Seepage and Conveyance Technical Feedback Group Meeting

March 31, 2016
(recap of February 12, 2016 Meeting)

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Agenda

• Introductions
• Purpose
• Operational Decision Making
• Almond Study – Phase 1  
  – Response to Comments
• Almond Study – Phase 2  
  – Potential Field Program
• Wrap-Up, Action Items

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Meeting Purpose

• Recap of February 12, 2016 SCTFG Meeting
• Continue to uphold the ongoing commitment in the SMP to protect crops from material adverse groundwater seepage impacts
• Set root zones at levels that are protective
• Set root zones at levels supported by science

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OPERATIONAL DECISION MAKING

OPERATIONS VS. THRESHOLDS

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Operate to Thresholds, Example 2

Reach X

Reach Y

San Joaquin River Water Surface

Ground Surface

Threshold (by crop)

GW Elev. After Flow Increase

GW Table

Maximum increase in GW elevation

No Flow is released into Reach Y because GW already at threshold

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Root Zone Threshold Terms

- **Seepage Threshold**: Root Zone Depth: 6 ft
  - Where most uptake occurs
- **Active Root Zone**: 2–3 ft bgs, 80% of roots
  - Where most uptake occurs
- **Effective Root Zone**: 3–5 ft bgs, Over 90% of roots
  - Not necessarily typical
- **Maximum Root Zone**: 6–13 ft bgs
  - Not necessarily typical

Aerated Root Zone

Seepage Threshold

Root Zone Depth: 6 ft

Capillary Fringe

Water Table

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Threshold Calculation: Agricultural Practices Method

Root Zone Depth + Capillary Fringe = Seepage Threshold

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Conclusions from Comments

• General agreement on 6 foot root zone
• Must be combined with a capillary fringe of up to 4 feet depending on site-specific factors
• Capillary fringe was not considered as part of Phase 1 Study
  – Current SMP: capillary fringe is 6 inches or 1 foot
  – Reclamation is planning to revise the SMP to clarify that capillary rise may be higher depending on site specific soils

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Path Forward

• Responses to comments
  – Handout at today’s meeting

• Field program (Phase 2)
Possible 2017 Seepage Management Plan Edits

- Almond Root Zone
  - Current SMP (2016 Restoration Flows): 9 feet

- Capillary Fringe
  - Current SMP: 0.5 – 1 foot
  - Future SMP: 0.5 – 4 feet depending on site specific conditions

- Groundwater Threshold Change
  - 9.5 – 10 feet $\rightarrow$ 6.5 – 10 feet
  - Likely, no change in threshold in silt / clay soil types

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Potential Phase 2 Study

- Better understand impact of site specific conditions
- Two potential topics of study:
  1. **Capillary Fringe**: Further refine the understanding of site specific capillary fringe
  2. **Almond Root Zone**: Field characterization of almond root depth

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Potential Phase 2 Study

- Potential study topics are not mutually inclusive or exclusive
- Topics are draft concepts only at this point in time
- Reclamation and participating stakeholders may determine that one, none or a combination of both concepts are desired

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Site Specific Capillary Fringe Study

• Capillary fringe arose out of Phase 1 efforts as an important topic

• Objectives:
  – Evaluate existing data and literature and identify data gaps that need to be addressed.
  – Develop specific guidelines for the range of capillary fringe in various soils and site conditions, to be used in conjunction with root depth estimates to protect almond roots from seepage in the project area.

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Site Specific Root Zone Study

• Root zone information developed in the Phase 1 efforts would be validated

• Objectives
  – Validate root zones as anticipated by UCCE experts and scientific literature
  – Characterize specific root depths within soil conditions typical of SJRRP area
  – Provide quantitative support for the almond root zone threshold specified in the SMP
Phase 2 Study Concepts

Conceptual approach:

• Evaluate variety of representative soil and/or groundwater conditions

• Low invasive coring method to observe capillary fringe and/or roots in the field
Phase 2 Study Concepts

Conceptual approach (cont.):

• Build on existing data
• Obtain robust dataset to characterize the range in variability in root zone and/or capillary fringe
Phase 2 Study Concepts

Example study site

Example layout of core locations within a study site

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Next Steps – Phase 2

• Collaboration – We would like to work with you
• Scoping – Get input from growers on how to approach Phase 2
• Application – Determine objectives and refine approaches

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Thoughts?

- What do you think?
- Should we do a field study?
WRAP-UP, ACTION ITEMS
Contact

- Technical Feedback Group: Katrina Harrison
  - 916-978-5465
  - KHarrison@usbr.gov

- Seepage Concerns: Seepage Hotline
  - 916-978-4398
  - RestorationFlows@restoresjr.net
FIELD STUDY METHODS
Methods of Studying Root Depth

• Non-invasive

  – Ground Penetrating Radar
    • Transmits and senses waves from different media
    • Restricted to specific soil types and dry soils
  
  – Differential Electric Conductance
    • Measures differences in conductance caused by moisture
    • Technology needs more development
Methods of Studying Root Depth

• High Invasive
  – Whole Root Excavation and/or Pits and Trenches
    • Time, effort and cost intensive
    • Safety concerns
  – Root Excavation by Supersonic Airstream
    • “Blasts” soil away from roots
    • Time, effort and cost intensive
    • Requires specialized equipment and training

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Methods of Studying Root Depth (continued)

• Low Invasive
  – Hand-Operated Sampling Tubes and Augers
    • Ineffective in compacted/hard pan soils
    • Time consuming
  – Hydraulic Soil Core Sampling
    • Mechanical core sampling
    • Relatively quick
    • Possible in all soil types
    • Safe

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Capillary Fringe

Soil Surface

Capillary Rise

% water
% air

Soil Volumetric Water Content %

Saturated

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Figure A-2.
Vertical Section of 3D Capillary Fringe Simulation.
CF=Capillary Fringe (I and II); H=Height; S=Saturation.
**Terminology**

**Active Root Zone**
- The portion of the effective root zone where most of the nutrient and water uptake occur.

**Effective Root Depth**
- Typically thought of as the zone where most of the roots are and where most of the root function (anchorage, water and nutrient uptake) takes place.

**Maximum Root Depth**
- The total depth that a tree’s roots can (but don’t necessarily) reach.

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# Capillary Fringe Observations

<table>
<thead>
<tr>
<th>Category</th>
<th>Soil Texture</th>
<th>Number of Observations</th>
<th>Average Rise, Inches</th>
<th>95% Confidence Range, inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sand, loamy sand</td>
<td>15</td>
<td>6.9</td>
<td>4.1 – 9.1</td>
</tr>
<tr>
<td>2</td>
<td>Sandy loam, loamy fine sand</td>
<td>4</td>
<td>13.75</td>
<td>9.5 – 18.1</td>
</tr>
<tr>
<td>3</td>
<td>Fine sandy loam, loam, silt loam, very fine sandy loam</td>
<td>21</td>
<td>18.3</td>
<td>14.3 – 22.3</td>
</tr>
<tr>
<td>4</td>
<td>Clay loam, silty clay loam, clay</td>
<td>6</td>
<td>10.3</td>
<td>5.1 – 15.5</td>
</tr>
<tr>
<td>2 and 3</td>
<td>Loamy fine sand, silt loam</td>
<td>25</td>
<td>17.6</td>
<td>14.1 – 20.9</td>
</tr>
</tbody>
</table>

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# Capillary Fringe Observations

## 2009 to 2015

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Observations</th>
<th>Average Thickness (Inches)</th>
<th>95% Confidence Range (Inches)</th>
<th>Anoxic Zone Thickness (Inches)</th>
<th>Anoxic Zone Adjustment (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sands, loamy sands</td>
<td>39</td>
<td>8.6</td>
<td>7.2 - 10.0</td>
<td>4.3</td>
<td>6</td>
</tr>
<tr>
<td>All other soils</td>
<td>160</td>
<td>17.0</td>
<td>15.5 - 18.5</td>
<td>8.5</td>
<td>12</td>
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<tr>
<td>All soils</td>
<td>199</td>
<td>15.4</td>
<td>14.1 - 16.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Median Daily Electrical Conductivity – SJR near Mendota, CA

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