

WATER APPROPRIATIONS PERMIT APPLICATION

Exxon RAS #2-8077
14258 Jarrettsville Pike
Phoenix, Maryland

Files: BA2006G003 and BA2006G103

June 13, 2007

PRESENTATION OUTLINE

- Purpose of Appropriation
- Groundwater Recovery Approach
- Location of Groundwater Recovery
- Groundwater Recovery Quantity
- Summary of Groundwater Level Monitoring
- Evaluation of Potential Impact to Surface Water and Groundwater
- Conclusions
- Alternative Water Supply Contingency Plan

PURPOSE OF APPROPRIATION

- To remove gasoline constituents from groundwater.
- To protect private supply wells.
- To protect surface water.

GROUNDWATER RECOVERY APPROACH

- Interruption to the local hydrologic cycle is minimized:
 - Groundwater is recovered where it approaches its natural discharge to local surface water.
 - Treated groundwater is then discharged to its natural discharge areas proportional to recovered quantities.
- The effect on local groundwater levels is mitigated by recovering groundwater at relatively low recovery rates from multiple wells distributed among numerous properties.

GROUNDWATER RECOVERY APPROACH

- Groundwater recovery is not for consumptive use that would require meeting a constant demand:
 - Groundwater recovery rates need only be sufficient to ensure hydraulic capture of gasoline constituents.
 - Groundwater recovery rates increase in response to precipitation.
 - Groundwater recovery rates decrease during periods of lesser precipitation.

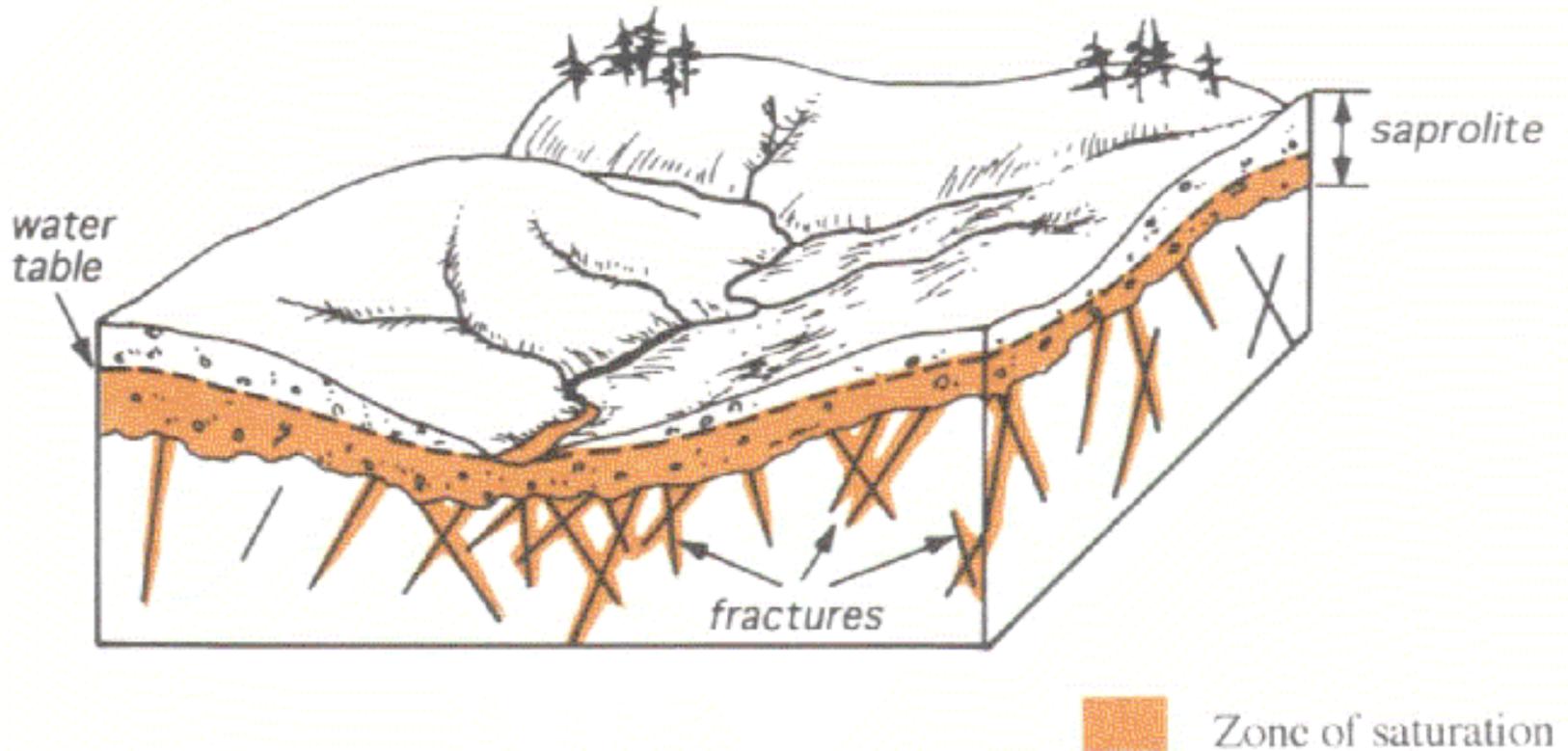
GROUNDWATER RECOVERY APPROACH

- Groundwater is recovered from relatively shallow depths (commonly less than 60 feet deep); private supply wells tend to be much deeper (commonly deeper than 200 feet).
- Groundwater levels are monitored in more than 80 observations wells, including 6 unused private supply wells located on and adjacent to properties from which groundwater is recovered.

GROUNDWATER RECOVERY APPROACH

- Concerns about diminished water supplies are investigated on a case-by-case basis according to an Alternative Water Supply Contingency Plan that was submitted to MDE on June 14, 2006.
- Groundwater recovery is expected to be scaled back over time and terminated when deemed appropriate by MDE.

Igneous and Metamorphic Rocks



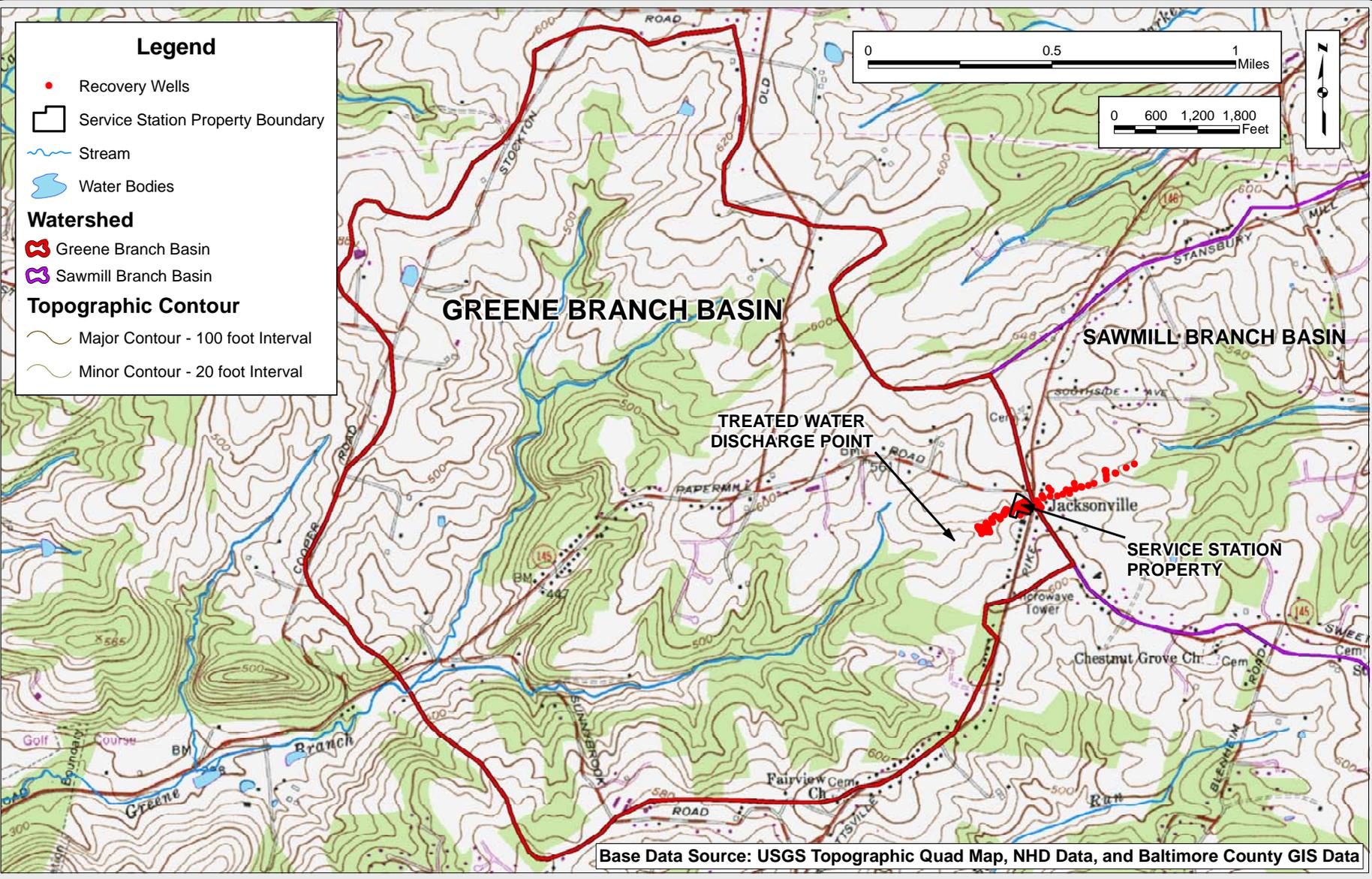
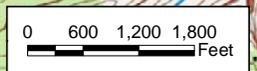
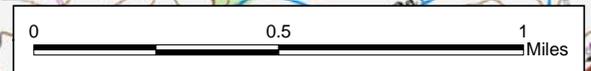
Block diagram of general hydrologic features for igneous and metamorphic rocks (MDGS, 1998)

LOCATION OF GROUNDWATER RECOVERY

- Groundwater is recovered from the Greene Branch (BA2006G003) and Sawmill Branch (BA2006G103) subwatershed drainage basins in the vicinity of 14258 Jarrettsville Pike, Phoenix, MD.

Legend

- Recovery Wells
- ▭ Service Station Property Boundary
- ~ Stream
- ☪ Water Bodies
- Watershed**
- ▭ Greene Branch Basin
- ▭ Sawmill Branch Basin
- Topographic Contour**
- Major Contour - 100 foot Interval
- Minor Contour - 20 foot Interval



GREENE BRANCH BASIN

SAWMILL BRANCH BASIN

**TREATED WATER
DISCHARGE POINT**

Jacksonville

**SERVICE STATION
PROPERTY**

Base Data Source: USGS Topographic Quad Map, NHD Data, and Baltimore County GIS Data

Legend

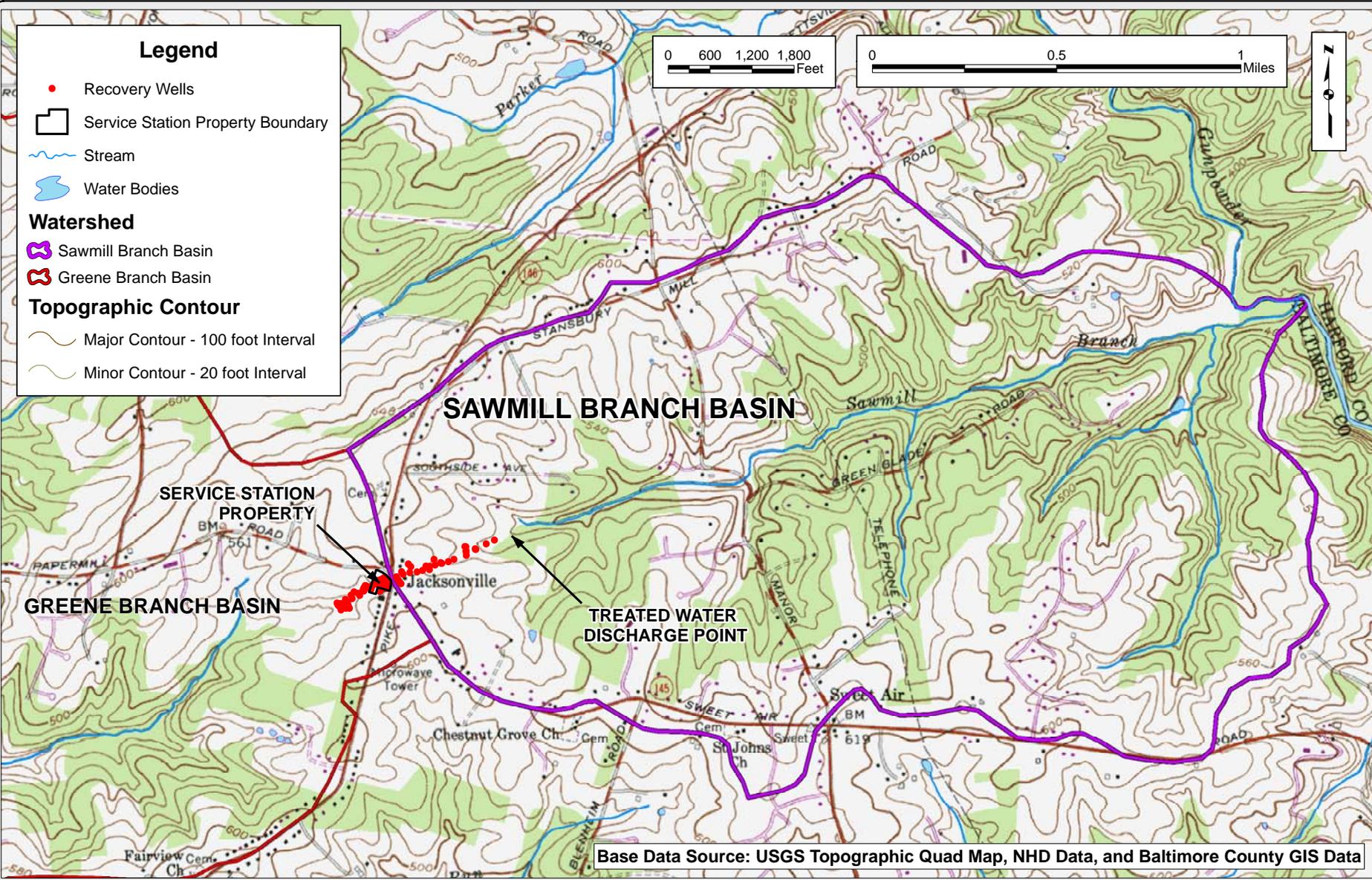
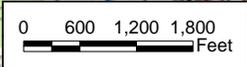
- Recovery Wells
- Service Station Property Boundary
- ~ Stream
- ☪ Water Bodies

Watershed

- 🟪 Sawmill Branch Basin
- 🟫 Greene Branch Basin

Topographic Contour

- Major Contour - 100 foot Interval
- Minor Contour - 20 foot Interval

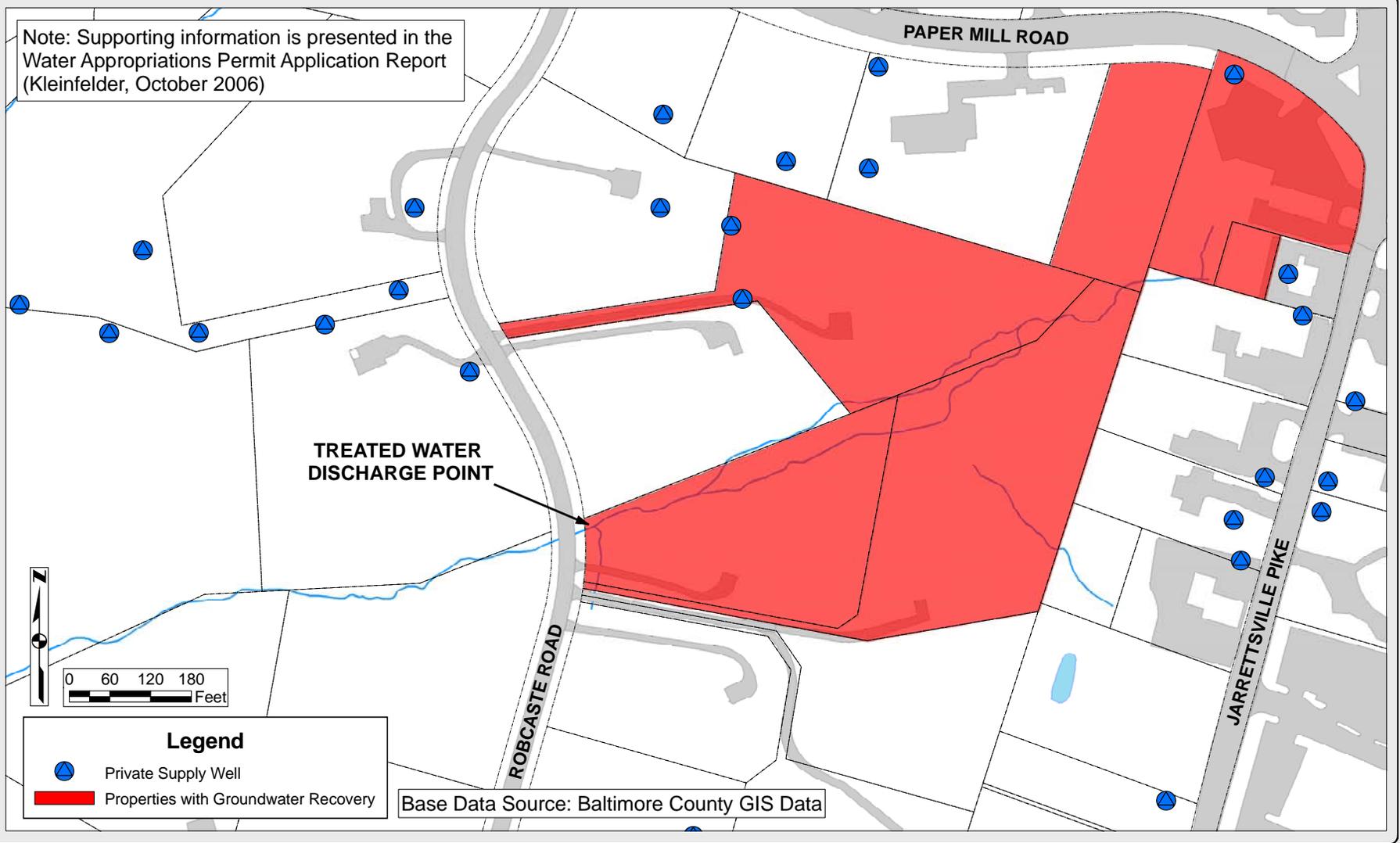


Base Data Source: USGS Topographic Quad Map, NHD Data, and Baltimore County GIS Data

LOCATION OF GROUNDWATER RECOVERY

- Groundwater is currently recovered from up to 83 recovery wells, and 90 recovery wells are to be permitted (an average of less than 1 gpm/well).
- Groundwater is currently recovered from up to 51 recovery wells located on 6 properties, comprising 10.4 acres in the 1,831-acre Greene Branch basin (BA2006G003).
- Groundwater is currently recovered from up to 32 recovery wells located on 9 properties, comprising 12.8 acres in the 1,899-acre Sawmill Branch basin (BA2006G103).

Note: Supporting information is presented in the Water Appropriations Permit Application Report (Kleinfelder, October 2006)



TREATED WATER DISCHARGE POINT

PAPER MILL ROAD

ROBCASTE ROAD

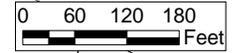
JARRETTSVILLE PIKE

Legend

-  Private Supply Well
-  Properties with Groundwater Recovery

Base Data Source: Baltimore County GIS Data

Note: Supporting information is presented in the Water Appropriations Permit Application Report (Kleinfelder, October 2006)



JARRETSVILLE PIKE

SWEET AIR RD

HAMPSHIRE KNOB DR.

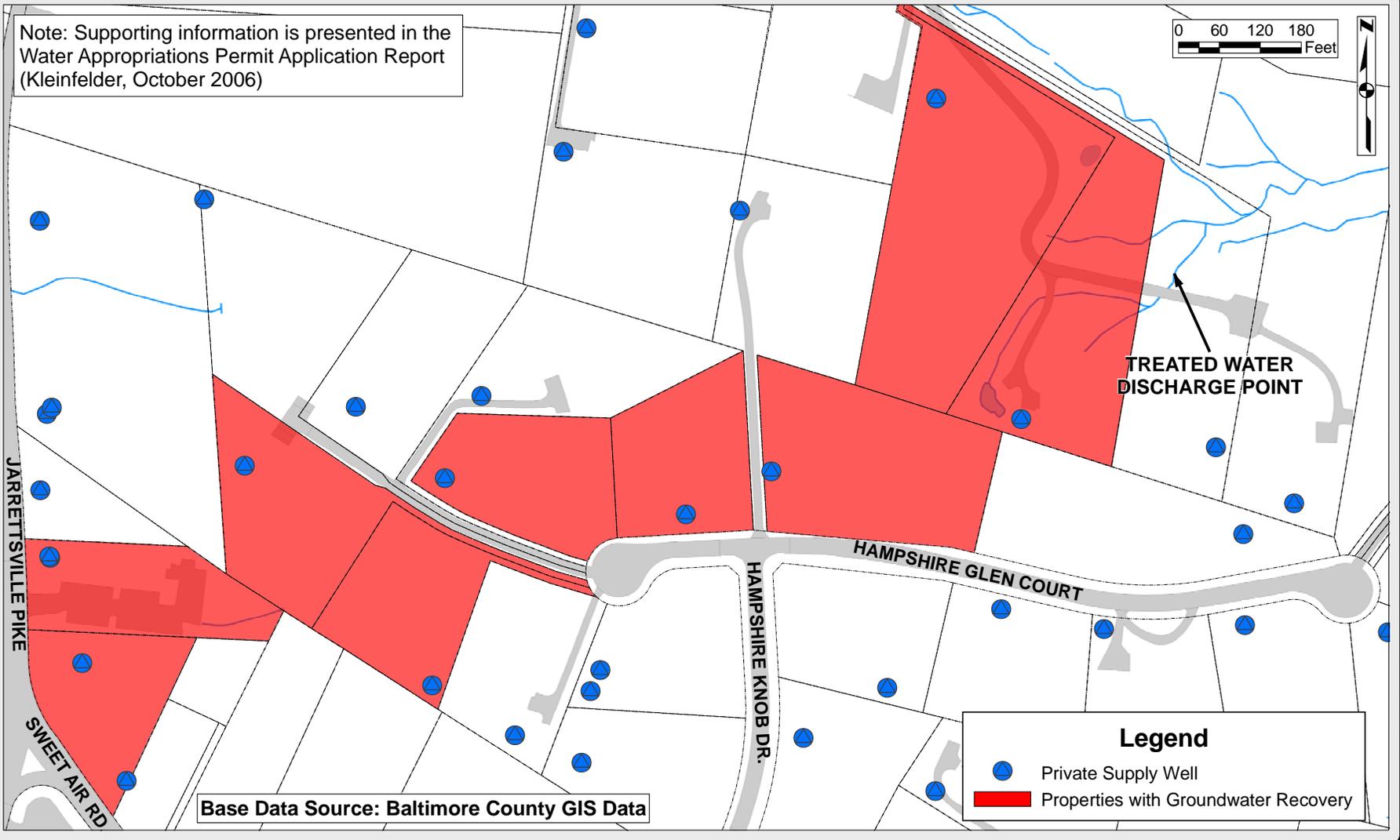
HAMPSHIRE GLEN COURT

TREATED WATER DISCHARGE POINT

Base Data Source: Baltimore County GIS Data

Legend

-  Private Supply Well
-  Properties with Groundwater Recovery

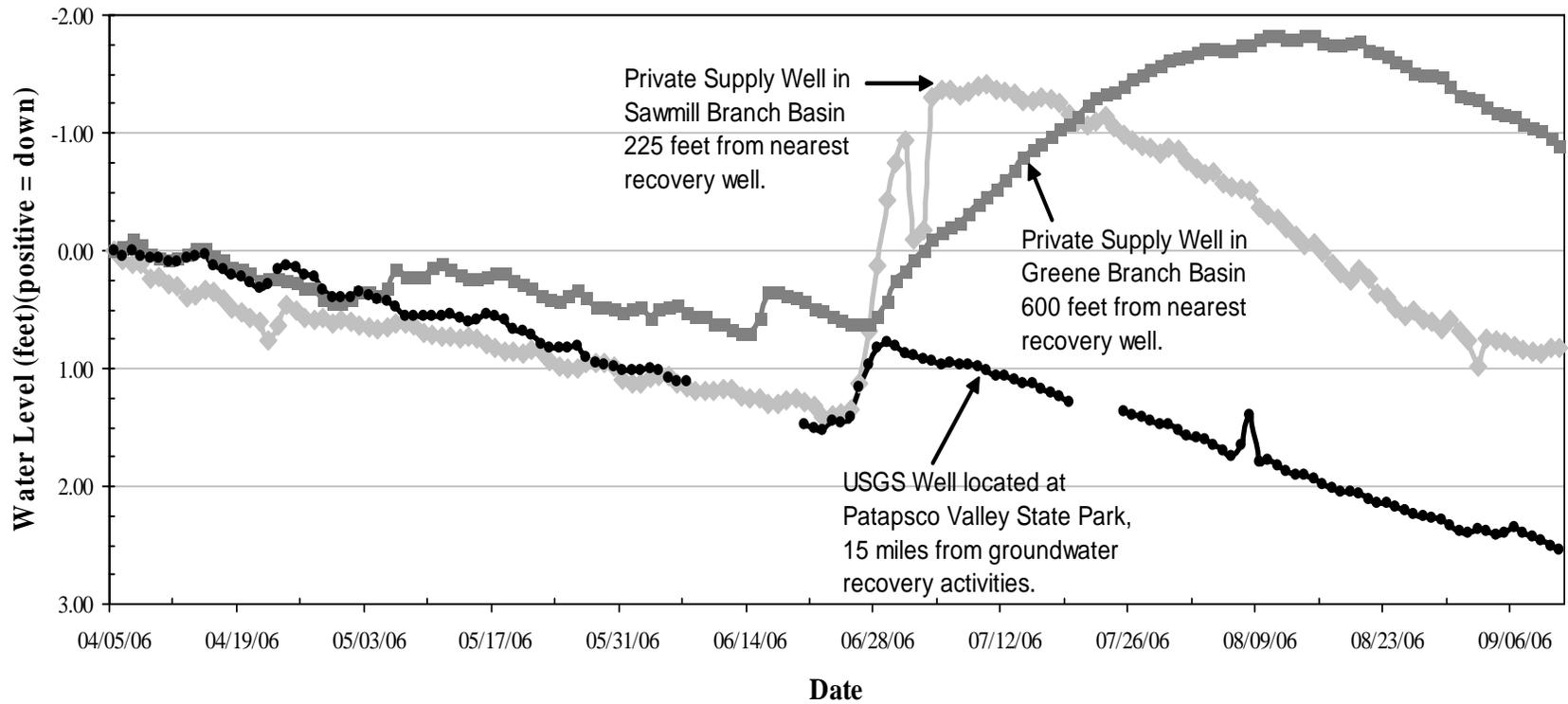


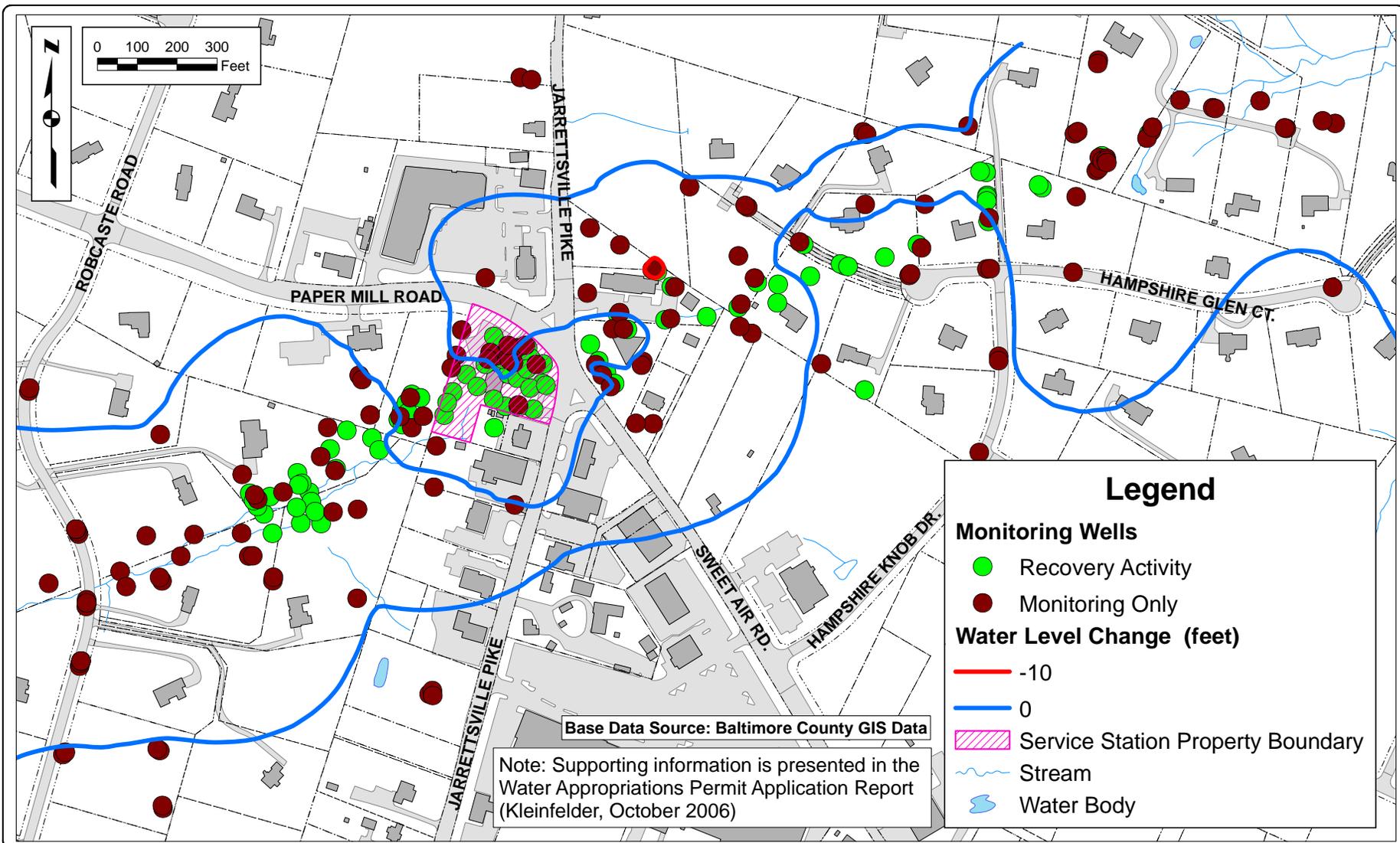
GROUNDWATER RECOVERY QUANTITY

- Total Appropriation for Supplemental Permits
 - 68,500 gallons per day (annual average)
 - 91,800 gallons per day (month of maximum use)
- Greene Branch basin (BA2006003)
 - 27,400 gallons per day (annual average)
 - 36,700 gallons per day (month of maximum use)
- Sawmill Branch basin (BA2006G103)
 - 41,100 gallons per day (annual average)
 - 55,100 gallons per day (month of maximum use)

Water Level Monitoring Data

- ◆ 14311 Jarrettsville Pike (225 feet from recovery well)
- 14209 Robcaste Road (600 feet from recovery well)
- USGS 392045076512501 (15 miles from study area)





Groundwater Level Change
May 1, 2006 to September 11, 2006

EVALUATION OF POTENTIAL IMPACT TO SURFACE WATER AND GROUNDWATER

- Surface water is replenished by the discharge of treated groundwater to the headwaters of the Greene Branch and Sawmill Branch drainage basins.
- Groundwater level changes tend to be localized around the ephemeral drainage channels in the upper reaches of the Greene Branch and Sawmill Branch basins.
- Measured groundwater level changes within 225 feet (Sawmill Branch) and 600 feet (Greene Branch) from the groundwater recovery zone were not due to local groundwater recovery activities.

EVALUATION OF POTENTIAL IMPACT TO SURFACE WATER AND GROUNDWATER

- Local unused private supply wells were observed to experience greater replenishment than the regional observation well used for reference.
- Suspected declines in supply well yield have been investigated according to the Alternative Water Supply Contingency Plan. Groundwater level decline due to recovery activities was not identified as a cause.

CONCLUSIONS

- Interruption to the local hydrologic cycle is minimized.
- No unreasonable impacts to groundwater supply availability is expected in the future due to groundwater recovery activities.
- Surface water is not adversely affected by groundwater recovery, because it is replenished by the discharge of treated groundwater.

ALTERNATIVE WATER SUPPLY CONTINGENCY PLAN

- An Alternative Water Supply Contingency Plan was submitted to the MDE on June 14, 2006.
- Private supply wells with suspected low yield will be investigated on a case-by-case basis.

ALTERNATIVE WATER SUPPLY CONTINGENCY PLAN

- Should a suspected low yield concern be attributable to groundwater recovery activities, the plan outlines various response options:
 - Design, supply, delivery and installation of a potable water supply system (potable water tank and transfer pump).
 - Lower the existing well pump in the well or deepen the existing well.
 - Install a replacement well on a different portion of the property.
 - Install a deeper replacement well on the property.

ALTERNATIVE WATER SUPPLY CONTINGENCY PLAN

- The specific response to a confirmed low yield concern will be determined within the provisions of the plan in conjunction with the MDE.

ALTERNATIVE WATER SUPPLY CONTINGENCY PLAN

- The MDE Water Supply Program can be contacted with questions about the water appropriations permit application or concerns about low well yield that is suspected to be due to groundwater recovery operations:

410-537-3714