Sustainable groundwater management and groundwater dependent ecosystems

Jeanette Howard
Groundwater Data Workshop
January 28, 2016
Groundwater is a key resource, impacting freshwater ecosystems, land, population...
... and providing vital support to ecosystems

- Ecosystems losses and drop in groundwater levels are correlated
- Groundwater levels maintain groundwater dependent ecosystems and baseflows to our rivers and streams
Road Map

• How are GDEs protected under SGMA?
• What and where are GDEs?
• Thoughts on managing for interconnected surface water and GDEs
Road Map

• How are GDEs protected under SGMA?
• What and where are GDEs?
• Thoughts on managing for interconnected surface water and GDEs
SGMA: STATE POLICY OF SUSTAINABLE, LOCAL GROUNDWATER MANAGEMENT

“It is the policy of the state that groundwater resources be managed sustainably for long-term reliability and multiple economic, social, and environmental benefits for current and future beneficial uses. Sustainable groundwater management is best achieved locally through the development, implementation, and updating of plans and programs based on the best available science.” (Water Code Section 113)
SGMA’s Ecosystem Protection Requirements

SGMA definition of sustainability

Links with ECOSYSTEMS benefits

1. Lowering of groundwater levels
2. Depletion of interconnected surface water

Source: Union of Concerned Scientists 2015
SGMA: GROUNDWATER SUSTAINABILITY PLANS

10727.4. ADDITIONAL PLAN ELEMENTS include:

(i) Impacts on groundwater dependent ecosystems.
Road Map

• How are GDEs protected under SGMA?
• **What and where are GDEs?**
• Thoughts on managing for interconnected surface water and GDEs
GDE types and classification

SUBSURFACE ECOSYSTEMS

- Karst and caves
- Subsurface phreatic aquifer ecosystems
- Baseflow (hyporheic)
GDE types and classification

SURFACE ECOSYSTEMS

• Groundwater dependent wetlands and vegetation alliances
• Baseflow (streams)
• Phreatophytes
• Seeps and springs
• Estuarine and near shore marine ecosystems
Building the case for nature: Mapping GDEs Statewide

UPDATING DATA AND DEVELOPING ONLINE TOOL
Mapping GDEs at the Basin scale

1. Map riparian phreatophytes

2. Map depth to groundwater

3. Overlay

* 70% of the riparian vegetation (almost 14,000 acres) is found in areas where groundwater is less than 30 feet below the surface.

*Phreatophytes in areas with deeper groundwater (>30 feet) may be relying on perched aquifers or summer dam releases.
April 2011

The Nature Conservancy
December 2013
May 2015

The Nature Conservancy
Building the case for nature:
Assess surface water-groundwater interaction
Groundwater contribution to rivers
Road Map

• How are GDEs protected under SGMA?
• What and where are GDEs?
• **Thoughts on managing for interconnected surface water and GDEs**
Groundwater-Dependent Ecosystems: Ecosystems that require access to, replenishment or benefit from, or otherwise rely on subsurface stores of water to function or persist. Groundwater-Dependent Ecosystems are often supported by Interconnected Surface Water.
Disconnected Surface Water: surface waters that feature a year-round, unsaturated zone of sediments between the lowest elevation of the surface water body and the top of the saturated groundwater zone and that infiltrate water through the unsaturated zone into groundwater.

Interconnected Surface Water: Surface waters, including streams, lakes, rivers, and wetlands that are not disconnected from groundwater. This includes losing streams and water bodies where surface water is being lost but is still connected to groundwater by a saturated zone. Interconnected Surface Water often supports Groundwater-Dependent Ecosystems.
GSPs

- Map Interconnected Surface Water (ISW) and Groundwater-Dependent Ecosystems (GDEs)
- List of ecosystems rely on ISW and/or comprise GDEs
- A water budget that includes needs of native plants and animals in terms groundwater levels necessary to sustain them.
- Measurable ecological objectives for maintaining and enhancing ISW and GDE health. (e.g. Measuring What Matters 2015)
  - Objectives to maintain groundwater levels should include levels needed to sustain GDEs.
  - Objectives to maintain interconnected surface waters
  - Set ecological thresholds and triggers conservatively
- Monitor the size, volume and temporal availability of interconnected surface water bodies.
- Monitor extent and health of GDEs
**Assessing and Managing Risk: A Framework for Managing for GDEs (and ISWs)**

- Identify GDEs
- Classify GDEs
- Assess & Map GDE Risk
- Identify GDE Thresholds
- Monitor and Manage GDE Risk

  - TNC mapping effort
  - Based on local groundwater levels
  - Risk determined through scoring
  - Thresholds would be statewide defined according to Risk and GDE classifications
  - GSAs would outline this in their GSPs

Source: NSW Office of Water, 2012
Froend et al., 2004
Assessing Risk to GDEs: A Wetland example

**SUSCEPTIBILITY SCORE = A + B + C**

### A

<table>
<thead>
<tr>
<th>Conservation Value Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem with international, national or regional conservation values (legislated) that has little evidence of alteration from surrounding land-use practices</td>
<td>1</td>
</tr>
<tr>
<td>Ecosystem with international, national, or regional conservation values (legislated) that has evidence of low to moderate impacts from surrounding land-use practices</td>
<td>2</td>
</tr>
<tr>
<td>Ecosystem that has not been assessed for conservation values or is poorly understood, and that has evidence of low to moderate impacts from surrounding land-use</td>
<td>3</td>
</tr>
<tr>
<td>Ecosystem with no recognized conservation values that has been moderately to severely degraded by surrounding land-use patterns</td>
<td>4</td>
</tr>
</tbody>
</table>

### B

**Historic rate of gw level change**

<table>
<thead>
<tr>
<th>Wetland Category</th>
<th>No change or increase</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3 m</td>
<td>-</td>
<td>&lt;0.25m</td>
<td>0.25-0.5m</td>
<td>&gt;0.5m</td>
</tr>
<tr>
<td>3-6m</td>
<td>-</td>
<td>&lt;0.75m</td>
<td>0.75-1m</td>
<td>&gt;1m</td>
</tr>
<tr>
<td>6-10m</td>
<td>-</td>
<td>&lt;1.25m</td>
<td>1.25-1.5m</td>
<td>&gt;1.5m</td>
</tr>
</tbody>
</table>

### C

<table>
<thead>
<tr>
<th>Depth to groundwater Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10m</td>
<td>4</td>
</tr>
<tr>
<td>6-10m</td>
<td>3</td>
</tr>
<tr>
<td>3-6m</td>
<td>2</td>
</tr>
<tr>
<td>0-3m</td>
<td>1</td>
</tr>
</tbody>
</table>

(Froend, et al., 2004)
Identifying Thresholds Based on Risk Classification

RISK OF IMPACT LEVEL AND MAGNITUDE OF CHANGE (M/YEAR)

Table 2: Risk of impact level and magnitude of permissible change (m) for phreatophytic vegetation.

<table>
<thead>
<tr>
<th>Phreatophytic category</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3m (wetland)</td>
<td>0-0.25</td>
<td>0.25-0.5</td>
<td>0.5-0.75</td>
<td>&gt;0.75</td>
</tr>
<tr>
<td>0-3m (terrestrial)</td>
<td>0-0.75</td>
<td>0.75-1.25</td>
<td>1.25-1.75</td>
<td>&gt;1.75</td>
</tr>
<tr>
<td>3-6m</td>
<td>0-1.0</td>
<td>1.0-1.5</td>
<td>1.5-2.25</td>
<td>&gt;2.25</td>
</tr>
<tr>
<td>6-10m</td>
<td>0-1.25</td>
<td>1.25-2.0</td>
<td>2.0-2.75</td>
<td>&gt;2.75</td>
</tr>
</tbody>
</table>

Table 3: Risk of impact level and rate of permissible change (m/year) for phreatophytic vegetation.

<table>
<thead>
<tr>
<th>Phreatophytic category</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3m (wetland)</td>
<td>0-0.1</td>
<td>0.1-0.2</td>
<td>0.2-0.3</td>
<td>&gt;0.3</td>
</tr>
<tr>
<td>0-3m (terrestrial)</td>
<td>0-0.1</td>
<td>0.1-0.25</td>
<td>0.25-0.5</td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>3-6m</td>
<td>0-0.1</td>
<td>0.1-0.25</td>
<td>0.25-0.5</td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>6-10m</td>
<td>0-0.1</td>
<td>0.1-0.25</td>
<td>0.25-0.5</td>
<td>&gt;0.5</td>
</tr>
</tbody>
</table>

(Froend, et al., 2004)
Monitoring and Managing GDEs Based on Risk Classification

Possible Management Options:

1. Restrict groundwater pumping or impose groundwater management fees (as authorized under SGMA).

2. Construct groundwater recharge projects (in lieu or direct)
FINAL THOUGHTS

• We can begin to develop tools and guidance to manage for GDEs today.

• Data will help reduce uncertainty – but we don’t need to wait for perfect data to take action.