CV-SALTS Technical Advisory Committee Meeting

When: Friday, May 30, 2014 from 10:00 AM to 12:00 PM
Location: Teleconference
Conference #: (712) 432-0360 Participant Code: 927571#

Agenda

1. Welcome and Introductions
   a. Approve action notes from March 28, 2014

2. SSALTS Phase 2 Project Update – Identification and Characterization of Selected Salt Treatment Options - Joe LeClaire, CDM Smith - 60 minutes

   – TAC Recommendations Regarding the City of Dixon’s Site Specific Study & Addendum_04.11.14
   – City of Dixon – Request for Clarification Letter_05.27.14

4. EC/TDS Ratios – Karen Ashby and Danielle Moss, LWA – 15 minutes

5. CV-SALTS Data Management Concept – Richard Meyerhoff, Rob Parsons, CDM Smith - 15 minutes

6. Groundwater Quality Informational Item – David Cehrs, Kings River Conservation District Board of Directors – 5 minutes

7. Other CV-SALTS Project/Contract Updates – As needed Status Updates - 10 minutes
   a. Phase II Conceptual Model – Richard Meyerhoff
   b. Tulare Lake MUN Archetype – Roger Reynolds
   c. MUN POTW – Jeanne Chilcott
   d. Lower San Joaquin River Committee – Mike Johnson

8. Next Meeting/Call Preliminary Date: June, TBD

One or more Central Valley Regional Water Quality Control Board members may attend.
CV-SALTS Technical Advisory Committee Meeting ACTION NOTES

Convened:  Friday, March 28, 2014 from 1:30 to 3:30 PM
Participants:  Roger Reynolds (Chair), Joe DiGiorgio, Nigel Quinn, David Cehrs, James Witty, Joe LeClaire, Mike Johnson, Diane Barclay, John Dickey, Tom Grovhough, Tom Quasebarth, Anne Olson, Lysa Voight, Bruce Houdesheldt, Lacey Mount, Jeanne Chilcott

Agenda

Item 1: Welcome & Introductions
• Nigel Quinn moved to approve, and David Cehrs seconded, and the Meeting Action Notes from November 15th were approved.

Item 2: City of Dixon, Site-Specific Boron Objective Study Report, (The RWQCB requested CV-SALTS review the proposed site specific criteria for the protection of the agricultural groundwater supply beneficial use. See attached Dixon Site Specific Boron Objective Study documents and the letter sent to RWQCB by CV-SALTS on October 17, 2013.)
• Joe DiGiorgio, Stantec, presented an overview and background for the study. The following documents had been provided to the committee for review:
  o City of Dixon WWTF: Site Specific Boron Objective Study, Feb 7, 2014
  o City of Dixon WWTF: Site Specific Boron Objective Study-Addendum, Feb 14, 2014
• After discussion of the above by the committee, Joe LeClaire, CDM-Smith summarized the Draft TAC review comments and letter.
  o Stantec had provided an initial response to the TAC Comments and Letter prior to the meeting: Appendix X DRAFT Response to DRAFT TAC Comments
• After discussion Committee members were asked to respond with any additional comments on all four of the above documents no later than Friday, April 4th. Pending review of committee comments, the letter is tentatively scheduled for review/approval at the 4/11 meeting of the Executive Committee.

Item 4: Other CV-SALTS Project/Contract Updates
  a) Phase II Conceptual Model/Tom Quasebarth – Workplan approved on 3/7, LWA working with SJVDA to finalize contract. Scheduled start date is 4/1
  b) Tulare Lake MUN Archetype/Roger Reynolds – Board staff review of tech report should be completed shortly. A meeting will be set up to review with Tulare Lake Drainage District.
  c) SSALTS /Joe LeClaire – Phase 2 work in progress, depending on schedule, propose 2 checkpoints with TAC: April-Identification of Alternatives, May-Characterization of Options
  d) MUN POTW/Jeanne Chilcott – Draft Final will be done early next week. Still on schedule to have CEQA done by end of the summer.
  e) Lower San Joaquin River Committee/Mike Johnson – Moving forward on two major tasks: development of recommendations for EC objectives, and development of implementation alternatives.

Item 6: Next Meeting/Call
• The next Technical Advisory Committee Meeting is tentatively set for April 22nd.
SSALTS
Progress Update:
Identification and Characterization of Selected Salt Treatment and Disposal/Storage Options

May 30, 2014

Joe LeClaire, PhD
Don Schroeder, PE
Richard Meyerhoff, PhD
1. Introduction and Background
Phase 2: Develop Potential Salt Management Strategies

- Develop In-Valley Salt Management Alternatives
- Develop Out-of-Valley Salt Management Alternatives
- Develop Hybrid Salt Management Alternatives
SSALTS Phase 2 Study Approach

The overarching goal of SSALTS is to develop alternatives to balance inflows and outflows of salt such that the current salinity levels are sustainable allowing for current beneficial uses.

- Consider impacts of limited degradation of certain groundwater subbasins/IAZs. Consider impacts of de-designation of certain beneficial uses for certain subbasins.
- Utilize the projected salt load/salt flux (output from Phase 2 conceptual model) in order to determine appropriate treatment and disposal/storage options.
Salinity Management Categories

• Source control measures

• Brine minimization

• Salt or brine disposal or storage

“The primary impediment to brackish groundwater desalting is the need for infrastructure that allows environmentally acceptable disposal of the concentrate discharge, which may contain constituents not found in seawater.”

2. Central Valley Salt Flux
SSALTS Process Flow Diagram

1. Conceptual Model
2. Net Salt Flux in Each IAZ
3. Ambient TDS Concentrations in Groundwater (Impaired Areas)
4. Groundwater (Feed Water) Chemistry
5. Mass to be Extracted
6. Volume to be Extracted
7. Treatment Technologies/Number of Facilities
8. Disposal/Storage Options
<table>
<thead>
<tr>
<th>Central Valley Zone</th>
<th>IAZ</th>
<th>Acres (x1000)</th>
<th>Square Miles</th>
<th>TDS Loading for IAZ (tons)</th>
<th>GW [TDS]</th>
<th>Volume Needed to be Removed (MGD)</th>
<th>Volume Concentrate - 85% Efficiency (MGD)</th>
<th>Brine [TDS]</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Northern Central**

<table>
<thead>
<tr>
<th>IAZ</th>
<th>Acres (x1000)</th>
<th>Square Miles</th>
<th>TDS Loading for IAZ (tons)</th>
<th>GW [TDS]</th>
<th>Volume Needed to be Removed (MGD)</th>
<th>Volume Concentrate - 85% Efficiency (MGD)</th>
<th>Brine [TDS]</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>391</td>
<td>611</td>
<td>26,722</td>
<td>53,444</td>
<td>107,320</td>
<td></td>
<td>370</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>744</td>
<td>1,163</td>
<td>33,625</td>
<td>68,070</td>
<td>135,320</td>
<td></td>
<td>201</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>712</td>
<td>1,112</td>
<td>138,133</td>
<td>275,481</td>
<td>550,961</td>
<td></td>
<td>583</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>358</td>
<td>560</td>
<td>27,624</td>
<td>55,248</td>
<td>110,496</td>
<td></td>
<td>761</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>612</td>
<td>957</td>
<td>26,310</td>
<td>53,295</td>
<td>106,589</td>
<td></td>
<td>329</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>668</td>
<td>1,044</td>
<td>320,310</td>
<td>640,619</td>
<td>1,280,502</td>
<td></td>
<td>1,060</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>342</td>
<td>534</td>
<td>13,572</td>
<td>27,143</td>
<td>54,287</td>
<td></td>
<td>398</td>
<td></td>
</tr>
</tbody>
</table>

**Middle Central**

<table>
<thead>
<tr>
<th>IAZ</th>
<th>Acres (x1000)</th>
<th>Square Miles</th>
<th>TDS Loading for IAZ (tons)</th>
<th>GW [TDS]</th>
<th>Volume Needed to be Removed (MGD)</th>
<th>Volume Concentrate - 85% Efficiency (MGD)</th>
<th>Brine [TDS]</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>872</td>
<td>1,362</td>
<td>41,332</td>
<td>82,665</td>
<td>165,329</td>
<td></td>
<td>438</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>756</td>
<td>1,181</td>
<td>56,668</td>
<td>113,335</td>
<td>226,670</td>
<td></td>
<td>961</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>180</td>
<td>282</td>
<td>110,518</td>
<td>220,837</td>
<td>441,674</td>
<td></td>
<td>842</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>425</td>
<td>664</td>
<td>151,320</td>
<td>302,639</td>
<td>605,279</td>
<td></td>
<td>565</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>346</td>
<td>540</td>
<td>165,527</td>
<td>331,055</td>
<td>662,110</td>
<td></td>
<td>825</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1,055</td>
<td>1,648</td>
<td>105,827</td>
<td>211,655</td>
<td>422,147</td>
<td></td>
<td>648</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>513</td>
<td>801</td>
<td>445,603</td>
<td>890,640</td>
<td>1,781,845</td>
<td></td>
<td>1,160</td>
<td></td>
</tr>
</tbody>
</table>

**Southern Central**

<table>
<thead>
<tr>
<th>IAZ</th>
<th>Acres (x1000)</th>
<th>Square Miles</th>
<th>TDS Loading for IAZ (tons)</th>
<th>GW [TDS]</th>
<th>Volume Needed to be Removed (MGD)</th>
<th>Volume Concentrate - 85% Efficiency (MGD)</th>
<th>Brine [TDS]</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>685</td>
<td>1,071</td>
<td>565,557</td>
<td>1,131,114</td>
<td>2,262,984</td>
<td></td>
<td>3,375</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>911</td>
<td>1,423</td>
<td>119,500</td>
<td>239,001</td>
<td>478,002</td>
<td></td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>306</td>
<td>478</td>
<td>59,029</td>
<td>69,485</td>
<td>90,736</td>
<td></td>
<td>575</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>364</td>
<td>569</td>
<td>77,841</td>
<td>155,682</td>
<td>310,962</td>
<td></td>
<td>520</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>869</td>
<td>1,358</td>
<td>119,739</td>
<td>228,940</td>
<td>447,343</td>
<td></td>
<td>598</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>874</td>
<td>1,365</td>
<td>744,724</td>
<td>1,489,447</td>
<td>2,979,857</td>
<td></td>
<td>11,300</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>451</td>
<td>705</td>
<td>72,086</td>
<td>140,691</td>
<td>278,400</td>
<td></td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>707</td>
<td>1,105</td>
<td>162,101</td>
<td>303,940</td>
<td>588,397</td>
<td></td>
<td>335</td>
<td></td>
</tr>
</tbody>
</table>

**Totals**

|                  | 13,141 | 20,533 | 7,084,426 | 354 | 693 | 1,369 |

Brine Volume/Concentration
Extraction over the Entire IAZ
Figure 7-17. Identifying CVHM Model Grid Cells Containing a Well Test Over 1000 mg/L TDS
Brine Volume/Concentrations Over Impaired Areas

• Same method that was used to establish the salt balance for each IAZ
• Assume that extraction/treatment would occur only over areas of impairment
• Will be based on the median TDS concentrations for ambient conditions
• Result in more realistic estimates of groundwater pumping, brine generated, and product water produced.
3. Treatment and Salt Recovery Technologies
Desalination Concepts

• Thermodynamics
  – the minimum amount of work (energy) required to desalinate a salt water solution is related to the starting and ending salt concentration in the treated water
  – the greater the difference between the starting and ending salt concentration, the greater the energy requirement

• Seawater desalination (35,000 mg/L TDS) at 50% recovery requires a minimum of 5500 kWh/MG
  – includes only energy required for salt removal
Other Cost Considerations

- Chemicals
- Pre-treatment
- Equipment
- Operations and maintenance
- Water conveyance
- Land
- Process Water
Central Valley Technology Options

• Mature technologies by multiple manufacturers – can be standalone or combined
  – Reverse osmosis, ion exchange, lime softening, evaporation ponds
• SIMS – Smarts Integrated Membrane System
• WaterFX Aqua4 System – Multi-effect Distillation
• ZDD by Veolia – Electrodialysis Metathesis
• New Sky Energy – Temperature Control and Electrodialysis
Reverse Osmosis

- Salty water pushed through a tightly wound semi-permeable membrane at high pressure
- Water molecules pass through membrane
- Dissolved salts are rejected
Reverse Osmosis

- Mature technology
- Projected 1.2 billion gal/day treated by RO in US by 2015
- Produces concentrated brine stream 3-25% of feed volume
- High requirements: power, chemicals, maintenance
- Can be combined with other technologies to achieve very high recovery
Smart Integrated Membrane System

- Developed at UCLA
- Reverse osmosis system in 40 ft cargo trailer
- Operated remotely (reduces cost)
- Can treat up to 25,000 gal/day (can be scaled up)
- As with conventional RO, brine is produced
Zero Discharge Desalination

- Based on Electrodialysis Metathesis and Reverse Osmosis
- Can achieve up to 97% water recovery.
Zero Discharge Desalination

- Replaces ions in feed water with sodium and chloride
- Differs from conventional electrodialysis in that it uses an additional type of ion exchange membrane to recover mixed ion streams
New Sky Energy Sulfate-Based Electrolysis Processing with Flexible Feed Control

- Mixed concentrated brine containing sodium sulfate
- At least 250,000 mg/L TDS

Sodium sulfate crystals

Distilled Water

Sodium chloride brine

Chemical purification

High purity sodium sulfate

No change in water volume

Can be treated further to remove sodium chloride by RO

Can be converted to sulfuric acid and sodium hydroxide and used to capture carbon dioxide from the atmosphere
New Sky Energy Sulfate-Based Electrolysis Processing with Flexible Feed Control

• Not a water treatment technology
• Focused on recovery of valuable salt based products from waste brine for profit
• Can potentially use recovered products to transform carbon dioxide to carbonates
• Produces sodium chloride waste stream
WaterFX Aqua4 System

- Solar thermal powered multi-effect distillation
WaterFX Aqua4 System

- Compatible with variable water qualities
- Use solar thermal collection to power process
- Does not remove volatile constituents
- Produces low volume concentrated brine
- Projection: 200kW system = 6 gpm freshwater
- Projection: $1.36/1000 gal fresh water
WaterFX Aqua4 System

- Currently piloting at Panoche Water District
- 200kw, 6 gpm system
- 1400gpm system under construction
Fort Irwin Water Works
Combined Technologies
Fort Irwin Water Works
Combined Technologies

- Utilizes electrodialysis reversal, lime softening, microfiltration, reverse osmosis, ion exchange, mechanical evaporation, and evaporation ponds (example of combined technologies for high recovery)
- Will produce 6 MGD at 99% recovery
- Will be largest ZLD plant in US – scheduled for 2015
## Comparison Matrix

<table>
<thead>
<tr>
<th>Name</th>
<th>Technology</th>
<th>Applicability</th>
<th>Capacity</th>
<th>Cost</th>
</tr>
</thead>
</table>
| **Smart Integrated Membrane System** | • Reverse osmosis  
• Remote operations | • Brackish groundwater  
• Agricultural runoff | • UP to 25,000 gal/day at current scale  
• Can be scaled up | • $5.7/1000 gal |
| **New Sky Energy**         | • Temperature control  
• Electrodialysis | • Industrial waste with waste heat  
• Brines containing sodium sulfate and sodium chloride | • 58 ton/day salt products (in Central Valley, CA) | • $10 million |
| **Zero Discharge Desalination** | • Reverse Osmosis  
• Electrodialysis  
• Metathesis | • Industrial, municipal, or agricultural brine  
• Brackish groundwater | • Fully scalable  
• Up to 97% recovery  
• Can deal with selenium | Feed: 2500 mg/L TDS  
Product: 800 mg/L TDS  
@ 1 MGD: $2.6/1000 gal  
@ 4 MGD: $2.0/1000 gal |
| **Water FX – Aqua4**       | • Multi-effect Distillation  
• Thermal Solar Technology | • Industrial, municipal, or agricultural brine  
• Brackish groundwater | • 200 AF water per 1 acre of solar collectors  
• 24 gpm at pilot scale  
• Currently building a 1400 gpm system | • $1.4/1000 gal |
| **Fort Irwin Process**     | • Electrodialysis Reversal  
• Lime Softening  
• Microfiltration  
• Reverse Osmosis  
• Ion Exchange  
• Mechanical Evaporation  
• Evaporation Ponds | • Specifically design for Fort Irwin  
• Can be configured to treat many different water sources | • Facility will produce 6 MGD at 99% recovery | |

*Note: TDS stands for Total Dissolved Solids.*
## Estimate of Brine Properties for Conventional RO

### Results Summary - TLDD (MEB Drainage Sumps)

<table>
<thead>
<tr>
<th>Flow Data</th>
<th>gpm</th>
<th>Analytical Data</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Feed:</td>
<td>625</td>
<td>Raw Feed TDS</td>
<td>11,941</td>
</tr>
<tr>
<td>Product:</td>
<td>500</td>
<td>Product TDS</td>
<td>159</td>
</tr>
<tr>
<td>Concentrate:</td>
<td>125</td>
<td>Concentrate TDS</td>
<td>58,936</td>
</tr>
<tr>
<td>Recovery:</td>
<td>80.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mn exceeds saturation  
Ca $\text{SO}_4$ exceeds saturation  
Mn may be a limiting factor; may need a pretreatment process such as green sands to remove.  
If Ca is removed using additional pretreatment such as ion exchangers, recovery can be higher.

### Results Summary - Grasslands

<table>
<thead>
<tr>
<th>Flow Data</th>
<th>gpm</th>
<th>Analytical Data</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Feed:</td>
<td>557</td>
<td>Raw Feed TDS</td>
<td>3,180</td>
</tr>
<tr>
<td>Product:</td>
<td>500</td>
<td>Product TDS</td>
<td>293</td>
</tr>
<tr>
<td>Concentrate:</td>
<td>57</td>
<td>Concentrate TDS</td>
<td>28,555</td>
</tr>
<tr>
<td>Recovery:</td>
<td>89.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fe exceeds saturation  
Ca $\text{SO}_4$ exceeds saturation  
Fe may be a limiting factor; may need a pretreatment process such as green sands to remove.  
If Ca is removed using additional pretreatment such as ion exchangers, recovery can be higher.
4. Disposal and Storage Options
Brine/Salt Storage/Disposal

- Oil & Gas Industry: Hydraulic Fracturing
- Deep well injection
- San Joaquin real-time management program
  - Grasslands By-Pass Project
  - SJRRP
- Landfill or storage areas
  - Brine line to storage areas (e.g., Tulare Lake Bed)
- Trucks or rail to transport brine in or out of the valley
- Regional treatment and brineline to a Basin Plan-qualified outfall
  - Bay Area WWTPs
  - New outfalls – brine would need to meet requirements of the Basin Plan
Supply Brine to Oil and Gas Industry for Use in Hydraulic Fracturing

• Industry has need for injection water
• Desalter brine suitable and offsets need to seek other sources
• Oil and gas companies would potentially be willing to purchase brine water
• Oil and gas companies would build necessary project infrastructure
  – Conveyance pipelines
  – Equalization basins
• Estimates of need
  – Potential 700 wells/year for foreseeable future (20 to 30 year planning horizon)
  – 80K to 300K gal/well (one time)
  – Relatively limited need
## Oil & Gas Industry as a Potential Market: Hydraulic Fracturing

<table>
<thead>
<tr>
<th>Number of Wells Annually</th>
<th>Volume of Water (gal/yr/well)</th>
<th>Volume of Water for HF (gal/yr)</th>
<th>Volume of Water for HF (mgd)</th>
<th>Concentration of TDS in Brine (mg/L)</th>
<th>Mass TDS Removed (tons/yr)</th>
<th>Net TDS Inflow in Southern CV (tons/yr)</th>
<th>Percentage TDS Potentially Removed in Southern CV by HF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>80,000</td>
<td>56,000,000</td>
<td>0.15</td>
<td>58,900</td>
<td>13,763</td>
<td>3,758,301</td>
<td>0.4%</td>
</tr>
<tr>
<td>700</td>
<td>300,000</td>
<td>210,000,000</td>
<td>0.58</td>
<td>58,900</td>
<td>51,612</td>
<td>3,758,301</td>
<td>1.4%</td>
</tr>
</tbody>
</table>
### Oil & Gas Industry as a Potential Market: Hydraulic Fracturing

<table>
<thead>
<tr>
<th>Number of Wells Annually (gal/yr/well)</th>
<th>Volume of Water for HF (gal/yr)</th>
<th>Volume of Water for HF (AFY)</th>
<th>Volume of Water for HF ($)</th>
<th>Unit Price ($)</th>
<th>Price ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>80,000</td>
<td>56,000,000</td>
<td>172</td>
<td>$1,164</td>
<td>$199,999</td>
</tr>
<tr>
<td>700</td>
<td>300,000</td>
<td>210,000,000</td>
<td>644</td>
<td>$1,164</td>
<td>$749,995</td>
</tr>
</tbody>
</table>
Supply Brine to Oil and Gas Industry for Use in Hydraulic Fracturing

• Potential benefits
  – Range of brine water quality acceptable for this use
  – Replaces need for other water supplies (local gw, surface water)
  – Potential revenue could partially offset costs of desalination and delivery

• Concerns/drawbacks
  – Overall need small compared to potential brine production
  – Will require flexibility in delivering brine to different well fields as need moves
  – While industry projects long term continuation of practice, ultimate lifetime uncertain
Dedicated Deep Well Injection

• New brine injection wells would be constructed in deep formations – not tied to locations where oil and gas production is occurring
• This is approach that Hilmar Cheese implemented (not currently operating)
• Wells likely to be > 3,000 ft. bgs (Hilmar wells are approx. 4,100 ft. bgs)
• Assume capacity < 0.5 mgd (Hilmar wells are approx. 0.2 mgd)
• At this capacity, would need 3-5 deep wells per 1 mgd of brine to be disposed of
• Maximum potential limited by deep aquifer properties
Dedicated Deep Well Injection

• Potential benefits
  – Not limited to areas where oil and gas drilling is prevalent
  – Could be implemented close to local/regional desalter (minimize conveyance)

• Concerns/drawbacks
  – Dependent upon local deep geophysical conditions and capacity for long term storage
  – Must demonstrate good separation from overlying aquifers with water supply potential
  – Must anticipate and be able to avoid incompatibility and precipitation/clogging issues
  – Deep wells expensive to construct and operate
## Deep Well Injection (per well)

<table>
<thead>
<tr>
<th>Capacity (mgd)</th>
<th>Volume of Water for DWI (gal/yr)</th>
<th>Mass TDS Removed (tons/yr)</th>
<th>Net TDS Inflow in CV (tons/yr)</th>
<th>Percentage TDS Potentially Removed in CV by DWI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>73,050,000</td>
<td>8,704</td>
<td>7,084,426</td>
<td>0.12%</td>
</tr>
<tr>
<td>0.5</td>
<td>182,625,000</td>
<td>21,760</td>
<td>7,084,426</td>
<td>0.31%</td>
</tr>
</tbody>
</table>
Tons of Salt Removed by Grasslands By-Pass Project
Grasslands By-Pass Project

- 54,674 tons of salt removed by GBP in 2013
  - 2.5% of salt influx in the middle Central Valley
  - 0.8% of the salt influx in the Central Valley
- Significant reduction in salt discharge since 1995 (237,530 tons)
- Project will limit discharge to near-zero by 2019
## Landfilling as a Disposal/Storage Option

<table>
<thead>
<tr>
<th>Central Valley Zone</th>
<th>IAZ</th>
<th>Acres (x1000)</th>
<th>Square Miles</th>
<th>TDS Loading (kg per acre)</th>
<th>Volume of Dry Salt (Low End)</th>
<th>Volume of Dry Salt (High End)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ft³</td>
<td>acre ft</td>
</tr>
<tr>
<td>Northern Central</td>
<td>1</td>
<td>391</td>
<td>611</td>
<td>124</td>
<td>1.24E+06</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>744</td>
<td>1,163</td>
<td>83</td>
<td>1.58E+06</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>712</td>
<td>1,112</td>
<td>351</td>
<td>6.41E+06</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>358</td>
<td>560</td>
<td>140</td>
<td>1.28E+06</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>612</td>
<td>957</td>
<td>79</td>
<td>1.24E+06</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>668</td>
<td>1,044</td>
<td>870</td>
<td>1.49E+07</td>
<td>342</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>342</td>
<td>534</td>
<td>72</td>
<td>6.31E+05</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total for Northern Central IAZs</td>
<td></td>
<td>626</td>
<td></td>
<td></td>
<td>1.24E+06</td>
<td>29</td>
</tr>
<tr>
<td>Middle Central</td>
<td>8</td>
<td>872</td>
<td>1,362</td>
<td>86</td>
<td>1.92E+06</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>756</td>
<td>1,181</td>
<td>136</td>
<td>2.64E+06</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>180</td>
<td>282</td>
<td>1,113</td>
<td>5.14E+06</td>
<td>118</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>425</td>
<td>664</td>
<td>646</td>
<td>7.04E+06</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>346</td>
<td>540</td>
<td>868</td>
<td>7.70E+06</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>1,055</td>
<td>1,648</td>
<td>182</td>
<td>4.92E+06</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>513</td>
<td>801</td>
<td>1,575</td>
<td>2.07E+07</td>
<td>475</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total for Middle Central IAZs</td>
<td></td>
<td>1,149</td>
<td></td>
<td></td>
<td>1.92E+06</td>
<td>44</td>
</tr>
<tr>
<td>Southern Central</td>
<td>14</td>
<td>685</td>
<td>1,071</td>
<td>1,498</td>
<td>2.63E+07</td>
<td>604</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>911</td>
<td>1,423</td>
<td>238</td>
<td>5.56E+06</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>306</td>
<td>478</td>
<td>206</td>
<td>1.62E+06</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>364</td>
<td>569</td>
<td>388</td>
<td>3.62E+06</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>869</td>
<td>1,358</td>
<td>239</td>
<td>5.32E+06</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>874</td>
<td>1,365</td>
<td>1,546</td>
<td>3.46E+07</td>
<td>795</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>451</td>
<td>705</td>
<td>283</td>
<td>3.27E+06</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>707</td>
<td>1,105</td>
<td>390</td>
<td>7.07E+06</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total for Southern Central IAZs</td>
<td></td>
<td>2,006</td>
<td></td>
<td></td>
<td>2.63E+07</td>
<td>604</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>13,141</td>
<td>20,533</td>
<td></td>
<td>1.65E+08</td>
<td>3,782</td>
</tr>
</tbody>
</table>
Rail or Truck to EBMUD’s Main WWTP

• Trucking costs:
  – $0.10 to $0.15 per gallon at 100 miles
  – Hilmar Cheese currently paying about $3.5M year in trucking costs for brine disposal

• Possibly re-equip rail spur into the WWTP?

• Questions being researched by EBMUD staff:
  – Would EBMUD re-equip the rail line to the WWTP and factor into its per gallon treatment fee?
  – What is the cost per gallon of brine for rail delivery? Range of volumes that each tanker car transports?
  – How is mileage/distance factored in?
Questions being researched by EBMUD staff:

- For non-organic brine, can the rail tanker cars be staged at regional locations so that a single locomotive can pick up several cars along the way (milk run)? How long can the cars be staged? BOD issues?
- For either option, is there a limit on the brine concentration (just in terms of transportation, not treatment)?
- Can greenhouse gas effects be estimated on a unit basis for both trucking brine and for rail delivery?
- EBMUD is working with Hilmar Cheese for a possible pilot project to uncover the push points. Can rail lines be linked up between the WWTP and Hilmar Cheese?
Rail or Truck to EBMUD’s Main WWTP

• Possible to transport biosolids from EBMUD on the return trip
  – Soils on the west side are often nutrient poor.
  – Currently EBMUD is paying to have biosolids removed:
    • $37 per ton
    • 6 truck loads per day at 20 tons per truck
    • 120 tons per day
    • $1.6M per year
  – Phytoremediation
    • Crops that are salt and B tolerant
    • Selective uptake of Se
    • Minimal water requirements
    • Accepted by agricultural community
    • Economic value
    • Brassica family: mustard & canola (oil is the product)
    • Nutraceutical – prickly pear cactus
Potential Discharge to Bay Area WWTPs

• Projected capacity of EBMUD’s Main WWTP + other WWTPs
• Outfall-specific concerns
  – Salinity
  – Temperature
  – Other constituents
  – Agricultural chemicals
• Permitting
  – Regional Board
  – Coastal Commission
• Treatment capacity versus outfall capacity
  – BOD limits
  – Unit cost differences
Current Capacity of EBMUD’s Main WWTP

- Permitted for 170 mgd
- Currently using about 50 mgd
- Up to 100 mgd available capacity
- Issue with toxicity testing of juvenile trout
- EBMUD would work with the Regional Board to modify the discharge permit
- Fees = $0.03 to $0.06 per gallon
  - Concentrated brine from groundwater and drain lines could potentially be discharged through outfall.
  - Food processing waste would be introduced at the headworks.
  - 100 MGD would cost $1B to $2B annually
- Assumes no other water quality issues
## WWTP Capacity for Brine Disposal

<table>
<thead>
<tr>
<th>Capacity (mgd)</th>
<th>Concentration of TDS in Brine (mg/L)</th>
<th>Mass TDS Removed (tons/yr)</th>
<th>Net TDS Inflow in CV (tons/yr)</th>
<th>Percentage TDS Potentially Removed in CV by DWI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>30,000</td>
<td>4,572,242</td>
<td>7,084,426</td>
<td>65%</td>
</tr>
<tr>
<td>100</td>
<td>60,000</td>
<td>9,144,484</td>
<td>7,084,426</td>
<td>129%</td>
</tr>
</tbody>
</table>
Brineline Alignment Considerations

• Re-purpose an existing/abandoned pipeline
  – Natural gas
  – Oil and gas
• Utilize easement/right-of-way
• Research abandoned pipelines
• Initial Source - California Energy Commission: Siting Transmission & Environmental Protection Division, Cartography Unit
Elevation Profiles for Two Alternative Alignments

Elevation Profiles

Profile Miles

Elevation (ft MSL)

Alternative 1

Alternative 2
Alternate Pipeline Alignments
Next Steps

• Estimate groundwater extraction, brine generation, and product water for impaired areas of each IAZ.

• Comparison of planning-level cost and capacity. For example:
  – HF could remove 14,000 to 52,000 tons/year (0.2 to 0.7% of net salt inflow)
  – GBP removed 54,674 tons of salt in 2013 (0.8% of net salt inflow). Near zero discharge by 2019
  – DWI (per well) could remove 8,704 to 21,760 tons/year (0.12 to 0.31% of net salt inflow)
  – Landfill or surface storage requires 8000 AFY
  – Brine line to a WWTP could remove 4.5 to 9 million tons/year (65 to 139% of net salt inflow)
Next Steps

• Planning-level costs for the disposal/storage options, including appurtenances and related infrastructure
• Planning level review of salt market: revenue and capacity
• Meet with EBMUD staff
  – Rail option
  – Feasibility of brine disposal at their WWTP plant
Subject: Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) Technical Advisory Committee Recommendations Regarding the City of Dixon’s Site Specific Boron Study and Addendum (Order No. R5-2008-0136)

Dear Ms. Olson,

On September 12, 2013, the CV-SALTS Technical Advisory Committee (TAC) reviewed and discussed the Site-Specific Boron Objective Study Work Plan (Stantec 2013), as it related to ongoing CV-SALTS evaluations to determine appropriate salinity water quality objectives to protect agricultural supply water. A letter from the TAC, dated October 17, 2013, was submitted to you with a finding that the “TAC agreed that the Work Plan as proposed will achieve the stated objectives of the project” with the provision that “the project proponent provide the technical justification for the proposed annual average in the Study Report.” Subsequent to that letter, the City of Dixon submitted a Site Specific Boron Objective Study (Stantec 2014a) and a Site Specific Salinity Objective Study as an Addendum to the Boron Study (Stantec 2014b). The TAC has reviewed the studies to determine if the objectives of the work plan were met through the completion of the studies. This consistency review follows our general technical comments below. The TAC recommendations are in italics following each general comment and the comments in the work plan consistency review. The general comments are grouped by the two studies and the analysis of the averaging period, which is applicable to both studies. Each set of comments are prioritized in order of importance.

General Comments

Site Specific Boron Objective Study

1. The site-specific objective studies generally attempt to determine the threshold concentrations in soil solution below which the crops would be protected at a 95 percent of yield basis for those crops that comprised more than 5 percent of the land use in the study area. A steady-state salinity model (Rhoades and Merrill, 1976) based on plant uptake was used to determine boron concentrations in soil solution as a function of boron concentrations in irrigation water for various crops under one or more leaching fraction/irrigation scenarios. The salinity model and the results shown in Figure 2 should be explained with greater clarity to improve understanding. Dixon should consider adding a table that illustrates the steps used in the analyses in a sequential manner. Working through a specific example would be helpful. If possible, the model should be included as an electronic addendum to facilitate the review process.

2. There are a number of assumptions and statements throughout the study that are not supported with sufficient citations from literature or with actual data to allow the reviewer to easily come to the conclusions reached in the report. As an example, the following statement is made: “Assuming that sunflower yield responds similar to other seed and grain crops, adding 1 mg/L boron to the threshold would reduce yield by less than 5 percent; therefore, a soil solution boron concentration of…”

---

1 Figure 2, page 2.6, Stantec 2014a
2 Page 2.6 of Stantec 2014a
concentration of 1.75 mg/L is anticipated to be protective of the 95 percent yield for sunflowers."

There are two potential issues with this statement: (i) the assumption that the yield of sunflower response to boron concentration in soil solution is similar to other seed and grain crops is not supported herein by literature, and (ii) the data showing the yield response curve for other seed and grain crops is not presented. Dixon should support all statements and assumptions in the studies with literature or with data. Note that the physiology of sunflower, a dicot, differs significantly from cereal grains, which are all monocots. The other major dicot seed crop (safflower) is grown in the cool season, whereas sunflower is grown during the warm season. It could thus be argued that these oilseeds and grains are not intuitive models for sunflower.

3. In Section 2.2, the following statement is made, "The most limiting local crops based on sensitivity to boron are wheat, sunflowers, and beans. Beans were not identified as a potential crop in the City's survey, and the most recent 2003 DWR survey reported that all beans were irrigated with a surface water supply." During its policy discussions, CV-SALTS has recognized that when interpreting narrative AGR standards, it is essential to focus on areas that actually recharge the water supply being used to irrigate the sensitive crop in question. Beans irrigated with surface water are thus irrelevant to an AGR standard for groundwater. Even if beans were irrigated with groundwater, CV-SALTS has had technical discussions concerning the criteria for deciding which crops to evaluate in this type of analysis. One method is to only evaluate crops that are grown on more than five percent of the study area. A second method is rank-order the crops from those with the greatest land area to least. The total land area would then be summed until 95 percent of the study area is accounted for. Only these relatively common crops would be evaluated. Applying either of these methods to the Dixon area would exclude beans as a crop to be evaluated. The TAC recommends that the methods discussed by CV-SALTS to determine sensitive crop species be used in this study; in this case, sunflower would be the crop under consideration.

4. In Section 2.3.4, the following two statements are made: "This 95 percent threshold for a wheat-bean rotation can be achieved using an irrigation water supply with a boron concentration of 1.5 mg/L at both 15 and 25 percent LR. Increasing the irrigation water supply boron concentration to 1.8 mg/L is protective of 95 percent yield of snap beans and wheat rotation at both LR, and weighing all factors this value is proposed as an appropriate site specific objective (SSO) for boron." Neither beans nor snap beans are crops that are common according to CV-SALTS criteria in the study area. As discussed in General Comment 3, sunflower should be the sensitive crop analyzed in this study. Note that the proposed numerical, site-specific objective for boron would not be very different.

5. Table 1 has column headings for the constituents of concern that include "Potable Water," "Raw Wastewater," and "Proposed Discharge to Groundwater (annual average)." Please add footnotes to the table to clarify the meaning of the column headings. Consider renaming the last column to "Estimated Concentrations in WWTF Discharge to Groundwater." Also consider renaming the table from "Agricultural Use Protection – Constituents of Concern (mg/L)" to "Summary of Average Concentrations of Constituents of Concern inform 20XX to 20YY."

6. In the first paragraph of Section 2.3, the following statement is made: "This model calculates the salt concentration in quarter fractions of the root zone, and the linear average of these concentrations is recommended to represent soil salinity under infrequent irrigations." Please provide some supporting information that this model is applicable to cropping conditions in the Dixon area. Also include an example regarding "infrequent irrigation" (e.g., weekly). Note that literature supports an exponential uptake profile. Where this condition exists, and a linear uptake model is used for analysis, calculated thresholds will be significantly lower than real thresholds.
7. In the second paragraph of Section 2.4, the following statement is made: “If the maximum rate of irrigation (12.3 inches) and maximum irrigation water boron concentration (1.8 mg/L) from the boron buildup modeling were applied to an acre of this soil, and all boron remained in the surface foot of soil, it would take over 11 years to apply 4 lbs of boron and achieve the equilibrium 0.7 mg/L soil solution boron concentration.” It is not clear what is meant by the “equilibrium 0.7 mg/L soil solution boron concentration” – please clarify. Note that if leaching occurs, all boron would not remain in the surface foot of soil over the 11 year period, because some would be leached. Irrigation with a more concentrated solution over time will bring the system to a new equilibrium in which the solid phase is in equilibrium with the new hydro-chemical regime. Achieving an equilibrium within 11 years makes this irrigation scenario appear to be less than sustainable. Perhaps the underlying assumptions should be re-visited or more clearly explained.

8. In the second paragraph of Section 3.2, the following statement is made: “The Yolo County Flood Control and Water Conservation District (YFCWCD) reported the long term average boron concentration for its irrigation supply (Cache Creek at the Capay Dam) was 1.7 mg/L and average boron concentrations of groundwater in Yolo County range from 0.6 to 6.6 mg/L (YFCWCD, 2007).” While the boron concentrations in the irrigation supply and groundwater are similar to concentrations in the Dixon study area, no data are presented that would support the argument that there was not significant yield (greater than 5 percent) reductions due to the presence of boron in irrigation supply at those concentrations. In other words, yield data for Yolo County compared with averages for other crops was not presented. It is recognized that a multitude of other factors affect yield, so drawing conclusions from this line of reasoning may not be tenable. In any case, the existence of high background B concentrations is not evidence that they do not affect crop yield.

Site Specific Salinity Objective Study as an Addendum to the Boron Study

9. In Section 1.1, the following statements are made: “The major findings of the salinity research were that osmotic stress was the primary cause of crop decline...” and “Generally, annual crops are not susceptible to sodium and chloride toxicity.” However, it is recognized that leaf burn and foliar stress can result from overhead sprinkler irrigation if it is not timed properly. Please provide background or rationale for developing site-specific objectives for sodium and chloride. Note that crops comprising more than 5 percent of the study area – while affected by osmotic stress (electrical conductivity [EC]) – are not susceptible to sodium or chloride toxicity from root uptake. As an alternative, elevated sodium could be compared to ranges that, at varying levels of EC, can affect soil permeability. The sodium adsorption ratio (SAR) and the EC are the critical parameters for protecting AGR beneficial uses in this study area.

10. In Section 2.1, Table 1 provides salinity threshold and the EC value where there is less than a 95 percent yield reduction. Please cite the reference(s) for these values. Pursuant to Comment 2, please provide references or supporting data for all assumptions and statements. Table 1 also lists sodium and chloride concentrations supposedly associated with a less than 95 percent yield reduction for the study area crops. However, these concentrations may not be directly related to yield reduction, because they were estimated based on ratios of these ions to a threshold EC. The threshold EC was determined in a test designed to evaluate crop yield response to salinity, not sodium or chloride. Calling these derived concentrations of sodium and chloride “objectives” implies that water at a slightly higher concentration would be deleterious to the crops in question, while the method employed does not support this conclusion. The TAC recommends that these concentrations not be reported as proposed objectives. If included in the study, they should be labeled as “concentrations of Na and Cl that would be associated with an EC threshold at the assumed molar ratios of specific ions.” Also please consider reducing the number of significant figures to two and adding “Estimated” to the table title.

---

7 Page 2.7 of Stantec 2014a
8 Page 3.2 of Stantec 2014a
9 Page 1.1 of Stantec 2014b
10 Page 2.1 of Stantec 2014b
Averaging Period

11. The October 17, 2013 CV-SALTS letter states that the “TAC recommended that the project proponent provide the technical justification for the proposed annual average in the Study Report. In addition, the TAC recommends that the project proponent participate in future TAC discussions regarding the averaging periods.” The Site-Specific Boron Objective study states that “there is limited knowledge on boron’s role in plant nutrition as well as on the mechanisms responsible for boron toxicity.” This should be documented with literature citations. This study also discusses the buffering or signal-dampening response to fluctuations in boron concentration in the soil system, which is likely to occur. The salinity addendum also cites best management practices (BMPs) that can ameliorate higher salinity during stages of plant growth where there is higher sensitivity to salinity: “1) salt sensitive crops are generally planted in the spring after seasonal precipitation has leached soluble salts from the soil; 2) Pre-plant irrigations can be applied to minimize soil salinity encountered during the early growth stages.” These BMPs should be documented. Dixon has provided some discussion about how variations in boron concentrations in the discharge are buffered by soil sorption. In terms of the averaging period for discharge measurements: this depends on how the boron concentrations in the discharge vary over time. Dixon needs to demonstrate that the long-term average concentration of the discharge is represented by their proposed metric. The TAC continues to recommend that Dixon stay involved and continue to participate in the on-going discussions concerning the averaging periods.

Work Plan Consistency Review

In reviewing these two studies, the TAC performed a consistency review between the work plan and the study – in other words, did the study achieve the work plan objectives. The work plan objectives and findings are summarized below.

1. “Additional crop types of regional significance have been compiled by the Dixon RCD and Solano County. The California Department of Water Resources (DWR) conducted land use surveys of Solano County in 1994 and 2003, which identified crops grown and irrigation methods in individual fields during those years. These sources of information will be used to document agricultural practices in the area.” This work plan requirement/proposed task is substantively accomplished in the study.

2. “Other pertinent agriculture practices which help reduce impacts from salt, and therefore boron, include artificial drainage, adjustments to leaching fraction, soil amendments, and supplemental (i.e. higher quality) irrigation water, if available. These practices are more difficult to characterize and quantify, primarily due to individual farmers experience with, and application of, these practices. Generally, the best source of this information is from discussions with local Cooperative Extension agents, resource conservation districts, and/or irrigation districts. Therefore, the study will solicit such input from the Dixon RCD. Difficult to tell if RCD or the UC Cooperative Extension staff was contacted for information, but agricultural practices are discussed in Section 2.3. The TAC recommends clarification regarding degree to which input was provided by Dixon RCD.

3. “Available SID reports and the available groundwater reports will be reviewed to identify irrigation water quality in the area. We will also obtain water quality information that may be provided by the local farmers.” A summary of irrigation and groundwater quality data is not presented. The TAC recommends that these data be presented to the extent that they were acquired.

4. The Soil Survey of Solano County prepared by the Soil Conservation Service (NRCS) in 1977 provides the most comprehensive assessment of soils in the area and will be used to identify soil
types and salinity management related aspects of those soils. This work plan requirement/proposed task is substantively accomplished in the study.

5. “Additionally, the presence of calcium, nitrogen, and potassium can affect plant uptake as well as expression of boron deficiency and toxicity symptoms. Available literature will be reviewed to assess, at least qualitatively, the ability of area soils to buffer the concentration of boron in the soil solution and ameliorate detrimental effects on crops. This work plan requirement/proposed task appears to have been substantively accomplished in the study. However, as noted in General Comment 2, the literature needs to be sufficiently cited in the studies to demonstrate adherence to this element.

6. “Local climatic data will be reviewed and used to assess boron loading and where applicable any discrepancies with reported tolerance studies. Average year rainfall amounts will be used to calculate loading and/or leaching of boron. This work plan requirement/proposed task is substantively accomplished in the study. Climatic data should be provided as an attachment.

7. “The potential for flooding in the area will be reviewed to determine if substantial volumes of stormwater are contributing to irrigation demand and/or flushing the soils. This work plan requirement/proposed task is not discussed in the study. If flooding is thought not to occur in the study area because of the slope and drainage system, then this should be stated. For other study areas, flooding is a potentially important phenomenon in that it can flush the root zone of salts, including boron.

In summary, the TAC appreciates having the opportunity review the findings from this study and addendum. In terms of the boron site-specific objective, the TAC recommends that the methods discussed by CV-SALTS to determine sensitive crop species be used in this study; in this case, sunflower would be the crop under consideration (General Comment 3). For the salinity addendum, the TAC recommends that the derived concentrations of sodium and chloride not be reported as proposed objectives. If included in the study, they should be labeled as “concentrations of Na and Cl that would be associated with an EC threshold at the assumed molar ratios of specific ions” (General Comment 10). Conservative assumptions in calculating sodium and chloride thresholds in this study result in threshold values that are likely lower than necessary to be protective of the AGR beneficial use and this may not be appropriate for other study areas. In addition to these two comments, the TAC believes that findings in this study can be more strongly demonstrated by addressing the other comments noted above. Many of these comments are clarifications or requests for supporting documentation all of which will result in a more robust report. Finally, the City’s proposal concerning averaging periods will be taken into consideration in the TAC’s evaluation of appropriate methodologies for temporal averaging for compliance.

Sincerely,

Nigel Quinn  Parry Klassen
Chair, CV-SALTS Technical Advisory Committee  Chair, CV-SALTS Executive Committee

Cc:  Joe Leach, City Engineer/Public Works Director, City of Dixon
      Robert Busby, Supervising Engineer, CVWB
      Andrew Altevogt, Assistant Executive Officer, CVWB
      Jeanne Chilcott, Central Valley Regional Water Quality Control Board
References


May 27, 2014
File: 184030042

Attention: Nigel Quinn and Parry Klassen
CV_SALTS c/o The Central Valley Salinity Coalition, Inc.
360 Lakeside Ave
Redlands, CA 92373

Reference: CV_SALTS Review of City of Dixon Boron Site-Specific Objective – Request for Clarification

Gentlemen,

On behalf of the City of Dixon, thank you for your very detailed review of our Boron Study and associated addenda as expressed in your April 11, 2014 letter to Anne Olson at the Regional Board. We appreciate your desire for a final document to consolidate the work, with full footnotes and references to facilitate future efforts by CV-SALTS and stakeholders developing the regional salt and nutrient management plan (SNMP). We will work with the Regional Board staff to submit a final consolidated document.

The City’s tentative Waste Discharge Requirements (WDRs) are now being circulated for public comment, with comments due by June 9, 2014. In order to facilitate setting a more definitive discharge limit for boron in the final WDRs, we request a clarification of General Comment No. 4 in your letter where you state that, with the use of sunflowers as the appropriate crop, the proposed numeric objective for boron would not be much different (from the 1.8 mg/L numeric objective that the City had proposed as being protective of the 95 percent yield for a snap bean and wheat rotation). The City agrees that sunflower is the appropriate crop to use, and based on the information available, and using procedures specified in the August 2, 2013 Workplan (Ref; Table 4 of the February 7, 2014 Report), that would result in a range of 1.7 – 1.8 mg/L for irrigation water, depending on the leaching requirement chosen by the farmers. Can you provide clarification and/or concurrence that this was the intent of your General Comment No. 4?

A tentative response before June 9, 2014 would be appreciated. I will be available for both the May 30, 2014 TAC meeting, and the June 13, 2014 Executive Committee meeting to answer any questions you may have.
Reference: CV_SALTS Review of City of Dixon Boron Site-Specific Objective – Request for Clarification

Regards,

STANTEC CONSULTING SERVICES INC.

Joe DiGiorgio, P. E.
Senior Engineer, Water
Phone: (916) 773-8100
Joe.DiGiorgio@stantec.com

c. Joe Leach P. E., City of Dixon;
   Robin Merod, PhD, Regional Water Quality Control Board – Central Valley Region

Dixon Boron Clarification

Design with community in mind
Memorandum

To: CV-SALTS Technical Advisory Committee (TAC)

From: Richard Meyerhoff, CDM Smith
       Rob Parsons, CDM Smith

Date: May 27, 2014

Subject: Data Management Concept

Overview

Through its technical work, CV-SALTS has become a potential data source to the public. Currently, data can be made available to stakeholders through implementation of the CV-SALTS Data Access Request Procedure. Upon approval of a data request, arrangements are made to transfer the requested data. One of the challenges of this process has been providing information regarding what data are available for request. Given the increasing number of data requests and the need to facilitate data sharing, CV-SALTS requested that CDM Smith evaluate data management options and develop a Data Management Concept for CV-SALTS. Accordingly, CDM Smith reviewed current open source geoportal software and software development options to determine a suitable solution for the management of spatial and tabular data for CV-SALTS. The purpose of this memorandum is to summarize findings to date and provide a recommendation for next steps.

ESRI Geoportal Software

The most practical and cost effective tool was determined to be ESRI's Geoportal software. The Basic Geoportal page – Live Web Application may be viewed here: [http://gptogcsri.com/geoportal/catalog/main/home.page](http://gptogcsri.com/geoportal/catalog/main/home.page). Examples of a live Geoportal software-based website may be reviewed at this website: [http://www.esri.com/software/arcgis/geoportal/live-user-sites](http://www.esri.com/software/arcgis/geoportal/live-user-sites). Key elements of this tool include:

- Software is an easy to install out-of-the-box free open source solution, i.e., there would be no cost to CV-SALTS to acquire the software. However, if CV-SALTS wanted to have ESRI technical support, then this would incur costs. The need for ESRI support is optional.
- Software has a wide range of capabilities, including (a) data cataloging; (b) site administration; (c) data publishing; (d) data discovery; and (e) full data searches.
- Searches are completed based on metadata and allow for full keyword searches.
- Software will support Federal Geographic Data Committee (FGDC) compliant metadata which is specified for all GIS work completed for CV-SALTS.
The search engine employed is fully configurable and provides a smart ranking to provide the best possible search results.

Software includes a map previewer for spatial sources of data.

A flexible security model is included that will accommodate a simple login or allow a more complex authentication model which utilizes external Lightweight Directory Access Protocol (LDAP).

On the surface, this software is the least difficult of the open source solutions to implement.

Since the software is developed by ESRI there is certainty that it will be compatible with the spatial data types required to be submitted to CV-SALTS.

The Live Geoportal-based sites webpage (see link above) provides examples of webpages that rely on ESRI's Geoportal software. One of the better examples that characterizes the CV-SALTS need best is the Canadian Saskatchewan GeoSask Portal (https://www.geosask.ca/Portal/). This website provides the following purpose for its web portal: "GeoSask is a centralized public website that provides one clear online access point to different types of maps and geographic information related to Saskatchewan land from across various government sources." Tailor the sentence to reflect CV-SALTS (in terms of organization and geography) and you have a similar need/application. Similarly, the State of Oregon has developed a publicly accessible Spatial Data Library to provide the means to find, access, and share geospatial data using the ESRI Geoportal software. A live implementation of the software is accessible from this link: http://spatialdata.oregonexplorer.info/geoportal/catalog/main/home.page. Example screenshots from this website are provided in Attachment A to this memorandum.

**Additional Issues for CV-SALTS Consideration**

If the ESRI Geoportal software were selected for use by CV-SALTS the following issues require further evaluation or discussion:

- **Compatibility with HostGator (CV-SALTS website host provider)** – After a technical review of HostGator, CDM Smith believes that the system utilized to host the CV-SALTS website is likely capable of hosting the ESRI Geoportal software. Our technical review included direct conversations with HostGator and compiling a list of current versioned software and comparing that information to the ESRI system requirements document to assure the HostGator Linux-based server can run the software. The overall conclusion is that the server appears to be equipped with all required elements listed as a part of the requirements document and therefore is capable of running the ESRI Geoportal software. However, CDM Smith is not privy to the complete layout of the current hosting server and therefore cannot completely guarantee an effective hosting environment for the Geoportal software. These findings could be evaluated fully as part of a pilot test (see below).

- **Data Administration** – If a geoportal data access site is developed for CV-SALTS, it will be necessary for CV-SALTS to establish administrative responsibilities and/or procedures regarding
maintaining and administrating the data site, e.g., ensuring the data are kept current, providing access to files requested after completion of the data request approval process.

**Recommendation for Next Steps**

To assure that ESRI’s Geoportal software will provide the necessary capability required by CV-SALTS and that it is fully compatible with the CV-SALTS website, CDM Smith highly recommends a pilot test of the software. We estimate that for a maximum of 10 hours of labor (recommended for execution under CDM Smith’s Technical Project Manager Services contract), we can test installation and functionality to assure that this software will truly provide the needed capabilities and ease of use for internal and external users. Based on the outcome of this test, we would brief the TAC on the outcome of pilot test. If the test is successful, we could include a live demonstration as part of the briefing. Based on the outcome of the pilot test and TAC briefing, a recommendation would be made to the Executive Committee for discussion.
Attachment A – Oregon Spatial Data Library Screenshots – Example Use of the ESRI GeoPortal Software.

![Home or Initial Screen view at Oregon Spatial Data Library](image)

**Figure 1.** Home or Initial Screen view at Oregon Spatial Data Library
Figure 2. Data Search Screen
Figure 3. Data Browser Screen
Figure 4. Data Download Screen
# CV-SALTS Meeting Calendar

## 2014

### January

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

### February

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### March

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### April

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### May

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### June

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### July

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### August

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### September

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### October

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### November

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### December

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>

### Notes

- 2nd or 3rd Thursdays
- Dark Green Exec Comm Policy
- RWQCB Update Bold Underline
- Lt. Green Hatch Exec Comm Admin
- First or Second Friday
- Yellow Salty 5
- Lower San Jaquin River Committee
- TAC Meeting on 3/28
- Dark in July & December for Policy
- State Board Presentation 1/21/14
- May 15 move to 22nd for CVCWA
- Nov 13 vs 20 due to Thanksgiving