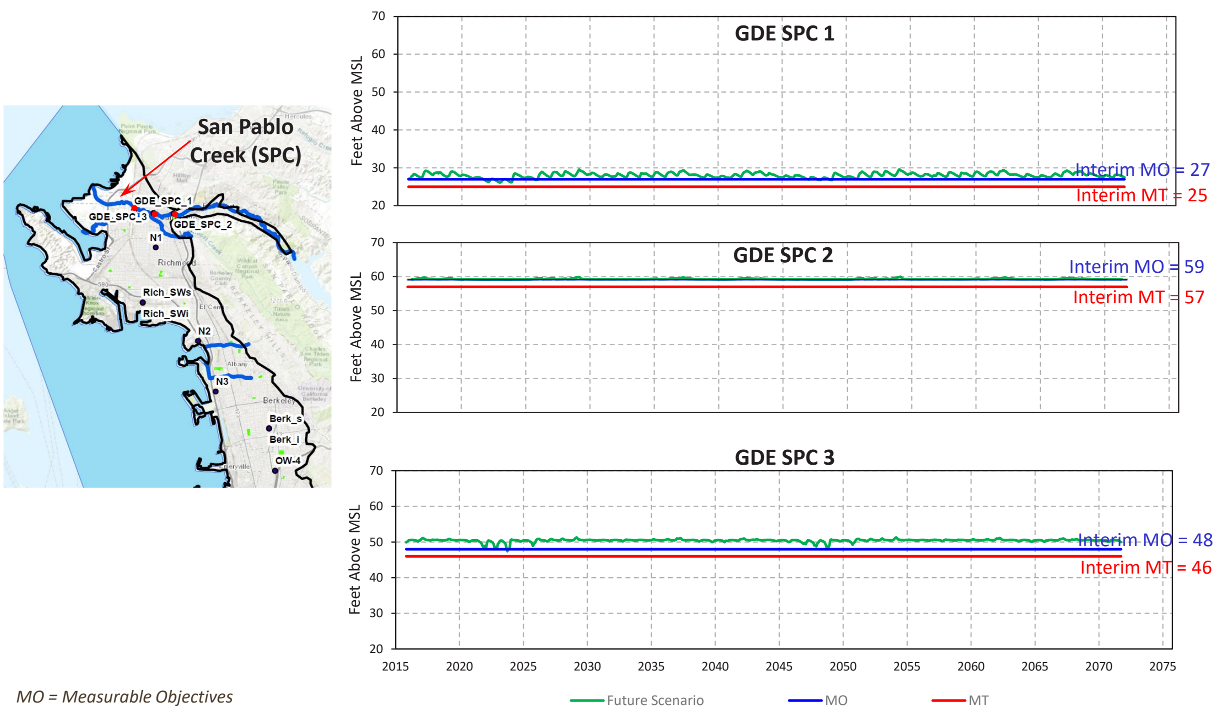
- Insufficient water for beneficial uses/users such as for aquatic species and GDEs

INTERIM CRITERIA

UNDESIRABLE RESULTS	MINIMUM THRESHOLDS	MEASURABLE OBJECTIVES & INTERIM MILESTONES
• **Shallow GW levels near major streams used as a proxy** • **50% of RMS wells fall below MT for two consecutive non-drought years** • **50% is reasonable because of small number of shallow RMS wells near streams**	• **2 feet below MO** *Based on GW model runs* *Difference between baseline conditions and sustainability (pumping at 3,600 AFY versus 12,500AFY)* *Shallow GW levels decreased between 0 – 1.8 feet*	• **Low end of model-derived range of GW level fluctuations**

SAMPLE MONITORING WELL DATA

See Appendix 3 for all locations



MO = Measurable Objectives
MT = Minimum Threshold

While plans have been developed to collect data and fill data gaps over the next several years, best available data have been used to establish initial interim minimum thresholds and measurable objectives for depletion of interconnected surface water. These hydrographs show use of groundwater levels as a proxy based on groundwater model results at potential future shallow well locations to establish interim sustainable management criteria. Similar surface water depletion hydrographs with sustainable management criteria for other RMS wells are presented in Appendix 3.F.

CHAPTER 4: PROJECTS AND MANAGEMENT ACTIONS

Projects

EBMUD and City of Hayward are committed to developing diverse water supply portfolios to help improve resiliency in the face of changing climate, water supply needs, and regulations. In addition to water conservation and recycled water, beneficial use of groundwater is an important potential source. The GSAs are also committed to maintaining sustainability within the EBP Subbasin, and the existing and potential future projects reflect the GSAs' desire to fill data gaps and let science-based decision making drive the feasibility of future groundwater pumping.

The projects and management actions are described in accordance with:

- **Introduction to Projects and Management Actions (CCR Title 23, Sections 354.42 and 354.44)**

After sufficient data collection, EBMUD future projects under consideration may include additional phases of Bayside, irrigation with groundwater, and the use of groundwater to supplement flows into San Leandro Creek. Potential future Hayward projects may include a well conversion study and a conjunctive use study.

EBMUD's Bayside Phase 1 and Hayward's emergency wells were evaluated based on the six sustainability indicators, and found to meet sustainability goals and measurable objectives without any undesirable results for the EBP Subbasin.

EBMUD BAYSIDE PHASE 1 FACILITY

Completed in 2010, this facility enables EBMUD to inject potable drinking water into the Deep Aquifer of the EBP Subbasin during wet years and also to extract, treat, and use groundwater as a supplemental supply during times of drought. Phase 1 consists of an injection/extraction well, a water treatment plant and distribution pipelines connecting the treatment plant to the well, a subsidence monitoring system, and a network of groundwater monitoring wells.

Average annual operating cost: $30,000 to $200,000

HAYWARD EMERGENCY WELLS

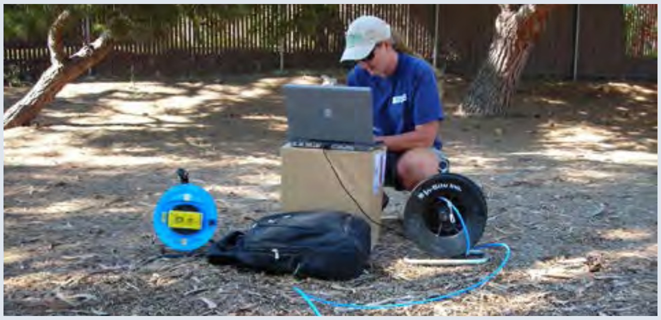
Emergency supply wells are planned for use as extraction-only wells to provide supplemental water supply to Hayward in the event of a short-term emergency, such as may occur with an earthquake that interrupts surface water supplies. Hayward has already constructed five extraction wells that are screened primarily in the Deep Aquifer, three of which are located within the EBP Subbasin.

Average annual operating cost: $60,000 to $500,000, in years operated for emergency water supply

Monitoring Actions

Implementing the following monitoring actions allows for effective groundwater basin management necessary to meet GSP/SGMA requirements while significantly improving the understanding of groundwater basin conditions, including stream-aquifer interaction.

GROUNDWATER LEVEL MONITORING



- Costs include both existing RMS wells and RMS wells planned for construction under a DWR Proposition 68 grant that are scheduled to be completed by mid-2022
- Most of these wells have (or will have) transducers installed for automated water level monitoring

GROUNDWATER QUALITY

- Same group of wells as for RMS groundwater level monitoring
- Sampled annually for arsenic, nitrate, chloride, and TDS with a more comprehensive list of analytes tested every five years
- Baseline sampling for key constituents is needed over the initial four years of GSP implementation to provide the basis for establishing MOs and MTs

SURFACE WATER MONITORING

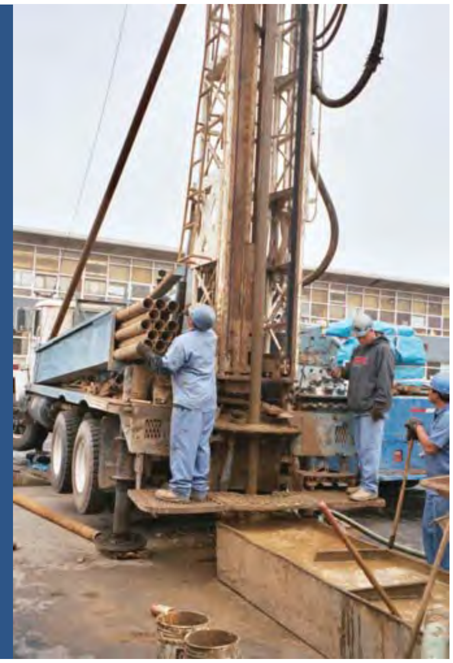
- Install new stream gauges.
- Collect stream discharge data as close together in time as possible to improve understanding of gaining and losing reaches along a length of stream
- Isotope sampling
- Monitor events during different seasons and water year types
- An initial baseline habitat/GDE survey will be conducted, with regular biological surveys thereafter to monitor ecosystem health in potential GDE areas

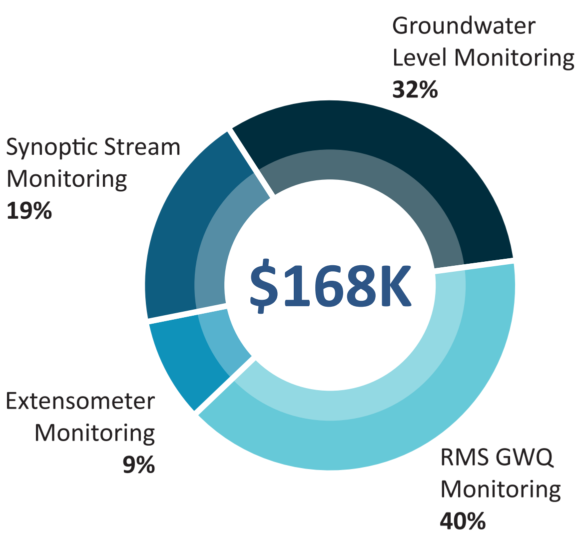
SUBSIDENCE

- The five-year GSP Update Report will include more detailed reporting on other data sets being collected such as subsidence (extensometer) data
- Subsidence monitoring will include collection of groundwater levels from RMS wells for comparison to extensometer data

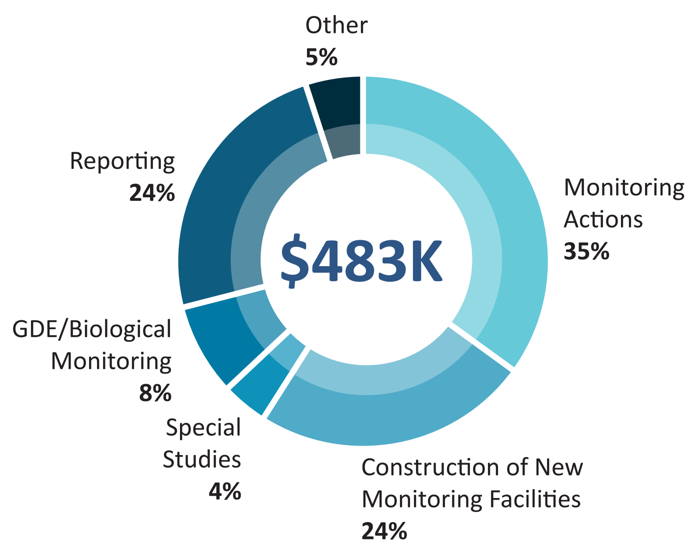
Future Informed by Science

Monitoring actions are going to fill data gaps to drive **science-based solutions** in the future.


Drilling operation for nested monitoring well



Estimated average annual operating costs for monitoring actions (not including potential management or administrative costs)



Annual costs of all management actions (not including potential management or administrative costs)

CHAPTER 5: PLAN IMPLEMENTATION

Estimated Costs

The EBMUD and Hayward GSAs will incur costs for managing the GSP implementation; planning and specialized studies; ongoing monitoring and installation of new facilities; and providing general administration (in addition to the capital and operating costs of projects included in Chapter 4). These project management costs can be categorized as:

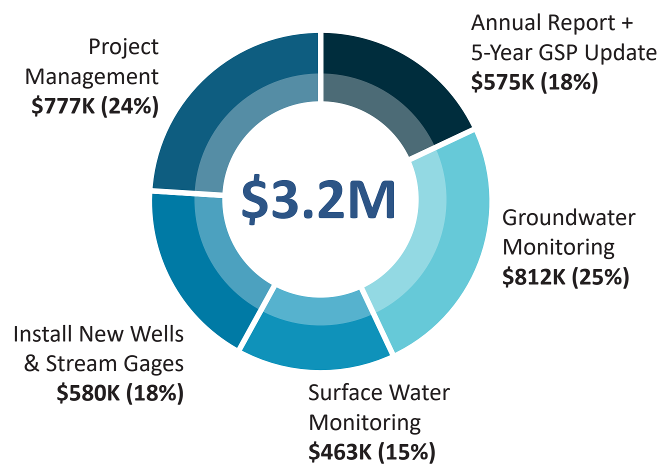
- **GSA Administration:** meetings, reporting, record keeping, bookkeeping, legal advice, continued outreach to stakeholders, and government relations
- **GSP Studies:** various planning, technical, and economic/ fiscal studies
- **GSP Implementation and Updates:** include internal GSA coordination, meetings, and document preparation
- **Project Planning:** evaluate other project ideas proposed by stakeholders, assess cost-effectiveness of planned projects, and evaluate the joint implementation of multiple projects to ensure the GSP continues to meet the sustainability goal
- **Meetings and Stakeholder Outreach:** following submittal of the GSP, the GSAs will continue to conduct stakeholder outreach and hold meetings to discuss progress with GSP Implementation
- **Monitoring:** tracking Subbasin conditions and sustainability indicators by collecting groundwater extraction and injection data, measuring groundwater elevations and water quality, and tracking total water use
- **Contingency:** actions needed to implement additional management measures if Subbasin conditions start trending towards minimum thresholds in any area

GSP FINANCING

The GSAs are pursuing a combined approach, targeting available grants, and considering a combination of fees and assessments to cover operating and program-specific costs. As required by statute, the GSAs would complete an engineer's report, rate study, and other necessary analyses to document and justify any rate, fee, or assessment.

As part of GSP Development, Chapter 5 addresses the following requirements:

- ☑ **Cost Estimate for Plan Implementation and Funding Sources (CCR Title 23, Section 354.6e)**
- ☑ **Annual Reports and Periodic Evaluation (CCR Title 23, Sections 356.2 and 356.4)**



Estimated five-year costs for proposed implementation activities (to be refined as plan implementation begins). Estimate doesn't include the project costs, but does include the monitoring and management costs from Chapter 4.

Meeting and engaging with stakeholders will be a high priority throughout GSP implementation.

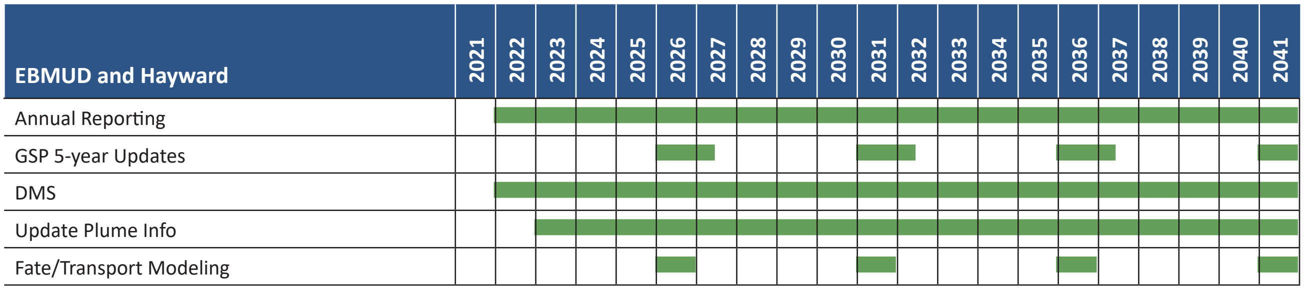
Schedule for Implementation

While the primary sustainability projects began prior to SGMA becoming law and are already contributing to the Subbasin sustainability goal, the GSAs will begin implementing other GSP activities in 2022, with full implementation of projects and management actions to maintain sustainability by 2042. Full schedules are shown below for all planned activities.

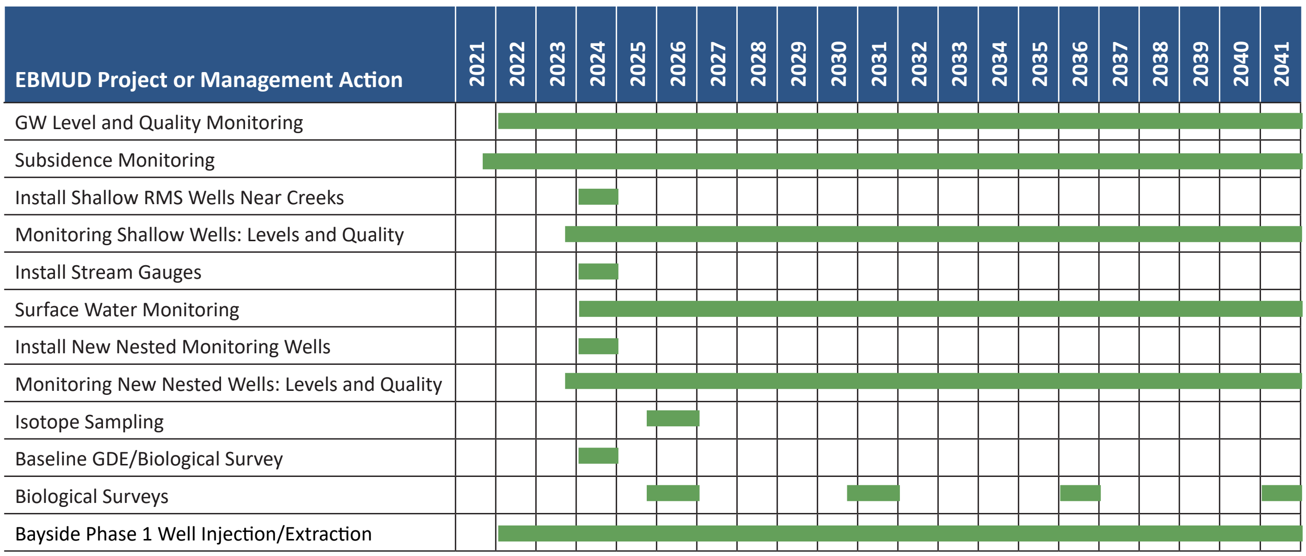
OPTI DATA MANAGEMENT SYSTEM (DMS)

GSP monitoring data will be collected via a web-based DMS to enable utilization of the same data and tools for visualization and analysis to support sustainable groundwater management and transparent reporting of data and results in the subbasin.

Combined GSA Management Actions



EBMUD GSA Implementation Schedule



Hayward GSA Implementation Schedule