Approach to Numerical Groundwater-Flow and Contaminant Fate and Transport Modeling

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Hadnot Point/Holcomb Boulevard Modeling Approach

- Groundwater Flow Modeling-Regional
  - Steady-State
  - Transient
- Groundwater Flow Modeling-Local
- Contaminant Fate and Transport-Local
Tarawa Terrace Model

- Groundwater Flow (MODFLOW)
- Contaminant Fate and Transport (MT3DMS)
- Simple Mixing Model (WTP)
- Water Distribution System (EPANET)

*** D R A F T - SUBJECT TO CHANGE ***
343 rows
303 columns
10 layers
Cell size=150 ft/side
**PEST optimization**

### Horizontal Hydraulic Conductivity

<table>
<thead>
<tr>
<th>Iteration</th>
<th>$\Phi$ (ft/day)</th>
<th>Layer 1 (ft/day)</th>
<th>Layer 2 (ft/day)</th>
<th>Layer 4 (ft/day)</th>
<th>Layer 6 (ft/day)</th>
<th>Layer 8 (ft/day)</th>
<th>Layer 10 (ft/day)</th>
<th>Zone 1</th>
<th>Zone 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60479</td>
<td>13.5</td>
<td>23.5</td>
<td>37.4</td>
<td>37.4</td>
<td>15.5</td>
<td>15.5</td>
<td>0.00200</td>
<td>0.00200</td>
</tr>
<tr>
<td>2</td>
<td>42427</td>
<td>2.7</td>
<td>24.7</td>
<td>35.4</td>
<td>37.0</td>
<td>15.8</td>
<td>17.1</td>
<td>0.00141</td>
<td>0.00308</td>
</tr>
<tr>
<td>3</td>
<td>41891</td>
<td>5.1</td>
<td>26.4</td>
<td>34.3</td>
<td>37.1</td>
<td>16.5</td>
<td>18.8</td>
<td>0.00141</td>
<td>0.00365</td>
</tr>
<tr>
<td>4</td>
<td>40987</td>
<td>6.9</td>
<td>29.4</td>
<td>29.9</td>
<td>36.0</td>
<td>15.7</td>
<td>21.2</td>
<td>0.00136</td>
<td>0.00369</td>
</tr>
<tr>
<td>5</td>
<td>40914</td>
<td>3.6</td>
<td>31.8</td>
<td>6.0</td>
<td>29.2</td>
<td>10.5</td>
<td>31.6</td>
<td>0.00134</td>
<td>0.00313</td>
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<tr>
<td>6</td>
<td>40900</td>
<td>3.5</td>
<td>32.3</td>
<td>1.2</td>
<td>28.4</td>
<td>9.1</td>
<td>34.5</td>
<td>0.00134</td>
<td>0.00298</td>
</tr>
</tbody>
</table>

Total model calls = 78

\[
\Phi = \sum_{i=1}^{n} \left( h_o - h_s \right)^2
\]
Calibration results

- Automated Parameter Calibration
  - PEST
  - UCODE
- RMS Error = 5.46 ft

EXPLANATION
- Red dots: Monitor Wells
- Blue diamonds: Supply Wells

OBSERVED WATER LEVEL, IN FEET ABOVE NGVD 1929

SIMULATED WATER LEVEL, IN FEET ABOVE NGVD 1929

29 APR 09

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Steady-State Model Preliminary Results

HEAD RESIDUALS

- < -5 ft
- -5 ft to 5 ft
- > 5 ft
- > 37 ft

*** DRAFT - SUBJECT TO CHANGE ***

29 APR 09
# HPHB and TT side-by-side comparison

<table>
<thead>
<tr>
<th></th>
<th>Tarawa Terrace</th>
<th>HPHB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Row</strong></td>
<td>200</td>
<td>343</td>
</tr>
<tr>
<td><strong>Column</strong></td>
<td>270</td>
<td>303</td>
</tr>
<tr>
<td><strong>Layer</strong></td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td><strong>Cell Size</strong></td>
<td>50 ft</td>
<td>150 ft</td>
</tr>
</tbody>
</table>

**Available data:**

<table>
<thead>
<tr>
<th></th>
<th>Tarawa Terrace</th>
<th>HPHB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady state</td>
<td>59 measurements</td>
<td>546 measurements</td>
</tr>
<tr>
<td>Transient</td>
<td>789 measurements</td>
<td>5407 measurements</td>
</tr>
<tr>
<td><strong>Contaminant</strong></td>
<td>PCE</td>
<td>Chlorinated Solvents</td>
</tr>
<tr>
<td>concentration</td>
<td>36 supply wells</td>
<td>100 supply wells</td>
</tr>
<tr>
<td></td>
<td>25 WTP</td>
<td>31 HP WTP</td>
</tr>
</tbody>
</table>
Proposed approach

Numerical Model → Steady-State Flow Model → Transport model on LGR models

→ Transient Flow Model

Choose Areas for LGR

→ Evaluate effects of pumping at LGR boundaries

*** D R A F T - SUBJECT TO CHANGE ***
Proposed approach

Numerical Model

Steady-State Flow Model

Transient Flow Model

Choose Areas for LGR

Evaluate effects of pumping at LGR boundaries

Transport model on LGR models

• MODFLOW 2000
• PEST
Proposed approach

1. **Numerical Model**
2. **Steady-State Flow Model**
3. **Transport model on LGR models**
4. **Transient Flow Model**
5. **Choose Areas for LGR**
6. **Evaluate effects of pumping at LGR boundaries**

*** D R A F T - SUBJECT TO CHANGE ***
Proposed approach

Numerical Model → Steady-State Flow Model → Transport model on LGR models

Transient Flow Model → Choose Areas for LGR

Evaluate effects of pumping at LGR boundaries
Proposed approach

Numerical Model → Steady-State Flow Model → Transport model on LGR models

Choose Areas for LGR → Transient Flow Model

Evaluate effects of pumping at LGR boundaries

MT3DMS
PEST
Questions