5. Evaluation Results/Recommended Alternatives

5.1. Summary of Evaluation

Table 5-1 presents cost estimates for water supply alternatives except for estimated groundwater alternative costs which are presented in Table 5-2. For some alternatives we have relied on prior cost estimates developed by other consultants working for the County or towns and we have noted such instances in Table 5-1. The cost estimates are conceptual in that no design level analysis has been conducted by Malcolm Pirnie to better confirm the specific facilities required for each alternative. Nevertheless, the range of costs for the various alternatives does allow them to be compared in terms of their relative cost, one to another.

For the alternatives presented in Tables 5-1 and 5-2 we have also included allowances for new pumping and transmission capacity and/or water treatment capacity that would be required to deliver water to the applicable service areas. This puts these alternatives on a more equal basis for purposes of comparing unit capital costs per gallon of safe yield benefit.

More detailed cost estimate breakdowns for the Gillis Falls, Union Mills and Piney Run Reservoir alternatives were prepared by Schnabel Engineering working in conjunction with Malcolm Pirnie to define and evaluate reservoir options (see Appendix B). Assumptions used for estimating aquatic habitat mitigation were based on Malcolm Pirnie's direction.

The individual evaluation scoring matrices for all alternatives are included in Appendix D. A summary of the overall evaluation scoring, as well as the rank (in relation to other alternatives) is presented in Table 5-3. Table 5-4 shows all water supply alternatives, sorted by overall rank.

5.2. Recommended Alternatives (based on scoring)

The following section summarizes the recommended water supply alternatives for each Carroll County WSA that is projected to experience a deficit under the Build-out scenario. These recommendations are based on the Evaluation Scoring Results presented in Tables 5-3 and 5-4. Continuing investigations of the recommended alternatives would be warranted to move these options forward. Depending on the relative importance

individual communities place on the evaluation criteria used in this report, other lower-scoring alternatives may make more sense for those communities to pursue.

5.2.1. Hampstead WSA

In order to meet the 0.528 mgd projected Build-out water supply deficit, the following alternatives are recommended, in order of their scoring results:

1. Union Mills Reservoir – Expanded (R-4b)
2. Interconnection with the York Water Company (I-2)
3. Union Mills Reservoir – Proposed (R-4a)

5.2.2. Manchester WSA

In order to meet the potential 0.124 mgd projected Build-out water appropriation deficit (assuming continued reduced groundwater well capacities), the following alternatives are recommended, in order of their scoring results:

1. Union Mills Reservoir – Expanded (R-4b)
2. Interconnection with the York Water Company (I-2)
3. Union Mills Reservoir – Proposed (R-4a)

5.2.3. Mount Airy WSA

In order to meet the 0.364 mgd projected Build-out water supply deficit, the following alternatives are recommended, in order of their scoring results:

1. Piney Run Reservoir – Use as a Water Source (R-2)
2. Interconnection with Frederick County (I-1)

5.2.4. New Windsor WSA

In order to meet the 0.198 mgd projected Build-out water supply deficit, the following alternative is recommended:

1. New Windsor Wells (G-3) – drill and develop three additional groundwater wells to meet projected water supply needs.

5.2.5. Taneytown WSA

In order to meet the 1.164 mgd projected Build-out water supply deficit, the following alternatives are recommended, in order of their scoring results:

1. Union Mills Reservoir – Expanded (R-4b). This option involves flow augmentation of Big Pipe Creek from the Union Mills Reservoir, as well as a new intake near Taneytown, new raw water pipeline and a new WTP in Taneytown.

2. Union Mills Reservoir – Proposed (R-4a). This option involves flow augmentation of Big Pipe Creek from the Union Mills Reservoir, as well as a new intake near Taneytown, new raw water pipeline and a new WTP in Taneytown.

5.2.6. Union Bridge WSA

In order to meet the 0.594 mgd projected Build-out water supply deficit, the following alternatives are recommended, in order of their scoring results:

1. Lehigh Quarry – Union Bridge (Q-2)

2. Union Bridge Wells (G-5)

5.2.7. Westminster WSA

In order to meet the 1.176 mgd projected Build-out water supply deficit, the following alternatives are recommended, in order of their scoring results:

1. Union Mills Reservoir – Expanded (R-4b)

2. Medford Quarry – Use as a Permanent Supply (Q-4)

3. Westminster Wells (G-6)

Table 5-1
Alternative Cost Breakdown Summary

													Schnabel Cost Estimates												
		Project Yield	WTP Capacity (1)	Raw Water Pipeline			Treated Water Pipeline			Storage	Pump Stations	Land Acquisition	Dam + Spillway	Stream/Wetland Mitigation	Road/Bridge Relocations & Other	WTP Cost (2)	Raw Water Pipe Cost	Treated Water Pipe Cost	Storage Cost	Pump Station Cost	Land Acquisition Cost	Cost Subtotal	Capital Cost (3)	Unit Capital Cost	Notes
Alt. No.	Alternative Description	mgd	mgd	mgd	diam (in)	feet	mgd	diam (in)	feet	MG	No.	acres	$M	$M	$M	$M	$M	$M	$M	$M	$M	$M	Cost + Contingency ($M)	Capital Cost/Yield ($/gallon)	
R-1a	Gillis Falls Reservoir (Proposed - Elev 610)	3.85	2.0	2.0	16.0	10,560					1	587	$ 32.0	$ 35.0	$ 2.0	$ 8.0	$ 1.84	$ -	$ -	$ 0.70	$ 5.87	$ 48.4	$ 104.4	$ 27.1	Costs include Schnabel-based contingency for dam and spillway, with 40% contingency added for all other project cost components (excluding land acquisition costs).
R-1b	Gillis Falls Reservoir (Expanded - Elev 630)	5.00	2.0	2.0	16.0	10,560					1	1541	$ 43.0	$ 47.0	$ 2.0	$ 8.0	$ 1.84	$ -	$ -	$ 0.70	$ 15.41	$ 68.9	$ 141.8	$ 28.4	Costs include Schnabel-based contingency for dam and spillway, with 40% contingency added for all other project cost components (excluding land acquisition costs).
R-2	Piney Run Reservoir - Use as Water Source	3.65	2.0	2.0	16.0	1,000	2.0	16.0	55,440	3	2		$ -			$ 8.0	$ 0.17	$ 9.65	$ 1.65	$ 1.40	$ -	$ 20.9	$ 29.2	$ 8.0	
R-3	Expansion of Piney Run Reservoir	0.46											$ 4.2	$ 2.9	$ 0.4	$ -	$ -	$ -	$ -	$ -	$ -	$ 4.2	$ 8.8	$ 19.2	Costs calculated for incremental safe yield increase, which assume all other project improvements will have been made for Alternative R-2. Costs include Schnabel-based contingency for dam and spillway, with 40% contingency added for all other project cost components (excluding land acquisition costs).
R-4a	Union Mills Reservoir (Proposed - Elev 610)	3.76	5.0	4.0	20.0	31,680	1.5/0.25	12.0	41,278		3	781	$ 28.0	$ 25.0	$ 4.0	$ 20.0	$ 6.15	$ 4.21	$ -	$ 2.08	$ 7.81	$ 68.2	$ 121.8	$ 32.4	Costs include Schnabel-based contingency for dam and spillway, with 40% contingency added for all other project cost components (excluding land acquisition costs).
R-4b	Union Mills Reservoir (Expanded - Elev 630)	7.93	5.0	4.0	20.0	31,680	1.5/0.25	12.0	41,278		3	1738	$ 38.0	$ 40.0	$ 4.0	$ 20.0	$ 6.15	$ 4.21	$ -	$ 2.08	$ 17.38	$ 87.8	$ 162.4	$ 20.5	Costs include Schnabel-based contingency for dam and spillway, with 40% contingency added for all other project cost components (excluding land acquisition costs).
R-5	Increase Capacity of Cranberry Reservoir	0.10	0.0										$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ 0.2	$ 0.3	$ 2.8	Cost for Cranberry Reservoir expansion provided by Westminster staff.
R-6	Prettyboy Reservoir	2.00	3.0	3.0	16.0	39,600	2.0/0.25	16.0	51,216		3		$ -			$ 12.0	$ 6.89	$ 7.49	$ -	$ 2.03	$ -	$ 28.4	$ 39.8	$ 19.9	
S-1	New Surface Water Intake in Gillis Falls Area	0.85	1.2		16.0	15,840	1.2	12.0	1,056	120.0	2		$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ 40.0	$ 40.0	$ 47.1	Cost Estimate based on Hazen & Sawyer Water Supply Study for Mount Airy (April 2006)
S-2	New Intake on Big Pipe Creek in Union Mills Area (Westminster)	0.70	1.0	4.0	20.0	28,322				280	2		$ -			$ 4.0	$ 6.00	$ -	$ 5.39	$ 1.40	$ -	$ 16.8	$ 23.5	$ 33.6	
S-3	New Intake on Little Pipe Creek for Westminster	0.50	1.0	1.0	12.0	14,684				260	2		$ -			$ 4.0	$ 1.54	$ -	$ 5.47	$ 1.10	$ -	$ 12.1	$ 17.0	$ 33.9	
S-4	New Intake on Big Pipe Creek for Taneytown	0.40	1.0	1.0	12.0	14,735				125	2		$ -			$ 4.0	$ 1.55	$ -	$ 2.69	$ 1.10	$ -	$ 9.3	$ 13.1	$ 32.7	
Q-1	Hyde's Quarry - New Raw Water Reservoir	0.50	0.0	1.0	12.0	10,438					1		$ -			$ -	$ 1.10	$ -	$ -	$ 0.60	$ -	$ 1.7	$ 2.4	$ 4.7	
Q-2	Lehigh Quarry - Union Bridge	0.60	1.0	1.0	12.0	2,640					1		$ -			$ 4.0	$ 0.28	$ -	$ -	$ 0.60	$ -	$ 4.9	$ 6.8	$ 11.4	
Q-3	Lehigh Quarry - New Windsor	0.25	0.5	0.5	8.0	8,976					1		$ -			$ 2.0	$ 0.75	$ -	$ -	$ 0.55	$ -	$ 3.3	$ 4.6	$ 18.5	
Q-4	Medford Quarry - Use as Permanent Supply	0.14	0.0								1		$ -			$ -	$ -	$ -	$ -	$ 0.50	$ -	$ 0.5	$ 0.7	$ 5.0	
I-1	Mount Airy Interconnection with Frederick County	0.85	0.0				1.2	12.0	40,128		1		$ -			$ -	$ -	$ 4.21	$ -	$ 0.62	$ -	$ 12.3	$ 12.3	$ 14.4	Cost Estimate based on Hazen & Sawyer Water Supply Study for Mount Airy - Addendum No. 1 (April 17, 2007)
I-2	Interconnection with the York Water Company	0.90	0.0				1.5	12.0	43,084		1		$ -			$ -	$ -	$ 4.52	$ -	$ 0.65	$ -	$ 5.2	$ 7.2	$ 8.0	
I-3	Freedom to Supply Mount Airy with Use of Existing Sources	0.75	0.0				1.0	12.0	51,216		1		$ -			$ -	$ -	$ 5.38	$ -	$ 0.60	$ -	$ 6.0	$ 8.4	$ 11.2	

Notes:
(1) WTP and pipeline capacities were based on supplying the Build-out scenario max. day demand (using max day factor of 1.5), regardless of excess source capacity.
(2) WTP cost (new or expansion) assumed to be $4M/mgd.
(3) Contingency of 40% added to all project components EXCEPT Schnabel Dam and Spillway Costs and Land Acquisition Costs. Contingencies already accounted for in the Hazen & Sawyer estimates for Alternatives I-1 and S-1.
(4) Cost estimates do not include water purchase costs for the alternatives involving water suppliers located outside of Carroll County

Table 5-2:

COST ESTIMATION FOR GROUNDWATER WELL OPTIONS

(based on average MDE groundwater appropriation)

	UNITS	G-1 Hampstead	G-2 Mount Airy	G-3 New Windsor	G-4 Taneytown	G-5 Union Bridge	G-6 Westminster	G-7 Union Mills	G-8 Manchester
Yield	gpd	528,000	364,000	198,000	1,164,000	594,000	1,176,000	563,310	124,000
Average Well Depth	ft bgs	221	211	115	497	165	347	347	221
Average Casing Depth	ft bgs	51	46	75	63	50	135	135	51
Well Pumping Rate	gpm	18	51	46	51	69	91	39	18
Number of Wells	--	20	5	3	16	6	9	10	6
Well Cost	**$**	**$ 1,032,000**	**$ 256,000**	**$ 140,000**	**$ 1,049,000**	**$ 293,000**	**$ 529,000**	**$ 587,000**	**$ 310,000**
No. Pump Houses		**5**	**3**	**2**	**8**	**3**	**5**	**5**	**2**
Pump House Size	**sq. ft.**	**550**	**632**	**516**	**758**	**1031**	**1225**	**587**	**500**
Pump House & Treatment Cost	**$**	**$ 908,000**	**$ 626,000**	**$ 341,000**	**$ 2,001,000**	**$ 1,021,000**	**$ 2,022,000**	**$ 969,000**	**$ 330,000**
Electrical Cost	**$**	**$ 25,000**	**$ 15,000**	**$ 10,000**	**$ 40,000**	**$ 15,000**	**$ 25,000**	**$ 25,000**	**$ 10,000**
Average Pipe Length	**mile**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Piping Costs	**$**	**$ 788,000**	**$ 473,000**	**$ 315,000**	**$ 1,260,000**	**$ 473,000**	**$ 788,000**	**$ 788,000**	**$ 315,000**
Additional Piping Cost	**$**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 6,496,800**	**$ -**
PH, Treatment, Piping & Elect. Cost	**$**	**$ 1,721,000**	**$ 1,114,000**	**$ 666,000**	**$ 3,301,000**	**$ 1,509,000**	**$ 2,835,000**	**$ 8,278,800**	**$ 655,000**
Total Cost (includes contingency)	**$**	**$ 3,304,000**	**$ 1,644,000**	**$ 968,000**	**$ 5,220,000**	**$ 2,163,000**	**$ 4,037,000**	**$ 11,939,000**	**$ 1,158,000**
Unit Cost	**$/gallon**	**$ 6.26**	**$ 4.52**	**$ 4.89**	**$ 4.49**	**$ 3.64**	**$ 3.43**	**$ 21.20**	**$ 9.34**

Assumptions

- Total costs based on average well properties in each water service area (WSA) rounded up to the nearest thousand dollar value
- Unit costs based on typical values in the Mid-Atlantic
- Costs associated with connecting new wells to the water supply grid are estimated at $5,000 per pump house. Assumed that power supply source is available at well sites.
- Cost estimation does not include land/easement acquisition costs
- Costs adjusted upward by a 20% contingency factor
- 8 inch production wells with approximately 1 to 4 wells per pump house. Based on previous studies, 4 wells per pump house was assumed for Hampstead (G-1), while 3 wells per pump house was assumed for Manchester (G-8).
- Number of wells based on projected additional demand divided by the average current MDE groundwater appropriation per well by service area
- Union Bridge casing depth assumed from the average county-wide ratio of well depth to casing depth as no data was available for Union Bridge WSA
- Manchester well depth, casing depth, and well pumping rate assumed to be the same as Hampstead, as no data was available for Manchester WSA
- Pump house size based on total gpm/pump house. Assume 7.5 sq. ft/ per gpm required (based on Manchester's Hallie Hills Station 2, which was 750 sq. ft for 100 gpm flow). A minimum pump house footprint of 500 sq. ft. was assumed.
- Additional storage requirements were not assessed, and therefore storage costs were not included in the estimates.
- Piping costs are ~$60/l.f. ($315,000/mile), based on 6-inch transmission main. An average new transmission main length of 0.5 miles was assumed for all alternatives.
- Pump houses are assumed to be masonry structures, equipped with chemical monitoring and dosing equipment and emergency generators. Cost per sq. ft. estimated at $300 for the structure and $30 for chemical monitoring and treatment equipment (disinfection and pH adjustment equipment).
- G-7 (Union Mills Area Wells) include cost estimates for a 5-mile raw water pipeline to the Westminster Service Area sized to meet proposed Union Mills Reservoir project needs and a new pump station (20-inch pipeline and 4 mgd pump station). Pipeline and pump station costs were adjusted upward by a 40% contingency factor.

	Unit Cost	Unit
Drilling	50	$/ft of well
Casing	10	$/ft of casing
Aquifer Test	20,000	$/well
Site Analysis + Permitting	20,000	$/well
Pump House & Chemical Treatment	330	$/pump house sq. ft.
Piping	315,000	$/mile
Electrical	5,000	$/pump house

Table 5-3
Alternatives Evaluation Scoring Summary and Rankings

MALCOLM PIRNIE

Alternative No.	Alternative Description	Criteria Weights				Overall Performance	Alternatives Base Rank
		0.40	0.20	0.20	0.20		
		Numerical Scores					
		Water Supply Benefits	Environmental Impacts	Implementability	Relative Cost Estimate		
R-1a	Gillis Falls Reservoir (Proposed - Elev 610)	2.4	1.7	1.0	1.0	1.7	23
R-1b	Gillis Falls Reservoir (Expanded - Elev 630)	2.4	1.7	1.0	1.0	1.7	23
R-2	Piney Run Reservoir - Use as Water Source	2.6	3.0	2.3	2.5	2.6	1
R-3	Expansion of Piney Run Reservoir	1.6	2.4	1.8	1.5	1.8	19
R-4a	Union Mills Reservoir (Proposed - Elev 610)	2.8	1.8	1.5	1.0	2.0	6
R-4b	Union Mills Reservoir (Expanded - Elev 630)	3.0	1.8	1.5	1.5	2.2	2
R-5	Increase Capacity of Cranberry Reservoir	1.2	2.0	2.0	3.0	1.9	12
R-6	Prettyboy Reservoir	1.9	2.5	1.8	1.5	1.9	12
S-1	New Surface Water Intake in Gillis Falls Area	2.0	2.1	2.0	1.0	1.8	19
S-2	New Intake on Big Pipe Creek in Union Mills Area (Westminster)	1.4	2.3	1.5	1.0	1.5	26
S-3	New Intake on Little Pipe Creek for Westminster	1.4	2.4	2.0	1.0	1.6	25
S-4	New Intake on Big Pipe Creek for Taneytown	1.4	2.0	1.3	1.0	1.4	27
Q-1	Hyde's Quarry - New Raw Water Reservoir	1.4	2.4	2.0	3.0	2.0	6
Q-2	Lehigh Quarry - Union Bridge	1.8	2.4	1.8	2.0	1.9	12
Q-3	Lehigh Quarry - New Windsor	1.8	2.4	2.0	1.5	1.9	12
Q-4	Medford Quarry - Use as Permanent Supply	1.4	2.7	2.0	3.0	2.1	3
I-1	Mount Airy Interconnection with Frederick County	1.7	2.8	2.0	2.0	2.0	6
I-2	Interconnection with the York Water Company	1.7	2.8	1.8	2.5	2.1	3
I-3	Freedom to Supply Mount Airy Using Existing Sources	1.8	2.3	1.5	2.0	1.9	12
G-1	Hampstead Wells	1.4	2.7	1.0	2.5	1.8	19
G-2	Mount Airy Wells	1.4	2.7	1.5	3.0	2.0	6
G-3	New Windsor Wells	1.4	2.7	1.5	3.0	2.0	6
G-4	Taneytown Wells	1.4	2.7	1.0	3.0	1.9	12
G-5	Union Bridge Wells	1.4	2.7	1.0	2.5	1.9	12
G-6	Westminster Wells	1.4	2.7	2.0	3.0	2.1	3
G-7	Union Mills Area Wells	1.4	2.7	2.0	1.5	1.8	19
G-8	Manchester Wells	1.4	2.7	2.0	2.5	2.0	6

Note:
(a) Numerical Scores: Highest (3); Lowest (1)

Table 5-4
Alternatives Evaluation Scoring Summary and Rankings - SORTED BY RANK

MALCOLM PIRNIE

Alternative No.	Alternative Description	Criteria Weights				Overall Performance	Alternatives Base Rank
		0.40	0.20	0.20	0.20		
		Numerical Scores					
		Water Supply Benefits	Environmental Impacts	Implementability	Relative Cost Estimate		
R-2	Piney Run Reservoir - Use as Water Source	2.6	3.0	2.3	2.5	2.6	1
R-4b	Union Mills Reservoir (Expanded - Elev 630)	3.0	1.8	1.5	1.5	2.2	2
Q-4	Medford Quarry - Use as Permanent Supply	1.4	2.7	2.0	3.0	2.1	3
I-2	Interconnection with the York Water Company	1.7	2.8	1.8	2.5	2.1	3
G-6	Westminster Wells	1.4	2.7	2.0	3.0	2.1	3
R-4a	Union Mills Reservoir (Proposed - Elev 610)	2.8	1.8	1.5	1.0	2.0	6
Q-1	Hyde's Quarry - New Raw Water Reservoir	1.4	2.4	2.0	3.0	2.0	6
I-1	Mount Airy Interconnection with Frederick County	1.7	2.8	2.0	2.0	2.0	6
G-2	Mount Airy Wells	1.4	2.7	1.5	3.0	2.0	6
G-3	New Windsor Wells	1.4	2.7	1.5	3.0	2.0	6
G-8	Manchester Wells	1.4	2.7	2.0	2.5	2.0	6
R-5	Increase Capacity of Cranberry Reservoir	1.2	2.0	2.0	3.0	1.9	12
R-6	Prettyboy Reservoir	1.9	2.5	1.8	1.5	1.9	12
Q-2	Lehigh Quarry - Union Bridge	1.8	2.4	1.8	2.0	1.9	12
Q-3	Lehigh Quarry - New Windsor	1.8	2.4	2.0	1.5	1.9	12
I-3	Freedom to Supply Mount Airy Using Existing Sources	1.8	2.3	1.5	2.0	1.9	12
G-4	Taneytown Wells	1.4	2.7	1.0	3.0	1.9	12
G-5	Union Bridge Wells	1.4	2.7	1.0	2.5	1.9	12
R-3	Expansion of Piney Run Reservoir	1.6	2.4	1.8	1.5	1.8	19
S-1	New Surface Water Intake in Gillis Falls Area	2.0	2.1	2.0	1.0	1.8	19
G-1	Hampstead Wells	1.4	2.7	1.0	2.5	1.8	19
G-7	Union Mills Area Wells	1.4	2.7	2.0	1.5	1.8	19
R-1a	Gillis Falls Reservoir (Proposed - Elev 610)	2.4	1.7	1.0	1.0	1.7	23
R-1b	Gillis Falls Reservoir (Expanded - Elev 630)	2.4	1.7	1.0	1.0	1.7	23
S-3	New Intake on Little Pipe Creek for Westminster	1.4	2.4	2.0	1.0	1.6	25
S-2	New Intake on Big Pipe Creek in Union Mills Area (Westminster)	1.4	2.3	1.5	1.0	1.5	26
S-4	New Intake on Big Pipe Creek for Taneytown	1.4	2.0	1.3	1.0	1.4	27

Note:
(a) Numerical Scores: Highest (3); Lowest (1)

6. References

[1]Malcolm Pirnie, Inc., 2009. *Carroll County Water Demands and Availability*. July 2009.

[2] Hazen and Sawyer, 2006-2007. Water Supply Alternatives Study for Town of Mount Airy (April 2006) and Report Addendum No. 1 (April 2007).

[3] MDE, Date unknown. *Water Balance Summary*. Word Document provided by Pat Hammond of MDE on Feb 20, 2009.

[4] R.E. Wright Associates, 1988. *Carroll County Water Resources Study (Volumes I-II)*. May 1988.

[5] Malcolm Pirnie, Inc., 2009. *Carroll County Wastewater Limitations*. May, 2009

[6] MDE. 2003. *Guidelines for Land Treatment of Municipal Wastewaters*. 33 p.