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Technical Memorandum No. 3

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Subject: Conventional Treatment System Objectives and Operations
MMWD Seawater Desalination Pilot Plant Program
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INTRODUCTION

Separate technical memoranda describe the preliminary performance objectives and operations for the different primary components of the MMWD Seawater Desalination Pilot Plant program. The Pilot Plant Program Technical Memoranda (TM) include:

- TM No. 1: Intake and Return Water System Objectives and Operations
- TM No. 2: MF/UF Filtration System Objectives and Operations
- TM No. 3: Conventional Treatment System Objectives and Operations
- TM No. 4: SWRO Objectives and Operations
- TM No. 5: Solids Handling System Objectives and Operations
- TM No. 6: Water Quality Sampling and Analysis Program
- TM No. 7: Post Treatment Systems

This memorandum, TM-3, outlines the preliminary performance objectives and operations plan for the conventional treatment systems for the MMWD Seawater Desalination Pilot Plant Program. Process and Instrumentation Diagram (P&ID) P-4 shows a detailed schematic diagram of the pilot plant Conventional Treatment System as a pre-treatment to the SWRO.

CONVENTIONAL TREATMENT SYSTEM COMPONENTS

The Conventional Treatment System includes:

- Flocculation Tank
- High-Rate Clarifier using Tube Settlers
- Granular Media Filtration (GMF)
- GMF Filtrate Tank
- Chemicals (Coagulant, Flocculant, Filter aid)

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Flocculation Tank

The proposed treatment process for the conventional treatment system portion of the pilot plant will be able to test the following processes:

- Coagulation-flocculation-clarification-filtration, (1)
- Coagulation-flocculation-filtration (~~Direct In-line~~ Filtration) (2)
- Coagulation-filtration (~~In-Line~~ ~~Coagulation/Direct~~ Filtration) (3)

The coagulant will be rapidly mixed into the process water and then provided with approximately 10 minutes of detention time in the Flocculation Tank to create the floc particles. The pilot will be equipped with the provision to inject a polymer coagulant aid to the process water in the flocculation tank. The 10-minute contact time approximates the transit time of the seawater from the Marin Rod and Gun Club Site to the proposed Pelican Way site for the full-scale facility at a 6- to 7-feet per second flow rate. For a full scale facility, it may be possible to use hydraulic flocculation in the intake pipeline to the plant.

The coagulant and polymer feed systems will include a small chemical storage tank and a manually operated chemical dosing pump. The chemical feed pumps will be automatically stopped if the conventional treatment system is automatically stopped.

Clarifier

The flocculated water will flow to the clarifier by gravity to ensure the floc formed in the Flocculation Tank is not broken up prior to clarification. The proposed clarifier process for the conventional filtration portion of the pilot plant will be a circular clarifier with tube settlers. The data from operation of the conventional treatment train with and without clarification will permit us to determine if clarification is required to produce satisfactory RO feedwater for the source water. Design criteria for alternative type clarifiers can be determined from the pilot data.

The typical flow rate to the clarifier is expected to be approx. 40 gpm. However, by shutting down one of the MF/UF trains, the clarifier could be operated up to approx. 80 gpm to test higher treatment rates. The clarifier will be designed with an internal baffle to permit flows at 40 gpm and 80 gpm with the following design criteria:

- Overflow rate: 2 gpm/ft²
- Hydraulic Detention Time: Approx. 32 min

For flows of 40 gpm, only one half of the clarifier will be used. For 80 gpm, both sides can be used. One half of the clarifier can also be used for pretreatment ahead of one of the MF/UF systems if desired.

When testing In-line and Direct Filtration, the clarifier and flocculation tank, respectively, will be bypassed and the conditioned source water sent directly to the filters.

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Granular Media Filters

The granular media filters (GMFs) are 42-inch diameter pressure filters in series to permit simulating a single deep bed filter. Each filter has a surface area of 6.2 ft². The media that will be used in the filters is:

First vessel: Full depth (36") of anthracite with an effective size of 1.0-1.1 mm, a specific gravity of 1.55-1.65 and a uniformity coefficient <1.7.

Second vessel: 2/3 depth (24 inches) of silica sand with an effective size of 0.45-0.65, a specific gravity of 2.6, and a uniformity coefficient of <1.5. The remaining 1/3 depth (12 inches) of garnet having an effective size of 0.18-0.28, a specific gravity of 4.0-4.2, and a uniformity coefficient of <2.2.

The grain surface area of this combination of anthracite/silica sand/garnet sand should be similar, or higher, than the two media, deep bed filter system operated at Point Lisas, Trinidad SWRO Facility. To date, the Point Lisas facility has produced satisfactory RO feed water on a challenging source water.

Based on a minimum flow rate of 35 gpm to the downstream RO units, the minimum flow rate through the GMFs will be approximate 40 gpm. By removing one MF/UF system from service, the flow rate through the GMFs could be increased to 60 gpm. At these two flow rates, the loading rates of the GMFs would be:

4 gpm/ft² @ 40 gpm

6 gpm/ft² @ 60 gpm

The GMF will automatically backwash based on time or on differential pressure. The GMF pilot skid will stop operation and will backwash the first pressure filter vessel. The filter will then startup and perform a filter-to-waste cycle (adjustable based on time). After a period of approximately 60 minutes (required to re-fill the backwash supply tank), the GMF pilot skid will stop operation and will backwash the second pressure filter vessel. The filter will then startup and perform a filter-to-waste cycle (adjustable based on time).

GMF Filtrate Tank

Filtered water from the conventional filters will be captured in the GMF Filtrate Tank to supply the associated seawater reverse osmosis (SWRO) unit. The tank has a hydraulic residence time of approximately 38 minutes and supplies the SWRO unit when the GMF pressure filters are periodically shut down for backwash and filter-to-waste operations. Excess filtered water from the GMF Filtrate Tank will overflow to the Return Water Tank.

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GMF Backwash Supply Tank

Excess MF/UF filtrate or concentrate from the SWRO systems will be captured in a 2,000-gallon tank to serve as a supply for backwashing the GMFs. A float valve will ensure the supply tank is kept full.

CONVENTIONAL TREATMENT SYSTEM OBJECTIVES

The Conventional Treatment System objectives are grouped into water treatment objectives and system performance objectives. The system performance objectives described below are general guidelines for the pilot study and will be reviewed and revised as necessary during the study. These performance objectives will help guide the conduct of the pilot study and set the performance goals for the proposed full-scale system.

Source Water Quality

The source water quality from the North San Francisco Bay will be described in more detail in Technical Memorandum No. 6. The general, expected source water quality is summarized below to assist in developing the preliminary pilot system objectives and operations plans.

Table 1: Expected North San Francisco Bay Source Water Quality

Parameter	Units	Source Water		
		Average	Maximum	Minimum
Turbidity	NTU	12	>100	1
Total Dissolved Solids	mg/L	29,900	32,100	27,000
Temperature	° C	15	20	5
pH	units	8.1	8.0	8.2

Conventional Treatment System Water Treatment Objectives

The water treatment objectives for the Conventional Treatment System include:

- Produce a filtered water turbidity of less than 0.2 NTU over 95 % of the time.
- Produce a filtered water silt density index of less than 4.
- Reduce source water TOC to reduce SWRO membrane fouling.

Conventional Treatment System Performance Objectives

The overall system performance objective for the pilot study is to determine the most economical combination of treatment processes (i.e., flocculation, clarification and granular media filtration) and operating parameters for the Conventional Treatment System that meets the water quality objectives.

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PROPOSED CONVENTIONAL TREATMENT SYSTEM OPERATIONS PLAN

The following Conventional Treatment System operational parameters will be monitored and evaluated during the course of the pilot study:

- Chemical types and doses for clarification and filtration
- Clarification requirements
- GMF filtration (loading) rates
- Backwash frequency and duration and flow rates
- Determine filter operational parameters, filter run volumes, etc.

Water Sampling and Analysis Plan

The water sampling and analysis for the pilot plant program will be described in more detail in Technical Memorandum No. 6. The following water quality parameters will be monitored and analyzed as part of the evaluation of the Conventional Treatment System.

- Feed Water (influent to rapid mix) On-line Instruments - Turbidity, Temperature (both from the MF/UF instruments)
- Feed Water grab samples - TOC, UV-254, EFS, TSS, Turbidity.
- Clarified Water On-line Instruments: Turbidity
- Filtrate On-line Instruments: Turbidity
- Filtrate grab samples: Particle Counts, TOC, UV-254, EFS, SDI
- Spent Washwater: TSS, Turbidity.

Preliminary Operations Plan

The preliminary operations plan for the Conventional Treatment System is shown in Table 2 below. We will perform jar testing to determine the initial coagulant and polymer doses. We propose to initially use ferric chloride as the coagulant for the seawater source.

Table 2: Conventional Treatment System Control Variables

Variable	Variable Type and Range
Chemical dosages	Based on jar testing and source water quality variations
Coagulant type	Ferric Chloride
Coagulant Aid Polymer	Cationic Polymer
Filter Aid Polymer	Non-ionic Polymer
Media loading rate	4 and 6 gpm/ft ²

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Variable	Variable Type and Range
Backwash process water	Filtrate or SWRO concentrate

Table 3: Preliminary Conventional Pre-Treatment Operations Schedule

Approx. Start Date	Approx. Period	Treatment Process	Coagulant	Coagulant Dose	Comments
TBD	2 weeks	Equipment Delivery, Installation, Startup and Training			
	4 weeks	1	Ferric Chloride	Jar Test	Expected Winter Conditions
	3 weeks	2	Ferric Chloride	Jar Test	Expected Winter Conditions
	3 weeks	3	Ferric Chloride	Jar Test	Expected Winter Conditions
	4 weeks	1	Ferric Chloride	Jar Test	Expected /Spring Conditions
	4 weeks	2	Ferric Chloride	Jar Test	Expected Spring Conditions
	4 weeks	1	Ferric Chloride	Jar Test	Expected Summer Conditions
	4 weeks	2	Ferric Chloride	Jar Test	Expected Summer Conditions
	4 weeks	*	Ferric Chloride	Jar Test	*Operations TBD
	12 weeks	*	Ferric Chloride	Jar Test	*Optional Extended Testing
	1 week	Equipment Shutdown and Shipping			

Treatment Process legend:

- Coagulation-flocculation-clarification-filtration, (1)
- Coagulation-flocculation-filtration (In-line Filtration) (2)
- Coagulation-filtration (Direct Filtration) (3)

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Conventional Filter Spent Washwater

The GMFs will backwash approximately once per day depending on the source water quality or differential pressure across the filters. The spent washwater will be captured in the 4,000 gallon Spent Washwater Tank in the Solids Handling System (See TM-5).

Clarifier Sludge

The clarifier sludge will periodically transferred to a sludge sump and pumped to the sanitary sewer as described in TM-5, Solids Handling System.

TM No. 3 Document Review History:

1. Tom Pankratz first Draft review completed 11/4/04.
2. Tom Pankratz and Todd Reynolds reviewed first Draft 11/5/04.
3. Todd Reynolds prepared final Draft (dated 11/9/04).
4. Jim Lozier reviewed final Draft (dated 12/19/04).
5. Todd Reynolds and Val Frenkel incorporated review comments (12/20/04).
6. Jim Lozier reviewed revised Final Draft (12/22/04).

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File

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