4. Water Reuse Alternatives and Evaluation

The recycling and reuse of WWTP effluent (or "reclaimed water") is a viable long-term strategy for overcoming wastewater disposal limitations. A discussion of reuse options was presented in the May 2009 Carroll County Wastewater Limitations report[5]. The most viable reuse option in Carroll County is water reuse on cropland and/or turfgrass, which is discussed in Section 4. Other options that were evaluated include using industrial WWTP excess capacity to treat wastewater for reuse applications, as well as industrial use of municipally treated wastewater for non-potable use as process water.

4.1. Water Reuse Alternatives

Water reuse of reclaimed water will likely require both surface water and groundwater NPDES permits and is subject to State requirements for effluent irrigation systems as documented in MDE's *Guidelines for Land Treatment of Municipal Wastewaters*[6]. Under these regulations, water used for irrigation must meet either Class I or Class II quality requirements, with associated buffer requirements (Table 4-1). Maryland has also proposed draft amendments to the land treatment guidelines, which include Class III requirements for systems to which the public would have access.

The slopes of land to be irrigated must be less than 15% on cultivated lands and less than 25% on forested lands. Irrigation of Class I and Class II effluent is limited to locations where the depth of groundwater is at least four feet.

Table 4-1

Maryland's Class I and Class II Effluent Quality and Buffer Requirements

Class	Quality Requirements	Buffer Requirements
I	■ 5-day Biochemical Oxygen Demand (BOD5) <70 mg/l ■ Suspended solids <90 mg/l ■ pH: 6.5-8.5 ■ Fecal Coliform < 200 MPN/100 ml, or <3 MPN/100 ml for golf course irrigation	■ Minimum of 200 feet from the wetted perimeter to property lines, waterways and public roads in open areas. ■ Minimum of 500 feet from the wetted perimeter to houses or other occupied structures. ■ 50% reduction in distance with tree buffers.
II	■ BOD5 <10 mg/l ■ Suspended solids <10 mg/l, pH: 6.5-8.5 ■ Fecal Coliform < 3 MPN/100 ml	■ Minimum of 25 feet from the wetted perimeter to property lines, housing structures, waterways and public roads. ■ Minimum of 50 feet to schools and playgrounds. ■ Minimum of 100 feet to potable wells and water intakes
III (proposed)	■ BOD-5 < 10 mg/L (30-day avg) ■ Turbidity < 2 NTU (daily avg) and 5 NTU (max) ■ Fecal Coliforms < 2.2 MPN per 100 mL (30-day geometric mean)	■ 50 ft for wells ■ 100 ft for outdoor public eating, drinking and bathing facilities

Seasonal reuse of treated effluent can benefit those localities whose discharge to surface water is limited by loading caps or other water quality parameters such as temperature (see Table 3-1 in Wastewater Limitation Evaluation, May 2009). Because a high level of treatment is still required, it does not provide relief for facilities that are primarily limited by treatment capacity. However, irrigative reuse is expected to be especially beneficial for (1) major WWTPs that would be limited by nutrient loading caps even after installation of ENR technology; (2) minor facilities that could implement reuse as an alternative to ENR technology. In most cases it will still be necessary to discharge to surface water in the winter, or in other seasons if the demand/land area for reused water is less than the total effluent generated. Facilities that have concentration-based nutrient limits would still be required to attain those limits when discharging to surface water.

4.1.1. Methodology

Reuse alternatives were evaluated through a GIS analysis of land use in the vicinity of each of the County's and town's major wastewater treatment plants (WWTP) with capacities exceeding 0.5 mgd. Potential reuse sites that would warrant additional study were identified within a 1-mile and 2-mile search radius from each evaluated WWTP using the 2007 MDE Land use/Land Classification spatial data layer and adjusted using more recent 2009 aerial photography (see Figure 4-1 for the location of WWTPs that were evaluated). Sites were also identified by examining existing agricultural and industrial water appropriation permits within the search radii. Land use categories

identified as potential locations for wastewater reuse include athletic fields, croplands, golf courses, open urban land and pastures. For conceptual evaluation purposes, it was assumed that water reuse in the County could occur on public access sites under the newly adopted Maryland regulations for Class III Effluent. Small (less than 50 acres in size) and non-contiguous parcels were identified within the 1-mile and 2-mile radius areas, and were eliminated from the total land area due to limited demands in these areas. Construction of long water reuse pipelines to these small and non-contiguous parcels would not be economically feasible. For estimation purposes, it was assumed that 50% of the potentially usable land areas within the one and two-mile radius of each WWTP would be available for water reuse (i.e. 50% of the land is irrigable, while the remaining 50% of the land consists of impervious surfaces such as buildings and roadways or is otherwise unsuitable for use). Tables 4-2 and 4-3 summarize the total irrigable land available near each major WWTP, within the one and two-mile radius, respectively.

The quantities of irrigable land required to land apply 50% of the Projected Build-out wastewater flows for each plant were calculated. The projected Build-out flow is defined as the wastewater flows from the Designated Growth Areas (DGA), as presented in Table 3-1 of the Wastewater Limitations Report (Malcolm Pirnie, May 2009). In order to calculate the amount of land required, a water reuse rate was defined as 1 mgd per 585 acres of land. This rate assumes the following:

- Land buffers – assumed to be 10% of the site area.
- No long-term storage of reuse water during winter months - assumed that wastewater will be discharged to receiving water body during winter months. Winter months are defined as the three coldest months of the year when frozen ground conditions occur and vegetation is dormant.
- Assumes that the water reuse rate of reclaimed water is approximately 0.9 inches per week during periods when irrigation is feasible.
- 25% rainfall and other events shutoff factor during non-Winter months.

Table 4-4 summarizes the quantity of land required to meet 50% of the projected build-out wastewater flows through water reuse, assuming a water reuse rate of 1 mgd per 585 acres.

4.1.2. Potential Locations for Water Reuse

Based on the methodology and assumptions presented in Section 4.1.1, all of the municipalities have the irrigable land available to potentially accept 50% of the projected build-out flow for water reuse, with the exception of the Freedom Service Area. It should be noted that this analysis has been performed at the conceptual level, and a more detailed assessment of the potential sites would be required in order to obtain approval from MDE.

Taneytown and Manchester both have sufficient land available within a one-mile radius of their respective WWTPs to potentially reuse 50% of their projected build-out wastewater flows. The potential land available for Taneytown is shown on Figure 4-2, while the potential land available for Manchester is shown on Figure 4-3.

Westminster, Mount Airy and Hampstead all have sufficient land available within a two-mile radius of their respective WWTPs to potentially reuse 50% of their projected build-out wastewater flows. The potential land available for the three municipalities is shown in Figures 4-4, 4-5, and 4-6, respectively.

The Freedom Service Area does not have enough irrigable land available to meet 50% of the projected build-out demand for wastewater flows. As shown in Table 4-3, 573 acres of irrigable land are available; however, approximately 1,578 acres are required to meet the reuse demand of 2.7 mgd (see Table 4-4). Using the application rate of 1 mgd per 585 acres and 573 acres of available irrigable land (within a two-mile radius of the WWTP, see Figure 4-7), approximately 0.98 mgd of wastewater flow could potentially be reused (18% of the projected build-out flow of 5.4 mgd.)

It should be noted that the spatial accuracy of the land use used in the evaluation is such that it is most appropriate for planning purposes to indicate the sites most likely to be suitable for water reuse. More detailed investigations of a site's other potential land use limitations, as well as detailed field investigations of a site's hydraulic and nutrient assimilation capacity should be conducted following a site's selection as a preferred water reuse location.

4.2. Use of Excess Industrial Wastewater Capacity

The Task 3 Carroll County Wastewater Limitations report (Malcolm Pirnie, May 2009) briefly addressed the concept of using excess industrial wastewater treatment capacity to treat future municipal wastewater flows in Carroll County at two industrial facilities (BTR-Hampstead and Congoleum Corp.). For the Task 4 alternatives evaluation, additional inquiries were made with MDE and facility representatives to determine whether use of excess industrial wastewater treatment capacity is a viable alternative. The BTR-Hampstead plant is located in the southern part of the Hampstead Service Area, near the boundary with Baltimore County, while the Congoleum Corp. plant is located in Finksburg, near the northern tip of Liberty Reservoir.

4.2.1. BTR—Hampstead

Information on the BTR-Hampstead WWTP, also known as the Black and Decker plant, was obtained from the following sources:

- The latest available NPDES permit fact sheet, dated 2002.
- A telephone interview with Ed Gertler, MDE industrial permitter, June 23, 2009.
- A telephone interview with Doug Myers, Maryland Environmental Service (MES), June 30, 2009.
- A February 2008 report by the Maryland Environmental Service entitled *Black and Decker Wastewater Treatment Plan Condition and Capacity Evaluation Report.*

Evaluation of Excess Treatment Capacity: According to the NPDES fact sheet, the BTR-Hampstead plant is "engaged in warehousing, packaging, and manufacturing of powdered metal parts." The wastewater treatment plant, which is operated by MES, consists of an activated sludge process that currently receives 5,000-6,000 gpd of sanitary wastewater from the facility. The activated sludge treatment process was originally rated for 150,000 gpd, but MES has determined that the actual treatment capacity is in the 50,000 to 100,000 gpd range.

Effluent from the activated sludge process is directed to a holding pond that also receives stormwater, treated groundwater, and non-contact cooling water. Water in the holding pond is pumped to a physical/chemical (P/C) treatment process consisting of chemical flocculation, settling and filtration. Alum is added for phosphorus removal and suspended solids According to MES (2008), the P/C treatment process was operated at a rate of 300,000 gpd every other week in 2007.

Effluent from the P/C process is directed to a polishing pond, from which the facility pumps non-contact cooling water. Overflow from the polishing pond is discharged to an unnamed tributary to Deep Run, which is a tributary to the North Branch of the Patapsco River upstream of Liberty Reservoir. Although the combined treatment system does not have a flow rating, the daily average flow in 2007 was about 180,000 gpd, of which less than 5 percent was effluent from the activated sludge process.

BTR-Hampstead's activated sludge process is operating at only 6 to 12 percent of its design capacity, and so theoretically has the capability to accept additional sanitary flows. If the actual capacity is 50,000 to 100,000 gpd as estimated by MES, the system could treat an additional 44,000 to 94,000 gpd. However, challenges to the use of this system to treat additional municipal flows include the following:

- The facility has no formal nutrient wasteload allocation and was not designed for nitrogen removal. Therefore, nutrient loads from future municipal sources would still have to be offset in some fashion, and the plant would most likely have to be upgraded to improve the nutrient removal capabilities.

- Most of the wastewater treatment equipment is over 35 years old and was estimated by MES (2008) to have a projected service life of less than 10 years.

Required improvements were estimated to cost between $2.9 million and $4.75 million, not including nutrient removal upgrades and associated solids handling equipment.

- Diverting wastewater flows from the Town of Hampstead WWTP would require significant and costly additions/modifications of the collection system (D. Myers, pers. comm., 30 Jun 2009).

For the reasons cited above, the BTR-Hampstead plant is not considered a viable alternative for treating a large portion of the wastewater flows from the Town of Hampstead. Given the level of investment required to refurbish/upgrade the plant and modify the collection system, it would probably be more cost-effective to build a new plant or expand the existing Town of Hampstead WWTP. The BTR-Hampstead plant could be a viable option for treating small local sanitary wastewater flows that would require little modification of the plant or collection system.

Evaluation of Potential Demand for Effluent: BTR-Hampstead is already obligated to pump and treat groundwater, producing water that is sufficient both in quantity and quality to meet non-contact cooling water needs. As a result, there is little technical or economic incentive for the plant to purchase or accept wastewater effluent at this time.

4.2.2. Congoleum Corporation

Information on the Congoleum Corp. wastewater treatment system was obtained from the following sources:

- The latest available NPDES permit fact sheet, dated 2002.
- A telephone interview with Ed Gertler, MDE industrial permitter, June 23, 2009.
- Telephone interview with T.C. Garrod, Congoleum Corp., June 23, 2009 and July 6, 2009.

Evaluation of Excess Treatment Capacity: The Congoleum Corp. in Finksburg manufactures felt that is used as a backing for vinyl flooring. The felt product is produced from limestone, wood fibers, and mineral fillers. Most of the process wastewater is derived from water that is used to clean the felt manufacturing equipment and drainage from the felt drying process. Other wastewater streams include boiler blowdown and sanitary wastewater. However, sanitary wastewater represents a small fraction (≤1%) of the total wastewater generated. Wastewater is directed to a series of six lagoons for primary settling, which is followed by an activated sludge aeration tank, clarification, chlorination, and dechlorination. A floating bubbler is used seasonally to aerate the effluent prior to discharge to the North Branch of the Patapsco River, upstream of Liberty Reservoir.

The wastewater treatment system has a design capacity of 500,000 to 600,000 gpd, and was sized to account for a potential increase in manufacturing at the site. Due to economic/market conditions, manufacturing has not increased at the facility, and in fact has decreased from past years. Congoleum's average wastewater flow is currently about 216,000 gpd. Although changing market/economic conditions might cause a future increase in manufacturing, the wastewater treatment system is large enough that an undetermined amount of excess treatment capacity is expected to remain (T.C. Garrod, pers. comm., 23 June 2009).

Congoleum's process wastewater is very different from a municipal wastewater. The influent to the activated sludge process is low in solids and BOD, and much of the TOC is poorly degradable. In the opinion of both Congoleum and MDE staff, the biological wastewater treatment process would actually perform better with a higher proportion of sanitary wastewater. However, the wastewater treatment system would likely require engineering upgrades and process modifications to accommodate municipal wastewater influent. Additions that might be required include preliminary treatment equipment (grit chamber, screens, *etc.*), modified primary clarification facilities, and solids handling equipment.

Nutrient load caps represent an important limitation to the ability of the system to accept municipal wastewater. Because the facility discharges upstream of Liberty Reservoir, its renewed NPDES permit is expected to have a total phosphorus limit of 0.3 mg/L in accordance with the *2005 Action Strategy for the Reservoir Watersheds*. The facility also has Chesapeake Bay-related nutrient caps of 4,005 lb/yr total nitrogen and 160 lb/yr total phosphorus. These loading caps were based on a flow of 263,000 gpd, a total nitrogen concentration of 5 mg/L, and a total phosphorus concentration of 0.2 mg/L.

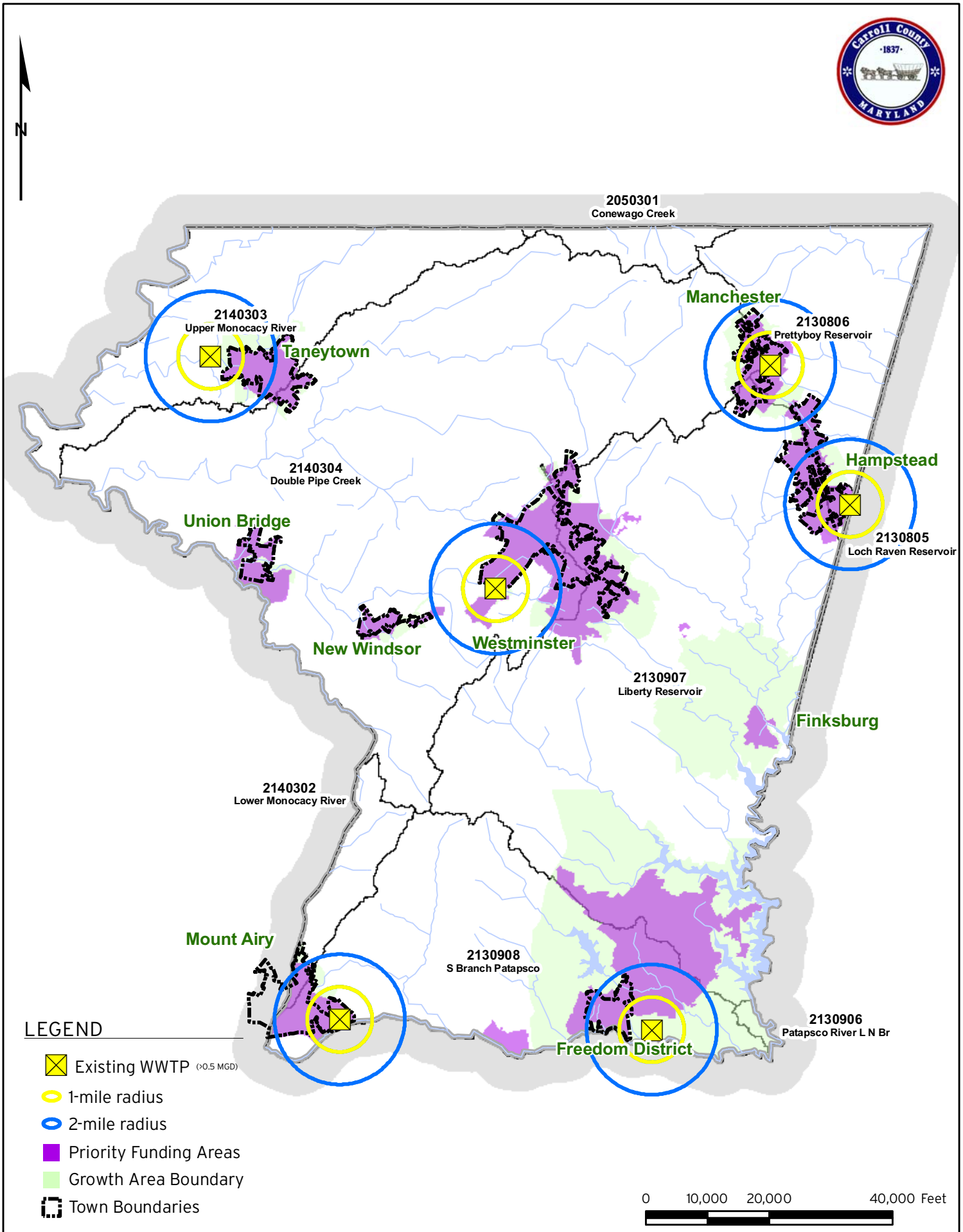
The Congoleum wastewater influent is nutrient-poor, such that nutrient addition is required to facilitate the biological treatment process. The facility was not designed for nutrient removal, although it does have the capability of chemical addition and settling for some phosphorus removal. If Congoleum accepted a significant flow of municipal wastewater, it would probably be necessary to upgrade the treatment system with enhanced nutrient removal capabilities. At the generally-accepted limits of technology for nitrogen removal at municipal facilities (TN=3.0 mg/L), the plant flow could only discharge about 439,000 gpd, which is less than the design capacity.

In summary, the Congoleum Corp. has 100,000 to 200,000 gpd excess treatment capacity and is likely to have at least a portion of this excess capacity well into the future. Its process would actually benefit from additional sanitary wastewater. However, with regard to accepting additional sanitary flows, the nutrient load caps would be more limiting than the design capacity of the system. Congoleum Corp.'s wastewater treatment system should be considered a potentially viable option for treating small, local sanitary

flows that Congoleum could accept without major upgrades to the treatment process or collection system. Use of the full excess capacity (100,000 to 200,000 gpd) would also be a viable option, but would likely require an ENR upgrade of the plant, treatability studies, additional preliminary/primary treatment capability, and other process modifications.

Evaluation of Potential Demand for Effluent: The Congoleum Corp. currently holds a water appropriation permit (CL1993S019) to withdraw an average of 500,000 gpd from the North Branch of the Patapsco River. This water source is filtered for use as process water. The facility does not have a history of experiencing manufacturing limitations with regard to water quantity or quality. However, Congoleum staff report the quality of the surface water supply does vary and might affect product quality (T.C. Garrod, pers. comm., 23 June 2009). Recent demands have averaged about 5 million gallons per month, but demand could average 9-10 million gallons per month if Congoleum's market conditions improve.

Because Congoleum does not currently pay a third party for this water supply, there is little financial incentive for the facility to pay for wastewater effluent. However, it cannot be ruled out that the facility would accept wastewater effluent to partially or fully replace its existing supply. Important factors would be the quality of the effluent, relative to their process needs, and the consistency of that quality. Congoleum would have to perform laboratory testing to determine if wastewater effluent would be compatible with their process. If wastewater effluent had higher or more consistent quality than their existing surface water supply, it would provide an incentive for Congoleum to accept free or low cost effluent.



MALCOLM PIRNIE	CARROLL COUNTY, MD ALTERNATIVES EVALUATION	WWTP Locations & Potential Reuse Locations	Aug 2009 Figure 4-1

Table 4-2: Summary of Land Available within 1-Mile Radius of WWTPs

Wastewater Treatment Plant	Land Available within 1-mile Radius of WWTP					Total Land Available within 1-mile Radius	Land Available for Water Reuse/Land Application (Assume 50% irrigable land)	Land Needed
	Athletic Field	Cropland	Golf Course	Open Urban Land	Pasture			
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Freedom	50.3	319.9	0.0	10.7	36.8	417.6	208.8	1,577.9
Hampstead	15.7	77.5	0.0	32.1	257.1	382.4	191.2	454.2
Manchester	28.7	541.1	0.0	29.6	27.6	627.0	313.5	245.1
Mt Airy	0.0	326.8	0.0	11.9	80.2	418.8	209.4	409.2
Taneytown	15.2	1271.0	0.0	0.0	123.1	1409.2	704.6	510.3
Westminster	0.0	440.3	181.3	54.2	115.6	791.3	395.6	1,669.0

Notes:

Available land excludes existing Manchester Spray Fields, as well as small (<50 acre and non-continguous parcels)

Table 4-3: Summary of Land Available within 2-Mile Radius of WWTPs

Wastewater Treatment Plant	Land Available within 2-mile Radius of WWTP					Total Land Available within 2-mile Radius	Land Available for Water Reuse/Land Application (Assume 50% irrigable land)	Land Needed
	Athletic Field	Cropland	Golf Course	Open Urban Land	Pasture			
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Freedom	53.5	622.9	0.0	44.1	424.6	1145.1	572.5	1,577.9
Hampstead	101.5	684.5	3.0	39.7	1007.9	1836.6	918.3	454.2
Manchester	28.7	2860.8	87.8	46.8	371.6	3395.7	1,697.8	245.1
Mt Airy	44.3	955.6	0.0	50.1	383.6	1433.6	716.8	409.2
Taneytown	21.9	4890.2	0.0	15.4	426.3	5353.7	2,676.9	510.3
Westminster	0.0	2820.3	261.5	97.1	552.3	3731.3	1,865.6	1,669.0

Notes:

Available land excludes existing Manchester Spray Fields, as well as small (<50 acre and non-continguous parcels)

Table 4-4: Summary of Land Required for Reuse of 50% of Build-Out WWTP Flow

Wastewater Treatment Plant	Planned Design Capacity	Projected Build-Out Flow[1]	Reuse Flow (50% of Projected Build-Out Flow)	Assumed Land Application Rate[2]	Amount of Land Required to Reuse 50% of Build-Out Flow
	(mgd)	(mgd)	(mgd)	(1 mgd/585 acres)	(acres)
Freedom	3.50	5.39	2.70	585	1,578
Hampstead	0.90	1.55	0.78	585	454
Manchester	0.50	0.84	0.42	585	245
Mount Airy	1.20	1.40	0.70	585	409
Taneytown	1.10	1.74	0.87	585	510
Westminster	6.50	5.71	2.85	585	1,669

Notes:

[1] Projected build-out wastewater flows from the Designated Growth Areas (DGA), as presented in Table 3-1 of the Wastewater Limitations Report (Malcolm Pirnie, May 2009)

[2] Application Rate includes assumptions of land buffers, no long-term storage for winter months, and 25% rainfall and other events shutoff factor