Monterey Peninsula Water
Management District

95-10 Project
Constraints Analysis

Prepared for:

Monterey Peninsula Water Management District
5 Harris Court, Building G
Monterey, CA 93942-0085
Contact: Andy Bell

Prepared by:

ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814
Contact: Mike Rushton
916/737-3000

and

Camp, Dresser & McKee, Inc.
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596-3580
Contact: Polly Boissevain

August 2008

Constraints Analysis
Monterey Peninsula
Water Management District
95-10 Project

Prepared for:

Monterey Peninsula Water Management District
5 Harris Court, Building G
Monterey, CA 93942-0085
Contact: Andy Bell

Prepared by:

ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814
Contact: Mike Rushton
916/737-3000

and

Camp, Dresser & McKee, Inc.
100 Pringle Avenue, Suite 300
Walnut Creek, CA 94596-3580
Contact: Polly Boissevain
925/296-8077

August 2008

ICF Jones & Stokes. 2008. Constraints Analysis Monterey Peninsula Water Management District 95-10 Project. August. (ICF J&S 00494.08.) Sacramento, CA. Prepared for: Monterey Peninsula Water Management District.

Contents

Page

Tables

Page

Figures

Follows Page

Acronyms and Abbreviations

AFA	acre-feet annually
CAW	California American Water
CCA	California Coastal Act
CCC	California Coastal Commission
CDM	Camp Dresser & McKee
DFG	California Department of Fish and Game
DPR	California Department of Parks and Recreation
FORA	Fort Ord Reuse Authority
gpm	gallons per minute
HCP	Habitat Conservation Plan
HDD	horizontal directionally drilled
LCP	local coastal plan
MBNMS	NOAA Monterey Bay National Marine Sanctuary
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
mgd	million gallons per day
MPWMD	Monterey Peninsula Water Management District
MRWPCA	Monterey Regional Water Pollution Control Agency
NMFS	National Marine Fisheries Service
Park	Fort Ord Dunes State Park
RWQCB	Regional Water Quality Control Board
Sand City	City of Sand City
SWRCB	State Water Resources Control Board
USFWS	U.S. Fish and Wildlife Service
WWTP	wastewater treatment plant

Constraints Analysis

Monterey Peninsula Water Management District 95-10 Project

1 Introduction

Project Overview

The Monterey Peninsula Water Management District (MPWMD) manages and regulates the use, reuse, reclamation and conservation of water within its boundaries on the Monterey Peninsula. About 80% of the water collected, stored, and distributed within the MPWMD boundaries is done so by California American Water (CAW), which serves approximately 95% of Monterey Peninsula residents and businesses. Approximately 70% of the water delivered by CAW is diverted from the Carmel River Basin. In 1995, the State Water Resources Control Board (SWRCB) determined that the Carmel River was over-appropriated in the drier seasons of the year and issued Order WR 95-10 to reduce CAW's unlawful diversions from the Carmel River. Since issuance of WR 95-10, MPWMD has sought to develop and/or support projects that would meet the order's direction to seek alternative sources of water for the Monterey Peninsula.

In 2002, MPWMD initiated engineering and environmental evaluations of a local desalination project in the City of Sand City (Sand City)/former Fort Ord region of the Monterey County coast, seeking to develop a project that could supply up to 8,400 acre-feet annually (AFA) of potable water to the CAW system for delivery to the community. This is equivalent to 7.5 million gallons per day (mgd), average daily production. The project considered the use of horizontal directionally drilled (HDD) or radial wells to provide feed water from the shallow coastal Dune Sands aquifer, the construction of a local desalination water treatment plant, and the disposal of brine either back to the shallow aquifer along the coast or to the Monterey Regional Water Pollution Control Agency (MRWPCA) regional wastewater outfall near the mouth of the Salinas River.

Feed water collection alternatives for the earlier project focused on locating wells in the Sand City area and southern part of former Fort Ord, west of Highway 1, and drilling offshore from the coast to target the Dune Sands aquifer offshore. Field geotechnical and geophysical studies concluded that the Dune Sands aquifer did not extend significantly offshore, and that only radial wells, or HDD wells parallel to the shore were likely feasible. These options would require

siting collector wells in Sand City and former Fort Ord, and using the regional wastewater treatment plant outfall for brine disposal. Development of this local project was halted in 2004 to consider participation in larger, regional water supply projects that were being planned by other entities.

In January of 2008, the MPWMD Board of Directors authorized staff and its consultants to develop a scope and cost to re-initiate the evaluation of the Sand City/former Fort Ord area desalination project. Following receipt of proposals from ICF Jones & Stokes and Camp Dresser & McKee (CDM), the Board of Directors acted on April 21, 2008 to authorize staff and consultants to embark on the first phase of a phased approach to update the work completed in 2002-2004.

The first phase is a constraints analysis to determine whether there are feasible feed water intake and brine discharge conceptual designs with no irreconcilable policy or regulatory constraints that would discourage further evaluation of the desalination project. It also considers discharging brine from the water treatment process through the MRWPCA wastewater outfall to Monterey Bay. The proposed project considered in this report is now being described as the MPWMD 95-10 Project. This phase identifies the largest project that is feasible, as well as the largest feed water alternative that could be implemented more quickly, due to fewer implementation or regulatory issues or technical data gaps that would require additional field investigation. This first phase did not evaluate treatment plant sites because the original sites located in Sand City were found to be unavailable and the alternative sites identified in the past two months have not been discussed in sufficient detail with the owners to determine their availability. The Phase 1 study does not provide preliminary design or project construction and operation cost information. This information will be developed in Phase 2 of the study, should it be authorized by the MPWMD Board of Directors.

Phase 1 Study Overview

The objective of this first phase of work is to re-evaluate the earlier MPWMD seawater desalination project and identify whether a project can be developed that would provide a new potable water supply yielding up to 8,400 AFA (7.5 mgd average production). For a seawater source production capacity of 7.5 mgd, 15 mgd of firm feed water collection capacity is required. Firm well capacity is defined as the well capacity that could be in-service at any given time, with some wells out of service due to planned maintenance or unplanned equipment problems. Depending on the collector well technology, 16.5 to 19 mgd of total well capacity would be required to insure a firm capacity of 15 mgd. The first phase also re-evaluated the use of the MRWPCA wastewater outfall to Monterey Bay as the brine disposal mechanism. This element of the project was considered to be the only feasible method of brine disposal, regardless of the location or nature of the feed water collection system selected. Further work to refine outfall disposal requirements and review alternate desalination water treatment plant site locations, initially planned in Phase 1, was deferred based on discussions with MPWMD staff, pending selection of well collector alternatives that could move forward into a subsequent phase. This phase identifies feasible

collector well project sizes, implementation issues and next steps, so that the MPWMD Board of Directors can determine whether to proceed with a full engineering and environmental analysis of the 95-10 Project. To achieve this objective, the study team performed the following tasks for the Phase 1 analysis. The results of each of these tasks are presented in a subsequent section of the report.

- **Develop Conceptual Geologic Model (Section 2)**. Hydrogeologic information related to the Seaside Basin was compiled and reviewed, and used to develop a conceptual geologic model of the Aromas Sand and the dunes sands, collectively referred to as the Dune Sands aquifer, the target aquifer for feed water collection wells. Information was compiled for the Sand City and former Fort Ord areas, from a variety of sources, including field information from the Sand City desalination project, the Seaside Basin sentinel well program, and Fort Ord groundwater monitoring and cleanup activities.
- **Identify Constraints and Opportunities (Section 2).** The team compiled information on various technical, policy and regulatory issues that could affect siting of feed water collection wells. GIS tools were used to overlay technical information about constraints on maps of the Sand City and former Fort Ord coastal areas, and identify preliminary feed water collection alternatives. MPWMD staff and consultants also participated in a series of meetings with key planning, regulatory and resource agency staff. Initial meetings were held with Sand City and California Department of Parks and Recreation (DPR) to discuss potential land use restrictions and other policies that would affect siting of wells. Subsequent meetings with these and other agencies presented project location and design information to agency staff and obtained input about potential policy and regulatory issues that would affect implementation of alternatives.
- **Develop Alternatives (Section 2).** Using information from the constraints analysis and initial meetings with Sand City and DPR representatives, the team identified preliminary feed water collection well alternatives, and refined these in a design charrette (a collaborative technical workshop) with technical experts from MPWMD and the consulting team. Alternatives were further refined based on information gathered in agency meetings.
- **Develop Project Screening Criteria (Section 3)**. The screening criteria presented in Section 3 address key technical, policy, and regulatory issues to be considered for project viability. They were used to evaluate how different feed water collection alternatives perform. Initial criteria were identified at the project outset. These were consolidated and refined by the team during Phase 1 work into four criteria addressing technical, regulatory, policy and cost considerations.
- **Screen Alternatives (Section 3).** Feed water alternatives were scored for each of the project screening criteria to determine a prioritized list of projects that could be developed. Sensitivity analysis was conducted as part of the screening to assess how changes in stakeholder perception of the relative importance of the objectives could influence the selected feed water options.

- **Present Findings and Next Steps (Section 4).** Highest ranked projects from the screening analysis are identified, along with data gaps, and next steps that would be required for project implementation.

Tasks were structured to develop and present information in collaborative workshops with MPWMD staff and consultants, leveraging the collective hydrogeologic expertise of MPWMD staff and technical experts who have worked for many years on local groundwater issues. Subsequent sections of this summary report document the evaluations and findings for each of these activities.

2 Alternatives Development

This section describes the process used to develop potential feed water collection alternatives and presents the results of the alternatives development, including development of the geologic model, identification of constraints and opportunities and formulation of alternatives, as described in Section 1. Each topic is described in detail below.

Geologic Model

A conceptual geologic model of Sand City and former Fort Ord coastal area was developed to aid in the placement of potential seawater collector wells for the 95-10 Project. The geologic model relies on the most recent geologic interpretation developed by Derrik Williams and Martin Feeney (Williams and Feeney pers. comm.) which compiled many sources of data and information from previous studies as part of the Seaside Basin Watermaster's Draft Basin Management Action Plan. The conceptual model only pertains to the coastal geologic formations thought to be in direct hydrogeologic connection with the Monterey Bay. Two water bearing units were identified with the potential to provide feed water to the 95-10 Project. These units include the Dune Sands aquifer and the saline-intruded 180-foot aquifer in the southern Salinas Basin. Both of these units are described in more detail below in addition to a discussion on the boundary between the Seaside and Salinas Groundwater Basins.

Aromas Sand and Dune Sands

The Aromas Sand and the dune sands (collectively referred to as Dune Sands) are extensive from Seaside to Ford Ord in both the Seaside Basin and the southern extent of the Salinas Basin on former Fort Ord. The Dune Sands are in direct communication with the ocean and are only saturated at the coastal margin. Consequently, they provide little value as a freshwater aquifer in the Seaside or southern Salinas Groundwater Basins.

The Dune Sands has a high potential to produce seawater using HDD wells, radial wells (Ranney collectors), or conventional vertical wells. The extent of the Dune Sands along the coastal margin is depicted in Figure 1 with the cross section location shown in Figure 2. The saturated thickness of the Dune Sands throughout the Seaside Basin and southern Salinas Basin varies from 20 to 50 feet as determined by groundwater monitoring wells installed for Sand City in 2004 as part of its desalination project investigation (CDM 2004). Groundwater extraction wells installed in the Dune Sands by Sand City for brackish groundwater extraction have shown extraction rates on the order of 600 gallons per minute (gpm) with only minimal well drawdown (Feeney 2008 pers. comm.). For the constraints analysis, we have assumed that the Dune Sands will have similar aquifer production properties along the coastal margin with the ability to produce 2-3 gpm per linear foot of casing for horizontally completed wells and 500 gpm for conventional wells.

In the Seaside Basin, the two principal aquifers beneath the 95-10 Project area are the Paso Robles Formation and the Santa Margarita Sandstone. The Paso Robles Formation underlies the Dune Sands and is fresh water-bearing. A lower permeable silt/clay unit has been identified separating the Dune Sands from the Paso Robles Formation at a depth of approximately 50-75 feet below sea level. In close proximity to the beach (less than 400 feet from the ocean), this unit appears continuous from Sand City to Fort Ord. There is less geologic data on this unit to the east and consequently, its inland (greater than 400 feet from the ocean) continuity is not known, but is thought to be discontinuous (Feeney et al. pers. comm.).

The Santa Margarita Sandstone is not present north of Watermaster Well MW-4 or grades into the lower Purisima Formation (see Figure 1). Because of this formation's depth and separation from the Dune Sands by the lower permeable Purisima Formation, extraction of sea water from the Dune Sands is likely to have no effect on the Santa Margarita Sandstone aquifer.

The extent of Dune Sands offshore into the marine environment is little understood but is not expected to be significant. In 2004 CDM, together with CapRock (CDM 2004), attempted to map the offshore environment using geophysical techniques. The purpose of the work was to identify offshore sediment thickness for the purpose of supporting offshore HDD or radial collector wells. This study identified one area in the Fort Ord area (see Figures 3 and 4) that may have suitable sediment thickness (~40 feet) to support offshore wells.

180-Foot Aquifer

The 180-foot aquifer is one of the primary water bearing units of the Salinas Basin. The aquifer naming process in the Salinas Basin historically used the depth of the principal water bearing formation to name the aquifer. The 180-foot aquifer is most often correlated with the younger alluvial deposits associated with the Salinas River. The 180-foot aquifer corresponds most closely with the depths of the Aromas Sand and /or upper Paso Robles Formation in the coastal portion

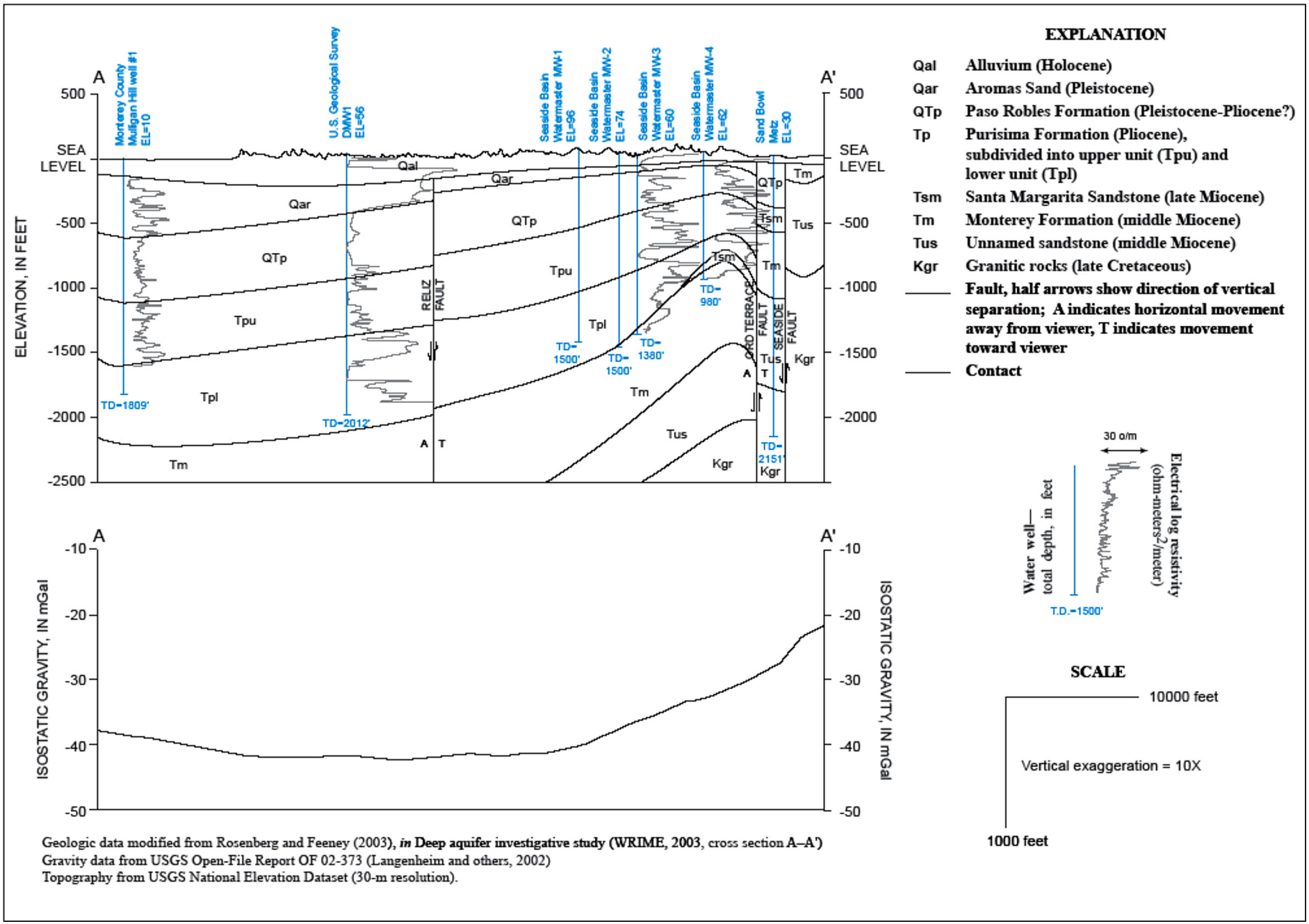
of the Seaside Basin (see Figure 1), but the Paso Robles produces substantially less water. In the Salinas Basin, the 180-foot aquifer is intruded by saline groundwater and the regional groundwater gradient is driving groundwater flow inland (Williams pers. comm.).

Work by HydroMetrics using the groundwater model developed for the Fort Ord Sites 2 and 12 groundwater remediation program, have demonstrated that extracting groundwater from the 180-foot aquifer in the vicinity of the abandoned wastewater treatment plant at former Fort Ord has a net positive effect on reducing saline intrusion into the Salinas Basin (see Figure 4 for the location of the former wastewater treatment plant). This is principally the case if the future regional groundwater gradient and flow continue inland from the ocean, damaging a larger area of the aquifer system. If flow gradients are reversed at a future date, extracting from the 180-foot aquifer would induce a small area of saline intrusion that would otherwise not occur. However, modeling results demonstrate that all the well-induced saline intrusion would be captured by the extraction wells (Williams pers. comm.).

A well in the 180-foot aquifer is capable of producing several thousand gallons per minute and would be capable of producing desalination feed water from the saltwater-intruded zone (Feeney 2008).

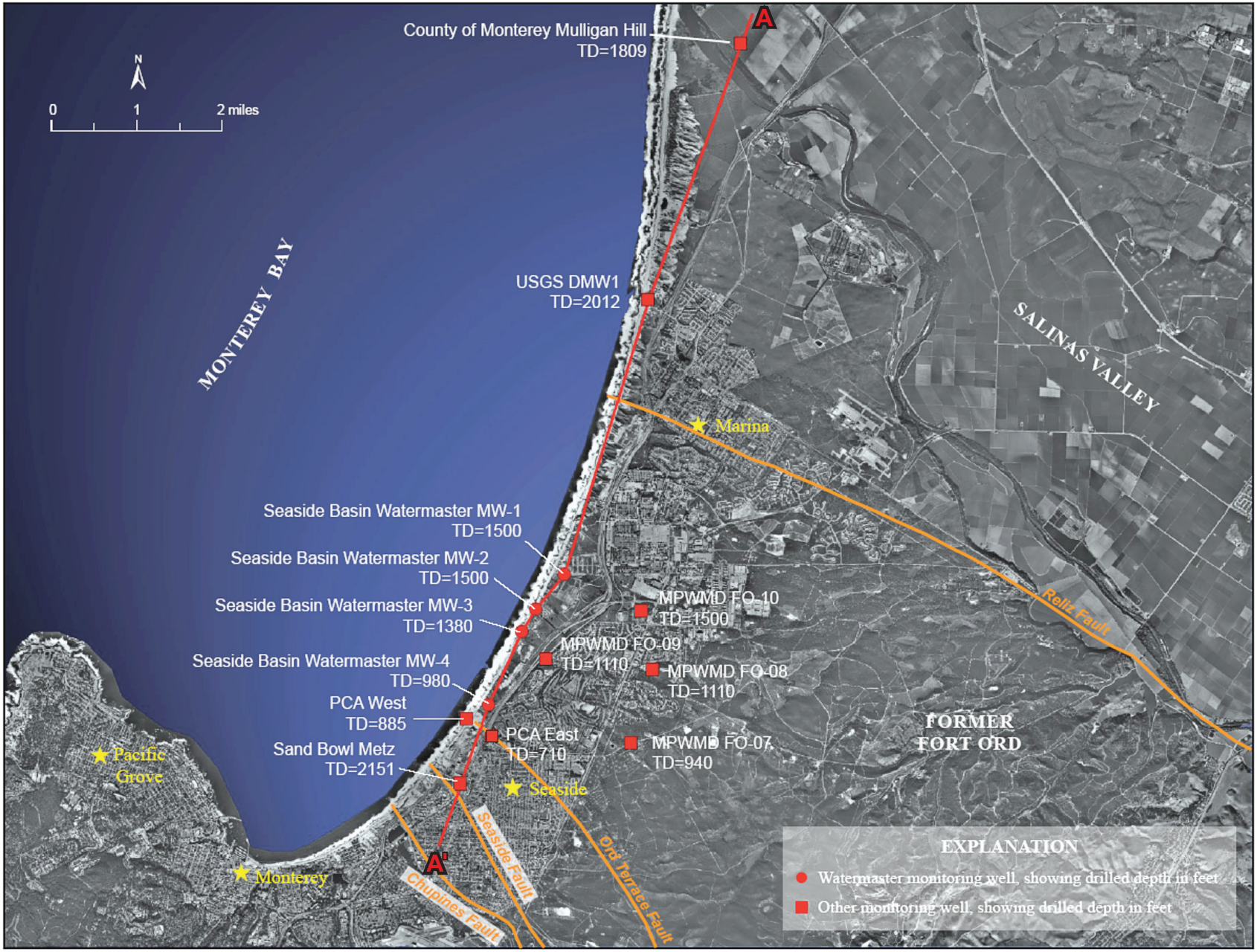
Seaside Basin and Salinas Basin Boundary

The Seaside and Salinas Basins' shared boundary is an important descriptive element for the purposes of defining a feed water extraction project as part of this constraints analysis. The MPWMD's boundary extends into the Salinas Basin and the Monterey County Water Resources Agency (MCWRA) currently prohibits the transfer of water out of the Salinas Basin (see constraints analysis discussion below). The northern boundary of the Seaside Basin is a flow divide where groundwater to the north of this divide flows to the Salinas Basin and groundwater to the south flows to the Seaside Basin. The approximate flow divide between the Salinas and the Seaside Basins is depicted in Figure 5 for the Paso Robles Formation (Note: because of pumping and aquifer characteristics differences, the flow divide for the Santa Margarita Sandstone is different). This flow divide is influenced by pumping in both basins and can change over time as a function of pumping rates and locations. As shown in Figure 5, the basin boundary is not a defined line but a zone subject to fluctuation over time. The basin boundary in the Dune Sands is not defined. Because the Dune Sands are in direct hydraulic communication with the ocean and only saturated along the coastal margin, there is unlikely to be any defined Salinas Basin/Seaside Basin flow boundary for this unit.



Geologic data modified from Rosenberg and Feeney (2003), ***in*** **Deep aquifer investigative study (WRIME, 2003,** cross section **A–A')**
Gravity data from USGS Open-File Report OF 02-373 (Langenheim and others, 2002)
Topography from USGS National Elevation Dataset (30-m resolution).

Figure 1
Cross-Section A-A'



Orthophoto base from HJW (1999), 1:36,000 scale imagery

Source: Feeney 2007.

Figure 2
Location of Cross-Section A-A'

Figure 3
Constraints Analysis—South

Figure 4
Constraints Analysis—North

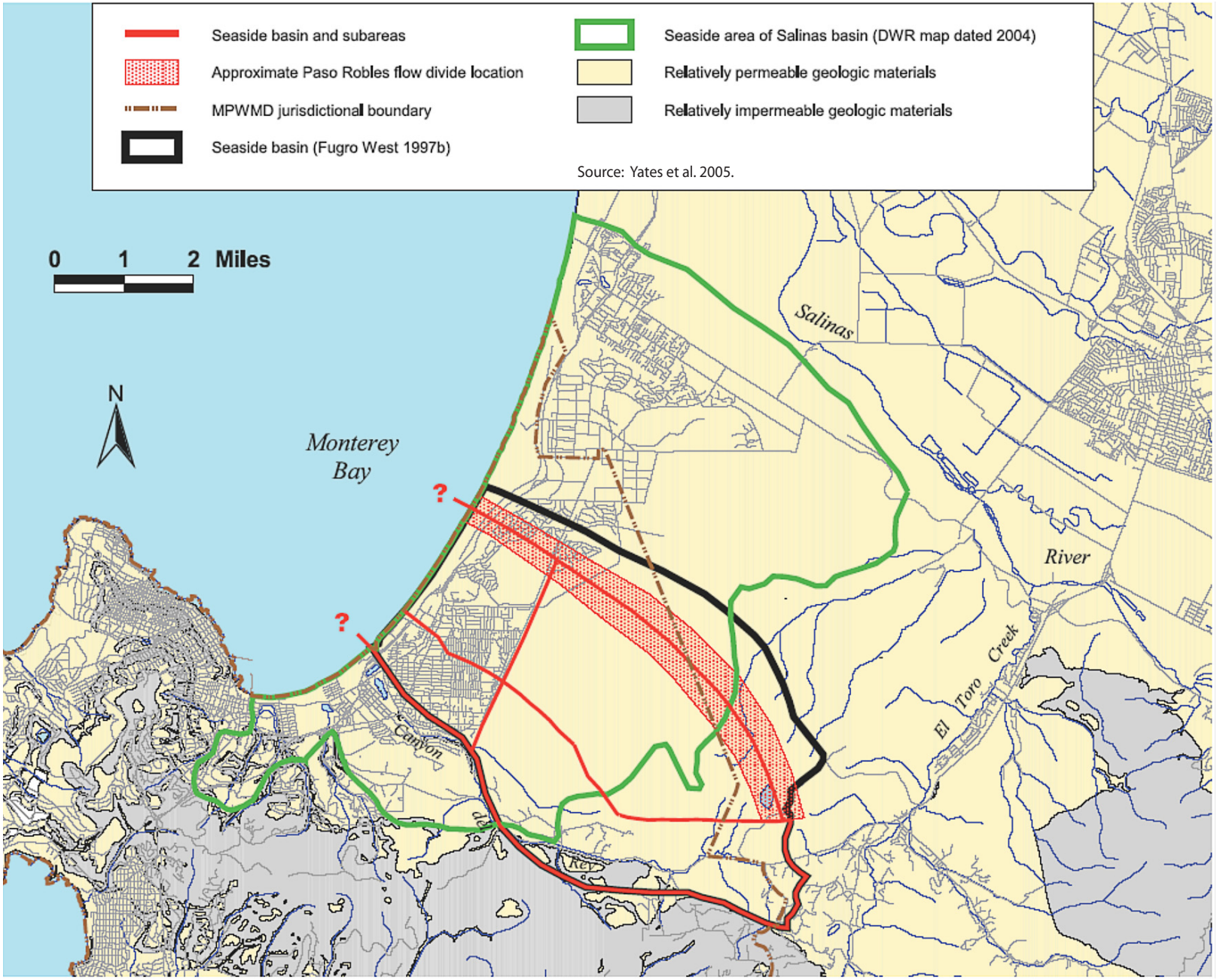


Figure 5
Seaside Basin Boundaries

Constraints and Opportunities

Engineering/Geology Issues

The following sections present the engineering and geologic opportunities and constraints that the project team identified to help guide well placement and gauge potential well performance.

Dune Sands Production. The Dune Sands as described above have the potential to deliver the required quantity of feed water for the 95-10 Project. This formation is in direct hydraulic communication with the ocean and the unit is only saturated in the coastal environment, separating it from other adjudicated water in the Seaside Basin. A clay layer separates this unit from the underlying Paso Robles Formation along the coastal margin.

180-Foot Aquifer. The 180-foot aquifer is intruded with salt water in the Salinas Basin both locally at Fort Ord and more regionally. Producing water from the 180-foot aquifer could slow saline migration into the Salinas Basin by developing a cutoff groundwater depression. The 180-foot aquifer is highly productive and has the capacity to supply substantial quantities of groundwater from the ocean for the 95-10 Project.

Offshore Well Production. Consideration was given to completing HDD or radial wells off the coast. Geophysical work conducted by CDM in 2004 identified only a small area at Fort Ord where the Dune Sands Formation appeared to extend off shore (see area bounded in pink on Figure 3). Attempting to place well infrastructure in other locations would require costly boat-based geotechnical investigations to verify the competence of marine formations to support collector well production rates. Drilling wells offshore without additional geotechnical data presents potentially unacceptable "frac out" (loss of drilling fluids) risk to the Monterey Bay marine environment. Additionally, the costs for the HDD well infrastructure would be very high and without marine formation geologic data, the well production rates would be unknown. Other associated constraints are presented in the drilling technologies discussion below.

Fort Ord Groundwater Contamination. The Fort Ord area contains a chlorinated solvent groundwater contamination plume currently in remediation (See Figure 4). Attempts were made to avoid the contaminated groundwater when siting well infrastructure.

Drilling Technologies. Three well completion technologies were reviewed to provide feed water to the project. These methodologies included: HDD wells, radial (Ranney collector) wells, and conventional wells. HDD wells are drilled horizontally with a boring machine. For the purpose of developing high-flow production wells, there must be an entrance and exit location for the boring machine, essentially eliminating any "dead end" locations including drilling offshore. HDD technology is expensive and potentially impractical at Fort Ord given the high elevation of the land surface near the coastline, with respect to the

target aquifer depths. The maximum practical distance for HDD application of this type (groundwater collection) is approximately 1,000 feet at former Fort Ord.

Radial wells operate by first installing a caisson to the target groundwater production depth (approximately 50 feet below sea level for the 95-10 Project area) and horizontally drilling or jacking wells in a radial fashion into the target formation. Radial well technology is well understood but generally expensive. At Fort Ord, radial well completion cost would be more expensive given the depth of caisson required to reach the target groundwater zone. Ground surface elevations at potential well sites range from about 60 feet to 80 feet. Within a limited construction footprint, radial wells can produce large quantities of groundwater. The maximum practical distance wells can be horizontally advanced from the caisson is approximately 200 feet.

Conventional wells drilled into the Dune Sands or 180-foot aquifer present a significant cost opportunity when compared to other drilling technologies. Conventional wells can be used to produce water from the Dune Sands or the 180-foot aquifer. To supply the fully contemplated 95-10 Project capacity from the Dune Sands using conventional wells would require a large number of potential sites.

Policy and Regulatory Issues

The development of potential policy and regulatory constraints has been a two step process. The first step was to reconsider the location and nature of the structural features of the project. MPWMD staff and consultants met to review the project features developed in 2002-2004 and to discuss changed circumstances and new information developed since that time that would influence the project's location and design. This effort included participation in a design charrette. With the information from this first step, staff and consultants participated in a series of meetings with key planning, regulatory and resource agency staff. At these meetings, the consultants presented project locations and design information to the agency staff and asked questions about potential policy and regulatory issues that would affect the success of the 95-10 Project. A series of project designs and locations were discussed. The information gathered in those meetings and information collected through additional research is the basis for this constraints discussion.

Land Use

Concerns with land use planning consistency and compatibility are primarily the responsibility of the land use planning bodies in the project area. The principal entities are Sand City, DPR and the California Coastal Commission (CCC). On private property, the land owner is also a major factor in determining the feasibility of constructing water supply facilities.

Sand City. Sand City was the principal site investigated for feed water collection and water treatment in the 2002-2004 study conducted for MPWMD (Jones & Stokes 2004). The collection facilities were located west of Highway 1 in the vicinity of Seaside State Beach. In meetings with Sand City staff in June 2008, it was determined that Sand City had its own desalination project in the early stages of construction near this Seaside State Beach location (Figure 3); staff were opposed to any new project being constructed in the area that would adversely affect the groundwater extraction facilities. Sand City staff also indicated that other properties within the city limits along the coast were in various stages of development and would be unlikely locations for MPWMD desalination facilities. Proposals to place such facilities in the coastal area would likely require a coastal development permit, zoning amendment, design and encroachment permits, and possibly a general plan amendment. The Sand City staff also indicated that there were no remaining one-acre parcels in the city limits that would be available for a desalination water treatment facility (Matarazzo, Simonich, Heisinger pers. comm.).

California Department of Parks and Recreation. DPR currently manages all of the former Fort Ord land west of Highway 1. It is planned as the Fort Ord Dunes State Park (Park). These lands are still in Army ownership, but are set to be transferred to DPR in the near future. Currently, any proposed third party actions within the Park require Army review and approval. Any use of the former Fort Ord wastewater treatment plant (WWTP) site would also require approval from Marina Coast Water District (MCWD), as it holds an easement on this property (Gray, McMenamy, Palkovic pers. comm.).

The principal land use policy issues that exist with placement of desalination facilities on DPR property are consistency with planned park uses and habitat restoration plans. Any facilities constructed in the Park would need to be placed in areas planned for development in the Park general plan. The general plan identifies four significant development zones within the park, allowing adequate space to accommodate radial or conventional groundwater extraction wells (see Figures 3 and 4 for development zones). These sites are designated for a variety of visitor-serving uses, including utilities (Environmental Science Associates 2004). Conversations with DPR staff in Monterey did not indicate that extraction wells would be prohibited if they were located in these zones (Gray pers. comm.). Facilities proposed for areas outside of the development zones would interfere with planned habitat restoration or would impact existing sensitive habitats and would be discouraged.

A third policy concern raised by DPR staff relates to placement of permanent infrastructure within state parks as a general practice. Problems with abandoned third-party infrastructure in state parks have resulted in a general opposition to the introduction of new third-party structures. It would be necessary to seek approval from regional- or state-level managers to determine whether specific projects would be allowed (Gray pers. comm.).

From a regulatory perspective, well construction on DPR property would require a lease. DPR cannot issue a lease for more than 5-10 years; any lease longer than that would have to be issued by the State Department of General Services. This

was not described as a "fatal flaw" for the MPWMD project being considered (Gray, McMenamy, Palkovic pers. comm.).

California Coastal Commission. The CCC regulates coastal development through authorities contained in the California Coastal Act (CCA). The 95-10 Project, whether located within Sand City or Fort Ord Dunes State Park, would require issuance of a CCC coastal development permit. The CCC would review the project's consistency with policies in the Sand City Local Coastal Plan (LCP) and the CCA through this permit process. The CCA has specific policies that address protection of marine and terrestrial biological resources, public access and recreation, water quality, visual impacts, agricultural lands, commercial fisheries, industrial uses, power plants, ports, and public works. Conversations with CCC staff (Ewing and Luster pers. comms.) made it clear that desalination projects in the coastal zone are reviewed on a case-by-case basis. There are no policies that encourage or reject the location of desalination plants in the coastal zone; each must be reviewed in light of its consistency with the policies mentioned above (Luster pers. comm.). There is no evidence that a well-planned 95-10 Project would be unlikely to receive a coastal development permit from the CCC. The CCC's guidance for considering desalination facilities along the California coast are contained in a March 2004 document entitled *Seawater Desalination and the California Coastal Act* (California Coastal Commission 2004). In this document, the CCC indicates support for considering subsurface intake of source water where feasible and evaluating use of existing wastewater outfalls for brine disposal. The CCC also suggests it would be concerned about any desalination project that would induce growth in or near the coastal zone.

Private Landowners. Several coastal parcels within the project study area are in private ownership. The largest of these, referred to as the SNG site, is located immediately south of former Fort Ord and north of the Monterey Peninsula Regional Park District park site (see Figure 3). A plan for a coastal development at this site has already been approved by Sand City and is in the final stages of approval through the CCC. A conversation with a representative of SNG determined that the site is not available for major desalination facilities. The current plan does not include such facilities and there is a concern that any changes in site use could lead to added regulatory review of the development that is already proposed. (Ghandour pers. comm.)

Biological Resources

The only element of the proposed project that would directly affect marine biological resources is the discharge of brine through the MRWPCA ocean outfall. The potential for changes in ocean salinity at the outfall site is of concern for larger mobile species such as marine mammals and fish, and smaller micro flora and fauna that are moved through the water column primarily by ocean currents. Salinity changes below the outfall structure, either on the ballast rocks or on the ocean bottom, are also of concern for non-mobile species that attach to the rocks or live on or within the ocean's sandy or muddy substrate.

The proposed project's feed water collection, water treatment and water transmission facilities all have the potential to adversely affect sensitive coastal wildlife habitats. Of special concern are the areas beaches which are home to protected bird species, and the coastal sand dunes that are home to protected plant, reptile and invertebrate species.

Management and protection of marine and coastal biological resources are shared by a number of agencies (NOAA Monterey Bay National Marine Sanctuary [MBNMS], U.S. Fish and Wildlife Service [USFWS], National Marine Fisheries Service [NMFS], CCC, California Department of Fish and Game [DFG], DPR, State Water Resources Control Board [SWRCB], Central Coast Regional Water Quality Control Board [RWQCB]). None of these agencies have policies or regulations that ban discharge of brine to the ocean or construction of well facilities along the coast of southern Monterey Bay.

Monterey Bay National Marine Sanctuary. The MBNMS was established to protect the marine resources of a large section of the central California coast, including Monterey Bay biological resources. The draft sanctuary management plan includes a desalination action plan that encourages a regional approach to desalination around the bay. It suggests development of a regional desalination program that evaluates the benefits of joint facilities serving multiple jurisdictions versus construction of multiple smaller plants (U.S. Department of Commerce, National Oceanic and Atmospheric Administration 2006). As a part of its management plan implementation process, the MBNMS is also developing desalination facility siting guidelines that will minimize impacts to MBNMS resources. The siting guidelines will encourage use of appropriately sited existing pipelines into the ocean to minimize seabed alteration (Damitz pers. comm.).

U.S. Fish and Wildlife Service. The FWS is involved in a federal Endangered Species Act compliance planning process with the Fort Ord Reuse Authority (FORA) regarding all former Fort Ord lands. This area includes the coastal lands currently managed by DPR as the Fort Ord Dunes State Park. The FWS would be concerned about any change in land use in the State Park that would diminish the habitat values being protected and enhanced by the Habitat Conservation Plan (HCP) currently being developed by FORA. An initial conversation with FWS staff working on the HCP indicated that construction of well facilities within areas already planned for development in the park general plan would not be a major concern if approved by DPR and if construction and operation activities would not adversely affect adjacent sensitive biological resources (Martin pers. comm.).

National Marine Fisheries Service. The NMFS is responsible for management and protection of anadromous fish in state waters and marine mammals along the California coast. This agency would be concerned if the desalination facilities had adverse effects or might result in take of these biological resources. To date, there is no evidence that the proposed project would adversely affect or take anadromous fish or marine mammals. NMFS would participate in project review through the CEQA process.

California Coastal Commission. The CCC participates in the review and approval of coastal desalination facilities through its authority under the CCA, and particularly through its coastal development permit process (see above under Land Use). The CCC has a major responsibility for the stewardship of biological resources along the coast as directed in the CCA. One of the principal policies in this legislation relates to the protection, enhancement and restoration of important habitats and biological communities (California Coastal Commission 2004). Any project requiring review through the coastal development permit process will have to present detailed information on the potential effects on coastal biological resources. In the 95-10 Project area, sensitive coastal dune habitats and related endangered species will need to be addressed. Most of the projects being considered in this constraints analysis are located to avoid effects on coastal habitats and sensitive species. The planned use of the MRWPCA wastewater outfall for brine disposal is consistent with the CCC's recommendation regarding brine discharges to coastal waters. The use of groundwater extraction wells for feed water collection is also consistent with the CCC's concern regarding construction of any new ocean floor seawater intakes (California Coastal Commission 2004, pg. 68).

California Department of Fish and Game. DFG is responsible for the management and protection of the fish and wildlife resources of the state. Its chief concerns for the desalination project are related to sensitive plant and animal species present along the southern Monterey Bay coast line and at the MRWPCA ocean discharge location. This agency is participating in the HCP development process mentioned above in the FWS section and would be concerned about any changes in land use on Fort Ord Dunes State Park that were not consistent with the intent of the HCP habitat protection and restoration goals. DFG would also be concerned about any effects of project construction along the parts of the coast within Sand City. Sensitive dune vegetation and beach habitats are of greatest concern in this area. DFG would participate in review of the desalination project through the CEQA process, and possibly through a compliance review of the California Endangered Species Act.

California Department of Parks and Recreation. The DPR is a steward of all biological resources located on its park properties. At Fort Ord Dunes State Park, wildlife habitat protection and restoration are principal goals of the facility. Through conversations with DPR staff, it is clear that any desalination facilities located within the state park would have to be consistent with these protection and restoration goals (Gray pers. comm.). The alternatives development process for this desalination project has guided the location of facilities on lands that are already developed or planned for development so that habitat loss would not be a concern.

State Water Resources Control Board. The SWRCB establishes water quality standards for the near-shore waters of California through its Ocean Plan. These standards are designed to protect the beneficial uses of the ocean, including commercial and sport fishing, mariculture, rare and endangered species, marine habitat, fish migration, fish spawning and shellfish harvesting among others. The Ocean Plan was first adopted in 1972 and is updated every three years. There is currently an Ocean Plan update going through a review process. This update

includes a proposed amendment that directly addresses desalination facilities and brine disposal. The SWRCB is considering an Ocean Plan objective that would protect the biological beneficial uses of the ocean from adverse salinity increases. A scoping document for this amendment recommends establishment of a narrative water quality objective where salinity should not exceed a certain percentage of natural background (California State Water Resources Control Board 2007). The percentage has not been established. While establishment of a salinity objective is unlikely to eliminate ocean disposal of desalination brine, it may dictate stringent mixing requirements at open ocean discharge locations.

Central Coast Regional Water Quality Control Board. The Central Coast RWQCB regulates the MRWPCA ocean discharge of wastewater through an NPDES permit and waste discharge requirements. These requirements must insure protection of ocean beneficial uses as described in the SWRCB Ocean Plan. The current MRWPCA NPDES permit includes a provision for discharge of brine through the wastewater outfall. If the volume of brine is increased beyond what is already allowed (375,000 gallons average daily flow), MRWPCA must first conduct a brine disposal study that would identify the characteristics of the brine and assess the effect of this new waste on the plant's ability to meet waste discharge requirements. Any new facilities needed to accommodate the added brine would also have to be described (California Regional Water Quality Control Board, Central Coast Region n.d.). In a meeting with Central Coast RWQCB staff, the potential for adding brine to the MRWPCA outfall was discussed and there was no indication that this discharge mode would be un-approvable (von Langen pers. comm.). A significant study effort, however, would be needed to analyze the effects of the brine on the beneficial uses of the ocean.

Water Resources

Seaside Groundwater Basin. The Seaside Basin is an adjudicated groundwater basin whereby the courts have imposed a physical solution to eliminate the overdraft of groundwater created by basin users. The adjudication decision specifically assigned water rights to Sand City to extract an unspecified quantity of brackish water from the Aromas Sands Formation for the purposes of supplying a desalination facility. As part of the adjudication order, Sand City can produce brackish water so long as it does not cause substantial adverse physical impact to the Seaside Basin or any of its users. The Seaside Basin Adjudication does not specifically limit the production of seawater that does not cause adverse impacts to other basin users including Sand City's right to produce brackish groundwater (Laredo 2006).

Sand City has begun construction of its desalination facility including the plant and installation of brackish water extraction wells (two each at Tioga Avenue and Vista del Mar, see Figure 3). Sand City has stated concern over the 95-10 Project and has sought assurance that any facilities proposed for the 95-10 Project would not impact their project by increasing salinity or pump lifts.

In addition to not impacting the Sand City project, any proposed 95-10 Project along the coastal margin producing ocean water from the Dune Sands, must not create a material injury to the Seaside Basin or any of its users. Consequently, any proposed project would need to clearly demonstrate that its source water is separated from both the Paso Robles and Santa Margarita aquifers. The project would require concurrence from the Seaside Basin Watermaster.

Salinas Groundwater Basin. As presented in the geology section above, the boundary between the Seaside and Salinas Basins is represented by a flow divide. This flow divide is influenced by pumping in both basins and can change over time as a function of pumping rates and locations. The MCWRA Act, Chapter 52-21 specifically prohibits the extraction and export of groundwater outside of the Salinas Basin except for water used at Fort Ord. The act is incorporated into the California Water Code and would require the approval of the State legislature to amend it.

Export could technically include both the 180-foot aquifer and groundwater produced in the Dune Sands within the Salinas Basin. The Dune Sands are in direct hydraulic communication with the ocean and only saturated along the coastal margin, consequently, there is unlikely to be a defined flow boundary represented by the Salinas and Seaside Basins. However, because this extraction could occur within the legally recognized Salinas Basin,, approval for export of the Dune Sands water could be required from the MCWRA. Further work is required to define the Salinas and Seaside Basins' boundary for the Dune Sands.

The 180-foot aquifer is a recognized water bearing unit in the Salinas Basin. Extraction of brackish water from this unit could assist in mitigating saline intrusion by developing a groundwater depression; however, there are technical, legal, and political challenges to using this water source necessitating early collaboration with the MCWRA. In discussions with MCWRA representatives (Weeks, et. al, pers. comm.), groundwater extraction from the 180-foot aquifer in the Salinas Basin for export for municipal use outside the Salinas Basin would be precedent setting, and therefore would have significant institutional and policy ramifications for Salinas Basin users. Although extraction from the 180-foot aquifer would be more politically sensitive, a project in the Dune Sands aquifer could be controversial and would need to demonstrate that it is extracting seawater and not impacting brackish groundwater.

SWRCB Anti-Degradation Policy. The RWQCB is responsible for implementing the SWRCB's anti-degradation policy (Policy 68-16) which requires that the quality of surface water and groundwater be maintained to the maximum extent possible. Relative to the 95-10 Project, the project cannot result in a degradation of groundwater quality from saline intrusion below that which currently exists. Exceptions include reducing water quality if it will not reasonably affect beneficial uses and can be demonstrated to benefit the people of California. The policy specifies that groundwater quality is defined as the best quality since enactment of the policy in 1968.

It is likely that producing groundwater from the Dune Sands will be exempt from the anti-degradation policy due to its close proximity to the ocean and high salt

content. Extracting groundwater from the 180-foot aquifer presents different challenges as this unit was once fresh water bearing and long-term Salinas Basin plans propose to raise groundwater heads, reversing the saltwater intrusion and restoring the groundwater to potable quality.

MRWPCA Outfall. The current concept for the 95-10 Project includes use of the MRWPCA regional wastewater outfall to Monterey Bay for brine disposal. Other brine disposal methods are not being investigated. To address this element of the project, two meetings were held with MRWPCA staff. One of the meetings was attended by a RWQCB representative. MRWPCA identified several potential constraints to this use of the outfall. First, the MRWPCA NPDES permit allows discharge of a small amount of brine with the wastewater; however, it requires a significant study of effects on wastewater quality and diffusion at the outfall site if a larger brine disposal volume is contemplated. The MRWPCA is concerned about how the brine might affect its ability to meet the chemical constituent limits and dilution requirements of its permit. Modeling would have to be undertaken to answer questions around this issue (Haertel pers. comm.). Second, some structure would need to be constructed to allow connection of a brine disposal line into its wastewater outfall. While these are potential constraints, the MRWPCA staff was supportive of the MPWMD efforts to further its investigation of a Sand City/former Fort Ord area desalination facility using the wastewater outfall for brine disposal (Crook, Hagemann, Holden, Israel pers. comm.). RWQCB staff at the second meeting indicated that MPWMD was going in the right direction by considering use of an existing outfall for brine disposal (von Langen pers. comm.). A significant effluent discharge modeling effort would be needed to allow both the MRWPCA and the RWQCB to seriously consider brine disposal through the outfall.

Geological Processes

Shoreline erosion. The threat of shoreline erosion is the major geological process constraint to establishment of new desalination facilities along southern Monterey Bay. Numerous studies in the past ten years have revealed the extent of ocean bluff migration inland; some of these studies have also made attempts at establishing future erosion rates (Philip Williams & Associates, Ltd. 2008). Because of the significant erosion that has occurred, any leases, easements or permits issued by land management agencies along the coast would be subject to careful review of erosion hazards. Setback requirements would need to be predicted and then placed as conditions on any project. The principal agencies that would be interested in this issue are Sand City, DPR and CCC. Wells or pipelines placed along the coast would have to be located sufficiently back from the coast to avoid being exposed to ocean wave action during the life of the facilities, or be able to be moved farther inland cost effectively when erosion became a threat (Ewing pers. comm.). There are planned development areas on Fort Ord Dunes State Park that are sufficiently back from the ocean that they should not be threatened by erosion during the life of a typical conventional or radial well system.

Alternatives

Table 1 and Figures 6 and 7 summarize feed water collection alternatives identified in the analysis. Using maps and information on potential project constraints, 25 feed water collection alternatives were identified at nine different sites. Five sites are in Sand City; four are in former Fort Ord. At each location, the following three drilling technologies, capacities and spacing requirements were used to identify total collection capacity:

- **HDD Wells**: Wells would be horizontal directionally drilled and installed parallel to the shoreline in the Dune Sands. Well casing length of up to 1,000 feet in length, with collector well capacities of up to 2,000 gpm, based on a collector rate of 2 gpm per lineal foot of screen.
- **Radial Wells**: Wells would include a caisson with five collector spokes radiating out from the caisson a length of 200 feet into the Dune Sands. Collection capacity of 3,000 gpm per well, based on a collector rate of 3 gpm per foot of screen. Wells spaced a minimum of 500 feet apart.
- **Conventional Wells:** Conventional wells would produce from the Dune Sands or the 180-foot aquifer. Most well locations were assumed to be screened in the Dune Sands with a collection capacity estimated at 500 gpm per well. Two locations farther north in former Fort Ord evaluated conventional wells screened in the 180-foot aquifer, which is in the coastal area of the Salinas Basin, where this aquifer is saline intruded. Wells screened in the 180-foot aquifer were assumed to have collection capacities of 2,000 gpm per well, but could be much greater. All conventional wells were spaced a minimum of 100 feet apart.

Offshore HDD wells were initially considered in the analysis, targeting an area off the coast of former Fort Ord, where geophysical surveys conducted in 2004 showed Dune Sands potentially extending offshore. However, this area, outlined in pink on Figures 3 and 6, has no onshore road access from former Fort Ord. Therefore, offshore HDD wells were not used to formulate collector well alternatives. Given the unknowns associated with permeable marine deposits and potential risk of frac-out during drilling, no other sites were considered viable for offshore well placement.

Collector rates for the Dune Sands Formation were developed based on field data from the Sand City desalination project, where a test well was capable of producing 600 gpm (30 feet of saturated well), with insignificant drawdown 100 feet away from the well. Well capacities would depend on formation thickness and formation transmissivity. Since there are few data to estimate transmissivity in northern Sand City or on former Fort Ord, a range of collector well capacities was used, with Sand City test data used to define the upper bound of anticipated production capacity.

Collector rates for the 180-foot aquifer formation were developed based on personal experience of planning team member Martin Feeney, who has performed extensive production work in the 180-foot aquifer.

Figure 6
Alternatives—South

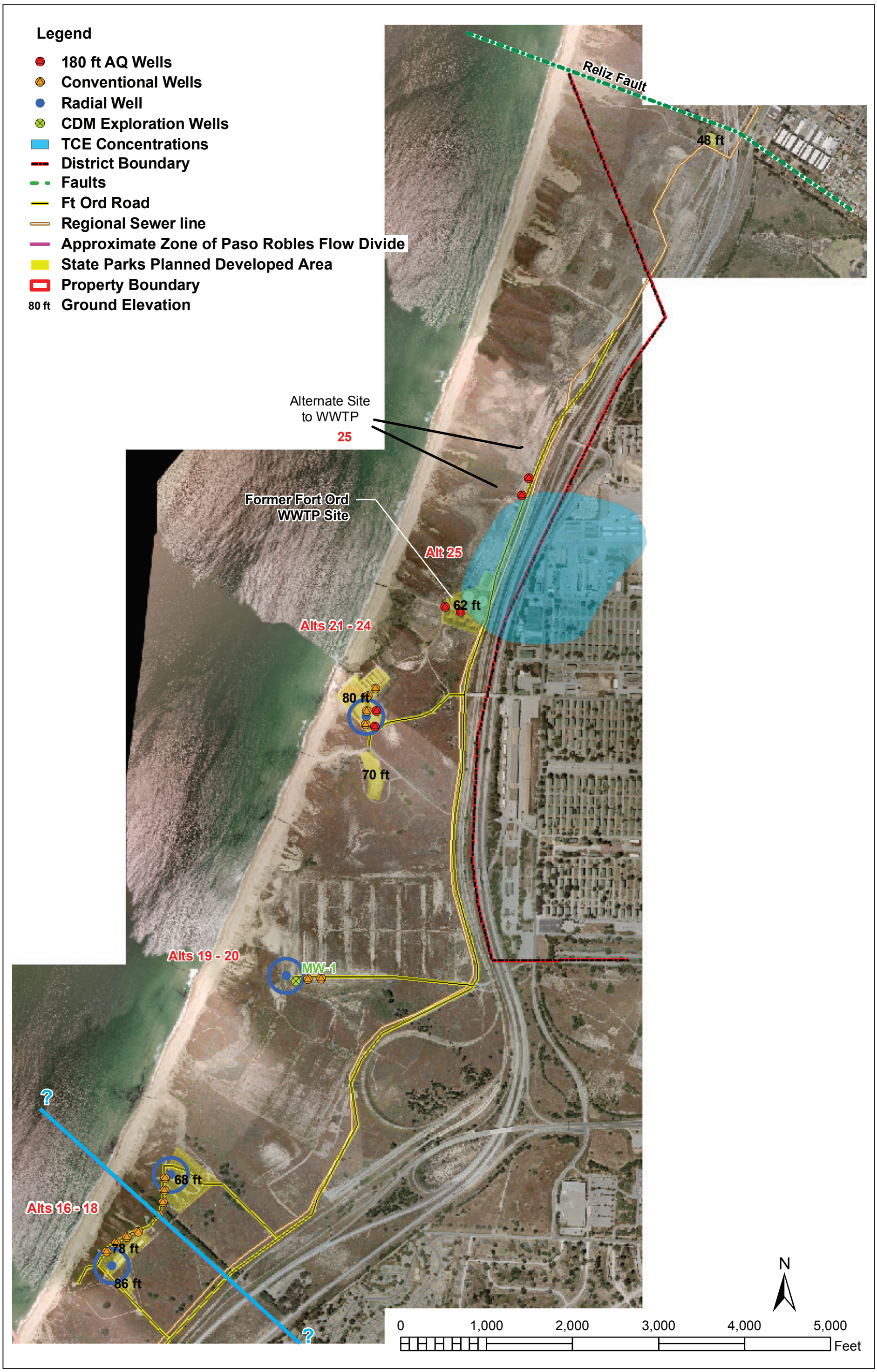


Figure 7
Alternatives—North

Collector well locations were identified based on land use and technical constraints. Projects that could have significant policy issues that would affect project implementation, such as a project that would impact Sand City's desalination project and require replacement of Sand City's supply, were not categorically excluded from consideration. Rather, significant issues affecting project implementation were addressed as part of the alternatives screening process, discussed in Section 3. The following considerations were taken into account in identifying well locations:

- **Sand City**: Most properties evaluated have planned redevelopment, and well locations would need to be compatible with planned site uses. Southernmost properties have the potential to impact the Sand City's desalination project, which is currently under construction. Groundwater modeling would be required for these sites to demonstrate that they do not impact the City's project, or identify mitigation that would be required to compensate Sand City for any loss in water production. Portions of the Monterey Peninsula Regional Parks District site have been developed for park uses and would be visually sensitive. A former landfill was located on the northern part of the property, but has been excavated and recontoured.
- **Former Fort Ord:** Siting of facilities was based on review of the Fort Ord Dunes State Park General Plan (Environmental Science Associates 2004) and discussions with a local DPR representative (Gray pers. comm.). DPR either has begun or has future plans to restore much of the park area to native coastal habitat, and would allow construction only in disturbed areas, along road rights-of-way, or areas where facilities are planned. Based on these constraints, well sites were selected that are closer to the bluffs, to target higher transmissivity, more saline areas within the shallow aquifer formation, along roads that will be maintained for park access to trails or other recreation facilities, or in areas where active recreational facilities, such as campgrounds or trailheads, and supporting road and parking infrastructure is planned.

Table 1 summarizes alternatives, starting at the southernmost extent of the area evaluated, working north. Figures 6 and 7 identify the general project locations, with conceptual locations for wells indicated on the map.

Table 1. Summary of Feed Water Collection Well Alternatives

Alt	Location Owner	Description	Well Type	Details	Flow Rate	Public property?
1	Sand City Desal Site- Sand City	South of Tioga Avenue. Project facilities located in vicinity of Sand City collection and disposal wells.	HDD	1,500 ft	3,000 gpm	Y
2			Radial	2 wells	6,000 gpm	Y
3			Conv. (Shallow)	15 wells	7,500 gpm	Y
4	Sand City - Malibu Development LLC	North of Tioga Avenue. Property slated for re-development, though no identified active plans.	HDD	500 ft	1,000 gpm	N
5			Radial	1 well	3,000 gpm	N
6			Conv. (Shallow)	2 wells	1,000 gpm	N
7	Sand City - Sand City Re-Development Agency	Property owned by Sand City Re-development Agency. An EIR is underway for a resort planned at this site.	HDD	500 ft	1,000 gpm	N
8			Radial	2 wells	6,000 gpm	N
9			Conv. (Shallow)	7 wells	3,500 gpm	N
10	Sand City - Monterey Peninsula Regional Parks District	Property owned by Monterey Peninsula Regional Parks District.	HDD	1,000 ft	2,000 gpm	Y
11			Radial	1 well	3,000 gpm	Y
12			Conv. (Shallow)	5 wells	2,500 gpm	Y
13	Sand City – SNG Development Corporation	Property owned by SNG. Property slated for re-development.	HDD	600 ft	1,200 gpm	N
14			Radial	2 wells	6,000 gpm	N
15			Conv. (Shallow)	6 wells	3,000 gpm	N
16	Former Fort Ord: Bunker Site- DPR	Approximate northern extent of Seaside Basin. Former ammunition supply bunkers. Slated for development as a camping area.	HDD	1,000 ft	2,000 gpm	Y
17			Radial	2 wells	6,000 gpm	Y
18			Conv. (Shallow)	8 wells	4,000 gpm	Y
19	Former Fort Ord: MW-1- DPR	Location of Seaside Basin Sentinel Well # 1, and test boring location in 2004 CDM study.	Radial	1 well	3,000 gpm	Y
20			Conv. (Shallow)	2 wells	1,000 gpm	Y
21			HDD	1,000 ft	2,000 gpm	Y
22	Former Fort Ord: Stilwell- DPR	Former site of Stillwell Hall. Planned parking area and trail access point.	Radial	1 well	3,000 gpm	Y
23			Conv. (Shallow)	4 wells	2,000 gpm	Y
24			Conv. (180')	2 wells	4,000 gpm	Y
25	Former Fort Ord: WWTP DPR	Site of former Fort Ord Wastewater Treatment Plant.	Conv. (180')	2 wells	4,000 gpm	Y

3 Alternatives Screening

Project Screening Criteria

The team identified project screening criteria to evaluate different feed water collection alternatives. The criteria address key technical, policy, and regulatory issues to be considered for project viability and were used to evaluate how different feed water collection alternatives perform compared with other alternatives.

The consulting team and MPWMD staff developed initial screening criteria, summarized in Table 2, at the project outset, based on the team's understanding of the issues at that time. The table summarizes the initial criteria, including a description of specific evaluation considerations, and how each criterion was used or modified during Phase 1 based on information gathered during the analysis.

Table 2. Initial Criteria Identified for Screening Alternatives

Initial Screening Criteria and Descriptions	How Used in Phase 1 Analysis
Potential Quantity of Supply	
This criterion identifies the projected supply yield that could be developed by an alternative. Quantity of supply was ultimately not used as a screening criterion, but rather used as part of the project scoring, with alternatives that produce higher yields rated higher than projects that produce smaller yields.	Used as part of project scoring, to provide a relative ranking of projects based on their project yield.
Certainty of drilling technology	
This criterion considers whether an alternative relies on proven technology (e.g. radial, conventional, onshore HDD wells), or relies on new technology that may not be proven in the proposed application (offshore HDD wells).	Retained as part of a more general criterion Drilling and Siting Complexity

Initial Screening Criteria and Descriptions	How Used in Phase 1 Analysis
Frac-out risk	
This criterion assesses what risk of frac out is presented by the well drilling needed to implement the option. Frac out is a concern for offshore wells, and could occur if overlying materials above the drilled well are uplifted during drilling, due to localized pressure exerted by the advancement of the bore hole. Frac out is a concern because drilling fluids would be released into Monterey Bay.	Eliminated as a criterion once offshore drilling alternatives screened from further consideration
Influence on adjudicated groundwater	
This criterion assesses what degree of impact an alternative would have on adjudicated groundwater in the Seaside Basin.	Retained as part of a more general policy criterion to assess an alternative's potential impacts to the Sand City desalination project. Alternatives target the Dune Sands aquifer to avoid impacts to Seaside Basin water supply wells that draw from the Paso Robles and Santa Margarita Formations.
Regulatory considerations	
This criterion assesses various policy, regulatory, and environmental factors, including land use constraints, endangered species effects, permitting and how they affect implementation.	Retained.
Development water cost	
This criterion provides a relative measure of cost to develop the feed water collector alternative, since cost estimates were not prepared as part of this phase of work.	Retained

As part of a design charrette, consultants and MPWMD staff refined and consolidated the initial set of criteria, based on information gathered during Phase 1 evaluations. Table 3 summarizes the four criteria that were selected. The table also indicates relative weights assigned to each of the criterion by the team. The relative weights, which sum to 100 percent, reflect the team's collective opinions about the relative importance of each criterion. As discussed in the Alternatives Analysis section, sensitivity analysis was also conducted to assess the sensitivity of criteria weights on alternative rankings. Table 3 summarizes the final criteria used to evaluate alternatives, and the relative weights assigned by the consulting and MPWMD staff.

Table 3. Final Criteria Used in Alternative Screening

Criterion	Relative Weight Used in Analysis
Drilling and Siting Complexity	
This criterion considers whether an alternative relies on proven technology (e.g. radial, conventional, onshore HDD wells), or new technology that may not be proven in the proposed application (offshore HDD wells). The criterion also considered site factors that would affect the complexity of well installation (e.g. construction in bluffs vs. beach).	20%
Policy Considerations	
This criterion includes legal, public or policy issues that would affect project implementation. This criterion assesses whether policy issues are likely to preclude, complicate or lengthen project implementation.	40%
Regulatory Considerations	
This criterion assesses various environmental and permitting factors, including land use constraints, biological and water resources effects, geological processes and others that would be instrumental in regulatory approvals of a project.	30%
Development water cost	
This criterion provides a relative measure of cost to develop the feed water collector alternative, since cost estimates were not prepared as part of this phase of work.	10%

Alternatives Screening

Table 4 and Figure 8 present the results of the alternatives screening process. Each of the 25 alternatives described above was ranked with high, medium, or low constraints under each of the four final screening criteria. The high, medium, and low rankings were established by the consultant team based primarily on professional judgment of relative risk to the success of a desalination project at the alternative location. Final rankings are presented with and without regard to the amount of water likely to be available from the site.

For the drilling and siting complexity criterion, construction of conventional wells was given a low ranking. The simplicity of the technology and the minimal space needed for construction and operation make this type of well most likely to be successful. Radial wells were given a medium ranking because of the size of the equipment needed and the relative difficulty of extending a large caisson to significant depths, especially at former Fort Ord locations. The HDD technology was given a high constraint likelihood because of the difficulty of slant drilling, especially to significant depths at former Fort Ord.

As stated earlier, the policy criterion includes a variety of potential constraints, including restrictions contained in law, in policy and planning documents, or in judgments stated by public agency representatives. The most significant constraints were contained in legislation relating to inter-basin transfer of groundwater, which would affect the success of the Stilwell and Fort Ord Former WWTP alternatives, and in statements made by Sand City officials regarding the availability of undeveloped land within the city, which would affect the Sand City and Sand City Redevelopment collection well alternatives, as well as location of a treatment plant. The remaining collection well alternatives have potentially restrictive issues from a land use plan consistency standpoint, or from the perspective of agency concerns. None of the alternatives were judged to have a low potential for constraints from a policy perspective.

Regulatory constraints were judged from the likelihood of carrying a project through the permitting process, given the various environmental issues and regulations that must be considered. The Monterey Peninsula Regional Park District alternatives were given a high constraint because of its status as a park with no development planned, its high visibility and its status as a habitat preserve area. The Bunker, Stilwell and Fort Ord WWTP alternative sites were given a low constraint ranking because there are areas with existing or planned development at these sites, and this preliminary review indicates there is space to locate facilities a sufficient distance from the coast to avoid coastal erosion issues. There is also potential at these sites for participation in habitat restoration efforts as part of project implementation.

Development water costs were judged qualitatively, relative to the different collector well technologies considered and the production estimated for each type of collector well technology. In general, the HDD and radial well technologies were rated medium to high cost because they require more specialty construction and equipment relative to the yield they produce. Construction costs for conventional wells were rated low to medium because well construction can be performed using conventional construction methods. Construction costs for all technologies would generally be higher at former Fort Ord due to the additional depth to reach the target formation.

Table 4 lists the projects, running from south to north, and provides information on the location, type of collector well technology, and estimated yield. As noted above, each alternative was assigned a high, medium or low rating (low being "best" or least constrained, high being "worst" or most constrained). These ratings were then converted to ten-point scale scores and projects were ranked in order of their scores, with a score of 1 indicating the "best" or least constrained alternative. Rankings are shown on the right-hand side of the figure, both without regard to flow and with regard to flow. The rankings with regard to flow factor the alternative's flow rate into the score. For example, Alternative 1, with a flow rate of 3,000 gpm and Alternative 7, with a flow rate of 1,000 gpm, have the same ratings. Both have the same ranking without regard to flow, but Alternative 1 has a better (lower) rank when considering project flow rate.

Figure 8 graphically shows all of the alternatives, with their relative scores based on the 10-point scale. In developing recommendations for alternatives that could

Monterey Peninsula Water Management District

Preliminary Screening - Well Siting

View Chart | Flow Parameters | Point Values

Project #	Location	Well Type	Details	Flow Rate	Public property?	Screening Criteria: Drilling and Siting Complexity	Screening Criteria: Policy Restriction	Screening Criteria: Regulatory Restriction	Screening Criteria: Feed Water System Cost	Final Ranking: Without Regard to Flow	Final Ranking: With Regard to Flow
						H / M / L	H / M / L	H / M / L	H / M / L		
						Criteria Weighting: 20%	40%	30%	10%		
1	Sand City	HDD	1,500 ft	3,000 gpm	Y	H	H	M	M	24	21
2	Sand City	Radial	2 wells	6,000 gpm	Y	M	H	M	M	21	9
3	Sand City	Conv. (Shallow)	15 wells	7,500 gpm	Y	L	H	M	L	16	2
4	Private	HDD	500 ft	1,000 gpm	N	H	M	M	M	18	24
5	Private	Radial	1 well	3,000 gpm	N	M	M	M	M	10	12
6	Private	Conv. (Shallow)	2 wells	1,000 gpm	N	L	M	M	L	3	19
7	Sand City Dev.	HDD	500 ft	1,000 gpm	N	H	H	M	M	24	25
8	Sand City Dev.	Radial	2 wells	6,000 gpm	N	M	H	M	M	21	9
9	Sand City Dev.	Conv. (Shallow)	7 wells	3,500 gpm	N	L	H	M	L	16	11
10	Monterey RP	HDD	1,000 ft	2,000 gpm	Y	H	M	H	M	23	22
11	Monterey RP	Radial	1 well	3,000 gpm	Y	M	M	H	M	20	16
12	Monterey RP	Conv. (Shallow)	5 wells	2,500 gpm	Y	L	M	H	L	12	15
13	SNG	HDD	600 ft	1,200 gpm	N	H	M	M	M	18	23
14	SNG	Radial	2 wells	6,000 gpm	N	M	M	M	M	10	4
15	SNG	Conv. (Shallow)	6 wells	3,000 gpm	N	L	M	M	L	3	7
16	Bunker	HDD	1,000 ft	2,000 gpm	Y	H	M	L	H	12	17
17	Bunker	Radial	2 wells	6,000 gpm	Y	M	M	L	H	6	1
18	Bunker	Conv. (Shallow)	8 wells	4,000 gpm	Y	L	M	L	L	1	3
19	FO: MW-1	Radial	1 well	3,000 gpm	Y	M	M	M	H	15	13
20	FO: MW-1	Conv. (Shallow)	2 wells	1,000 gpm	Y	L	M	M	L	3	19
21	FO: Stilwell	HDD	1,000 ft	2,000 gpm	Y	H	M	L	H	12	17
22	FO: Stilwell	Radial	1 well	3,000 gpm	Y	M	M	L	H	6	8
23	FO: Stilwell	Conv. (Shallow)	4 wells	2,000 gpm	Y	M	M	L	M	2	14
24	FO: Stilwell	Conv. (180')	2 wells	4,000 gpm	Y	L	H	L	M	8	5
25	FO: Former WWTP	Conv. (180')	2 wells	4,000 gpm	Y	L	H	L	M	8	5

Table 4. Results of Collector Well Screening

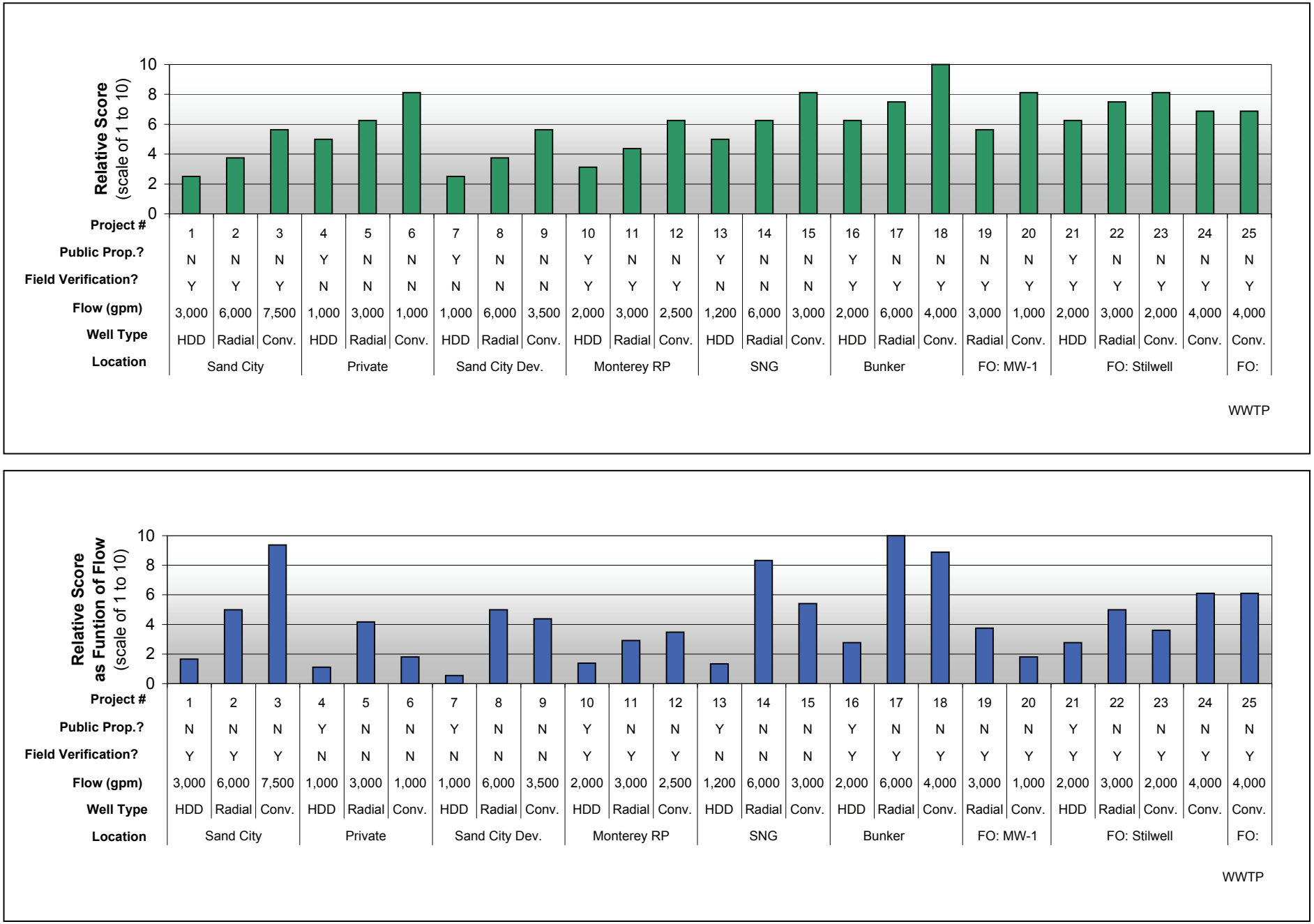


Figure 8
Alternatives and Relative Scores

move forward, the team identified alternatives that were generally ranked higher, and had consistent scores.

In general, HDD options performed poorly when compared with radial and conventional well alternatives because of their higher drilling and siting complexity, their higher cost and lower yield. Also, sites at former Fort Ord generally performed better than sites in the Sand City area, due to potential land use constraints and potential impacts to the Sand City project currently under construction.

The four criteria used for the screening analysis were weighted by the consulting team and MPWMD staff based on their perceived relative importance. The relative weights, which sum to 100 percent, reflect the team's collective opinions about the relative importance of each criterion. The two technical criteria, siting and drilling complexity and cost, total 30 percent, with policy and regulatory issues totaling 70 percent.

A sensitivity analysis was performed to determine the effect of changing the relative weights of the criteria to the alternatives ranking. The sensitivity analysis was performed assigning 70 percent to technical criteria and 30 percent to policy and regulatory criteria. The sensitivity analysis found that these changes had relatively little impact on alternatives, with the following exceptions:

- Alternative 3, conventional wells at Sand City, has a high score for ranking, with regard to flow, or without regard to flow. This reflects the fact that the most significant issues on this project are policy-related, due to potential impacts to the Sand City desalination project.
- Alternatives 17 and 22, radial wells at former Fort Ord, significantly fall in the rankings, due to the more difficult construction issues and higher relative cost for construction of these wells at former Fort Ord, where the water table is much deeper due to the presence of the coastal bluffs.

Formulation of Potential Projects

Based on the results of the screening, alternatives at three different sites were evaluated for project pairing. These alternatives are summarized below:

- **Alt 17 or 18: Fort Ord, Bunker Site**. Developed with either radial wells (6,000 gpm) or conventional wells (4,000 gpm).
- **Alt 25: Fort Ord, Former Wastewater Treatment Plant Site.** Developed with conventional wells in the 180-foot aquifer (4,000 gpm).
- **Alt 22, 23 or 24: Fort Ord, former Stilwell Hall Site.** Developed with radial wells (3,000 gpm), conventional wells in the Dune Sands aquifer (2,000 gpm), or conventional wells in the 180-foot aquifer (4,000 gpm).

As discussed in the beginning of this report, MPWMD is seeking a project with a production capacity of 8,400 AF/year, or 7.5 mgd. For a production capacity of

7.5 mgd, 15 mgd (10,400 gpm) of feed water collector capacity is required. Additional capacity must also be included, assuming that at least one well is out of service at any given time for maintenance. Table 5 summarizes four possible combinations of the alternatives that could be developed into a project.

Table 5. Potential Projects and Capacities

Project	Alternatives in Project	Total Capacity	Firm Capacity (1)	WTP Capacity	Notes
Projects in the Dune Sands Aquifer					
Example Project 1					
	Alt 18: Conventional Wells at Bunker Site	4,000			Least implementation issues of all projects evaluated.
	Totals (gpm)	**4,000**	**3500**		
	Totals (mgd)	**5.8**	**5.0**	**2.5**	
Example Project 2					
	Alt 18: Conventional Wells at Bunker Site	4,000			Potential inter-basin transfer issues for wells at Stilwell.
	Alt 23: Conventional Wells at Stilwell Site	2,000			
	Totals (gpm)	**6,000**	**5,500**		
	Totals (mgd)	**8.6**	**7.9**	**4.0**	
Projects in the Dune Sands Aquifer and 180-foot Aquifer					
Example Project 3					
	Alt 18: Conventional Wells at Bunker/Dune Sands	4,000			Potential inter-basin transfer issues for wells at Stilwell and WWTP
	Alt 24: Conventional Wells at Stilwell/180-foot Aquifer	4,000			
	Alt 25: Conventional Wells at WWTP/180-foot Aquifer	4,000			
	Totals (gpm)	**12,000**	**10,000**		
	Totals (mgd)	**17.3**	**14.4**	**7.2**	
Example Project 4					
	Alt 18: Conventional Wells at Bunker/Dune Sands	4,000			Potential inter-basin transfer issues for wells at Stilwell and WWTP
	Alt 22: Radial Well at Stilwell/Dune Sands	3,000			
	Alt 24: Conventional Wells at Stilwell/180-foot Aquifer	4,000			
	Alt 25: Conventional Wells at WWTP/180-foot Aquifer	4,000			
	Totals (gpm)	**15,000**	**12,000**		
	Totals (mgd)	**21.6**	**17.3**	**8.7**	

(1) Computed assuming the largest well out of service as a standby

As the table shows, the only way to assemble projects to meet the 7.5 mgd production goal for the project is with wells drilled in the 180-foot aquifer, paired with shallow wells at the Bunker Site. No pairing of conventional or radial wells at the sites using the Dune Sands aquifer would provide sufficient collector well capacity to meet the project production goal of 7.5 mgd.

4 Findings and Next Steps

Findings

The ICF Jones & Stokes/CDM team has identified the following feed water development findings for the 95-10 Project:

- A project with an estimated WTP production capability of up to 8,400 AFY (7.5 mgd) is technically feasible, with wells installed on former Fort Ord, making use of the Dune Sands aquifer and the 180-foot aquifer of the Salinas Groundwater Basin. Initial conversations with MCWRA indicate that inter-basin transfer of water from the 180-foot aquifer would be extremely politically sensitive and would ultimately require State legislature approval to amend the MCWRA Act, which could significantly lengthen the project implementation timeline.
- If the 180-foot aquifer is not used as a source for feed water, the anticipated project yield is less than 8,400 AFY. Depending on project configuration, a project with an estimated WTP production capability of 2,800 AFY (2.5 mgd) to 4,400 AFY (4.0 mgd) is technically feasible.
- All of the options evaluated presented institutional and land use obstacles of far greater significance than technical concerns. While none of the agencies interviewed identified issues that would preclude a project at this stage, successful implementation of any project option will require aggressive and collaborative discussion and negotiations with land use, resource, and regulatory agencies.
- The analysis found that projects at or in the vicinity of the Sand City desalination project currently under construction are technically viable and could have a production capability of 6,000 AFY (5.0 mgd) or more with the least cost. However, in a meeting and subsequent conversations with Sand City staff, they expressed strong objections to siting any desalination facilities within the city limits. Their objections included potential for impacts to the Sand City desalination project and incompatibility with planned development at potential project sites. Therefore, none of the projects in Sand City were recommended for further consideration.

Data Gaps and Next Steps

Key data gaps identified in the Phase 1 analysis and next steps to implement a project are presented below. Table 6 summarizes the next steps, including a schedule and budget range.

1. Address Policy Issues Related to Implementation Feasibility

Three significant policy issues were identified that could affect project implementation. Although agency discussions were held as part of this Phase 1 analysis, further work is advisable to more definitively address these issues and determine whether they preclude project implementation. It is assumed that ICF Jones & Stokes staff would initiate these discussions, with support from CDM as needed.

- Inter-basin Transfer. As noted in this document, Chapter 52-21 of the MCWRA enabling legislation specifically prohibits the extraction and export of groundwater outside of the Salinas Basin except for use at Fort Ord. Initial discussions with the MCWRA indicate that while not a fatal flaw, this issue is significant and could considerably lengthen the implementation timeline for a project. Further discussion with MCWRA and agricultural stakeholders regarding use of the 180-foot and Dune Sands aquifers in the northern portion of former Fort Ord is advised. Additionally, a hydrogeologic determination- consisting of review and interpretation of existing information- should be conducted for the Dune Sands basin boundary.
- SWRCB Anti-Degradation Policy. Per this policy, a project cannot result in degradation of groundwater quality from saline intrusion below that which currently exists. Confirmation is advised as to how the policy would be applied to use of the 180-foot and Dune Sands aquifers along the southern Monterey Bay coastline.
- Site Review with DPR. General plan information was used to identify Fort Ord Dunes State Park "development areas" (areas not set aside as habitat) with potential for well sites, and two meetings were held to review well placement concepts with local DPR representatives. Additional work is needed to define specific DPR plans/locations for facilities, to refine site constraints and identify potential well site locations, both for field programs and permanent facilities. A meeting should also be held with regional representatives at DPR to review potential projects.

2. Perform Phase 2 Technical Evaluations

If completion of the policy issues review indicates that a project is still feasible, MPWMD should authorize Phase 2 of the CDM engineering scope for collection and analysis of additional hydrogeology and engineering information to describe a project and alternatives. Key activities are identified below:

- Field Hydrogeologic Investigations. Conduct field investigations to refine well siting locations and yields. Field activities would include:
  - Place exploratory borings to verify the extent and continuity of the clay layer overlying the Paso Robles Formation at the project sites.
  - Install test production and observation wells in the Dune Sands aquifer at Bunker and Stilwell sites to assess potential project yields. The Stilwell site testing could also be used to further assess whether the Dune Sands aquifer in this location is within the Salinas Basin.
  - Perform flow testing and monitoring on installed test production wells.
- Groundwater Modeling. Conduct groundwater modeling to assess potential impacts to the Salinas and Seaside Basins.
- Outfall Brine Characterization Studies. The MRWPCA NPDES permit would require brine characterization studies to assess brine constituents and how constituent levels relate to the permitted levels in the NPDES permit.
- Project Description. Using information from the 2004 CDM study, the project description for all project aspects would be updated and finalized. This would include identifying specific WTP locations, evaluating raw and treated water pipeline alignments and connections to CAW distribution/transmission facilities. Project facilities layouts and cost estimates would be prepared.

3. Prepare Phase 3 EIR.

ICF Jones & Stokes, with support from CDM, would prepare a draft and final EIR on the project and alternatives identified in Phase 2.

Table 6. Summary of Next Steps, Schedule and Initial Budget Estimates

Activity/Task	Schedule	Budget		
1. Complete Policy Review for Projects	Sep – Oct 2008	$13,000	-	$19,000
Additional consultations with MCWRA, RWQCB, DPR				
2. Authorize Phase 2 Scope of Work - Detailed Facilities Plan for EIR	Nov 2008 – Apr 2010			
Field Hydrogeology Investigations		$150,000	-	$250,000
Groundwater Modeling		$70,000	-	$150,000
Outfall Brine Characterization Studies		$50,000	-	$100,000
Finalize Project Descriptions		$40,000	-	$80,000
Project Management		$40,000	-	$80,000
		$350,000	-	$660,000
3. Authorize Phase 3 Scope of Work - Prepare EIR	May – Dec 2010	$200,000	-	$250,000
Project Totals		$563,000	-	$929,000

5 References

Printed References

California Coastal Commission. 2004. *Seawater Desalination and the California Coastal Act.* California Coastal Commission, San Francisco, CA.

California Regional Water Quality Control Board, Central Coast Region. n.d. *Waste Discharge Requirements for the Monterey Regional Water Pollution Control Agency Regional Treatment Plant (Order No. R3-2008-0008).* California Regional Water Quality Control Board, Central Coast Region, San Luis Obispo, CA.

California State Water Resources Control Board. 1968. *Resolution 68-16, Statement of Policy with Respect to Maintaining High Quality Waters in California.* California State Water Resources Control Board, Sacramento, CA.

California State Water Resources Control Board. 2007. *Scoping Document, Amendment of the Water Quality Control Plan – Ocean Waters of California.* Division of Water Quality, Sacramento, CA.

Camp, Dresser & McKee, Inc. 2004. *Sand City Desalination Project Feasibility Study.* Final Report, Volume 1. Walnut Creek, CA. Prepared for Monterey Peninsula Water Management District, Monterey, CA.

Environmental Science Associates. 2004. *Fort Ord Dunes State Park Preliminary General Plan and Draft Environmental Impact Report.* San Francisco, CA. Prepared for California Department of Parks and Recreation, Sacramento, CA.

Feeney, M. B. 2007. Seaside Groundwater Basin Watermaster: Seawater Sentinel wells Project, Summary of Operations. Ventura, CA. Prepared for Seaside Basin Watermaster, Seaside, CA.

Jones & Stokes. 2004. Monterey Peninsula Water Management District Water Supply Project Draft Environmental Impact Report, Board Review Draft. Sacramento, CA. Prepared for Monterey Peninsula Water Management District, Monterey, CA.

Laredo, David. 2006. *Water Rights Relating to Sand City Desalination Projects, Memorandum to Andrew Bell, Monterey Peninsula Water Management District.* Pacific Grove, CA. Prepared for Monterey Peninsula Water Management District, Monterey, CA.

Philip Williams & Associates, Ltd. 2008. *Draft Coastal Regional Sediment Management Plan for Southern Monterey Bay.* San Francisco, CA. Prepared for Association of Monterey Bay Area Governments, Marina, CA.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 2006. *Monterey Bay National Marine Sanctuary Draft Management Plan.* Volume III. National Ocean Service, National Marine Sanctuary Program. Washington, D.C..

Watermaster, 2008. Compilation of Seaside Basin Geology compiled by Derrik Williams of Hydrometrics for the Seaside Basin Watermaster's Draft Basin Management Action Plan. Seaside Basin Watermaster, Monterey, CA.

Yates, E.B., M.B. Feeney and L.I. Rosenberg. 2005. *Seaside Groundwater Basin: Update on Water Resource Conditions.* Ventura, CA. Prepared for Monterey Peninsula Water Management District, Monterey, CA.

Personal Communications

Damitz, Brad. Environmental Policy Specialist, Monterey Bay National Marine Sanctuary, Monterey, CA. July 15 and 23, 2008 – telephone conversations.

Ewing, Leslie. Ocean Engineer, California Coastal Commission, San Francisco, CA. July 23, 2008 – telephone conversation.

Feeney, Martin. 2008. Hydrogeologist. Independent Consultant, Ventura, CA; Williams, Derrik. Hydrogeologist, HydroMetrics, Oakland, CA; Oliver, Joe. Hydrogeologist. Monterey Peninsula Water Management District, Monterey, CA. June 30, 2008 - Roundtable discussion on Seaside Basin geology during Design Charrette Workshop at Monterey Peninsula Water Management District, Monterey CA.

Feeney, Martin. 2008. Hydrogeologist. Independent Consultant, Ventura, CA. June 10, 2008 and July 28, 2008 - telephone conversations.

Ghandour, Ed. Corporate representative. SNG Development Corporation. San Francisco, CA. July 24, 2008 – telephone conversation.

Gray, Ken. Staff Park and Recreation Specialist. California Department of Parks and Recreation, Monterey District. Monterey, CA. June 5, 2008 – Meeting.

Gray, Ken. Staff Park and Recreation Specialist. McMenamy, Mike. Supervising State Park Ranger. Palkovic, Amy, Environmental Scientist. California Department of Parks and Recreation, Monterey District. Monterey, CA. July 16, 2008 – Meeting.

Haertel, Garrett. Compliance Engineer, Monterey Regional Water Pollution Control Agency, Monterey, CA. July 16, 2008 – Meeting.

Israel, Keith. General Manager. Hagemann, Brad. Assistant General Manager. Holden, Robert. Principal Engineer. Crook, James. Special Projects Engineer/Reclamation. Monterey Regional Water Pollution Control Agency, Monterey, CA, June 5, 2008 – Meeting.

Johnson, Rob. Chief of Water Management and Planning, Monterey County Water Resources Agency, Salinas, CA. July 2008 – telephone conversation.

Luster, Tom. Environmental Scientist, California Coastal Commission, San Francisco, CA. July 30, 2008 – telephone conversation.

Martin, Jacob. Senior Biologist, U.S. Fish and Wildlife Service, Ventura, CA. August 5, 2008 – telephone conversation.

Matarazzo, Steve. Community Development Director. Heisinger, James. Legal Counsel. Simonich, Rich. City Engineer. City of Sand City, CA. June 5, 2008 – Meeting.

Von Langen, Peter. Engineering Geologist, Central Coast Regional Water Quality Control Board, San Luis Obispo, CA. July 16, 2008 – Meeting.

Weeks, Curtis. General Manager. Johnson, Rob. Chief of Water Management and Planning, Monterey County Water Resources Agency. Salinas, CA. August 5, 2008 – Meeting.

Williams, Derrik. Hydrogeologist, HydroMetrics, Oakland, CA. Draft Memorandum to Martin Feeney, *Preliminary Modeling Results for the MCWD Desalination Intake.* July 23, 2008 – Memorandum.