We are here today to discuss …

- The Santa Clara River Estuary Special Studies
- Provide an update on the Estuary Subwatershed Study
- Facilitate initial discussion of alternatives to be evaluated
- Get input from you, the Stakeholders
Agenda for the day

• Introduction/Background
• Update on the Estuary Subwatershed Study
  – Overview of study intent and approach
  – Focal species and habitat needs
  – Physical/Hydrologic characteristics
  – Water Quality
  – Estuary Function
• Discussion of future discharge alternatives
  – Initial scenario evaluation
  – Climate change effects
• Questions and Next Steps
Introduction
The special studies will answer …

…What is the best use of the treated water resources from the Ventura Water Reclamation Facilities to protect the health of the Santa Clara River Estuary?
# Project Schedule

<table>
<thead>
<tr>
<th>Task Description</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuary Subwatershed Study</td>
<td>MJ</td>
<td>JD</td>
<td>JF</td>
</tr>
<tr>
<td>Recycled Water Study (Phase 1)</td>
<td>JF</td>
<td>MA</td>
<td>MAM</td>
</tr>
<tr>
<td>Treatment Wetlands Feasibility Study</td>
<td>MAM</td>
<td>MJD</td>
<td>JFM</td>
</tr>
<tr>
<td>Stakeholder Workshops</td>
<td>M</td>
<td>M</td>
<td>J</td>
</tr>
</tbody>
</table>
Last meeting, we provided an update on the Year 1 Estuary Monitoring Study and a recap of the Recycled Water Market and Wetlands Feasibility Studies.

- **Estuary Monitoring/Aessment** (due March 2011)
- **Recycled Water Market Study** (submitted March 2010)
- **Wetlands Feasibility Study** (submitted March 2010)

Estuary Alternatives Development
What we want from you today is ...

• Listen to an update on the Estuary Subwatershed Study
  – Is it providing the information you need/hoped for?
  – Do you understand how the data and conceptual models will be used?

• Based on the analysis to date, what are your suggestions for the alternatives evaluation?
Estuary Subwatershed Study
Estuary Subwatershed Study Approach

Data Review and Collection

Estuary Water Balance

Estuary Physical/Biological Condition

Estuary Ecosystem Function

Climate Change

Develop/Optimize Discharge Scenarios
Overview

1. **Ecosystem Overview**
   - Overall conceptual model
   - Focal species habitat needs

2. **Water Balance**
   - Preliminary assessment (2009-2010)

3. **Water Quality**
   - Assessment (2000-2010)
   - Water quality (nutrient) balance

4. **Ecosystem Functioning**
   - Current functioning
   - Stage-Habitat Relationships (2009-2010)

5. **Discharge Scenarios**
Focal Species: Tidewater Goby

Tidewater Goby

- *Eucyclogobius newberryi*

Listing Status

- Federally endangered

General Characteristics

- Prefers a stable lagoon water levels
- Requires shallow areas with coarse sand for construction of nesting burrows
- Egg incubation and rearing from April to October with year-round residency of adults

Habitat Needs:

- Temp: 8 - 25° C (44 - 79° F)
- Salinity: 0 - 41 ppt
- Depth: 1.0 - 4.9 ft
Focal Species: Steelhead

Steelhead Trout
- *Oncorhynchus mykiss*
  Southern Steelhead ESU

Listing Status
- Federally endangered

General Characteristics
- Larger smolts prefer deeper water with cover (i.e., large woody debris, overhanging vegetation, man-made structures, etc.)
- Rearing steelhead may be found year-round, although upmigrant adults typically arrive during open mouth conditions in winter/spring

Habitat Needs:
- Temp: 15 - 24° C (59 - 79° F)
- Dissolved Oxygen
  - Survival: >1.5-2.0 mg/L
  - Growth: >7.0 mg/L
- Depth
  - Open water: >3.0 ft
  - Inundated veg: >0.5 ft
  - Edge: 0.5 - 3.0 ft
Focal Species: Least Tern

California Least Tern
- *Sternula antillarum browni*

Listing Status
- Federally and state endangered

General Characteristics
- Nests in spring and summer on barren to sparsely-vegetated beaches above high tide
- Nesting April-September
- Absent October-March
- Forages on small fish by hovering and plunging into shallow estuaries, lagoons, coastal ponds, or nearshore waters

Habitat Needs:
- Foraging areas
  - >0.5 ft water depth

Photo: USFWS
Focal Species: Snowy Plover

Western Snowy Plover
• *Charadrius alexandrinus nivosus*

Listing Status
• Federally endangered

General Characteristics
• Nests in spring and summer on barren to sparsely-vegetated beaches above high tide
• Year-round residency, with larger over-wintering population (September-February)
• Forages by gleaning for small invertebrates on sand, surf-cast seaweed, or low-growing plants

Habitat Needs:
• Foraging areas
  • Open beach and foredune habitats (e.g., *Abronia* spp. - *Ambrosia chamissonis* plant alliance)

Photo: Callie Bowdish
Overview

1. Ecosystem Overview
   - Overall conceptual model
   - Focal species habitat needs

2. Water Balance
   - Preliminary assessment (2009-2010)

3. Water Quality
   - Assessment (2000-2010)
   - Water quality (nutrient) balance

4. Ecosystem Functioning
   - Current functioning
   - Stage-Habitat Relationships (2009-2010)

5. Discharge Scenarios
Simplified SCRE Water Balance

\[ V_{SCRE} = \text{River} + \text{VWRF} + \text{Runoff} + \text{Rain} + \text{GW(in)} + \text{Ocean(in)} - \text{GW(out)} - \text{Ocean(out)} - \text{Evaporation} \]
Stage and GW Elev. Monitoring Locations

- GW-1
- GW-2
- GW-3
- SR-1
- SR-2
- North Sonde
- South Sonde
Compiled SCRE Stage (May 2009 to July 2010)

- SR-1 stage (measured)
- SR-1 stage (from correl w/ South Sonde stage)
- SR-1 stage (inferred)
- Tide (Santa Barbara, CA)

Water surface elevation (ft NAVD88)
SCRE Stage: Time Exceeded
(May 2009 to July 2010)
2005 Bathymetry from 2005 LiDAR
2009 Bathymetry from 2005 LiDAR

Bed Elevation (ft NAVD88)

- <4 ft
- 4-5 ft
- 5-8 ft
- 6-7 ft
- 7-8 ft
- 8-9 ft
- 9-10 ft
- 10-11 ft
- 11-12 ft
- 12-13 ft
- 13-14 ft
Current ‘Full’ Area (below ~10 ft NAVD88)
SCRE Inundated Volume (May 2009 to July 2010)
South Bank Groundwater Flow
(October 2009 to May 2010)

Date

-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Avg GW flow over 30-min time step (cfs)

SR-1 (Estuary stage)

GW discharge across south bank

SCRE stage (ft NAVD88)
SCRE Inundated Volume (May 2009 to July 2010)

Water Balance Period

Date

SCRE volume (acre-ft)
**SCRE Component Flow Volume**

(10/25/09 – 5/3/10)

---

**Flow volume (acre-ft)**

- **Evaporation (-)**
- **Precipitation (+)**
- **GW Q across south bank (-)**
- **GW Q across mouth berm (-)**
- **GW Q across south bank (+)**
- **GW Q across mouth berm (+)**
- **WRF effluent Q (+)**
- **SCR Q @ Victoria Ave bridge (+)**
- **Surface Q out mouth (-)**
- **Surface Q in mouth (+)**
- **Runoff Q below Victoria Ave bridge (+)**
- **Surface Q in mouth (+)**
- **Unmeasured flows (+)**

---

**Flow volume (acre-ft)**
SCRE Inundated Volume (May 2009 to July 2010)

3 Filling Periods
SCRE Component Flow Volume
(3 filling periods)

Flow volume (acre-ft)

-1.0E+03
-5.0E+02
0.0E+00
5.0E+02
1.0E+03
1.5E+03
2.0E+03
2.5E+03

Evaporation (-)
Precipitation (+)
GW Q across south bank (-)
GW Q across south bank (+)
GW Q across mouth berm (-)
GW Q across mouth berm (+)
VWRF effluent Q (+)
SCR Q @ Victoria Ave bridge (+)
Runoff Q below Victoria Ave bridge (+)
Surface Q out mouth (-)
Surface Q in mouth (+)
Unmeasured flows (+)

SCRE inflows
SCRE outflows
Water balance summary

- SCRE reaches quasi-equilibrium stage and volume when mouth closed (i.e., 'full' condition)
- Takes 2-4 weeks to reach ‘full’ condition
- On average, dominant inflow = river discharge, dominant outflow = surface flow out mouth
- During filling periods, VWRF discharge accounts for a large portion of inflow, especially during low-flow conditions
- Water Balance will be used as predictive tool in assessing VWRF discharge alternatives
Overview

1. Ecosystem Overview
   - Overall conceptual model
   - Focal species habitat needs

2. Water Balance
   - Preliminary assessment (2009-2010)

3. Water Quality
   - Assessment (2000-2010)
   - Water quality (nutrient) balance

4. Ecosystem Functioning
   - Current functioning
   - Stage-Habitat Relationships (2009-2010)

5. Discharge Scenarios
Existing Water Quality Conditions

- Historical (2000-2010) samples periodically exceed Basin Plan water quality objectives for
  - Ammonia
  - Biostimulatory substances (303(d) list)
  - DO
  - pH
  - Pesticides (303(d) list)
  - Toxicity (303(d) list)

- Generally within suitable ranges for focal fish species
  - Avg. DO: 7.6-18.0 mg/L (Open); <7-18.3 mg/L (Closed)
  - Temp: 55-73°F (Open); 55-77°F (Closed)
WQ Sampling Locations

GW-1
GW-2
GW-3
North Sonde
South Sonde
E-U1
E-U2
E-U3
E-M1
E-M2
E-L1
E-L2
R-1
E-U2
E-U1
E-U3
E-M1
E-M2
E-L1
E-L2
GW-1
GW-2
GW-3
North Sonde
South Sonde

© 2010 Google
Image U.S. Geological Survey
Image © 2010 DigitalGlobe
DO Percent Exceedance – North Sonde

Fraction of DO observations

- >7 mg/L
- 2-7 mg/L unknown
- <2 mg/L

Month:
- Feb-09
- Apr-09
- Jun-09
- Aug-09
- Oct-09
- Dec-09
- Feb-10
- Apr-10
- Jun-10
DO Percent Exceedance – South Sonde

Fraction of DO observations

- >7 mg/L
- 2-7 mg/L
- <2 mg/L

Feb-09, Apr-09, Jun-09, Aug-09, Oct-09, Dec-09, Feb-10, Apr-10, Jun-10
Avg. SCRE Nutrients (2000-2010)

Winter Open Mouth

Nitrogen (mg-N/L)

- TKN
- NH4
- NO3
Avg. SCRE Nutrients (2000-2010)

Spring Closed Mouth

Nitrogen (mg-N/L)

Riverine | Upper Estuary | Middle Estuary | Outfall | Lower Estuary | Near Mouth

TKN | NH4 | NO3
Avg. SCRE Chlorophyll-a (2000-2010)

Spring

Chlorophyll-a (ug/L)

- Riverine
- Upper Estuary
- Middle Estuary
- Outfall
- Lower Estuary
- Near Mouth

Closed
Open
## Metals are meeting permit limits at VWRF

<table>
<thead>
<tr>
<th>Metal (ug/L)</th>
<th>Permit Average Monthly</th>
<th>Monthly Average at ETS (2008-2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>6.7</td>
<td>3.1*</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.051</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>Silver</td>
<td>0.71</td>
<td>&lt;0.2</td>
</tr>
<tr>
<td>Zinc</td>
<td>45</td>
<td>24.9</td>
</tr>
</tbody>
</table>

*More than 50% of samples were below detection limit (<2 ug/l)*
Water quality mixing conditions

Wind
VRWF Inflow
River Flow
Tidal and Berm Flow
Wind Mixing

Typical:

Wind	Salinity	DO
Nutrient balance using mixing model approach

Storage = Inputs - Outputs

Concentration = \[
\frac{(\text{River} + \text{VWRF} + \text{Runoff} + \text{Rain} + \text{GW(in)} - \text{GW(out)} - \text{Ocean})}{\text{Volume}}
\]
Predictive Tools: Water Quality (Nitrogen) Balance (2009-10)

Observed and Predicted Total Nitrogen (mg/L)

<table>
<thead>
<tr>
<th></th>
<th>Lower Estuary</th>
<th>Mouth</th>
<th>Estuary Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept/09</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Nov/09</td>
<td>11.9</td>
<td>11.8</td>
<td>17.7</td>
</tr>
<tr>
<td>Jan/10</td>
<td>4.1</td>
<td>4.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Mar/10</td>
<td>10.8</td>
<td>11.6</td>
<td>11.9</td>
</tr>
<tr>
<td>May/10</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>July/10</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>
### Predictive Tools: Water Quality (Phosphorus) Balance (2009-10)

<table>
<thead>
<tr>
<th></th>
<th>Sept/09</th>
<th>Nov/09</th>
<th>Jan/10</th>
<th>Mar/10</th>
<th>May/10</th>
<th>July/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth</td>
<td>NA</td>
<td>1.3</td>
<td>0.5</td>
<td>0.9</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Lower Estuary</td>
<td>NA</td>
<td>1.3</td>
<td>0.5</td>
<td>0.9</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Estuary</td>
<td>NA</td>
<td>2.0</td>
<td>0.4</td>
<td>1.3</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Predicted</td>
<td>NA</td>
<td>2.0</td>
<td>0.4</td>
<td>1.3</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Observed and Predicted Total Phosphorus (mg/L)
Water quality summary

- Historical (2000-2010) samples periodically exceed Basin Plan Water Quality Objectives for several parameters
- SCRE has high algal levels under both open and closed mouth conditions, affecting DO and pH
- VWRF has met RWQCB discharge effluent limitations, but is associated with elevated nutrient levels.
- Mixing Model approach will be used to model reductions in nutrient loads and to assess changes in algal levels
Overview

1. Ecosystem Overview
   - Overall conceptual model
   - Focal species habitat needs

2. Water Balance
   - Preliminary assessment (2009-2010)

3. Water Quality
   - Assessment (2000-2010)
   - Water quality (nutrient) balance

4. Ecosystem Functioning
   - Current functioning
   - Stage-Habitat Relationships (2009-2010)

5. Discharge Scenarios
Current Ecosystem Functioning

- Primary SCRE functions supporting existing Basin Plan beneficial uses
  - Flow regulation
  - Sediment storage and beach building
  - Water quality regulation
  - Aquatic habitat maintenance
  - Wildlife habitat maintenance
  - Recreational opportunities
Current Ecosystem Functioning: VWRF Effects on Primary Functions

- Primary SCRE functions supporting existing beneficial uses
  - Flow regulation
  - Sediment storage and beach building
  - Water quality regulation
  - Aquatic habitat maintenance
  - Wildlife habitat maintenance
  - Recreational opportunities
Current Ecosystem Functioning: VWRF Effects on Primary Functions

- Primary SCRE functions supporting existing beneficial uses
  - Flow regulation
  - Sediment storage and beach building
  - Water quality regulation
  - Aquatic habitat maintenance
  - Wildlife habitat maintenance
  - Recreational opportunities
Water quality regulation

- Lagoonal System with Wind mixing
- Large Fluctuations in DO under Closed Mouth Conditions due to Algae
- Although VWRF appears as largest nutrient source, excess Nutrients (N, P) arriving from multiple sources
Current Ecosystem Functioning: VWRF Effects on Primary Functions

- Primary SCRE functions supporting existing beneficial uses
  - Flow regulation
  - Sediment storage and beach building
  - Water quality regulation
  - Aquatic habitat maintenance
  - Wildlife habitat maintenance
  - Recreational opportunities
Aquatic and wildlife habitat maintenance

• Aquatic Habitat (Southern steelhead and Tidewater goby)
  – Existing DO conditions may not support steelhead rearing at all times
  – Stage-Habitat analysis centers upon maintenance of suitable depth and cover

• Wildlife Habitat (CA Least Tern and Snowy Plover)
  – Birds use beach and foredune habitats for nesting
  – Analysis centers upon maintenance of open water (CA Least Tern) and SCRE margin (Snowy Plover) foraging areas
Stage-habitat relationships

• Developed general ‘rules’ for determining suitable habitat as a function of stage
  – Range of suitable depths, substrate, and cover (or vegetation) associations

• Fish
  – Water depth
  – Distance from cover

• Birds
  – Minimum water depth
  – Vegetation density
  – Vegetation type
Tidewater Goby Stage-Habitat Relationship

Depth Criteria: 1.0 – 4.9 ft
Tidewater Goby Stage-Habitat Relationship

Stage = 8 ft NAVD88
Tidewater Goby Stage-Habitat Relationship

Stage = 12 ft NAVD88

Tidewater goby habitat area (acres)

SCRE stage (ft NAVD88)
Tidewater Goby Habitat Availability
(available >50% of the time)

Spring (Breeding and Rearing):
May-Jun 2009
Tidewater Goby Habitat Availability
(available >50% of the time)

Summer (Breeding and rearing):
July-Sept 2009
Tidewater Goby Habitat Availability
(available >50% of the time)

Fall (Adult Residency):
Oct-Dec 2009
Tidewater Goby Habitat Availability
(available >50% of the time)

Winter (Adult Residency):
Jan-March 2010
Steelhead Stage-Habitat Relationship

Depth Criteria:
- 0.5-3 ft (Edge)
- >0.5 ft (Inundated veg)
- >3 ft (Open water)

Steelhead rearing habitat (acres)

SCRE stage (ft NAVD88)

Edge habitat
Inundated veg habitat
Open water habitat
TOTAL habitat
Steelhead Stage-Habitat Relationship

Stage = 9 ft NAVD88
Steelhead Stage-Habitat Relationship

Stage = 12 ft NAVD88
Steelhead Habitat Availability
>50% of the time

Spring (Juvenile rearing)
May-Jun 2009
Steelhead Habitat Availability
>50% of the time

Spring (Juvenile rearing)
Jul-Sep 2009

Steelhead total rearing habitat (acres)
SCR stage (ft NAVD88)

(available)
Steelhead Habitat Availability
>50% of the time

Fall (Rearing and up-migration)
Oct-Dec 2009
Steelhead Habitat Availability

>50% of the time

Winter (Rearing and up-migration)
Jan-March 2010
Least tern Stage-Habitat Availability
(Depth criteria >0.5 ft)
Least tern Stage-Habitat Relationship

Stage = 6 ft NAVD88
Least tern Stage-Habitat Relationship

Stage = 8 ft NAVD88
Least tern Habitat Availability
>50% of the time

Spring (Nesting and rearing)
May-Jun 2009
Least tern Habitat Availability
>50% of the time

Summer (Nesting and rearing)
July-Sept 2009
Snowy Plover Stage-Habitat Relationship

Open beach and foredune habitat
Snowy Plover Stage-Habitat Relationship

Stage = 6 ft NAVD88
Snowy Plover Stage-Habitat Relationship

Stage = 10 ft NAVD88
Snowy Plover Habitat Availability
(available >50% of the time)

Spring (Nesting and rearing) May-Jun 2009

SCREW stage (ft NAVD88)

Snowy plover habitat (acres)
Snowy Plover Habitat Availability
(available >50% of the time)

Summer (Nesting and rearing)
July-Sept 2009
Snowy Plover Habitat Availability
(available >50% of the time)

Fall (Non-breeding)
Oct-Dec 2009
Snowy Plover Habitat Availability
(available >50% of the time)

Winter (Non-breeding)
Jan-March 2010

(SCRE stage (ft NAVD88)

Snowy plover habitat (acres)
Aquatic and wildlife habitat maintenance

- Available habitat generally increases with SCRE Stage
  - Max tidewater goby habitat area <10 ft
  - Max Southern steelhead habitat area >10 ft
  - Max Least tern foraging habitat area >8 ft
  - Max Snowy plover nesting and foraging habitat area at 5-10 ft
Current Ecosystem Functioning

VWRF effects on Primary Functions:

- Flow regulation
- Sediment storage and beach building
- Water quality regulation
- Aquatic habitat maintenance
- Wildlife habitat maintenance
- **Recreational opportunities**
Recreational Opportunities

‘Full’ SCRE Inundation Extent ~ 10 ft NAVD88
Recreational Opportunities

• Likely that floodplain saturation existed historically
  
    – Primarily summer months
    – Affects campground usage

    NAVD88 SCREE stage and water table elevations are high ~10 ft

    McGrath State Beach campground gets saturated when

1. Ecosystem Overview
   - Overall conceptual model
   - Focal species habitat needs

2. Water Balance
   - Preliminary assessment (2009-2010)

3. Water Quality
   - Assessment (2001-2010)
   - Water quality (nutrient) balance

4. Ecosystem Functioning
   - Current functioning
   - Stage-Habitat Relationships (2009-2010)

5. Discharge Scenarios
Nov. 2009 - You provided input on potential alternatives for recycled water and wetlands.
Discharge Scenarios

• Future Conditions Evaluation (baseline)
  – Climate change

• Scenario identification
  – Maintain existing (0% removal)
  – Complete diversion/recycling (100% removal)
  – TBD
  – TBD
Evaluating future scenarios

• Base Case (existing + planned improvements)

• Consideration of future changes:
  – Growth (higher flows)
  – Climate change
    ▪ Temperature
    ▪ Sea level

• Parameters can be varied:
  – Amount of flow into estuary
    ▪ Total annual
    ▪ Seasonal contribution
  – Quality of effluent into estuary
What scenarios should we consider evaluating?

- **Planned WWTP Improvements**
- **Existing**
  - All Onsite – Existing Location
  - All Offsite – No Discharge to Estuary
Draft Estuary Subwatershed Synthesis Report will be released in January, finalized in March

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estuary Subwatershed Study</td>
<td></td>
<td></td>
<td>Next Stakeholder Workshop in Feb 2011 to get comments on report</td>
</tr>
<tr>
<td>Recycled Water Study (Phase 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment Wetlands Feasibility Study</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stakeholder Workshops</td>
<td>▼ ▼ ▼ ▼ ▼</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Opportunity to comment before February…

- Provide comments, questions to Karen Waln at KWaln@ci.ventura.ca.us
- Follow along on City website at www.cityofventura.net/rivers