Meeting Requirements for Water Supply Permitting

Wednesday June 3, 2015
Westborough, Mass.
Agenda

9:00 am  Welcome and Introductions
9:15    Brief Review of the WMA Regulations
9:30    Your Requirements
10:00   Assessing Potential Actions across Your Subbasin(s) and System(s)
10:30   BREAK
10:45   Methods, Tools and Resources
11:55   Review and Adjourn

** Please complete the training evaluation before leaving **

Time is allotted for questions and discussion in each section.
New Permitting Requirements

1. **Coldwater Fishery Resource consult**
   If you have a permitted source in a subbasin with a CFR; pumping optimization focused on CFRs

2. **Minimize Existing Impacts on Streamflow**
   If you have a permitted source in a depleted subbasin*

3. **Mitigate impact of increased withdrawals**
   For requests above baseline

4. **Show no feasible alternative**
   If your request makes the subbasin change to a more impacted category

* At least 25% August net groundwater depletion (est. August streamflow level in an unimpacted subbasin, minus gw withdrawals, plus returns via septic or gw discharges).
A. Minimizing existing impacts

A. **Desktop Optimization** of existing and alternative sources—screening operational changes and alternative sources to decrease impacts on streamflow

B. **Water Releases** from upstream surface sources that could improve streamflow, or **Returns** to the subbasin by increasing recharge or decreasing I/I, preferably to same subbasin

C. **Additional Conservation Measures** that go beyond the standard WMA requirements, both indoor and outdoor, such as outdoor watering restrictions, reduce water losses. Meet 65/10 performance standards.

D. **Alternatives** can be proposed that will minimize impacts

E. **Develop a Minimization Plan** to be approved by DEP.
B. Mitigating future impacts

“Prior to beginning any mitigation planning, priority should be given to exhausting all feasible options for demand management”

A. **Direct mitigation**: I/I improvements, stormwater recharge, surface water releases. Volumes can be calculated.

B. **Indirect mitigation**: stream restoration, private well bylaw, culvert replacements to meet crossing standards, land protection in zone I or II, dam removal, etc. Qualitative credit system against withdrawals.

C. **Develop a Mitigation Plan** to be approved by DEP. Mitigation should be commensurate with impact.
# Subbasin Data Summary

<table>
<thead>
<tr>
<th>Subbasin Data Summary</th>
<th>subbasin 12010</th>
<th>subbasin 12020</th>
<th>subbasin 12026</th>
<th>subbasin 12027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent August Net Groundwater Depletion</td>
<td>43.0%</td>
<td>59.6%</td>
<td>55.4%</td>
<td>surcharged</td>
</tr>
<tr>
<td>MWI Affected Flow (for use in Source Optimization for Minimization Planning)</td>
<td>0.459</td>
<td>4.929</td>
<td>0.206</td>
<td>0.5</td>
</tr>
<tr>
<td>Groundwater Withdrawal Category (GWC)</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Does increase above BL cause GWC change?</td>
<td>&gt;0.019 mgd</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Biological Category (BC)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Does increase above BL cause BC change?</td>
<td>No</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Permitted Sources</td>
<td>07G, 08G</td>
<td>03G, 04G, 06G, 10G, 11G</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Registered only Sources</td>
<td>none</td>
<td>05G</td>
<td>01G, 02G</td>
<td>Sandra Pond</td>
</tr>
</tbody>
</table>

## Non-essential Outdoor Water Use Streamflow Trigger Information May 1 through Sept 30

USGS Gage 01097000 - Assabet River at Maynard, MA

<table>
<thead>
<tr>
<th>Time Period</th>
<th>May - June</th>
<th>July - Sept</th>
<th>7 Day Low Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger Value</td>
<td>119 cfs</td>
<td>42 cfs</td>
<td>18 cfs</td>
</tr>
</tbody>
</table>
# Permit Renewal Summary Sheet

## Permit Data Summary

### Existing Total WMA Authorization (mgd)
- 3.1

### Registration Volume (mgd)
- 1.92

### Permitted Volume (mgd)
- 1.18

### Number of Sources

<table>
<thead>
<tr>
<th>Ground</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>10*</td>
<td>1</td>
</tr>
</tbody>
</table>

*7 wells are permitted

### Reported Use Summary

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Withdrawal (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.99</td>
</tr>
<tr>
<td>2011</td>
<td>2.1</td>
</tr>
<tr>
<td>2012</td>
<td>2.23</td>
</tr>
<tr>
<td>2013</td>
<td>2.08</td>
</tr>
<tr>
<td>2014</td>
<td>1.97</td>
</tr>
</tbody>
</table>

#### Average
- 2.07

### Performance Standard Summary

<table>
<thead>
<tr>
<th>Standard</th>
<th>Base from DCR Forecast</th>
<th>2013 DEP Accepted</th>
<th>Statewide Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGPCD</td>
<td>NA</td>
<td>64</td>
<td>65</td>
</tr>
<tr>
<td>UAW</td>
<td>NA</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

### Water Needs Forecast Summary

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2021</th>
<th>2026</th>
<th>2031</th>
<th>5% Buffer</th>
<th>2031 + buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on 65 RGPCD and 10% UAW (mgd)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Temporary Allocation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Permit Requirements Information</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated total allocation (reg + perm)</td>
<td>TBD</td>
</tr>
<tr>
<td>Baseline (BL) in mgd</td>
<td>2.30</td>
</tr>
<tr>
<td>Projected increase above BL</td>
<td>TBD</td>
</tr>
<tr>
<td>Estimated Permit Tier</td>
<td>1 to 3</td>
</tr>
<tr>
<td>Mitigation Plan Required?</td>
<td>TBD</td>
</tr>
<tr>
<td>Coldwater Fishery Resource (CFR) Consult?</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimization Required?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Temporary Allocation to be determined during permit process.

2005 withdrawal volume + 5%

Actual withdrawals are below baseline, but projected total allocation may exceed baseline.

Permit tier and mitigation depend on temporary allocation. Increase above baseline changes GWC in subbasin 12010

CFR present in subbasin 12020. CFRs also present in subbasins 12026 and 12027, but sources are not permitted.

August net depletion is greater than 25% in subbasins 12010 & 12020.
Welcome to the Massachusetts Water Management Act (WMA) Permitting Tool. This database is for use by Public Water Suppliers (PWS), consultants, watershed groups, government agencies and others to evaluate the impact of groundwater withdrawals. Water Management Act permitting requires that new groundwater sources and/or increases in groundwater withdrawals from existing sources be evaluated for impact to streamflow. The WMA Permitting Tool can be used in conjunction with the SWMI interactive map, available at the SWMI Technical Resources webpage (link below). The WMA Permitting Tool is organized into two main screens: PWS and Subbasin Characteristics. The PWS screen contains data for each of the approximately 250 PWSs regulated under the WMA: baseline and 20-Year Water Needs Forecast rates; year 2010 Authorized rates; actual annual use since 2006; and authorized rates for those PWS permits that have been renewed for 20 years. The PWS screen also lists the PWS wells and other water use points (e.g. NPDES discharge points, groundwater discharge points, wells of non-PWS entities such as golf courses, and wells of non-WMA PWS entities such as restaurants) in each subbasin in which the PWS has water supply sources.

DEP SWMI Webpage: http://www.mass.gov/dep/water/resources/swmi.htm
# WMA Tool – Subbasin View

**Subbasin Characteristics**

<table>
<thead>
<tr>
<th>Sub Basin ID:</th>
<th>Major Basin:</th>
<th>HUC12 Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>13055</td>
<td>Merrimack</td>
<td>Stony Brook</td>
</tr>
</tbody>
</table>

**Subbasin Cumulative Data (includes this subbasin and all upstream contributing subbasins)**

<table>
<thead>
<tr>
<th>Subbasin Information</th>
<th>August Wastewater Discharges (mgd)</th>
<th>August Groundwater Withdrawals (mgd)</th>
<th>Additional GW Withdrawal Volume to Cause a Change in Existing GWC and BC:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Square Miles):</td>
<td>Ground Water Discharge: 0.000</td>
<td>PWS and Commercial Wells: 1.468</td>
<td>To Change GWC (mgd): 0.000</td>
</tr>
<tr>
<td>Impervious Cover (%)</td>
<td>Septic Systems: +0.186</td>
<td>Private Wells: +0.176</td>
<td>To Change BC (mgd): 0</td>
</tr>
<tr>
<td>Surface Water withdrawals exist in or upstream of subbasin:</td>
<td>Total Subsurface Discharge: = 0.186</td>
<td>Total Groundwater Withdrawals: 1.644</td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td>Surface Water (NPDES): 0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Individual Subbasin Data (only includes this subbasin)**

| Coldwater Fisheries Resource Exist: | Net Groundwater Depletion (NGD): 124.7 |

| Net Groundwater Depletion (%) | 124.7 |

**Unaffected streamflow, Ground Water withdrawals, Groundwater Withdrawal Category (GWC) and Biologic Category (BC).**

<table>
<thead>
<tr>
<th>Estimated August Condition</th>
<th>Proposed Changes to existing GW Withdrawal</th>
<th>Existing vs. Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaffected Streamflow (mgd)*</td>
<td>1.189</td>
<td></td>
</tr>
<tr>
<td>GW Withdrawals (mgd)**</td>
<td>-1.644</td>
<td></td>
</tr>
<tr>
<td>(Unaffected Streamflow) - (GW Withdrawals)</td>
<td>= -0.475</td>
<td></td>
</tr>
<tr>
<td>(GW Withdrawals) / (Unaffected Streamflow)</td>
<td>= 140.6%</td>
<td></td>
</tr>
<tr>
<td>Groundwater Withdrawal Category (1-5)</td>
<td>GWC: 5</td>
<td></td>
</tr>
<tr>
<td>Biologic Category (1-5)</td>
<td>BC: 5</td>
<td></td>
</tr>
</tbody>
</table>

**Proposed Changes to existing GW Withdrawal**

<table>
<thead>
<tr>
<th>Change (+/-) to existing GW Withdrawal (mgd)</th>
<th>Unaffected Streamflow (mgd)</th>
<th>Proposed Total GW Withdrawal (mgd)</th>
<th>(Unaffected Streamflow) - (Prop. GW Withdrawal)</th>
<th>(Proposed GW Withdrawal) / (Unaffected Streamflow)</th>
<th>Proposed Groundwater Withdrawal Category (1-5)</th>
<th>Proposed Biologic Category (1-5)</th>
<th>Existing vs. Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change (+/-) to existing GW Withdrawal (mgd)</td>
<td>1.189</td>
<td>-1.644</td>
<td>= -0.475</td>
<td>= 140.6%</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Existing vs. Proposed**

<table>
<thead>
<tr>
<th>Percent Difference</th>
<th>0.0%</th>
<th>Change in GWC?</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in BC?</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### WMA Tool – PWS View

#### Baseline and 20 Year Water Needs Forecast Rates:

<table>
<thead>
<tr>
<th>BASIN</th>
<th>Baseline Rate (MGD)</th>
<th>Baseline Methodology</th>
<th>20 Year Water Needs Forecast + 5% (65/10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERRIMACK</td>
<td>1.11</td>
<td>2003-2005 AVG + 5%</td>
<td>Water Needs Forecast not yet done</td>
</tr>
</tbody>
</table>

#### 2010 Authorized Rates:

<table>
<thead>
<tr>
<th>BASIN</th>
<th>Registered Rate (MGD)</th>
<th>2010 Permitted Rate (MGD)</th>
<th>2010 Authorized Rate (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERRIMACK</td>
<td>0.83</td>
<td>0.63</td>
<td>1.46</td>
</tr>
</tbody>
</table>

#### Actual Annual Use (mgd):

<table>
<thead>
<tr>
<th>BASIN</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERRIMACK</td>
<td>1.23</td>
<td>1.36</td>
<td>1.1</td>
<td>1.11</td>
<td>1.23</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

#### PWS Authorized Rates, Water Use Points and Subbasins:

- PWS Withdrawal Points by Subbasin
- All Water Use Points in PWS’s Subbasin
- Subbasins

#### Comments:

Merrimack permits not yet renewed
## All Water Use Points In Subbasins

<table>
<thead>
<tr>
<th>SUB BASIN ID</th>
<th>TOWN</th>
<th>ASIN</th>
<th>PROGRAM</th>
<th>SOURCE TYPE</th>
<th>POINT NAME</th>
<th>DEP POINT ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>13065</td>
<td>AYER</td>
<td>Merrimack</td>
<td>WMA/PWS</td>
<td>Withdrawal-GW</td>
<td>SPECTACLE POND # 1 WELL</td>
<td>2019000-03G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OWNER: AYER DPW WATER DIVISION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AYER</td>
<td>Merrimack</td>
<td>WMA/PWS</td>
<td>Withdrawal-GW</td>
<td>SPECTACLE POND # 2 WELL</td>
<td>2019000-04G</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>OWNER: AYER DPW WATER DIVISION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AYER</td>
<td>Merrimack</td>
<td>PWS</td>
<td>Withdrawal-GW</td>
<td>WELL #1</td>
<td>2019007-01G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OWNER: LITTLETON LYNE APARTMENTS</td>
<td></td>
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<tr>
<td></td>
<td>GROTON</td>
<td>Merrimack</td>
<td>PWS</td>
<td>Withdrawal-GW</td>
<td>WELL #1</td>
<td>2115005-01G</td>
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<tr>
<td></td>
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<td>OWNER: GROTON JADE</td>
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<tr>
<td></td>
<td>LITTLETON</td>
<td>Merrimack</td>
<td>NPDES</td>
<td>Discharge-SW</td>
<td>SPECTACLE POND WTF - LITTLETON</td>
<td>2150000-04G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OWNER: SPECTACLE POND WTF - LITTLETON</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LITTLETON</td>
<td>Merrimack</td>
<td>WMA/PWS</td>
<td>Withdrawal-GW</td>
<td>GPW SPECTACLE POND (WELL #5)</td>
<td>2150000-04G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OWNER: LITTLETON WATER DEPARTMENT</td>
<td></td>
</tr>
</tbody>
</table>
Assessing Subbasins and Systems

- Review data
- Triage management options by assessing overall conditions

Subbasins
- Impact status
- Withdrawals to change categories
- Impoundments (ponds, reservoirs)

System water flows
- Permittee’s withdrawals and discharges
- Other withdrawals and discharges
Assessing Subbasins and Systems

<table>
<thead>
<tr>
<th>Subbasin ID</th>
<th>Aug Net Depletion (%)</th>
<th>CFR</th>
<th>GWC (mgd)</th>
<th>Change GWC (mgd)</th>
<th>BC</th>
<th>Change BC (mgd)</th>
<th>Intersecting Towns</th>
<th>August Unaffected Flow (mgd)</th>
<th>August GW withdrawals (mgd)</th>
<th>August GW discharges (mgd)</th>
<th>Major Sources</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source subbasins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13055</td>
<td>125</td>
<td>No</td>
<td>5</td>
<td>NA</td>
<td>5</td>
<td>NA</td>
<td>Harvard, Ayer, Groton, Westford</td>
<td>1.169</td>
<td>1.644</td>
<td>0.186</td>
<td>LWD Gw 0.56; Ayer Gw 0.91</td>
<td>Ayer sewered &amp; discharge out of subbasin</td>
</tr>
<tr>
<td>13054</td>
<td>89</td>
<td>No</td>
<td>5</td>
<td>NA</td>
<td>5</td>
<td>NA</td>
<td>Westford</td>
<td>1.661</td>
<td>1.821</td>
<td>0.349</td>
<td>LWD Gw 0.69; Westford Gw 0.86; non-PWS Gw 0.15</td>
<td>SWD 0.293</td>
</tr>
<tr>
<td>Non-source subbasins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12047</td>
<td>-23</td>
<td>No</td>
<td>3</td>
<td>0.045</td>
<td>5</td>
<td>NA</td>
<td>Boxborough, Harvard, Westford</td>
<td>0.446</td>
<td>0.066</td>
<td>0.168</td>
<td>Westford private wells at 0.06</td>
<td>-</td>
</tr>
</tbody>
</table>

Minimization of existing impacts

Tier determination for mitigation

Water balance & overall picture
Water Balance Across Subbasins

The chart illustrates the water balance across different subbasins, showing the flow of water in terms of millions of gallons per day (MGD). The subbasins are marked with IDs 13055, 13054, 12047, 12051, 12052, 12054, and 12055. The chart indicates the LWD Withdrawals, LWD Customers’ Septic Returns, and LWD Net Depletion.
Detailed Water Balance for One Subbasin

- LWD 13055 Withdrawal
- Other Withdrawal
- Runoff
- Recharge
- LWD 13055 Septic Returns
- Flow, WMOST

Average Flow Over 2000-2004 Time Period (MGD)
Very Detailed Water Balance for One Subbasin and One System

WMA tool:
Subbasin 13055
14% Impervious
13.6 square miles
Unaffected Flow: 1.17
Affected Flow: 0.00
GWW Total=1.64
PWS & Comm=1.47
Private=0.18
GWD Total = 0.19
Septic=0.19
GWD=0.00
SWW Total < 0.01
SWD Total < 0.01

Notes:
Units are million gallons per day unless otherwise noted.
Values are average reported values for August from 2000 through 2004 as summarized in WMA tool and SYE output. The sum of individual withdrawals or discharges from SYE does not always equal WMA tool summary value.
Private users are households on private well water and users with withdrawals less than 100,000 gallons per day.
* Septic values were calculated based on MA Water Indicators report methodology, except for LWD for which local data was used.

MPB Subbasin 13054
Whitcomb and Beaver Brook Wells

CPB Subbasin 12047
Cobbs’ Pond proposed wells

CPB Subbasins 12052, 12051, 12054, 12055, 12066

Positive withdrawal, withdrawals are equal to the withdrawal minus 100,000 gallons per day.

Withdrawal
Discharge

Active surface storage at Spectacle Pond

Streamflow targets

Private Users in Ayer
Ayer Water Department
GWW=0.91

Littleton Lyne Apartments
GWW=0.01

Private Users in Littleton
Littleton Water Department
Subbasin 13055 GWW=0.56
Subbasin 13054 GWW=0.69

Aggregate Industries
GWW/SWW<0.01

Groton Water Department
GWW=0

Private Users in Groton

Private Users in Westford

Private Users in Harvard

WWTP Discharge = 0.77

Subbasin 13055 GWW=0.56
Subbasin 13054 GWW=0.69

SYE output:
Triage Options

- **At subbasin level**
  - Release schedule from ponds/reservoirs
  - Large septic returns in other non-source subbasins
  - Sewered – expand via “Smart Sewering” and get recharge credit
  - “Inexpensive” stormwater retrofit sites
  - Negotiating new development – water efficient, stormwater/ww smart

- **At system level**
  - Removing barriers to flexible pumping operations*
  - Reduce UAW and water conservation especially summer use
  - External water sources – MWRA, neighboring towns in different subbasins

* DEP can consider total withdrawal allocation to be from any one pump unless limits specified in the permit
After break

- Resources – Data, Tools & Methods
Resources – Data, Tools & Methods

- MassDEP – SWMI Viewer, WMA Tool, background data and reports
- MassGIS
- Stormwater calculator
- Conservation calculator
- Well withdrawal optimization
- WMOST

(Refer to Resources handout)
SWMI Viewer - August Net Gw Depletion and CFR
SWMI Viewer - Groundwater Withdrawal Impact Category
SWMI Viewer - Biological Impact Category
MassGIS

- Image Data
- Census/Demographic Data
- Coastal and Marine Features
- Conservation/Recreation
- Cultural Resources
- Environmental Monitoring
- Indexes
- Infrastructure
- Physical Resources
- Political/Administrative Boundaries
- Regulated Areas
- Miscellaneous

Regulated Areas

- MassDEP Wellhead Protection Areas (Zone IIs, IWPAs) Updated - 7/9/2014
- Non-Potential Drinking Water Source Areas
- Surface Water Supply Protection Areas (ZONE A, B, C) Updated - 10/7/2013
Credit calculators

- Forthcoming in July 2015
- Estimate potential credit and associated cost
  - Conservation - indoor and outdoor demand reductions for multiple practices
  - Stormwater retrofits for existing development
Well pumping optimization

The Web-Based STRMDEPL08 evaluates four analytical solutions that simulate streamflow depletion by a nearby pumping well. It is based on STRMDEPL08 *(Reeves, 2008)* and the earlier STRMDEPL *(Barlow, 2000)*. These two earlier programs are written in Fortran, require text input files, and produce tabular output. The web-based version was written to provide an easier interface to the analytical solutions with more convenient units and simplified output. *(View more...)*

**Calculate Streamflow Depletion by Nearby Pumping Well**

**Fully penetrating stream with no streambed resistance (Jenkins, 1968)**
- Distance (ft):
- Transmissivity (ft²/day):
- Storage Coefficient:
- Pumping Rate (gpm):
- Days of Pumping:

**Fully penetrating stream with streambed resistance (Hantush, 1965)**
- Distance (ft):
- Transmissivity (ft²/day):
- Storage Coefficient:
- Streambed Leakance (ft):
- Pumping Rate (gpm):
- Days of Pumping:
WMOST Objective

What is the least cost set of actions to meet WMA requirements and projected water needs?

→ Screening-level analysis
Management Questions/ Goals

- Meet need for water and wastewater
- Achieve minimum in-stream flows
- Reduce flood flows
- Reaching wastewater discharge permit limit
- Capital planning with new development & climate change
Management Practices

- Optimize, Expand or Build Infrastructure
  - Optimize operations (e.g., timing and ratio of ground and surface withdrawals or between wells)
  - Surface water storage and release
  - Repair distribution and/or sewer collection pipes
  - Increase or build new capacity

- Stormwater/ Impervious Cover
  - BMPs or policies to reduce impervious areas
  - Land conservation
Management Practices

- Demand Management
  - Reduce UAW
  - Outdoor water use policy
  - Conservation/ summer pricing
  - Incentives/ rebates to improve water efficiency
  - Nonpotable reuse

- Aquifer recharge (Spring skimming or WW recharge)

- Interbasin transfer of water or wastewater (e.g., MWRA)
Using WMOST to meet WMA

- Model setup
  - One per subbasin

- Scenarios
  - WMA Baseline / Validation
  - Minimization
  - Mitigation

- Reconciling
  - Subbasins meet WMA requirements
  - Systems meet operational needs
LWD Minimization - Setup

- 2 source subbasins \(\rightarrow\) 2 model setups

- Demand
  - Total = Existing demand (2009-2013)
  - Allocation = Half of total demand each (based on historic pumping)

- Basic permit conditions met*

- Streamflow targets
  - LWD’s share of GWC4
  - Full GWC 4
  - Full GWC 3

*e.g., basic demand management, 65 RGPCD, 10% UAW
### LWD Minimization – Results

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>13055</th>
<th>13054</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streamflow target</strong></td>
<td>Pond Outflow</td>
<td>Channel Flow</td>
</tr>
<tr>
<td><strong>Management practices</strong></td>
<td>$/year</td>
<td>Units Implemented</td>
</tr>
<tr>
<td>Groundwater pumping and treatment</td>
<td>$752,000</td>
<td>No additional capacity</td>
</tr>
<tr>
<td>Demand management</td>
<td>$10,000 for half the demand</td>
<td>Indoor, outdoor, pricing</td>
</tr>
<tr>
<td>Potable distribution system repair</td>
<td>$4,500 for half the system</td>
<td>99% of leaks</td>
</tr>
<tr>
<td>Surface water pumping and treatment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Potable water from subbasin 12047</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stormwater retrofit: infiltration basin (acres at design event)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Annual operating cost</td>
<td>$0.76 million</td>
<td>$1.01 million</td>
</tr>
<tr>
<td>Water revenue (includes rate increase)</td>
<td>$1.08 million</td>
<td>$1.08 million</td>
</tr>
</tbody>
</table>

**Note:** Costs are rounded to the nearest thousand dollars. Capacity for new infrastructure is the maximum capacity in millions of gallons per day (MGD) and not the average daily use.

*Cost = $1.78 mil/yr Rev= $2.16 mil/yr
*Need accounting for fixed costs (aka overhead)
**LWD’s share of GWC4
LWD Mitigation - Setup

- 2 source subbasins, 1 potential new source subbasin \( \Rightarrow \) 3 setups

- Demand
  - Total = Projected demand based on WNF
  - Allocation
    - Same between two existing source subbasin for demand
    - Potential source subbasin \( \Rightarrow \) based on results of existing source subbasins’ needs for inter-subbasin transfer

- Basic permit conditions still met

- Streamflow – maintain flow achieved under minimization
### LWD Mitigation – Results

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>13055</th>
<th>13054</th>
<th>12047 at 0.20 MGD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streamflow Target</strong></td>
<td>Pond Outflow</td>
<td>Channel Flow</td>
<td>Channel Flow</td>
</tr>
<tr>
<td><strong>Management practices</strong></td>
<td>$/year</td>
<td>Units Implemented</td>
<td>$/year</td>
</tr>
<tr>
<td>Groundwater pumping and treatment</td>
<td>$977,000</td>
<td>No additional capacity</td>
<td>$662,000</td>
</tr>
<tr>
<td>Demand management</td>
<td>$10,000 for half the demand</td>
<td>Indoor, outdoor, pricing</td>
<td>$10,000 for half the demand</td>
</tr>
<tr>
<td>Potable distribution system repair</td>
<td>$4,500 for half the system</td>
<td>99% of leaks</td>
<td>$4,500 for half the system</td>
</tr>
<tr>
<td>Surface storage at Spectacle Pond</td>
<td>&lt;$1,000</td>
<td>0.84 MG</td>
<td>Not available</td>
</tr>
<tr>
<td>Surface water pumping and treatment</td>
<td>-</td>
<td>-</td>
<td>$109,000</td>
</tr>
<tr>
<td>Potable water from subbasin 12047</td>
<td>-</td>
<td>-</td>
<td>$421,000</td>
</tr>
<tr>
<td>Stormwater retrofit: infiltration basin (acres at design depth)</td>
<td>-</td>
<td>-</td>
<td>$74,000</td>
</tr>
<tr>
<td>ASR</td>
<td>$181,000</td>
<td>0.28 MGD</td>
<td>$30,000</td>
</tr>
<tr>
<td>Annual Operating Cost</td>
<td></td>
<td>$0.99 million</td>
<td>$1.31 million</td>
</tr>
<tr>
<td>Water Revenue (includes rate increase)</td>
<td></td>
<td>$1.41 million</td>
<td>$1.41 million</td>
</tr>
</tbody>
</table>

Note: Costs are rounded to the nearest thousand dollars. Capacity for new infrastructure is the maximum capacity in millions of gallons per day (MGD) and not the average daily use.

#### Cost = $2.52 mil/yr

Revenue = $2.82 mil/yr

At this screening level, these are considered equivalent

*Need accounting for fixed costs (aka overhead)

**LWD’s share of GWC4
Putting it together for a strategy

- Reduce UAW to maximum extent possible
- Increase water efficiency/ Reduce demand
  - Outdoor water behavior and equipment
  - Pricing especially targeting outdoor use
  - Incentives for efficient indoor fixtures
- Confirm regulatory and cost feasibility of refined outflow controls at Spectacle Pond
- New source development
  - Refine cost estimates for completion
  - Continue to track demand distribution
Putting it together for a strategy

- Stormwater recharge
  - Conduct feasibility study with specific sites, refine cost estimates, consider secondary benefits for town/other departments
  - Compile and track stormwater related efforts since 2005 and going forward

- Confirm lack of practicality/cost feasibility of surface water pumping

- ASR to be pursued last
Hydrology

- Data from 6 New England watershed models (HSPF), Time series of runoff, recharge and precipitation for 1960-2010
- Landscape characteristics (infiltration, percent IS, groundwater recession coefficient)

Stormwater

- Link with stormwater model to produce “BMP managed” runoff/recharge time series
- Three BMPs – bioretention/rain garden, infiltration trench, detention pond
Thank You to:

- Town of Westborough for the use of their facilities
- Town of Littleton for the use of their WMOST data
- MassDEP, DCR and MWRA

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