4.11 PRODUCT WATER QUALITY

The following section is based on the Municipal Water District of Orange County 2005 Urban Water Management Plan (MWDOC 2005), the Huntington Beach Seawater Desalination Plant Pressure Surge Analysis (Northwest Hydraulic Consultants 2010), Watershed Sanitary Survey Report (2002), prepared by Archibald and Wahlberg Consultants; the Distribution System Corrosion Control for Desalination Seawater (McGuire Environmental Consultants 2002), and the Disinfection Byproduct Formation Report (McGuire Environmental Consultants 2004).

This section discusses the potential for the proposed desalination facility to impact product water quality in the region. Factors influencing the ability of the facility to produce quality product water are assessed both for the co-located scenario and for the stand-alone scenario. Since the original circulation of the REIR, the state department responsible for overseeing compliance of public and private water systems with drinking water regulations and for issuing the required Drinking Water Permits changed from the Department of Health Services to the California Department of Public Health. However, permits acquired from the DHS remain valid. The majority of the factors influencing the quality of the desalination facility's product water will remain the same for both scenarios. However, the potential for negative impacts to product water quality to occur as a result of HBGS non-routine operations will be reduced in the case that the proposed facility operates as a stand-alone operation. It should also be noted that source water quality issues are discussed in more detail in Section 4.10, which includes an analysis of potential impacts on product water that could be caused by source water contamination.

EXISTING CONDITIONS

Four water sources (imported water from the Metropolitan Water District of Southern California (MWD), surface water, groundwater, and recycled water) are currently managed, treated, and distributed through the Orange County distribution system to customers throughout Orange County. The potable water quality within the Orange County distribution system is in compliance with all regulatory drinking water standards. A description of the regulations currently applicable to the existing potable water supply within Orange County (and which would also be applicable to the proposed project) is provided below.

REGULATORY FRAMEWORK – DRINKING WATER

California Department of Public Health – Title 22

The California Department of Public Health (CDPH) (formerly the Department of Health Services or DHS) administers all provisions relating to the regulation of drinking water to protect public health. California's Safe Drinking Water Act requires CDPH to administer laws relating to drinking water regulation, including setting and enforcing both federal and state drinking water standards, administering water quality testing programs, and administering permits for public water system operations. The standards established by CDPH are found in Title 22 of the California Code of Regulations (CCR).

The CDPH is responsible for ensuring that all public and private water systems are operated in compliance with drinking water regulations. Current drinking water regulations include both primary and secondary standards. Compliance with primary standards is mandatory because these standards are based on potential health effects on water users. The primary standards define maximum contaminant levels (MCLs) that cannot be exceeded by any public and private water system. All standards except turbidity are applicable at the water user's tap. Secondary standards are those parameters that may adversely affect the aesthetic quality of drinking water, such as taste and odor. These standards are not federally enforceable, although CDPH reserves the right to enforce secondary standards if warranted.

Under Title 22 of the California Code of Regulations, CDPH would regulate the operation of the Seawater Desalination Facility at Huntington Beach and would oversee the quality of the product water produced. In addition, CDPH would be responsible for ensuring that the product water blended with existing water supplies would meet the minimum recommended standards for contaminants in drinking water that has been established by the United States Environmental Protection Agency (EPA).

To comply with the CDPH regulatory requirements, the applicant would apply for a domestic water supply permit as a water supply wholesaler pursuant to the Regulations Relating to Domestic Water Systems. According to the CDPH's Drinking Water Application Permit Instructions, this includes the submission of the following:

- A Permit Application;
- A Technical, Managerial, and Financial Report ; and
- A Technical Report that is prepared by a qualified engineer and that addresses all of the following significant elements: general water system information, source water information, treatment and design information, distribution system information, operational plans, and environmental documentation.

Operational Plans provided in the Technical Report include the following:

- A Water Quality Monitoring Plan to ensure product water quality compliance with drinking water standards;
- A Water System Operations Plan; and
- A Disaster/Emergency Response Plan.

Permit provisions for similar municipal water supply projects typically include

- Submittal of plans and specifications for Department approval prior to construction;
- Compliance with the Surface Water Treatment Rule (SWTR) – including the treated water turbidity, disinfection residuals and CT levels;
- All water must be treated – no bypassing;
- Complete water quality analyses conducted by an approved laboratory;
- Adequate corrosion control;

- Updated watershed sanitary survey every five years;
- Mandatory use of American National Standards Institute (ANSI) and National Safety Foundation (NSF) approved chemicals;
- Raw water bacteriological monitoring;
- Certified treatment facility operators; and
- Submission of monthly operation reports and a report after the first year of operation detailing the effectiveness of the facility's performance, a list of any violations and a list of any needed additions or operational changes.

California Department of Public Health Action Levels

In addition to the Safe Drinking Water Act, which sets the primary and secondary MCLs for water quality constituents, the California CDPH has established health-based advisory levels, known as "action levels," for specific chemicals that may be found in drinking water. The levels in Table 4.11-1, CDPH Drinking Water Notification Levels*,* provide information to public water agencies and others about certain non-regulated chemicals in drinking water that lack MCLs. Furthermore, Table 4.11-2, Response Levels, provides response-level information at which CDPH recommends removal of a source from service.

Unlike MCLs, which are enforceable regulatory standards, action levels are advisory in nature and not enforceable standards. However, if a chemical is present over its action level, the following apply:

- Local government notification
- Consumer notification
- Removal of a drinking water source from service – CDPH recommends that the drinking water system take the source out of a service if a chemical is present at levels considerably higher than the action levels. Response levels for these recommendations are presented in Table 4.11-2.

TABLE 4.11-1
CALIFORNIA DEPARTMENT OF PUBLIC HEALTH
DRINKING WATER NOTIFICATION LEVELS

CHEMICAL	NOTIFICATION LEVEL (MILLIGRAMS PER LITER)
Boron	1
n-Butylbenzene	0.26
sec- Butylbenzene	0.26
Tert- Butylbenze	0.26
Carbon disulfide	0.16
Chlorate**	0.8
2-Chlorotoluene	0.14
4-Chlorotoluene	0.14
Dichlorodifluoromethane (Freon 12)	1
1,4-Dioxane	0.003
Ethylene glycol	14
Formaldehyde	0.1
HMX	0.35
Isopropylbenzene	0.77
Manganese**	0.5
Methyl isobutyl (MIBK)	0.12
Naphthalene	0.017
N-Nitrosodiethylamine (NDEA)	0.00001
N-Nitrosodiethylamine (NDMA)	0.00001
N-Nitrosodi-n-propylamine (NDPA)	0.00001
Propachlor	.09
n-Propylbenzene	0.26
RDX	0.0003
Teritiary butyl alcohol (TBA)	0.012
1,2,3-Trichloropropane (1,2,3-TCP)	0.000005
1,2,4-Trimethylbenzene	0.33
1,3,5-Trimethylbenzene	0.33
Trinitrotoluene (TNT)	0.001
Vanadium**	0.05

Source: CDPH 2007.

TABLE 4.11-2
RESPONSE LEVELS
(AT WHICH CALIFORNIA DEPARTMENT OF PUBLIC HEALTH RECOMMENDS REMOVAL OF A SOURCE FROM SERVICE)

CHEMICAL	TOXICOLOGICAL ENDPOINT	RESPONSE LEVEL (MULTIPLES OF NOTIFICATION LEVEL)
1,4-Dioxane; RDX; TBA; 1,2,3-TCP;TNT	Cancer risk	100 times the NL
NDPA	Cancer risk	50 times the NL
NDMA	Cancer risk	30 times the NL
NDEA	Cancer risk	10 times the NL
All Others	Non-cancer	10 times the NL

Note: NL = Notification level.
Source: CDPH 2007.

Santa Ana Regional Water Quality Control Board – Basin Plan

The Porter-Cologne Water Quality Control Act, which became Division 7 of the California Water Code, establishes the responsibilities and authorities of the nine Regional Water Quality Control Boards (RWQCBs) and the State Water Resources Control Board (SWRCB). Each Regional Board is directed to create a water quality control plan, to include three main components: (1) beneficial uses that are to be protected, (2) water quality objectives that protect those uses, and (3) an implementation plan to accomplish those objectives. In accordance with the criteria in the California Porter-Cologne Water Quality Control Act and other pertinent state and federal rules and regulations, the Santa Ana Regional Water Quality Control Board (SARWQCB) is responsible for water quality control planning within its region. Santa Ana falls within the jurisdiction of the Region 8 of the RWQCB. The Santa Ana Basin—Region 8, Water Quality Control Plan establishes standards for compliance in the Santa Ana Basin. The SARWQCB specifies water quality objectives specific to the Santa Ana River Basin according to waterbody type: ocean waters, enclosed bays and estuaries, inland surface waters, and groundwaters. In most cases, narrative objectives apply to all waterbodies; however, in specific cases, numerical objectives are established for individual waterbodies (SARWQCB 2008, Chapter 4). Use of desalinated seawater from the Huntington Beach Seawater Desalination Plant will not affect any groundwater basin water quality objectives via groundwater spreading, conjunctive use, or the use of recycled water in Orange County.

IMPACTS

As the proposed project would introduce an entirely new source of potable water into the Orange County water supply system, the following information analyzes the quality of potable water produced by the desalination facility and its potential impacts on existing potable water quality and the distribution system within Orange County. An analysis of the desalinated product water's compliance with regulatory drinking water standards is provided in addition to a description of potential impacts to existing water supplies in regards to corrosion, chlorine residual, disinfection byproducts, taste/odor, and hydraulics.

SIGNIFICANCE CRITERIA

Under the California Environmental Quality Act (CEQA) Guidelines (14 CCR 15000 et seq. CEQA Guidelines), a project may be considered to have a significant environmental impact if it would:

- Violate any water quality standards
- Require the construction of new water treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects
- Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed
- Otherwise substantially degrade water quality.

WATER QUALITY STANDARDS

The product water quality from the Seawater Desalination Project at Huntington Beach can be potentially impacted by the following factors:

- Ocean water quality fluctuations
- Ocean water red tide algal bloom event
- Huntington Beach Generating Station (HBGS) non-routine operations
- Reverse osmosis (RO) membrane performance.

These potential impacts on product water quality are discussed below.

Ocean Water Quality Fluctuations

The product water of the proposed seawater desalination facility may be impacted by natural changes in ocean water salinity, temperature, turbidity, and pathogen concentration. Typically, ocean water salinity and temperature changes are triggered by natural seasonal events. As discussed in Section 4.10, Ocean Water Quality, and the Watershed Sanitary Survey (Appendix L), the intake ocean water turbidity and pathogen concentration changes are mainly driven by rain events.

In order to maintain a consistent quality of desalinated product water, the applicant would be required to obtain a drinking water permit from the CDPH that would address monitoring of source water quality and its effects on product water quality. The applicant has been working with CDPH to obtain such a permit. On August 10, 2002, CDPH issued a conceptual approval letter for the Seawater Desalination Project at Huntington Beach.

The desalination facility intake water quality in terms of turbidity (which is a surrogate indicator for potential elevated pathogen content) and salinity would be measured automatically and monitored continuously at the desalination facility intake. Instrumentation for continuous monitoring and recording of these parameters would be installed at the desalination facility intake pump station. In event of excessive increase in intake seawater turbidity and/or salinity, this instrumentation would trigger alarms that would notify desalination facility staff. If the intake turbidity reaches a preset maximum level, this instrumentation would automatically trigger chlorination of the source water, thereby reducing the source water pathogens to acceptable levels even before the water reaches the RO treatment facilities. In addition to the automation provisions, turbidity and salinity would also be measured manually by the desalination staff at least once a day and the intake seawater would be analyzed for bacteriological content at least once per week. In the event of elevated intake seawater turbidity, laboratory bacteriological content analysis would be performed more frequently.

In addition to the intake water quality monitoring instrumentation, the desalination facility pretreatment filtration facilities would be equipped with filter effluent turbidimeters and particle counters. This equipment would allow facility operators to continuously monitor pretreatment filter performance and to trigger adjustments of desalination facility operations to accommodate intake water quality changes.

Desalinated product water quality would also be monitored continuously for salinity and chlorine residuals and would be tested frequently for bacteriological content.

In summary, desalinated product water quality would be tested in accordance with the requirements of CCR Title 22 and the CDPH. Product water quality impacts due to ocean water quality fluctuations are not anticipated to occur upon implementation of the design features described above.

Refer also to Section 4.10, Ocean Water Quality and Marine Biological Resources for an additional discussion related to the Ocean Water Quality.

Ocean Water Red Tide Algal Bloom Events

At various times throughout the year, the surf zone along the Pacific Ocean may experience unusually large growth of marine algae (phytoplankton), which “bloom” and accumulate into dense visible patches near the ocean surface such that the water appears to be colored. This phenomenon is commonly known as “red tide.” During a red tide event, some of the algae produce elevated concentrations of specific organic compounds (such as the biotoxins saxitoxin and domoic acid) and store these compounds in their cells. The concentrations of organic compounds produced during red tide events are not harmful for humans if the ocean water is ingested directly. Oysters and other filter-feeding shellfish such as clams, mussels, and scallops can accumulate and concentrate these organic compounds in their tissues in excess of 1,000 times. Therefore, directly ingested red-tide ocean water typically does not cause harm to humans, while consumption of shellfish that has high concentrations of organic compounds generated during red tides may result in harm. This is a well-known phenomenon, and the CDPH has a shellfish monitoring program to ensure that shellfish are not consumed during these periods.

Red tides are natural phenomenon usually occurring when temperature, salinity, and nutrients in the ocean reach suitable levels to trigger a red tide bloom. The exact combination of factors that trigger red tide blooms is presently unknown, but some experts believe that high temperatures combined with lack of rainfall are at the root of red tide events. There are no known ways to control red tides. Therefore, the desalination facility would be designed to maintain high-quality potable water (consistent with regulatory standards) in the event of a red tide event.

The Seawater Desalination Project at Huntington Beach has a number of design features, which are more fully described in Section 3 of this SEIR that would to protect against the passage of red tide-related algal organic compounds through the treatment processes. These features include the following:

- Deep Intake Configuration to Minimize Algae Entrainment: Most of the algal biomass during red tide events floats on the surface. The HBGS intake (the source from which the desalination facility would divert seawater) is located at depth of approximately 33 feet below the water surface. Algal presence, accumulation, and growth at this depth are minimal because of the limited access of sunlight, which is vital for algal growth.

  HBGS intake water is collected through a velocity cap atop a rectangular intake tower. The maximum mean water velocity at the inlet to the intake conduit is only 2 feet per second (fps), which minimizes collection of red tide algae from the ocean surface, where they are most abundant. Because of the low intake velocity and significant depth of the outfall, the amount of the algae that would be entrained along with the intake water and would be conveyed to the desalination facility would be minimized, thereby protecting the desalination facility from exposure to significant amounts of red tide-related algal organic compounds.

  In the case that HBGS were to discontinue operation as contemplated in the stand alone scenario, the proposed seawater desalination facility would intake water directly from the Pacific Ocean via the existing HBGS intake pipe. This would continue use of the same deep intake method which provides a barrier against algae entrainment, and would not result in any adverse changes to product water quality.

- Chlorination of Intake Seawater: The desalination facility intake pump station would be equipped with a sodium hypochlorite feed system, which would be used for intake seawater chlorination on an as-needed basis. During episodes of red tide/algae blooms, chlorine would be applied at dosages of 3 to 5 milligrams per liter (mg/L). Chlorine is a strong oxidant, which applied at the high dosages indicated above, would reduce the concentration of red tide-related algal organic compounds in the seawater, thereby further minimizing their content in the facility product water. In addition, intake seawater chlorination upstream of the pretreatment sand filters would significantly decrease algae growth in the filter cells.

  Chlorination of intake source water is a method commonly used for controlling algal blooms in conventional water treatment facilities applying direct filtration. At present, a significant portion of the intake water sources in the U.S. are surface water sources occasionally exposed to algae blooms (reservoirs, lakes, slow-flowing portions of rivers). Typically, conventional treatment facilities applying granular media filtration and chlorination as key treatment methods are effective in treating surface water at times of algae blooms.

- Enhanced Coagulation of Intake Seawater: The desalination facility pretreatment filters would be equipped with a coagulant (ferric sulfate or ferric chloride) feed system, which would be applied continuously at the seawater intake at dosages of 5 to 10 mg/L. During episodes of red tide/algae blooms, coagulation dosage would be increased to up to 20 to 30 mg/L to achieve enhanced coagulation and removal of algae and algae-related organic matter from the intake water.

- Microfiltration or Dual Media Sand Filtration Algae Barrier: Algae conveyed with the intake seawater would be retained in the filter media and removed from the filters during filter cell backwashing. Because algae cells are the carrier of the red tide elevated concentration of algal organic compounds, their physical removal in the dual media filters would significantly reduce the potential for release from the algal biomass into the seawater that would be processed in the downstream treatment facilities (cartridge filters and RO membranes). Filter effluent water turbidity is expected to be maintained in a range of 0.05 to 0.3 nephelometric turbidity units (NTU).

- Microfiltration or Dual Media Sand Filter Covers: The surface of all pretreatment filters and filter channels would be covered to minimize sunlight exposure. Filter cell covers have proven to be an effective measure for minimizing algae growth in the filter cells. In combination with chlorination and enhanced coagulation, this measure would assure that the intake water algae are effectively retained and their growth in the filter media suppressed.

- Cartridge Filter Algae Barrier: The pretreatment filter effluent would be processed through 5-micron cartridge filters located downstream of the granular media filters and ahead of the RO membranes. Therefore, the cartridge filters would provide an additional protection barrier in terms of algae cell propagation. The cartridge filter effluent would be practically devoid of all red tide algae and algal particles.

- RO Membranes: RO membranes are very effective in removing soluble compounds of molecular size smaller than the size of the red tide algal organic compounds. The proposed membrane elements at the seawater desalination facility would be capable of removing more than 99.6% of the chloride ions contained in the seawater. Because the membrane elements work as physical barriers, they would also be very effective in removing organic molecules several times larger than chloride ions, such as these of the red tide algal organic compounds. A study completed by the US Army Biochemical Research and Development Laboratory in 1993 clearly indicates that RO treatment is an effective method for removal of algal organic compounds, including saxotoxin. Recent research has demonstrated complete removal of domoic acid and saxitoxin by the RO process during algae blooms. Domoic Acid and saxitoxin are expected to be the algal toxins most likely to occur in Pacific Ocean near the desalination facility. Based on the size of these molecules and the size of other algal toxins, rejection of other algal toxins is also expected.

- Final Disinfection: The permeate from the reverse osmosis system would be disinfected with chlorine followed by ammonia addition for chloramination. This final barrier of algal organic compound inactivation would provide additional assurance in terms of product water quality and safety. To ensure compatibility with MWD and other water supplies and to prevent a reduction in fluoride concentration for the users of these supplies when blending occurs, the Huntington Beach facility will also fluoridate the product water. Fluoride is added at the treatment facility as a liquid chemical in a manner similar to other chemicals required for treatment, such as the chlorine added for disinfection. The concentration of fluoride to be added is protective of public health and the optimal fluoride dose and precision of addition will be achieved in compliance with the regulations specified by the State of California.

- Emergency Facility Shutdown: Desalination facility operation can be discontinued within 10 minutes after notification in the event of red tide/algal blooms of catastrophic proportions and advisory by pertinent local and state heath safety agencies. Red tide genesis and development are usually closely followed by public health agencies. Red tide growth to a level of a major calamity usually happens in a matter of days rather than minutes. Continuous communication with pertinent regulatory agencies during the times of red tide conditions and toxin production would allow ample time for emergency shutdown in extreme cases of red tide occurrence and toxin production.

Seawater desalination facilities using RO membranes similar to those proposed for the Seawater Desalination Project at Huntington Beach have operated successfully for more than 20 years in other parts of the world with scarce alternative water resources (Spain, Cyprus, Israel, the Middle East, and the Caribbean). In all of these locations, red tide/algal blooms have occurred occasionally in the past. The fact that there are no documented cases of red tide health or safety problems associated with the operation of RO seawater desalination facilities worldwide is indicative of the capability of these systems to perform reliably and effectively under red tide conditions. The use of the above mentioned design features will also ensure that the facility will operate reliably at its design capacity. Thus, less-than-significant impacts are anticipated in this regard.

Huntington Beach Generating System Non-Routine Operations

While the desalination facility is in operation in conjunction with the HBGS, unusual activities at the HBGS, such as seawater emergency intake pump shut downs and failures, electrical equipment malfunctions, excessively high temperature of the cooling water, etc., may impact product water quality and desalination facility performance. In the case that HBGS were to cease the use of their once-through cooling and the proposed desalination facility were to operate as a stand-alone operation, independently drawing water from the Pacific Ocean, HBGS non-routine operations would not pose the potential for any adverse impacts to the product water quality. The Seawater Desalination Project at Huntington Beach would have six different provisions incorporating several protection/notification devices to account for non-routine operations at the HBGS:

- Automatic Control Interlock between HBGS Pumps and Desalination Facility Intake Pumps: The shutdown controls of the desalination facility intake pumps would be interlocked with the HBGS pumps, so when HBGS pump operation is discontinued to prepare for heat treatment, non-routine or even routine pump shutdown, this would automatically trigger an alarm at the desalination facility along with shutdown of the desalination intake pumps. After this emergency shutdown, the intake pumps would have to be started up manually, and the operations staff would be required to check the reason of shutdown with the HBGS staff before restarting the treatment facility intake pumps.

- Continuous Intake Pump Flow Measurement Devices: Seawater intake pumps would be equipped with flow meters, which would record the pumped flow continuously. If the intake flow is discontinued for any reason, including non-routine HBGS operations, this would trigger automatic intake pump shutdown.

- Continuous Intake Water Temperature Measurement Devices: The desalination facility intake pump station would be equipped with instrumentation for continuous measurement of the intake temperature. Any fluctuations of the intake temperature outside preset normal limits would trigger alarm and intake pump shutdown. This monitoring equipment would provide additional protection against heat treatment or other unusual intake water quality conditions.

- Continuous Intake Water Salinity/Conductivity Measurement Devices: The desalination facility intake pump station would be equipped with instrumentation for continuous measurement of the intake seawater salinity. Any fluctuations of the intake salinity outside preset normal operational limits would trigger an alarm and initiate intake pump shutdown. This monitoring equipment would provide additional protection against discharge of unusual fresh water/surface water streams in the facility outfall.

- Continuous Intake Water Oil Spill/Leak Detection Monitoring Devices: The desalination facility intake pump station would be equipped with instrumentation for oil spill/leak detection. Detection of oil in the intake water even in concentrations lower than 0.5 mg/L would automatically trigger an alarm and initiate intake pump shutdown. This monitoring equipment would provide additional protection against unusual intake water quality conditions.

- Routine Communication with HBGS Staff: The desalination facility staff of each shift would be required to contact HBGS personnel at least once per shift and inquire about unusual planned or unplanned events at the HBGS. If non-routine operations are planned at the HBGS, the desalination facility would be informed and would modify desalination facility operations accordingly.

Implementation of the six provisions described above would minimize impacts in this regard to less-than-significant levels.

Reverse Osmosis Membrane Performance

As the RO membrane elements age, their rejection capabilities usually decrease. This may trigger a change in product water quality from the Seawater Desalination Project at Huntington Beach.

The RO system membrane performance would continuously monitor feed seawater and permeate conductivity and the differential pressure through the membranes. If permeate salinity (i.e., total dissolved solids (TDS)) concentration exceeds the design level, membranes would be cleaned to recover their original performance capabilities. In addition, an average of 10% to 15% of the membrane elements would be replaced every year, thereby maintaining the product water quality at a steady level.

It is estimated that the product water quality for TDS is 350 mg/L, based on the use of high-rejection seawater desalination membranes at the third year of desalination facility operations. Typically, during the first three years of facility operations, the average product water quality TDS concentration would be lower than 350 mg/L. After the third year of operations, a portion (typically

10% to 15% per year) of the desalination facility membrane elements would be replaced to maintain the product water quality close to the target TDS concentration of 350 mg/L. Membrane replacement is a standard approach commonly used in seawater desalination facilities to maintain product water quality at a long-term steady target level. In addition, chloride and sodium are estimated to average 180 mg/L and 120 mg/L, respectively.

As shown in Table 4.11-3, Product Water Quality Comparison, the Seawater Desalination Project at Huntington Beach would produce product water with lower TDS levels than that currently delivered to Orange County water purveyors by MWD, and the estimated water quality levels for TDS, chloride, and sodium comply with the narrative water quality objectives in the Basin Plan. Additionally, when the desalinated water is integrated into the water supply system, it is not predicted that recycled water would exceed the Basin Plan narrative water quality objectives based on model results of the potable and wastewater distribution and collection systems..

The desalination facility would use industry standard 8-inch desalination membrane elements, which are available from a number of specialized membrane manufacturers. The membrane element manufacturers and their products pre-qualified for this project include the following:

- Hydranautics
- Filmtec/D
- Koch/Fluid Systems
- Toray

Key design membrane element parameters common for the products of these suppliers include the following:

- Membrane type: spiral-wound, thin film composite
- Applied flux: 8 to 12 gpd/sf at recovery rate of 45% to 55%
- Nominal salt rejection: 99.6% or higher
- Applied pressure: 800 to 1,100 pounds per square inch (psi)
- Maximum pressure drop per element: 10 psi
- Maximum feed water SDI (15 min): 5.0
- Free chlorine resistance: less than 0.1 mg/L
- Operating pH range: 2 to 11
- Quality assurance/quality check membrane production and testing procedures.

The actual membrane element that would be used for the proposed desalination facility would be selected during the detailed engineering design phase of this project. The product water projections are performed for two conditions: new membranes at facility start-up and membranes at the third year of facility operations. All projections are completed for low flow and high salinity scenario conditions in terms of intake water salinity and temperature and membrane performance characteristics.

At the beginning of the desalination facility operation the TDS concentration of the RO system permeate is projected to be between 226 and 308 mg/L, and at the end of the third year of desalination facility operations it is projected to be between 257 and 349 mg/L (based on projections of product water quality and membrane performance in accordance with modeling specifications provided by two of the four membrane suppliers, Toray and Hydranautics). As previously indicated, the permeate water quality would be maintained at a third-year operations level over the entire 30-year period of facility operations by replacement of a portion of the membrane elements every year. It should be noted that the projections above are for the water quality of the RO system permeate as it exits the desalination system. Prior to distribution, the desalination facility permeate would be conditioned by calcite dissolution and carbon dioxide for stabilization and corrosion control, and with chlorine for final disinfection. The addition of these conditioning chemicals would increase the final product water TDS concentration by 30 to 50 mg/L. Therefore, at facility start-up, the TDS of the product water delivered to the distribution system is expected to be in a range of 260 to 340 mg/L, while for the entire 30-year period of facility operations the TDS concentration would be in a range of 300 to 400 mg/L and would average 350 mg/L.

The projections presented above are developed using conservative assumptions for the type and performance of the membrane elements, intake water salinity, and temperature. The applicant's previous pilot testing experience in Tampa and Carlsbad, and the actual performance of the same Toray membranes in Trinidad, indicate that the membrane manufacturer projections carry a safety factor of 10% to 15%, and the actual product water quality is always better than that projected by the software.

Advances in membrane technology over the next 25 years are expected to yield membrane elements capable of producing water of TDS concentration below 300 mg/L for most of the useful life of the desalination facility. Therefore, the projected product water TDS concentration of 350 mg/L is a reliable and conservative estimate of the potable water quality that would be delivered to the distribution system by the Seawater Desalination Project at Huntington Beach.

As described in Section 3.0, Project Description, the facility would be capable of meeting all drinking water standards through multiple treatment processes, which include flocculation and coagulation, pretreatment filters, cartridge filters, RO membranes, and product water conditioning and disinfection facilities. A comparison between the projected product water quality of the Seawater Desalination Project at Huntington Beach and the CDPH primary and secondary water quality standards is presented in Table 4.11-3, Product Water Quality Comparison. Review of this table indicates that the desalination facility product water quality meets all current CDPH water quality MCL standards. It is also noted, that of all the chemicals listed in Table 4.11-1, boron is the only compound that is detectable in the product drinking water from the seawater desalination facility. After the RO treatment process, the desalted water boron level is approximately 0.6–1.0 mg/L, which is below the CDPH action level. The project would also be consistent with all requirements of the SARWQCB Basin Plan. Thus, impacts related to water quality and water quality standards would not be significant.

TABLE 4.11-3
PRODUCT WATER QUALITY COMPARISON

	PRIMARY MCL OR (SECONDARY MCL)	PROJECTED WATER QUALITY HUNTINGTON BEACH DESALINATION FACILITY (AVERAGE)	HUNTINGTON BEACH POTABLE GROUNDWATER (2009 CCR)	SEAL BEACH POTABLE GROUNDWATER (2009 CCR)	FOUNTAIN VALLEY POTABLE GROUNDWATER (2009 CCR) (AVERAGE)	NEWPORT BEACH POTABLE GROUNDWATER (2009 CCR) (AVERAGE)	IRVINE RANCH WATER DISTRICT GROUNDWATER (2009 CCR) (AVERAGE)	MWD DIEMER FILTRATION PLANT (2009 CCR) (AVERAGE)
RADIOACTIVITY (pCi/L)								
Alpha Radiation	15	<DLR	4.0	<DLR	3.8	6.8	<3	<DLR
Beta Radiation	50	<DLR	NR	<DLR	NR	<DLR	<4	<DLR
Combined Radium	5	<DLR		<DLR	<DLR	<DLR	<1	<DLR
Uranium	20	<DLR	4.1	<1	4.8	7.8	<1	<DLR
VOLATILE ORGANICS (ppb)								
Tetrachloroethylene	5	<DLR	<DLR	<DLR	<DLR	<DLR	<0.5	<DLR
Trichloroethylene	5	<DLR	<DLR	<DLR	<DLR	<DLR	<0.5	<DLR
INORGANICS (ppm)								
Aluminum	1	10 (μg/L)	<0.05	<DLR	ND	<DLR	<0.05	75
Arsenic (ppb)	10	0.01 (μg/L)	<2	<DLR	ND	<DLR	<2	ND
Fluoride naturally occurring	2	0.15 (μg/L)	0.39	.44	0.36	0.36	0.25	0.3
Nitrate	45	0.5 (mg/L)	<10	<DLR	4.4	7.5	5.7	
Nitrate+Nitrite (as N)	10	1 (mg/L)	<0.4	<DLR	1.1	1.7	1.3	0.5
Selenium (ppb)	50	<DLR (μg/L)	<DLR	<DLR	<5.0	<DLR	<5	<DLR
SECONDARY STANDARDS (ppm)								
Chloride	250	180 (mg/L)	59	14	21	59	104	88
Color (units)	15	1	2	8.3	ND	<3	<3	2
Iron (ppb)	300	2 (μg/L)	<100	<DLR	<DLR	<DLR	<100	<DLR
Manganese (ppb)	50	<DLR	<DLR	<DLR	<DLR	<DLR	<20	<DLR
Odor (TON)	3	1	<1	1.1	ND	1	<1	2

TABLE 4.11-3 (CONTINUED)

	PRIMARY MCL OR (SECONDARY MCL)	PROJECTED WATER QUALITY HUNTINGTON BEACH DESALINATION FACILITY (AVERAGE)	HUNTINGTON BEACH POTABLE GROUNDWATER (2009 CCR)	SEAL BEACH POTABLE GROUNDWATER (2009 CCR)	FOUNTAIN VALLEY POTABLE GROUNDWATER (2009 CCR) (AVERAGE)	NEWPORT BEACH POTABLE GROUNDWATER (2009 CCR) (AVERAGE)	IRVINE RANCH WATER DISTRICT GROUNDWATER (2009 CCR) (AVERAGE)	MWD DIEMER FILTRATION PLANT (2009 CCR) (AVERAGE)
Specific Conductance (μmhos/cm)	900	720	610	370	640	759	950	801
Sulfate	250	10	59	33	83	121	183	158
Total Dissolved Solids	500	300	357	213	370	466	486	469
Turbidity (NTU)	5	<DLR DS	0.32	0.1	0.1	<0.1	0.85	<DLR
OTHER ANALYSES (ppm)								
Alkalinity	Not Regulated	50	156	130	177	176	201	93
Total hardness	Not regulated	50	194	52	229	265	289	201
Magnesium	Not regulated	15	10	2.0	13	14	22	21
pH (Units)	Not regulated	8.0	8.2	8.6	8.1	8.2	7.9	8.2
Potassium	Not regulated	5.0	2.6	1.2	2.4	3.1	2.4	3.9
Sodium	Not regulated	120	48	61	42	54	99	83

Notes: **ppb** = parts-per-billion; **ppm** = parts-per-million; **pCi/L** = picoCuries per liter; **ntu** = nephelometric turbidity units; **μmho/cm** = micromhos per centimeter; **NR** = not required to be analyzed; **ND** = not detected; **<DLR** = average is less than the detection limit for reporting purposes; **MCL** = maximum contaminant level.

Sources: City of Huntington Beach 2009, City of Seal Beach 2009; City of Fountain Valley 2009; City of Newport Beach 2009; IRWD 2009; MWD 2009.

PRODUCT WATER RELIABILITY

The desalination facility operations would be fully automated and key systems would be provided with redundant equipment and controls per the requirements of Title 22 of the CCR. The electrical substation and desalination facility will be built with redundant systems such that in the event of equipment repair or failure, power to the product water pump station will be maintained. The product water storage tank will supply approximately 5 hours of water supply at full facility production capacity flows, and longer durations at reduced flow. In the event of an underground booster pump station power outage, the booster pump station would be equipped with on-site power generators that would allow their operation to continue even if the main source of power supply has been interrupted. The desalination facility would be manned 24 hours per day, 365 days per year by skilled and certified operators, which would coordinate facility and pump station operations with that of all other water purveyors delivering water to or operating the water distribution system facilities.

As a part of desalination and pumping station operations, the operations staff would develop an earthquake mitigation and preparedness plan, which would be coordinated with the City. This plan would define coordination measures to provide continuous facility operations and water delivery under earthquake emergency conditions, if possible.

The desalination facility would be designed with one standby RO train to provide additional reliability of water production and supply. Typically, desalination facilities, including the existing desalination facilities in California, are designed to operate with all available RO trains in operation at all times. During the times of potential outages caused by scheduled or unscheduled maintenance or emergency events, such as an earthquake, these facilities operate at reduced capacity or are down for a certain period of time. The proposed desalination facility would be designed to produce 50 MGD of product water with 13 RO trains, and it would be constructed with an additional 14th RO standby train, which can produce up to 4.2 MGD of water at any time. This additional train would provide increased reliability and redundancy that exceeds current reliability standards and common practices for desalination facility design.

The issues of reliability of the supply and emergency service provisions would be dictated by the terms of the institutional agreements negotiated with the regional water purveyors (including Municipal Water District of Orange County (MWDOC) and MWD) and by the terms of the water supply agreements negotiated with potential customers that would purchase the product water produced at the desalination facility. Thus, impacts would be less than significant.

The project is comprised of a water production and treatment facility and all environmental effects of construction and operation of the facility are fully addressed and analyzed in this SEIR. Additionally, the project would not create additional demand for water supplies, and is proposed as a replacement water supply facility, as more fully discussed in Sections 3 and 6 of this SEIR. Therefore, the project would not result in significant adverse effects on water supply.

ORANGE COUNTY WATER DISTRIBUTION SYSTEM

The introduction of desalinated product water into the existing Orange County distribution system may result in impacts regarding the following:

- Blended water quality
- Blended water corrosivity
- Blended water chlorine residual
- Blended water disinfection byproduct concentration
- Blended water taste and odor
- Hydraulics.

Blended Water Quality

Due to distribution system operations at certain points in the system, desalinated water may blend with other source waters, such as local groundwater or imported water from the MWD. This blending could improve blended water quality, especially if the receiving agencies are predominantly using imported water, which has higher levels of TDS, sulfate, hardness, and disinfection byproducts than desalinated water.

The desalination facility would produce drinking water of very high and consistent quality, which meets or exceeds all applicable regulatory requirements established by the EPA and the CDPH. The desalinated water would be produced applying state-of-the-art seawater RO membranes, which are capable of removing practically all contaminants in the source water, including turbidity, taste, odor, color, bacteria, viruses, salts, proteins, asbestos, organics, etc.

Currently, EPA recognizes RO membrane treatment as a best available technology for water treatment and for meeting future water quality regulations.

The desalinated water would have approximately 100 mg/L lower salinity (i.e., TDS) than the existing drinking water supplies. The lower drinking water salinity would result in better taste and lower overall water distribution system corrosivity. The desalinated seawater would be softer than the existing water sources. Softer water has a number of benefits, such as better taste, formation of less calcium deposits on household appliances and cutlery, and lower detergent use. Commercial and industrial establishments that currently use softening devices to treat the potable water would also benefit from introduction of the softer desalinated water in the distribution system, as their softening costs may be reduced and some of these users may not need to soften their water anymore (most industrial users typically require water with a hardness below 80 mg/L—as desalinated water would reduce hardness by at least 50%, softening costs would also be reduced commensurately). Similar to TDS, drinking water of lower sulfate consternation would have a better taste. The desalinated water would have order-of-magnitude lower disinfection byproducts, such as total trihalomethanes and halocetic acids (or TTHMs and HAAs, respectively) concentrations than the existing drinking water (refer to Appendix S, Disinfection Byproduct Formation Study). Disinfection byproducts are well known carcinogens and their reduction in the drinking water as a result of the blending of the desalinated water with other water sources would be an added benefit. As such, the blending of desalinated product water with existing imported MWD water is not anticipated to result in significant impacts.

Blended Water Corrosivity

Blending the desalinated product water with existing water from other sources may change the water quality of the blend in terms of its corrosive effect on the existing water distribution system. When evaluating potential short-term and long-term impacts of blending treated waters from different sources, one of the most important considerations is the potential for corrosion of pipes and residential fixtures. Excessive corrosion over time might lead to colored water in homes, stained fixtures, pipe failures, and non-compliance with the Lead and Copper Rule. In 1992, the EPA promulgated the Lead and Copper Rule to protect drinking water consumers from excessively high concentrations of lead and copper in the drinking water caused by corrosion of household and public building plumbing systems. The rule sets limits for lead and copper in samples collected from faucets with risk for elevated lead and copper concentrations. The limits for lead and copper are 15 μg/L (micrograms per liter) and 1.3 mg/L, respectively.

Similar to all other potable water sources in the distribution system, product water from the Seawater Desalination Project at Huntington Beach would be chemically conditioned at the treatment facility prior to delivery to the distribution system to mitigate its corrosivity. Lime, in combination with carbon dioxide, would be added for post-treatment stabilization of the RO water as a source for pH and alkalinity adjustment and hardness addition. A corrosion control study describing in detail the type and amount of corrosion control chemicals planned to be used for this project are presented in Appendix T, Distribution System Corrosion Control Study.

The product water from the seawater desalination facility would be suitable for delivery through the existing water distribution system and would be comparable and compatible to the other water sources currently delivering water to the same system. Prior to delivery to the water distribution system, the desalinated water would be conditioned using lime and carbon dioxide to achieve the following corrosion control driven water quality parameters, which are known to be consistent with water currently distributed throughout Orange County:

- pH of 8 to 8.5
- Langelier Saturation Index (LSI) of 0.0 to 0.5
- Alkalinity of 40 mg/L or higher.

These water goals are established based on current practices of the MWD, MWDOC, and most water agencies and municipalities in Orange County. The water goals are rooted in the Safe Drinking Water Act's water quality standards.

These water quality goals would be achieved by the addition of the following chemicals:

- Calcite dissolution to achieve alkalinity and calcium concentrations of 60 to 80 mg/L as $CaCO_3$
- Carbon dioxide at dosage of 0 to 30 mg/L (average of 6 mg/L).

Adopting this proven corrosion control strategy would result in a non-corrosive product that can be seamlessly integrated into the system.

A corrosion pilot study was conducted and published in conjunction with the development of the Carlsbad Seawater Desalination Facility. This study evaluated the corrosion behavior of fully conditioned and disinfected desalinated seawater and blends of desalinated seawater and treated imported surface water from MWD. The pilot tested several types of plumbing materials, including common distribution system piping and appurtances and household plumbing materials (lined steel, copper, lead, etc.). The pilot distribution systems were operated to simulate the flow patterns that might be experience in a typical household. No significant regulatory or aesthetic water quality impacts were observed during the extended pilot testing. In fact, observed metal concentrations in the pilot distribution system were found to be lower when using desalinated seawater than compared to treated surface water.

A similar distribution system corrosion pilot study was conducted by the Water Research Foundation and West Basin Municipal Water District at a seawater desalination pilot facility located in El Segundo, CA. Similar and comparable results were observed, thus confirming the results of the corrosion testing (Appendix T). Lower concentrations of regulated metals and other metals associated with household plumbing were observed in pipe sections that received desalinated seawater in comparison to those that received treated imported water. Most oxic groundwater, excepting groundwater sources that are impacted by reducing conditions (for instance those that have iron and manganese or sulfides), is naturally non-corrosive because it is in equilibrium with aquifer materials and has relatively high natural alkalinity. Properly operated typical groundwater wells and properly operated and treated groundwater wells which require treatment do not result in corrosive potable water for distribution. Therefore groundwater and blends of groundwater with treated surface water and treated desalinated seawater are also not expected to be corrosive and not result in corrosion-related water quality compliance issues in the distribution system. In addition, a corrosion monitoring system would be installed in the proposed transmission pipeline at points of interconnection with the existing water distribution system to ensure that the proposed corrosion control measures are effective and adequate. As such, impacts in regards to corrosion are not anticipated to be significant upon implementation of the design features described above.

Chlorine Residual

The disinfected desalinated water may impact the disinfection of the existing water sources. The potential impacts include a change in the concentration of disinfection byproducts and a reduction of chloramine residual in the other water sources with which desalinated water is blended. The potential impacts and their assessment are described in detail in a separate study provided in Appendix S, Disinfection Byproduct Formation Study.

The desalinated product water would be disinfected prior to delivery to the distribution system. Chlorine, in the form of sodium hypochlorite, would be added as a disinfectant to meet CDPH water quality standards for potable water disinfection. The desalted water would meet current imported water disinfection methods so as to not change any disinfection protocol currently being used by water agencies. Controlling biological growth in the transmission pipelines and in the receiving reservoirs in the distribution system would be accomplished by adding ammonia to the chlorinated water to form chloramines. Potable water from MWD, as well as that from some local groundwater sources, also contains chloramines as the final residual disinfectant. All of these treated water sources would have compatible chlorine residuals.

The desalinated water would be chloraminated by sequential application of sodium hypochlorite and ammonia to achieve a chloramine residual concentration at the point of delivery to the distribution system in a range of 2 to 2.5 mg/L. A detailed description of the proposed chloramination process is provided in Appendix S, Disinfection Byproduct Formation Study. This study confirms that after blending of the chloraminated product water from the desalination facility with disinfected product water from other sources, the chloramine residual of the blend meets the target level in the distribution system of 2 to 2.5 mg/L. The pilot distribution system pilot tests demonstrated that chlorine residuals in desalinated seawater persisted as long as chlorine residuals in treated imported water. As such, impacts in this regard are not anticipated to be significant.

Disinfection Byproduct Concentration

The desalinated product water may impact the content of disinfection byproducts (known to be carcinogenic) of existing water sources within the distribution system. The two key groups of regulated disinfection byproducts that can be impacted are TTHMs and HHAs. The desalinated water typically has higher concentration of bromides than the other water sources. Bromides may create additional disinfection byproducts. Therefore, when blended with other source waters, the desalinated water may increase the concentration of disinfection byproducts in the other sources. On the other hand, the existing water sources in Orange County typically contain much higher level of organics than the desalinated water, which is practically void of organics. Organics are also a potential source of disinfection byproducts. Therefore, blending of desalinated water with other water sources may have a positive impact on water sources with high organic concentrations.

Blending desalinated water with existing sources of supply would result in a product that is comparable to existing supplies and meets all disinfection byproduct limits. Desalinated seawater contains lower levels of organics than existing Orange County sources, such as the MWD's Diemer filtration facility and all other local groundwater water sources. Therefore, blending of desalinated water with other source waters in the distribution system would have a beneficial effect, and it would lower the overall disinfection byproduct concentration of the blend. The results of Appendix S, Disinfection Byproduct Formation Study, confirm the beneficial effect of the desalinated water on the blended water quality in terms of disinfection byproducts. As such, impacts in this regard are not anticipated to be significant.

Blended Water Taste and Odor

No measurable impact on odor is expected as a result of the integration of the desalinated water with water from other sources in the distribution system. The desalinated water would be softer and would have lower salinity than the other water sources. Therefore, blending of these sources would result in an overall reduction of the salinity and hardness of the water delivered to the customers. Lower salinity and hardness of the blended product water would be beneficial and would have a positive effect on the taste of the water delivered to the customers.

As shown in Table 4.11-3, the projected quality of the project water after RO treatment is closely comparable with the finished water it would blend with in the distribution system. In terms of odor, the desalination facility product water would meet the CDPH MCL. In terms of regulated volatile organics, and other compounds that may impact product water taste and odor, product water from the Seawater Desalination Project at Huntington Beach would comply with all drinking water standards and does not differ substantially from the water quality of the other sources of product water in the distribution system. Therefore, the desalinated water would be better than or equal to existing water sources in the distribution system in terms of taste and odor. With pores ranging from 0.00005 to 0.0000002 microns (for comparison, a human hair is 200 microns in diameter) the RO membranes would retain and remove over 99.5% of the seawater salinity and over 99% of the metals and organics, which may cause undesirable taste and odor of the product water.

As indicated in Appendix U, Desalination Facilities Located Throughout the World, desalinated seawater has been used for over 20 years worldwide without any problems encountered in terms of taste or odor quality. In 1999, Marin County completed a taste and odor survey of desalinated seawater and over 99% of the participants in the test indicated that desalinated seawater tasted better than alternative water sources.

A taste test conducted by the San Diego County Water Authority evaluated the ability of consumers to detect changes in the taste of blends of desalinated seawater and treated imported water. The taste test challenged representative consumers selected by a food testing laboratory to differentiate between 100% treated and stabilized desalinated seawater, 100% treated imported water, and several blends of the two water supplies. The taste tests also included ranges of the chemicals used to condition and stabilize desalinated seawater, namely calcium alkalinity and chlorine. Results of the taste test showed that consumers could not distinguish between a range of calcium alkalinity addition, and could not detect the differences between any of the blends of supplies.

To protect against potential taste and odor problems associated with the startup of facility operations, just prior to startup, a sequential flushing program would be coordinated with the involved water agencies to minimize any sediment disturbance that might occur due to flow reversal in a portion of the existing distribution system. A flushing program would minimize any aesthetic issues that might be created through flow reversal.

In addition, a sampling location would be established near the physical connection of the transmission pipeline to the OC-44 feeder. A monitoring program would be implemented for this location incorporating the following parameters: coliform bacteria, heterotrophic bacteria, chlorine residual, disinfection byproducts, and aesthetic parameters such as turbidity, odor, and color, as well as corrosion indices. The purpose of this sampling point is to verify on a regular basis that no degradation of water quality has occurred during any period of storage at the facility site or in the transmission pipeline and that mixing of desalinated water with water from other sources continues to be compatible.

In summary, because of the close chemical compatibility between the desalinated water produced at the Seawater Desalination Project at Huntington Beach and that of existing water sources in Orange County, no impacts in regards to taste and odor are expected. If such problems occur, the desalination facility water quality can be adjusted by controlling the RO membrane system removal efficiency in terms of particular compounds that may cause taste and/or odor issues, or the product water conditioning chemicals can be changed.[1]

[1] The RO membrane system efficiency, in terms of particular compounds, would be controlled by measuring the turbidity of the desalinated water produced by the membrane system. Turbidity monitoring is achieved by installation of turbidimeters on the individual RO membrane trains and a turbidimeter that measures the turbidity of the desalinated water at the point of which the water leaves the facility site. If the turbidity is above a preset level determined by the CDPH regulatory requirements, the individual RO membrane trains would be checked for leaks and the defective or failed membrane elements would be replaced.

Recycled Water Impacts

Desalinated seawater has unique water quality and can cause several changes in the water quality of treated wastewater used for recycled water irrigation. Because desalinated seawater has lower concentrations of total dissolved solids and hardness, which will reduce the use of water softeners, recycled water will have lower concentrations of these constituents compared to recycled water derived from groundwater and surface water. However, desalinated seawater has slightly higher concentrations of sodium, chloride, and boron, and these constituents have the potential to exhibit higher concentrations in recycled water than would otherwise be observed using other sources of supply. Irrigation practices in Orange County, particularly the ability to irrigate turf grass and the ability to grow strawberries and avocados, are sensitive to recycled water quality. If the water quality balance between sodium and calcium exceeds well-known thresholds (as reflected by the SAR or sodium adsorption ratio), then it becomes difficult to infiltrate soil with irrigation water. For crops, exceeding water quality thresholds can cause reductions in yield and has aesthetic impacts (leaf burn).

A mass-balance model was developed to determine the water quality of those supplies, the fraction of water softener use, and the relative sources of supply that influence or are tributary to a wastewater/recycling facility. Recycled water quality was determined to be the source of supply distribution changes, as a function of seasonal variations in water supply (based on historical and predicted flows). Changes in water quality were shown to be minimal during the summer as flows and demands from sources other than the seawater desalination facility increased. Winter water quality demonstrated increases in sodium, chloride, and boron concentrations, but these increases remained within the same range of impact in agricultural criteria (such as SAR and threshold chloride concentrations) as before the introduction of desalinated seawater. Irrigators and farmers manage the current impacts of recycled water on turf grass and crops through the use of irrigation flow pattern and management techniques, and through the use of soil amendments to maintain productivity and permeability. The use of desalinated seawater will not significantly change the impacts to recycled water irrigation that are currently experienced without using desalinated supplies. It is expected that the current use of softener will decrease with the introduction of desalinated water and that resulting water quality and economic benefits of softer water will accrue to the region.

Hydraulics

Implementation of the proposed project may have hydraulic impacts on the regional water distribution system. A total of three new pump stations and modification to an additional existing pump station would be necessary for operation of the project: 1) a product water pump station at the desalination facility site, 2) the OC-44 underground booster pump station in Newport Beach, and 3) the Coastal Junction underground booster pump station in Irvine; and 4) modifications to the existing OC-35 pump station would also be required. The product water delivery system includes several existing transmission mains:

- OC-44 Transmission Line
- East Orange County Feeder #2 (EOCF #2)
- Irvine Cross Feeder

- Orange County Feeder Extension
- Coastal Supply Line
- Aufdenkamp Transmission Main
- Joint (formerly Tri-Cities) Transmission Main
- West Orange County Water Board Feeder 1
- West Orange County Water Board Feeder 2

Appendix V, Pressure Surge Analysis, provides a discussion of potential impacts of the four pump stations associated with the project, and evaluates potential effects of potential pressure changes associated with the proposed pump stations on the existing water delivery system. The results of the pressure surge analysis of the product water delivery system show that the most significant hydraulic transient events will result from a loss of power to the booster pump stations. Power failures are typically unpredictable and will therefore occur at the booster pump stations at irregular intervals. Following a loss of power to the pumps, there will be a rapid drop in both the flow rate and discharge pressure combined with a rapid increase in the suction pressure at the booster pump stations. The results of the power failure simulations for the system show that traveling low-pressure (i.e., pressure drop) waves will be created on the discharge side of each of the booster pump stations by the drop in pressure. Simultaneously, a pressure upsurge wave is created on the suction side of each booster pump station following pump power failure. These high and low pressure waves will propagate out from the booster pump stations and into the suction and discharge pipelines, respectively, toward the demand locations and other booster pump stations.

The maximum hydraulic grade line (HGL) elevation that results from the upsurge created by a loss of power to the OC-44 booster pump station is predicted to exceed the set point HGL of the pressure relief valve on the OC-44 Transmission Main. The opening of the pressure relief valve creates a pressure drop wave that is predicted to drop the minimum HGL elevation sufficiently to create vapor pressure in both the proposed project water delivery pipelines and OC-44 Transmission Main. Similarly, a pressure upsurge wave created by the Coastal Junction Booster Pump Station will propagate from EOCF#2 into the Irvine Cross Feeder and Orange County Feeder Extension, and is predicted to exceed the maximum allowable HGL in the Irvine Cross Feeder as well as the set point HGL elevation for the pressure relief valve on the Orange County Feeder Extension. The opening of the Orange County Feeder Extension pressure relief valve also generates a significant pressure drop wave that is predicted to create vapor pressure in the pipeline. Vapor pressure conditions are also predicted in the Irvine Cross Feeder and Joint Transmission Mains following loss of power to the booster pump stations.

The duration of the low pressure will be long enough for vapor cavities to form in the pipelines. Upon re-pressurization of the pipelines by water hammer wave reflections, any vapor cavities that form will collapse and in the process produce very large magnitude positive pressures that could damage the pipelines and possibly create premature leaks. When subjected to negative pressures, a leak may become a source of pathogen intrusion. If the pipelines do not have sufficient strength, they may collapse under the large magnitude negative pressures associated with vapor pressure. In addition, the combination air and vacuum relief valves installed on the existing transmission mains are predicted to close suddenly upon re-pressurization of the pipeline, which could damage the floats and create additional adverse pressures in the product water delivery system.

To eliminate large negative pressures and the possibility of vapor cavity formation in the delivery pipeline system above, surge protection measures, including installation of pressurized surge tanks are incorporated into the project design for the product water pump station and the OC-44 booster pump station, as described in Section 3.4.

In addition to the proposed surge tanks, additional hydraulic modifications would be needed for the existing water distribution system have been incorporated into the project in order to avoid potential effects related to pressure surges and to facilitate product water delivery. These modifications are described in Section 3.4, and in detail in Appendix V, and generally include valves, bypass structures, and other minor modifications on the following transmission mains:

- OC-44 Transmission Line
- East Orange County Feeder #2 (EOCF #2)
- Irvine Cross Feeder
- Aufdenkamp Transmission Main
- Joint (formerly Tri-Cities) Transmission Main
- West Orange County Water Board Feeder 2

Additional modeling would be performed during the design phase of the project because the specific design and specifications for the booster pump stations is not fully developed at this time, and the surge analysis modeling is sensitive to the specific design and configuration of pumps and valves. However, it is not anticipated that substantial modifications would be required to achieve the level of protection to existing water transmission facilities that is proposed with the proposed project features. With the proposed project design features as described in Section 3.4 and Appendix V, no significant impacts to existing water facilities would result, and no water quality impacts from potential damage to facilities is anticipated.

SUMMARY OF IMPACTS

Although the project is not expected to result in impacts to product water quality, mitigation measures are presented to document project design features and ensure that these efforts are included as requirements in future project plans.

MITIGATION MEASURES

The project is not expected to result in significant impacts to regional potable water supplies with the project design features incorporated as discussed in this section. The following mitigation measures are presented to document project design features and ensure that these efforts are included as requirements in future project plans.

PRODUCT WATER QUALITY

PW-1 Prior to project operations, the applicant shall obtain all required drinking water permits from the California Department of Health Services. These permits are anticipated to consist of the following:

- A Wholesale Drinking Water Permit (on August 10, 2002, the California Department of Health Services issued a conceptual approval letter for the Seawater Desalination Project at Huntington Beach)

- An Administrative Change to Retail Agencies' Drinking Water Permit (to include desalinated water from the proposed project as an approved source of supply for the California Department of Health Services).

PW-2 During final design of the proposed project, the applicant shall incorporate the following six provisions to protect water quality in the event of "non-routine" operations (defined as operations such as seawater emergency intake pump shutdowns and failures, electricity equipment malfunctions, excessively high temperature of the cooling water, etc.):

- Automatic Control Interlock between HBGS Pumps and Desalination Facility Intake Pumps: The shutdown controls of the desalination facility intake pumps shall be interlocked with the HBGS pumps so that during co-location, when HBGS pump operation is discontinued to prepare for heat treatment, non-routine, or even routine pump shutdown, this would automatically trigger an alarm at the desalination facility along with shutdown of the desalination intake pumps. After this emergency shutdown, the intake pumps shall be started up manually, and the operations staff would be required to check the reason of shutdown with the HBGS staff before restarting the treatment facility intake pumps.

- Continuous Intake Pump Flow Measurement Devices: Seawater intake pumps shall be equipped with flowmeters, which would record the pumped flow continuously. If the intake flow is discontinued for any reason, including non-routine HBGS operations, automatic intake pump shutdown shall occur.

- Continuous Intake Water Temperature Measurement Devices: The desalination facility intake pump station shall be equipped with instrumentation for continuous measurement of the intake temperature. Any fluctuations of the intake temperature outside preset normal limits shall trigger alarm and intake pump shutdown. This monitoring equipment shall provide additional protection against heat treatment or other unusual intake water quality conditions.

- Continuous Intake Water Salinity/Conductivity Measurement Devices: The desalination facility intake pump station shall be equipped with instrumentation for continuous measurement of the intake seawater salinity. Any fluctuations of the intake salinity outside preset normal operational limits shall trigger an alarm and initiate intake pump shutdown. This monitoring equipment shall provide additional protection against discharge of unusual freshwater/surface water streams in the facility outfall.

- Continuous Intake Water Oil Spill/Leak Detection Monitoring Devices: The desalination facility intake pump station shall be equipped with instrumentation for oil spill/leak detection. Detection of oil in the intake water even in concentrations lower than 0.5 mg/L shall automatically trigger an alarm and initiate intake pump shutdown. This monitoring equipment shall provide additional protection against unusual intake water quality conditions.

- Routine Communication with HBGS Staff: While the desalination facility is in operation in conjunction with the HBGS, the desalination facility staff of each shift shall be required to contact HBGS personnel at least once per shift and inquire about unusual planned or unplanned events at the HBGS. If non-routine operations are planned at the HBGS, the desalination facility shall modify desalination facility operations accordingly.

PW-3 During project operations, the RO membrane system shall be continuously monitored for feed seawater and permeate conductivity and the differential pressure through the membranes. If permeate salinity (i.e., total dissolved solids) concentration exceeds the design level, membranes shall be cleaned to recover their original performance capabilities.

PRODUCT WATER RELIABILITY

PW-4 Prior to project operations, the desalination facility operations staff shall develop an earthquake preparedness plan, which shall be reviewed and approved by the City of Huntington Beach. The plan shall be in compliance with all applicable regulations and shall include safety planning documentation providing measures that include but are not limited to coordination procedures with appropriate agencies and facility operations procedures to ensure water delivery under earthquake emergency conditions are maintained.

ORANGE COUNTY WATER DISTRIBUTION SYSTEM

PW-5 Prior to project operations, a corrosion monitoring system shall be installed in the proposed transmission pipeline at points of interconnection with the existing water distribution system to ensure that the proposed corrosion control measures are effective and adequate.

PW-6 To protect against potential taste and odor problems associated with the startup of facility operations, a sequential flushing program shall be initiated just prior to project startup that shall be coordinated with the involved water agencies to minimize sediment disturbance that might occur due to flow reversal in a portion of the existing distribution system.

PW-7 Prior to project operations, a sampling location shall be established near the physical connection of the transmission pipeline to the OC-44 feeder. A monitoring program shall be implemented for this location incorporating the following parameters: coliform bacteria, heterotrophic bacteria, chlorine residual, disinfection byproducts, and aesthetic parameters such as turbidity, odor, and color, as well as corrosion indices.

PW-8 Prior to project operations, the applicant shall coordinate with and obtain approval as required from applicable local water agencies that own and operate the distribution system with which the desalinated water would come in contact. Various operating approvals and corresponding agreements shall be signed before the desalinated water is introduced into the local distribution system.

UNAVOIDABLE SIGNIFICANT IMPACTS

None have been identified.

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