8.1 Proposed Project Components – Alternatives Summary Evaluation and Comparison

As described in **Section 4, Project Description**, the proposed desalination project would consist of: (1) seawater desalination plant; (2) seawater intake and conveyance system; (3) brine storage, disposal, and conveyance system; (4) City-District intertie for distribution of potable water; and (5) environmental design, operation, and construction features. This section identifies a wide range of desalination alternatives that were considered during the development of the proposed project or that were raised during the scoping process for this EIR. Alternatives that were considered but eliminated from further consideration are described below with the rationale for their elimination provided.

This section also provides a summary description of the proposed component location alternatives for the desalination plant and the seawater intake and conveyance system being considered for the proposed project. A summary of the proposed impacts of each of these location alternatives is then provided, based on the results of the impact analysis performed in **Section 5, Environmental Analysis**. The ability of each of the location alternatives to meet the project objectives is also evaluated.

8.1.1 Desalination Alternatives Eliminated from Further Consideration

There are a number of desalination-related alternatives that have been studied or otherwise reviewed by the **scwd**[2] Desalination Program, were raised during the NOP process, and/or have been otherwise suggested as potentially feasible during the timeframe of this EIR. Desalination-related alternatives that have been eliminated from further consideration in this EIR include:

- Desalination component alternatives, such as plant site location alternatives, reuse of existing facilities, seawater intake design alternatives, and intertie alternatives;
- Other regional locations for the proposed project;
- Water import from other proposed desalination projects to the south;
- Water curtailment alternatives involving different desalination plant capacities; and
- Other desalination treatment technologies.

These alternatives are further described below.

Desalination Component Alternatives

Plant Site Alternatives

The IWP Program EIR contemplated three potential areas for a desalination plant site, all of which were located on the west side of the City within the City's water service area (see **Appendix K, Site Selection for Seawater Desalination Treatment Plant**). The three areas, referred to as Area A, Area B, and Area C, were selected based on: (1) proximity to possible intake locations and brine disposal facilities at the City's WWTF, adequate water distribution system infrastructure, and power supply; (2) adequate space requirements; and (3) consistency with surrounding land uses. As part of the initiation of the preliminary design process and environmental review for the proposed project, these potential sites for the desalination plant have been further narrowed down and several additional sites were considered but determined not to provide enough land area, or had other constraints or limitations. See **Appendix K** for additional information about the eliminated sites.

The Industrial Park Area (Area A) was determined in the IWP Program EIR to be the environmentally superior plant site location. Three plant sites within Area A are evaluated in **Section 5** of this EIR. A comparative summary evaluation of these three plant sites is provided below in **Section 8.1.2, Desalination Component Alternatives Considered in Detail**.

The Shaffer Road/Antonelli Pond Area (Area B) is located between Shaffer Road and Antonelli Pond – an artificial impoundment along lower Moore Creek. Delaware Avenue and the Homeless Garden Project bound the property to the south and north, respectively. The site is undeveloped and surrounded by other open space uses and residential uses to the south. Area B was eliminated from further consideration, as it was unlikely that enough land area would be available for the plant site when taking into consideration environmental constraints and regulatory requirements. Additionally, as this site is at the western edge of the City, adjacent to the Moore Creek Corridor and Antonelli Pond, there are likely to be more substantial environmental impacts associated with siting a desalination plant at this location, as compared to an infill site with surrounding development. For these reasons, it is no longer being pursued for this proposed project and is therefore eliminated from further consideration in this EIR.

The Terrace Point/Marine Science Campus Area (Area C) was eliminated, as the UCSC Marine Science Campus Coastal Long Range Development Plan, approved after the certification of the IWP Program EIR, does not contemplate a desalination plant on that site. Pursuing a desalination plant on this site would require subsequent approvals from the UC Regents and the Coastal Commission. Additionally, as this site is at the western edge of the City, adjacent to the Moore Creek Corridor, Younger Lagoon Reserve, and north coast agricultural lands, there are likely to be more substantial environmental impacts associated with siting a desalination plant at this location, as compared to an infill site with surrounding development. For these reasons, the site is no longer being pursued for this project and is therefore eliminated from further consideration in this EIR.

A number of "new" sites were also reviewed through the project description development process and were not pursued due to feasibility issues related to size constraints, existing development, environmental constraints, and/or land acquisition concerns, as described in **Appendix K**. Given the presence of feasibility issues, other sites are not expected to meet the primary objectives of the proposed project.

Reuse of Existing Facilities

The IWP Program EIR evaluated the potential that an existing building in Area A could be utilized for the proposed project. Since that time, the availability of such space in Area A or in the larger surrounding industrial area has become more limited and existing buildings of sufficient size are not available or would be difficult to retrofit. During the preparation of the preliminary design for the desalination plant, **scwd²** staff and the design team met with the property owners of the Harmony Foods complex and discussed the potential use of the existing industrial buildings for the proposed desalination plant. The approach to use the existing buildings was dismissed due to technical, safety, and regulatory limitations that would likely cost more to address as compared to new construction on the same or an adjacent site. Limitations that were identified included, but were not limited to:

- **Code Compliance:** Existing buildings do not meet current building codes for new structures, including those related to energy efficiency. Extensive study, design, demolition and retrofit work would be required to meet building and seismic codes.
- **Below-Grade Construction:** The proposed desalination plant would require below-grade construction for piping, electrical conduits and other structures. Working around the existing buildings would add construction time and expense to the proposed project.
- **Plant Hydraulic Profile:** The elevations of the existing buildings are not optimal for integrating upstream (pretreatment) and downstream (post treatment) facilities into the proposed plant. Additional pumping facilities and complicated and expensive construction would be required to move process waters through the proposed plant.
- **Corrosion Control:** Elements within the existing buildings were not designed for exposure to seawater and would require retrofit with appropriate materials and application of coatings.
- **Specialty Construction:** Existing buildings would require additional modifications to meet specific requirements for noise attenuation: HVAC, chemical facilities and other features beyond the original design intent for the industrial buildings.
- **Layout and Access:** Additional site planning and coordination would be required to develop vehicle and visitor access that would be sufficient for both the proposed project and adjacent businesses.
- **Uncertain Condition of Existing Structures:** If deficiencies or changed conditions are identified with the existing facilities during final design or construction, the schedule

could be delayed, and the City and the District could be responsible for change orders to correct the problems.

For the reasons noted above, reuse of existing facilities in Area A was not considered to be feasible and would not likely meet the primary objectives of the proposed project, and therefore was eliminated from further consideration in this EIR. See **Appendix L, scwd² Seawater Desalination Plant – Phase 1 Preliminary Design: Volume 1 – Report & Volume 2 - Drawings** for additional information.

Seawater Intake and Conveyance System Alternatives

As indicated in **Section 4**, a number of studies have been conducted since 2001 that have informed the **scwd²** Desalination Program about the types of seawater intake structures, and possible locations that could be considered for the proposed project. Two fundamental types of intake structures have been evaluated, including sub-seafloor intakes and screened, open-ocean intakes. **Appendix H, scwd² Seawater Desalination Intake Technical Feasibility Study,** evaluated the feasibility and site-specific requirements of both sub-seafloor and screened, open-ocean intake approaches. This study incorporated the findings of **Appendix F, scwd² Seawater Desalination Program Offshore Geophysical Study** and **Appendix G, City of Santa Cruz Water Department & Soquel Creek Water District scwd² Desalination Program Open Ocean Intake Effects Study**, both of which were reviewed by two technical working groups (TWG) convened to provide independent, scientific review and guidance on the planning, execution and reporting of the two studies. The coastline from above Wilder Ranch State Beach down to Capitola was evaluated and it was determined that the offshore alluvial portion of the San Lorenzo River should be evaluated for a potential site for a sub-seafloor intake. Open-ocean intakes were considered between the mouth of the San Lorenzo River and roughly Natural Bridges State Beach to provide for close proximity to the City's WWTF outfall, and industrial lands on the Westside of the City.

The assessment of feasibility of the various intake options was based on evaluation criteria that reflect the **scwd²** Desalination Program objectives and include:

- Production capacity and reliability – This criterion considered the ability of the intake system to provide up to 6.3 mgd of seawater for the operation of the 2.5 mgd desalination facility at all times and especially during periods of drought.[1] Because the primary function of the intake system is to provide a specified quantity of source water to the desalination plant, this criterion is considered as a "pass-fail" screening level criterion. An intake alternative that could not provide the required production capacity was not considered further.

[1] As indicated in **Section 4**, to produce 2.5 mgd of treated product water reliably, the seawater intake system would be designed with a capacity to provide a maximum flow of 7 mgd of raw seawater. In practice, the maximum flow of seawater delivered from the proposed intake would be 6.3 mgd, as described above.

- Proven technology and track record (risk) - This performance criterion considered whether or not the intake technology has been successfully installed and operated at other desalination facilities and the operational track record for the intake technology.
- Energy use - This performance criterion considered the relative amount of energy required for the operation of the different intake alternatives.
- Permitting – This criterion considered the complexity of obtaining permits from various governmental agencies.
- Operational flexibility and maintainability – This criterion considered the relative complexity and flexibility in operating and maintaining the intake system.
- Constructability - This criterion considers the relative complexity of constructing the different intake systems.
- Project lifecycle costs - The cost criterion for the intake alternatives includes capital, operations and lifecycle costs.

Based on the above, the Intake Technical Feasibility Study concluded that a screened, open-ocean intake is the apparent best intake approach in terms of engineering feasibility, based on a review of this approach against the evaluation criteria (**Appendix H**), which reflect the primary objectives of the proposed project. Therefore, this intake approach has been incorporated into the proposed project (see **Section 4**). Additionally, as discussed in **Section 5.2** and **Section 7**, the proposed project and operation of the seawater intake would not cause significant adverse impacts to marine life due to entrainment or impingement. Environmental design features of the proposed project require that the intake screen slot size and through-screen velocity meet the design criteria of CDFW and NMFS, which would minimize entrainment and impingement.

In general, deep sand and gravel alluvium that is hydraulically connected to the ocean is required for sub-seafloor intakes. With that consideration, the **scwd²** Desalination Program conducted a detailed Offshore Geophysical Study to identify the location, dimensions, and depth of the probable offshore portion of an alluvial basin associated with the San Lorenzo River, and to provide an initial characterization of the type of sediment filling the basin (**Appendix F**). The offshore portion of this alluvial basin was the focus of the study, based on the results of a 2001 conceptual-level hydrogeological study conducted to evaluate the potential for vertical beach-well intakes (Black & Veatch Engineers and Hopkins Groundwater Consultants, 2002) and consultation with United States Geological Survey (USGS) staff. (See **Section 4** for additional information about the Hopkins study and the consultation with USGS.) The geophysical and hydrogeological data and information obtained from the Offshore Geophysical Study were used in the evaluation of the technical and engineering feasibility of the sub-seafloor intake approaches for the **scwd²** Desalination Program, provided in the Intake Technical Feasibility Study.

While one of the sub-seafloor intake approaches, offshore radial collector wells, was determined to be potentially viable, it was not recommended for the project. The other sub-seafloor intake approaches considered in the Intake Technical Feasibility Study, vertical beach wells, slant wells, and an offshore engineered infiltration gallery, were not determined to be feasible. The sub-seafloor intakes that were evaluated are summarized below with an explanation as to why they were determined to be infeasible or were otherwise not recommended, based on the conclusions of the Intake Technical Feasibility Study. See **Appendix H,** for additional information about the intake approaches determined not to be feasible.

Additionally, a technical memorandum reviewing the status of subsurface intakes was prepared in support of this EIR (**Appendix AA, Intake Alternatives – Review and Status of Subsurface Intakes**). As such systems are proposed as a potential solution to impingement and entrainment (I&E) of marine life associated with open-ocean intakes, a review of the literature and other subsurface intake systems was conducted to gather available information related to these systems. A wide net was cast to understand where and what kind of subsurface intakes are utilized throughout the world. Relatively few subsurface seawater intake systems exist or are readily accessible on commercially or publically operating water supply projects. Each subsurface seawater intake system has its site-specific set of issues and challenges. As a result, it is difficult to draw any significant conclusions associated with their design, installation, operation, maintenance, capital costs, water quality, and associated potential environmental impacts. However, the information does serve as a primer of practical experience with subsurface intakes. Based on the outcome of this limited review, there is currently no known association between implementation of alternative subsurface intake methods and lessening the impacts of impingement and entrainment associated with water withdrawals for drinking water facilities or eliminating the need for pretreatment upstream of the sweater reverse osmosis system. See **Appendix AA** for additional information. A number of other locations for the seawater intake pump station were also considered but determined not to be viable, as further described below.

Sub-Seafloor Intakes

Radial Collector Wells. Radial collector wells consist of large, vertical concrete shafts (caissons) sunk down into the seafloor, with well screens extending from the caisson in a radial pattern. The brackish groundwater and seawater flow through the seafloor alluvial materials and into horizontal well screens that connect to the caisson. The collector pumps at the intake pump station would draw water from the caisson. As noted in the Intake Technical Feasibility Study an offshore sub-seafloor radial collector well system could be constructed in the offshore alluvial basin, off the San Lorenzo River, out past the end of the Municipal Wharf. The Intake Technical Feasibility Study concluded that although offshore radial collector wells are potentially viable, they are not recommended for the **scwd²** Desalination Program, because they:

1. May not be able to reliably provide the required production capacity. The mobile sediment layer and the heterogeneous nature of the offshore alluvial channel sediment will limit the vertical and horizontal movement of water to the collectors. Therefore, it is expected that multiple collector wells (2 or 3, or more collector wells) would be needed to provide the required flow rates. Multiple wells would have significant capital costs and there may not be space for more than 2 or 3 collector wells in the offshore alluvial

channel. In order to understand the actual production capabilities from a radial collector well, a full-size system would need to be constructed, operated, and monitored. This very expensive information gathering exercise would carry the risk that after committing significant resources to construct the system, the intake may not provide the required production capacity.

2. <u>Are an unproven technology in an offshore marine environment</u>. While radial collector wells have been used in rivers and on beaches, there have not been any radial collector wells installed in offshore locations. Therefore, there is no long-term radial collector well operational track record in offshore, open seawater locations.

3. <u>Provide low operational flexibility.</u> Radial collector wells have limited operational flexibility and relatively complex maintenance requirements if they clog up or lose production capacity, given their buried nature. If a collector well irreversibly clogs up and loses capacity, there is no way to increase production other than installation of additional new collector wells, which would require significant construction, expense, and time. Such additional new collector wells could also be subject to similar operational problems.

4. <u>Are the most complex to construct</u>. Radial collector wells have the highest degree of complexity to construct because this type of system has not been constructed in ocean environments and it would require the construction and connection of multiple offshore radial wells.

5. <u>Can be damaged or destroyed.</u> Depending on the location and sand depth over the intake, storm events could expose the well components leading to damage or destruction of the system.

Because radial collector wells may not be able to provide the required production capacity, are unproven in an offshore marine environment, and carry significant risks to pursue, they would not meet the feasibility criteria identified above. Therefore, the use of radial collector wells was eliminated from further consideration as a project component alternative in this EIR.

Vertical Beach Wells. Vertical beach wells are drilled vertically down into the sand and alluvial materials beneath the beach similar to a typical groundwater well. Based on the Intake Technical Feasibility Report, only twelve verticals wells could be built on the Santa Cruz Main Beach in front of the Santa Cruz Boardwalk. The shallow alluvium channel and the moderate-to-poor hydraulic conductivities of the sediments provide the modeled total flow rate of only 1.5 mgd, which is not enough source water for the proposed project. Furthermore, SWRCB Order 98-08 restricts further water withdrawals from the San Lorenzo River during the period of June 1 to November 31 each year, upstream of the sandbar. Withdrawals from the vertical wells would need to be reduced or eliminated if freshwater is drawn into the wells through the alluvial basin due to increased likelihood of impact to the freshwater levels in the San Lorenzo River (especially during drought). Because vertical wells would not provide the required production capacity, and would impact the freshwater levels in the San Lorenzo River, this alternative did not meet the screening level criterion and was not identified as technically feasible in the Intake Technical Feasibility Report. Therefore, the use of vertical beach wells was eliminated from further consideration as a project component alternative in this EIR.

Slant Wells. Slant wells are a relatively new type of well technology where the well is installed at a "slanted angle" between vertical and horizontal. Only one location was available to accommodate three slant wells off of Seabright Beach. The Intake Technical Feasibility Report concluded that although three slant wells could be constructed in the relatively protected location of Seabright Beach and extend through the bedrock and into the near-shore alluvial channel, the narrow aquifer, relatively low hydraulic conductivities and variable nature of the alluvial sediments in this area makes it unlikely that the slant wells could produce the required flow rates for the proposed project. Also, the slant wells would likely impact the freshwater levels in the San Lorenzo River, especially during drought, which could violate the conditions of the California State Water Resources Control Board Order 98-08, which has already fully apportioned the freshwater in the San Lorenzo River. Because slant wells would not provide the required production, and would impact the freshwater levels in the San Lorenzo River, this alternative did not meet the screening level criterion and was not identified as technically feasible in the Intake Technical Feasibility Report. Therefore, the use of slant wells was eliminated from further consideration as a project component alternative in this EIR.

Engineered Infiltration Galleries. Engineered Infiltration Galleries consist of a group of well screens or perforated collection pipes that are typically buried horizontally and arranged over an area of sand below the low-low tide level. Seawater percolates down through the sand and into the perforated collection pipes. This intake system could be constructed in the offshore alluvial basin, off the San Lorenzo River, out near the end of the Santa Cruz Municipal Wharf. This approach would consist of dredging a large area of the alluvial material to form a "gallery." Collector piping and engineered gravel and sand (media) would be placed in the gallery. Seawater would move vertically down through the engineered gravel and sand to the perforated collector piping and then into the central collector, which would be connected to an onshore pump station.

The Intake Technical Feasibility Report concluded that an engineered infiltration gallery is not expected to be able to reliably provide the required production capacity. The gallery would likely be plugged by fine sediment from winter storm discharge from the San Lorenzo River, which would reduce the production capacity and reliability. The engineered media would likely need to be dredged and replaced every few years, at great expense, and production would be stopped during those periods. Further, large storm events could also potentially reduce production capacity by eroding away the engineered media. Given that an offshore infiltration gallery would have a high potential for plugging and erosion and would not provide reliable production capacity, this alternative did not meet the screening level criterion and was not identified as technically feasible in the Intake Technical Feasibility Report. Therefore, the use of an engineered infiltration gallery was eliminated from further consideration as a project component alternative in this EIR.

Other Intake Pump Station Locations

Pursuant to recommendations provided in the Intake Technical Feasibility Study, **Appendix I**, **Seawater Intake Facility Conceptual Design Report scwd² Regional Seawater Desalination Project,** was prepared for the seawater intake that recommended conceptual design, construction approach, and site locations for project components. The Intake Conceptual Design Report evaluated and identified site locations for three primary facility components: Intake Screens, Intake Pipeline and the Intake Pump Station (**Appendix I**). Eighteen pump station site locations were evaluated along the Santa Cruz Coast from the San Lorenzo River to Natural Bridges State Beach. Ten of the eighteen sites were screened out as being infeasible for various reasons, including size of the site, size of the available area for construction staging, loss of parking, excessive conflicts along streets, geologic conditions, construction and operational problems, and conflicts with other planned development. See **Appendix I,** for additional information about the pump station sites determined not to be feasible.

Intertie Alternatives

Pipelines

The IWP Program EIR evaluated three intertie corridor alternatives for providing the connection between the City's and the District's service areas. From Ocean Street, these corridors generally followed: (1) Water Street, Soquel Avenue, and Soquel Drive (Corridor 5); (2) Water Street, Soquel Avenue, and Capitola Road (Corridor 6); and (3) East Cliff Drive, Murray Street, and the railroad right-of-way (Corridor 7). The pipeline alignment currently proposed and described in **Section 4** is similar, but not identical, to Corridor 5 from the IWP Program EIR.

As part of the planning for the proposed project, it was determined that additional storage capacity would be needed along the intertie in order to move water between the two service areas. The need for such storage had not been identified or evaluated previously in the IWP Program EIR. **Appendix BB, Desalination Plant Hydraulic Modeling and Analysis** (Hydraulic Modeling and Analysis), performed for the proposed project evaluated a range of pipeline corridors and storage tank locations (see further discussion below) by comparing their cost, constructability, construction phasing opportunities, impact on existing system, service pressures, headlosses, fire flows, synergy with planned/future/required water infrastructure improvements for City and District, efficiency of use of existing water infrastructure facilities (transmission pipelines, grid systems, storage tanks, pump stations), and water quality. The analysis determined that a pipeline alignment generally along the currently proposed location was needed because it solved existing City system inefficiencies and pressure problems in the north-east side of the City's service area, allowed for construction phasing which offered greater flexibility and cost savings, and utilized the existing DeLaveaga tanks for buffer storage, which eliminated the need to construct a new storage tank (**Appendix BB**). Therefore, other pipeline corridors (Corridors 6 and 7) were eliminated from further consideration and evaluation in this EIR. See **Appendix BB** for additional information about the eliminated pipeline corridors.

Storage Tanks

As indicated above, as part of the planning for the proposed project, it was determined that additional buffer storage capacity would be needed along the proposed City-District Intertie System in order to move water between the two service areas. The Notice of Preparation (NOP) for this project identified the existing DeLaveaga tanks, as well as three proposed tank alternatives (A-C) that would be potentially evaluated for the proposed project (see **Appendix A, Scoping Report City of Santa Cruz and Soquel Creek Water District (scwd**[2]**) Regional Seawater Desalination Project**).

Subsequently, the Hydraulic Modeling Analysis (**Appendix BB**) performed for the proposed project evaluated these storage tank locations and determined that adequate storage could be provided by the existing DeLaveaga tanks, which is owned by the City. The other tank alternative locations were eliminated from further consideration, as the sites are not owned by the City or District and would have required a land purchase, and the environmental effects would likely be greater given that all three sites are currently undeveloped (**Appendix BB**). Therefore, the other storage tank alternatives contemplated in the NOP were eliminated from further consideration and evaluation in this EIR.

Regional Location Alternatives

A number of NOP comments indicated that other regional locations, such as Moss Landing and the former Cemex cement plant, should be considered by the lead agencies for this project. These and other more distant locations were not considered for the proposed project due to their distance from the City's WWTF outfall, which allows for the blending of the brine from the desalination plant with the WWTF effluent. Moss Landing is approximately 25 miles and the former Cemex cement plant is approximately 12 miles from the WWTF outfall. As a result of these distances, these locations would require much more extensive pipeline conveyances for brine discharge and improvements to provide for the distribution of product water and connection between the two service areas, as compared to the proposed project. Therefore, these location alternatives were eliminated from further consideration in this EIR.

Water Import from Other Desalination Projects

There are two other proposed desalination projects that would be located in Moss Landing that have been described as being potentially available to serve a variety of communities in Santa Cruz, San Benito, and Monterey Counties. These two projects are the Deep Water Desal Project and the People's Project, which are described below. California American Water (CalAm) is also pursuing a project comprising a combination of groundwater reuse, aquifer storage and recovery, and desalination, which is identified to meet the water supply needs of the Monterey Peninsula and to discontinue water diversions from the Carmel River. The CalAm project has not been defined to meet the water supply needs of other regions and therefore would not be considered for the proposed project.

- **DeepWater Desal.** DeepWater Desal LLC is proposing the DeepWater Desal Project, a 25-mgd seawater reverse osmosis (SWRO) desalination facility that could serve Santa Cruz, San Benito, and Monterey Counties. The desalination facility would be constructed at Capurro Ranch on a leased 8.14-acre property located on Highway 1 near Moss Landing. Approximately 50 million gallons of raw seawater per day would be drawn via a screened passive open-water intake at a depth of about 100 feet through an existing pipeline and easement located on the edge of the Monterey Submarine Canyon. Approximately 25 mgd of brine discharge would be diluted in the existing Moss Landing Power Plant's cooling water discharge and returned to the ocean. Power would be provided to the project by the local electrical supply existing within the footprint of the existing facility. Renewable sources of power are being investigated for this project.
- **People's Project.** The People's Moss Landing Water Desalination Project (People's Project) would be a 10-mgd desalination facility located at the Moss Landing Green Commercial Park, adjacent to the Moss Landing Power Plant on the former National Refractories & Minerals Corporation site. Approximately 25 acres of this site would be designated for the desalination plant. The People's Project would consist of the following major components: screened, passive open-water intake; intake piping and pump station (existing); outfall pipeline (existing); pretreatment media filtration system; 10-mgd seawater desalination system; onsite product water storage tanks; post-treatment facilities; product water pump station; solids handling system; electrical and solar power supply system and energy recovery system; and approximately 13 miles of transmission and/or distribution pipeline to convey product water to the Monterey Peninsula (Moss Landing Commercial Business Park, LLC, 2013).

The concept of importing water into the City and District water service areas from these projects has not been specifically investigated. Both of these projects are still in the early planning process and are not as far along as the proposed project and therefore the timing and certainty of the availability of water for import from these possible sources cannot be ascertained. In addition, infrastructure for water transfer to both the City and the District all the way from Moss Landing would require feasibility and environmental analyses, permit approvals, water agreements, cost benefit analysis, which would require a lengthy evaluation process. Moreover, they are not likely to provide a substantial reduction in environmental effects. While import from these sources could be technically feasible, if these projects are pursued and approved, the City and District have no control over these projects and whether or not they are pursued or ultimately approved. Given all of these considerations, an alternative involving import of water from either of these other proposed desalination projects would not meet the primary project objectives and was eliminated from further consideration in this EIR.

Small and Larger Capacity Desalination Projects

The IWP and IWP Program EIR also evaluated smaller and larger capacity regional desalination alternatives. The capacity of the proposed project and these other capacity alternatives were based on a range of acceptable curtailments[2], as identified through the IWP process. The Larger Capacity/No Curtailment Alternative would have resulted in a larger plant capacity (5 mgd) to ensure that no curtailment would be required during drought conditions. The Smaller Capacity/High Curtailment Alternative would have resulted in a smaller plant capacity (2 mgd) and would have required greater curtailment during drought conditions (25 percent). These alternatives were not selected after the IWP and IWP Program EIR were completed.

The Larger Capacity/No Curtailment Alternative was rejected as it would not require curtailment per the adopted IWP, and it would not reduce potentially significant environmental effects. A larger capacity alternative could more fully meet the current project objective related to reducing the City's existing reliance on coastal streams and rivers that support listed species as part of the City's pending habitat conservation planning process, as it would allow the City to further reduce its reliance on flowing sources. However, the alternative would not reduce the significant environmental effects of the proposed project. Therefore, it was eliminated from further consideration in this EIR.

The Smaller Capacity/High Curtailment Alternative was rejected during the IWP process, as it would have greater community and economic effects on City water customers during drought conditions, would not substantially reduce infrastructure costs, and would only marginally reduce environmental effects associated with the operation of the facility. Additionally, this alternative would not meet the current project objective of providing a supplemental water supply sufficient to permit the City to reduce its existing reliance on coastal streams and rivers that support listed species as part of the City's pending habitat conservation planning process. Therefore, this alternative, which would result in a smaller desalination plant than is currently proposed, is eliminated from further consideration as an alternative in this EIR.

Other Desalination Treatment and Disposal Technologies

Pretreatment Alternatives

Different pretreatment systems were evaluated by CDM Smith for the **scwd²** Desalination Program to determine if one of these systems was more effective in controlling the fouling of SWRO membranes (see **Appendix D, scwd² Final Seawater Reverse Osmosis Desalination Pilot Test Program Report and Appendices**, and **Appendix L**). The Desalination Plant Pilot Study Report (**Appendix D**) also considered cost, feasibility, chemical and energy use, operation and maintenance requirements, and reliability. The pretreatment systems evaluated included the

2 Acceptable curtailments are the range of peak-season shortages that were determined to be tolerable for Santa Cruz customers. The acceptable curtailment profiles evaluated in the IWP were 0 percent, 15 percent, and 25 percent (Gary Fiske & Associates, 2003).

following types of filtration systems: granular media filters (GMF), slow sand filters (SSF), and microfiltration/ultrafiltration (UF/MF) membranes. GMF have been used for more than 30 years as pretreatment upstream of SWRO membranes, and MF/UF membranes have been used for the past 5 years in such applications. SSF has not been used in SWRO desalination plants, but it was included because of its lower chemical and energy requirements. Based on the evaluation, pretreatment for the project would consist of a system that includes UF/MF membranes. Dissolved Air Flotation (DAF) basins were also added to address poor water quality conditions that occur during storm events and algae blooms (see **Section 4** for additional information about this pretreatment system).

GMFs were eliminated from further consideration because they may carry a risk that plant production would be reduced during storm or red tide events. GMFs would rely on chemical optimization and careful monitoring and control of the filter operations to meet the pretreatment goals established for the project. Under challenging raw water conditions such as red tides or storm events, the GMFs would require significantly more operator attention and optimization than the other pretreatment alternatives. Even when operators respond quickly to changes in raw water quality, the water quality produced by GMF will vary; and these variations in water quality can reduce the production efficiency of the filters and cause accelerated fouling of the downstream RO membranes. To account for this loss of production during such events, standby units would be required to compensate for the decreased production, according to the Pilot Report.

Slow sand filtration is a biological process that cleans water much the same way a sandy bed of a river cleans and recharges an aquifer. The system primarily consists of a layer of sand and a layer of microbes that naturally develops on top of the sand (called the schmutzdecke) which can effectively remove particulates and bacteria before the ocean water is processed through the reverse osmosis membranes. SSFs were eliminated from further consideration as they are not a proven technology for SWRO plants, there is uncertainty about algae growth if filters are not covered, they would require at least one year of demonstration-scale testing to determine whether they could be recommended for the project, and they consume far more land area required than the other alternatives evaluated (10 acres, as compared to 2.0 to 3.5 acres).

Treatment Alternatives

The **scwd²** Desalination Program is proposing to use seawater reverse osmosis (SWRO) in the treatment of seawater. A number of NOP comments indicated that other desalination technologies should be considered for the project. Technologies recommended by commenters included nano tubes, evaporation chambers, multistage flash distillation, use of ammonia as a catalyst for desalination, etc. A memorandum was prepared by the City that discusses other desalination technologies that were determined not to be pursued for the proposed project, as further described below (see also **Appendix CC, Comparison of Desalination Technologies**).

While other desalination treatment technologies have been eliminated from further consideration, there is currently a great deal of research and study being pursued related to other desalination treatment technologies. If any of these methods prove to be superior to the reverse osmosis method the City piloted and proposes, the City and District will consider retrofitting processes or alternate designs to take advantage of them, where practical.

Thermal Distillation

The process involves boiling of sea water which then creates steam vapor. As the steam vapor cools and condenses, pure water droplets form, which results in distilled water. Though this technology has matured significantly, its usage is limited to areas where clean water is an absolute necessity for life and fuel is not prohibitively expensive. For example, 1,000 British Thermal Units ("BTU's") of energy are necessary to vaporize one pound of water into steam; or 8.55 million BTU's per kgal. This would equate to over 6 megawatts of power necessary to boil enough water to match the capacity of the proposed seawater desalination plant. The distillation process has been further optimized through Multiple Effect Distillation (MED),Multi-Stage Flash Distillation (MSF), and Vapor Compression Distillation (VC) processes to increase efficiency of the basic distillation process and to lower fuel costs. Due to the costs associated with power generation and the exotic materials needed to coexist in the harsh saline water temperatures, most thermal desalination plants are cogeneration facilities. The current research maintains that thermal desalination plants have higher capital and operating and maintenance costs compared to virtually all other desalting processes.

If the City and the District were to pursue thermal desalination, a new power plant would have to be constructed in Santa Cruz for steam; or the project would have to be located at a significant distance from the City's and District's water service areas if the power plant in Moss Landing were utilized to boil water for the thermal desalination process. A new power plant in Santa Cruz would actually be larger than the power needs of the thermal desalination process alone – due to the process requirements to remove supplemental steam needed for the desalination process. Also, due to the lower total recovery of seawater using thermal distillation compared to SWRO, the currently proposed intake capacity would have to be about 2.5-times larger to accommodate the need for additional cooling water (for dilution of brine and inefficiencies in the process). Lastly, cooling towers would need to be installed to decrease the temperature of the brine before it is returned to the ocean. Therefore, thermal desalination is not considered to be a practical and environmentally sensitive alternative and was not incorporated into the project description for the proposed project.

Forward Osmosis

Forward osmosis (FO) is the opposite of reverse osmosis. Forward osmosis is where osmotic pressure from a concentrated solution, also known as the "osmotic agent," draws seawater or other sources of water containing impurities, through a semi-permeable membrane. The water dilutes the osmotic agent, leaving concentrated impurities and salt behind in the seawater and a mixture of diluted osmotic agent and water is produced. The osmotic agent then would either need to be separated out from the water or can be ingested, depending on the agent. A number of companies have invested in research and development of this process, but its commercial application is very limited. One company, HTI, is relatively established and has developed commercial versions of FO technology for specific uses in the oil and gas/wastewater markets segments, and also for limited use for the general public and the military. However, the water produced for public use by this company does not meet the EPA secondary drinking water quality standard, which is less than 500 mg/L TDS. In contrast, the Pilot Study demonstrated that the proposed desalination plant will produce drinking water that does not exceed the secondary standard for salinity.

A significant, known limitation of FO technology today is the low membrane flux due to the time it takes for water to permeate across the semi-permeable barrier into the osmotic agent. Compared to the proposed project, a FO plant would require greater than 10 times the surface area and associated land mass needed to produce the equivalent capacity of water. Another limitation is the ability of the FO membrane to reject the osmotic agent. Since the majority of osmotic agents are largely toxic, back-transport of the agent into the discharge/concentrate could significantly affect the environment. Additionally, it must also be separated from the purified water. Based on the current research, RO is identified as the preferred desalination technology. Use of FO technology as it is currently available was therefore, not considered for incorporation into the project description for the proposed project.

Other Technologies

Carbon nanotubes (CNT), Electrodialysis - Continuous Electrodeionization (ED-CEDI), solar evaporation, and clathrate formation (freezing) are in a group of alternative technologies that offer a promising future for desalination technology. None are prevalent or commercialized in seawater desalination, and do not bear consideration as a full-scale desalination process by the **scwd²** Desalination Program at this time. Therefore, these technologies were not considered for incorporation into the project description for the proposed project.

Brine Disposal Alternatives

There were a number of NOP comments that indicated that the brine should be processed into salt or should otherwise be reused so that it does not require ocean disposal. Various brine disposal alternatives are discussed below based on **Appendix DD, Comparison of Brine Disposal Technologies**.

Sea Salt Production

The SWRO brine produced from the desalination process has a much higher salinity and is suitable for converting into sea salt by evaporating seawater in large solar ponds. However, the land area required for solar ponds would be very large and the City has no significant land area available for this purpose. One alternative to using solar ponds would be to concentrate the brine solution to about 200,000 mg/L TDS and truck the concentrated brine to a salt manufacturing facility for further processing to produce salt. Various technologies are available to accomplish the brine concentration, as described in **Appendix DD**. However, they are not proven technologies and/or are capital- and energy-intensive. Even if there were an acceptable technology for concentrating brine, a substantial number of truck trips from the desalination plant site to a salt manufacturing facility in the Bay Area (e.g., Leslie Salt in Newark, CA) would be required. Therefore, using the brine concentrate for sea salt production was not considered for incorporation into the project description for the proposed project.

Chemical Recovery

SWRO brine contains large quantities of minerals that may have commercial value when extracted. Besides salt (sodium chloride), magnesium, calcium, sulfate and bromide are valuable minerals that are used in agricultural and commercial uses. Currently commercially available technology exists to extract magnesium and calcium salts from concentrate and for production of structural materials from these salts. While there is the potential for beneficial uses of recovered chemicals in SWRO, the economic and market viability is unknown and would require a separate detailed study. Given that the **scwd**[2] Desalination Program is not in the chemical manufacturing business, this alternative was not evaluated further or incorporated into the project description for the proposed project.

Beach Wells

Discharging the SWRO brine through beach wells could be environmentally friendly if local geological conditions are amenable and other equal or more attractive alternatives are unavailable. Beach wells are used for small- and medium-sized desalination plants with limited success. The cities of Marina and Sand City have used shallow coastal wells for RO brine disposal. Prior to being taken off-line, the brine from the Marina SWRO plant was no longer being discharged through the beach well because of severe scaling problems. The 0.6-mgd Sand City desalination plant began operation in 2009 and continues to discharge RO brine through its subsurface discharge. At Sand City the beach formation is large areas of ancient deep, sand dunes. Thus local conditions were suitable for a small scale brine injection discharge. Studies have been conducted along the coast of Santa Cruz that indicated that the geological formation would not provide adequate permeability for the proposed discharge; thus, this alternative was not further pursued or incorporated into the project description for the proposed project.

Discharge via a New Ocean Outfall

Direct ocean discharge through dedicated ocean outfalls is widely used for SWRO projects of all sizes throughout the world. The main purpose of every ocean outfall is to dispose of the brine in an environmentally safe manner, minimizing the discharge zone size in which the salinity is elevated outside of the typical range of tolerance of the marine organisms inhabiting the discharge area. The two alternatives available to accelerate brine mixing from an ocean outfall discharge rely on the naturally occurring mixing capacity of the tidal zone or brine discharge beyond the tidal zone through the outfall's offshore diffuser to improve mixing. Obtaining permits in California for installation of a new ocean outfall and the direct brine discharge, as opposed to blended discharge, is a more difficult process due to potential environmental impacts. Hence, a dedicated brine disposal outfall was not pursued further for the proposed project, particularly because co-disposal with treated wastewater effluent through the existing outfall would reduce the potential for marine water quality effects.

8.1.2 Desalination Component Alternatives Considered in Detail

Seawater Intake Location Alternatives

Description

Based on the recommendations of the Intake Technical Feasibility Study (**Appendix H**), the proposed project includes an open-ocean intake structure. A number of potentially feasible alternative seawater intake and conveyance system locations were identified on or near the Municipal Wharf, along West Cliff Drive, and on sites on or near the alternative desalination plant sites. Each of these locations would extend into the Monterey Bay from potential pump station locations. **Table 8.1-1, Summary of Intake System Site Alternatives**, identifies and describes these sites. **Figure 4-3, Desalination System Area**, in **Section 4** illustrates their locations. The pump stations at all of these sites, except SI-17, would be different only in the depth of the wet well, which would depend on hydraulic requirements.

The 2,500-square-foot pump station could be an enclosed, below-grade facility, to reduce its visibility from surrounding locations. With this approach, some components would still need to be placed above grade, such as access hatches, electrical transformers, parking, driveways, and fencing. The pump station could also be constructed in an above-grade, single-story building, approximately 10 to 15 feet in height, designed to reflect the surrounding development at each site. The EIR considers both options as appropriate throughout the analysis.

The SI-17 pump station would be unique from the other alternative locations in that it would be located immediately adjacent to the Municipal Wharf near the mid-point bend of the existing wharf structure. The 2,500-square foot pump station would be surrounded by new decking. The combined pump station and decking would be approximately 7,000 square feet in area. A short ramp between the new decking and the existing wharf would be the only connection between the two structures. The pump station facilities (pumps, electrical controls, etc.) would be located below the surface of the new decking, but access points and maintenance hatches would be installed on the surface of the new pump station structure. A pump station at this location would extend 10 to 15 feet below the decking surface and the pump station wet well would extend to the ocean floor. The pump station and wet well would be made of concrete with surface color and texture designed to blend with the materials of the existing wharf. The pump station would be faced toward the ocean so as to be less visible from points onshore.

The alignment of the raw water transfer piping from the intake pump station to the desalination plant would be somewhat different for each alternative depending on the location of the seawater intake pump station. The raw water transfer piping would be buried within public rights-of-way primarily within areas having paved surfaces, for most alignments. The transfer pipelines from the pump station for SI-17 to the shore, is the exception, as it would be placed off the east side of the Wharf and buried below or laid upon the sea floor and anchored. See **Section 4** for additional design and construction details.

The Intake Conceptual Design Report conducted a comparative and sensitivity analysis of all eight intake sites evaluated (see **Appendix I**). From an engineering perspective and evaluating physical site, construction, and operational aspects, SI-14 was determined to be the most advantageous site. Even though this option is the most costly of the sites evaluated, there are operational advantages to having the intake pump station at the same location as the desalination plant and the comparative evaluation in **Appendix I** demonstrates this.

Table 8.1-1. Summary of Intake System Site Alternatives

Intake Site#[1]	Intake Pump Station Location	Intake Structure Location
SI-4	Woodrow Ave and West Cliff Drive, small park/greenbelt on City property	Off West Cliff Drive, 100 feet beyond outer edge of kelp forests
SI-5	1102 David Way at West Cliff Drive, undeveloped parcel	Off West Cliff Drive, 100 feet beyond outer edge of kelp forests
SI-7	1700 West Cliff Drive at Merced Ave, 3 contiguous undeveloped parcels	Off West Cliff Drive, 100 feet beyond outer edge of kelp forests
SI-9	Motel parking lot at 525 2nd Street, facing Beach Street, east of Pacific Ave	Near Municipal Wharf on sandy bottom
SI-14	Desalination Plant Area A, 2240 Delaware Avenue	Off West Cliff Drive, 100 feet beyond outer edge of kelp forests
SI-16	Pacific Collegiate School sports field, 255 Swift Street (Santa Cruz City Schools property)	Off West Cliff Drive, 100 feet beyond outer edge of kelp forests
SI-17	Adjacent to the Santa Cruz Municipal Wharf	Off Municipal Wharf on sandy bottom
SI-18	SCCRTC property located south of Depot Park and used by the City as a corporation yard for the wharf	Near Municipal Wharf on sandy bottom

Source: Appendix I, Seawater Intake Facility Conceptual Design Report scwd² Regional Seawater Desalination Project.
Notes:
1. The Intake Site #s are based on the numbering used in Appendix I, which evaluated 18 sites, and determined that 8 were viable.
Acronyms: SCCRTC = Santa Cruz County Regional Transportation Commission

Environmental Analysis

Table 8.1-2, Summary of Environmental Impacts for Component Alternatives, provides a comparison of the environmental impacts of each of the eight seawater intake alternatives evaluated. The following acronyms and symbols are used in **Table 8.1-2**:

- **SU** = Potentially significant and unavoidable impacts
- **LTSM** = potentially significant impacts that can be reduced to less than significant with the implementation of identified mitigation measures
- **LTS** = Less than significant impact
- **NI** = No impact
- -- = Impact not applicable, or not applicable to individual project components
- **+** = Impact is somewhat greater in comparison to other component alternatives evaluated

Table 8.1-2. Comparison of Environmental Impacts of Component Intake and Plant Site Alternatives

Impact[1]	LEVEL OF SIGNIFICANCE										
	Seawater Intake Site Alternatives								Plant Site Alternatives		
	SI-4	SI-5	SI-7	SI-9	SI-14	SI-16	SI-17	SI-18	A-1	A-2	A-3
5.1 Hydrology and Water Quality											
5.1-1: Construction Water Quality – Onshore Components	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.1-2: Construction and Maintenance Water Quality – Offshore Components	LTSM+	LTSM+	LTSM+	LTSM	LTSM+	LTSM+	LTSM	LTSM	--	--	--
5.1-5: Drainage	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTSM	LTSM	LTSM
5.1-6: Flooding and Inundation	LTS+	LTS+	LTS+	LTS+	LTS	LTS	LTS+	LTS+	LTS	LTS	LTS
5.1-7: Product Water Quality	--	--	--	--	--	--	--	--	LTS	LTS	LTS
5.2 Marine Biological Resources											
5.2-1: Entrainment/ Impingement	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	--	--	--
5.2-3: Construction & Maintenance Water Quality	LTS+	LTS+	LTS+	LTS	LTS+	LTS+	LTS	LTS	--	--	--
5.2-4: Underwater and Airborne Construction Noise	LTSM	LTSM	LTSM	LTS	LTSM	LTSM	LTSM	LTS	--	--	--
5.2-5: Fill/Placement of Intake Structures	LTSM	LTSM	LTSM	LTS	LTSM	LTSM	LTS	LTS	--	--	--
5.2-6: Movement of Fish or Wildlife	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	--	--	--

Table 8.1-2. Comparison of Environmental Impacts of Component Intake and Plant Site Alternatives

Impact[1]	LEVEL OF SIGNIFICANCE										
	Seawater Intake Site Alternatives								Plant Site Alternatives		
	SI-4	SI-5	SI-7	SI-9	SI-14	SI-16	SI-17	SI-18	A-1	A-2	A-3
5.3 Terrestrial Biological Resources											
5.3-1: Special-Status Species	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTSM	LTS
5.3-2: Riparian Habitat	LTSM	LTS	LTS	LTS	LTS	LTS	LTS	LTSM	LTS	LTSM	LTS
5.3-3: Monarch Butterfly Overwinter Habitat	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	SU	LTS
5.3-4: Waters and Wetlands	LTSM	NI	NI	NI	NI	NI	NI	LTSM	NI	LTSM	LTS
5.3-5: Wildlife Movement	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.3-6: Conflict with Local Plans	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	SU	LTSM
5.4 Land Use, Planning, and Recreation											
5.4 1: Conflicts with Land Use Plans, Policies, and Regulations	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	SU	LTSM
5.5 Air Quality and Climate Impacts											
5.5-4: Sensitive Receptors	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.5-5: Odors	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.6 Noise and Vibration											
5.6-1: Operational Noise	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.6-2: Construction Noise	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.6-3: Vibration	LTS	LTS	LTS	LTS	LTS	LTS	LTSM	LTS	LTSM	LTS	LTS

Table 8.1-2. Comparison of Environmental Impacts of Component Intake and Plant Site Alternatives

Impact[1]	LEVEL OF SIGNIFICANCE										
	Seawater Intake Site Alternatives								Plant Site Alternatives		
	SI-4	SI-5	SI-7	SI-9	SI-14	SI-16	SI-17	SI-18	A-1	A-2	A-3
5.7 Geology and Soils											
5.7-1: Seismic Hazards	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.7-2: Coastal Bluff Retreat	LTS	LTS	LTS	LTS	NI	NI	NI	LTS	NI	NI	NI
5.7-3: Other Slope Hazards	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTSM	LTSM	LTSM
5.7-4: Expansive and Corrosive Soils	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.8 Cultural Resources											
5.8-1: Known Cultural Resources	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.8-2: Unknown Cultural Resources	LTSM	LTSM	LTSM	LTSM+	LTSM	LTSM	LTSM+	LTSM+	LTSM	LTSM+	LTSM
5.8-3: Human Remains	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.8-4: Paleontological Resource	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.9 Utilities and Service Systems											
5.9-1: Water Supply	--	--	--	--	--	--	--	--	LTS	LTS	LTS
5.9-2: Wastewater	--	--	--	--	--	--	--	--	LTSM	LTSM	LTSM
5.9-3: Solid Waste	--	--	--	--	--	--	--	--	LTS	LTS	LTS
5.10 Aesthetics											
5.10-1: Scenic Vistas	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.10-2: Scenic Resources	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

Table 8.1-2. Comparison of Environmental Impacts of Component Intake and Plant Site Alternatives

Impact[1]	LEVEL OF SIGNIFICANCE										
	Seawater Intake Site Alternatives								Plant Site Alternatives		
	SI-4	SI-5	SI-7	SI-9	SI-14	SI-16	SI-17	SI-18	A-1	A-2	A-3
5.10-3: Visual Character	LTS+	LTS+	LTS+	LTS+	LTS	LTS	LTS+	LTS	LTS	LTS	LTS
5.10-4: Light and Glare	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.11 Hazards and Hazardous Materials											
5.11-1: Construction Impacts	LTSM	LTSM	LTSM	LTSM	LTSM+	LTSM	LTSM	LTSM+	LTSM+	LTSM	LTSM+
5.11-2: Operational Impacts	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.11-3: Hazardous Materials Impacts Near Schools	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM	LTSM
5.12 Traffic and Transportation											
5.12 1: Traffic	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
5.12 2: Emergency Access	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

Note:
1. Only those impacts which relate to the specific project component alternatives are included in this table.
Acronyms:
SU = Potentially significant and unavoidable impact
LTSM = Less than significant impact after mitigation
LTS = Less than significant impact
NI = No impact
-- = Impact not applicable, or not applicable to individual project components
+ = Impact is somewhat greater in comparison to other component alternatives evaluated

The table indicates that there would be no distinction between the alternatives for many of the impacts analyzed. However, there are distinctions in some impact categories as summarized below.

- **Section 5.1, Hydrology and Water Quality (Impacts 5.1-2 and 5.1-6)**: All of the intake alternative locations would require mitigation measures to reduce construction and maintenance impacts related to the offshore components to less than significant. However, construction impacts would be somewhat greater (though still less than significant with mitigation measures) for the intake locations on rocky bottoms given the presence of nearby kelp forests and the need to conduct rock excavations at these locations. Such would be the case for SI-4, SI-5, SI-7, SI-14, and SI-16. See Impact 5.1-2 for additional information.

  None of the intake locations would result in significant impacts requiring mitigation measures related to flooding and inundation due to a location in a flood hazard area, tsunami inundation area, or area potentially subject to sea-level rise (Impact 5.1-6). However, an intake pump station at SI-4, SI-5, SI-7, SI-9, SI-17, and SI-18 would have somewhat greater impacts related to flooding and inundation, as compared to SI-14 and SI-16, as these sites are located in or immediately adjacent to the tsunami inundation area. Additionally, a pump station at SI-17 adjacent the Municipal Wharf would be in an area designated as a VE Zone, which is subject to a 1 percent annual chance of flooding, with the additional risk of being exposed to wave action. An intake pump station at SI-18 would be located on land adjacent to the Neary Lagoon outlet channel in a large section of downtown Santa Cruz in an A99 Zone, which is an area to be protected from 1 percent annual chance flood by a federal flood protection system under construction, for which no base flood elevations have been determined. An intake pump station in these locations could experience minor damage if flooding or inundation were to occur. Although the structure would be water-resistant, flooding of the wet well could take place in a flood event, which could result in minor damage.3 Because the desalination plant and associated intake system would not be considered a critical facility, it could be taken off line temporarily in the event of an emergency, and then brought back on line after any needed repairs have been completed. Because the pump station would be relatively small and unmanned, it would not increase the potential for floods or expose people to flood hazards.

  The intake pump station sites should not be at risk of inundation from sea-level rise, anticipated to be approximately 4 feet above 2000 levels, given the current elevations above mean sea level at these sites; however, the pump station wet well at SI-17 would extend from the pump station down to the ocean floor and would be subject to wave action. An environmental design features of the proposed project will require that any

[3] The pump station structure could be designed to be water proof, if needed or desired by the City and District, such as might be the case for SI-17 on the Municipal Wharf.

proposed project facilities subject to coastal wave action would be designed to account for wave heights, storm surge, water levels, scouring and erosion, maximum and minimum tides, and currents associated with a 100-year storm event and factoring in anticipated water levels due to sea level rise and global warming over the life of the structures. See Impact 5.1-6 for additional information.

- **Section 5.2, Marine Biological Resources (Impacts 5.2-3, 5.2-4, and 5.2-5)**: The construction impacts on the marine environment would be greatest at the intake sites involving rock excavation and/or pile driving, including SI-4, SI-5, SI-7, SI-14, SI-16, and SI-17. Specifically, none of the intake alternative locations would require mitigation measures to reduce construction water quality impacts on marine life to less than significant (Impact 5.2-3). However, these less-than-significant marine water quality impacts would be somewhat greater at the intake sites involving rock excavation, including SI-4, SI-5, SI-7, SI-14, and SI-16. Likewise, construction noise impacts on marine life would be somewhat greater at sites involving rock excavation or pile driving, including SI-4, SI-5, SI-7, SI-14, SI-16, and SI-17 (Impact 5.2-4). The other sites (SI-9 and SI-18) would not require rock excavation and/or pile driving and the construction noise impacts on marine life would be less than significant at those locations.

  Construction of the proposed intake structure at SI-4, SI-5, SI-7, SI-14, or SI-16 would require the implementation of a mitigation measure to ensure that rocky habitats on the west side of the project area, such as rocky bottom kelp forest habitats, are avoided and impacts are reduced to less than significant. Impacts on kelp forest habitats and other marine habitats designated by regulatory agencies would be less than significant at SI-9, SI-17, and SI-18 (Impact 5.2-5).

- **Section 5.3, Terrestrial Biological Resources (Impacts 5.3-2 and 5.3-6):** An intake pump station at either SI-4 or SI-18 could have potentially significant impacts to riparian habitat (Impact 5.3-2); however, mitigation measures will ensure that riparian setbacks are adhered to and vegetation is protected during construction. Riparian habitat does not occur on or near the other intake pump station sites.

- **Section 5.6, Noise and Vibration (Impact 5.6-3)**: The construction of an intake pump station at SI-17 would require the implementation of a mitigation measure to ensure construction vibration due to pile driving does not result in significant impacts to adjacent structures. The impact of construction vibration at all other intake pump station sites would be less than significant.

- **Section 5.8, Cultural Resources (Impact 5.8-2)**: All of the onshore portions of the intake alternative locations would require mitigation measures to reduce the potential significant impacts related to the inadvertent discovery of cultural resources during construction to less than significant. However, the conveyances for SI-9, SI-17, and SI-18 would transit through an area having identified sensitivity for buried archaeological resources and therefore would require additional mitigation to reduce the potential impacts to less than significant. Additional mitigation would also be required for an intake pump station sited on either SI-9 or SI-18.

- **Section 5.10, Aesthetics (Impact 5.10-3)**: An intake pump station at any of the alternative sites would not substantially degrade the existing visual character or quality of the site and its surroundings. If constructed as an above ground building, the intake pump station could be designed to reflect the surrounding development at the selected site. For example, along West Cliff Drive a pump station at SI-4, SI-5, or SI-7 could be designed with a mass and shape of a non-descript contemporary residence with exterior design elements that would be architecturally similar to surrounding residential buildings. Given the size and the adaptability of the exterior façade to match surrounding uses, the intake pump station would not likely alter the visual character of the various pump station sites and their surroundings. Additionally, a Design Permit per City Municipal Code will review, evaluate, and condition the architectural and site planning characteristics of the intake pump station. However, the impacts on existing visual character would be somewhat greater (though still less than significant) for the intake locations on West Cliff Drive (SI-4, SI-5, and SI-7), near the beach and waterfront area (SI-9), and the Municipal Wharf (SI-17) given the scenic qualities of these locations.
- **Section 5.11, Hazards and Hazardous Materials (Impact 5.11-1)**: All of the onshore portions of the intake alternative locations would require mitigation measures to reduce the potentially significant construction impacts related to hazardous materials and contamination to less than significant. However, these impacts could be somewhat greater (though still less than significant with mitigation) for SI-14 given the proximity to known contamination and for SI-18 given the potential for contamination due to historic site uses.

Ability to Meet Project Objectives

All of the seawater intake location alternatives could be implemented as part of the proposed project and would meet project objectives. Intake location SI-4 could be timelier to implement given that it is already owned by the City and, therefore, could more fully implement Objective #1. While the City currently uses SI-18 for storage, implementation of this alternative would not necessarily be faster than other alternatives given that it is owned by the Santa Cruz County Regional Transportation Commission, there are competing interests for the site, and permitting could be more complex for the site. It is likely that it could take more time to design, permit and construct an intake pump station at the Municipal Wharf (SI-17) due to its location in the nearshore ocean environment and the heavy use of the existing wharf, particularly during summer. These complexities associated with SI-17 could also result in slightly less flexibility to deal with any potential changes to the intake pump station that may be needed in the future as a result of changed conditions, as described in Objective #7.

An intake pump station at SI-14 would more fully implement Objective #5 given the efficiencies provided by consolidating the intake pump station at the desalination plant site. Of the intake locations evaluated, SI-9 and SI-18 would have the least construction impacts on marine resources, given their sandy-bottom location. However the pump station at SI-18 would be located in an area with concerns related to flooding, nearby riparian and open water habitat, and potential for contaminated soils and archaeological resources. SI-9, therefore, would more fully implement Objective #9 related to environmental concerns, as compared to the other alternatives.

Related to Objective #12, capital costs would be highest at SI-14 given the depth of the wet well for the pump station and the length of tunneling for the intake pipelines. However, this site may have reduced operations and maintenance costs given that a raw water transfer pipeline would not be required and the raw seawater would not have to be pumped to the desalination plant from the intake pump station (see **Appendix I**). See **Table 8.1-3, Ability of Seawater Intake Location Alternatives to Meet Project Objectives** for a detailed explanation by objective.

Table 8.1-3. Ability of Seawater Intake Location Alternatives to Meet Project Objectives

#	Project Objective Summary	Would Alternatives Meet Project Objectives?
1	Provide a supplemental water supply in a timely manner that meets the IWP and IRP program objectives and provides the necessary amount of water.	Yes Intake SI-4 may be timelier to implement given that it is already owned by the City (SI-4). Other locations would likely take longer to pursue. In particular, Site SI-17, while owned by the City, would likely require a lengthy permitting review.
2	Allow the City to reduce its ongoing effects on listed species in the coastal streams and rivers from which the City currently diverts water, by reducing its existing reliance on those streams and rivers.	Yes
3	Provide the District with a supplemental supply that will offset groundwater pumping to reduce overdraft and allow for aquifer recovery.	Yes
4	Protect the local economy and community from the effects of an uncertain water supply.	Yes
5	Develop a supplemental water supply that promotes efficient use of resources and infrastructure, avoids duplicative infrastructure, and has regional benefits.	Yes An intake pump station at SI-14 would more fully implement this objective given the efficiencies provided by consolidating facilities at the desalination plant site.
6	Provide a supplemental water supply that serves to diversify the water supplies available to the City and District.	Yes
7	Provide flexibility to efficiently and cost effectively meet future changed conditions, including changes in demand, changes in regulatory requirements, or changes in source water quality.	Yes Given its location in the near shore environment and adjacent to the heavily used wharf, Intake SI-17 could offer slightly less flexibility to meet future changed conditions.
8	Plan for climate change.	Yes
9	Provide a supplemental water supply that avoids or minimizes significant impacts, including—but not limited to—adverse impacts to marine and coastal	Yes Of the intake locations evaluated SI-9 and SI-18 would have the least impacts on marine resources, given their sandy-

Table 8.1-3. Ability of Seawater Intake Location Alternatives to Meet Project Objectives

#	Project Objective Summary	Would Alternatives Meet Project Objectives?
	resources	bottom location. Due to the presence of the rocky bottom and nearby kelp forest at SI-4, SI-5, SI-7, SI-14, and SI-16 and the need for rock excavation on the ocean bottom, these sites could have potentially greater temporary impacts during construction. Likewise, pile driving at SI-17 could also have potentially greater construction impacts. SI-18 and SI-4 are located adjacent to riparian and/or open water areas. SI-18 is also located in the flood zone and in an area with potential for contaminated soils and archaeological resources. SI-9, therefore, would more fully implement Objective #9 related to minimizing environmental effects, as compared to the other alternatives.
10	Provide a supplemental water supply that does not increase greenhouse gas emissions over existing conditions.	Yes
11	Provide a supplemental water supply that helps the City to adjust to the significantly reduced yield from the City's Live Oak well field.	Yes
12	Provide a supplemental water supply that is relatively cost-effective in terms of both capital and operation/maintenance costs.	Yes Capital costs would be highest at SI-14 given the depth of the wet well for the pump station and lowest for SI-7 and SI-17. Mid-range capital costs would be required for SI-4, SI-5, SI-9, SI-16, and SI-18 (see Appendix I). O&M costs for each alternative have not been estimated, but are anticipated to be generally similar for all alternatives, with SI-14 providing some level of extra efficiency given its proximity to the desalination plant.

Acronyms:
IRP = Integrated Resources Plan　IWP = Integrated Water Plan　O&M = Operations and Maintenance

Desalination Plant Location Alternatives

Description

Three alternative plant sites are being considered and evaluated in this EIR. All three sites are located within the Industrial Park Area (Area A). **Table 8.1-4, Summary of Plant Site Location Alternatives,** describes the three locations and required acreage, which would range from approximately 5 to 8 acres. All three alternative sites are currently undeveloped. The proposed project facilities would be the same at each of the proposed plant sites and would include space for pretreatment processing, desalination treatment and energy recovery, post-treatment processing and distribution, brine storage and disposal, residuals handling and disposal, chemical systems, and their associated support facilities. The desalination plant would also include space for other related and support uses, including but not limited to: (1) operations and control systems; (2) maintenance and facilities storage; (3) electrical operations and utility connections; (4) parking and access; (5) stormwater detention and treatment; (6) landscaping; and (7) outdoor viewing and gathering areas. **Section 4** provides a detailed description of all of the plant systems and facilities identified above.

While all of the above facilities would be located at each of the three alternative locations, the configuration of these facilities would be unique to each site, as illustrated in **Figures 4.7 through 4.10, Conceptual Site Plans for Desalination Plant Alternatives** in **Section 4**. These figures provide conceptual layouts for each of the plant site alternatives under consideration. The site plan of the selected site would be refined during the final design process.

Table 8.1-4. Summary of Plant Site Location Alternatives

Plant Site #	Description	Approximate Acreage[1]		
		Plant Site	Additional Paving & Conveyance	Total
A-1	All or portions of 4 contiguous parcels located in the northwestern corner of Area A	3.9	0.8	4.7
A-2	All or portions of 5 contiguous parcels located in the southwestern corner of Area A; Acreage does not include riparian area (1.0 acre).	3.4	0.7	4.1
A-3	All or portions of 3 contiguous parcels in mostly the northeastern corner of Area A, but access would extend into the southern portion of Area A. Two subareas of the site are connected by a utility corridor.	5.9	1.5	7.4

Source: Derived from Appendix L, scwd[2] Seawater Desalination Plant – Phase 1 Preliminary Design: Volume 1 – Report & Volume 2 – Drawings.

Notes:

1. The total acreages for each of the plant sites vary due to the characteristics and orientation of each site and related access requirements. Plant Site A-3 is substantially larger than the other two plant sites to account for the need to provide access and utility connections between the two subareas.

Environmental Analysis

Table 8.1-2, Summary of Environmental Impacts for Component Alternatives, provides a comparison of the environmental impacts of each of the three desalination plant site alternatives evaluated. The table indicates that there would be no distinction between the alternatives for many of the impacts analyzed. However, there are distinctions in some impact categories as summarized below:

- **Section 5.3, Terrestrial Biological Resources (Impacts 5.3-1, 5.3-2, 5.3-3, 5.3-4, and 5.3-6)**: There are distinctions between the three plant site alternatives for most of the terrestrial impacts evaluated. Overall, Plant Site A-2 would have greater impacts related to special-status species (Impact 5.3-1), riparian and wetland habitat (Impacts 5.3-2 and 5.3-4), Monarch overwintering habitat (Impact 5.3-3), and potential conflicts with local plans related to biological resources that are related to tree removal on the site (Impact 5.3-6). With the exception of Monarch overwintering habitat (Impact 5.3-3) and related potential partial policy conflicts (Impact 5.3-6), all of the impacts could be reduced to less than significant with identified mitigation measures. Plant Site A-2 could result in a substantial adverse effect to monarch butterfly overwintering habitat in Natural Bridges

State Beach (NBSB), if trees to be removed on this site provide a secondary wind break to that habitat, even with the implementation of identified mitigation measures.

- **Section 5.4, Land Use, Planning, and Recreation (Impact 5.4-1)**: None of the plant sites under consideration would result in conflicts with applicable land use plans, policies, or regulations, except for Plant Site A-2 as it relates to the potentially significant impacts to the Monarch overwintering habitat in NBSB and related potential for City General Plan and LCP partial policy conflicts (Impact 5.4-1).
- **Section 5.6, Noise and Vibration (Impact 5.6-3)**: Plant Site A-1 would require the implementation of a mitigation measure to ensure construction vibration due to pile driving does not result in significant impacts to adjacent structures. The other plant sites would not require such mitigation, as they are further away from adjacent structures.
- **Section 5.8, Cultural Resources (Impact 5.8-2)**: All of the plant sites would require mitigation measures to reduce the potential significant impacts related to the inadvertent discovery of cultural resources during construction to less than significant. However, Plant Site A-2 would be located in an area having identified sensitivity for buried archaeological resources and therefore would require additional mitigation to reduce the potential impacts to less than significant.
- **Section 5.11, Hazards and Hazardous Materials (Impact 5.11-1)**: All plant site location alternatives would require mitigation measures to reduce the potential significant construction impacts related to hazardous materials and contamination to less than significant. However, these impacts could potentially be somewhat greater for Plant Sites A-1 and A-3 given the potential for some level of contamination on these sites.

Ability to Meet Project Objectives

All of the desalination plant site location alternatives would meet the basic project objectives. However, Plant Site A-2 would not meet Objective #9 as it could result in a potentially significant and unavoidable impact related to the adjacent Monarch overwintering habitat in NBSB, if trees to be removed provide secondary wind break to the roost in NBSB. Related to Objective #12, capital costs would be highest for Plant Site A-3 given that it is larger and is a split site so construction costs would be higher and therefore this alternative would not meet Objective #12 as fully as the other alternatives (see **Appendix L**). See **Table 8.1-5, Ability of Desalination Plant Site Location Alternatives to Meet Project Objectives** for a detailed explanation by objective.

Table 8.1-5. Ability of Desalination Plant Site Alternatives to Meet Project Objectives

#	Project Objective Summary	Would Alternatives to Meet Project Objectives?
1	Provide a supplemental water supply in a timely manner that meets the IWP and IRP program objectives and provides the necessary amount of water.	Yes
2	Allow the City to reduce its ongoing effects on listed species in the coastal streams and rivers from which the City currently diverts water, by reducing its existing reliance on those streams and rivers.	Yes
3	Provide the District with a supplemental supply that will offset groundwater pumping to reduce overdraft and allow for aquifer recovery.	Yes
4	Protect the local economy and community from the effects of an uncertain water supply.	Yes
5	Develop a supplemental water supply that promotes efficient use of resources and infrastructure, avoids duplicative infrastructure, and has regional benefits.	Yes
6	Provide a supplemental water supply that serves to diversify the water supplies available to the City and District.	Yes
7	Provide flexibility to efficiently and cost effectively meet future changed conditions, including changes in demand, changes in regulatory requirements, or changes in source water quality.	Yes
8	Plan for climate change.	Yes
9	Provide a supplemental water supply that avoids or minimizes significant impacts.	Yes – Plant Sites A-1 and A-3 No – Plant Site A-2 Plant Site A-2 could result in a potentially significant and unavoidable impact related to the adjacent Monarch overwintering habitat in NBSB, if trees to be removed provide secondary wind break to the roost in NBSB.
10	Provide a supplemental water supply that does not increase greenhouse gas emissions over existing conditions.	Yes
11	Provide a supplemental water supply that helps the City to adjust to the significantly reduced yield from the City's Live Oak well field.	Yes
12	Provide a supplemental water supply that is relatively cost-effective in terms of both capital and operation/maintenance costs.	Yes Capital costs would be highest at Plant Site A-3, as the site is larger and is a split site, which therefore requires additional costs for: yard piping, grading and paving, electrical and instrumentation, and landscaping. Capital costs for Plant Sites A-1 and A-2 would be similar. O&M costs would be the same or similar for all three alternatives (see Appendix L).

Acronyms:
IRP = Integrated Resources Plan
IWP = Integrated Water Plan
NBSB = Natural Bridges State Beach
O&M = Operations and maintenance

8.1.3 Overall Comparison of Alternatives

Section 8.1.2 provides a comparative analysis of the site locations alternatives for the seawater intake system and the desalination plant, based on the environmental evaluation conducted in **Section 5** of this EIR and the comparison of impacts and objectives provided above. A summary of the overall comparison of these site alternatives is provided below.

Seawater Intake Alternatives

Where impacts of the intake alternatives were determined to be significant, feasible mitigation measures are available in all instances to reduce impacts to less than significant, as shown in **Table 8.1-2**. Distinctions between the sites from an environmental perspective are not substantial. Temporary marine water quality and marine life construction-phase impacts would be somewhat greater at the intake sites on the west side (SI-4, SI-5, SI-7, SI-14, and SI-16) due to the need for excavation in rock and at the intake site on the Municipal Wharf (SI-17) due to the need for pile driving. These activities would not be required at SI-9 or SI-18. An intake pump station at SI-4, SI-5, SI-7, SI-9, SI-17, and SI-18 would have somewhat greater impacts related to flooding or inundation, as compared to SI-14 and SI-16, as these sites are located in or immediately adjacent to the tsunami inundation area or could be subject to other flood hazards. The impacts on existing visual character would be somewhat greater for the intake locations on West Cliff Drive (SI-4, SI-5, and SI-7), near the beach and waterfront area (SI-9), and the Municipal Wharf (SI-17) given the scenic qualities of these locations. Other distinctions that could occur at the various sites are described previously.

All of the seawater intake location alternatives are technically feasible and would meet project objectives. Intake location SI-4 could be timelier to implement given that it is owned by the City (SI-4). Permitting and construction could be more complex for the intake site at the Municipal Wharf (SI-17) and likely at SI-18 near Depot Park, as well. An intake pump station at SI-14 would have efficiencies provided by consolidating the intake pump station at the desalination plant site. However, the capital costs would be highest at SI-14 given the depth of the wet well for the pump station and the length of tunneling for the intake pipelines.

Plant Site Alternatives

In almost all cases, where impacts of Plant Sites A-1, A-2, and A-3 were determined to be significant, feasible mitigation measures are available to reduce impacts to less than significant. However, there is a distinction between Plant Site A-2 and the other two sites in terms of environmental impacts, with A-2 having greater impacts overall in a number of impact categories. In particular, Plant Site A-2 could result in a substantial adverse effect to monarch butterfly overwintering habitat in NBSB, if trees to be removed provide a secondary wind break to that habitat, even with the implementation of identified mitigation measures. Additionally, Plant Site A-2, as it is currently designed, would not meet the project objective that seeks to avoid potentially significant impacts. Therefore, for the above reasons, this EIR assumes that the proposed project would not involve the selection of Plant Site A-2 as the preferred plant site, based on its current configuration and related potentially significant unavoidable impacts.

There is little distinction, however, between Plant Site A-1 and Plant Site A-3 in terms of environmental impacts. These sites would also meet all of the project objectives; however, capital costs would be higher for Plant Site A-3 given that it is larger and is a split site so construction costs would be higher.