3. Water Supply Alternatives and Evaluation

A brief discussion of the criteria that were used in the evaluation of water supply options, along with a brief discussion of each water supply alternative is presented below. Results of the evaluation are presented in Section 5.

3.1. Source of Information

Information pertaining to the alternatives was derived from a number of sources, including previously published studies and reports, conversations with water service area contacts for each locality (see Appendix A), and new analysis conducted by Malcolm Pirnie.

Cost information for the Gillis Falls, Union Mills and Piney Run Reservoir alternatives was prepared by Schnabel Engineering working in conjunction with Malcolm Pirnie to define and evaluate reservoir options (included in Appendix B).

3.2. Alternatives Evaluation Criteria

The alternatives were evaluated against several criteria, which are grouped into the following categories:

- Water Supply Benefits
- Environmental Impacts
- Implementability
- Relative Cost Estimate

3.2.1. Water Supply Benefits

The Water Supply Benefits of each alternative were evaluated based on the following categories:

- Safe Yield – the more favorable alternatives under this category are those that either meet or exceed the water supply needs of the localities likely to be served by an alternative. The less favorable alternatives are those that do not meet the long-term needs of the localities.

- Improved Reliability – the more favorable alternatives under this category are considered more resilient to drought and future regulatory trends, while the less favorable alternatives are those sources such as groundwater supplies that may be more susceptible to procedural changes in how appropriations are made by the State. In general, a more diverse mix of water supply sources should improve overall water supply reliability for the County. Likewise, water sources that are under more direct control of the County and towns (as opposed to purchase agreements with communities outside the County) would generally be considered more reliable for the long-term.

3.2.2. Environmental Impacts

The Environmental Impacts of each alternative were evaluated based on the following categories listed below. In general, the more favorable alternatives with respect to environmental impacts are those that have a relatively small project footprint, which minimizes the impact to local residents, habitat and wildlife.

- Surface Water Impacts – the more favorable alternatives under this category are those that do not have negative environmental impacts on streams or other surface waters, while those that rank less favorable are the alternatives that have the potential to cause negative habitat impacts.

- Groundwater Impacts – the more favorable alternatives under this category are those that have no impact on the quality or quantity of groundwater in the region. The less favorable alternatives under this category are those that have the potential to negatively affect the groundwater quality or quantity in the region.

- Wetland and Stream Impacts – the more favorable alternatives under this category are those that have no negative effects on wetlands or streams as a result of project implementation. The less favorable alternatives are those that have the potential to negatively affect wetlands or streams, such as reservoirs, which require stream and wetland inundation in order to construct.

- Impacts to Current Land Use – the more favorable alternatives under this category are those that have minimal impacts to the current land or source use. The less favorable alternatives under this category are those that have the potential to create significant impacts to the current land use.

- Infrastructure Impacts – the more favorable alternatives under this category are those that have minimal impacts to roads and other infrastructure. The less favorable alternatives under this category are those that have significant impacts to roads and other infrastructure, such as projects that require the relocation of a road.

- Cultural and Historic Impacts – the more favorable alternatives under this category are those that have no impacts to cultural or historic sites. The less favorable alternatives under this category are those that have the potential to cause negative impacts to cultural and historic sites. It should be noted that most of the alternatives evaluated are still in the conceptual phase, therefore, no new studies have been performed to evaluate cultural or historic impacts.

3.2.3. Implementability

The implementability of each alternative was evaluated from the standpoint of potential opposition from environmental advocacy organizations or other special interest groups, potential permitting complexities that could result in lengthy timeframes for regulatory approval, or other legal or institutional challenges that an alternative may face, such as local political opposition.

3.2.4. Relative Cost Estimate

Based on available cost information from prior studies for the County and towns, as well as new cost estimates prepared by Malcolm Pirnie and Schnabel Engineering, alternatives were evaluated based on the Unit Capital Cost of the project ($/gallon). The more favorable alternatives under this category are those with lower capital cost per gallon as compared to other alternatives. The less favorable alternatives under this category are those with the highest capital costs per gallon as compared to the other alternatives.

It was possible to be more specific in terms of identifying potential footprint locations for surface water options than for groundwater alternatives where specific well locations have not been fully defined and more assumptions had to be made.

3.3. Description of Alternatives

Water supply alternatives have been developed and evaluated in this effort. These alternatives are broken down by alternative type (Reservoir, Stream/River Intake, Quarry, Interconnection, Groundwater and Demand Management). The alternatives are delineated in the following sections, with summarized highlights of each.

For each of the potential water supply alternatives, the following information has been included in the evaluation:

1. Fact Sheet – containing a project description, key implementation steps, and a project vicinity map.

2. Location Map – containing a more detailed map showing the location of the alternative and associated facilities.

3. Evaluation Matrix – containing the criteria scores as assigned by Malcolm Pirnie across all of the water supply alternatives. The individual scoring matrices for each alternative are presented in Appendix D. A summary matrix of criteria scores is presented in Section 5.

For Demand Management, a table listing various existing practices by the County and towns is presented.

Figures 3-1 and 3-2 show the County-wide locations of surface water supply options and groundwater supply options, respectively. Table 3-1 summarizes the communities that would be served by each alternative.

3.3.1. Reservoir Alternatives

In developing concepts for the Gillis Falls, Piney Run and Union Mills reservoir alternatives, monthly timestep water balance analyses specific to the drainage areas at each reservoir site were completed by Malcolm Pirnie. Streamflow data used in these analyses were obtained for USGS gages 01586000 (North Branch Patapsco River at Cedarhurst, MD) and 01639500 (Big Pipe Creek at Bruceville, MD). This work was conducted to estimate potential safe yield benefits during drought of record conditions. These water balance analyses take into account updated reservoir dimensions, natural inflow via runoff, net evaporation estimates specific to each month of the simulated record, minimum release assumptions, and minimum storage reserve assumptions (i.e., dead storage). Table 3-2 includes pertinent characteristics of the Gillis Falls, Piney Run and Union Mills reservoir alternatives and indicates whether the information was developed by Malcolm Pirnie or is based on prior studies conducted for the County.

In addition to the safe yield analyses, Malcolm Pirnie worked closely with its subcontractor Schnabel Engineering to produce a Preliminary Evaluation of Reservoir Alternatives which is included in Appendix B. This report describes the basis for the design concepts and estimated costs developed for the reservoir alternatives.

Alternative R-1a: Gillis Falls Reservoir (Proposed)

- Reservoir to serve as regional source of supply for Mount Airy and Sykesville/Freedom Service Areas.
- Safe Yield: 3.85 mgd with Normal Pool Elevation of 610 ft.

Alternative R-1b: Gillis Falls Reservoir (Expanded)

- Reservoir to serve as regional source of supply for Mount Airy and Sykesville/Freedom Service Areas.
- Safe Yield: 5.0 mgd with Normal Pool Elevation of 630 ft

Alternative R-2: Piney Run Reservoir – Use as a Water Resource

- Existing reservoir to be utilized as a water supply source for Mount Airy and the Sykesville/Freedom Water Service Areas.
- Safe Yield: 3.65 mgd with a Normal Pool Elevation of 524 feet

Alternative R-3: Expansion of Piney Run Reservoir

- Increase capacity of the existing reservoir to be utilized as a water supply source for Mount Airy and the Sykesville/Freedom Water Service Areas. Capacity increased by raising the spillway riser and emergency spillway.
- Raise the normal pool elevation by 4 feet, which increases the Safe Yield to 4.11 mgd (0.46 mgd increase from existing safe yield of Piney Run Reservoir).

Alternative R-4a: Union Mills Reservoir (Proposed)

- Regional reservoir planned to supplement Westminster, Hampstead, Taneytown and Manchester Water Service Areas.
- Safe Yield: 3.76 mgd with Normal Pool Elevation of 610 feet.

Alternative R-4b: Union Mills Reservoir (Expanded)

- Regional reservoir planned to supplement Westminster, Hampstead, Taneytown and Manchester Water Service Areas.
- Safe Yield: 7.93 mgd with Normal Pool Elevation of 630 feet.

Alternative R-5: Increase Capacity of Cranberry Reservoir

- Existing 115 MG raw water reservoir serves as terminal reservoir in Westminster system, which supplies raw water to the Cranberry WTP.

- Potential Expansion Options:
  - Expand horizontally through purchase of additional land (60 MG increase)
  - Expand vertically through raising dam one foot (~8 MG increase)

Alternative R-6: Prettyboy Reservoir

- Baltimore's plans to develop 120 mgd treatment plant for its Susquehanna River intake could significantly increase the reliability of Baltimore's system, so purchase of excess capacity from Prettyboy Reservoir may be practicable.
- Conceptual plans for a 3.0 mgd intake and a 7.5-mile long, 16-inch raw water pipeline from Prettyboy Reservoir to a new 3.0 mgd WTP in Hampstead. Also requires a high service pump station located at the intake site.

3.3.2. Stream/River Intake Alternatives

Information on Alternative S-1 was obtained from Hazen and Sawyer's Water Supply Alternatives Study for the Town of Mount Airy (April 2006 report and April 2007 addendum)[2].

The current MDE approach to permitting new surface water withdrawals is to require significant minimum flowby amounts. Consequently, in order for a stream intake project to be dependable even under drought conditions (i.e., when natural flows decline below desired minimum flows), additional storage is needed for such periods. Therefore, in developing concepts for stream intake options S-2, S-3 and S-4, daily timestep water balance analyses specific to the drainage areas at each intake site were completed by Malcolm Pirnie. Streamflow data used in these analyses were obtained for USGS gage 01639500 (Big Pipe Creek at Bruceville, MD). This work was conducted to estimate potential raw water pumped storage volume required to secure the desired safe yield during drought of record conditions.

These water balance analyses were simplified in that natural inflow via runoff, net evaporation, seepage losses and minimum releases were not considered. Instead, the storage change term (daily change in storage volume) was assumed to dominate the water balance for a small impoundment. Using these water balance analyses, the desired safe yield was set and then the optimum stream pump station capacity and required storage was estimated, assuming that a minimum 20% storage reserve would be retained in worst simulated drought periods. Based on recent input from MDE, the Maryland Most Common Flow Method (May-October and November-April averaging periods) was used to define minimum instream flow levels below which no stream withdrawals would be allowed to meet demand or refill raw water storage. Table 3-3 includes pertinent characteristics of stream intake sites for alternatives S-2, S-3 and S-4.

Alternative S-1: New Surface Water Intake in Gillis Falls Area

- Develop new surface water intake on Carroll County-owned property near the proposed Gillis Falls Reservoir.
- Safe Yield: 0.85 mgd with a 100-120 MG off-stream storage impoundment

Alternative S-2: New Intake on Big Pipe Creek in Union Mills Area

- Develop new surface water intake on Big Pipe Creek in the vicinity of the proposed Union Mills Reservoir dam area to supply water to Westminster.
- Safe Yield: 0.70 mgd yield achieved with a 4.0 mgd intake and a 280 MG storage impoundment.

Alternative S-3: New Intake on Little Pipe Creek for Westminster

- Develop new surface water intake on Little Pipe Creek as an additional short-term supply option for Westminster.
- Safe Yield: 0.5 mgd yield achieved with a 1.3 mgd intake and a 260 MG storage impoundment. Also potential to use Hyde's Quarry as a backup supply to be used when stream flows in Little Pipe Creek are below minimum in-stream flows.

Alternative S-4: New Intake on Big Pipe Creek for Taneytown

- Develop new surface water intake on Big Pipe Creek as an additional short-term supply option for Taneytown.
- Safe Yield: 0.4 mgd yield achieved with a 2.0 mgd intake and a 125 MG storage impoundment.

3.3.3. Quarry Alternatives

Alternative Q-1: Hyde's Quarry – New Raw Water Reservoir

- Construct a raw water line to Westminster's Service Area for additional supply. Hyde's Quarry could also be used solely as a backup supply for the proposed Little Pipe Creek Intake (see Alternative S-3).
- Approximate yield of 0.5 mgd needed to serve as backup supply for Little Pipe Creek Intake.

Alternative Q-2: Lehigh Quarry – Union Bridge

- Use of Lehigh Quarry in Union Bridge as a raw water reservoir to supply approximately 0.6 mgd to Union Bridge.
- Due to contamination concerns, this option is more feasible when quarry operations cease.

Alternative Q-3: Lehigh Quarry – New Windsor

- Use of Lehigh Quarry near New Windsor as a raw water reservoir to supply approximately 0.25 mgd to New Windsor.
- Preferred method of transferring water to the WTP is via a release to the nearby stream, and subsequent withdrawal at the treatment plant.

Alternative Q-4: Medford Quarry – Use as a Permanent Water Supply

- Convert Westminster's current "Emergency Only" appropriations permit for the Medford Quarry to a permanent normal use appropriations permit.
- Previous dewatering records indicate that the average available groundwater is approximately 139,000 gpd, which may be the yield that can be expected to be appropriated if the permit is converted to normal use.

3.3.4. Interconnection Alternatives

Alternative I-1: Mount Airy Interconnection with Frederick County

- Interconnection with the Frederick County water system and purchase agreement to supply 0.85 mgd (with a maximum agreement of 1.2 mgd).

Alternative I-2: Interconnection with York Water Company

- Interconnection with the York Water Company to provide approximately 0.90 mgd of finished water to Manchester and Hampstead. Requires a purchase agreement between all parties.

Alternative I-3: Freedom to Supply Mount Airy Using Existing Sources

- Sykesville/Freedom to supply Mount Airy using projected 1.09 mgd surplus from existing water supply sources.
- Conceptual plans for a 9.7-mile long transmission main between the Sykesville/Freedom Service Area and the Mount Airy Service Area.

3.3.5. Groundwater Alternatives

Groundwater alternatives were developed for six service areas (Hampstead, Mount Airy, New Windsor, Taneytown, Union Bridge, and Westminster) that have projected demands above their existing appropriations (Figure 3-2). A groundwater alternative was also developed for the Manchester service area to satisfy potential demands resulting from actual groundwater capacity being less than the currently appropriated supply. Finally, a separate groundwater alternative was developed for the Union Mills Reservoir area, utilizing County-owned land to supply the Westminster service area with additional water. Fact sheets for each of these alternatives (excluding the Manchester groundwater alternative) are presented at the end of Section 3. The analyses supporting these alternatives were based on the current criteria for obtaining an MDE groundwater appropriation permit:

1) demonstrated demand,
2) available groundwater recharge,
3) well yield, and
4) no adverse impact to nearby wells.

Typically, the most restrictive of the above criteria, on a case-by-case basis, controls the permitting of groundwater appropriations in Maryland.

Probable future additional demand requirements for the County's service areas total approximately 4.0 MGD and are discussed in Section 2.2 above.

Available groundwater recharge for each water service area was determined according to MDE methods[3]. MDE's method of determining groundwater recharge available for appropriation is based on lands that are owned or controlled by the permittee on a watershed-by-watershed basis, with basins greater than two square miles being protected, using the following steps:

1. The 1-in-10 year drought recharge rate is applied to the areas owned or controlled the permittee,
2. Losses due to impermeable surfaces are deducted from the effective recharge rate,
3. The calculated 7Q10 stream flow is subtracted from the effective recharge rate to provide additional protection for baseflow,
4. Withdrawals are assumed to be equally distributed throughout the watershed,

5. Half of the appropriated water usage is assumed to involve consumptive uses (such as municipal supplies and golf courses), while the other half is assumed to involve non-consumptive uses (such as subdivisions on individual wells and septic systems).

Exemptions to the above methodology have been made for previously existing well, quarries and mines, and where public health is an issue. Water budgets for each water service area are presented in Appendix C and summarized in Table 3-4. The amount of additional land that each water service area would likely need to own or control in order to have sufficient recharge area for the projected additional demands was estimated using the average recharge rate for each water service area. Four of the six water service areas are likely to require ownership/control of a total of approximately 5,180 acres of additional recharge areas in order to obtain appropriations meeting the projected demand shortfall. It may be possible that some of the County-owned lands could be credited to the water service areas as recharge areas provided they are in the same watershed as proposed appropriation(s).

Likely well yields in the vicinity of each water service area were estimated based on an analysis of typical hydrogeologic parameter values determined in previously reported field investigations[4]. Field test derived values of the specific capacity of municipal wells in each water service area were multiplied by the saturated depth to the top of the water bearing zone of the well to determine the maximum acceptable pumping rate in an average well in each service area. The maximum pumping rate was reduced by a factor of safety of 10% to provide a more conservative yield estimate for each well. This method of estimating likely yield was applied over the median, minimum, and maximum values of wells in each water service area to determine both a likely well yield and the anticipated range of values for productive wells in the vicinity of each water service area. Well yields determined using this method were compared to the average appropriation permitted by MDE per municipal groundwater well by service area. The average per well MDE groundwater appropriation was typically lower and therefore more restrictive than the median of the field tested values. In order to be conservative, the average MDE appropriation values were used as the basis for evaluating individual groundwater alternatives. The results of the analysis are presented in Appendix C and summarized in Table 3-4.

Impacts to nearby wells are difficult to predict in the fractured rock area of Maryland without direct field investigations. For the purpose of this evaluation, it was assumed that any wells for which the County or municipalities would seek to obtain a groundwater appropriation permit would be situated such that they are not hydraulically connected to a significant extent or that they are located at a sufficient distance to minimize impacts to nearby wells. Therefore, only the first three MDE groundwater appropriation criteria were directly evaluated.

Key groundwater implementation steps as well as concise descriptions of the groundwater alternatives are presented below. Based on prior experience, these implementation steps would take a significant amount of time to complete.

1. Obtain control over sufficient acreage in the appropriate watershed(s) to meet the MDE required recharge rate.
2. Begin MDE water appropriation permitting process
3. Acquire ownership or easement of well site(s)obtain control over sufficient acreage in the appropriate watershed(s) to meet the MDE required recharge rate.
4. Drill and develop well site(s)
5. Conduct pumping test(s) and source water quality analyses
6. Finalize MDE water appropriation permit process
7. Install permanent wellhead(s) and fencing and construct treatment/transmission infrastructure necessary to connect wells to the WSA distribution system

Alternative G-1: Hampstead Groundwater Wells

- Drill and develop 20 groundwater wells (based on the average MDE appropriation of existing Hampstead wells) to meet projected additional demand requirements of approximately 528,000 gpd.

Alternative G-2: Mount Airy Groundwater Wells

- Drill and develop 5 groundwater wells (based on the average MDE appropriation of existing Mount Airy wells) to meet projected additional demand requirements of approximately 364,000 gpd.

Alternative G-3: New Windsor Groundwater Wells

- Drill and develop 3 groundwater wells (based on the average MDE appropriation of existing New Windsor wells) to meet projected additional demand requirements of approximately 198,000 gpd.

Alternative G-4: Taneytown Groundwater Wells

- Drill and develop 16 groundwater wells (based on the average MDE appropriation of existing Taneytown wells) to meet projected additional demand requirements of approximately 1,164,000 gpd.

- Additional sites will likely need to be identified to complete this alternative

Alternative G-5: Union Bridge Groundwater Wells

- Drill and develop 6 groundwater wells (based on the average MDE appropriation of existing Union Bridge wells) to meet projected additional demand requirements of approximately 594,000 gpd.

Alternative G-6: Westminster Groundwater Wells

- Drill and develop 9 groundwater wells (based on the average MDE appropriation of existing Westminster wells) to meet projected additional demand requirements of approximately 1,176,000 gpd.

Alternative G-7: Union Mills Area Wells

- Drill and develop 10 groundwater wells (based on the average MDE appropriation for existing Manchester and Westminster wells) on existing County-owned property in the proposed Union Mills Reservoir area to meet a portion of the projected additional demand requirements for Westminster.

- Construction of new 5-mile long raw water transmission main to pump groundwater to Cranberry Reservoir for treatment at the Cranberry WTP. Pipeline to be sized for Union Mills Reservoir (Alternative R-4a).

Alternative G-8: Manchester Wells

- Drill and develop 6 groundwater wells to meet potential appropriated water demand deficit of approximately 124,000 gpd (Build-out Demand less 2007 Average Day Withdrawals).

- Number of groundwater wells required to satisfy this potential 124,000 gpd deficit was calculated as follows:

    - No. Wells = 124,000 gpd / Average Demand per Well

        - Average Demand per Well = 2007 Average Usage/No. of Wells
          21,488 gpd/well = 300,826 gpd/14 wells

3.3.6. Demand Management

Water utilities can implement a number of Demand Management practices. Some measures result in more permanent reductions of water use during normal operating conditions, while other measures achieve temporary demand reductions during emergencies related to drought or other circumstances. Categories and examples of Demand Management practices are as follows:

- Public Education Measures – including informative brochures, posters, newsletters and websites that educate customers on ways that they can conserve water.
- Water Loss Management – including leak detection and repair programs, meter replacement programs, and water use audits that reduce the amount of water loss in a system.
- Drought Management Measures – typically include voluntary and mandatory water use restrictions that are implemented during a drought. Restrictions may include those related to lawn watering, car washing, etc.
- Low-Flow Devices – utilities may distribute low flow plumbing devices to their customers for free or a reduced cost.
- Water Use Rate Schedule – billing rate structures that charge a higher rate for greater water consumption. A progressive water rate schedule may encourage conservation by customers.
- Billing Cycle – typically a more frequent billing cycle (i.e. monthly) makes it easier for utilities to track water use and determine if leaks are a problem as well as provide more timely feedback to water customers on their usage patterns.
- Other Demand Management Measures – may include rain barrel programs, efforts to adjust irrigation system settings for more efficient water use, xeriscaping, cistern use, promotion of low impact development technologies, etc.

As part of moving forward with development of new water supply alternatives, it is important, as a first step, to document the Demand Management practices that are already being followed by the localities within Carroll County. Based on such an inventory, it may become more apparent where additional demand management efforts should be considered. Table 3-5 summarizes the existing Demand Management practices that are in place for each locality, based on the Draft Carroll County Comprehensive Water Conservation Recommendations, conversations with water service area representatives at the May 21, 2009 progress meeting, and telephone conversations with water system contacts.