WATER DEMAND SCENARIOS: UNDERSTANDING and APPLICATION

Derek Winstanley
RWSPC
November 21, 2008

Data from Professor Dziegielewski’s and Wittman Hydro Planning Associates Inc.
water demand reports (2008)
## COMPARISONS:
### NE ILLINOIS & E-C ILLINOIS
(gallons per capita per day without electric power)

<table>
<thead>
<tr>
<th></th>
<th>NE ILLINOIS</th>
<th>E-C ILLINOIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 2005</td>
<td>8.74M</td>
<td>Population 2005</td>
</tr>
<tr>
<td></td>
<td>2050 12.11M</td>
<td>2050 1.34M</td>
</tr>
<tr>
<td>GPCD 2005 normal</td>
<td>169</td>
<td>GPCD 2005 normal</td>
</tr>
<tr>
<td>2050 LRI</td>
<td>131</td>
<td>2050 LRI</td>
</tr>
<tr>
<td>2050 CT</td>
<td>166</td>
<td>2050 CT</td>
</tr>
<tr>
<td>2050 MRI</td>
<td>201</td>
<td>2050 MRI</td>
</tr>
</tbody>
</table>
## WATER DEMAND (million gallons per day) without electric power

<table>
<thead>
<tr>
<th>NE ILLINOIS</th>
<th>E-C ILLINOIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2005 NORMAL</strong></td>
<td><strong>2005 NORMAL</strong></td>
</tr>
<tr>
<td>1,480</td>
<td>339</td>
</tr>
<tr>
<td><strong>2050 LRI</strong></td>
<td><strong>2050 LRI</strong></td>
</tr>
<tr>
<td>+107 (+7%)</td>
<td>+120 (+35%)</td>
</tr>
<tr>
<td><strong>2050 CT</strong></td>
<td><strong>2050 CT</strong></td>
</tr>
<tr>
<td>+530 (+36%)</td>
<td>+174 (+51%)</td>
</tr>
<tr>
<td><strong>2050 MRI</strong></td>
<td><strong>2050 MRI</strong></td>
</tr>
<tr>
<td>+949 (+64%)</td>
<td>+233 (+69%)</td>
</tr>
<tr>
<td><strong>DROUGHT CT</strong></td>
<td><strong>DROUGHT CT</strong></td>
</tr>
<tr>
<td>+128 (+9%)</td>
<td>+106 (+31%)</td>
</tr>
<tr>
<td>+3°F TEMP CT</td>
<td>+3°F TEMP CT</td>
</tr>
<tr>
<td>+89 (+6%)</td>
<td>+39 (+12%)</td>
</tr>
<tr>
<td>CT+DR+3°F</td>
<td>CT+DR+3°F</td>
</tr>
<tr>
<td>+747 (+50%)</td>
<td>+319 (+93%)</td>
</tr>
<tr>
<td><strong>PEAK SEASON</strong></td>
<td><strong>PEAK SEASON</strong></td>
</tr>
<tr>
<td>x0.2 - x2.0</td>
<td>x0.2 - x2.7</td>
</tr>
<tr>
<td><strong>PEAK DAY</strong></td>
<td><strong>PEAK DAY</strong></td>
</tr>
<tr>
<td>x1.6 – x3.0</td>
<td>x1.6 – x7.0</td>
</tr>
</tbody>
</table>
EAST-CENTRAL ILLINOIS
WATER DEMAND TO 2050 (MGD)
CURRENT TRENDS SCENARIO [blue = 2005 normal]

1. CT Scenario
   (average annual daily)
2. Peak season (x2?)
3. Peak day (x3.5?)
ELASTICITIES OF EXPLANATORY VARIABLES
PUBLIC WATER SUPPLIES (1985-2005)

<table>
<thead>
<tr>
<th>NE ILLINOIS</th>
<th>E-C ILLINOIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer temp</td>
<td>1.10</td>
</tr>
<tr>
<td>Summer precip</td>
<td>-0.09</td>
</tr>
<tr>
<td>Empl/pop ratio</td>
<td>0.09</td>
</tr>
<tr>
<td>Water price</td>
<td>-0.15</td>
</tr>
<tr>
<td>Income</td>
<td>0.28</td>
</tr>
<tr>
<td>Conservation</td>
<td>-0.06</td>
</tr>
<tr>
<td>Summer temp</td>
<td>1.42</td>
</tr>
<tr>
<td>Summer precip</td>
<td>-0.11</td>
</tr>
<tr>
<td>Empl/pop ratio</td>
<td>0.64</td>
</tr>
<tr>
<td>Water price</td>
<td>-0.22</td>
</tr>
<tr>
<td>Income</td>
<td>0.32</td>
</tr>
<tr>
<td>Conservation</td>
<td>-0.003</td>
</tr>
</tbody>
</table>
### E-C ILLINOIS:
**SENSITIVITY TO CHANGING VALUES OF VARIABLES**

**Public Water Supply**

<table>
<thead>
<tr>
<th>Variable</th>
<th>a) 20% change in GPCD can be achieved by changing the variables by the following %</th>
<th>b) If the variables change by 20% GPCD changes by the following %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household income</td>
<td>62%</td>
<td>6%</td>
</tr>
<tr>
<td>Water conservation</td>
<td>6,666%</td>
<td>0.06%</td>
</tr>
<tr>
<td>Water price</td>
<td>91%</td>
<td>4%</td>
</tr>
<tr>
<td>Employ/population ratio</td>
<td>31%</td>
<td>13%</td>
</tr>
<tr>
<td>Summer temperature</td>
<td>14% (= 11°F)</td>
<td>28% (= 23°F)</td>
</tr>
<tr>
<td>Summer precipitation</td>
<td>182% (= 33 ins)</td>
<td>2% (= 0.4ins)</td>
</tr>
</tbody>
</table>

Population: a 20% change in population would result in a 20% change in water demand, if GPCD remains constant.
# Public Water Supply: EXPLANATORY VARIABLES USED TO 2050

## NE ILLINOIS
- Population: +39%
- Empl/pop ratio constant
- LRI
- Income: +0.5% yr
- Water price: +2.5% yr
- Conservation: Historical trend +50%
- + more people Cook & DuPage

## E-C ILLINOIS
- Population: +28%
- Empl/pop ratio constant
- LRI
- Income: +0.5% yr
- Water price: +1.5% yr
- Conservation: reduced to 10% historical

## CT
- Income: +0.7% yr
- Water price: +0.9% yr
- Conservation: Historical trend

## MRI
- Income: +1.0% yr
- Water price: 0% yr
- Conservation trend removed
+ more people Kane, Kendall & McHenry
WATER DEMAND TO 2050 (mgd): 11 COUNTIES NE ILLINOIS
(Same % increases for drought and climate change assumed for LRI and MRI scenarios as in CT scenario)
WATER DEMAND TO 2050 (mgd):
15 COUNTIES EAST-CENTRAL ILLINOIS
(Same % increases for drought and climate change assumed for LRI and MRI scenarios as in CT scenario)
Water withdrawals in East-Central Illinois (mgd) by water-use sector – excluding power generation
Water withdrawals in Northeastern Illinois (mgd) by water-use sector – excluding power generation

- **Domestic**
- **Irrigation and Agriculture**
- **Commerce & industry**
- **Public water supplies**

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic</th>
<th>Irrigation and Agriculture</th>
<th>Commerce &amp; industry</th>
<th>Public water supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 Normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050 LRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050 CT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050 MRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
East-Central Illinois: Effects of drought and climate change on water withdrawals (mgd): CT scenario
CONCLUSIONS

• Regional approach selected because of regional differences
• NE and EC Illinois are very different regions
• Population in NE Illinois projected to increase by 3.4 million and in Illinois by 0.3 million
• Much more water needed in NE Illinois although % increase is larger in EC Illinois
• CMAP – committed to integrated regional planning and management
• Much more irrigation in EC Illinois
• Wide range of uncertainty in future water demands
• Assumptions about future water demands different in 2 regions
• No reason why management plans for NE and EC Illinois should be the same
CONCLUSIONS (contd.)

• Planning for drought with 40% below normal precipitation could give slightly more protection than planning for climate change with precipitation 3.5ins below normal and an increase in temperature of 3ºF.
QUESTIONS for the RWSPC

• How can 3 scenarios be used?
• Select one scenario as the best planning scenario to 2050?
  2005 (339mgd) +CT (+174mgd) + drought (+106mgd)
  = 619mgd = +83%
• Texas model would be:
  2005 (339mgd) +pop.increase (+102mgd) + drought
  (+106mgd) = +547mgd = +61%
• Would there be any reason to recommend a decrease in water withdrawals below a baseline scenario? e.g. if ISWS analysis indicates impacts of these withdrawals are unacceptable to you, or you conclude that current and future water-use practices should be more efficient.