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Managing Water in the West

Current Reclamation Research at the AWPF Treatment Wetlands

City of Oxnard Department of Public Works
Applied Wetlands Research Workshop
April, 30th 2013

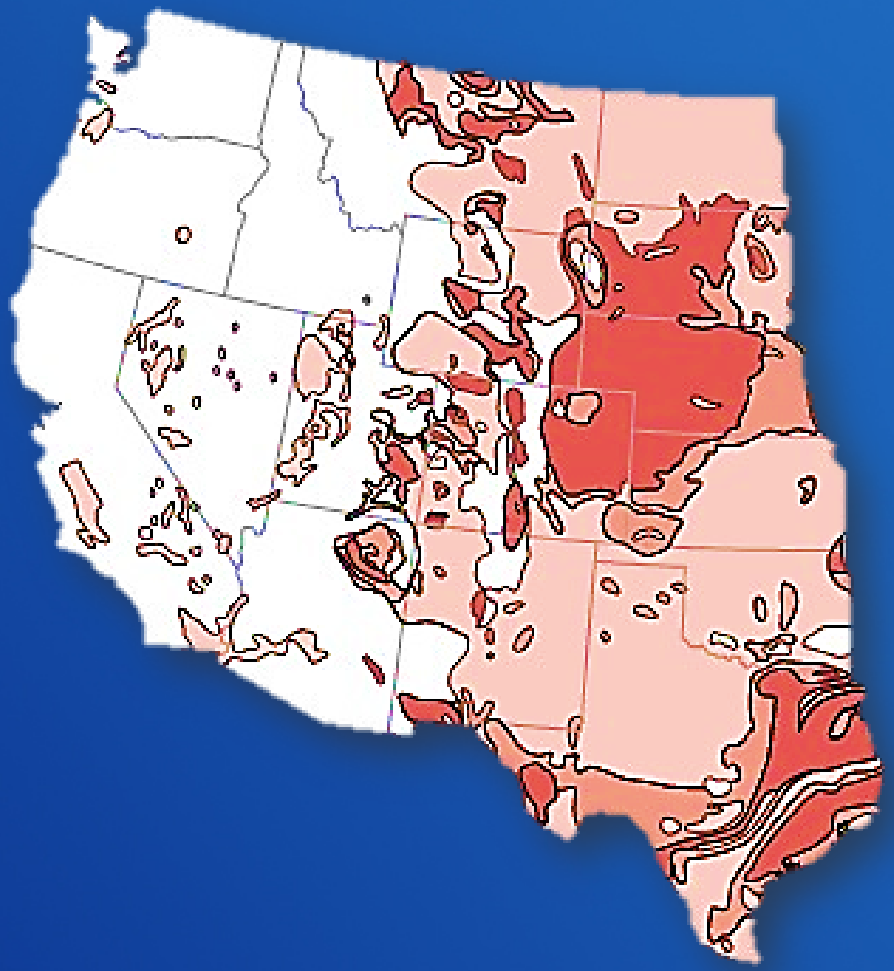
U.S. Department of the Interior
Bureau of Reclamation

Bureau of Reclamation: Advanced Water Treatment

Advanced water treatment to develop “new” water supplies in the Western US

- brackish surface and groundwater
- reclaimed wastewater
- Industrial wastewater
- seawater

Alternative strategies for concentrate management for membrane technologies



Saline Groundwater Resources USGS, W. Alley (2003) from Feth et al. (1965)

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AWPF Wetland Research Objectives

Can coastal saline treatment wetlands be created and/or restored using concentrate?

1. Demonstrate the use of wetlands as a natural treatment technology for RO concentrate
2. Determine optimized performance of the wetland for concentrate treatment and scale-up
3. Establish points of comparison with other engineered wetland treatment systems in the western US
4. Evaluate potential for creating and/or restoring coastal saline wetlands habitat

Reclamation AWPF Wetland Research

Wetland Monitoring Plan

- Vegetation
- Soil and Sediment
- Water quality

Baseline Monitoring

(June, 2012)

- Vegetation morphology
- Vegetation uptake analysis
- Soil and Sediment
- Water Quality

Repeating Annual Monitoring

(June, 2013)

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AWPF Wetland Monitoring Plan

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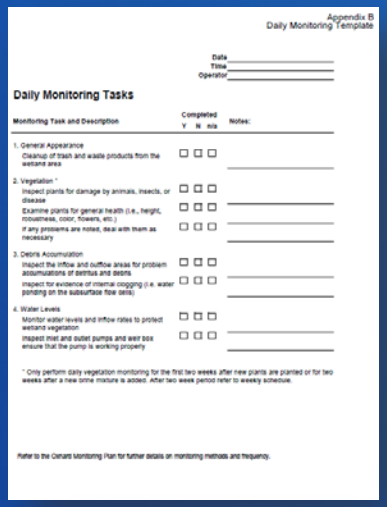
Managing Water in the West

**Oxnard Saline Treatment Wetlands:
Monitoring Plan, Baseline Monitoring Results,
and Supplemental Research Topics**

City of Oxnard, California

U.S. Department of the Interior
Bureau of Reclamation

September 2012



Appendix B
Daily Monitoring Template

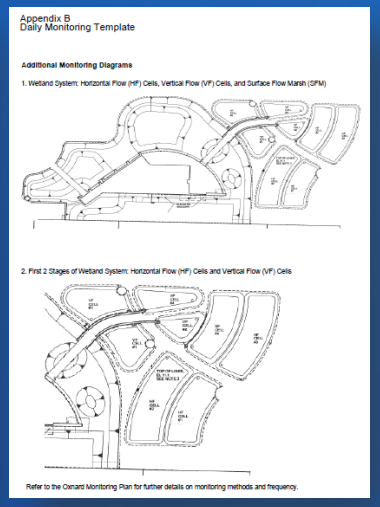
Date
Time
Operator

Daily Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. General Appearance				
Cleanup of trash and waste products from the wetland area	☐	☐	☐	
2. Vegetation *				
Inspect plants for damage by animals, insects, or disease	☐	☐	☐	
Examine plants for general health (i.e., height, robustness, color, flowers, etc.)	☐	☐	☐	
If any problems are noted, deal with them as necessary	☐	☐	☐	
3. Debris Accumulation				
Inspect the inflow and outflow areas for problem accumulations of detritus and debris	☐	☐	☐	
Inspect for evidence of internal clogging (i.e. water ponding on the subsurface flow cells)	☐	☐	☐	
4. Water Levels				
Monitor water levels and inflow rates to protect wetland vegetation	☐	☐	☐	
Inspect inlet and outlet pumps and weir box ensure that the pump is working properly	☐	☐	☐	

* Only perform daily vegetation monitoring for the first two weeks after new plants are planted or for two weeks after a new brine mixture is added. After two week period refer to weekly schedule.

Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.



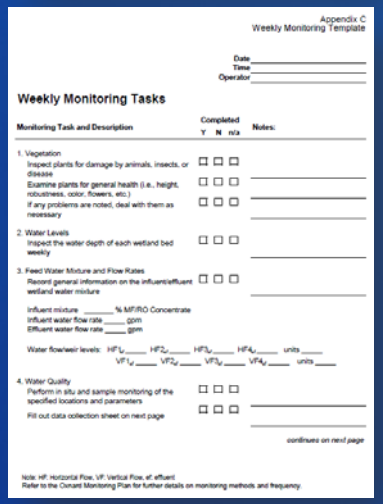
Appendix B
Daily Monitoring Template

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)

2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells

Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.



Appendix C
Weekly Monitoring Template

Date
Time
Operator

Weekly Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Vegetation				
Inspect plants for damage by animals, insects, or disease	☐	☐	☐	
Examine plants for general health (i.e., height, robustness, color, flowers, etc.)	☐	☐	☐	
If any problems are noted, deal with them as necessary	☐	☐	☐	
2. Water Levels				
Inspect the water depth of each wetland bed weekly	☐	☐	☐	
3. Feed Water Mixture and Flow Rates				
Record general information on the influent/effluent wetland water mixture	☐	☐	☐	
Influent mixture _____ % MF/RO Concentrate				
Influent water flow rate _____ gpm				
Effluent water flow rate _____ gpm				
Water flow/weir levels: $HF1_V$ _____ $HF2_V$ _____ $HF3_V$ _____ $HF4_V$ _____ units _____				
$VF1_V$ _____ $VF2_V$ _____ $VF3_V$ _____ $VF4_V$ _____ units _____				
4. Water Quality				
Perform in situ and sample monitoring of the specified locations and parameters	☐	☐	☐	
Fill out data collection sheet on next page	☐	☐	☐	

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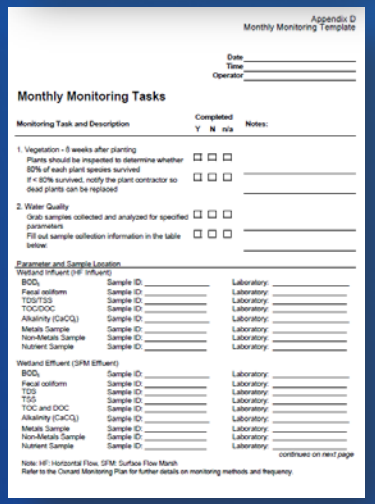
Note: HF: Horizontal Flow, VF: Vertical Flow, ef: effluent
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.



Appendix D
Monthly Monitoring Template

Date
Time
Operator

Monthly Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Vegetation - 8 weeks after planting				
Plants should be inspected to determine whether 80% of each plant species survived	☐	☐	☐	
If < 80% survived, notify the plant contractor so dead plants can be replaced	☐	☐	☐	
2. Water Quality				
Grab samples collected and analyzed for specified parameters	☐	☐	☐	
Fill out sample collection information in the table below:	☐	☐	☐	

Parameter and Sample Location

Wetland Influent (HF Influent)

BOD_5	Sample ID:	Laboratory:
Fecal coliform	Sample ID:	Laboratory:
TDS/TSS	Sample ID:	Laboratory:
TOC/DOC	Sample ID:	Laboratory:
Alkalinity ($CaCO_3$)	Sample ID:	Laboratory:
Metals Sample	Sample ID:	Laboratory:
Non-Metals Sample	Sample ID:	Laboratory:
Nutrient Sample	Sample ID:	Laboratory:

Wetland Effluent (SFM Effluent)

BOD_5	Sample ID:	Laboratory:
Fecal coliform	Sample ID:	Laboratory:
TDS	Sample ID:	Laboratory:
TSS	Sample ID:	Laboratory:
TOC and DOC	Sample ID:	Laboratory:
Alkalinity ($CaCO_3$)	Sample ID:	Laboratory:
Metals Sample	Sample ID:	Laboratory:
Non-Metals Sample	Sample ID:	Laboratory:
Nutrient Sample	Sample ID:	Laboratory:

continues on next page

Note: HF: Horizontal Flow, SFM: Surface Flow Marsh
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

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Baseline Vegetation and Soil Monitoring

Morphology

- yerba mansa, salt grass, softstem bull rush, California bulrush

Plant Density

- Culms/plant
- Culm diameters and lengths
- Dry wt. above & below ground

Vegetation and Soil

- N, P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn, B, NO3-N, Mo, Al, As, Se, Hg

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Baseline Water Quality
Oxnard's Annual Water Report

Table 9. Estimated Influent Water Quality from Oxnard's Annual Water Report[1]

Bulk Monitoring Parameters		Inorganic Chemicals	
Turbidity (monthly) (NTU)	0.03	Aluminum (ppb)	78.5
Total Chlorine Residual (ppm)	1.90	Arsenic (ppb)	2.0
Alkalinity (ppm)	156.3	Barium (ppb)	ND
Hardness (total hardness) (ppm)	389.0	Boron (ppb)	310.3
		Calcium (ppm)	96.4
pH (pH Units)	8.20	Chloride (ppm)	65.0
Specific Conductance (umho/cm)	506.5	Fluoride (ppb)	0.71
		Iron (ppb)	ND
Total Dissolved Solids (ppm)	755.9	Magnesium (ppm)	34.11
Total Organic Carbon (ppm)	1.6	Manganese (ppm)	0.0
Radionuclides		Nitrate (as N) (ppm)	0.4
Gross Alpha Particle Activity (pCi/L)	1.8	Nitrate (as NO_3) (ppm)	20.6
		Potassium (ppm)	3.0
Gross Beta Particle Activity (pCi/L)	ND	Selenium (ppb)	2.4
		Sodium (ppm)	61.5
Radon (pCi/L)	96.2	Sulfate (ppm)	319.1
Uranium (pCi/L)	3.0	Vanadium (ppb)	2.9

[1] ppm = parts per million; ppb = parts per billion; ND = not determined; pCi/L = picocuries per liter.

Table 1. Regional Water Quality Objectives for Inland Surface Waters and Wetlands

Regional Objectives for Inland Surface Waters

Ammonia	One-hour and four-day average concentrations of ammonia (un-ionized) and total ammonia depend on temperature, pH, and water designation (warm/cold).
Bacteria, coliform	In waters designated for non-water contact recreation (REC-2), fecal coliform concentration shall not exceed a log mean of 2,000/100 mL (based on a minimum of not less than four samples on any 30-day period), nor shall more than 10 percent (%) of samples collected during any 30-day period exceed 4,000/100 mL.
Bioaccumulation	Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels that are harmful to aquatic life or human health.
Biological oxygen demand (BOD5)	Waters shall be free of substances that result in increases in the BOD_5, which adversely affect beneficial uses.
Biostimulatory substances	Waters shall not contain biostimulatory substances (nutrients—nitrogen/phosphorus—and other compounds that stimulate aquatic growth) in concentrations that promote aquatic growth to the extent that such growth causes a nuisance or adversely affects beneficial
Chemica	
Chlorine,	
Color	
Exotic ve	
Floating	
Methylen activated (MBAS)	

Regional Objectives for Inland Surface Waters

Mineral quality	Numerical mineral quality objectives are dependent on individual inland surface waters and include TDS, sulfate, chloride, boron, nitrogen, and the sodium adsorption ratio.
Nitrogen (nitrate, nitrite)	Excess nitrogen in surface waters can cause health problems in humans and can lead to excess aquatic growth.
Oil and grease	Water shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause a nuisance, or that otherwise adversely affect beneficial uses.
Oxygen, dissolved (DO)	Dissolved oxygen requirements are dependent on the beneficial uses of the water body. At a minimum, the mean annual dissolved oxygen concentration of all waters shall be greater than 7 mg/L; and no single determination shall be less than 5.0 mg/L, except when natural conditions cause lesser concentrations.
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.
pH	pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge.
Polychlorinated biphenyls (PCBs)	The purposeful discharge of PCBs to waters of the region, or at locations where the waste can subsequently reach waters of the region is prohibited.
Radioactive substances	Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life or that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life.
Solid, suspended, or settleable materials	Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.
Taste and odor	Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses.
Temperature	The natural receiving water temperature of all regional waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life. The use of bioassays (toxicity tests) is widely accepted as a valid approach to evaluating toxicity of waste and receiving waters.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

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Annual Monitoring and Characterization

- Repeating Annual Monitoring (June, 2013)
  - Vegetation morphology
  - Vegetation uptake analysis
  - Soil and Sediment
  - Water Quality
- AWPF wetland water balance
- Contaminant removal model
- Engineered wetland process model for scale-up and cross site comparison

Potential Wetland Research Topics

- Water balance, hydraulic tracer testing
- Contaminant fate and cycling
- Metal speciation and removal (i.e. Se)
- Bioattenuation of emergent contaminants of concern
- Carbon sequestration
- Animal community organization and colonization
- Toxicity testing of brackish organisms
- Wetland comparison to native brackish wetland communities (biologic, wildlife, biotic, etc.)

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Environmental Applications and Research Group
Riparian & Wetland Studies

- *Proper design and operation of constructed wetlands for the improvement of water quality related to non-point pollution and wastewater effluent*

- Cooperative efforts with:
  - USGS, EPA, FWS
  - State fish and game agencies
  - City and local departments
  - Water resource agencies
  - Universities and private contractors

http://www.usbr.gov/pmts/eco_research/eco3.html

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