Carroll County
Alternatives Evaluation

Appendix C

Groundwater Assessment

6531-001-400

MALCOLM PIRNIE

		DEMAND	SERVICE AREA MDE AVAILABLE RECHARGE					ESTIMATED WELL REQUIREMENTS	
		❶	❶	❷	❸	❹	❺	❶	❷
			Priority + Future Service Area						
Alt	Growth Area	Probable Maximum Additional Water Requirement [gpd]	Area [ac]	Total Available Recharge [gpd]	Remaining Available Recharge [gpd]	Projected Water Surplus [gpd]	Total Required MDE GW Recharge Area [ac]	Number of Additional Wells based on Average MDE Appropriation per Groundwater Well [-]	Total Exploration Sites [-]
G-1	***Hampstead***	***528,000***	***2,656***	***934,979***	***214,364***	***-313,636***	***891***	***20***	***28***
G-2	*Mount Airy*	*364,000*	*3,543*	*1,197,463*	*532,598*	*168,598*	*0*	*5*	*54*
G-3	***New Windsor***	***198,000***	***953***	***290,665***	***94,665***	***-103,335***	***339***	***3***	***22***
G-4	***Taneytown***	***1,164,000***	***3,274***	***949,460***	***366,460***	***-797,540***	***2,750***	***16***	***5***
G-5	***Union Bridge***	***594,000***	***1,430***	***436,150***	***227,850***	***-366,150***	***1,200***	***6***	***11***
G-6	*Westminster*	*1,176,000†*	*8,543*	*3,007,136*	*1,531,136*	*355,136*	*0*	*9*	*38*
G-7	*Union Mills*	*N/A*	*1,600*	*563,310*	*563,310*	*563,310*	*0*	*10*	--
G-8	*Manchester*	*124,000††*	*0*	*0*	*0*	*0*	*0*	*6*	--
	WSA Totals	**4,148,000**	**20,399**	**6,815,853**	**2,967,073**	**-1,056,927**	**5,180**	**75**	**158**

Notes:

❶ Projected maximum groundwater requirement (see Table 2-1)
❶ Area of Priority+Future Service Area (GIS layer supplied by County)
❷ Total Available Recharge in Priority+Future Service Areas based on recommended MDE method (Recharge = 1yrQ10 - 7Q10 by hydrogeomorphic region)
❸ Adjusted Available Recharge in Piority+Future Service Areas (Total Available adjusted by subtracting existing allocations)
❹ Projected Surplus of Available Recharge (Max(❸,0)-❶)
❺ The amount of additional land that a given WSA would need to own/control to obtain an appropriation permit to meet total projected demands by groundwater (-MIN(❶/,0)*❷/❶)
❶ Estimated number of wells needed to meet maximum probable GW demands ❶
❷ Total number potential wells sites identified by the County and its water service areas for exploration

† Assumed existing withdrawals in Westminster are equal to actual yield because existing wells are known to have significantly lower yields than the permitted amount
†† Manchester needs additional wells to access water that is already appropriated, but cannot be used due to reduced well capacities.

Hampstead Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/21/2009

	Appropriation Watershed			WSA Totals
Own & Control Type	**Patapsco**	**Gunpowder**	**Loch Raven**	
Size (ac)				
WSA Priority+Future	1,060	1,189	407	**2,656**
GAB	1,815	1,193	413	**3,421**
Recharge Rate (gpd/ac)	**352**	**352**	**352**	
Own/Control Water (gpd)				
WSA Priority+Future	373,215	418,609	143,155	**934,979**
GAB	638,880	419,936	145,376	**1,204,192**
Existing Appropriations (gpd)	**583,000**	**206,400**	**141,000**	**930,400**
Net Availability (gpd)				
WSA Priority+Future	-209,785	212,209	2,155	**214,364**
GAB	55,880	213,536	4,376	**273,792**

Existing Appropriations	**930,400**	**Comment**
Patapsco	**583,000**	
County Wells	*283,000*	
11		*N Main Street*
12		*N Main Street*
20		*Hospital Well*
21		*Hospital Well*
28		*Corbin Well Field*
29		*Corbin Well Field*
31		*Widerman Well Field*
32		*Widerman Well Field*
Black & Decker	*300,000*	*Remediation Well*
Gunpowder	**206,400**	
County Wells	*156,000*	
19		*Greenmount Church*
24		*Small Crossings*
25		*Small Crossings*
TWC		
PWC-1		
33		*North Carroll Farm*
34		*North Carroll Farm*
Oakmont Green Golf Course	*50,400*	
Loch Raven	**141,000**	
13		*Route 88*
15		*Route 88*
22		*Roberts Field*
23		*Roberts Field*
26		*Roberts Field*
27		*Roberts Field*

Mount Airy Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/27/2009

	Appropriation Watershed				WSA Totals
Own & Control Type	**Middle Run**	**South Branch Patapsco**	**Woodville Branch**	**Upper Bush Creek**	
Size (ac)					
WSA Priority+Future	220	1,524	1,393	406	**3,543**
GAB	253	1,737	1,393	398	**3,781**
Recharge Rate (gpd/ac)	**372**	**372**	**305**	**305**	
Own/Control Water (gpd)					
WSA Priority+Future	81,840	566,928	424,865	123,830	**1,197,463**
GAB	94,116	646,055	424,865	121,390	**1,286,426**
Existing Appropriations (gpd)	**38,000**	**90,000**	**625,000**	**112,000**	**865,000**
Net Availability (gpd)					
WSA Priority+Future	43,840	476,928	-200,135	11,830	**532,598**
GAB	56,116	556,055	-200,135	9,390	**621,561**

Existing Appropriations	**865,000**
Middle Run (NE Basin)	**38,000**
Well 5	*38,000*
South Branch (SE Basin)	**90,000**
Well 6	*90,000*
Woodville Branch (NW basin)	**625,000**
Wells 1, 2, 3, 4	*307,000*
Well 8	*162,000*
Well 9	*79,000*
Well 10	*77,000*
Upper Brush Creek (SW Basin)	**112,000**
Well 7	*112,000*

New Windsor Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/27/2009

	Appropriation Watershed			WSA Totals
Own & Control Type	**Dickerson Run**	**Little Pipe Creek**	**Turkeyfoot Run**	
Size (ac)				
WSA Priority+Future	654	98	201	**953**
GAB	658	101	201	**960**
Recharge Rate (gpd/ac)	**305**	**305**	**305**	
Own/Control Water (gpd)				
WSA Priority+Future	199,470	29,890	61,305	**290,665**
GAB	200,690	30,805	61,305	**292,800**
Existing Appropriations (gpd)	**196,000**	**0**	**0**	**196,000**
Net Availability (gpd)				
WSA Priority+Future	3,470	29,890	61,305	**94,665**
GAB	4,690	30,805	61,305	**96,800**

Existing Appropriations	**196,000.00**	
Dickerson Run	**196,000.00**	
Main spring/Dennings	*143,000.00*	
Roops Meadow/Hillside	*53,000.00*	
Dickerson Run	*0.00*	*emergency use only*
Little Pipe Creek	**0.00**	
Turkeyfoot Run	**0.00**	

Taneytown Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/27/2009

	Appropriation Watershed		WSA Totals
Own & Control Type	**Big Pipe Creek**	**Piney Creek**	
Size (ac)			
WSA Priority+Future	540	2,734	**3,274**
GAB	539	2,730	**3,269**
Recharge Rate (gpd/ac)	**290**	**290**	
Own/Control Water (gpd)			
WSA Priority+Future	156,600	792,860	**949,460**
GAB	156,310	791,700	**948,010**
Existing Appropriations (gpd)	**103,000**	**480,000**	**583,000**
Net Availability (gpd)			
WSA Priority+Future	53,600	312,860	**366,460**
GAB	53,310	311,700	**365,010**

Existing Appropriations	**583,000**
Piney Creek	**103,000**
wells 15 & 16	*103,000*
Big Pipe Creek	**480,000**
wells 8,9,11,12,13	*390,000*
well 14	*90,000*

Union Bridge Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/28/2009

	Appropriation Watershed			WSA Totals
Own & Control Type	**Sams Creek**	**Priestland Branch**	**Cherry Branch / Little Pipe**	
Size (ac)				
WSA Priority+Future	393	767	270	**1,430**
GAB	427	921	292	**1,640**
Recharge Rate (gpd/ac)	**305**	**305**	**305**	
Own/Control Water (gpd)				
WSA Priority+Future	119,865	233,935	82,350	**436,150**
GAB	130,235	280,905	89,060	**500,200**
Existing Appropriations (gpd)	**0**	**208,300**	**0**	**208,300**
Net Availability (gpd)				
WSA Priority+Future	119,865	25,635	82,350	**227,850**
GAB	130,235	72,605	89,060	**291,900**

Existing Appropriations	**208,300**
Sams Creek	**0**
Priestland Branch	**208,300**
PW 1 & PW3	*166,000*
Philips	*42,300*
Cherry Br./Little Pipe	**0**
Bowman Well	*0*

Westminster Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/26/2009

	Appropriation Watershed			WSA Totals
Own & Control Type	**Patapsco**	**Big Pipe Creek**	**Little Pipe Creek**	
Size (ac)				
WSA Priority+Future	4,256	1,129	3,158	**8,543**
GAB	5,855	1,260	3,736	**10,851**
Recharge Rate (gpd/ac)	**372**	**305**	**352**	
Own/Control Water (gpd)				
WSA Priority+Future	1,498,112	397,408	1,111,616	**3,007,136**
GAB	2,060,960	443,520	1,315,072	**3,819,552**
Existing Appropriations (gpd)	**519,000**	**360,000**	**597,000**	**1,476,000**
Net Availability (gpd)				
WSA Priority+Future	979,112	37,408	514,616	**1,531,136**
GAB	1,541,960	83,520	718,072	**2,343,552**

Existing Appropriations	**1,476,000**	
Patapsco	**519,000**	
4	*170,000*	*Air Business Center*
5	*230,000*	*Krider's Church*
8	*119,000*	*Vo-Tech*
Big Pipe Creek	**360,000**	
3	*100,000*	*County Maintenance*
9	*125,000*	*Koontz Well*
10		*Koontz Well*
11	*135,000*	*Roops mill*
Little Pipe Creek	**597,000**	
1	*197,000*	*Wakefield Well 1*
2		*Wakefield Well 2*
6	*100,000*	*S. Center Street*
7	*300,000*	*Carfaro*

notes:

1. *does not account for discharge from Koontz Creamery well which is 500,000 gpd flow augmentation in the Patapsco watershed*

2. *does not include Wakefield Valley golf course at 86,000 gpd in the Little Pipe Creek watershed*

3. *does not include existing Medford Quarry appropriation for mining.*

Union Mills Groundwater Budget

Prepared by: Malcolm Pirnie **Date:** 8/17/2009

	Appropriation Watershed	WSA Totals
Own & Control Type	**Big Pipe Creek**	
Size (ac)		
WSA Priority+Future	1,600	**1,600**
GAB	1,600	**1,600**
Recharge Rate (gpd/ac)	**305**	
Own/Control Water (gpd)		
WSA Priority+Future	563,310	**563,310**
GAB	563,310	**563,310**
Existing Appropriations (gpd)	**0**	**0**
Net Availability (gpd)		
WSA Priority+Future	563,310	**563,310**
GAB	563,310	**563,310**

Existing Appropriations	**0**
Big Pipe Creek	**0**

Manchester Groundwater Budget

Prepared by: Carroll County Staff **Date:** 5/21/2009

	Appropriation Watershed			WSA Totals
Own & Control Type	**Middle Potomac**	**Patapsco**	**Gunpowder**	
Size (ac)				
WSA Priority+Future	310	352	1,102	**1,764**
GAB	970	665	2,112	**3,747**
Recharge Rate (gpd/ac)	**352**	**352**	**352**	
Own/Control Water (gpd)				
WSA Priority+Future	109,219	123,728	388,055	**621,002**
GAB	341,292	234,094	743,554	**1,318,940**
Existing Appropriations (gpd)	**134,000**	**123,000**	**324,000**	**581,000**
Net Availability (gpd)				
WSA Priority+Future	-24,781	728	64,055	**64,783**
GAB	207,292	111,094	419,554	**737,940**

Existing Appropriations	**581,000**
Middle Potomac	**134,000**
Bachman Road	
Crossroads 1	
Crossroads 2	
Hallie Hills	
Patapsco	**123,000**
Patricia Ct	*38,000*
Manchester Farms D	*69,700*
Manchester Farms B	
Park Ridge	*6,000*
Chauncey Hill	*9,300*
Gunpowder	**324,000**
walnut st spring/well	
route 30 (Lippy)	
Holland Drive	
Ferrier Road	
Black Farm	

ESTIMATED WELL REQUIREMENTS - ASSUMPTIONS

Drawdown Factor of Safety 10%

General Assumptions

- data based on 1988 Carroll County Water Resources Study by R.E. Wright Associates
- maximum drawdown based on the measured distance between static water level and top of water bearing zone with a 10% factor of safety
- maximum pump rates based on septic capacities measured in WSA wells and calculated maximum drawdown
- total demand based on values presented in the GW Demands spreadsheet.
- number of wells is the total demand divided by the average pump rate of the well rounded up to the nearest integer value

- likely yield scenarios based on the MDE's understanding of hydrogeology in the vicinity of each of the WSAs
- median yield scenarios based on the median of published information
- optimistic yield scenarios based on the median of the maximum values for a given parameter where a range was specified
- lower yield scenarios based on the median of the minimum values for a given parameter where a range was specified

Instructions

1 set demands in blue box
2 adjust pump rates in red box to ensure total drawdown does not exceed acceptable drawdown

HAMPSTEAD GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	4	28	149	--	ft - above aquifer bottom
Aquifer Thickness	60	67	193	--	ft
Specific Capacity	1.30	1.78	2.25	--	gpm/ft
Acceptable Drawdown	19.8	34.1	47.7	--	ft
Absolute Max Pump Rate	25.7	60.5	107.3	--	gpm
Pumping Rate	25	55	100	19	gpm
Total Demand	528,000	528,000	528,000	528,000	gpd
Well Drawdown	19.2	31.0	44.4	--	ft
Daily Pump Volume	36,000	79,200	144,000	27,619	gpd
Total Daily Pump Volume	540,000	554,400	576,000	552,381	gpd
Number of Wells	15	7	4	20	--

Notes:

- Aquifer data based on Hampstead information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

MOUNT AIRY GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	23	145	266	--	ft - above aquifer bottom
Aquifer Thickness	7	137	266	--	ft
Specific Capacity	8.00	8.00	8.00	--	gpm/ft
Acceptable Drawdown	11.7	14.4	18.0	--	ft
Absolute Max Pump Rate	93.6	115.2	144.0	--	gpm
Pumping Rate	40	75	75	60	gpm
Total Demand	364,000	364,000	364,000	364,000	gpd
Well Drawdown	5.0	9.4	9.4	--	ft
Daily Pump Volume	57,600	108,000	108,000	86,500	gpd
Total Daily Pump Volume	403,200	432,000	432,000	432,500	gpd
Number of Wells	7	4	4	5	--

Notes:

- Aquifer data based on Mount Airy information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

- Storage coefficient values were estimated from regional values presented in Chapter 4 of 1988 study

NEW WINDSOR GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	64	64	64	--	ft - above aquifer bottom
Aquifer Thickness	1	1	1	--	ft
Specific Capacity	15.00	15.00	15.00	--	gpm/ft
Acceptable Drawdown	56.7	56.7	56.7	--	ft
Absolute Max Pump Rate	850.5	850.5	850.5	--	gpm
Pumping Rate	50	100	100	68	gpm
Total Demand	198,000	198,000	198,000	198,000	gpd
Well Drawdown	3.3	6.7	6.7	--	ft
Daily Pump Volume	72,000	144,000	144,000	98,000	gpd
Total Daily Pump Volume	216,000	288,000	288,000	294,000	gpd
Number of Wells	3	2	2	3	--

Notes:

- Aquifer data based on New Windsor information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

TANEYTOWN GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	22	295	496	--	ft - above aquifer bottom
Aquifer Thickness	25	89	141	--	ft
Specific Capacity	0.90	1.10	1.60	--	gpm/ft
Acceptable Drawdown	45.9	72.9	243.0	--	ft
Absolute Max Pump Rate	41.3	80.2	388.8	--	gpm
Pumping Rate	40	80	380	51	gpm
Total Demand	1,164,000	1,164,000	1,164,000	1,164,000	gpd
Well Drawdown	44.4	72.7	237.5	--	ft
Daily Pump Volume	57,600	115,200	547,200	72,875	gpd
Total Daily Pump Volume	1,209,600	1,267,200	1,641,600	1,166,000	gpd
Number of Wells	21	11	3	16	--

Notes:

- Aquifer data based on Taneytown information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

UNION BRIDGE GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	64	216	530	--	ft - above aquifer bottom
Aquifer Thickness	1	21	374	--	ft
Specific Capacity	0.80	8.00	97.00	--	gpm/ft
Acceptable Drawdown	59.4	137.7	252.9	--	ft
Absolute Max Pump Rate	47.5	1101.6	24531.3	--	gpm
Pumping Rate	47	200	200	72	gpm
Total Demand	594,000	594,000	594,000	594,000	gpd
Well Drawdown	58.8	25.0	2.1	--	ft
Daily Pump Volume	67,680	288,000	288,000	104,150	gpd
Total Daily Pump Volume	609,120	864,000	864,000	624,900	gpd
Number of Wells	9	3	3	6	--

Notes:

- Aquifer data based on Union Bridge information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

WESTMINSTER GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	75	216	530	--	ft - above aquifer bottom
Aquifer Thickness	1	21	374	--	ft
Specific Capacity	0.80	8.00	97.00	--	gpm/ft
Acceptable Drawdown	59.4	137.7	252.9	--	ft
Absolute Max Pump Rate	47.5	1101.6	24531.3	--	gpm
Pumping Rate	45	200	550	93	gpm
Total Demand	1,176,000	1,176,000	1,176,000	1,176,000	gpd
Well Drawdown	56.3	25.0	5.7	--	ft
Daily Pump Volume	64,800	288,000	792,000	134,182	gpd
Total Daily Pump Volume	1,231,200	1,440,000	1,584,000	1,207,636	gpd
Number of Wells	19	5	2	9	--

Notes:

- Aquifer data based on Westminster information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates

UNION MILLS AREA GROUNDWATER OPTION - ESTIMATED WELL REQUIREMENTS

WITHDRAWAL SCENARIO

	LOWER YIELD	MEDIAN YIELD	OPTIMISTIC YIELD	AVG MDE APPROPRIATION	UNITS
Static Head	75	216	530	--	ft - above aquifer bottom
Aquifer Thickness	1	21	374	--	ft
Specific Capacity	0.80	8.00	97.00	--	gpm/ft
Acceptable Drawdown	59.4	137.7	252.9	--	ft
Absolute Max Pump Rate	47.5	1101.6	24531.3	--	gpm
Pumping Rate	45	200	550	43	gpm
Total Demand	563,310	563,310	563,310	563,310	gpd
Well Drawdown	56.3	25.0	5.7	--	ft
Daily Pump Volume	64,800	288,000	792,000	61,750	gpd
Total Daily Pump Volume	583,200	576,000	792,000	617,500	gpd
Number of Wells	9	2	1	10	--

Notes:

- Aquifer data based on Westminster information presented in the 1988 Water Resources Study of Carroll County by R.E. Wright Associates