HUGHESVILLE BUSINESS AREA

FINAL WATER/SEWER STUDY

VCI 09-0016

Prepared For
CHARLES COUNTY DEPARTMENT OF PLANNING AND GROWTH MANAGEMENT

Prepared By
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Job No: 01083704
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PROFESSIONAL CERTIFICATION. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State Of Maryland, License No. 14364,
Expiration Date 03-29-2011.

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1. INTRODUCTION

A. PURPOSE OF STUDY

The Water distribution and Sewer collection study has been prepared for the Hughesville Business area in Charles County, Maryland by KCI Technologies, Inc. (KCI), as consultant to the Charles County Department of Planning & Growth Management (PGM). KCI will identify and evaluate alternatives that will provide water and sewer services required to meet future water supply, storage and distribution; and wastewater collection, conveyance, treatment and disposal system demands for the Hughesville Business Area. This feasibility study is recommended as a major implementation item in the Hughesville Village Revitalization Plan.

B. PROJECT BACKGROUND

The Hughesville Village Revitalization Plan, adopted in May 2007 by the County Commissioners, is a master plan that focuses efforts to revitalize the Village in two key areas namely economic development and physical improvements. The Plan presents revitalization strategies with an emphasis on infill development that is appropriate in the context of a historic village center. A vital part of the implementation strategy for the Hughesville Plan is to provide needed infrastructure, including public water and sewer, to support infill development and redevelopment in the Village of Hughesville. The limits of the project are the Hughesville Revitalization Plan Study Area, which corresponds to the Hughesville Village Priority Funding Area Boundary ("Hughesville Village"), shown in Figure 1.

Currently the privately-owned and operated Hughesville Sanitary Commission provides wastewater service to 13 commercial lots located along MD Business Route 5 in the Village through the use of an absorption field (See Hughesville Sanitary Commission December 31, 2000 Report which is included in the Attachments). The system is currently operating at approximately 90% of the total capacity. The system consists mainly of terra cotta pipes and excessive inflow and infiltration is an issue of concern. The system's operational problems are resulting in water quality issues; the system cannot be expanded to meet current or future needs and thus will need to be phased out once public water and wastewater facilities are developed.

C. PROJECT SCOPE

The overall scope of this project is to conduct a feasibility study that provides various alternatives for a water system supply, storage and distribution and a sanitary sewer collection, conveyance, treatment and disposal; and recommendations for the best alternative for each. The best alternatives will be based on capital costs, as well as operations and maintenance costs, while minimizing impacts to both the natural environmental resources and socio-economic viability of the properties within the Village and surrounding areas. The study focuses on public water and wastewater facilities that will initially support the Village Core (Phase I), with the ability to be expanded to support the entire Hughesville Village Priority Funding Area (PFA- Phase II), Figure 1 below.

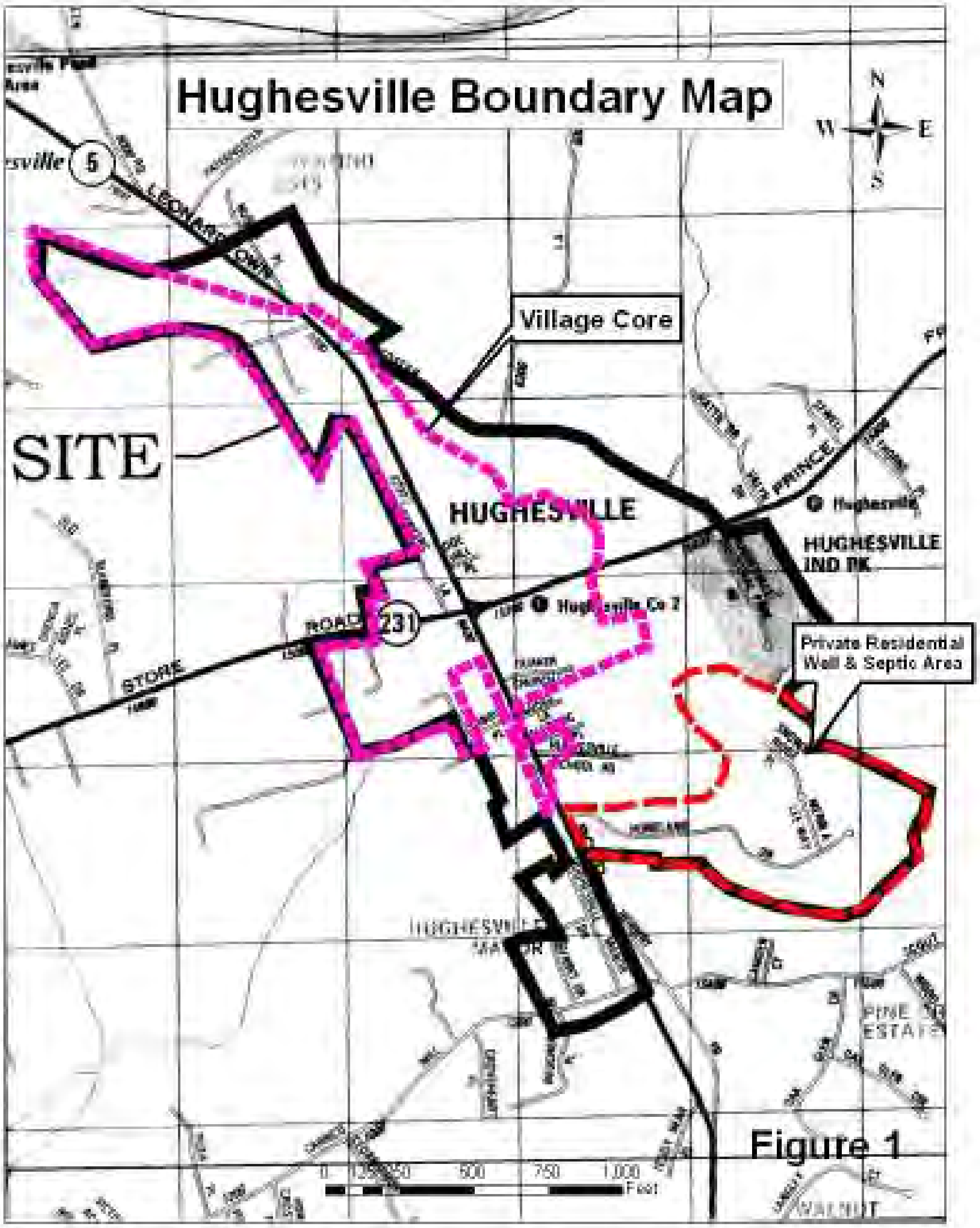


Figure 1: Hughesville Boundary Map

D. UTILITIES

Existing utility locations will present design constraints to the proposed water and sewer system alignments. Letter requests were sent to the local Utility providers, specifically SMECO, Comcast and Verizon, in order to avoid potential conflicts with the existing utilities. SMECO is the only utility company which responded. See Attachments section for copies of the letters.

SMECO has overhead electric facilities within the Hughesville PFA and one underground feeder located at the intersection of Old Leonardtown Road and 231. It is assumed that Verizon and Comcast also have overhead utilities in the area. Upon design of a water and/or sewer alternative, utilities will be surveyed and mapped to avoid conflict.

The County currently has no public water or wastewater service. Private well and septic systems exist on each lot, with the exception of a privately-owned and operated combined septic drain field which serves 13 commercial lots located along MD Business Route 5. The combined system will be phased out once a public sewer option is implemented.

2. HUGHESVILLE VILLAGE PROPOSED BUILD-OUT

The Hughesville Village is comprised of a total of 138 residential parcels and 92 commercial/industrial parcels. The "Village Core" is comprised of all of the commercial parcels along Route 5 and Route 231. Currently there are 59 commercial parcels (126 total acres) within the Village Core which have buildings on them. The shape file provided by Maryland Department of Planning (MDP) was used to project future flows for residential parcels based on two fields namely "NHC" and "Developed". The explanation of these two fields is as follows:

Current No. of Households = 1 (If Developed = Yes)
Current No. of Households = 0 (If Developed = No)
NHC = Additional No. of Households each parcel could expect at build out
Total No. of Households at Build Out = Current No. of Households + NHC

Therefore, the residential buildout represents the full buildable potential of a parcel based on its zoning classification as determined by MDP. Buildout includes the existing land occupancy and the future number of households.

The zoning classification (Figure 2, Appendix A) and the flow associated for all the parcels in the Hughesville Village at build out are shown in Table 1.

Table 1: Zoning Classification

Zoning	Zoning Description	No. of Parcels	Flow *
RV/AC	Village Residential	138	260 gpd/unit
CV	Village Commercial	74 (22.6 acres)**	2000 gpd/acre
IG	General Industrial	18 (34.3 acres) **	2000 gpd/acre

* Appendix "V", Charles County Water & Sewer Ordinance
**Maximum Buildable Area

For existing conditions, the area of the commercial building footprint was obtained from building shape file provided by Charles County and flow factors applied based on Appendix X of the Water & Sewer Ordinance. For build out conditions, the maximum area for a building on a commercial parcel was determined by the "Flow Area Ratio" obtained from Code of Charles County, September 2008 and is given as follows:

Maximum Area of Building = (Total Area of Parcel (GA) – 20% GA – LE)* Intensity

Intensity (Zoning CV) = 0.35 FAR
Intensity (Zoning IG) = 0.5 FAR
LE = Acres of Land Excluded = 25% GA - *Under the "Smart Growth" Areas Act of 1997, LE includes land : dedicated for public use by perpetual easement or fee simple acquisition; dedicated to recreational use; subject to a state agricultural easement or a local agricultural easement under a State-certified preservation program used for cemetery purposes; and identified by local government as a stream buffer, 100-year floodplain, habitat of threatened and endangered species, steep slope, or delineated non-tidal wetland on which development is prohibited by local ordinance.

A summary of the flow calculations for water and sewer within the Hughesville Village Study Area Boundary is shown in Table 2 and Table 3 respectively. The density data for buildout is tabulated in Appendix B. The peak factors for residential flows were based on the Charles County Water and Sewer Ordinance, Appendix R for Water and Appendix V for Wastewater. The maximum daily flow peaking factor in Appendix R is based on the number of units or EDU's. The flow equivalent to 1 unit = 260 gpd. In the case where the flow projection within commercially zoned areas is calculated based on acreage, the equivalent dwelling unit is calculated by dividing the ADF by 260. The ADF for buildout projections for Hughesville Village is 149,642. The total number of units = 149,642/260 ~ 576. Therefore a peak factor of 3.0 was used to calculate the Maximum Daily Flow for buildout of the entire Hughesville area. Note that the Hughesville Village Flows (Phase II) are all inclusive of the Study area boundary, and include the area within the Village Core (Phase I).

Table 2: Flow Projections for Water

Zoning	Existing				Buildout			
	Village Core (Phase I)		Hughesville Village (Phase II)		Village Core (Phase I)		Hughesville Village (Phase II)	
	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)
Residential (Households @ 260 gpd/unit)	0	0	124	32,240	0	0	138	35,880
Commercial (Buildable acres @ 2000gpd/acre)	13.7	27,364	16.1	32,264	44.3	88,676	56.9	113,762
Average Daily Flow (gpd)*	27,364		64,504		88,676		149,642	
Peak Factor (MDF)*	3.5		3.5		3.5		3.0	
Maximum Daily Flow (gpd)*	95,775		225,764		310,364		448,927	
Peak Factor (PHF)*	3.0		3.0		3.0		3.0	
Peak Hourly Flow (gpd)*	287,326		677,293		931,093		1,346,781	

* Appendix R, Charles County Water & Sewer Ordinance

Table 3: Flow Projections for Sewer

Zoning	Existing				Buildout			
	Village Core (Phase I)		Hughesville Village (Phase II)		Village Core (Phase I)		Hughesville Village (Phase II)	
	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)
Residential (Households @ 260 gpd/unit)	0	0	124	32,240	0	0	138	35,880
Commercial (Buildable acres @ 2000gpd/acre)	13.7	27,364	16.1	32,264	44.3	88,676	56.9	113,762
Average Daily Flow (Qa, gpd)	27,364		64,504		88,676		149,642	
Infiltration/Inflow (I/I, 400gpd/acre)	206.5	82,590	619.7	247,860	206.5	82,590	619.7	247,860
Average Daily Flow + I/I (Qa+I/I, gpd)	109,955		312,364		171,266		397,502	
Peak Flow (PF=4, Qp=4Qa, gpd)*	109,458		258,017		354,702		598,569	
Design Hydraulic Flow (Qp+I/I, gpd)	192,048		505,877		437,293		846,429	

* Appendix V, Charles County Water & Sewer Ordinance and I/I = 400 gpd/acre.

3. WATER FEASIBILITY STUDY REPORT

Background

The Hughesville Village is currently served by private potable wells, owned and maintained by each respective property owner. This section of the report focuses on public water facilities that will initially support the Village Core with the ability to be expanded to support the entire Hughesville Village Priority Funding Area (PFA). The Homeland Drive residential parcels are excluded from the study area of proposed public water and sewer service. The single family homes (Village Residential) in this area are built on large lots specifically sized to provide sufficient area for the successful use of on-site systems which generally make it uneconomical to provide public water and sewer. The Homeland Drive residential parcels can protect their drinking water wells and the environment by participating in Maryland Department of the Environment's Free Septic System Upgrade. The free upgrade removes harmful nitrogen pollution while at the same time protecting and extending the life of the existing septic system. The revised lower flow projections for water and sewer excluding properties on Homeland Drive are shown in Table 4 & Table 5 respectively.

Table 4: Flow Projections for Water (Exclude Homeland Drive Properties)

Zoning	Existing				Buildout			
	Village Core (Phase I)		Hughesville Village (Phase II)		Village Core (Phase I)		Hughesville Village (Phase II)	
	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)
Residential (Households @ 260 gpd/unit)	0	0	124	32,240	0	0	138	35,880
Commercial (Buildable acres @ 2000gpd/acre)	13.682	27,364	16.132	32,264	44.338	88,676	56.9	113,762
Average Daily Flow (gpd)*	27,364		64,504		88,676		149,642	
ADF (Along Homeland Drive)	0	0	39	10,140	0	0	54	14,040
Total ADF	27,364		54,364		88,676		135,602	
Peak Factor (MDF)*	3.5		3.5		3.5		3.0	
Maximum Daily Flow (gpd)*	95,775		190,274		310,364		406,807	
Peak Factor (PHF)*	3.0		3.0		3.0		3.0	
Peak Hourly Flow (gpd)*	287,326		570,823		931,093		1,220,421	

* Appendix R, Charles County Water & Sewer Ordinance

Table 5: Flow Projections for Sewer (Exclude Homeland Drive Properties)

Zoning	Existing				Buildout			
	Village Core (Phase I)		Hughesville Village (Phase II)		Village Core (Phase I)		Hughesville Village (Phase II)	
	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)	Units	Flow (gpd)
Residential (Households @ 260 gpd/unit)	0	0	124	32,240	0	0	138	35,880
Commercial (Buildable acres @ 2000gpd/acre)	13.7	27,364	16.1	32,264	44.3	88,676	56.9	113,762
Average Daily Flow (Qa, gpd)	27,364		64,504		88,676		149,642	
ADF (properties along Home Land Drive)	0	0	39	10,140	0	0	54	14,040
Infiltration/Inflow (I/I, 400gpd/acre)	206.5	82,590	379.5	151,787	206.5	82,590	379.5	151,787
Total Average Daily Flow	27,364		54,364		88,676		135,602	
Total Average Daily Flow + I/I (Qa+I/I, gpd)	109,955		206,151		171,266		287,389	
Peak Flow (PF=4, Qp=4Qa, gpd)*	109,458		217,457		354,702		542,409	
Design Hydraulic Flow (Qp+I/I, gpd)	192,048		369,244		437,293		694,197	

* Appendix R, Charles County Water & Sewer Ordinance

<u>Water Supply</u>

The existing residential and commercial parcels currently utilize individual private wells for water supply. An elevated water storage tank and wells are required to provide public water supply to the Hughesville Village. A recent study report namely, "HYDROGEOLOGIC DATA FROM SIX TEST WELLS IN THE UPPER PATAPSCO AND LOWER PATAPSCO AQUIFERS IN SOUTHERN MARYLAND" in July 2008 by Maryland Geological Survey is included in the Attachments. The survey shows that the aquifer test most applicable to Hughesville Area was performed on well (CH Cg 24) which is located northwest of Hughesville. KCI contacted David Drummond of the Maryland Geological Survey to discuss the well tests from the report. He clarified that due to inefficiencies associated with the well; the test results did not show the full yield of the well (MDE 80 percent management level). There is a possibility of obtaining 200 gpm if the well is drilled in the Lower Patapsco Formation. KCI used this information to determine the number of wells required to serve the Village Core Area and the Hughesville PFA. The report concludes that there is extreme variability in lithology and hydraulic properties of the Upper Patapsco and Lower Patapsco aquifers. Water-quality testing indicates that water in the Upper and Lower Patapsco aquifers is of good quality and can probably be used for most purposes. Chlorination of the water from the wells is required by MDE. In addition to chlorination, Charles County Waldorf Well #16 includes calcium chloride and orthophosphate feed systems which may also be required for these wells.

A. ALTERNATIVE W-1, WELLS

The proposed storage tank and well capacity were based on the Charles County Water & Sewer Ordinance Appendix R and is shown as follows:

Storage Tank = ADF + FF = 149,642 gpd +2000 gpm*120 min = 389,642 ~ 400,000 Gallons.

At build out, the supply rate for all wells = (MDF + FF)/1080 min/day (18 hours/day x 60 min/hr) = 599 gpm.

At build out, the well capacity with the largest well out of service = (ADF + FF)/1080 min/day = 348 gpm.

For existing conditions, Alternative W-1 includes installation of three 150 gpm capacity groundwater production wells with corresponding water treatment facilities (chlorination, calcium chloride and orthophosphate) and a 400,000 gallon Elevated Water Storage Tank to provide water supply and fire protection to the Village Core as well as Hughesville PFA demands (see Figure 3, Appendix C). The Tank is proposed at a central location for optimum water quality and distribution.

For the build out scenario, Alternative W-1 includes the installation of additional groundwater production well with corresponding water treatment facility (chlorination, calcium chloride and orthophosphate) at 150 gpm capacity. An 8" to 12" water distribution system will provide water service to each property within the Village Core with the ability to be expanded the water main system to support the entire Hughesville Village PFA.

<u>Easements Required</u>

Charles County Plan Preparation Package requires the following minimum easement widths for the range of pipe between 8" and 15": 15' perpetual easement and 30' temporary easement.

KCI proposes to construct the water main along established roadways to minimize easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50' perpetual easement along Old Leonardtown Road (MD Route 5) and Prince Frederick Road (MD Route 231). Construction of the water line can utilize this existing easement, requiring no additional easement along these two major roadways. At this planning level, it is assumed that the remainder of the water line, not along these town major roadways, will require the full easement width required by the Plan Preparation Package.

This Alternative will require approximately 64,000 SF of 15'perpetual easement, 127,000 SF of 30' temporary easement, and approximately 5.0 acres of land acquisition.

In addition, a fee-simple site acquisition will be required for construction of the water storage tank and well sites.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Utility Construction Permit
- SHA Utility Permit

Cost Estimate

Construction cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative W-1 (see Appendix C).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of water force main, 7% of the well construction cost (after administration and engineering fees) and 1% of the tank construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative W-1 (see Appendix C).

B. ALTERNATIVE W-2, INTERCONNECTION

Alternative W-2 is the installation of a St. Mary's County Metropolitan Commission (MetCom) Interconnection (see letter to MetCom included in the Attachments & Figure 4, Appendix C) and a 400,000 gallon Elevated Water Storage Tank to meet the water supply demands of Hughesville. The water distribution system will include 8" to 12" water mains providing water service to each property within the Village Core. The water mains within the core area will be sized to support expansion of the distribution system to supply service to the entire Hughesville Village PFA.

On July 30, 2009 Charles County, Aaron Hamm, Charles Strawberry, Jr., Cathy Hardy, Zakary Krebeck, met with MetCom, Chester Frederick, Jr., Dan Ichniowski. The agenda for this meeting was to discuss Hughesville flow projections for water, a MetCom water system interconnection to supply MetCom water to the County's Hughesville water storage and distribution water mains and or a MetCom emergency water system connection providing redundancy for both systems. MetCom indicated that existing MetCom small water system closest to the Hughesville area is approximately a mile from Charles County and consists of 4 wells, ground storage and an agreement with a private water system to provide emergency fire flows from their elevated water storage tank. The available capacity of this small existing MetCom water system is required for the existing and expanding commercial development in this MetCom service area and that extra capacity for supplying Hughesville is not currently available. Other problems with the option to connect to the MetCom system include: constructing the mile of water main required to connect the systems; and MetCom State authorization that limits their service area to St. Mary's County.

Although MetCom cannot supply water to Hughesville, they are interested in an emergency connection that provides redundancy for and will be beneficial to the operation of both systems. The County and MetCom agreed to continue with open communication as the planning development process continues.

4. SEWER FEASIBILITY STUDY REPORT

Background

The Hughesville Village is currently served by individual onsite septic systems, owned and maintained by each respective property owner, with the exception of a community absorption field which serves 13 commercial lots located within the Village Core. The privately-owned and operated Hughesville Sanitary Commission provides wastewater service for the system. The system is currently operating at approximately 90% and experiencing excessive inflow and infiltration, resulting in water quality issues. The system cannot be expanded to meet current or future needs and thus will be phased out once public water and wastewater facilities are developed.

The Comprehensive Water and Sewage Plan of Charles County Maryland have identified the area around Hughesville as an area of concern for on-site disposal of sewage. This area has a high water table and is not suited for septic systems and other on-site treatment systems as outlined in the report "Wastewater Treatment Study" for Southern Maryland Electric Cooperative Hughesville, MD. In addition, The Soil Survey of Charles County published by the US Department of Agriculture Soil Conservation Service, included in the Attachments, show very limited soil types suitable for slow rate treatment of wastewater (i.e. Spray irrigation) within the boundaries of Hughesville, therefore surrounding areas were investigated for suitable soils, and alternate means of wastewater disposal were evaluated.

Utilizing County and State Guidelines as well as prevailing Engineering practice, KCI investigated three collection system alternatives for public sewer service to Hughesville Village in addition to improved on-site systems. The collection system for Homeland Drive residential parcels is evaluated under an alternative called "Homeland Drive Grinder Pump Service Area." This Service Area can be combined with any of the three collection system alternatives. In addition, two wastewater pretreatment systems were evaluated, and three wastewater disposal system alternatives were evaluated in the following sections.

This section of the report focuses on public wastewater facilities that will initially support the Village Core (Phase I) with the ability to be expanded incrementally to support the entire Hughesville Village Priority Funding Area (Phase II).

A. SEWER COLLECTION ALTERNATIVES

A sewer collection system will collect the raw wastewater from Hughesville Village by a series of gravity sewers and/or pressure sewers and transfer it to a main effluent pump station at the western intersection of Prince Frederick Road and Leonardtown Road. The proposed location of the main effluent pump station is common to all three sewer collection alternatives. The means to arrive at the main effluent pump station varies.

1. S-1: OLD LEONARDTOWN ROAD COLLECTION SYSTEM

Alternative S-1 includes the development of a sewer collection system utilizing 8" gravity sewers and local submersible pump stations, which will convey the flow to a main effluent pump station at the western intersection of Prince Frederick Road and Leonardtown Road (See Figure 5, Appendix D). The Village of Hughesville is relatively flat and gravity sewer lines can be installed in a majority of areas without exceeding excessive depths, however booster pump stations are necessary at several locations.

This Alternative utilizes main roadways, specifically Old Leonardtown, for installation of the main trunk of the sewer collection system. This can be a favorable alternative due to the existing County right of way which can be utilized for utility construction. The 8" gravity sewer is proposed at a minimum 0.5% slope. This minimum slope is required to avoid excessive depths and construction of additional pump stations. The minimum slope of 0.5% provides 2.5 fps at full pipe capacity; however the velocities will be less than 2.5 fps at design flows. Odor control will be provided at the pump stations by using activated carbon canisters on the wet well vents and by using activated carbon manhole inserts at forcemain discharge manholes. Exemptions from County design standards for minimum design flow velocities of 2.5 fps may be granted by the County for 8" diameter gravity sewers. Several outer lying Pump Stations are necessary to avoid excessive sanitary line depths at the Village Core (See Figure 5, Appendix D).

Easements Required

Charles County Plan Preparation Package requires the following minimum easement widths for the range of pipe between 8” and 15”: 15’ perpetual easement and 30’ temporary easement, and pipes less than 8” require a 15’ perpetual easement.

KCI proposes to construct the 8” gravity sewer and 4” forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, along established roadways to minimize easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50’ perpetual easement along Old Leonardtown Road (MD Route 5) and Prince Frederick Road (MD Route 231). Construction of the sewer and forcemain can utilize this existing easement, requiring no additional easement along these two major roadways. At this planning level, it is assumed that the remainder of the line, outside of these two major roadways, will require the acquisition of a full easement width required by the Plan Preparation Package.

In addition, a fee-simple site acquisition will be required for construction of the pump stations with stand-by power.

This Alternative will require approximately 166,000 SF of 15’perpetual easement, 331,000 SF of 30’ temporary easement, and approximately 3.0 acres of land acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Utility Construction Permit
- SHA Utility Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-1 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of collection pipe and 4% of the pump station construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-1 (see Appendix D).

2. S-2: SIDE ALLEY (ST. MARYS COUNTY EASEMENT) COLLECTION SYSTEM

Alternative S-2 is similar to Alternative S-1, however, the main trunk line of the collection system is shifted from Old Leonardtown Road to the side alley (abandoned railroad right-of way) which runs parallel to the west of Old Leonardtown Road. This alternative will maintain the esthetics of Old Leonardtown Road, freeing it from sewer appurtenances (manhole lids). In addition, the side alley is not a traveled roadway, with the exception of a small portion called Bakers Lane, therefore maintenance of traffic requirements will be minimal along the alley as compared to Old Leonardtown Road. The alley (abandoned railroad right-of way) is owned by St. Mary's County, which simplifies easement acquisition to a single agreement.

This alternative, similar to Alternative 1, includes the development of a sewer collection system utilizing 8" gravity sewers and local submersible pump stations, which will convey the flow to a main effluent pump station at the western intersection of Prince Frederick Road and Leonardtown Road (See Figure 6, Appendix D).The Village of Hughesville is relatively flat and gravity sewer lines can be installed in a majority of areas without exceeding excessive depths, however booster pump stations are necessary at several locations.

The 8" gravity sewer is proposed at a minimum 0.5% slope. This minimum slope is required to avoid excessive depths and construction of additional pump stations. The minimum slope of 0.5% provides 2.5 fps at full pipe capacity; however the velocities will be less than 2.5 fps at design flows. Exemptions from County design standards for minimum design flow velocities of 2.5 fps may be granted by the County for 8" diameter gravity sewers.

Odor control will be provided at the pump stations using activated carbon canisters on the wetwell vents and using activated carbon manhole inserts at forcemain discharge manholes.

<u>Easements Required</u>

Charles County Plan Preparation Package requires the following minimum easement widths for the range of pipe between 8" and 15": 15' perpetual easement and 30' temporary easement, and pipes less than 8" require a 15' perpetual easement.

KCI proposes to construct the 8" gravity sewer and 4" forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, along established roadways to reduce easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50' perpetual easement along Prince Frederick Road (MD Route 231). Construction of the sewer and forcemain can utilize this existing easement, requiring no additional easement along this major roadway. At this planning level, it is assumed that the remainder of the line, outside of this major roadway, will require the acquisition of a full easement width required by the Plan Preparation Package. The side alley, owned by St. Mary's County, will require the acquisition of a full easement width for construction of the 8" sewer line.

In addition, a fee-simple site acquisition will be required for construction of the pump stations with stand-by power.

This Alternative will require approximately 271,000 SF of 15'perpetual easement, 541,000 SF of 30' temporary easement, and approximately 3.0 acres of land acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Utility Construction Permit
- SHA Utility Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-2 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of collection pipe and 4% of the pump station construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-2 (see Appendix D).

3. S-3: GRINDER PUMP COLLECTION SYSTEM

Alternative S-3 will include grinder pumps and low pressure forcemains to convey the flow from the Hughesville Village to a main effluent pump station at the western intersection of Prince Frederick Road and Leonardtown Road (See Figure 7, Appendix D).

Grinder pumps will be installed at each lot with a small diameter low pressure sewer house connection conveyed to a 4” low pressure forcemain along roadways. The forcemains will meet at a transition manhole outside of the pump station at Prince Frederick Road and Leonardtown Road. The Standard County Transition Manhole, S1.04, will be utilized at this location. The alignment will continue with an 8” PVC sewer line to the pump station.

The forcemain will require flushing manholes at dead ends and an air release valve, installed within a manhole, at highpoints along Prince Frederick Road and Old Leonardtown Road. A 4” forcemain will convey flows ranging from 100-200gpm at velocities ranging from 2.5-5.0 fps. Odor control will be provided at the pump stations using activated carbon canisters on the wet well vents and using activated carbon manhole inserts at forcemain discharge manholes.

Alternative S-3 will eliminate the need for deep construction sewers and local booster pump stations. This alternative can be installed along Old Leonardtown Road while maintaining the aesthetics, given the low pressure forcemain option has minimal sewer appurtenances (manhole lids).

Easements Required

Charles County Plan Preparation Package requires a 15’ perpetual easement for pipes less than 8”.

KCI proposes to construct the low pressure forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, along established roadways to reduce easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50’ perpetual easement along Old Leonardtown Road and Prince Frederick Road (MD Route 231), and a lesser easement along secondary roads. Given the minimal easement width required and the flexibility of the forcmain to stay within established right of ways, it is assumed that construction of the forcemain can utilize existing easements, requiring no easement acquisition.

However, a fee-simple site acquisition will be required for construction of the pump station with stand-by power, requiring approximately 1.0 acre of land acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval

- MDE Utility Construction Permit
- SHA Utility Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-3 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of collection pipe and 4% of the pump station construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative S-3 (see Appendix D).

4. HOMELAND DRIVE GRINDER PUMP SERVICE AREA

The Homeland Drive properties have been analyzed separately from this study in that it is uneconomical to provide conventional gravity sewer service to this area. The single family homes (Village Residential) in this area are built on large lots which makes it uneconomical to extend a public gravity sewer system to this area. Also the topography of the area is covered with trees, steep slopes and adjacent streams which make it difficult to construct a gravity sewer system in this area without significant negative environmental impacts to this sensitive area.

A viable option to provide public service to this area is by grinder pumps and a low pressure forcemain. This would eliminate the need for a pump station to serve this area and would be much less invasive with a smaller size line and more flexibility in placement of the forcemain as compared to a deep gravity sewer. A jack and bore will be required at the stream/wetland crossing in order to minimize disturbance to the stream. The Homeland Drive Grinder Pump Service Area can be combined with any of the other collection system alternatives. See Figures 5, 6 or 7 for the Grinder Pump Service Area.

If the County decides not to provide service to this area, KCI suggests on-site system upgrades provided by participating in Maryland Department of the Environment's Free Septic System Upgrade Program to remove harmful nitrogen pollution from the water supply while at the same time protecting and extending the life of the existing septic system. This can be pursued through MDE.

Easements Required

Charles County Plan Preparation Package requires a 15' perpetual easement for pipes less than 8".

KCI proposes to construct the low pressure forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, to reduce easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50' perpetual easement along Old Leonardtown Road and Prince Frederick Road (MD Route 231), and a lesser easement along secondary roads. Given the minimal easement width required and the flexibility of the forcmain to stay within established right of ways, it is assumed that construction of the forcemain can utilize existing easements, requiring no easement acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE/Army Corps Joint Wetland Permit

Cost Estimate

Cost estimates based on final build-out of the Homeland Drive properties have been developed for Alternative S-3 (see Appendix D).

Operation and Maintenance

Operation and Maintenance costs are estimated by calculating a cost of $1.50 per linear foot of sewer, equating to $8,000/year for build-out of Homeland Drive Properties.

B. WASTEWATER DISPOSAL SYSTEM ALTERNATIVES

A wastewater disposal system will provide a means to deliver the collected wastewater from the main effluent pump station presented in alternatives S-1, S-2 and S-3 to an ultimate source. Either of the Collection System Alternatives can be matched with either of the Disposal System Alternatives (which require a specific Treatment Alternative), described below:

1. D-1: INTERCONNECTIONS

KCI investigated interconnecting the Hughesville system to the local wastewater treatment plants within Charles County or to the adjacent sewer provider, MetCom, in St. Mary's County.

An interconnection with one of the existing wastewater treatment facilities in Charles County would require a forcemain from the main effluent pump station north along Old Leonardtown Road. Possible existing treatment plants in Charles County include Town of La Plata Wastewater Treatment Facility and the County owned Mattawoman Treatment Plant. The forcemain required to convey the Hughesville flows to these existing systems would be constructed outside of the road pavement within the County and state right-of-ways.

Interconnections to the Town of La Plata or Mattawoman Wastewater Treatment Plants to serve Hughesville could promote urban sprawl which conflicts with smart growth policies and conflicts with Hughesville's goal to maintain development that is appropriate in the context of a historic village center. These interconnections would require changes to the Master Plan that are not favored by Hughesville, an extensive and expensive pump and conveyance system and would require extensive and expensive upgrades to existing trunk sewers, pump stations and treatment plants. Neither the existing La Plata nor the Mattawoman wastewater systems can currently accept the flows from Hughesville PFA.

Based on the proximity of the alternative interconnection points, the MetCom interconnection appears to have the advantage of the shortest route through developed areas eliminating the Town of La Plata or Mattawoman Wastewater Treatment Plants through undeveloped areas from further consideration.

On July 30, 2009 Charles County, Aaron Hamm, Charles Strawberry, Jr., Cathy Hardy, Zak Krebeck, met with MetCom, Chester Frederick, Jr., Dan Ichniowski. The agenda for this meeting was to discuss Hughesville flow projections for sewer and MetCom conveyance, treatment and disposal of wastewater from the County's Hughesville sewage collection and conveyance system. MetCom indicated that MetCom does not have a public wastewater conveyance and treatment system in this area. Existing treatment in the area is provided by private systems. Some of the existing systems are experiencing problems similar to the problems of the existing Hughesville systems due to soil type.

Although MetCom cannot provide wastewater treatment to Hughesville, they are interested in a regional approach with a central public treatment and disposal facility that would serve both St. Mary's County and Hughesville. The key is soil type and locating sufficient acreage in either Charles County or St. Mary's County. The regional facility concept will be difficult to achieve due to the soil types and limited acreage in either County. Separate facilities may be required in each County to provide the acreage required.

As a result, the interconnection with MetCom is not a feasible alternative at this time and is eliminated from further consideration. The County and MetCom agreed to maintain open communications as the planning development process continues.

2. D-2: GROUNDWATER DISCHARGE: SPRAY IRRIGATION

This Alternative includes approximately 2 miles of forcemain from the main effluent pump station within the Hughesville Village to a packaged pretreatment system (see section T-1) and finally to a land disposal site located at the intersection of Goode Road and Fariforest Place. The land disposal site will includes large rotating rigs and storage lagoons for winter months.

Groundwater Discharge is achieved through various methods of land application in which the ultimate outlet for the remaining treated wastewater is the groundwater table. KCI investigated several land treatment options, prior to arriving at the suggestion for spray irrigation, for the disposal of the treated wastewater from the Hughesville system. Compared to the other land treatment alternatives of overland flow and rapid infiltration, spray irrigation (slow rate treatment process) is best suited for the soil types and high groundwater table found in this area. In addition, spray irrigation can co-exist with cultivated farmland crops, providing a nutrient source for crop growth and reducing withdrawal on the groundwater table by providing an alternate to irrigation via groundwater wells. KCI initiated correspondence with MDE regarding the groundwater discharge option (see Attachments).

Spray irrigation is a slow rate land treatment system, which implies that the treated wastewater is uniformly applied to the surface of the receiving site with the understanding that the wastewater will infiltrate into the soil profile. As the wastewater moves through the soil, most of the organic and inorganic constituents are removed, either taken up by plants or immobilized within the soil matrix. A complete vegetative cover is required for effective treatment.

Based on MDE's Guidelines for Land Treatment of Municipal Wastewaters (See Attachment), if the effluent quality meets Class I requirement, then

- A minimum buffer zone of 200 feet shall be provided between the wetted perimeter of spray irrigation areas and adjacent property lines, waterways, roads, etc.
- For residential properties, parks, and other areas where people congregate, a 500-foot buffer shall be provided for Class I effluent.

If the effluent quality meets Class II requirement, then

- 25-foot buffer zone should be provided from property lines, housing structures, public roads and streams.
- 50-foot buffer zone should be provided from school and playgrounds
- 100-foot buffer zone should be provided from potable wells and water intakes.

The County indicated a preference for Class II effluent; therefore, analysis of buffer land requirements will assume a Class II effluent being discharged via the spray irrigation system. Membrane Bio-Reactor treatment technology will be required to produce Class II effluent. This is analyzed under Treatment System Alternative T-1, see following sections.

KCI initially utilized the Soil Survey of Charles County published by the US Department of Agriculture Soil Conservation Service, to identify soil types suitable for slow rate treatment of wastewater (i.e. Spray irrigation), see attachments. Of these soil types, WdA and WdB types of soil for the disposal site are rated somewhat limited and are the most probable soil types in the area of interest to pass percolation tests for groundwater discharge. The closest plot of land with acceptable soil types is approximately 4.8 miles north of Hughesville at the intersection of Leonardtown Road and Bryantown Road, which includes 110 Acres of land classified as somewhat limited. Although these properties seemed favorable for spray irrigation, with the necessary buffers and site characteristics, they are zoned within the Rural Legacy Program and based on correspondence with the homeowners and DNR (see attachments) this alternative was discarded form further consideration.

Discussions with the Charles County Director of Environmental Health revealed some large properties within Hughesville which produced passing percolation results in the past, contrary to USGS soil mapping resources. Therefore, some large tracts closer to Hughesville can be promising. Specifically, Map 36, Parcel 24, owned by Southern MD Electric Cooperative; Map 36, Parcel 48, owned by Cecilia Johnston and R. Boone Jr.; Map 36, Parcel 16 owned by Trueman Hancock; and Map 36, Parcel 142 owned by Wayne Wilkerson, formerly S. Flory Diehl. The County suggests pursuing Parcel 142 as the most feasible for obtaining a large tract of land necessary for spray irrigation. The owners of Parcel 142 are willing to work with the County on this project. See Figure 8A for the locations of the alternative Spray Irrigation Field sites.

The footprint of land required for the disposal site is calculated based on MDE's Guidelines for Land Treatment of Municipal Wastewaters for spray irrigation as follows:

$$A = \frac{Q \times 365 \times (E+F)}{27{,}154 \times (365-G) \times H}$$

A= area in acres
Q= flow in gallons per day
E+F= loading cycle (loading plus rest period) in days per week
E= loading period in days per week = 1
F= rest period in days per week = 6
G= Storage requirement in days per year = 90
H= application rate (loading rate) in inches per week = 2

The total area of land required for spray irrigation of the Village Core buildout flow is approximately 30 acres (excluding buffers). A minimum additional 3 acres will be needed to provide a 25-foot buffer zone when the effluent meets Class II requirements.

For Hughesville Village buildout flow scenario, an additional of 19 acres to the Village Core buildout area would be required (excluding buffers) for spray irrigation. An additional 3 acres would be required to provide 25-foot buffer zone.

MDE requires a detailed Hydrologeological study be performed on the proposed site to be used for land application of treated wastewater, in conjunction with the Groundwater Discharge Permit requirements. The Hydrogeologic Report includes: a site location and description, description of the land treatment techniques, geology, soils and hydrology of the site, a plan of operation for the facility and general comments. See the attachments section for the MDE Guidelines for Land Treatment of Municipal Wastewaters, pages 22, 23 and 24 for a full outline of the required Study.

The main effluent Sewage Pump Station and the spray irrigation rigs will be constructed for the build-out flows with the sewage pumps initially sized only for the Village Core peak flows. Provisions will be provided to increase the pumping rate using larger impellors or replace the pumps in phases to accommodate build-out flow from the entire Hughesville Village PFA.

Easements Required

Charles County Plan Preparation Package requires a 15' perpetual easement for pipes less than 8".

KCI proposes to construct the 6" forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, along established roadways to reduce easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50' perpetual easement along Leonardtown Road (MD Route 5). Construction of the forcemain can utilize this existing easement, requiring no additional easement along these two major roadways. It is assumed that approximately 200 LF of pipe will require permanent and temporary easements near the land application site, once the alignment veers from Leonardtown Road.

In addition, a fee-simple site acquisition will be required for construction of the land disposal site. No existing utilities are anticipated on the farm land site.

Alternative D-2 will require 3,000 SF of perpetual easement, 6,000 SF of temporary easement and 52 acres of land acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Utility Construction Permit
- MDE Groundwater Discharge Permit
- SHA Utility Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative D-2 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of collection pipe and 6% of the drip irrigation construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative D-2 (see Appendix D).

3. D-3: SURFACEWATER DISCHARGE

Surfacewater discharge is proposed by pumping approximately 1.3 miles from the main effluent pump station within Hughesville Village to a packaged pretreatment plant designed specifically for Hughesville Village (see section T-2), to an off-site perennial stream (see Figure 8, Appendix D).

The discharge forcemain will be installed along Rte 231 within County right-of-way and along private property adjoining the stream outfall. The quantity of right-of way required along the stream will be dependent on the location of the surface water discharge allowed by Maryland Department of the Environment, as it relates to MDE's 303d List for Nutrient Impairments and TMDLs. KCI requested MDE surface discharge requirements dated March 23, 2009 and received May 26, 2009 surface discharge limits (see attachments). The MDE response states that "The most critical problem for a proposed surface discharge is lack of nutrient allocation for Hughesville under the Chesapeake Bay Tributary Strategy." The Municipal NPDES permits division prefers the other alternatives.

The main effluent Sewage Pump Station will be constructed for the build-out flows with the sewage pumps initially sized only for the Village Core peak flows. Provisions will be provided to increase the pumping rate using larger impellors or replace the pumps in phases to accommodate build-out flow from the entire Hughesville Village PFA.

Easements Required

Charles County Plan Preparation Package requires a minimum 15' perpetual easement for pipes less than 8".

KCI proposes to construct the 6" forcemain, avoiding existing utility poles, roadside ditches and pavement crossings as much as possible, along established roadways to reduce easement requirements and environmental impacts. All stream and wetland crossings will utilize trenchless construction to further reduce environmental impacts. It is assumed that there is a 50' perpetual easement along Burnt Store Road. Construction of the forcemain can utilize this existing easement, requiring no additional easement along this major roadway. It is assumed that approximately 2,000 LF of pipe will require permanent and temporary easements near the outfall site, once the alignment veers from Burnt Store Road.

In addition, a fee-simple site acquisition will be required for construction of the outfall at the surface disposal site. No existing utilities are anticipated on the outfall site.

Alternative D-3 will require 30,000 SF of perpetual easement, 60,000 SF of permanent easement and 1 acre of land acquisition.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Utility Construction Permit
- MDE Surfacewater Discharge Permit
- SHA Utility Permit
- County Forest Mitigation Permit
- MDE/Army Corps Joint Wetland Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative D-3 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of $1.50 per linear foot of collection pipe. O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative D-3 (see Appendix D).

C. WASTEWATER TREATMENT SYSTEM ALTERNATIVES

The construction of the treatment systems will be in two phases. The first phase is to serve the final build out for Village Core and the second phase is for the final build out of Hughesville Village.
Two different treatment systems, Membrane Bioreactor (MBR) Treatment and Sequencing Batch Reactor (SBR) Treatment, are proposed in this report. The MBR treatment system employs membrane technology and it aims to achieve land application Class II effluent requirement. SBR treatment system is proposed to meet the anticipated surface water discharge limits.
The design flow and influent characteristics for both construction phases are shown in Table 6.

Table 6: Treatment System Design Flow and Influent Design Loading

Characteristics	Concentration (mg/l)	Phase I (GPD)	Loading (lbs/day)	Phase II (GPD)	Loading (lbs/day)
Average Daily Flow	-	200,000		400,000	-
Hydraulic Design Flow	-	426,000		846,000	-
BOD_5	190		316.9		633.8
TSS	210		350.3		700.6
TN	40		66.7		133.4
NH_4^+-N	25		41.7		83.4
TP	7		11.7		23.4

Both proposed treatment systems are modular systems. The systems can handle a flow peaking factor of 2 – 2.5. Due to the nature of the service area where most of the flow comes from commercial properties, an equalization tank is proposed for each system to handle significant diurnal flow patterns. As recommended in Maryland Design Guideline, the volume of the equalization tank is sized for 15% of the average daily flow.

1. T-1: MBR TREATMENT SYSTEM

An MBR is an activated sludge process that uses membranes to filter out suspended solids, including harmful microorganisms such as viruses, bacteria and cysts. In other words, the membrane acts like a clarifier except the membrane is a perfect barrier to solids and microorganisms. It allows activated sludge reactors operating at very high concentration of mixed liquor suspended solids (typically 8,000 to 20,000 mg/l). The large amount of biomass in the activated sludge reactor is very resilient to fluctuation in loading, shock loadings, upsets and provides excellent treatment efficiency.
Due to the superior filtration nature of the membrane, the effluent quality is able to meet the land application Class II effluent quality, as shown in Table 7. Although Class II effluent requirement does not have nutrient limits, the effluent total nitrogen and total phosphorus is designed for 20 mg/l and 3 mg/l, respectively. The nutrient requirement is

based on nitrogen balance, crop uptake, and drinking water standards (nitrate-nitrogen less than 10 mg/l).

Table 7: MBR Effluent Design Criteria

Flow & Characteristics	Concentration (mg/l)	Reference
BOD_5	10	Class II
TSS	10	Class II
Fecal Coliform (MPN/100 ml)	3	Class II
pH (s.u.)	6.5-8.5	Class II
TN	20	Nitrogen Balance
TP	3	

The process diagram of the proposed packaged MBR treatment system is shown in Figure 9 (Phase I). The addition of UV disinfection is mostly for the purposes of safeguarding and regulatory compliance. Figure 9 also shows the tank sizes and number of the tanks required whereas Figure 10 presents a proposed hydraulic profile of the system. The main treatment unit (MBR) can be housed in pole barn type structure where HVAC and basic laboratory equipment are provided, although a building structure is not required. The TS in wasted activated sludge (WAS) is expected to be 5% with a daily flow of 2,600 GPD. There are two options to handling WAS. One is to store WAS in a sludge holding tank before it is hauled to a regional treatment plant for sludge processing. However, due to the volume (especially during Phase II), this option may not be feasible. The other option, process the WAS into Class B sludge for disposal, appears to be more favorable. This would include a sludge digester and a package dewatering equipment such as rotary press.
The mass balance of the system (Phase I) is calculated and shown in Figure 11.

The cost estimate, in current dollars, is shown in Appendix D. A complete duplicate system will be added to accommodate the increased flow for Phase II.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Construction Permit
- County Forest Mitigation Permit
- MDE/Army Corps Joint Wetland Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative T-1 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of 7% of the MBR construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative T-1 (see Appendix D).

2. T-2: SBR TREATMENT SYSTEM

SBR & Effluent Filter Treatment system is proposed for surface water discharge. The effluent discharge limit is shown in Table 9. The proposed total nitrogen and total phosphorus limits are equal or more stringent than that in Mr. Stephen Luckman's letter dated May 26, 2009 and are typical of Maryland's enhanced nutrient removal requirements.

Table 8: SBR Effluent Design Criteria

Flow & Characteristics	Concentration (mg/l)
BOD_5	10
TSS	5
TN	3
TP	0.3
Fecal Coliform (MPN/100 ml)	126
pH (s.u.)	6.5-8.5
DO	6

An SBR is an activated sludge process that uses a single sludge for BOD5 removal, nitrification, and denitrification. It eliminates clarifiers which are required to settle the sludge and maintain sludge inventory system. It operates in batches and each cycle contains Fill, React, Settle, Decant, and Idle phases. By alternating the reactor environment (air on and off) in the SBR during the react phase, it achieves nitrification and denitrification in addition to traditional BOD5 and TSS removal. SBRs are usually operated in two or more trains to accommodate continuous flow. The SBR system has gained popularity with the increase of regulatory demand for nitrogen reduction in wastewater industry.

Typically, chemical addition including carbon source, ferric, and possibly carbonate will be required to achieve enhanced nutrient removal. The total nitrogen in the SBR effluent is about 5 mg/l; therefore, effluent filter is needed for additional denitrification and further reduction of the nutrients associated with the solids in the effluent. The proposed effluent filters are of continuous backwash type which eliminates clear well and mud well as well as associated pumping units.

The process diagram of the proposed SBR and effluent filter treatment system is shown in Figure 12 (Phase I). Figure 12 also shows the tank sizes and number of the tanks required whereas Figure 13 presents a proposed hydraulic profile of the system. The SBR units will be housed in pole barn type structure where HVAC and basic laboratory equipment are provided. The TS in wasted activated sludge (WAS) from SBR is expected to be 0.7% with a daily flow of 5,400 GPD. There are two options to handling WAS. One is to store WAS in a sludge holding tank before it is hauled to a regional treatment plant for sludge processing. However, due to the volume (especially during Phase II), this option may not be feasible. The other option, process the WAS into Class B sludge for disposal, appears to be more favorable. This would include a sludge digester and a package dewatering equipment such as rotary press.
The mass balance of the system (Phase I) is calculated and shown in Figure 14. The cost estimate, in current dollars, is shown in Table 10. A complete duplicate system will be added to accommodate the increased flow for Phase II.

Permits

Permits required for this Alternative include:

- County Sediment and Erosion Control Permit
- County PGM Approval
- MDE Construction Permit
- County Forest Mitigation Permit
- MDE/Army Corps Joint Wetland Permit

Cost Estimate

Cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative T-2 (see Appendix D).

Operation and Maintenance

Operation and Maintenance (O&M) cost estimates were developed by calculating a cost of 5% of the SBR construction cost (after administration and engineering fees). O&M cost estimates based on final build-out of the Village Core and the Hughesville Village areas have been developed for Alternative T-2 (see Appendix D).

5. HYDRAULIC MODELING

A. WATER

Design Criteria

The Hughesville Village area is relatively flat with an approximate high elevation of 204 to a low elevation of 170. The level of the full tank is proposed to be at an elevation of 365. The static pressure range for Hughesville will be from 69 psi to 84 psi when the overflow elevation is 365.

The Department of Utilities confirmed that the Charles County towers normally operate at a maximum of 7 feet below the tank overflow level, therefore to be conservative KCI modeled the tanks at 10 foot below the tank overflow level. This level is considered to be the minimum operating level for storage allocated to meet peak day demands. Water storage below 10 feet is considered to be storage allocated for fire flows. The static pressure range for Hughesville will be from 65 psi to 80 psi when the overflow elevation is 355.

KCI modeled three elevated water storage tank site locations as follows: Hughesville Industrial Park, Rte. 5 Interchange and the current SMECO parcel location. All modeled alternative site locations produced similar water system pressure and flow (hydraulic) results. All of these site locations are considered central to this relatively small water system from a hydraulic water quality and distribution analysis standpoint.

To evaluate the flow capacity of the water system, KCI utilized the Charles County, Water & Sewer Ordinance, which states that the criteria for the design pipe flow is the largest of the following:

- Peak Hourly Flow or
- Maximum Daily Flow + Fire Flow

KCI used the above County criteria to evaluate the flow capacity of the water system. Fire Flow requirements are based on Charles County Water & Sewer Ordinance, Dec 2002, Appendix R, which states the following:

Single Family Fire Flow = 1,000 GPM for 2 hours
Apartment/Townhouses Fire Flow = 1,500 GPM for 2 hours
Industrial/Commercial Fire Flow = 2,000 GPM for 2 hours

Model Development & Analysis

KCI used KY Pipe Version 5.0 as the water modeling software as instructed by the County. The pipe network in Alternative W-1 was created in GIS. Average daily demand from flow projections for build-out scenario for Hughesville Village was accumulated at junctions, based on Thiessen polygon method in GIS. The Hazens Williams formula was used in the KYPipe model to analyze the existing conditions.

$$h_L = \frac{4.73\ L}{C^{1.852}\ D^{4.87}}\ Q^{1.852}$$

h_L = head loss due to friction (ft)
L = distance between two junction nodes (ft)
C = Hazen-William C-factor
D = diameter of pipe (ft)
Q = pipeline flow rate (cfs)
The roughness of the pipes is based on Charles County Water and Sewer Ordinance section 8.1.C.4 which is tabulated as follows:

Table 9: Hazen William's Roughness

Pipe Material	Pipe Size	Hazen-Williams "C" factor
DIP	3"-8"	100
DIP	10"-12"	110
DIP	16"-24"	120

The pipe and node network was then imported in KYPipe and the system was analyzed for three steady state conditions:

- ADF with largest well out of service*
- MDF + Fire flow*
- Peak Flow*

*(All Tanks operating at 10' Below Full)

The system deficiencies were also evaluated for the following criteria:

- Areas with service pressure below 50 pounds per square inch (psi)
- Areas with pressure below 20 psi during peak flows
- Fire flow deficiencies (as per the Water & Sewer Ordinance)

The results from the three steady state runs are shown in Appendix E (Figure 15, 16 & 17). The schematic from KYPipe with the node names and summary of results for the three scenarios is also provided in Appendix E. All the criteria for hydraulic design in the Charles County Water & Sewer Ordinance were met namely:

- the pressure at all nodes for the average daily flow scenario are above 65 psi,
- the fire flows at all the nodes are above 2000 gpm at a minimum residual pressure of 20 psi
- Peak flows at all the nodes are above 20 psi.

Once the implementation of an emergency connection with MetCom becomes more realistic an interconnection layout can be developed and the impacts of this connection can be modeled in concert with the proposed water distribution system.

B. SEWER

Design Criteria

The proposed sewer Alternative S2 which was approved by Charles County was modeled to perform the hydraulic analysis for Hughesville. As per Charles County Water & Sewer Ordinance, the capacity of the system is defined as the hydraulic flow at which the pipe is flowing 2/3 full (i.e. the hydraulic grade line, d/D = 0.67). The Manning formula was used to calculate pipe capacity (Q) for gravity pipes and is directly proportional to pipe area (A), hydraulic radius (R) and slope (S) and is indirectly proportional to Manning's n.

$$Q = A\frac{1.49\left(R^{2/3} \cdot S^{1/2}\right)}{n}$$

n = 0.011 for PVC pipes based on Appendix Z of Charles County Water & Sewer Ordinance. Also the cleansing velocity in the pipe should be 2.5 ft/s.

The Hazen-Williams formula was used to calculate the pipe size for proposed force main pipe for Alternatives S2.

Hazen-Williams formula (English units):

$Q= A \cdot C \cdot R^{0.63} \cdot S^{0.54}$

Q= Pipe capacity
A= pipe area
R= hydraulic radius
S= slope
C= Coefficient of Roughness

Model Development & Analysis

KCI used XPSWMM 2009 as the sewer modeling software. The pipe network in Alternative S-2 was created in GIS. Design hydraulic flow (Q_p+I/I) for build-out scenario for Hughesville Village was accumulated at nearest manhole, based on Thiessen polygon method in GIS.

The pipe and node network was then imported in XPSWMM and the hydraulic capacity of the system was analyzed for depth and velocity. The results from the hydraulic runs are shown in Appendix E (Figure 18 & Summary of Hydraulic results sheets 1 thru 4). All the criteria for hydraulic design depth were met as per the Charles County Water & Sewer Ordinance except for velocity of 2.5 ft/s. Decreasing the pipe diameter and increasing the slope of pipe will increase the velocity, however the proposed alternative uses the minimum 8" size required and conjunction with minimum slopes to achieve reasonable depth sewers. Exemptions from County design standards for minimum design flow velocities of 2.5 fps may be granted by the County for 8" diameter gravity sewers.

6. SUMMARY AND RECOMMENDATIONS

KCI recommends implementing water Alternative W-1, which provides water system supply and treatment infrastructure within the limits of the PFA. KCI also recommends the County pursue a future emergency interconnection with MetCom that provides redundancy for and will be beneficial for the operation of both systems.

KCI recommends implementing sewer Alternative S-2, Side Alley (abandoned railroad right-of-way) Collection System along St. Mary's County Easement. This alternative has the least disruption to traffic and existing roadway pavement, meeting the Hughesville and County project goals.

KCI recommends Wastewater Disposal Alternative D-2, Groundwater Discharge (Spray Irrigation) based on a site located near Hughesville that perks, with an owner willing to negotiate with the County and as the MDE preferred disposal alternative. The spray irrigation alternative provides treatment in the upper soil layer, reducing the wastewater treatment plant requirements and costs. Alternative D-3 includes wetland/ forest mitigation and permitting, which D-2 does not include; however, there is significantly less land acquisition required for D-3. In order to provide effluent quality sufficient for groundwater discharge, KCI recommends MBR Treatment as described in Alternative T-1.

A cost summary of the cost for the recommended alternatives is as follows:

Table 10: Construction Cost Summary of Recommended Alternative

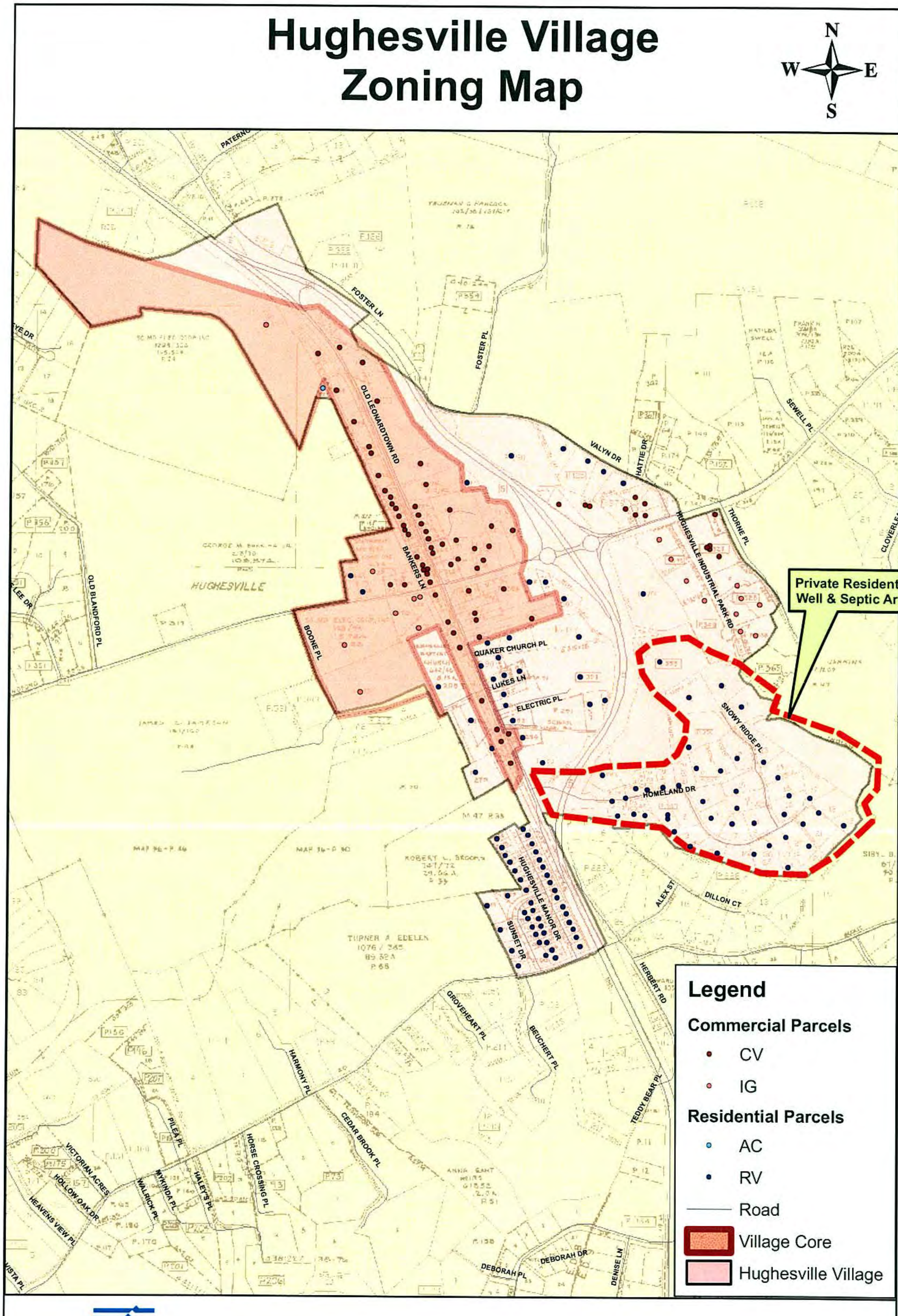
Alternative	Village Core	Additional for Hughesville Village	Total
W-1	$7,753,000	$2,971,000	**$10,724,000**
S-2	$3,601,000	$2,942,000	**$6,543,000**
D-2	$3,072,000	$1,449,000	**$4,521,000**
T-1	$4,470,000	$4,470,000	**$8,940,000**
Total	**$18,896,000**	**$11,832,000**	**$30,728,000**

Table 11: O&M Cost Summary of Recommended Alternative

Alternative	Village Core	Additional for Hughesville Village	Total
W-1	$123,000	$43,000	**$166,000**
S-2	$84,000	$49,000	**$133,000**
D-2	$90,000	$68,000	**$158,000**
T-1	$313,000	$313,000	**$626,000**
Total	**$610,000**	**$473,000**	**$1,083,000**

App. A

Hughesville Village Zoning Map



KCI TECHNOLOGIES

Figure 2

App. B

COMMERCIAL BUILDOUT DENSITY DATA

No.	ACCTID	ADDRESS	OWNER NAME	ACRES	ZONING	FAR	EXISTING (gpm)	BUILDOUT (gpm)
1	908028613	15064 BURNT STORE ROAD	SOUTHERN MD ELECTRIC COOP INC	6.7	IG	0.50	323.4	3,685.0
2	908014442	15080 BURNT STORE ROAD	FARRALL, MARY S REV TRT	0.8	CV	0.35	147.8	288.8
3	908028605	15085 BURNT STORE ROAD	SOUTHERN MD ELECTRIC COOP INC	2.2	IG	0.50	2699.5	1,215.5
4	908025185	15110 BURNT STORE ROAD	HOTEL CHARLES ENTERPRISES LLC	1.1	CV	0.35	579.5	412.0
5	909003703	15165 DOE HILL PL	CHESAPEAKE & POTOMAC TELEPHONE CO	0.9	CV	0.35	264.2	327.3
6	909005145	15180 DOE HILL PL	HUBBELL, LEONARD H SR & PENNY D	4.9	CV	0.35	316.2	1,901.9
7	909013393	6500 HUGHESVILLE INDUSTRIAL PARK ROAD	SOUTHSTAR LIMITED PARTNERSHIP	5.6	CV	0.35	312.9	2,148.3
8	909015388	6515 HUGHESVILLE INDUSTRIAL PARK ROAD	DEMCO ENTERPRISES LLC	2.2	IG	0.50	202.4	1,221.0
9	909013644	6520 HUGHESVILLE INDUSTRIAL PARK ROAD	RENTAL UNIFORM SER OF CULPEPER INC	0.8	CV	0.35	0.0	324.9
10	909013415	6530 HUGHESVILLE INDUSTRIAL PARK ROAD	FRIEND, MARTIN, STEVEN & JOHN	3.2	IG	0.50	270.0	1,749.0
11	909013687	6540 HUGHESVILLE INDUSTRIAL PARK ROAD	RADER, JAMES & ANN M	1.1	IG	0.50	438.4	605.0
12	909013431	6550 HUGHESVILLE INDUSTRIAL PARK ROAD	CECCHINI, LOUIS R & RACHEL M	2.6	IG	0.50	0.0	1,413.5
13	909015329	6560 HUGHESVILLE INDUSTRIAL PARK ROAD	UNITED PROPANE, INC	1.4	IG	0.50	68.3	770.0
14	909006117	8468 LEONARDTOWN ROAD	POTOMAC BAPTIST ASSOCIATION INC	2.0	CV	0.35	284.9	770.0
15	908024618	8471 LEONARDTOWN ROAD	MILSTEAD, MARY & DAVID & V YEAGER	0.4	CV	0.35	0.0	169.4
16	909001131	8592 LEONARDTOWN ROAD	DOBSON, RICHARD H	0.5	CV	0.35	95.4	202.5
17	908009716	8605 LEONARDTOWN ROAD	FISCHER, MICHAEL & TAMMY	0.1	CV	0.35	258.3	55.8
18	908009724	8625 LEONARDTOWN ROAD	BRIDGETT, WILLIAM A	0.4	CV	0.35	337.7	172.9
19	908018758	8785 LEONARDTOWN ROAD	HAMILTON, JENNINGS R	0.2	CV	0.35	203.6	80.9
20	909001379	8328 LEONARDTOWN ROAD	ESTEVEZ, MARY R D & C R DYSON JR	0.7	CV	0.35	134.5	265.3
21	908018162	8125 LEONARDTOWN ROAD	COUSINEAU FAMILY, LLC	1.6	CV	0.35	475.5	608.3
22	909032126	8126 LEONARDTOWN ROAD	SMOLINSKI, DONALD E & MARY R	9.1	CV	0.35	316.0	3,515.1
23	908014396	8137 LEONARDTOWN ROAD	FARMERS WAREHOUSE INC	1.5	CV	0.35	1923.3	573.7
24	909007156	8138 LEONARDTOWN ROAD	D & M RENTAL II LLC	2.1	CV	0.35	761.5	804.7
25	908014388	8143 LEONARDTOWN ROAD	FARMERS WAREHOUSE INC	1.5	CV	0.35	987.0	581.4
26	909000321	8144 LEONARDTOWN ROAD	BESCHE OIL CO	13.5	CV	0.35	0.0	5,193.7
27	909001565	8262 LEONARDTOWN ROAD	D & M RENTALS I LLC	4.8	CV	0.35	0.0	1,840.3
28	909003045	8280 LEONARDTOWN ROAD	WALTER, HELEN M	3.9	CV	0.35	611.2	1,501.5
29	908027633	8281 LEONARDTOWN ROAD	RUSSELL, JAMES L & GERTRUDE A	0.6	CV	0.35	455.3	215.6
30	909001069	8304 LEONARDTOWN ROAD	STONESTREET, JAMES Z & MARY K	1.0	CV	0.35	287.8	385.0
31	908054533	8311 LEONARDTOWN ROAD	STRATCHKO, FRANK G & NORMA E	0.4	CV	0.35	373.4	150.2
32	909001778	8316 LEONARDTOWN ROAD	QUADE, FRANCIS D & MARY JO	0.7	CV	0.35	568.1	257.2
33	908033013	8317 LEONARDTOWN ROAD	KERILL, HARRY J	0.2	CV	0.35	346.8	91.2
34	908028656	8329 LEONARDTOWN ROAD	SCHULTE, JOHN F & SUSAN R	0.2	CV	0.35	212.0	73.2
35	909004386	8340 LEONARDTOWN ROAD	MOWRY, RICHARD L & MARGARET A	0.8	CV	0.35	163.3	296.1
36	908008256	8341 LEONARDTOWN ROAD	MERCANTILE SOUTHERN MARYLAND BANK	0.7	CV	0.35	216.5	265.7
37	909008357	8352 LEONARDTOWN ROAD	ELROD, CAROLYN E FAMILY TRUST	0.6	CV	0.35	277.7	246.4
38	908019045	8371 LEONARDTOWN ROAD	SO MD TRI COUNTY COMMUNITY ACTION	0.3	CV	0.35	291.8	124.7
39	909008411	8372 LEONARDTOWN ROAD	JETT, PHILIP R & DEANNA L	0.3	CV	0.35	200.5	128.2
40	908016445	8377 LEONARDTOWN ROAD	SO MD TRI COUNTY COMMUNITY ACTION	0.1	CV	0.35	343.5	40.0
41	908061513	8383 LEONARDTOWN ROAD	SO MD TRI COUNTY COMMUNITY ACTION	0.1	CV	0.35	493.5	25.8
42	908013748	8383 LEONARDTOWN ROAD	SO MD TRI COUNTY COMMUNITY ACTION	0.1	CV	0.35	50.0	55.1
43	908018197	8389 LEONARDTOWN ROAD	SO MD TRI COUNTY COMMUNITY ACTION	0.2	CV	0.35	512.4	60.1
44	909009388	8394 LEONARDTOWN ROAD	WOOD, GLENN P & SHERRY G ET AL	0.6	CV	0.35	75.2	245.2
45	908028575	8395 LEONARDTOWN ROAD	ASSOC CATHOLIC CHAR OF WASH INC	0.3	CV	0.35	866.9	120.1
46	908025304	8431 LEONARDTOWN ROAD	QUADE, JAMES H & MYRTLE M	0.2	CV	0.35	448.2	92.4
47	909004475	8440 LEONARDTOWN ROAD	SOUTHERN MARYLAND BD REALTORS INC	1.3	CV	0.35	639.2	481.3
48	909009493	8450 LEONARDTOWN ROAD	ALDRIDGE, LEWIE M SR TRST ET AL	2.5	CV	0.35	63.8	977.9
49	908024863	8459 LEONARDTOWN ROAD	HUGHESVILLE COMM PROP JNT VENTURE	0.4	CV	0.35	293.8	150.2
50	909008837	8464 LEONARDTOWN ROAD	QUADE, WILLIAM LEO & VELMA P	0.9	CV	0.35	282.5	346.5
51	909004742	15190 PRINCE FREDERICK ROAD	SPITZ, STEVEN K & CANDACE C	0.8	CV	0.35	516.4	309.2
52	909009019	15200 PRINCE FREDERICK ROAD	ROSE, TONY W	0.8	CV	0.35	249.8	288.8
53	909000704	15210 PRINCE FREDERICK ROAD	HUBBELL, LEONARD H JR & JO ANNE	0.9	CV	0.35	253.3	353.4
54	909010033	15220 PRINCE FREDERICK ROAD	HUBBELL, LEONARD H	0.7	CV	0.35	761.2	271.8
55	909010564	15245 PRINCE FREDERICK ROAD	HUGHESVILLE VOL F D & RS INC	3.9	CV	0.35	1148.1	1,513.1
56	909002286	15260 PRINCE FREDERICK ROAD	HUGHESVILLE PROFESSIONAL CTR LLC	2.4	CV	0.35	321.2	935.6
57	909011935	15322 PRINCE FREDERICK ROAD	STATE HIGHWAY ADMINISTRATION	7.4	CV	0.35	0.0	2,837.5
58	909006451	15364 PRINCE FREDERICK ROAD	LEGAL AID BUREAU INC	2.0	CV	0.35	144.1	770.0
59	909012729	15485 PRINCE FREDERICK ROAD	N W O INC	1.0	CV	0.35	263.6	385.0
60	909010661	15230 PRINCE FREDERICK ROAD	HUBBELL, LEONARD H SR	2.1	CV	0.35	389.0	789.3
61	909005137	15240 PRINCE FREDERICK ROAD	KING, B CLARK & EVELYN B	4.3	CV	0.35	0.0	1,636.3
62	908013357	15215 SUNRISE PL	JHAVERI, BHASKER	0.7	CV	0.35	605.5	269.5
63	909025758	6410 TRUST PLACE DR	HAYNES BROTHERS PROPERTIES LLC	1.1	CV	0.35	521.9	427.4
64	909025723	6420 TRUST PLACE DR	HAYNES BROTHERS PROPERTIES LLC	1.1	CV	0.35	635.6	412.0
65	909025707	6430 TRUST PLACE DR	JWMK LLC	1.1	CV	0.35	340.1	404.3
66	908008906		STRATCHKO PROPERTIES LLC	0.5	CV	0.35	57.5	175.9
67	908014469		HUGHESVILLE WAREHOUSE, INC	1.3	CV	0.35	869.5	481.3
68	908017778		HUGHESVILLE SANITARY COMM INC	1.5	IG	0.50	375.4	825.0
69	908017786		HUGHESVILLE WAREHOUSE, INC	0.5	CV	0.35	0.0	189.4
70	909013652		RENTAL UNIFORM SER OF CULPEPER INC	0.9	CV	0.35	0.0	341.1
71	909013679		RENTAL UNIFORM SER OF CULPEPER INC	1.4	CV	0.35	0.0	539.0
72	909015361		LEXPARK LLC	3.4	IG	0.50	0.3	1,848.0
73	909015396		THOMAS, JEFFREY D	4.1	IG	0.50	0.0	2,277.0
74	909015442		HAYNES BROTHERS PROPERTIES LLC	2.3	CV	0.35	0.0	881.7
75	909015531		ARK & DOVE ENTERPRISES LLC	8.0	IG	0.50	0.0	4,416.5
76	908028583		ASSOC CATHOLIC CHAR OF WASH INC	0.7	CV	0.35	0.0	271.8
77	908031126		BOWLING, GILBERT O & ELIZABETH	0.2	CV	0.35	699.9	69.3
78	908031134		BOWLING, GILBERT O & ELIZABETH	0.4	CV	0.35	791.2	151.7
79	908033099		SOUTHERN MD ELECTRIC COOP INC	12.1	IG	0.50	0.0	6,660.5
80	908040982		STRATCHKO PROPERTIES LLC	0.2	CV	0.35	585.6	76.6

No.	ACCTID	ADDRESS	OWNER NAME	ACRES	ZONING	FAR	EXISTING (gpm)	BUILDOUT (gpm)
81	909004254		SOUTHERN MD BOARD OF REALTORS, INC	3.0	CV	0.35	0.0	1,143.5
82	909004548		NEAVE, MARY I	0.5	CV	0.35	267.8	207.9
83	909004556		NEAVE, MARY I H	0.3	CV	0.35	48.3	115.5
84	908026181		SOUTHERN MD ELECTRIC COOP INC	0.6	IG	0.50	27.7	341.0
85	908028192		SOUTHERN MD ELECTRIC COOP INC	15.7	IG	0.50	1006.1	8,651.5
86	908028567		SOUTHERN MD ELECTRIC COOP INC	0.5	IG	0.50	209.3	275.0
87	909006443		LEGAL AID BUREAU INC	0.9	CV	0.35	0.0	351.1
88	909013407		HUGHESVILLE INDUST PARK JOINT VENT	0.5	IG	0.50	1082.7	270.6
89	909013423		LUSBY, THOMAS E & MARIE B	1.0	IG	0.50	571.7	547.8
90	909025774		HAYNES BROTHERS PROPERTIES LLC	0.4	CV	0.35	47.6	146.3
91	909030042	14747 BANKS ODEE RD	HUGHESVILLE STATION LLC	5.2	CV	0.35	0.0	2,002.5
92	908018189	PO BOX 1937	SOUTHERN MD ELECTIC COOP INC	61.2	IG	0.50	0	33,679.5

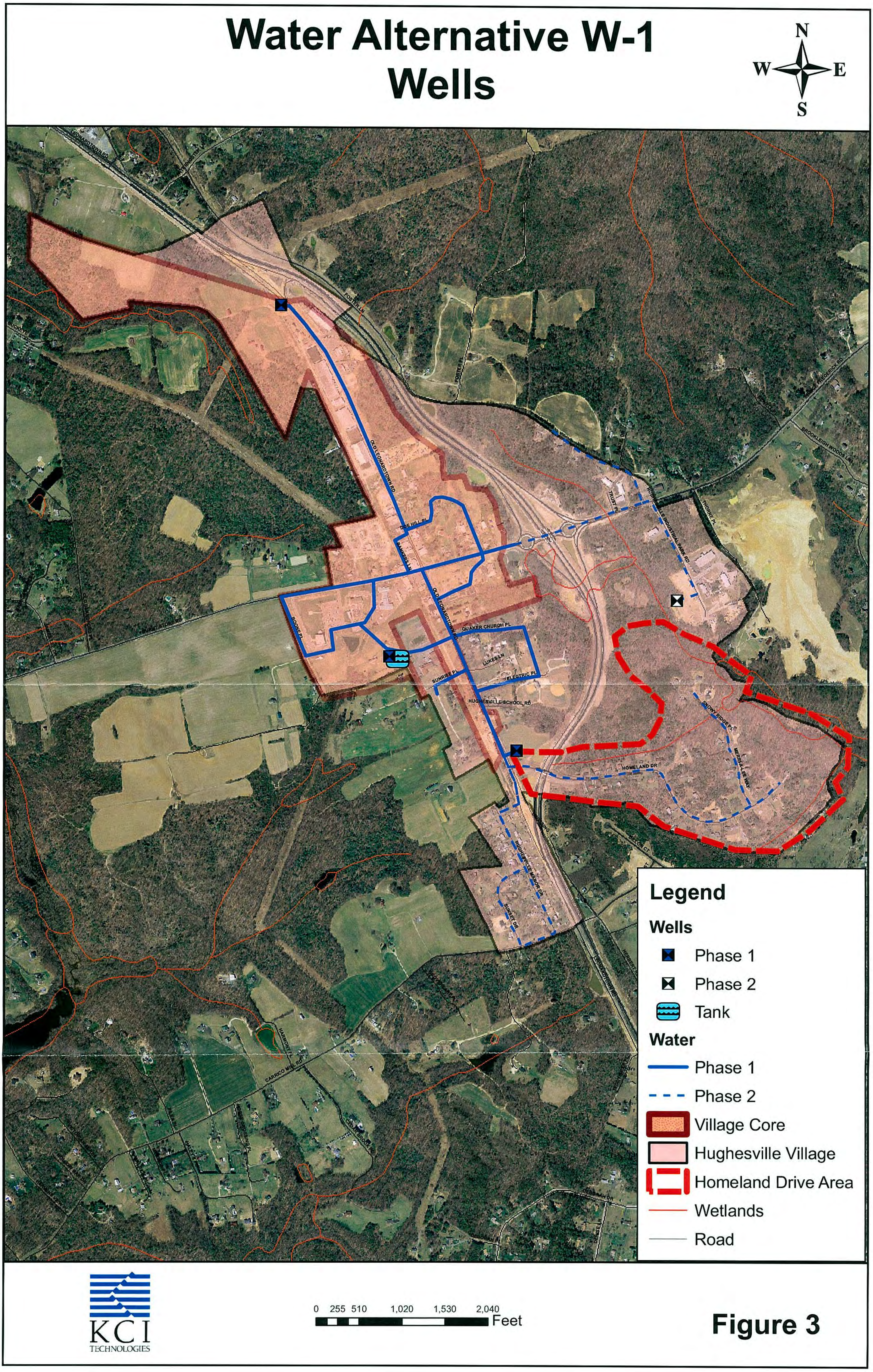
RESIDENTIAL BUILDOUT DENSITY DATA

No.	ACCTID	ADDRESS	OWNER NAME	ACRES	ZONING	NHC	EXISTING (gpm)	BUILDOUT (gpm)
1	908009457	15040 BURNT STORE ROAD	BOWLING, GEORGE M JR & DOROTHY M	2.1	RV	0	260	260
2	908018723	15052 BURNT STORE ROAD	WARRING, COLIN M	0.6	RV	0	260	260
3	909016244	15355 ELECTRIC PL	STATE HIGHWAY ADMINISTRATION	3.4	RV	0	260	260
4	909014489	15585 HOMELAND DR	TARDIF, DOROTHY M	2.1	RV	0	260	260
5	909014454	15595 HOMELAND DR	SHEFFLER, TONY A & JENNIFER L	3.2	RV	0	260	260
6	909005935	15360 HOMELAND DR	BOUDREAU, KATHRYN A	0.6	RV	0	260	260
7	909008314	15365 HOMELAND DR	FRENDER, JAMES W & ANN R	0.5	RV	0	260	260
8	909002448	15380 HOMELAND DR	HASPERT, DAVID J	0.6	RV	0	260	260
9	909006486	15385 HOMELAND DR	HOLMES, JUDSON E & PATRICIA A	0.5	RV	0	260	260
10	909004416	15400 HOMELAND DR	MCDONAGH, CLARENCE O JR & BARBARA	0.8	RV	0	260	260
11	909001743	15405 HOMELAND DR	FOWLER, LOIS ABELL	0.7	RV	0	260	260
12	909010084	15410 HOMELAND DR	AMEY, MARY P	1.6	RV	0	260	260
13	909010092	15420 HOMELAND DR	FIGERT, ROBERT W & VICKIE L	1.5	RV	0	260	260
14	909013628	15425 HOMELAND DR	GERARD, PRASAD & ANN MARIE OLIVA	2.0	RV	0	260	260
15	909010106	15450 HOMELAND DR	VOGEL, ROBERT D & JOAN K	1.5	RV	0	260	260
16	909013636	15455 HOMELAND DR	THERRES, JOSEPH L & BONITA A	2.0	RV	0	260	260
17	909013857	15460 HOMELAND DR	BOYER, TIMOTHY A	2.9	RV	0	260	260
18	909013849	15470 HOMELAND DR	LAUGHTON, ROBERT J & KATHARINE L	2.0	RV	0	260	260
19	909013814	15475 HOMELAND DR	DOVE, FRANK S	2.1	RV	0	260	260
20	909013822	15480 HOMELAND DR	FOUNTAIN, PEGGY A	2.0	RV	0	260	260
21	909014551	15495 HOMELAND DR	ERION, DARCY D & BARBARA J COX	2.0	RV	0	260	260
22	909014306	15500 HOMELAND DR	MULLINGS, MARSHALL W & JANE L	2.0	RV	0	260	260
23	909014543	15505 HOMELAND DR	HILL, LAWRENCE S JR & VEDA E	2.1	RV	0	260	260
24	909014314	15530 HOMELAND DR	BELCASTRO, PETER J SR & DAISY M	2.0	RV	0	260	260
25	909014535	15535 HOMELAND DR	BOWIE, BENJAMIN H IV & SUSAN G	2.9	RV	0	260	260
26	909014527	15555 HOMELAND DR	DUDLEY, ROBERT H & DEBRA A	2.4	RV	0	260	260
27	909014411	15560 HOMELAND DR	SIRNA, GREGORY W & MICHELLE L	2.0	RV	0	260	260
28	909014497	15565 HOMELAND DR	MCLAUGHLIN, JAMES S	2.5	RV	1	0	260
29	909014519	15569 HOMELAND DR	GRAY, LEN D & MERNA E	2.4	RV	0	260	260
30	909014438	15570 HOMELAND DR	KANISS, ALAN M & LYNN B	2.0	RV	0	260	260
31	909014462	15575 HOMELAND DR	GRIBGSBY, MICHAEL D JR	2.1	RV	0	260	260
32	909014446	15580 HOMELAND DR	WHELAN, ROBERT L & MERRY C	2.5	RV	0	260	260
33	908011281	15198 HUGHESVILLE MANOR DR	SLOPER, HOWARD & BONITA	0.5	RV	0	260	260
34	908018987	15204 HUGHESVILLE MANOR DR	VENDEMIA, JOHN A & BRENDA M	0.5	RV	0	260	260
35	908020361	15205 HUGHESVILLE MANOR DR	KISNER, KIRK A & PATRICIA A	0.5	RV	0	260	260
36	908009759	15210 HUGHESVILLE MANOR DR	PADGETT, ANGELA	0.5	RV	0	260	260
37	908027188	15211 HUGHESVILLE MANOR DR	ANDERSON, BRANDON E	0.5	RV	0	260	260
38	908030952	15216 HUGHESVILLE MANOR DR	WILLIAMS, ELEANOR E TRUSTEE	0.5	RV	0	260	260
39	908026351	15217 HUGHESVILLE MANOR DR	DIGULIMIO, DARLENE A ET AL	0.5	RV	0	260	260
40	908031215	15222 HUGHESVILLE MANOR DR	WOOD, DAVID C & JOYCE B	0.5	RV	0	260	260
41	908013136	15223 HUGHESVILLE MANOR DR	SMITH, THOMAS W & MARY J	0.5	RV	0	260	260
42	908011052	15150 HUGHESVILLE MANOR DR	BUGIN, JULIA	0.7	RV	0	260	260
43	908017131	15151 HUGHESVILLE MANOR DR	THERRES, JAMES G & SARA L	0.5	RV	0	260	260
44	908021627	15156 HUGHESVILLE MANOR DR	SMITH, JOSEPH R & JOAN C	0.5	RV	0	260	260
45	908014205	15157 HUGHESVILLE MANOR DR	NELSON, TOM F JR & T VAN HOOZIER	0.5	RV	0	260	260
46	908025282	15162 HUGHESVILLE MANOR DR	OWENS, JAMES A & EMMA J	0.5	RV	0	260	260
47	908019347	15163 HUGHESVILLE MANOR DR	ZANTZINGER, SUZANNE K	0.5	RV	0	260	260
48	908021147	15168 HUGHESVILLE MANOR DR	MAY, ELEANOR P	0.5	RV	0	260	260
49	908025584	15169 HUGHESVILLE MANOR DR	SHIPLEY, THOMAS C & GERALDINE E	0.4	RV	0	260	260
50	908015554	15174 HUGHESVILLE MANOR DR	GARDINER, JOSEPH L JR & LENA E	0.5	RV	0	260	260
51	908024782	15175 HUGHESVILLE MANOR DR	NELSON, THOMAS F	0.5	RV	0	260	260
52	908020442	15180 HUGHESVILLE MANOR DR	THOMPSON, DINAH L	0.5	RV	0	260	260
53	908009511	15181 HUGHESVILLE MANOR DR	DEAVERS, CLARA & GREGORY A ET AL	0.5	RV	0	260	260
54	908019002	15186 HUGHESVILLE MANOR DR	DOWNS, BENJAMIN & SUSANNE	0.5	RV	0	260	260
55	908030391	15192 HUGHESVILLE MANOR DR	PADGETT, ROBERT L & THERESA D	0.5	RV	0	260	260
56	908027129	15228 HUGHESVILLE MANOR DR	WHEELBARGER, KIM A	0.5	RV	0	260	260
57	908011001	15229 HUGHESVILLE MANOR DR	BUCKLER, PAUL G & PATRICIA A	0.5	RV	0	260	260
58	908008124	15234 HUGHESVILLE MANOR DR	KEITH, ROBERT G & SUSAN M	0.5	RV	0	260	260
59	908015775	15235 HUGHESVILLE MANOR DR	GEHRING, JENNIFER ETAL	0.5	RV	0	260	260
60	908013713	15240 HUGHESVILLE MANOR DR	D'ANTONIO, ANTHONY & LINDA A	0.5	RV	0	260	260
61	908017433	15241 HUGHESVILLE MANOR DR	FIELDS, MARY C & K C WELTI	0.5	RV	0	260	260
62	909001921	15200 HUGHESVILLE SCHOOL ROAD	GARNER, CHAD J & JENNIFER	1.8	RV	0	260	260
63	909000445	15225 HUGHESVILLE SCHOOL ROAD	DYSON, EVELYN J	1.3	RV	0	260	260
64	909004866	8474 LEONARDTOWN ROAD	STILES, MARTIN L	1.3	RV	0	260	260
65	909008829	8480 LEONARDTOWN ROAD	TURNER, SEAN F & MARY A	0.6	RV	0	260	260
66	909006435	8488 LEONARDTOWN ROAD	MOREY, WILLIAM T & SARAH T	1.3	RV	0	260	260
67	908032963	8505 LEONARDTOWN ROAD	HUGHESVILLE BAPTIST CHURCH	8.1	RV	0	260	260
68	909001956	8552 LEONARDTOWN ROAD	MATIN, HAMMAD S ET AL	2.3	RV	0	260	260
69	909000038	15250 LUKES LANE	ELROD, CAROLYN E FAMILY TURST	0.5	RV	0	260	260
70	909009175	15260 LUKES LANE	GLISTA, STEVEN M	0.9	RV	0	260	260
71	909006389	15275 LUKES LANE	COX, GARY R	1.1	RV	0	260	260
72	909014349	6745 MERRI A LEE WAY	KHAN, HABIB U & SHER & FAIZAN ETAL	2.0	RV	0	260	260
73	909014403	6760 MERRI A LEE WAY	JOHNSTON, ERIC W & KAREN S	2.0	RV	0	260	260
74	909014322	6765 MERRI A LEE WAY	WISE, GERALD W	2.1	RV	0	260	260
75	909014373	6710 MERRI A LEE WAY	DUKER, ROBERT W JR & J KERRY	2.5	RV	0	260	260
76	909014365	6715 MERRI A LEE WAY	WANDA, BRIAN & CORINA	2.3	RV	0	260	260
77	909014381	6730 MERRI A LEE WAY	HARPLE, PAUL P JR & C E SIEMER	2.4	RV	0	260	260
78	909014357	6735 MERRI A LEE WAY	CRAMP, JAMES B & LYNNE M	2.2	RV	0	260	260
79	909025804	15250 QUAKER CHURCH PL	MOZINGO, ALAN & PAMELA	2.4	RV	0	260	260
80	909025839	15300 QUAKER CHURCH PL	HARVEY-PRYOR, CYNTHIA D & W PRYOR	5.5	RV	1	260	520

No.	ACCTID	ADDRESS	OWNER NAME	ACRES	ZONING	NHC	EXISTING (gpm)	BUILDOUT (gpm)
81	909001492	15263 PRINCE FREDERICK ROAD	BARTRON, WILLIAM E JR & JOAN M	1.4	RV	0	260	260
82	909004858	15277 PRINCE FREDERICK ROAD	JONES, BRIAN S	1.3	RV	0	260	260
83	909002995	15371 PRINCE FREDERICK ROAD	LONG, MAURICE I JR	12.2	RV	5	260	1560
84	909015647	15490 SNOWY RIDGE PL	COOPER, KENNETH E SR & GLORIA J	4.4	RV	0	260	260
85	909015655	15495 SNOWY RIDGE PL	REVOIR, JAMIE L & KELLY L	5.2	RV	1	260	520
86	909015639	15500 SNOWY RIDGE PL	SAMUELS, RICHARD A & CRYSTAL L	4.8	RV	0	260	260
87	909015663	15505 SNOWY RIDGE PL	COVER, KEVIN A & SAUNDRA G	6.4	RV	2	260	780
88	908018103	15340 SUNSET DR	SHERMAN, DAVID L & VIRGINIA L	0.9	RV	0	260	260
89	908013209	15345 SUNSET DR	CANTER, JAMES EDW & MARIANNA MARY	0.8	RV	0	260	260
90	908025673	15285 SUNSET DR	GROOMS, KEVIN M & BARBARA B	0.5	RV	0	260	260
91	908016798	15290 SUNSET DR	LONG, STEVEN E & KIMBERLY J	0.5	RV	0	260	260
92	908031991	15295 SUNSET DR	TEFFEAU, MELVIN N & SHIRLEY B	1.2	RV	0	260	260
93	908021996	15300 SUNSET DR	LUKENICH, EDWARD & BRENDA F	0.5	RV	0	260	260
94	908009767	15305 SUNSET DR	BRIDGETT, BRUCE, WILLIAM, & TRACI	1.8	RV	0	260	260
95	908009503	15310 SUNSET DR	BOWLING, MARY E	0.5	RV	0	260	260
96	908011303	15315 SUNSET DR	RAFF, GEORGE P & PENNY R	1.0	RV	0	260	260
97	908012911	15320 SUNSET DR	GRAY, LARRY D & ANN L	0.5	RV	0	260	260
98	908065004	15325 SUNSET DR	CANTER, PHILIP F	1.0	RV	1	0	260
99	908017727	15330 SUNSET DR	BRANICK, WILLIAM G JR & MARY V	0.5	RV	0	260	260
100	908035105	15175 SUNRISE PL	DARGAN, ANTHONY & LEAH M	3.3	RV	0	260	260
101	908029911	15205 SUNRISE PL	PALMER, KIM F	1.7	RV	0	260	260
102	908019029	15280 SUNSET DR	BUSEY, CHARLES R JR ET AL	0.5	RV	0	260	260
103	909015493	6365 VALYN DR	WILLETT, JOSEPH R JR & NORA J	3.6	RV	0	260	260
104	909015485	6375 VALYN DR	FOWLER, RICHARD G JR	3.8	RV	0	260	260
105	909015477	6385 VALYN DR	BEACH, RONALD I & PATRICIA A	2.0	RV	0	260	260
106	909015469	6395 VALYN DR	DAUGHERTY, RONALD S & MICHELE L	2.0	RV	0	260	260
107	908014418		FARMERS WAREHOUSE INC	0.8	AC	1	0	260
108	909001077		SCHULTZ-COLLINS, JANE ET AL	5.8	RV	2	0	520
109	908058237		BRIDGETT, WILLIAM A	1.1	RV	1	0	260
110	909031561		STATE HIGHWAY ADMINISTRATION	2.9	RV	0	0	0
111	909031588		STATE HIGHWAY ADMINISTRATION	1.9	RV	0	0	0
112	909031693		STATE HIGHWAY ADMINISTRATION	0.9	RV	0	0	0
113	909031707		STATE HIGHWAY ADMINISTRATION	12.3	RV	0	0	0
114	909009833		COUNTY COMMISSIONERS OF CHAS CO MD	6.5	RV	0	0	0
115	909013237		MCFETRIDGE, CLIFFORD J	15.6	RV	6	260	1820
116	909013318		ADELPHIA FRIENDS MEETING, INC	0.9	RV	0	260	260
117	909015671		LONG, MAURICE I JR	22.7	RV	11	0	2860

App C.

Water Alternative W-1
Wells

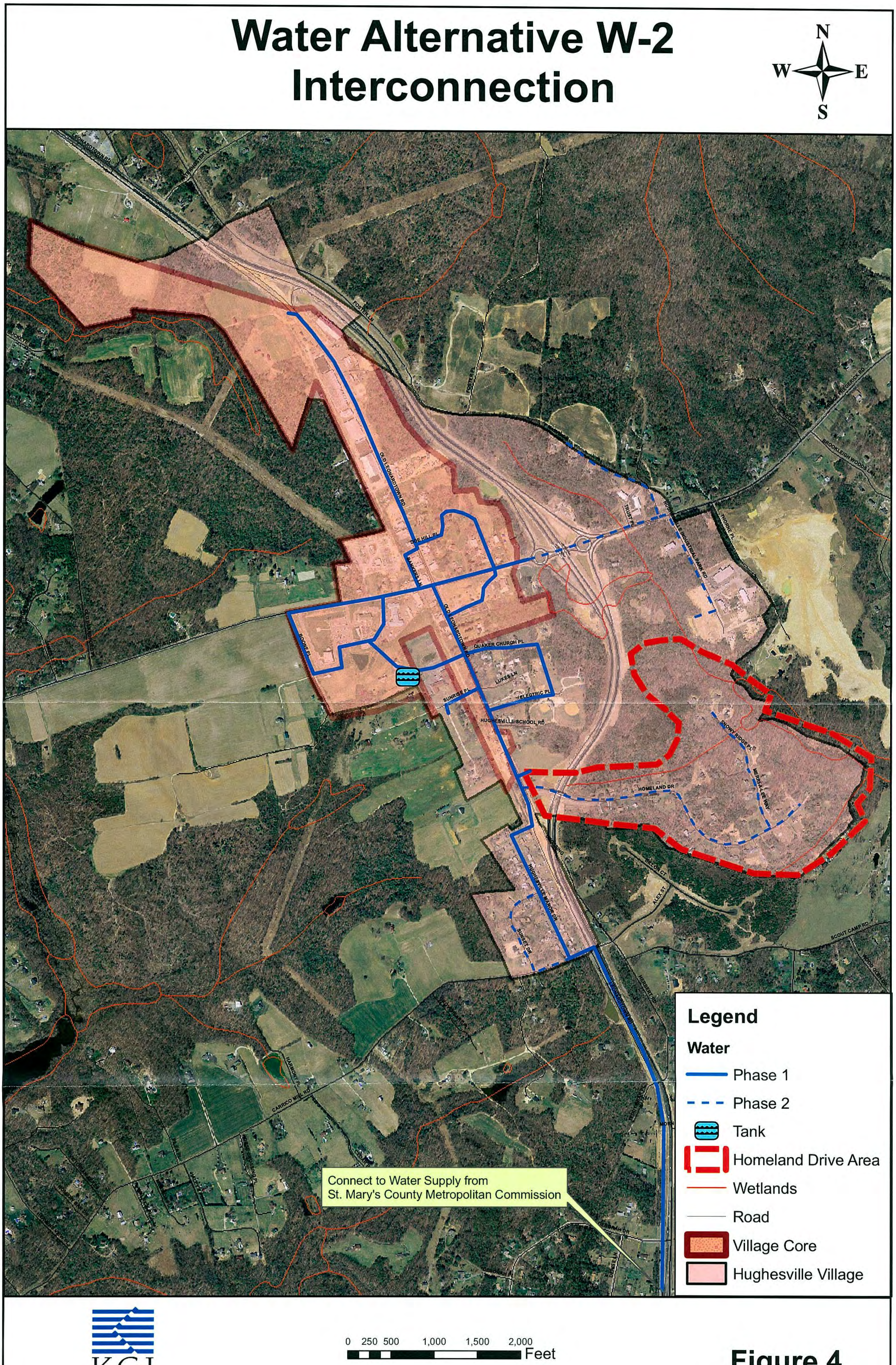


KCI TECHNOLOGIES

Figure 3

ENGINEERS ESTIMATE OF PROBABLE COST					
WATER ALTERNATIVE W-1, WELLS					
Item	Description	Unit Size	Estimated Quantity	Unit Price	Total Price
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	302	$2,020	$610,410
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	13,658	$74	$1,006,558
6	Seed, mulch and fertilizer	SY	17,420	$0.69	$12,020
7	Clear, grub and reforestation	AC	0	$7,330	$0
8	Silt Fence	LF	12,292	$4.38	$53,838
9	Stabilized Construction Entrance	EA	6	$1,090	$6,540
10	Furnish and Install 400,000 gallon elevated water storage tank, complete in place	LS	1	$1,233,410	$1,233,410
11	Furnish and Install 150 gpm production well, including well house, testing, chlorination, complete in place	EA	3	$243,070	$729,210
12	Land Acquisition	AC	4	$10,000	$40,000
13	Furnish and Install 12" DIP water main and associated appurtenances, including excavation, pipe bedding and backfill	LF	9,171	$66	$606,203
14	Furnish and Install 8" DIP water main and associated appurtenances, including excavation, pipe bedding and backfill	LF	8,960	$41	$367,360
15	Furnish and Install fire hydrant and 6" fire hydrant lead, complete in place	EA	60	$5,000	$302,183
16	1" 'K' Copper WHC (15' length)	EA	68	$220	$14,960
17	Perpetual Easement	SF	47,723	$2	$95,445
18	Temporary Easement	SF	95,445	$0.4	$38,178
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$5,168,815**
CONTINGENCY (20%)					**$1,033,763**
SUBTOTAL					**$6,202,578**
ENGINEERING & ADMINISTRATION (25%+/-)					**$1,550,645**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$7,753,223**
Hughesville Village Build-out (Phased Expansion)					
18	Mobilization	LS	1	$2,500	$2,500
19	Maintenance of traffic.	DAYS	188	$2,020	$379,760
20	Survey and Field Engineering	LS	1	$50,000	$50,000
21	Restore Wetland and Mitigation	SF	0	$2	$0
22	Bituminous Concrete Pavement Restoration	SY	4,553	$74	$335,519
23	Seed, mulch and fertilizer	SY	4,355	$1	$3,005
24	Clear, grub and reforestation	AC	0	$7,330	$0
25	Silt Fence	LF	4,097	$4	$17,946
26	Stabilized Construction Entrance	EA	2	$1,090	$2,180
27	Furnish and Install 150 gpm production well, including well house, testing, chlorination, complete in place	EA	1	$243,070	$243,070
28	Land Acquisition	AC	1	$10,000	$10,000
29	Furnish and Install 12" DIP water main and associated appurtenances, including excavation, pipe bedding and backfill	LF	8,217	$66	$543,144
30	Furnish and Install 8" DIP water main and associated appurtenances, including excavation, pipe bedding and backfill	LF	3,063	$41	$125,583
31	Furnish and Install fire hydrant and 6" fire hydrant lead, complete in place	EA	38	$5,000	$188,000
32	1" 'K' Copper WHC (15' length)	EA	161	$220	$35,420
33	Perpetual Easement	SF	15,908	$2	$31,815
34	Temporary Easement	SF	31,815	$0.4	$12,726
SUBTOTAL COST FOR HUGHESVILLE VILLAGE PHASED EXPANSION					**$1,980,668**
CONTINGENCY (20%)					**$396,134**
SUBTOTAL					**$2,376,801**
ENGINEERING & ADMINISTRATION (25%+/-)					**$594,200**
TOTAL COST FOR HUGHESVILLE VILLAGE PHASED EXPANSION					**$2,971,002**
TOTAL PROJECT COST					**$10,724,225**

Water Alternative W-2 Interconnection



KCI TECHNOLOGIES

Figure 4

App D

Sewer Collection Alternative S1
Old Leonardtown Road Collection System

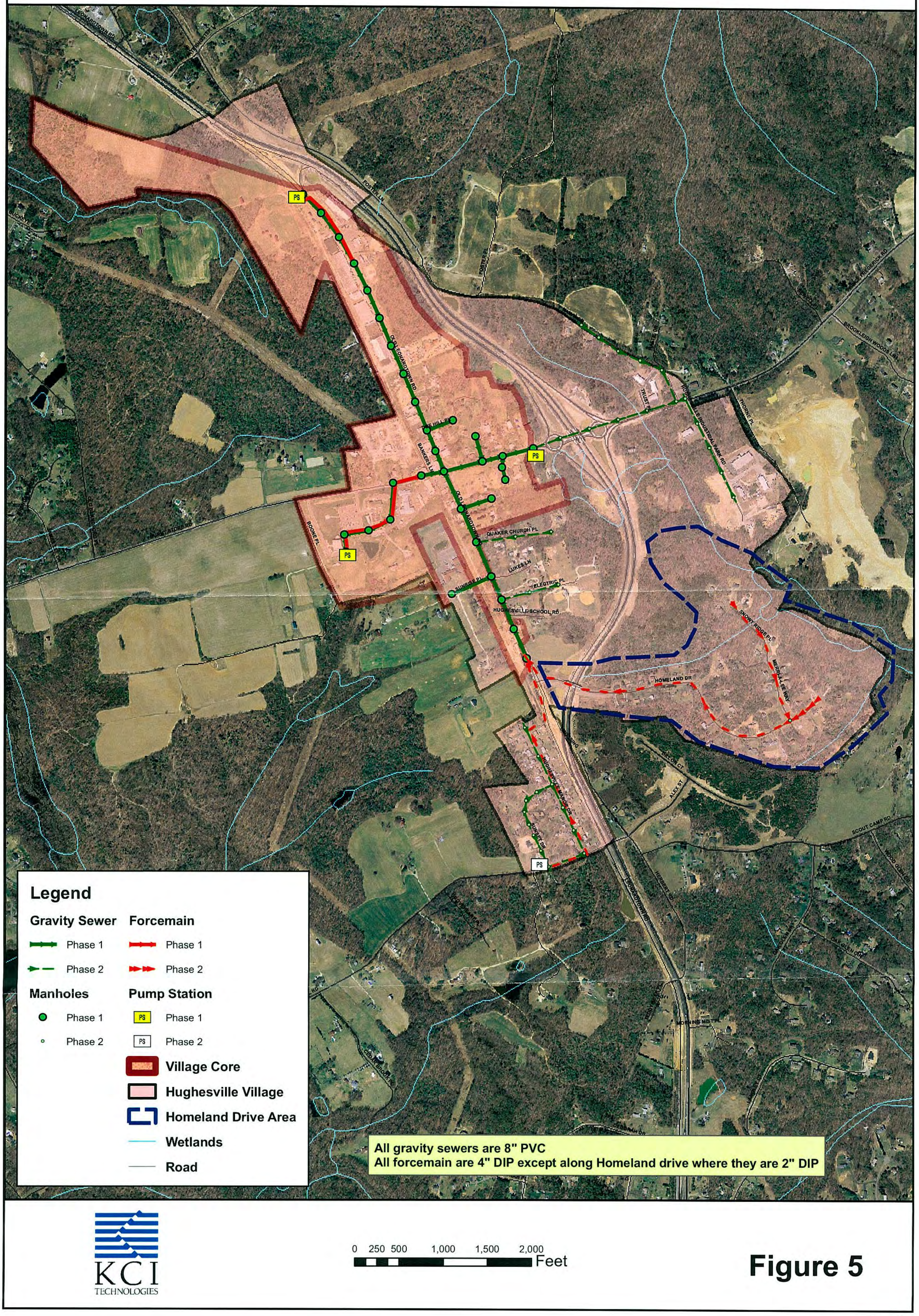
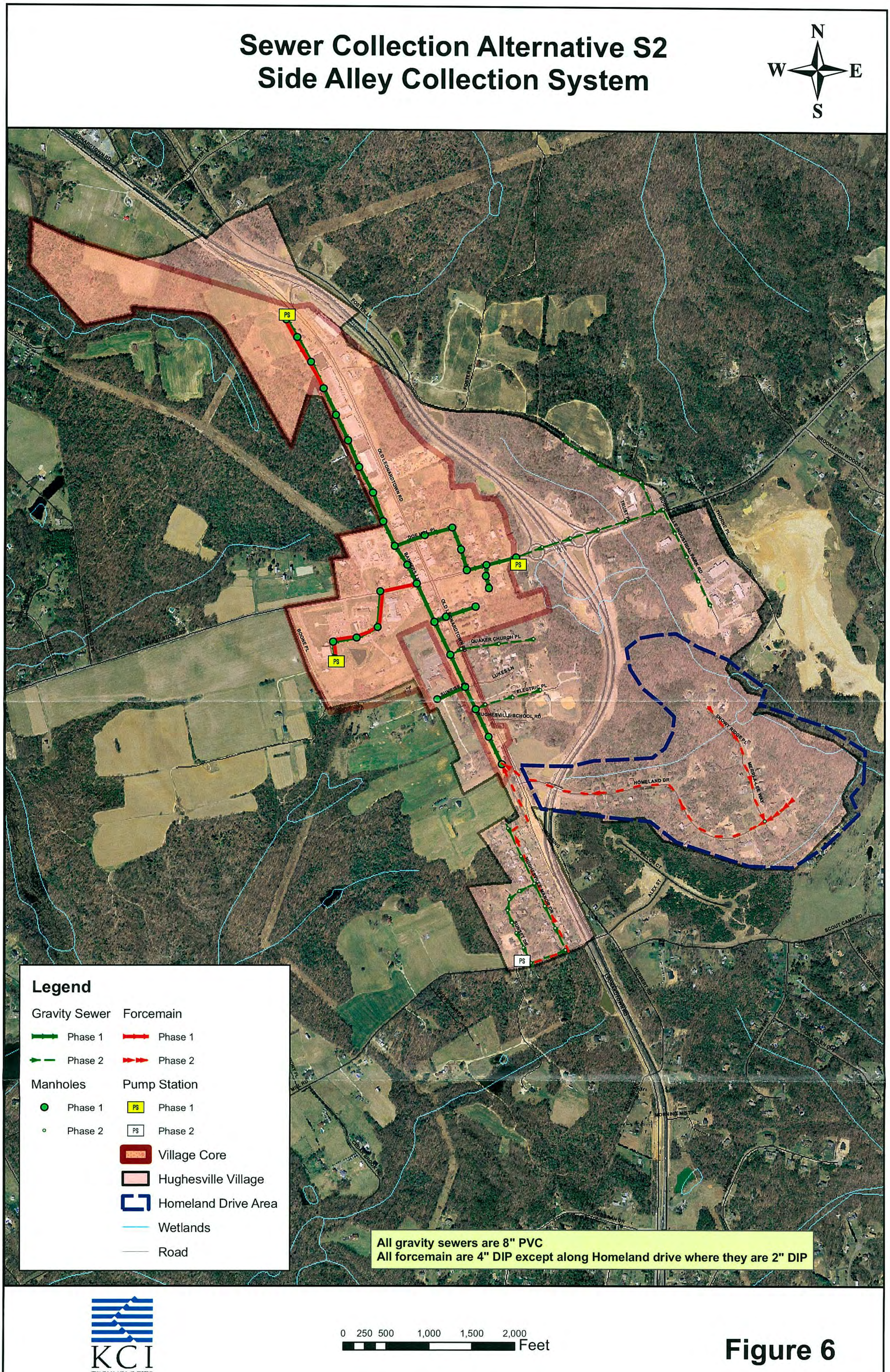


Figure 5

ENGINEERS ESTIMATE OF PROBABLE COST
SEWER COLLECTION ALTERNATIVE S-1, OLD LEONARDTOWN ROAD

Item	Description	Unit	Estimated Quantity	Unit Price	Total Price
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	26	$800	$21,048
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	7,103	$65	$461,717
6	Seed, mulch and fertilizer	SY	41,183	$0.69	$28,417
7	Clear, grub and reforestation	AC	0	$7,330	$0
8	Silt Fence	LF	7,561	$4.38	$33,117
9	Stabilized Construction Entrance	EA	4	$1,090	$4,360
10	Furnish and Install complete package pump station , approx. 140 gpm	LS	1	$291,000	$291,000
11	Furnish and Install complete package pump station , approx. 100 gpm	LS	1	$291,000	$291,000
12	Furnish and install 8" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	7,561	$35	$266,147
13	Furnish and install 10" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	2,512	$41	$102,992
13	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	2,597	$25	$64,925
14	Furnish and install sanitary sewer manhole including frame and cover, coomplete in place (average depth)	EA	34	$3,000	$102,000
15	Furnish and Install complete package pump station , approx. 460gpm	LS	1	$500,000	$500,000
16	Land Acquisition (PS site)	AC	2	$10,000	$20,000
17	6" SHC (15' Length)	EA	68	$450	$30,600
18	Perpetual Easement	SF	74,130	$2	$148,260
19	Temporary Easement	SF	148,260	$0.4	$59,304
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$2,477,387**
CONTINGENCY (20%)					**$495,477**
SUBTOTAL					**$2,972,864**
ENGINEERING & ADMINISTRATION (25%+/-)					**$743,216**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$3,716,080**
Hughesville Village (Phased Expansion)					
19	Mobilization	LS	1	$2,500	$2,500
20	Maintenance of traffic.	DAYS	107	$800	$85,552
21	Survey and Field Engineering	LS	1	$50,000	$50,000
22	Restore Wetland and Mitigation	SF	0	$2.40	$0
23	Bituminous Concrete Pavement Restoration	SY	4,387	$65	$285,133
24	Seed, mulch and fertilizer	SY	50,775	$0.69	$35,035
25	Clear, grub and reforestation	AC	0	$7,330	$0
26	Silt Fence	LF	7,616	$4.38	$33,358
27	Stabilized Construction Entrance	EA	2	$1,090	$2,180
28	Furnish and Install complete package pump station , approx. 100 gpm	LS	1	$291,000	$291,000
29	Upgrade pump station from 460 gpm to 600gpm	LS	1	$10,000	$10,000
30	Land Acquisition (PS site)	AC	1	$10,000	$10,000
31	Furnish and install 8" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	7,616	$41	$312,256
32	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	3,078	$25	$76,950
33	Furnish and install sanitary sewer manhole including frame and cover, coomplete in place (average depth)	EA	34	$3,000	$102,000
34	Upgrade 460 gpm pump station	LS	1	$50,000	$50,000
35	6" SHC (15' Length)	EA	161	$450	$72,450
36	Perpetual Easement	SF	91,395	$2	$182,790
37	Temporary Easement	SF	182,790	$0.4	$73,116
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$1,671,820**
CONTINGENCY (20%)					**$334,364**
SUBTOTAL					**$2,006,184**
ENGINEERING & ADMINISTRATION (25%+/-)					**$501,546**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$2,507,730**
TOTAL PROJECT COST					**$6,223,810**

Sewer Collection Alternative S2
Side Alley Collection System



KCI TECHNOLOGIES

Figure 6

ENGINEERS ESTIMATE OF PROBABLE COST
SEWER COLLECTION ALTERNATIVE S-2, ST. MARY'S COUNTY EASEMENT

Item	Description	Unit	Estimated Quantity	Unit Price	Total Price
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	26	$800	$21,048
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	2,593	$65	$168,531
6	Seed, mulch and fertilizer	SY	79,000	$0.69	$54,510
7	Clear, grub and reforestation	AC	0	$7,330	$0
8	Silt Fence	LF	7,561	$4.38	$33,117
9	Stabilized Construction Entrance	EA	4	$1,090	$4,360
10	Furnish and Install complete package pump station , approx. 140 gpm	LS	1	$291,000	$291,000
11	Furnish and Install complete package pump station , approx. 100 gpm	LS	1	$291,000	$291,000
12	Furnish and install 8" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	7,561	$35	$266,147
13	Furnish and install 10" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	2,512	$41	$102,992
14	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	2,597	$25	$64,925
15	Furnish and install sanitary sewer manhole including frame and cover, coomplete in place (average depth)	EA	34	$3,000	$102,000
16	Furnish and Install complete package pump station , approx. 460gpm	LS	1	$500,000	$500,000
17	Land Acquisition	AC	2	$10,000	$20,000
18	6" SHC (15' Length)	EA	68	$450	$30,600
19	Perpetual Easement	SF	142,200	$2	$284,400
20	Temporary Easement	SF	284,400	$0.4	$113,760
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$2,400,890**
CONTINGENCY (20%)					**$480,178**
SUBTOTAL					**$2,881,068**
ENGINEERING & ADMINISTRATION (25%+/-)					**$720,267**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$3,601,335**
Hughesville Village (Phased Expansion)					
19	Mobilization	LS	1	$2,500	$2,500
20	Maintenance of traffic.	DAYS	125	$800	$99,864
21	Survey and Field Engineering	LS	1	$50,000	$50,000
22	Restore Wetland and Mitigation	SF	0	$2.40	$0
23	Bituminous Concrete Pavement Restoration	SY	5,369	$65	$349,014
24	Seed, mulch and fertilizer	SY	71,433	$0.69	$49,289
25	Clear, grub and reforestation	AC	0	$7,330	$0
26	Silt Fence	LF	9,405	$4.38	$41,194
27	Stabilized Construction Entrance	EA	2	$1,090	$2,180
28	Furnish and Install complete package pump station , approx. 100 gpm	LS	1	$291,000	$291,000
29	Upgrade pump station from 460 gpm to 600gpm	LS	1	$10,000	$10,000
30	Furnish and install 8" sanitary sewer, and associated appurtenances, including excavation, pipe bedding and backfill	LF	9,405	$41	$385,605
31	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	3,078	$25	$76,950
32	Furnish and install sanitary sewer manhole including frame and cover, coomplete in place (average depth)	EA	37	$3,000	$111,000
33	Land Acquisition	AC	1	$10,000	$10,000
34	Upgrade 460 gpm pump station	LS	1	$50,000	$50,000
35	6" SHC (15' Length)	EA	161	$450	$72,450
36	Perpetual Easement	SF	128,580	$2	$257,160
37	Temporary Easement	SF	257,160	$0.4	$102,864
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$1,961,070**
CONTINGENCY (20%)					**$392,214**
SUBTOTAL					**$2,353,284**
ENGINEERING & ADMINISTRATION (25%+/-)					**$588,321**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$2,941,605**
TOTAL PROJECT COST					**$6,542,940**

Sewer Collection Alternative S3
Grinder Pump Collection System

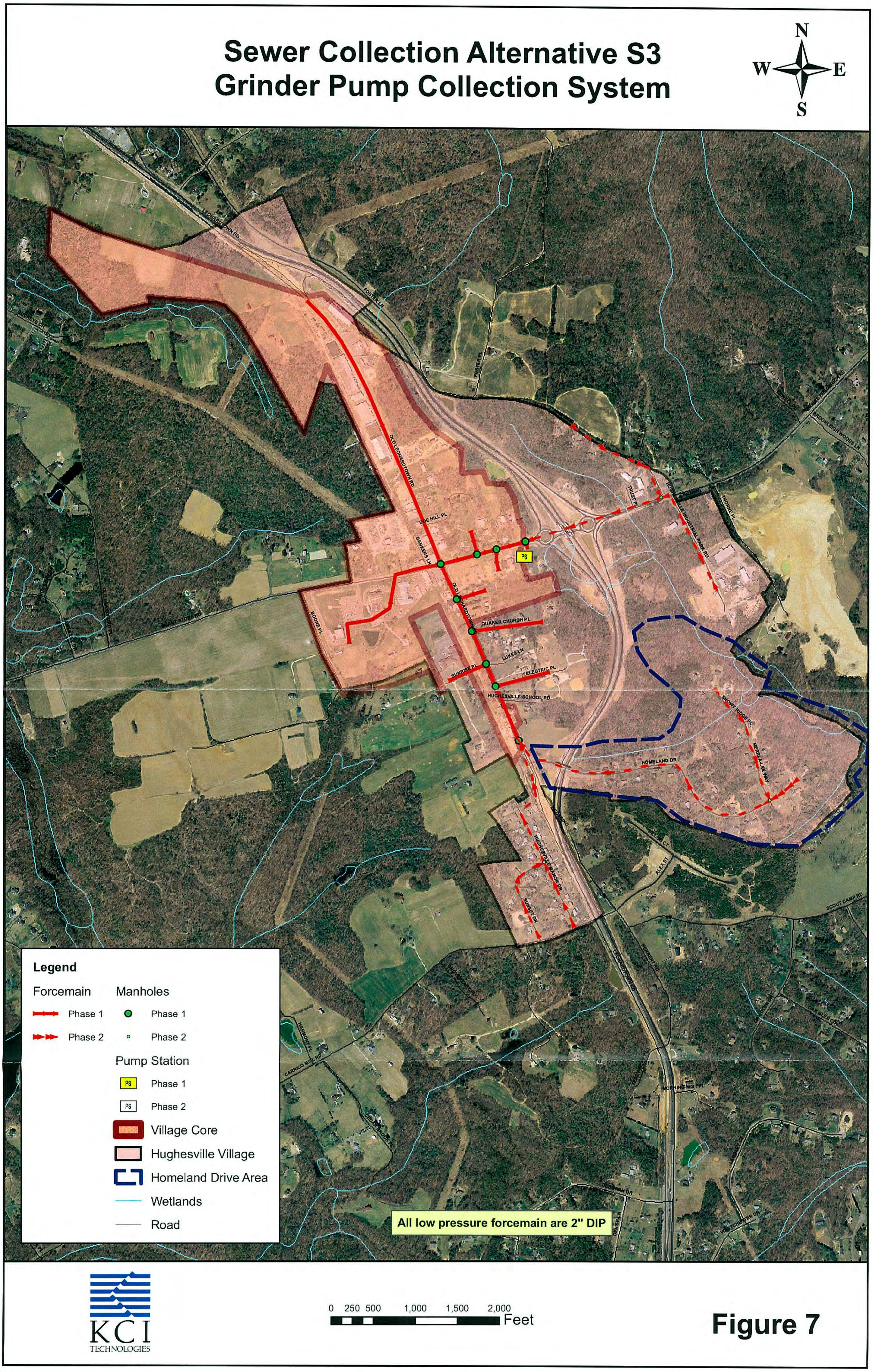


Figure 7

ENGINEERS ESTIMATE OF PROBABLE COST
SEWER COLLECTION ALTERNATIVE S-3, GRINDER PUMP COLLECTION SYSTEM

Item	Description	Unit	Estimated Quantity	Unit Price	Total Price
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	133	$800	$106,376
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	7,103	$65	$461,717
6	Seed, mulch and fertilizer	SY	41,183	$0.69	$28,417
7	Clear, grub and reforestation	AC	0	$7,330	$0
8	Silt Fence	LF	13,297	$4.38	$58,241
9	Stabilized Construction Entrance	EA	4	$1,090	$4,360
10	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	13,297	$25	$332,425
11	Sanitary sewer manhole including frame and cover, coomplete in place (average depth) with Air Vac or Air Release Valve	EA	4	$5,000	$20,000
12	Furnish and Install complete package pump station , approx. 460gpm	LS	1	$500,000	$500,000
13	Land Acquisition (PS site)	AC	1	$10,000	$10,000
14	Grinder Pump & low pressure service connection	EA	68	$10,000	$680,000
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$2,254,035**
CONTINGENCY (20%)					**$450,807**
SUBTOTAL					**$2,704,842**
ENGINEERING & ADMINISTRATION (25%+/-)					**$676,211**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$3,381,053**
Hughesville Village (Phased Expansion)					
17	Mobilization	LS	1	$2,500	$2,500
18	Maintenance of traffic.	DAYS	65	$800	$51,624
19	Survey and Field Engineering	LS	1	$50,000	$50,000
20	Restore Wetland and Mitigation	SF	0	$2.40	$0
21	Bituminous Concrete Pavement Restoration	SY	4,387	$65	$285,133
22	Seed, mulch and fertilizer	SY	50,775	$0.69	$35,035
23	Clear, grub and reforestation	AC	0	$7,330	$0
24	Silt Fence	LF	6,453	$4.38	$28,264
25	Stabilized Construction Entrance	EA	2	$1,090	$2,180
26	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	6,453	$25	$161,325
27	Sanitary sewer manhole including frame and cover, coomplete in place (average depth) with Air Vac or Air Release Valve	EA	2	$5,000	$10,000
28	Upgrade 460 gpm pump station	LS	1	$50,000	$50,000
29	Grinder Pump & low pressure service connection	EA	161	$10,000	$1,610,000
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$2,286,061**
CONTINGENCY (20%)					**$457,212**
SUBTOTAL					**$2,743,273**
ENGINEERING & ADMINISTRATION (25%+/-)					**$685,818**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$3,429,092**
TOTAL PROJECT COST					**$6,810,144**

ENGINEERS ESTIMATE OF PROBABLE COST HOMELAND DRIVE GRINDER PUMP SERVICE AREA					
Item	**Description**	**Unit**	**Estimated Quantity**	**Unit Price**	**Total Price**
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	54	$800	$43,480
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	3,019	$65	$196,264
6	Seed, mulch and fertilizer	SY	3,019	$0.69	$2,083
7	Clear, grub and reforestation	AC	0	$7,330	$0
8	Silt Fence	LF	5,435	$4.38	$23,805
9	Stabilized Construction Entrance	EA	2	$1,090	$2,180
10	Furnish and install 4" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	5,435	$25	$135,875
11	Transition Manhole (20' depth) including frame and cover complete in place	EA	1	$5,640	$5,640
12	Sanitary sewer manhole including frame and cover, complete in place (average depth) with Air Vac or Air Release Valve	EA	2	$5,000	$10,000
13	4" Jack and Bore	LF	50	$220	$11,000
14	Jack and Bore Pits	EA	2	$9,000	$18,000
15	Grinder Pump & low pressure service connection	EA	54	$10,000	$540,000
SUBTOTAL COST FOR HOMELAND DRIVE BUILDOUT					**$1,040,828**
CONTINGENCY (20%)					**$208,166**
SUBTOTAL					**$1,248,993**
ENGINEERING & ADMINISTRATION (25%+/-)					**$312,248**
TOTAL COST FOR HOMELAND DRIVE BUILDOUT					**$1,561,241**

Wastewater Disposal System Alternatives

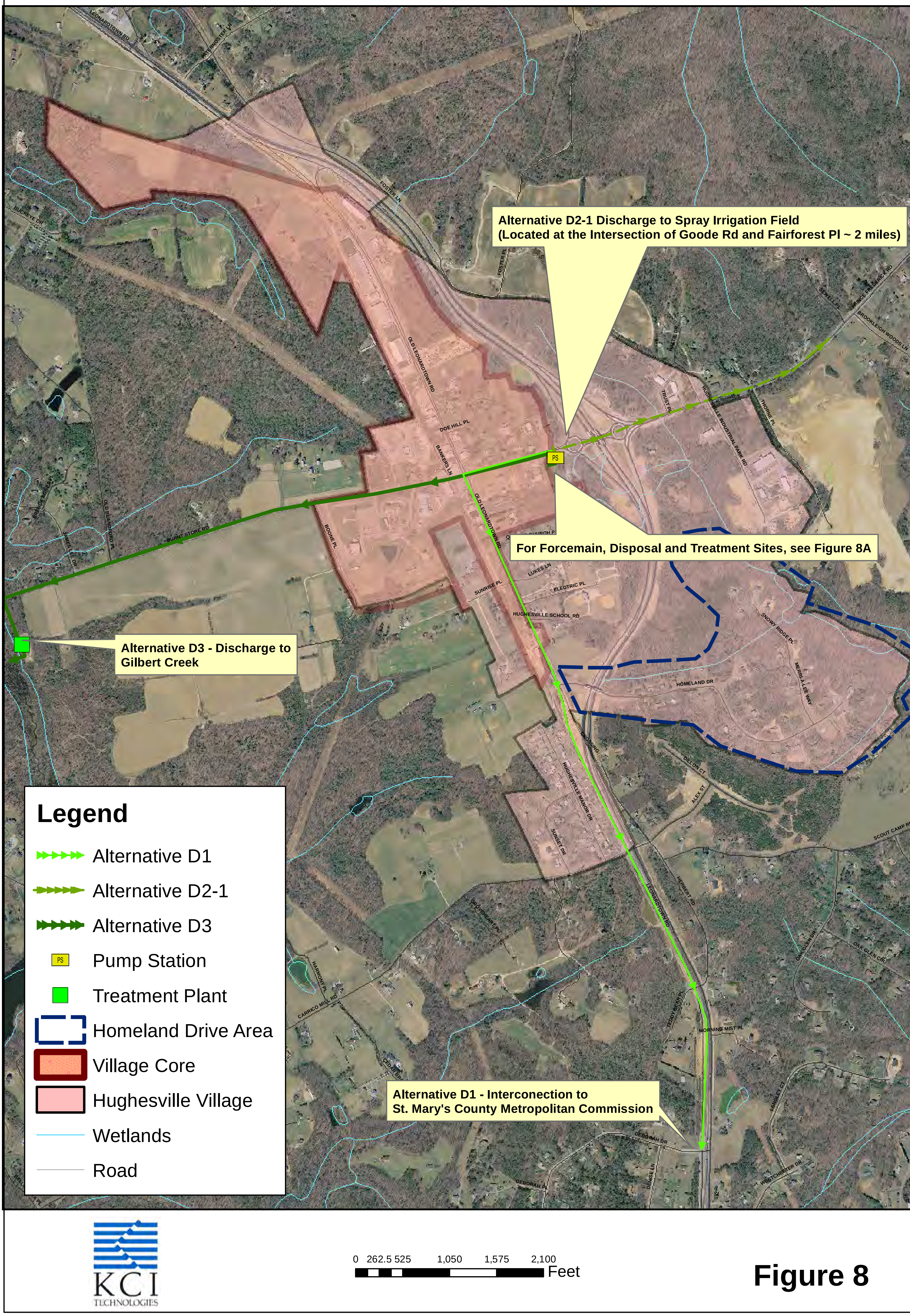


Figure 8

ENGINEERS ESTIMATE OF PROBABLE COST WASTEWATER DISPOSAL ALTERNATIVE D-2: GROUNDWATER DISCHARGE					
Item	**Description**	**Unit**	**Estimated Quantity**	**Unit Price**	**Total Price**
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	106	$800	$84,480
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	0	$2.40	$0
5	Bituminous Concrete Pavement Restoration	SY	5,867	$65	$381,333
6	Seed, mulch and fertilizer	SY	5,867	$0.69	$4,048
7	Clear, grub and reforestation	AC		$7,330	$0
8	Silt Fence	LF	10,560	$4.38	$46,253
9	Stabilized Construction Entrance	EA	2	$1,090	$2,180
10	Furnish and install 6" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	10,560	$41	$432,960
11	Perpetual Easement	SF	3,000	$2	$6,000
12	Temporary Easement	SF	6,000	$0.4	$2,400
15	Storage Lagoons	LS	1	$226,443	$226,443
16	Irrigation	LS	1	$479,693	$479,693
18	Land Acquisition	AC	33	$10,000	$330,000
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$2,048,290**
CONTINGENCY (20%)					**$409,658**
SUBTOTAL					**$2,457,948**
ENGINEERING & ADMINISTRATION (25%+/-)					**$614,487**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$3,072,435**
Hughesville Village Buildout (Phased Expansion)					
20	Mobilization	LS	1	$2,500	$2,500
21	Maintenance of traffic.	DAYS	20	$800	$16,000
22	Survey and Field Engineering	LS	1	$50,000	$50,000
23	Restore Wetland and Mitigation	SF	0	$2.40	$0
24	Bituminous Concrete Pavement Restoration	SY	0	$65	$0
25	Seed, mulch and fertilizer	SY	0	$0.69	$0
26	Clear, grub and reforestation	AC	0	$7,330	$0
27	Silt Fence	LF	0	$4.38	$0
28	Stabilized Construction Entrance	EA	1	$1,090	$1,090
31	Storage Lagoons	LS	1	$226,443	$226,443
32	Irrigation	LS	1	$479,693	$479,693
34	Land Acquisition	AC	19	$10,000	$190,000
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$965,726**
CONTINGENCY (20%)					**$193,145**
SUBTOTAL					**$1,158,871**
ENGINEERING & ADMINISTRATION (25%+/-)					**$289,718**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$1,448,589**
TOTAL PROJECT COST					**$4,521,023**

ENGINEERS ESTIMATE OF PROBABLE COST WASTEWATER DISPOSAL ALTERNATIVE D-3: SURFACEWATER DISCHARGE					
Item	**Description**	**Unit**	**Estimated Quantity**	**Unit Price**	**Total Price**
Village Core					
1	Mobilization	LS	1	$2,500	$2,500
2	Maintenance of traffic.	DAYS	69	$800	$54,912
3	Survey and Field Engineering	LS	1	$50,000	$50,000
4	Restore Wetland and Mitigation	SF	10,000	$2.40	$24,000
5	Bituminous Concrete Pavement Restoration	SY	3,813	$65	$247,867
6	Seed, mulch and fertilizer	SY	3,813	$0.69	$2,631
7	Clear, grub and reforestation	AC	0.2	$7,330	$1,683
8	Silt Fence	LF	6,864	$4.38	$30,064
9	Stabilized Construction Entrance	EA	2	$1,090	$2,180
10	Furnish and install 6" force main, and associated appurtenances, including excavation, pipe bedding and backfill	LF	6,864	$41	$281,424
11	Land Acquisition (outfall site)	AC	1	$10,000	$10,000
12	Perpetual Easement	SF	30,000	$2	$60,000
13	Temporary Easement	SF	60,000	$0.4	$24,000
14	Outfall Structure	LS	1	$100,000	$100,000
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$891,261**
CONTINGENCY (20%)					**$178,252**
SUBTOTAL					**$1,069,513**
ENGINEERING & ADMINISTRATION (25%+/-)					**$267,378**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$1,336,891**
Hughesville Village Buildout (Phased Expansion)					
15	Mobilization	LS	1	$2,500	$2,500
16	Maintenance of traffic.	DAYS	0	$800	$0
17	Survey and Field Engineering	LS	1	$50,000	$50,000
18	Restore Wetland and Mitigation	SF	0	$2.40	$0
19	Bituminous Concrete Pavement Restoration	SY	0	$65	$0
20	Seed, mulch and fertilizer	SY	0	$0.69	$0
21	Clear, grub and reforestation	AC	0.0	$7,330	$0
22	Silt Fence	LF	0	$4.38	$0
23	Stabilized Construction Entrance	EA	0	$1,090	$0
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$52,500**
CONTINGENCY (20%)					**$10,500**
SUBTOTAL					**$63,000**
ENGINEERING & ADMINISTRATION (25%+/-)					**$15,750**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$78,750**
TOTAL PROJECT COST					**$1,415,641**

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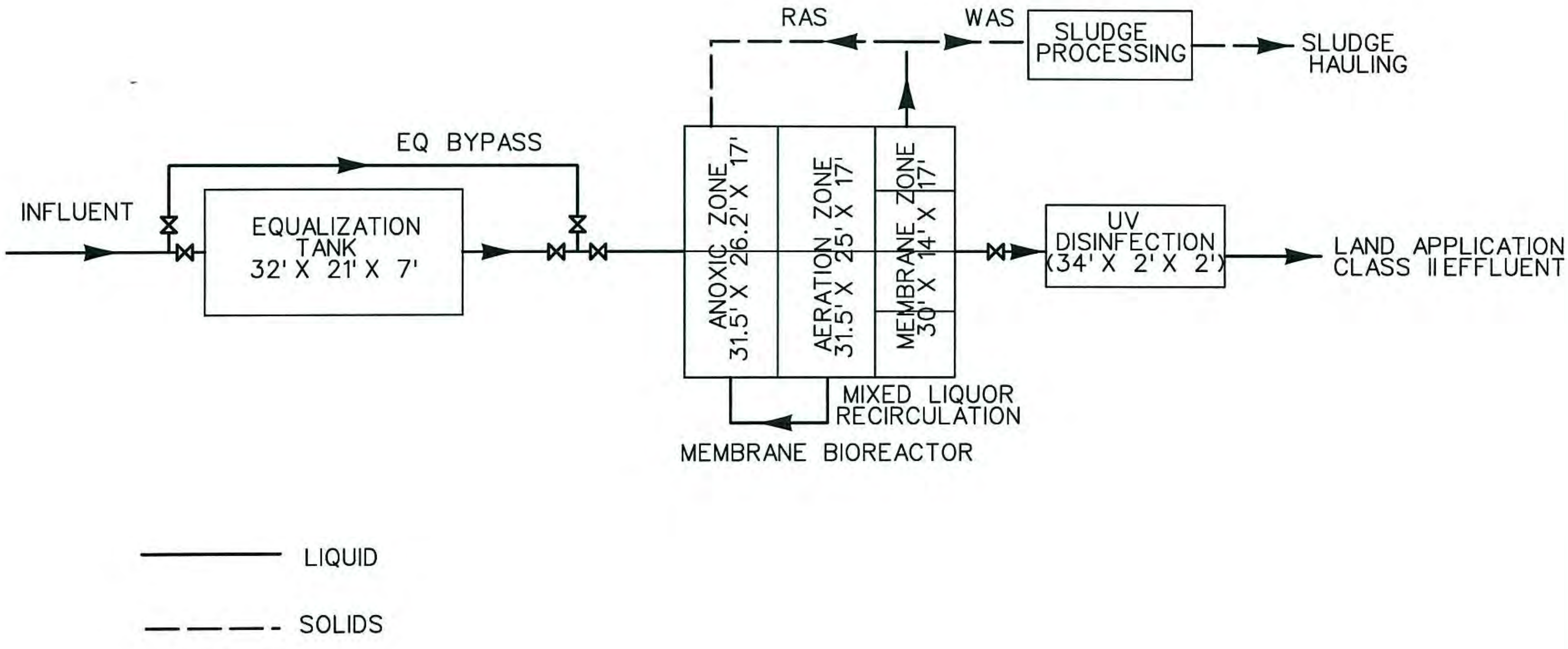
ALTERNATIVE D2 & T1
DISPOSAL & TREATMENT SITES

FIGURE 8A

PLOTTED: "04:25 PM on Monday, November 01, 2010" BY: Chander Kanta Division: P042 W-WW-Solid Waste GMA Emp FILE: M:\2008\01083704\drawings\location map-2.dgn



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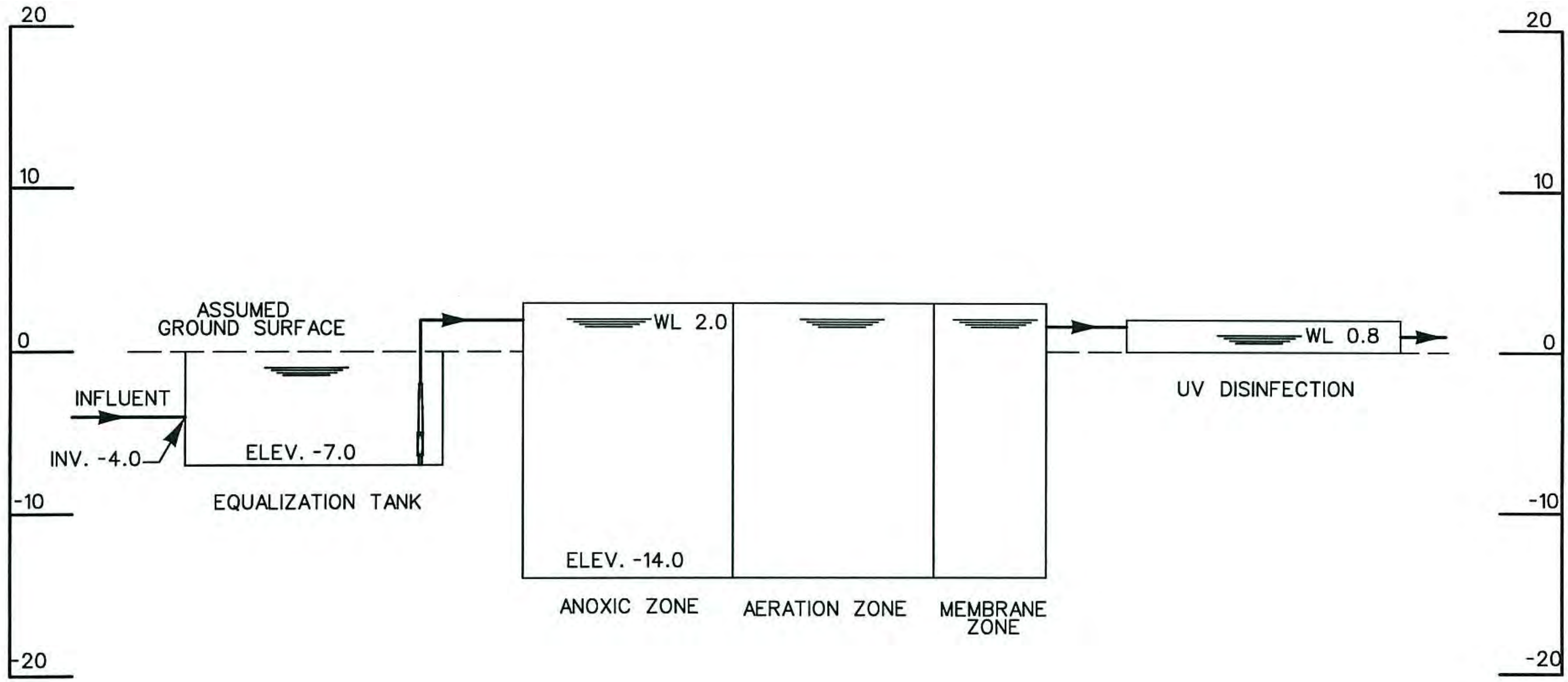
TREATMENT SYSTEM ALTERNATIVE T-1 MEMBRANE BIOREACTOR FLOW DIAGRAM (PHASE I)

FIGURE 9

PLOTTED: "01:06 PM on Monday, November 30, 2009" BY: Chander Kanta Division: 0102 Environmental Engineering FILE: M:\2008\01083704\drawings\Figures by GW\Figure 1 MBR



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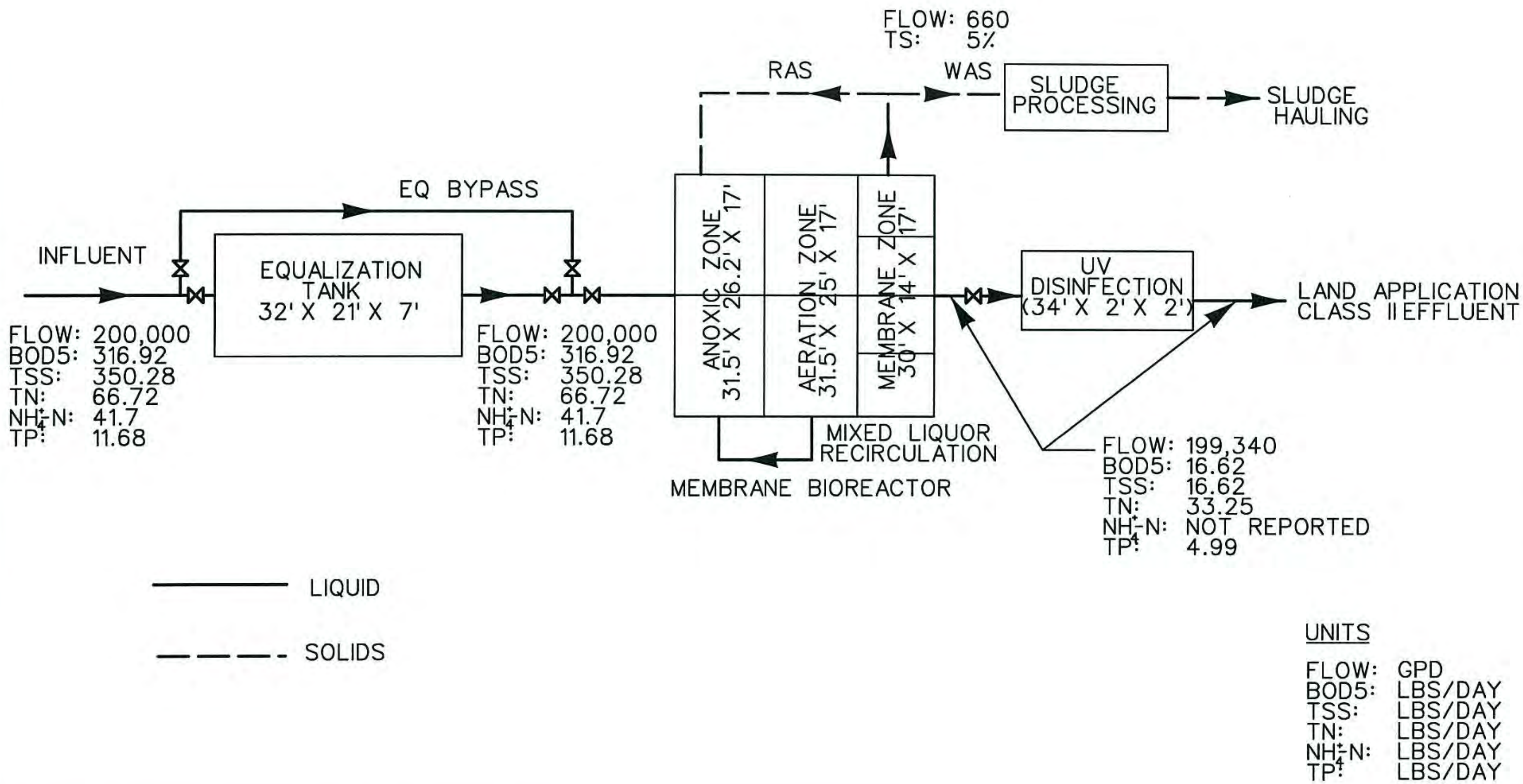
PLOTTED: "01:07 PM on Monday, November 30, 2009" BY: Chander Kanta Division: 0102 Environmental Engineering FILE: M:\2008\01083704\drawings\Figures by GW\Figure 2 MBF



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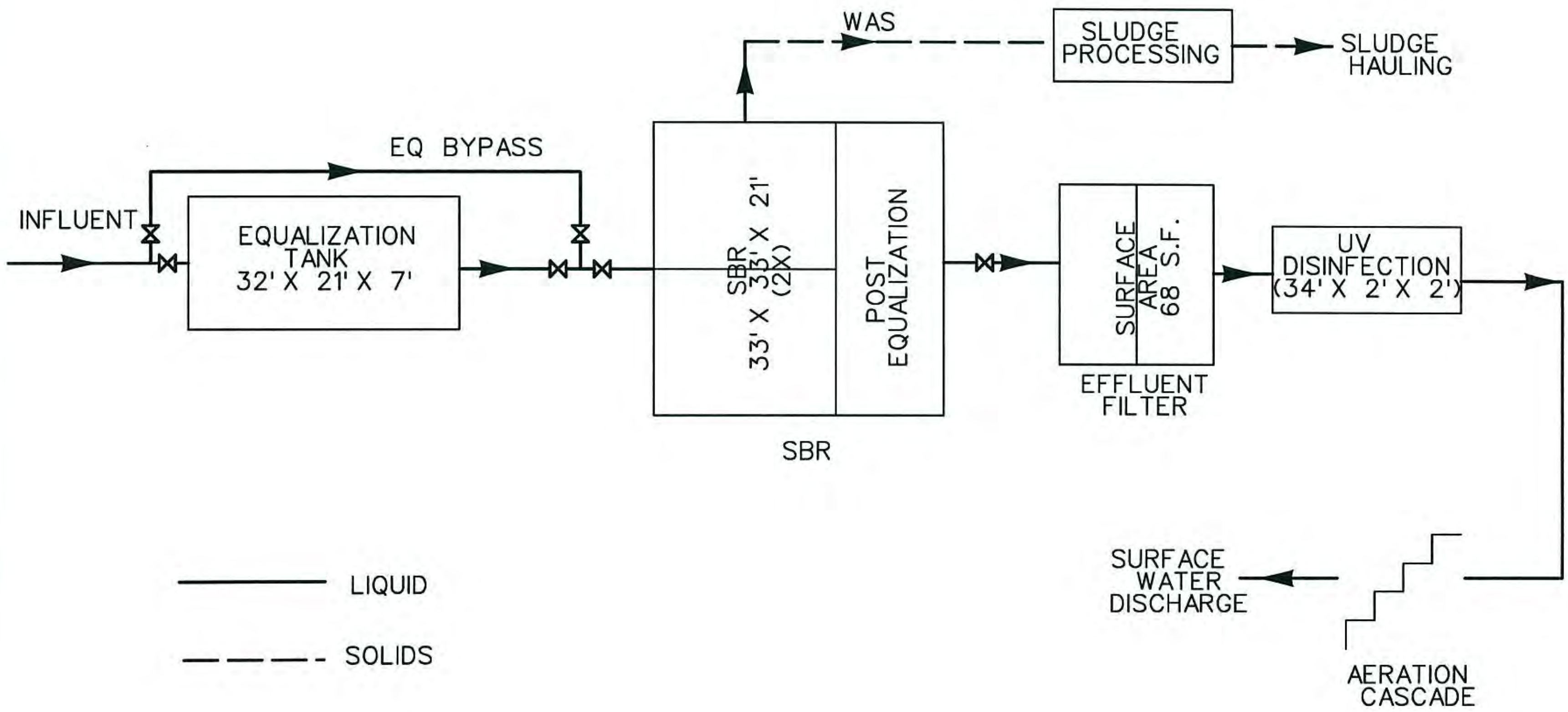
TREATMENT SYSTEM ALTERNATIVE T-1 MEMBRANE BIOREACTOR MASS BALANCE (PHASE I)

FIGURE 11

ENGINEERS ESTIMATE OF PROBABLE COST TREATMENT SYSTEM ALTERNATIVE T-1: MBR TREATMENT (FOR GROUNDWATER DISPOSAL)					
Item	**Description**	**Unit**	**Estimated Quantity**	**Unit Price**	**Total Price**
Village Core					
1	Equalization Tank	EA	1	$100,000	$100,000
2	EQ Tank Transfer Pump	EA	2	$15,000	$30,000
3	Membrane Bioreactor	EA	2	$800,000	$1,600,000
4	UV Disinfection	LS	1	$200,000	$200,000
5	Digester	EA	2	$300,000	$600,000
6	Sludge Dewatering system	EA	1	$250,000	$250,000
7	Building	EA	1	$200,000	$200,000
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$2,980,000**
CONTINGENCY (20%)					**$596,000**
SUBTOTAL					**$3,576,000**
ENGINEERING & ADMINISTRATION (25%+/-)					**$894,000**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$4,470,000**
Hughesville Village Buildout (Phased Expansion)					
1	Equalization Tank	EA	1	$100,000	$100,000
2	EQ Tank Transfer Pump	EA	2	$15,000	$30,000
3	Membrane Bioreactor	EA	2	$800,000	$1,600,000
4	UV Disinfection	LS	1	$200,000	$200,000
5	Digester	EA	2	$300,000	$600,000
6	Sludge Dewatering system	EA	1	$250,000	$250,000
7	Building	EA	1	$200,000	$200,000
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$2,980,000**
CONTINGENCY (20%)					**$596,000**
SUBTOTAL					**$3,576,000**
ENGINEERING & ADMINISTRATION (25%+/-)					**$894,000**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$4,470,000**
TOTAL PROJECT COST					**$8,940,000**



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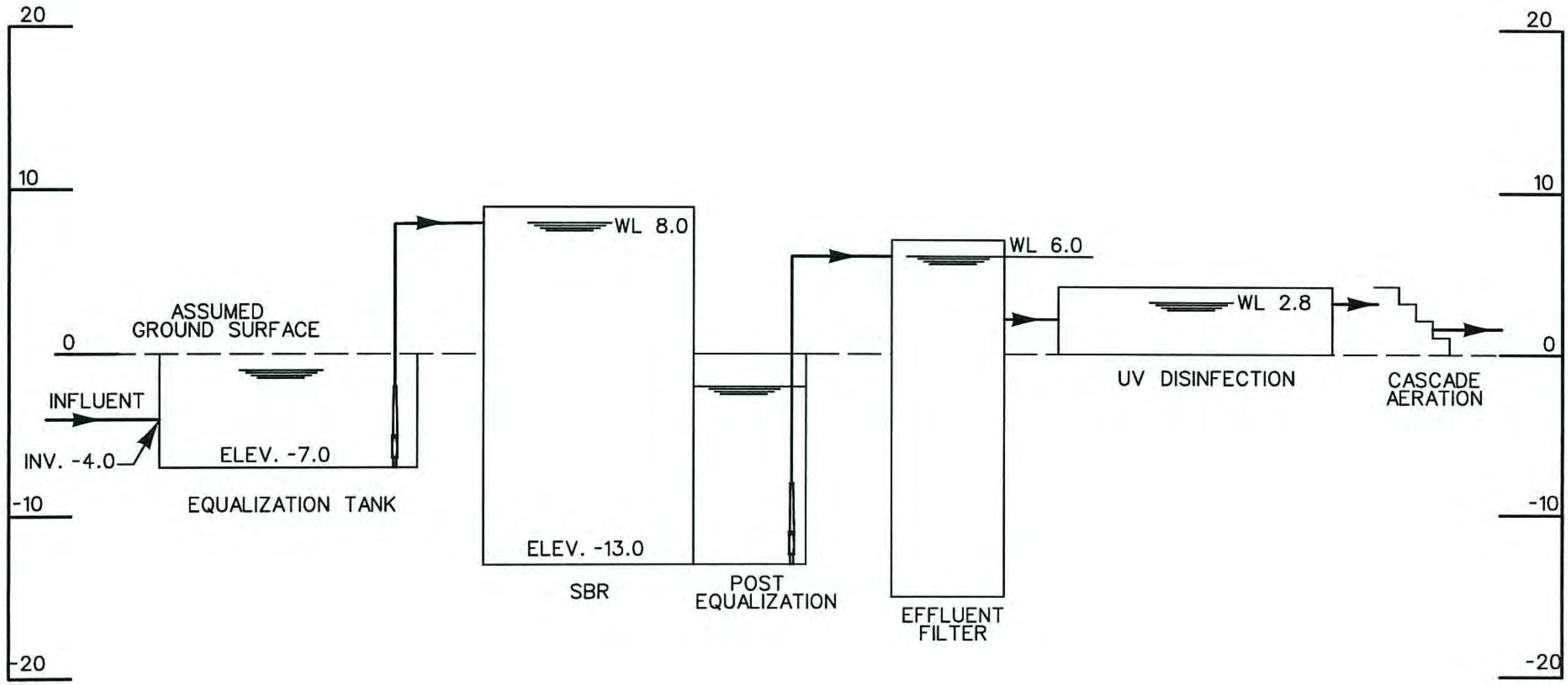
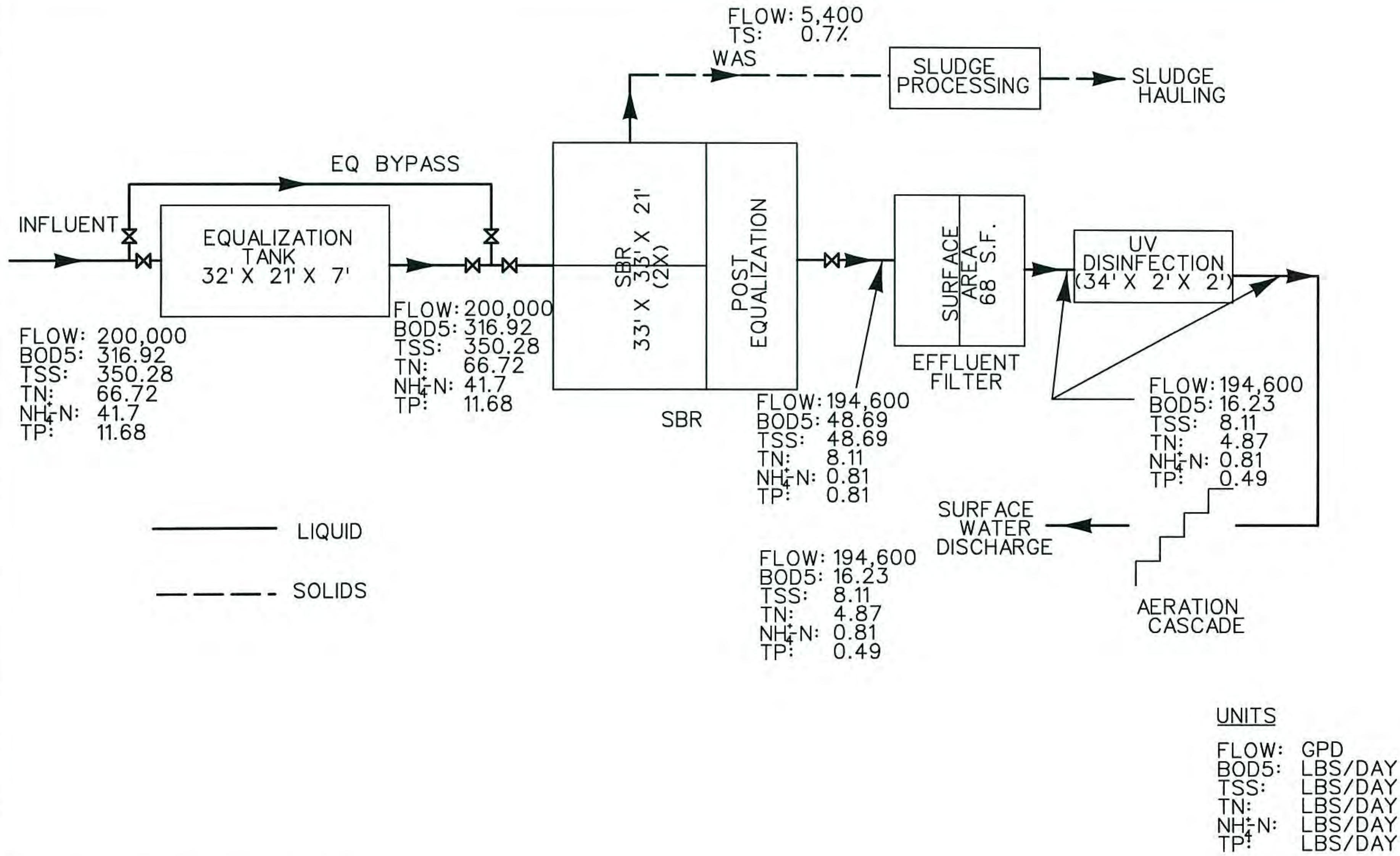
TREATMENT SYSTEM ALTERNATIVE T-2
SBR AND EFFLUENT FILTER
FLOW DIAGRAM (PHASE I)

FIGURE 12



KCI TECHNOLOGIES Engineers Planners Scientists Construction Managers 10 North Park Drive Hunt Valley, MD 21030 Phone: (410) 316-7800 Fax: (410) 316-7817 www.kci.com	DATE NOV 2009 SCALE NOT TO SCALE DESIGNED BY DRAWN BY	**TREATMENT SYSTEM ALTERNATIVE T-2 SBR AND EFFLUENT FILTER HYDRAULIC PROFILE**	FIGURE 13

PLOTTED: "01:10 PM on Monday, November 30, 2009" BY: Chander Kanta Division: 0102 Environmental Engineering FILE: M:\2008\01083704\drawings\Figures by GW\Figure 5 SBR



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TREATMENT SYSTEM ALTERNATIVE T-2 SBR AND EFFLUENT FILTER MASS BALANCE (PHASE I)

FIGURE 14

ENGINEERS ESTIMATE OF PROBABLE COST TREATMENT SYSTEM ALTERNATIVE T-2: SBR TREATMENT (FOR SURFACEWATER DISPOSAL)					
Item	**Description**	**Unit**	**Estimated Quantity**	**Unit Price**	**Total Price**
Village Core					
1	Equalization Tank	EA	1	$100,000	$100,000
2	EQ Tank Transfer Pump	EA	2	$15,000	$30,000
3	SBR	EA	2	$600,000	$1,200,000
4	Effluent Filter	EA	2	$380,000	$760,000
5	UV Disinfection	LS	1	$200,000	$200,000
6	Digester	EA	2	$300,000	$600,000
7	Sludge Dewatering System	EA	1	$250,000	$250,000
8	Building	LS	1	$200,000.0	$200,000
9	Chemical Facility	LS	1	$10,000.0	$10,000
10	Reaeration Cascade	LS	1	$20,000.0	$20,000
SUBTOTAL COST FOR VILLAGE CORE BUILDOUT					**$3,370,000**
CONTINGENCY (20%)					**$674,000**
SUBTOTAL					**$4,044,000**
ENGINEERING & ADMINISTRATION (25%+/-)					**$1,011,000**
TOTAL COST FOR VILLAGE CORE BUILDOUT					**$5,055,000**
Hughesville Village Buildout (Phased Expansion)					
1	Equalization Tank	EA	1	$100,000	$100,000
2	EQ Tank Transfer Pump	EA	2	$15,000	$30,000
3	SBR	EA	2	$600,000	$1,200,000
4	Effluent Filter	EA	2	$380,000	$760,000
5	UV Disinfection	LS	1	$200,000	$200,000
6	Digester	EA	2	$300,000	$600,000
7	Sludge Dewatering System	EA	1	$250,000	$250,000
8	Building	LS	1	$200,000.0	$200,000
9	Chemical Facility	LS	1	$10,000.0	$10,000
10	Reaeration Cascade	LS	1	$20,000.0	$20,000
SUBTOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$3,370,000**
CONTINGENCY (20%)					**$674,000**
SUBTOTAL					**$4,044,000**
ENGINEERING & ADMINISTRATION (25%+/-)					**$1,011,000**
TOTAL COST FOR HUGHESVILLE VILLAGE BUILDOUT					**$5,055,000**
TOTAL PROJECT COST					**$10,110,000**

ENGINEERS ESTIMATE OF OPERATION AND MAINTENANCE COST

Alternative	Phase	Component of Cost	Quantity	Construction Cost	With Contingency & Eng & Admin	O&M Factor	O&M Cost
S-1	I	Sewer	12,700			$1.50/LF	$19,050
	I	P.S. (new)	3	$1,085,000	$1,627,500	4%	$65,100
	II	Sewer	10,700			$1.50/LF	$16,050
	II	P.S. (new & upgrade)	3	$350,000	$525,000	4%	$21,000
						Total O&M S-1	**$121,200**
S-2	I	Sewer	12,700			$1.50/LF	$19,050
	I	P.S. (new)	3	$1,085,000	$1,627,500	4%	$65,100
	II	Sewer	18,700			$1.50/LF	$28,050
	II	P.S. (new & upgrade)	3	$350,000	$525,000	4%	$21,000
						Total O&M S-2	**$133,200**
S-3	I	Sewer	13,300			$1.50/LF	$19,950
	I	P.S. (new)	69	$1,180,000	$1,770,000	4%	$70,800
	II	Sewer	6,500			$1.50/LF	$9,750
	II	P.S. (new & upgrade)	162	$1,660,000	$2,490,000	4%	$99,600
						Total O&M S-3	**$200,100**
D-2	I	Sewer	10,500			$1.50/LF	$15,750
	I	Drip Irrigation		$820,000	$1,230,000	6%	$73,800
	II	Sewer	--			$1.50/LF	$0
	II	Drip Irrigation		$760,000	$1,140,000	6%	$68,400
						Total O&M D-2	**$157,950**
D-3	I	Sewer	6,900			$1.50/LF	$10,350
	II	Sewer	--				
						Total O&M D-3	**$10,350**
T-1	I	MBR			$4,470,000	7%	$312,900
	II	MBR			$4,470,000	7%	$312,900
						Total O&M T-1	**$625,800**
T-2	I	SBR			$5,055,000	5%	$252,750
	II	SBR			$5,055,000	5%	$252,750
						Total O&M T-2	**$505,500**
W-1	I	Water Line	18,200			$1.50/LF	$27,300
	I	Wells	3	$730,000	$1,095,000	7%	$76,650
	I	Tank	1	$1,250,000	$1,875,000	1%	$18,750
	II	Water Line	11,300			$1.50/LF	$16,950
	II	Wells	1	250000	$375,000	7%	$26,250
						Total O&M W-1	**$165,900**

Phase I- Village Core
Phase II- Hughesville Village (Phased Expansion)

App E.

Hughesville Water Distribution Model Analysis

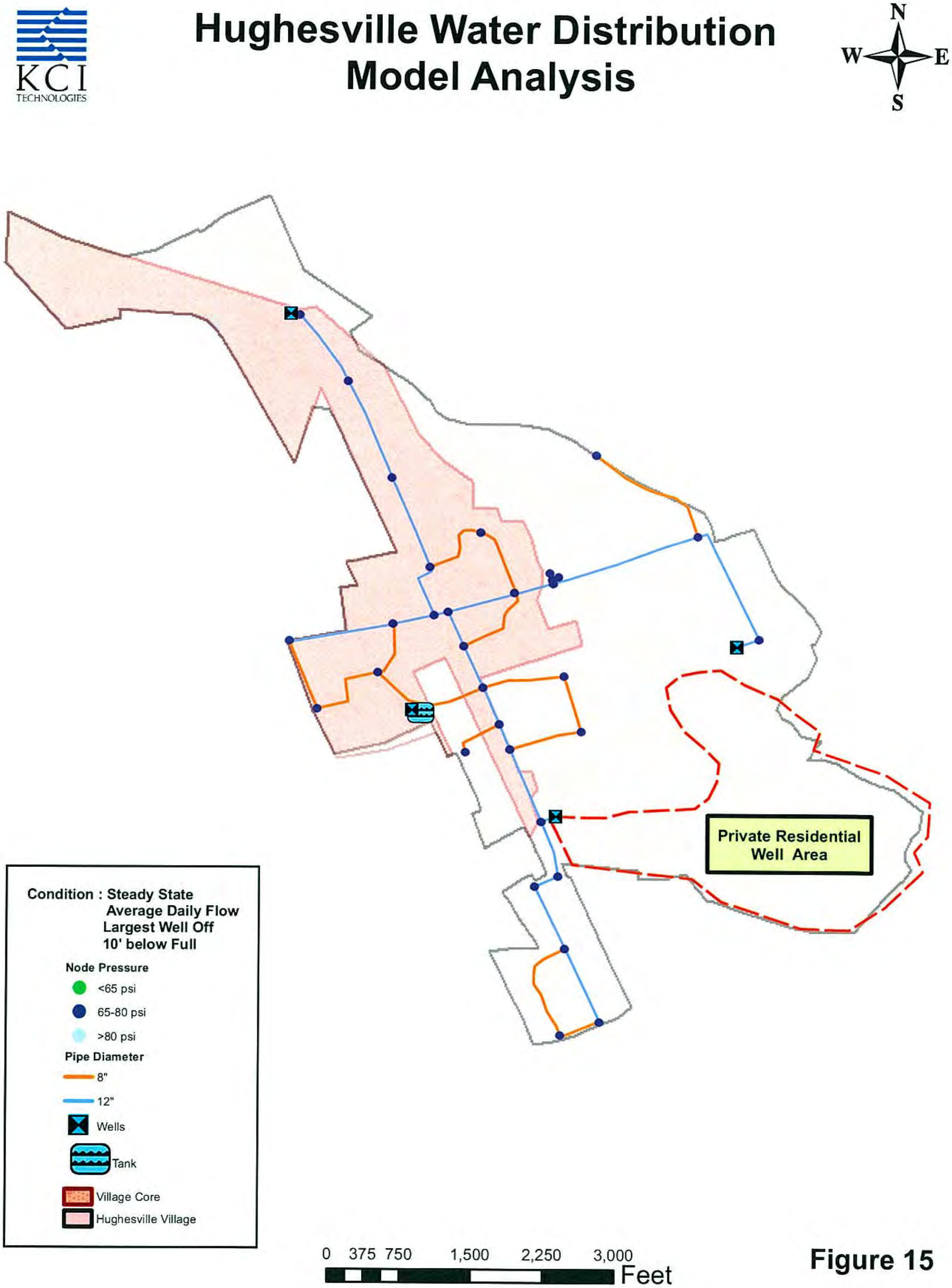

Figure 15

Hughesville Water Distribution Model Analysis

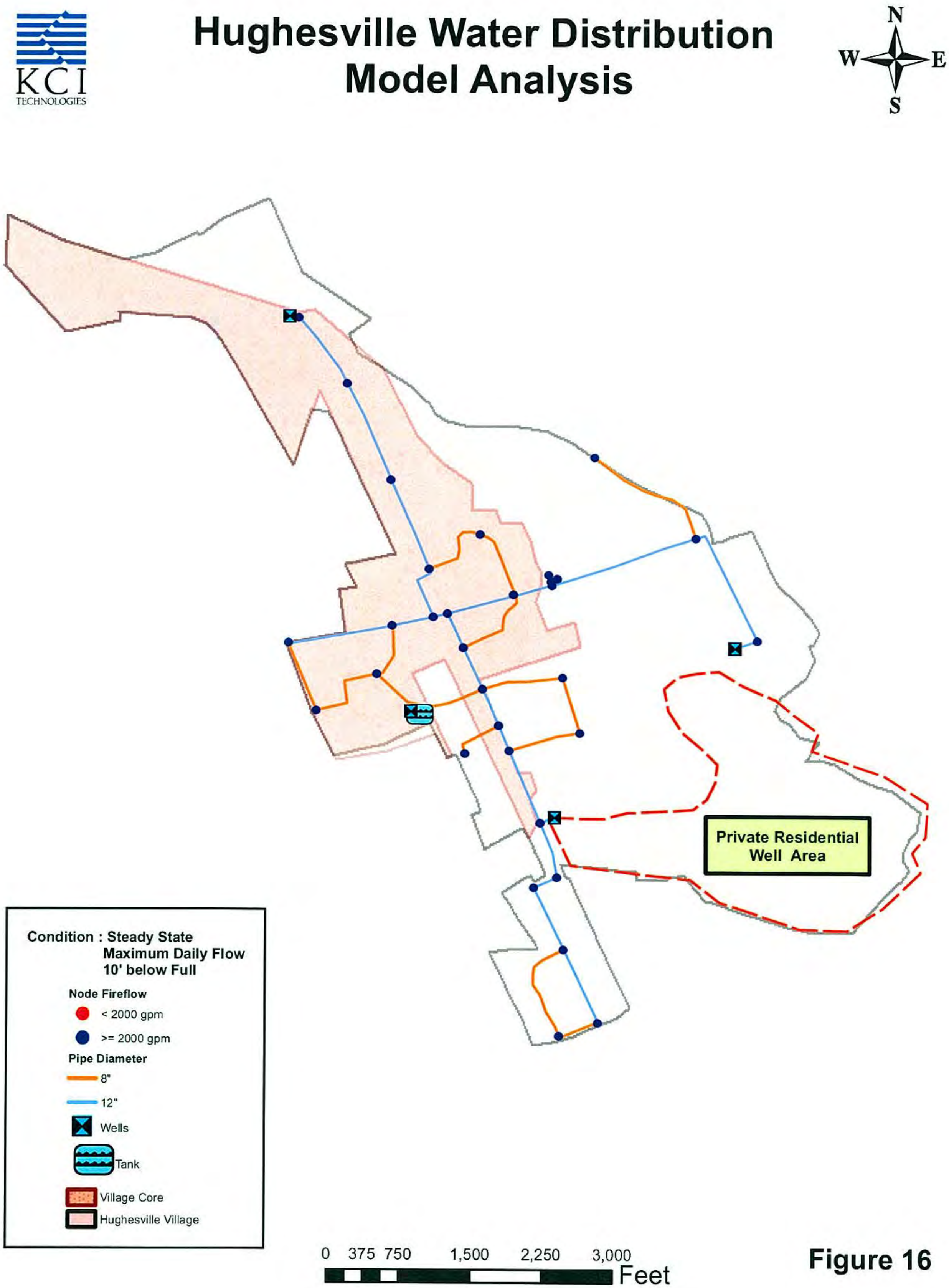

Figure 16

Hughesville Water Distribution Model Analysis

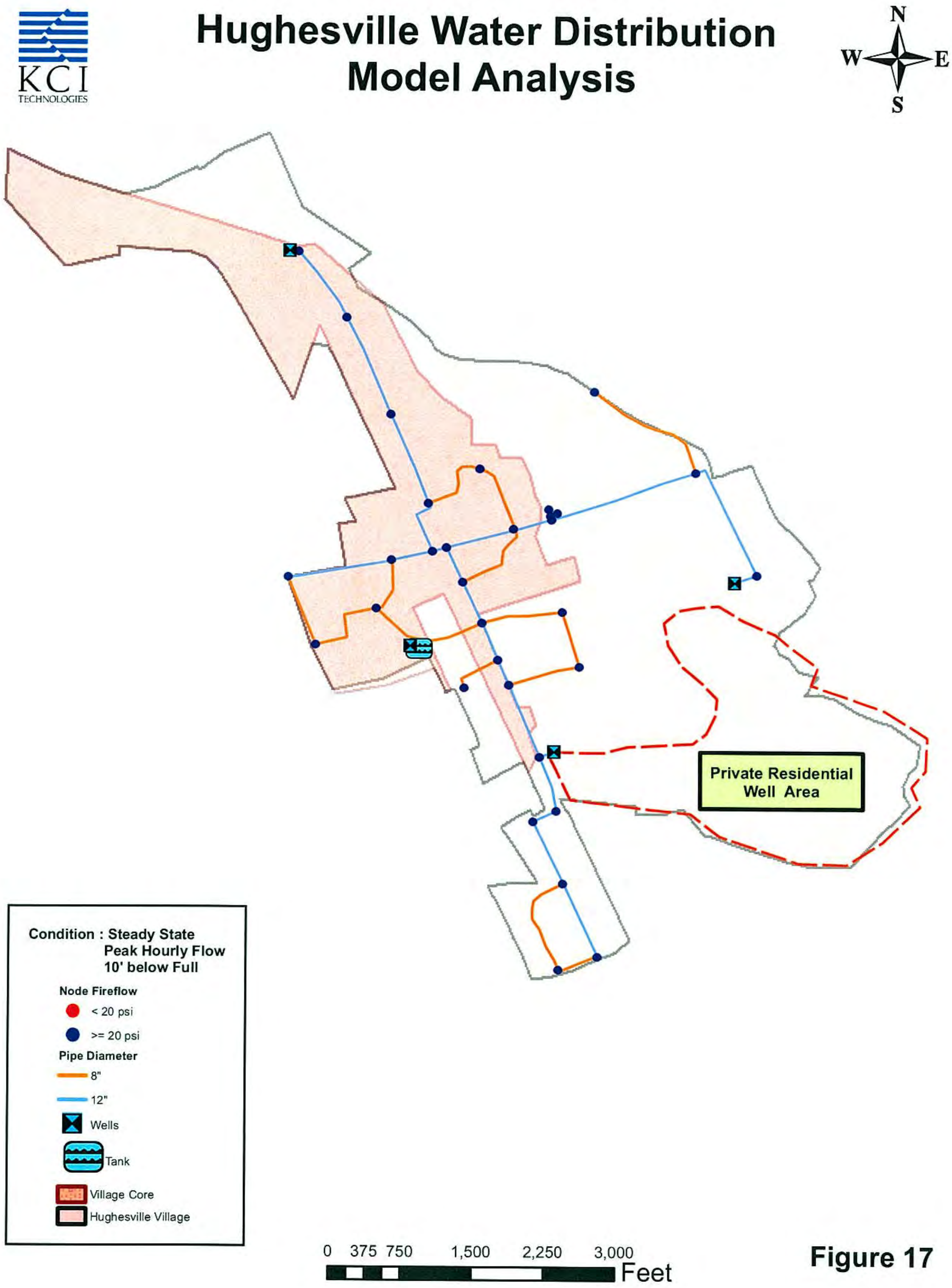

Figure 17

Hughesville Water Distribution System

Alternative W1

Hydraulic Model

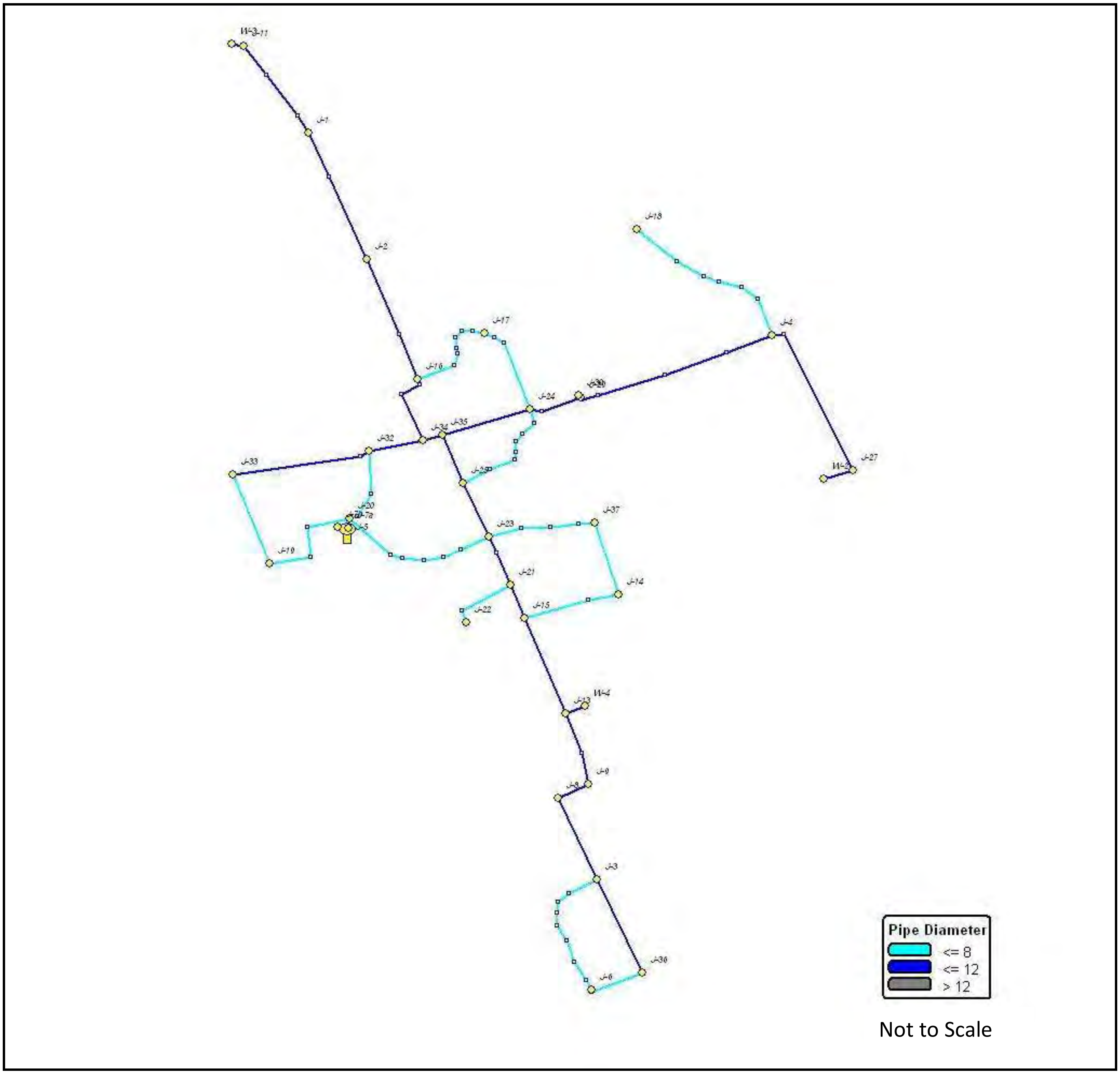

Figure 18

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* * * * * * * * * *   K Y P I P E 4   * * * * * * * * * *
*                                                         *
*              Pipe Network Modeling Software             *
*                                                         *
*                Copyrighted by KYPIPE LLC                *
*                 Version 4 - April 2008                  *
*                                                         *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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Date & Time: Mon Nov 30 11:29:37 2009

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POSTPROCESSOR RESULTS FILENAME ---
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```
**********************************************
S U M M A R Y   O F   O R I G I N A L   D A T A
**********************************************
```

U N I T S   S P E C I F I E D

FLOWRATE .... = gallons/minute
HEAD (HGL) .... = feet
PRESSURE .... = psig

P I P E L I N E   D A T A

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

P I P E N A M E	NODE NAMES #1	NODE NAMES #2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	342.29	12.00	110.0000	0.00
P-10	J-18	J-4	439.49	8.00	100.0000	0.00
P-11	J-19	J-20	278.69	8.00	100.0000	0.00
P-12	J-21	J-22	162.60	8.00	100.0000	0.00

P-13	J-20	J-23	385.22	8.00	100.0000	0.00
P-14	J-24	J-25	278.02	8.00	100.0000	0.00
P-15	J-15	J-13	252.74	12.00	110.0000	0.00
P-16	W-2	J-27	75.14	12.00	110.0000	0.00
P-19	J-32	J-33	336.93	12.00	110.0000	0.00
P-2	J-4	J-29	493.09	12.00	110.0000	0.00
P-20	J-11	J-1	263.49	12.00	110.0000	0.00
P-21	J-2	J-16	318.90	12.00	110.0000	0.00
P-22	J-16	J-34	186.24	12.00	110.0000	0.00
P-23	J-34	J-32	134.62	12.00	110.0000	0.00
P-24	J-20	J-32	189.15	8.00	100.0000	0.00
P-25	J-35	J-25	128.22	12.00	110.0000	0.00
P-26	J-25	J-23	146.33	12.00	110.0000	0.00
P-27	J-23	J-21	128.90	12.00	110.0000	0.00
P-28	J-21	J-15	88.04	12.00	110.0000	0.00
P-29	J-13	J-9	183.14	12.00	110.0000	0.00
P-3	J-6	J-3	346.47	8.00	100.0000	0.00
P-30	J-6	J-36	137.31	8.00	100.0000	0.00
P-31	J-20	J-7a	23.76	8.00	100.0000	0.00
P-32	J-3	J-8	220.62	12.00	110.0000	0.00
P-33	J-7a	J-5	30.04	8.00	100.0000	0.00
P-34	J-23	J-37	261.07	8.00	100.0000	0.00
P-35	J-37	J-14	185.90	8.00	100.0000	0.00
P-36	J-33	J-19	235.31	8.00	100.0000	0.00
P-37	J-34	J-35	47.17	12.00	110.0000	0.00
P-38	J-35	J-24	221.00	12.00	110.0000	0.00
P-39	J-24	J-29	129.25	12.00	110.0000	0.00

P-4	J-3	J-36	254.01	12.00	110.0000	0.00
P-40	J-4	J-27	402.59	12.00	110.0000	0.00
P-41	J-17	J-24	224.86	8.00	100.0000	0.00
P-42	J-7a	J-7b	26.62	8.00	100.0000	0.00
P-43	J-30	J-29	5.86	12.00	110.0000	0.00
P-5	J-8	J-9	81.67	12.00	110.0000	0.00
P-6	W-3	J-11	30.19	12.00	110.0000	0.00
P-7	W-4	J-13	51.01	12.00	110.0000	0.00
P-8	J-14	J-15	234.76	8.00	100.0000	0.00
P-9	J-16	J-17	244.41	8.00	100.0000	0.00

N O D E   D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		72.10	204.38	
J-11		210.50	189.02	
J-13		7.58	182.80	
J-14		13.00	197.07	
J-15		8.62	179.32	
J-16		18.58	189.51	
J-17		24.32	180.53	
J-18		11.88	188.63	
J-19		41.63	178.74	
J-2		28.91	188.22	
J-20		54.07	176.05	
J-21		6.56	178.23	
J-22		3.25	178.09	
J-23		10.75	180.45	
J-24		18.11	185.20	
J-25		17.96	180.09	
J-27		98.49	173.06	
J-29		26.83	176.45	
J-3		32.50	176.83	
J-30		0.00	176.44	
J-32		38.26	187.97	
J-33		0.00	174.60	
J-34		7.18	181.38	
J-35		3.74	180.07	

J-36	6.50	173.38	
J-37	12.02	186.58	
J-4	44.94	178.48	
J-5	----	178.30	355.00
J-6	16.25	173.96	
J-7a	0.00	177.00	
J-7b	-150.00	177.14	
J-8	13.00	181.77	
J-9	0.00	181.44	
W-2	-150.00	151.91	
W-3	-150.00	188.82	
W-4	0.00	174.73	

O U T P U T   O P T I O N   D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M   C O N F I G U R A T I O N

NUMBER OF PIPES ....(p) = 41
NUMBER OF END NODES ....(j) = 35
NUMBER OF PRIMARY LOOPS ....(l) = 6
NUMBER OF SUPPLY NODES ....(f) = 1
NUMBER OF SUPPLY ZONES ....(z) = 1

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Case: 0

RESULTS OBTAINED AFTER 9 TRIALS: ACCURACY = 0.00000

S I M U L A T I O N   D E S C R I P T I O N   (L A B E L)

P I P E L I N E   R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

P I P E   NODE NUMBERS   FLOWRATE   HEAD   MINOR   LINE
HL+ML/   HL/

N A M E	#1	#2	(gpm)	LOSS (ft)	LOSS (ft)	VELO. (ft/s)	1000 (ft/ft)	1000 (ft/ft)
P-1	J-2	J-1	132.60	0.03	0.00	0.38	0.08	0.08
P-10	J-4	J-18	11.88	0.00	0.00	0.08	0.01	0.01
P-11	J-20	J-19	135.15	0.20	0.00	0.86	0.73	0.73
P-12	J-21	J-22	3.25	0.00	0.00	0.02	0.00	0.00
P-13	J-20	J-23	151.04	0.35	0.00	0.96	0.90	0.90
P-14	J-25	J-24	18.49	0.01	0.00	0.12	0.02	0.02
P-15	J-15	J-13	75.83	0.01	0.00	0.22	0.03	0.03
P-16	W-2	J-27	150.00	0.01	0.00	0.43	0.10	0.10
P-19	J-33	J-32	93.53	0.01	0.00	0.27	0.04	0.04
P-2	J-29	J-4	5.31	0.00	0.00	0.02	0.00	0.00
P-20	J-1	J-11	60.50	0.01	0.00	0.17	0.02	0.02
P-21	J-16	J-2	161.51	0.04	0.00	0.46	0.12	0.12
P-22	J-34	J-16	167.93	0.02	0.00	0.48	0.13	0.13
P-23	J-32	J-34	262.52	0.04	0.00	0.74	0.29	0.29
P-24	J-20	J-32	207.25	0.30	0.00	1.32	1.61	1.61
P-25	J-35	J-25	15.43	0.00	0.00	0.04	0.00	0.00
P-26	J-23	J-25	21.01	0.00	0.00	0.06	0.00	0.00
P-27	J-23	J-21	95.60	0.01	0.00	0.27	0.04	0.04
P-28	J-21	J-15	85.79	0.00	0.00	0.24	0.04	0.04
P-29	J-13	J-9	68.25	0.00	0.00	0.19	0.02	0.02
P-3	J-3	J-6	7.11	0.00	0.00	0.05	0.00	0.00
P-30	J-36	J-6	9.14	0.00	0.00	0.06	0.00	0.00
P-31	J-7a	J-20	547.51	0.23	0.00	3.49	9.73	9.73
P-32	J-8	J-3	55.25	0.00	0.00	0.16	0.02	0.02

P-33	J-5	J-7a	397.51	0.16	0.00	2.54	5.38	5.38
P-34	J-23	J-37	23.68	0.01	0.00	0.15	0.03	0.03
P-35	J-37	J-14	11.66	0.00	0.00	0.07	0.01	0.01
P-36	J-19	J-33	93.53	0.09	0.00	0.60	0.37	0.37
P-37	J-34	J-35	87.40	0.00	0.00	0.25	0.04	0.04
P-38	J-35	J-24	68.23	0.01	0.00	0.19	0.02	0.02
P-39	J-24	J-29	32.14	0.00	0.00	0.09	0.01	0.01
P-4	J-3	J-36	15.64	0.00	0.00	0.04	0.00	0.00
P-40	J-27	J-4	51.51	0.01	0.00	0.15	0.01	0.01
P-41	J-24	J-17	36.47	0.01	0.00	0.23	0.06	0.06
P-42	J-7b	J-7a	150.00	0.02	0.00	0.96	0.88	0.88
P-43	J-30	J-29	0.00	0.00	0.00	0.00	0.00	0.00
P-5	J-9	J-8	68.25	0.00	0.00	0.19	0.02	0.02
P-6	W-3	J-11	150.00	0.00	0.00	0.43	0.10	0.10
P-7	W-4	J-13	0.00	0.00	0.00	0.00	0.00	0.00
P-8	J-15	J-14	1.34	0.00	0.00	0.01	0.00	0.00
P-9	J-17	J-16	12.15	0.00	0.00	0.08	0.01	0.01

N O D E   R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	NODE ELEVATION (ft)	PRESSURE HEAD (ft)	NODE PRESSURE (psi)
J-1		72.10	354.17	204.38	149.79	64.91
J-11		210.50	354.17	189.02	165.15	71.57
J-13		7.58	354.25	182.80	171.45	74.29

J-14	13.00	354.25	197.07	157.18	68.11
J-15	8.62	354.25	179.32	174.93	75.80
J-16	18.58	354.24	189.51	164.73	71.38
J-17	24.32	354.24	180.53	173.71	75.27
J-18	11.88	354.25	188.63	165.62	71.77
J-19	41.63	354.40	178.74	175.66	76.12
J-2	28.91	354.20	188.22	165.98	71.93
J-20	54.07	354.61	176.05	178.56	77.37
J-21	6.56	354.26	178.23	176.03	76.28
J-22	3.25	354.26	178.09	176.16	76.34
J-23	10.75	354.26	180.45	173.81	75.32
J-24	18.11	354.26	185.20	169.05	73.26
J-25	17.96	354.26	180.09	174.17	75.47
J-27	98.49	354.26	173.06	181.20	78.52
J-29	26.83	354.26	176.45	177.81	77.05
J-3	32.50	354.24	176.83	177.41	76.88
J-30	0.00	354.26	176.44	177.82	77.05
J-32	38.26	354.30	187.97	166.33	72.08
J-33	0.00	354.32	174.60	179.72	77.88
J-34	7.18	354.26	181.38	172.89	74.92
J-35	3.74	354.26	180.07	174.20	75.48
J-36	6.50	354.24	173.38	180.86	78.37
J-37	12.02	354.25	186.58	167.68	72.66
J-4	44.94	354.26	178.48	175.77	76.17
J-5	----	355.00	178.30	176.70	76.57
J-6	16.25	354.23	173.96	180.28	78.12
J-7a	0.00	354.84	177.00	177.84	77.06

J-7b	-150.00	354.86	177.14	177.72	77.01
J-8	13.00	354.24	181.77	172.46	74.73
J-9	0.00	354.24	181.44	172.80	74.88
W-2	-150.00	354.27	151.91	202.36	87.69
W-3	-150.00	354.17	188.82	165.35	71.65
W-4	0.00	354.25	174.73	179.52	77.79

M A X I M U M   A N D   M I N I M U M   V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
W-2	87.69	J-1	64.91
J-27	78.52	J-14	68.11
J-36	78.37	J-16	71.38
J-6	78.12	J-11	71.57
J-33	77.88	W-3	71.65

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-31	3.49	P-8	0.01
P-33	2.54	P-2	0.02
P-24	1.32	P-12	0.02
P-13	0.96	P-25	0.04
P-42	0.96	P-4	0.04

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-31	9.73	P-8	0.00
P-33	5.38	P-2	0.00
P-24	1.61	P-12	0.00
P-13	0.90	P-25	0.00
P-42	0.88	P-4	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-31	9.73	P-8	0.00
P-33	5.38	P-2	0.00
P-24	1.61	P-12	0.00
P-13	0.90	P-25	0.00
P-42	0.88	P-4	0.00

S U M M A R Y   O F   I N F L O W S   A N D   O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE (gpm)	NODE TITLE
J-5	397.51	

NET SYSTEM INFLOW = 397.51
NET SYSTEM OUTFLOW = 0.00
NET SYSTEM DEMAND = 397.51

***** HYDRAULIC ANALYSIS COMPLETED *****

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* * * * * * * * * *   K Y P I P E 4   * * * * * * * * * *
*                                                         *
*             Pipe Network Modeling Software              *
*                                                         *
*               Copyrighted by KYPIPE LLC                 *
*                Version 4 - April 2008                   *
*                                                         *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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Date & Time: Mon Nov 30 10:34:19 2009

INPUT DATA FILENAME --------------
M:\2008\01083704\HYDRAU~1\Water\ADF\ADF_Hugh.DT2
TABULATED OUTPUT FILENAME --------
M:\2008\01083704\HYDRAU~1\Water\ADF\ADF_Hugh.OT2
POSTPROCESSOR RESULTS FILENAME ---
M:\2008\01083704\HYDRAU~1\Water\ADF\ADF_Hugh.RS2

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**********************************************
S U M M A R Y   O F   O R I G I N A L   D A T A
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U N I T S   S P E C I F I E D

FLOWRATE .... = gallons/minute
HEAD (HGL) .... = feet
PRESSURE .... = psig

P I P E L I N E   D A T A

STATUS CODE: XX -CLOSED PIPE   CV -CHECK VALVE

P I P E N A M E	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	342.29	12.00	110.0000	0.00
P-10	J-18	J-4	439.49	8.00	100.0000	0.00
P-11	J-19	J-20	278.69	8.00	100.0000	0.00
P-12	J-21	J-22	162.60	8.00	100.0000	0.00

P-13	J-20	J-23	385.22	8.00	100.0000	0.00
P-14	J-24	J-25	278.02	8.00	100.0000	0.00
P-15	J-15	J-13	252.74	12.00	110.0000	0.00
P-16	W-2	J-27	75.14	12.00	110.0000	0.00
P-19	J-32	J-33	336.93	12.00	110.0000	0.00
P-2	J-4	J-29	493.09	12.00	110.0000	0.00
P-20	J-11	J-1	263.49	12.00	110.0000	0.00
P-21	J-2	J-16	318.90	12.00	110.0000	0.00
P-22	J-16	J-34	186.24	12.00	110.0000	0.00
P-23	J-34	J-32	134.62	12.00	110.0000	0.00
P-24	J-20	J-32	189.15	8.00	100.0000	0.00
P-25	J-35	J-25	128.22	12.00	110.0000	0.00
P-26	J-25	J-23	146.33	12.00	110.0000	0.00
P-27	J-23	J-21	128.90	12.00	110.0000	0.00
P-28	J-21	J-15	88.04	12.00	110.0000	0.00
P-29	J-13	J-9	183.14	12.00	110.0000	0.00
P-3	J-6	J-3	346.47	8.00	100.0000	0.00
P-30	J-6	J-36	137.31	8.00	100.0000	0.00
P-31	J-20	J-7a	23.76	8.00	100.0000	0.00
P-32	J-3	J-8	220.62	12.00	110.0000	0.00
P-33	J-7a	J-5	30.04	8.00	100.0000	0.00
P-34	J-23	J-37	261.07	8.00	100.0000	0.00
P-35	J-37	J-14	185.90	8.00	100.0000	0.00
P-36	J-33	J-19	235.31	8.00	100.0000	0.00
P-37	J-34	J-35	47.17	12.00	110.0000	0.00
P-38	J-35	J-24	221.00	12.00	110.0000	0.00
P-39	J-24	J-29	129.25	12.00	110.0000	0.00

P-4	J-3	J-36	254.01	12.00	110.0000	0.00
P-40	J-4	J-27	402.59	12.00	110.0000	0.00
P-41	J-17	J-24	224.86	8.00	100.0000	0.00
P-42	J-7a	J-7b	26.62	8.00	100.0000	0.00
P-43	J-30	J-29	5.86	12.00	110.0000	0.00
P-5	J-8	J-9	81.67	12.00	110.0000	0.00
P-6	W-3	J-11	30.19	12.00	110.0000	0.00
P-7	W-4	J-13	51.01	12.00	110.0000	0.00
P-8	J-14	J-15	234.76	8.00	100.0000	0.00
P-9	J-16	J-17	244.41	8.00	100.0000	0.00

N O D E   D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		8.01	204.38	
J-11		23.39	189.02	
J-13		0.84	182.80	
J-14		1.44	197.07	
J-15		0.96	179.32	
J-16		2.06	189.51	
J-17		2.70	180.53	
J-18		1.32	188.63	
J-19		4.63	178.74	
J-2		3.21	188.22	
J-20		6.01	176.05	
J-21		0.73	178.23	
J-22		0.36	178.09	
J-23		1.19	180.45	
J-24		2.01	185.20	
J-25		2.00	180.09	
J-27		10.94	173.06	
J-29		2.98	176.45	
J-3		3.61	176.83	
J-30		0.00	176.44	
J-32		4.25	187.97	
J-33		0.00	174.60	
J-34		0.80	181.38	
J-35		0.42	180.07	

J-36	0.72	173.38	
J-37	1.34	186.58	
J-4	4.99	178.48	
J-5	----	178.30	355.00
J-6	1.81	173.96	
J-7a	0.00	177.00	
J-7b	-150.00	177.14	
J-8	1.44	181.77	
J-9	0.00	181.44	
W-2	-150.00	151.91	
W-3	-150.00	188.82	
W-4	0.00	174.73	

O U T P U T   O P T I O N   D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M   C O N F I G U R A T I O N

NUMBER OF PIPES ....(p) = 41
NUMBER OF END NODES ....(j) = 35
NUMBER OF PRIMARY LOOPS ....(l) = 6
NUMBER OF SUPPLY NODES ....(f) = 1
NUMBER OF SUPPLY ZONES ....(z) = 1

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Case: 0

RESULTS OBTAINED AFTER 11 TRIALS: ACCURACY = 0.00000

S I M U L A T I O N   D E S C R I P T I O N   (L A B E L)

P I P E L I N E   R E S U L T S

STATUS CODE: XX -CLOSED PIPE   CV -CHECK VALVE

P I P E   NODE NUMBERS   FLOWRATE   HEAD   MINOR   LINE
HL+ML/   HL/

N A M E	#1	#2	(gpm)	LOSS (ft)	LOSS (ft)	VELO. (ft/s)	1000 (ft/ft)	1000 (ft/ft)
P-1	J-1	J-2	118.60	0.02	0.00	0.34	0.07	0.07
P-10	J-18	J-4	-1.32	0.00	0.00	0.01	0.00	0.00
P-11	J-19	J-20	50.25	0.03	0.00	0.32	0.12	0.12
P-12	J-21	J-22	0.36	0.00	0.00	0.00	0.00	0.00
P-13	J-20	J-23	-67.72	0.08	0.00	0.43	0.20	0.20
P-14	J-24	J-25	29.80	0.01	0.00	0.19	0.04	0.04
P-15	J-15	J-13	8.43	0.00	0.00	0.02	0.00	0.00
P-16	W-2	J-27	150.00	0.01	0.00	0.43	0.10	0.10
P-19	J-32	J-33	54.87	0.01	0.00	0.16	0.02	0.02
P-2	J-4	J-29	132.74	0.04	0.00	0.38	0.08	0.08
P-20	J-11	J-1	126.61	0.02	0.00	0.36	0.08	0.08
P-21	J-2	J-16	115.39	0.02	0.00	0.33	0.06	0.06
P-22	J-16	J-34	110.69	0.01	0.00	0.31	0.06	0.06
P-23	J-34	J-32	152.99	0.01	0.00	0.43	0.11	0.11
P-24	J-20	J-32	-93.87	0.07	0.00	0.60	0.37	0.37
P-25	J-35	J-25	54.36	0.00	0.00	0.15	0.02	0.02
P-26	J-25	J-23	82.17	0.00	0.00	0.23	0.03	0.03
P-27	J-23	J-21	10.62	0.00	0.00	0.03	0.00	0.00
P-28	J-21	J-15	9.53	0.00	0.00	0.03	0.00	0.00
P-29	J-13	J-9	7.58	0.00	0.00	0.02	0.00	0.00
P-3	J-6	J-3	-0.79	0.00	0.00	0.01	0.00	0.00
P-30	J-6	J-36	-1.02	0.00	0.00	0.01	0.00	0.00
P-31	J-20	J-7a	205.83	0.04	0.00	1.31	1.59	1.59
P-32	J-3	J-8	-6.14	0.00	0.00	0.02	0.00	0.00

P-33	J-7a	J-5	355.83	0.13	0.00	2.27	4.38	4.38
P-34	J-23	J-37	2.63	0.00	0.00	0.02	0.00	0.00
P-35	J-37	J-14	1.30	0.00	0.00	0.01	0.00	0.00
P-36	J-33	J-19	54.87	0.03	0.00	0.35	0.14	0.14
P-37	J-34	J-35	-43.10	0.00	0.00	0.12	0.01	0.01
P-38	J-35	J-24	-97.88	0.01	0.00	0.28	0.05	0.05
P-39	J-24	J-29	-129.76	0.01	0.00	0.37	0.08	0.08
P-4	J-3	J-36	1.74	0.00	0.00	0.00	0.00	0.00
P-40	J-4	J-27	-139.06	0.04	0.00	0.39	0.09	0.09
P-41	J-17	J-24	-0.07	0.00	0.00	0.00	0.00	0.00
P-42	J-7a	J-7b	-150.00	0.02	0.00	0.96	0.88	0.88
P-43	J-30	J-29	0.00	0.00	0.00	0.00	0.00	0.00
P-5	J-8	J-9	-7.58	0.00	0.00	0.02	0.00	0.00
P-6	W-3	J-11	150.00	0.00	0.00	0.43	0.10	0.10
P-7	W-4	J-13	0.00	0.00	0.00	0.00	0.00	0.00
P-8	J-14	J-15	-0.15	0.00	0.00	0.00	0.00	0.00
P-9	J-16	J-17	2.63	0.00	0.00	0.02	0.00	0.00

N O D E   R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	NODE ELEVATION (ft)	PRESSURE HEAD (ft)	NODE PRESSURE (psi)
J-1		8.01	355.31	204.38	150.93	65.40
J-11		23.39	355.33	189.02	166.31	72.07
J-13		0.84	355.25	182.80	172.45	74.73

J-14	1.44	355.25	197.07	158.17	68.54
J-15	0.96	355.25	179.32	175.93	76.24
J-16	2.06	355.26	189.51	165.75	71.83
J-17	2.70	355.26	180.53	174.73	75.72
J-18	1.32	355.32	188.63	166.69	72.23
J-19	4.63	355.20	178.74	176.46	76.46
J-2	3.21	355.29	188.22	167.07	72.39
J-20	6.01	355.17	176.05	179.12	77.62
J-21	0.73	355.25	178.23	177.02	76.71
J-22	0.36	355.25	178.09	177.15	76.77
J-23	1.19	355.25	180.45	174.80	75.75
J-24	2.01	355.26	185.20	170.06	73.69
J-25	2.00	355.25	180.09	175.16	75.90
J-27	10.94	355.35	173.06	182.29	78.99
J-29	2.98	355.27	176.45	178.82	77.49
J-3	3.61	355.25	176.83	178.42	77.31
J-30	0.00	355.27	176.44	178.83	77.50
J-32	4.25	355.24	187.97	167.27	72.48
J-33	0.00	355.23	174.60	180.64	78.28
J-34	0.80	355.25	181.38	173.88	75.35
J-35	0.42	355.25	180.07	175.19	75.92
J-36	0.72	355.25	173.38	181.87	78.81
J-37	1.34	355.25	186.58	168.67	73.09
J-4	4.99	355.32	178.48	176.83	76.63
J-5	----	355.00	178.30	176.70	76.57
J-6	1.81	355.25	173.96	181.29	78.56
J-7a	0.00	355.13	177.00	178.13	77.19

J-7b	-150.00	355.16	177.14	178.02	77.14
J-8	1.44	355.25	181.77	173.47	75.17
J-9	0.00	355.25	181.44	173.81	75.32
W-2	-150.00	355.36	151.91	203.45	88.16
W-3	-150.00	355.33	188.82	166.51	72.15
W-4	0.00	355.25	174.73	180.52	78.22

M A X I M U M   A N D   M I N I M U M   V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
W-2	88.16	J-1	65.40
J-27	78.99	J-14	68.54
J-36	78.81	J-16	71.83
J-6	78.56	J-11	72.07
J-33	78.28	W-3	72.15

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-33	2.27	P-41	0.00
P-31	1.31	P-8	0.00
P-42	0.96	P-12	0.00
P-24	0.60	P-4	0.00
P-23	0.43	P-3	0.01

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-33	4.38	P-41	0.00
P-31	1.59	P-8	0.00
P-42	0.88	P-12	0.00
P-24	0.37	P-4	0.00
P-13	0.20	P-3	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-33	4.38	P-41	0.00
P-31	1.59	P-8	0.00
P-42	0.88	P-12	0.00
P-24	0.37	P-4	0.00
P-13	0.20	P-3	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE (gpm)	NODE TITLE
J-5	-355.83	

NET SYSTEM INFLOW = 0.00
NET SYSTEM OUTFLOW = -355.83
NET SYSTEM DEMAND = -355.83

***** HYDRAULIC ANALYSIS COMPLETED *****

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* * * * * * * * * *   K Y P I P E 4   * * * * * * * * * *
*                                                         *
*              Pipe Network Modeling Software             *
*                                                         *
*               Copyrighted by KYPIPE LLC                 *
*                Version 4 - April 2008                   *
*                                                         *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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Date & Time: Mon Nov 30 11:25:36 2009

INPUT DATA FILENAME --------------
M:\2008\01083704\HYDRAU~1\Water\MDF\Mod_MDF_.DT2
TABULATED OUTPUT FILENAME --------
M:\2008\01083704\HYDRAU~1\Water\MDF\Mod_MDF_.OT2
POSTPROCESSOR RESULTS FILENAME ---
M:\2008\01083704\HYDRAU~1\Water\MDF\Mod_MDF_.RS2

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*********************************************
S U M M A R Y   O F   O R I G I N A L   D A T A
*********************************************
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U N I T S   S P E C I F I E D

FLOWRATE .... = gallons/minute
HEAD (HGL) .... = feet
PRESSURE .... = psig

P I P E L I N E   D A T A

STATUS CODE: XX -CLOSED PIPE   CV -CHECK VALVE

P I P E N A M E	NODE NAMES #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.
P-1	J-1	J-2	342.29	12.00	110.0000	0.00
P-10	J-18	J-4	439.49	8.00	100.0000	0.00
P-11	J-19	J-20	278.69	8.00	100.0000	0.00
P-12	J-21	J-22	162.60	8.00	100.0000	0.00

P-13	J-20	J-23	385.22	8.00	100.0000	0.00
P-14	J-24	J-25	278.02	8.00	100.0000	0.00
P-15	J-15	J-13	252.74	12.00	110.0000	0.00
P-16	W-2	J-27	75.14	12.00	110.0000	0.00
P-19	J-32	J-33	336.93	12.00	110.0000	0.00
P-2	J-4	J-29	493.09	12.00	110.0000	0.00
P-20	J-11	J-1	263.49	12.00	110.0000	0.00
P-21	J-2	J-16	318.90	12.00	110.0000	0.00
P-22	J-16	J-34	186.24	12.00	110.0000	0.00
P-23	J-34	J-32	134.62	12.00	110.0000	0.00
P-24	J-20	J-32	189.15	8.00	100.0000	0.00
P-25	J-35	J-25	128.22	12.00	110.0000	0.00
P-26	J-25	J-23	146.33	12.00	110.0000	0.00
P-27	J-23	J-21	128.90	12.00	110.0000	0.00
P-28	J-21	J-15	88.04	12.00	110.0000	0.00
P-29	J-13	J-9	183.14	12.00	110.0000	0.00
P-3	J-6	J-3	346.47	8.00	100.0000	0.00
P-30	J-6	J-36	137.31	8.00	100.0000	0.00
P-31	J-20	J-7a	23.76	8.00	100.0000	0.00
P-32	J-3	J-8	220.62	12.00	110.0000	0.00
P-33	J-7a	J-5	30.04	8.00	100.0000	0.00
P-34	J-23	J-37	261.07	8.00	100.0000	0.00
P-35	J-37	J-14	185.90	8.00	100.0000	0.00
P-36	J-33	J-19	235.31	8.00	100.0000	0.00
P-37	J-34	J-35	47.17	12.00	110.0000	0.00
P-38	J-35	J-24	221.00	12.00	110.0000	0.00
P-39	J-24	J-29	129.25	12.00	110.0000	0.00

P-4	J-3	J-36	254.01	12.00	110.0000	0.00
P-40	J-4	J-27	402.59	12.00	110.0000	0.00
P-41	J-17	J-24	224.86	8.00	100.0000	0.00
P-42	J-7a	J-7b	26.62	8.00	100.0000	0.00
P-43	J-30	J-29	5.86	12.00	110.0000	0.00
P-5	J-8	J-9	81.67	12.00	110.0000	0.00
P-6	W-3	J-11	30.19	12.00	110.0000	0.00
P-7	W-4	J-13	51.01	12.00	110.0000	0.00
P-8	J-14	J-15	234.76	8.00	100.0000	0.00
P-9	J-16	J-17	244.41	8.00	100.0000	0.00

N O D E   D A T A

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	EXTERNAL GRADE (ft)
J-1		24.03	204.38	
J-11		70.17	189.02	
J-13		2.53	182.80	
J-14		4.33	197.07	
J-15		2.87	179.32	
J-16		6.19	189.51	
J-17		8.11	180.53	
J-18		3.96	188.63	
J-19		13.88	178.75	
J-2		9.64	188.22	
J-20		18.02	176.05	
J-21		2.19	178.23	
J-22		1.08	178.09	
J-23		3.58	180.45	
J-24		6.04	185.20	
J-25		5.99	180.09	
J-27		32.83	173.06	
J-29		8.94	176.45	
J-3		10.83	176.83	
J-30		0.00	176.44	
J-32		12.75	187.97	
J-33		0.00	174.60	
J-34		2.39	181.38	
J-35		1.25	180.07	

J-36	2.17	173.38	
J-37	4.01	186.58	
J-4	14.98	178.48	
J-5	----	178.30	355.00
J-6	5.42	173.96	
J-7a	0.00	177.00	
J-7b	-150.00	177.14	
J-8	4.33	181.78	
J-9	0.00	181.44	
W-2	-150.00	151.91	
W-3	-150.00	188.82	
W-4	0.00	174.73	

O U T P U T   O P T I O N   D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 5
MAXIMUM AND MINIMUM VELOCITIES = 5
MAXIMUM AND MINIMUM HEAD LOSS/1000 = 5

S Y S T E M   C O N F I G U R A T I O N

NUMBER OF PIPES ....(p) = 41
NUMBER OF END NODES ....(j) = 35
NUMBER OF PRIMARY LOOPS ....(l) = 6
NUMBER OF SUPPLY NODES ....(f) = 1
NUMBER OF SUPPLY ZONES ....(z) = 1

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Case: 0

RESULTS OBTAINED AFTER 9 TRIALS: ACCURACY = 0.00008

S I M U L A T I O N   D E S C R I P T I O N   (L A B E L)

P I P E L I N E   R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

P I P E   NODE NUMBERS   FLOWRATE   HEAD   MINOR   LINE
HL+ML/   HL/

N A M E	#1	#2	(gpm)	LOSS (ft)	LOSS (ft)	VELO. (ft/s)	1000 (ft/ft)	1000 (ft/ft)
P-1	J-1	J-2	55.80	0.01	0.00	0.16	0.02	0.02
P-10	J-4	J-18	3.96	0.00	0.00	0.03	0.00	0.00
P-11	J-19	J-20	3.09	0.00	0.00	0.02	0.00	0.00
P-12	J-21	J-22	1.08	0.00	0.00	0.01	0.00	0.00
P-13	J-23	J-20	11.20	0.00	0.00	0.07	0.01	0.01
P-14	J-24	J-25	17.87	0.00	0.00	0.11	0.02	0.02
P-15	J-15	J-13	25.28	0.00	0.00	0.07	0.00	0.00
P-16	W-2	J-27	150.00	0.01	0.00	0.43	0.10	0.10
P-19	J-32	J-33	16.97	0.00	0.00	0.05	0.00	0.00
P-2	J-4	J-29	98.23	0.02	0.00	0.28	0.05	0.05
P-20	J-11	J-1	79.83	0.01	0.00	0.23	0.03	0.03
P-21	J-2	J-16	46.16	0.00	0.00	0.13	0.01	0.01
P-22	J-16	J-34	42.70	0.00	0.00	0.12	0.01	0.01
P-23	J-34	J-32	50.95	0.00	0.00	0.14	0.01	0.01
P-24	J-32	J-20	21.23	0.00	0.00	0.14	0.02	0.02
P-25	J-35	J-25	42.66	0.00	0.00	0.12	0.01	0.01
P-26	J-25	J-23	54.54	0.00	0.00	0.15	0.02	0.02
P-27	J-23	J-21	31.87	0.00	0.00	0.09	0.01	0.01
P-28	J-21	J-15	28.60	0.00	0.00	0.08	0.00	0.00
P-29	J-13	J-9	22.75	0.00	0.00	0.06	0.00	0.00
P-3	J-3	J-6	2.37	0.00	0.00	0.02	0.00	0.00
P-30	J-36	J-6	3.05	0.00	0.00	0.02	0.00	0.00
P-31	J-20	J-7a	17.50	0.00	0.00	0.11	0.02	0.02
P-32	J-8	J-3	18.42	0.00	0.00	0.05	0.00	0.00

P-33	J-7a	J-5	167.50	0.03	0.00	1.07	1.09	1.09
P-34	J-23	J-37	7.89	0.00	0.00	0.05	0.00	0.00
P-35	J-37	J-14	3.89	0.00	0.00	0.02	0.00	0.00
P-36	J-33	J-19	16.97	0.00	0.00	0.11	0.02	0.02
P-37	J-35	J-34	10.64	0.00	0.00	0.03	0.00	0.00
P-38	J-24	J-35	54.55	0.00	0.00	0.15	0.02	0.02
P-39	J-29	J-24	89.29	0.01	0.00	0.25	0.04	0.04
P-4	J-3	J-36	5.21	0.00	0.00	0.01	0.00	0.00
P-40	J-27	J-4	117.17	0.03	0.00	0.33	0.07	0.07
P-41	J-24	J-17	10.83	0.00	0.00	0.07	0.01	0.01
P-42	J-7b	J-7a	150.00	0.02	0.00	0.96	0.88	0.88
P-43	J-30	J-29	0.00	0.00	0.00	0.00	0.00	0.00
P-5	J-9	J-8	22.75	0.00	0.00	0.06	0.00	0.00
P-6	W-3	J-11	150.00	0.00	0.00	0.43	0.10	0.10
P-7	W-4	J-13	0.00	0.00	0.00	0.00	0.00	0.00
P-8	J-15	J-14	0.45	0.00	0.00	0.00	0.00	0.00
P-9	J-17	J-16	2.73	0.00	0.00	0.02	0.00	0.00

N O D E   R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	NODE ELEVATION (ft)	PRESSURE HEAD (ft)	NODE PRESSURE (psi)
J-1		24.03	355.05	204.38	150.67	65.29
J-11		70.17	355.06	189.02	166.04	71.95
J-13		2.53	355.03	182.80	172.24	74.64

J-14	4.33	355.03	197.07	157.96	68.45
J-15	2.87	355.03	179.32	175.72	76.14
J-16	6.19	355.04	189.51	165.53	71.73
J-17	8.11	355.04	180.53	174.51	75.62
J-18	3.96	355.07	188.63	166.44	72.13
J-19	13.88	355.03	178.75	176.29	76.39
J-2	9.64	355.04	188.22	166.82	72.29
J-20	18.02	355.03	176.05	178.98	77.56
J-21	2.19	355.04	178.23	176.81	76.62
J-22	1.08	355.03	178.09	176.94	76.67
J-23	3.58	355.04	180.45	174.59	75.65
J-24	6.04	355.04	185.20	169.84	73.60
J-25	5.99	355.04	180.09	174.95	75.81
J-27	32.83	355.10	173.06	182.04	78.88
J-29	8.94	355.05	176.45	178.60	77.39
J-3	10.83	355.03	176.83	178.20	77.22
J-30	0.00	355.05	176.44	178.61	77.40
J-32	12.75	355.04	187.97	167.07	72.40
J-33	0.00	355.04	174.60	180.44	78.19
J-34	2.39	355.04	181.38	173.66	75.25
J-35	1.25	355.04	180.07	174.97	75.82
J-36	2.17	355.03	173.38	181.66	78.72
J-37	4.01	355.03	186.58	168.46	73.00
J-4	14.98	355.07	178.48	176.59	76.52
J-5	----	355.00	178.30	176.70	76.57
J-6	5.42	355.03	173.96	181.07	78.47
J-7a	0.00	355.03	177.00	178.03	77.15

J-7b	-150.00	355.06	177.14	177.92	77.10
J-8	4.33	355.03	181.78	173.26	75.08
J-9	0.00	355.03	181.44	173.59	75.22
W-2	-150.00	355.11	151.91	203.20	88.05
W-3	-150.00	355.06	188.82	166.24	72.04
W-4	0.00	355.03	174.73	180.30	78.13

M A X I M U M   A N D   M I N I M U M   V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
W-2	88.05	J-1	65.29
J-27	78.88	J-14	68.45
J-36	78.72	J-16	71.73
J-6	78.47	J-11	71.95
J-33	78.19	W-3	72.04

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-33	1.07	P-8	0.00
P-42	0.96	P-12	0.01
P-16	0.43	P-4	0.01
P-6	0.43	P-3	0.02
P-40	0.33	P-9	0.02

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-33	1.09	P-8	0.00
P-42	0.88	P-12	0.00
P-16	0.10	P-4	0.00
P-6	0.10	P-3	0.00
P-40	0.07	P-9	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-33	1.09	P-8	0.00
P-42	0.88	P-12	0.00
P-16	0.10	P-4	0.00
P-6	0.10	P-3	0.00
P-40	0.07	P-9	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE (gpm)	NODE TITLE
J-5	-167.50	

NET SYSTEM INFLOW = 0.00
NET SYSTEM OUTFLOW = -167.50
NET SYSTEM DEMAND = -167.50

==
FireFlow/Hydrant Report
Fireflow/Hydrant Report:

Specified Minimum Pressure(psi or kPa): 20.0
Minimum Static Pressure(psi or kPa) : 20.0
Sp.Min Pres@FirePump Suctn(psi or kPa): 0.0

Flow-1: Flowrate to maintain the specified pressure at (hydrant) node
Node-2: Node that has a lower pressure than specified value at Flow-1
Flow-2: Flowrate to maintain the specified pressure at Node-2
Flow-3: Flowrate to maintain the specified pressure at Fire Pump Suction
(Flow-3 is based on combined value of hydrant and hose constants)

Hose Constant = 0.00

Hydrant Hydrant Elevation Demand Static Flow-1 Flow-2
Node-2 Flow-3 Flow NFPA
Node Constant gpm Pressure gpm gpm
gpm Capacity Color

J-1	204.4	24.0	65.3	4850.2		
J-11	189.0	70.2	72.0	4876.6		
J-13	182.8	2.5	74.6	5914.3		
J-14	197.1	4.3	68.5	4860.1		
J-15	179.3	2.9	76.1	6708.0	6374.0	J-14
J-16	189.5	6.2	71.7	6783.5	6318.8	J-1
J-17	180.5	8.1	75.6	5743.7		
J-18	188.6	4.0	72.1	2762.1		
J-19	178.7	13.9	76.4	6468.6		
J-2	188.2	9.6	72.3	5896.8	5461.9	J-1
J-20	176.1	18.0	77.6	10997.0	9676.0	J-1
J-21	178.2	2.2	76.6	6941.0	6508.0	J-14
J-22	178.1	1.1	76.7	4399.4		
J-23	180.5	3.6	75.7	7277.0	6756.7	J-14
J-24	185.2	6.0	73.6	7004.8	6833.6	J-1
J-25	180.1	6.0	75.8	7449.7	6918.7	J-1
J-27	173.1	32.8	78.9	5090.4		
J-29	176.5	8.9	77.4	6810.9	6470.1	J-18
J-3	176.8	10.8	77.2	5147.7		
J-30	176.4	0.0	77.4	6783.0	6461.2	J-18
J-32	188.0	12.8	72.4	7577.7	7077.5	J-1
J-33	174.6	0.0	78.2	7429.9	7293.2	J-1
J-34	181.4	2.4	75.3	7578.2	6815.6	J-1
J-35	180.1	1.2	75.8	7561.5	6842.6	J-1
J-36	173.4	2.2	78.7	4961.9		
J-37	186.6	4.0	73.0	5098.4		
J-4	178.5	15.0	76.5	5577.7	5343.2	J-18
J-6	174.0	5.4	78.5	4517.5		
J-7a	177.0	0.0	77.1	15010.4	13258.5	J-1
J-7b	177.1	-150.0	77.1	10540.3		
J-8	181.8	4.3	75.1	5396.1		
J-9	181.4	0.0	75.2	5552.5	5544.6	J-8
W-2	151.9	-150.0	88.1	5208.6	4907.6	J-27
W-3	188.8	-150.0	72.0	4622.6		
W-4	174.7	0.0	78.1	5992.1	5911.8	J-13

Hughesville Sewer Collection System
Alternative S2
Hydraulic Model

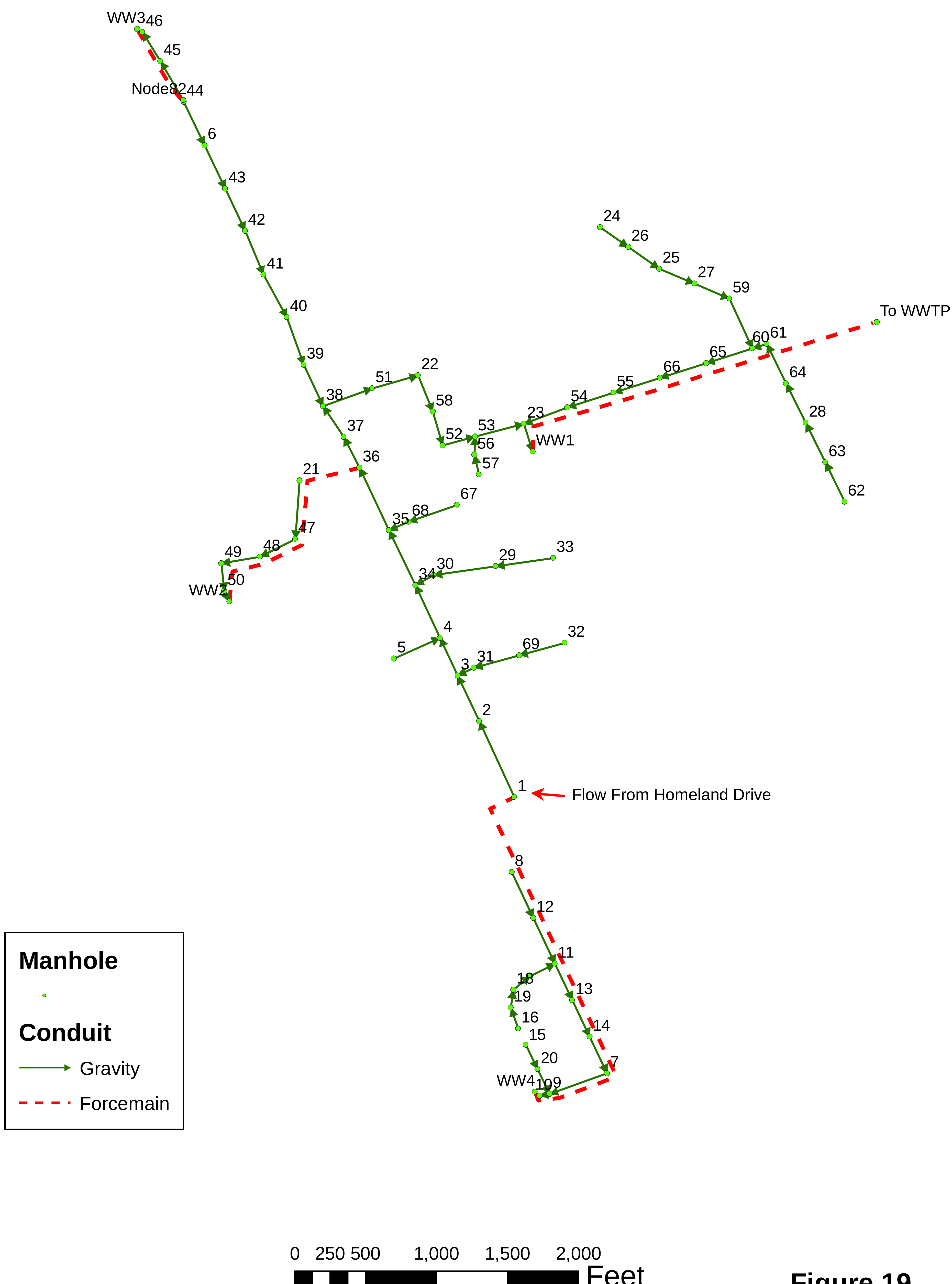


Figure 19

Hydraulic Model Output: Alternative D-2

Conduit Data

Conduit Name	Upstream Node Name	Downstream Node Name	n	Conduit Slope %	Length ft	Diameter (Height) in	Full Flow gpd (Q)	Design Hydraulic Flow gpd (q)	q/Q	d/D (depth/Diameter)	Is d/D <0.67?
Link1	1	2	0.011	0.5	353	7.764	601075	295367	0.491	0.496	Yes
Link10	7	9	0.011	0.5	430	7.764	601075	42657	0.071	0.18	Yes
Link11	9	10	0.011	0.5	60	7.764	601075	52998	0.088	0.201	Yes
Link12	16	19	0.011	0.5	155	7.764	601075	2585	0.004	0.049	Yes
Link13	19	18	0.011	0.5	130	7.764	601075	6463	0.011	0.075	Yes
Link14	18	17	0.011	0.5	153	7.764	601075	9048	0.015	0.087	Yes
Link15	17	11	0.011	0.5	195	7.764	601075	14219	0.024	0.107	Yes
Link16	15	20	0.011	1	193	7.764	853138	5171	0.006	0.056	Yes
Link17	20	9	0.011	1	193	7.764	853138	9048	0.011	0.073	Yes
Link18	4	34	0.011	0.5	410	7.764	601075	275977	0.459	0.475	Yes
Link19	34	35	0.011	0.5	429	7.764	601075	285672	0.475	0.486	Yes
Link2	2	3	0.011	0.5	336	7.764	601075	285672	0.475	0.486	Yes
Link20	35	36	0.011	0.5	487	7.764	601075	288257	0.480	0.488	Yes
Link21	36	37	0.011	0.5	243	9.516	1034107	419460	0.406	0.446	Yes
Link22	37	38	0.011	0.5	261	9.516	1034107	416874	0.403	0.547	Yes
Link23	32	69	0.011	3.951	329	7.764	1693350	10987	0.006	0.058	Yes
Link24	69	31	0.011	1.761	335	7.764	1131055	10987	0.010	0.07	Yes
Link25	31	3	0.011	0.5	127	7.764	601075	14865	0.025	0.324	Yes
Link26	33	29	0.011	0.5	410	7.764	601075	8402	0.014	0.084	Yes
Link27	29	30	0.011	0.869	443	7.764	794970	13573	0.017	0.091	Yes
Link28	30	34	0.011	0.5	145	7.764	601075	20036	0.033	0.126	Yes
Link29	67	68	0.011	3.343	362	7.764	1557624	4524	0.003	0.04	Yes
Link3	3	4	0.011	0.5	293	7.764	601075	285672	0.475	0.486	Yes
Link30	68	35	0.011	0.5	150	7.764	601075	4524	0.008	0.064	Yes
Link31	21	47	0.011	2.663	413	7.764	1389581	25206	0.018	0.094	Yes
Link32	47	48	0.011	0.5	273	7.764	601075	31670	0.053	0.156	Yes
Link33	48	49	0.011	0.5	280	7.764	601075	31670	0.053	0.156	Yes
Link34	49	50	0.011	0.5	197	7.764	601075	76265	0.127	0.24	Yes
Link35	45	46	0.011	0.5	244	7.764	601075	21328	0.035	0.236	Yes
Link36	Node82	45	0.011	0.5	327	7.764	601075	21328	0.035	0.129	Yes

Hydraulic Model Output: Alternative D-2

Conduit Data

Conduit Name	Upstream Node Name	Downstream Node Name	n	Conduit Slope %	Length ft	Diameter (Height) in	Full Flow gpd (Q)	Design Hydraulic Flow gpd (q)	q/Q	d/D (depth/Diameter)	Is d/D <0.67?
Link37	44	6	0.011	0.45	340	7.764	568759	201651	0.355	0.413	Yes
Link38	6	43	0.011	0.5	340	7.764	601075	210053	0.349	0.408	Yes
Link39	43	42	0.011	0.5	327	7.764	601075	239784	0.399	0.439	Yes
Link4	5	4	0.011	0.5	365	7.764	601075	1293	0.002	0.037	Yes
Link40	42	41	0.011	0.5	337	7.764	601075	240430	0.400	0.439	Yes
Link41	41	40	0.011	0.5	342	7.764	601075	243661	0.405	0.443	Yes
Link42	40	39	0.011	0.5	335	7.764	601075	263697	0.439	0.463	Yes
Link43	39	38	0.011	0.5	321	7.764	601075	268868	0.447	0.468	Yes
Link44	38	51	0.011	0.5	369	9.516	1034107	674109	0.652	0.591	Yes
Link45	51	22	0.011	0.5	335	9.516	1034107	679279	0.657	0.593	Yes
Link46	22	58	0.011	0.5	272	9.516	1034107	697376	0.674	0.604	Yes
Link47	58	52	0.011	0.5	250	9.516	1034107	705132	0.682	0.609	Yes
Link48	52	53	0.011	0.5	236	9.516	1034107	709656	0.686	0.611	Yes
Link49	57	56	0.011	3.451	142	7.764	1583476	7756	0.005	0.051	Yes
Link5	8	12	0.011	0.5	358	7.764	601075	7756	0.013	0.081	Yes
Link50	56	53	0.011	7.752	129	7.764	2371983	7756	0.003	0.042	Yes
Link51	53	23	0.011	0.5	356	9.516	1034107	715473	0.692	0.616	Yes
Link52	54	23	0.011	0.5	329	7.92	633391	140897	0.222	0.32	Yes
Link53	55	54	0.011	0.5	342	7.764	601075	140897	0.234	0.329	Yes
Link54	66	55	0.011	0.5	342	7.764	601075	124739	0.208	0.309	Yes
Link55	62	63	0.011	0.5	310	7.764	601075	25853	0.043	0.142	Yes
Link56	63	28	0.011	0.5	310	7.764	601075	49766	0.083	0.195	Yes
Link57	28	64	0.011	0.5	310	7.764	601075	86606	0.144	0.256	Yes
Link58	64	61	0.011	0.5	310	7.764	601075	95009	0.158	0.269	Yes
Link59	61	60	0.011	0.5	105	7.764	601075	95009	0.158	0.269	Yes
Link6	12	11	0.011	0.5	357	7.764	601075	14219	0.024	0.107	Yes
Link60	60	65	0.011	0.5	342	7.764	601075	104057	0.173	0.281	Yes
Link61	65	66	0.011	0.5	342	7.764	601075	120861	0.201	0.304	Yes
Link62	26	25	0.011	1	272	7.764	853138	2585	0.003	0.04	Yes
Link63	25	27	0.011	1	269	7.764	853138	3878	0.005	0.049	Yes

Hydraulic Model Output: Alternative D-2

Conduit Data

Conduit Name	Upstream Node Name	Downstream Node Name	n	Conduit Slope %	Length ft	Diameter (Height) in	Full Flow gpd (Q)	Design Hydraulic Flow gpd (q)	q/Q	d/D (depth/Diameter)	Is d/D <0.67?
Link64	27	59	0.011	1	267	7.764	853138	7109	0.008	0.065	Yes
Link65	59	60	0.011	1	386	7.764	853138	9048	0.011	0.073	Yes
Link7	11	13	0.011	0.5	285	7.764	601075	33608	0.056	0.16	Yes
Link74	50	WW2	0.011	0.5	50	7.764	601075	110520	0.184	0.29	Yes
Link75	23	WW1	0.011	1	190	9.516	1467139	864126	0.589	0.552	Yes
Link77	10	WW4	0.011	0.5	40	7.764	601075	54291	0.090	0.203	Yes
Link79	46	WW3	0.011	0.5	54	7.764	601075	193895	0.323	0.39	Yes
Link8	13	14	0.011	0.5	285	7.764	601075	37486	0.062	0.169	Yes
Link81	24	26	0.011	1	237	7.764	853138	1293	0.002	0.029	Yes
Link9	14	7	0.011	0.5	285	7.764	601075	41364	0.069	0.178	Yes
Link73	WW2	36	0.011	-0.109	1519	4.266		144129		0	NA
P4	WW4	1	0.011	-0.585	3078	4.266		144129		0	NA
P3	WW3	44	0.011	-1.021	1077	4.266		201651		0	NA
P1	WW1	Discharge	0.011	-3.5	1000	6.4		864126		0	NA

Hydraulic Model Output: Alternative D-2

Node Data

Name	Ground Elevation (Spill Crest) ft	Invert Elevation ft	Constant Inflow (4*ADF + I/I) gpd
1	183	178	14,993
10	175	164.98	260
11	176	172.22	1,040
12	178	174.11	1,300
13	175	170.69	780
14	174	169.16	780
15	180	169.44	1,040
16	182	175.775	520
17	180	173.295	1,040
18	180	174.155	520
19	182	174.9	780
2	179	176.13	859
20	178	167.41	780
21	189	183	4,906
22	181	158.2	3,892
23	176	152.23	1,456
24	186	180.71	260
25	178	175.42	260
26	183	178.24	260
27	187	172.63	687
28	178	166.81	7,190
29	200	177.85	1,040
3	178	173.16	260
30	178	173.9	1,290
31	178	173.9	780
32	198	193	2,080
33	185	180	1,663
34	176	169.45	169
35	178	167.2	1,068
36	181	164.66	1,008
37	185	163.34	306
38	189	162	266
39	188	176.54	1,033
4	177	171.6	530
40	187	178.32	3,923
41	192	180.13	633
42	190	181.92	69
43	194	183.57	5,775
44	193	187	0
45	188	185.26	0
46	188	183.94	33,679
47	178	171.9	1,216
48	178	170.43	0
49	178	168.93	8,652
5	178	174	260

Hydraulic Model Output: Alternative D-2

Node Data

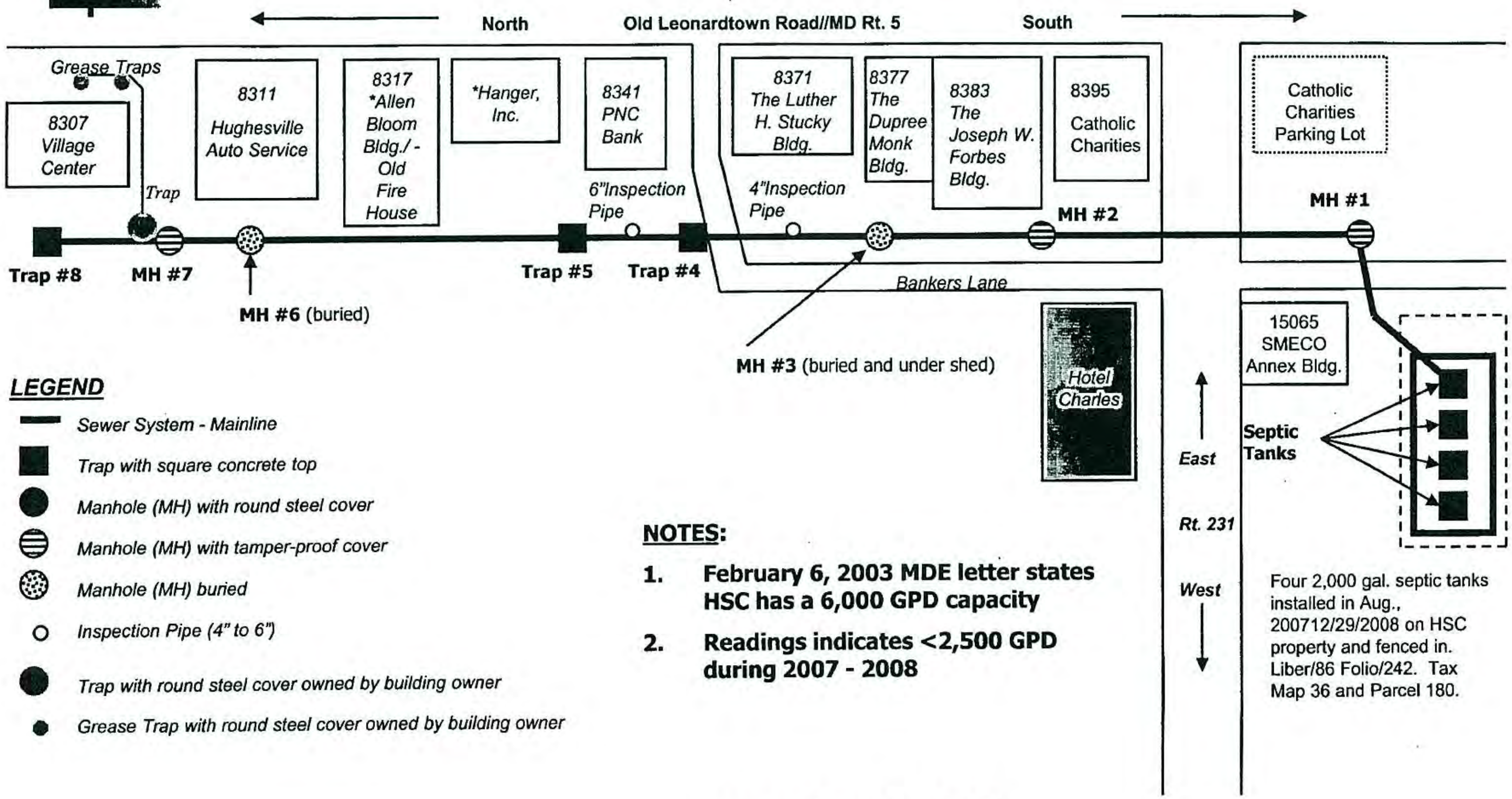
Name	Ground Elevation (Spill Crest) ft	Invert Elevation ft	Constant Inflow (4*ADF + I/I) gpd
50	178	167.84	6,661
51	189	160	1,508
52	184	155.39	1,186
53	183	154.11	0
54	170	155.645	0
55	168	157.46	3,189
56	184	170	0
57	183	175	1,513
58	178	156.74	1,774
59	184	169.86	412
6	201	185.37	1,638
60	177	162.89	0
61	179	163.515	0
62	174	170.11	5,085
63	176	168.46	4,687
64	181	165.16	1,606
65	170	161.08	3,280
66	169	159.27	770
67	198	185.1	828
68	178	172.9	0
69	184	179.9	0
7	173	167.63	260
8	181	176	1,560
9	174	165.38	260
Node82	193	187	4,123
Discharge	200	186	0
WW1	174	141	0
WW2	178	163	0
WW3	188	171	0
WW4	175	158	0
Total			149,642

Attachments

Hughesville Sanitary Commission

December 31, 2000 Report

HUGHESVILLE SANITARY COMMISSION



LEGEND

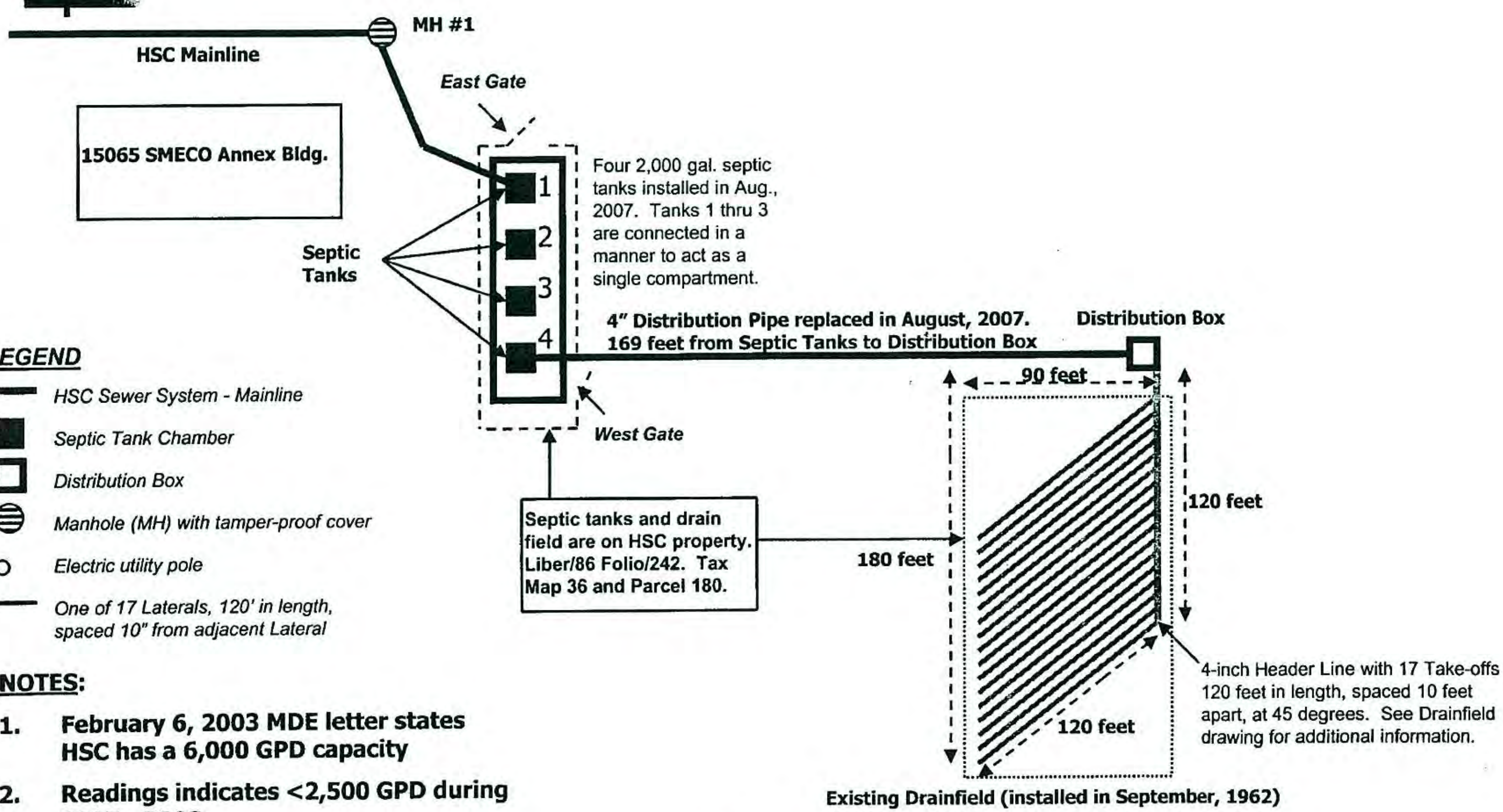
- *Sewer System - Mainline*
- *Trap with square concrete top*
- *Manhole (MH) with round steel cover*
- *Manhole (MH) with tamper-proof cover*
- *Manhole (MH) buried*
- *Inspection Pipe (4" to 6")*
- *Trap with round steel cover owned by building owner*
- *Grease Trap with round steel cover owned by building owner*

NOTES:

1. **February 6, 2003 MDE letter states HSC has a 6,000 GPD capacity**
2. **Readings indicates <2,500 GPD during 2007 - 2008**

December 31, 2008

HUGHESVILLE SANITARY COMMISSION



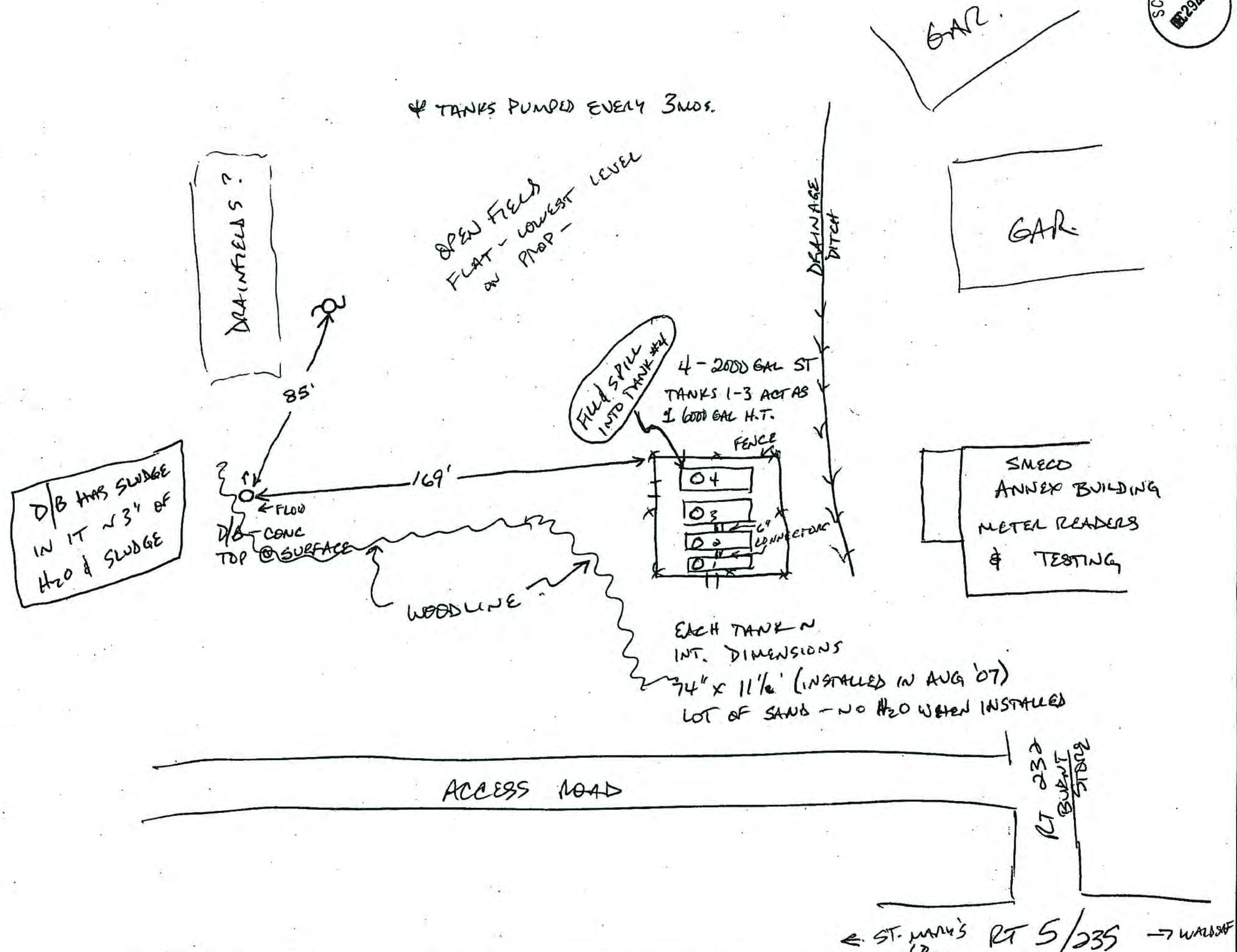
LEGEND

- *HSC Sewer System - Mainline*
- *Septic Tank Chamber*
- *Distribution Box*
- *Manhole (MH) with tamper-proof cover*
- *Electric utility pole*
- *One of 17 Laterals, 120' in length, spaced 10" from adjacent Lateral*

NOTES:

1. **February 6, 2003 MDE letter states HSC has a 6,000 GPD capacity**
2. **Readings indicates <2,500 GPD during 2007 - 2008**

December 31, 2008


GAR.
TANKS PUMPED EVERY 3 MOS.
DRAINFIELDS ?
OPEN FIELDS
FLAT - LOWEST LEVEL
ON PROP -
DRAINAGE DITCH
GAR.
FILL & SPILL INTO TANK #4
4 - 2000 GAL ST
TANKS 1-3 ACT AS
1 6000 GAL H.T.
FENCE
85'
169'
D/B HAS SLUDGE IN IT ~ 3" OF H2O & SLUDGE
FLOW
D/B - CONC
TOP @ SURFACE
6" CONNECTORS
SMECO
ANNEX BUILDING
METER READERS
& TESTING
WOODLINE
EACH TANK ~
INT. DIMENSIONS
74" x 11'1/2' (INSTALLED IN AUG '07)
LOT OF SAND - NO H2O WHEN INSTALLED
ACCESS ROAD
RT 232
BURNT STORE
← ST. MARY'S CO.
RT 5/235
→ WALDORF

HUGHESVILLE SANITARY COMMISSION
4th Qtr, 2007 and
1st Qtr, 2008 Usage

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#1	**SMECO Annex Building** **15065 Burnt Store Road**								
	Inline Meter	32971050			1580290	6,860	1573430	10,560	1562870
	Remote Meter								

Notes:

2007, 4th Quarter
92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (10,560 gal.)
average daily usage is 176 gal. (10,560 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 176 gal.)=16,192 gal.

2008, 1st Quarter
25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 176 gal. (10,560 gal. divided by 60 days)
Subtotal 1st Quarter (01/01/08-01/25/08) estimated usage is 4,400 (25 days x 176 gal.)
01/25/08 - 03/26/08 actual meter reading = 10,560 (gal.)
Total 1st Quarter total usage is 14,960 gal. (4,400 + 10,560)

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#2	**Catholic Charities** **8395 Pt. Lookout Rd.**								
	Inline Meter	19994745			2623000	48,140	2574860	84,900	2489960
	Remote Meter								

Notes:

2007, 4th Quarter
92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (84,900 gal.)
average daily usage is 1,415 gal. (84,900 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 1,415 gal.)=130,180 gal.

2008, 1st Quarter
25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 1,415 gal. (84,900 gal. divided by 60 days)
Subtotal 1st Quarter (01/01/08 - 01/25/08) estimated usage is 35,375 (25 days x 1,415 gal.)
01/25-08 - 03/26/08 actual meter reading = 84,900 (gal.)
Total 1st Quarter total usage is 120,275 gal. (35375 + 84,900)

HUGHESVILLE SANITARY COMMISSION
4th Qtr, 2007 and
1st Qtr, 2008 Usage

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#3	**Joseph W. Forbes Bldg** **8383 Pt. Lookout Rd.** Inline Meter Remote Meter	76423428			585270	8,790	576480	14,160	562320

Notes:

2007, 4th Quarter

92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (14,160 gal.)
average daily usage is 236 gal. (14,160 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 236 gal.)=21,712 gal.

2008, 1st Quarter

25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 236 gal. (14,160 gal. divided by 60 days)
Subtotal 1st Quarter (01/01/08 - 01/25/08) estimated usage is 5,900 (25 days x 236 gal.)
01/25-08 - 03/26/08 actual meter reading = 5,900 (gal.)
Total 1st Quarter total usage is 20,060 gal. (5,900 + 14,160)

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#4	**Dupree Monk Bldg.** **8377 Pt. Lookout Rd.** Inline Meter Remote Meter	33083964	415480	5,260	410220				

Notes:

2007, 4th Quarter

92 days (09/30/07 - 01/01/08), based upon 04/30/08 - 05/28/08 (28 days) usage (187 gal.)
average daily usage is 187 gal. (5,260 gal. divided by 28 days)
Total quarterly estimated usage is (92 days x 187 gal.)= 17,204 gal.

2008, 1st Quarter

85 days of average usage (01/01/08 - 03/26/08)
average daily usage is 187 gal. (5,260 gal. divided by 28 days)
Total 1st Quarter total usage is 15,895 gal.

HUGHESVILLE SANITARY COMMISSION
4th Qtr, 2007 and
1st Qtr, 2008 Usage

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#5	**Luther H. Stucky Bldg.**								
	8371 Pt. Lookout Rd.								
	Tri-County Commuity Action								
	Inline Meter	785840			1514430	2,970	1511460	5,730	1505730
	Remote Meter								
#6	**PNC Bank**								
	8341 Pt. Lookout Rd.						(Installed 03/28/08)		
	Inline Meter	96534018			662100	1,110	660990		
	Remote Meter								

#5 Notes:

2007, 4th Quarter
92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (5,730 gal.)
average daily usage is 95 gal. (5,730 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 95 gal.)=8,740 gal.

2008, 1st Quarter
25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 95 gal. (5,730 gal. divided by 60 days)
Subtotal 1st Quarter (01/01/08 - 01/25/08) estimated usage is 2,374 (25 days x 95 gal.)
01/25-08 - 03/26/08 actual meter reading = 5,730 (gal.)
Total 1st Quarter total usage is 8,104 gal. (5,730 + 2,374)

#6 Notes:

2007, 4th Quarter
92 days (09/30/07 - 01/01/08), based upon 03/28/08 - 04/30/08 (33 days) usage (1,110 gal.)
average daily usage is 33 gal. (1,110 gal. divided by 33 days)
Total quarterly estimated usage is (92 days x 33 gal.)=3,036 gal.

2008, 1st Quarter
87 days of average usage (01/01/08 - 03/28/08)
average daily usage is 33 gal. (1,110 gal. divided by 33 days)
Total 1st Quarter total usage is 2871 gal. (87 days x 33 gal.)

HUGHESVILLE SANITARY COMMISSION
4th Qtr, 2007 and
1st Qtr, 2008 Usage

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#7	**Hanger, Inc.**								
	Pt. Lookout Rd.								
	Inline Meter	528442			317470	170	317300	200	317100
	Remote Meter								

Notes:

2007, 4th Quarter

92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (200 gal.)
average daily usage is 3 gal. (200 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 3 gal.)=276 gal.

2008, 1st Quarter

25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 3 gal. (200 gal. divided by 60 days)
Subtotal, 1st Quarter (01/01/08 - 01/25/08) estimated usage is 75 (25 days x 3 gal.)
01/25-08 - 03/26/08 actual meter reading = 200 (gal.)
Total 1st Quarter total usage is 275 gal. (75 + 200)

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#8	**Allen Bloom/Old Firehouse**								
	Ke[illegible] Enterprises								
	8317 Pt. Lookout Rd.				Installed 05/05/08 with zero reading				
	Inline Meter	1293315	390						
	Remote Meter								

Notes:

2007, 4th Quarter

92 days (09/30/07 - 01/01/08), based upon 05/05/08 - 05/28/08 (23 days) usage (16 gal.)
average daily usage is 16 gal. (390 gal. divided by 23 days)
Total quarterly estimated usage is (92 days x 16 gal.)= 1,472 gal.

2008, 1st Quarter

85 days of average usage (05/05/08 - 05/23/08)
average daily usage is 16 gal. (390 gal. divided by 23 days)
Total 1st Quarter total usage is 1,360 gal.

HUGHESVILLE SANITARY COMMISSION
4th Qtr, 2007 and
1st Qtr, 2008 Usage

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#9	**Stratchko Garage**								
	Hughesville Auto Service								
	8311 Pt. Lookout Rd.								
	Inline Meter	785832			184010	150	183860	300	183560
	Remote Meter								
	Notes:								

2007, 4th Quarter

92 days (09/30/07 - 01/01/08), based upon 01/25/08 - 03/26/08 (60 days) usage (300 gal.)
average daily usage is 5 gal. (300 gal. divided by 60 days)
Total quarterly estimated usage is (92 days x 5 gal.)=460 gal.

2008, 1st Quarter

25 days of average usage (01/01/08 - 01/25/08), actual meter reading (01/25/08 - 03/26/08)
average daily usage is 5 gal. (300 gal. divided by 60 days)
Subtotal 1st Quarter (01/01/08 - 01/25/08) estimated usage is 125 (25 days x 5 gal.)
01/25-08 - 03/26/08 actual meter reading = 300 gal.
Total 1st Quarter total usage is 425 gal. (125 + 300)

Service	Building/Business	Meter Number	5/28/2008	Usage	4/30/2008	Usage	3/26/2008	Usage	1/25/2008
#10	**Stratchko House**								
	Village Center								
	8304-8307 Pt. Lookout Rd.								
	Inline Meter	2196431			0				
	Remote Meter								
	Notes:								

2007, 4th Quarter — **Connection fee only, no usage**

2008, 1st Quarter — **Connection fee only, no usage**

HYDROGEOLOGIC DATA FROM SIX TEST WELLS IN THE UPPER PATAPSCO AND LOWER PATAPSCO AQUIFERS IN SOUTHERN MARYLAND

Department of Natural Resources
Resource Assessment Service
MARYLAND GEOLOGICAL SURVEY
Jeffrey P. Halka, Acting Director

BASIC DATA REPORT NO. 22

HYDROGEOLOGIC DATA FROM SIX TEST WELLS IN THE UPPER PATAPSCO AND LOWER PATAPSCO AQUIFERS IN SOUTHERN MARYLAND

by

Nadine Calis and David D. Drummond

Prepared in cooperation with the
Boards of County Commissioners of
Calvert, Charles, and St. Mary's Counties
and the
United States Department of the Interior
Geological Survey

2008

State of Maryland

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Maryland Department of Natural Resources
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Maryland Department of
Natural Resources

John R. Griffin
Secretary

Eric Schwaab
Deputy Secretary

BASIC DATA REPORT NO. 22

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Jeffrey P. Halka, Acting Director
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HYDROGEOLOGIC DATA FROM SIX TEST WELLS IN THE UPPER PATAPSCO AND LOWER PATAPSCO AQUIFERS IN SOUTHERN MARYLAND

by

Nadine Calis and David D. Drummond

ABSTRACT

Six exploratory test wells were drilled in Southern Maryland to obtain hydrogeologic data for the Upper Patapsco and Lower Patapsco aquifers. Information collected from the test wells includes lithologic descriptions of sediments; biostratigraphic analyses using fossil pollen, spores, and plankton; geophysical logs; hydraulic characteristics; water-quality analyses; and water-level data. The hydrogeologic data were used in a regional study of the water-supply potential of the Coastal Plain aquifers in Calvert, Charles, and St. Mary's Counties, Maryland. This report documents the hydrogeologic data collected from the wells, and includes brief descriptions of associated drilling, construction, and data-collection procedures.

INTRODUCTION

Six exploratory test wells were drilled to depths of about 1,650 feet (ft) into the Upper Patapsco and Lower Patapsco aquifers between April 2001 and March 2003 (fig. 1). The test wells were drilled in order to obtain hydrogeologic data for the Patapsco aquifer system in Southern Maryland. The test-well drilling program was part of a regional study to assess the water-bearing potential of the aquifer system in Calvert, Charles, and St. Mary's Counties. Two wells were drilled in each county. The results of the regional study are presented in a summary administrative report (Drummond, 2005) and in a comprehensive final report (Drummond, 2007).

Location of Study Area and Test Wells

The study area comprises three counties in Southern Maryland: Calvert, Charles, and St. Mary's. This area is bounded by the Chesapeake Bay to the east, the Potomac River to the south and west, and Anne Arundel and Prince George's Counties to the north (fig. 1). The Commonwealth of Virginia lies across the Potomac River, and Washington, D.C. is about 15 miles (mi) to the north. The total land area of the three counties is 1,037 square miles (mi^2).

Well locations were chosen to provide hydrogeologic information where it was previously lacking, and to provide long-term monitoring of water levels. Wells CA Db 96 and CH Cg 24 were screened in the Upper Patapsco aquifer, and wells CA Fd 85, CH Bg 17, SM Bc 39, and SM Dd 72 were screened in the Lower Patapsco aquifer. Well numbers comprise a county prefix (CA for Calvert, CH for Charles, and SM for St. Mary's), a two-letter designation for the 5-minute latitude/longitude grid within each county, and a sequential number assigned to wells as they were inventoried within each 5-minute quadrangle. Curtin and Dine (1995) provide a full explanation of the well-numbering system, and include maps showing the 5-minute quadrangle grid for each county in Southern Maryland.

Hydrogeologic Setting

The study area lies completely within the Coastal Plain province of Maryland. Coastal Plain geologic formations consist of layers of sand, silt, clay, and gravel that generally become deeper and thicker to the southeast, and overlie a basement complex of largely crystalline bedrock. Sand and gravel layers form aquifers, which provide water to wells; clay and silt layers form confining units, which limit flow between the aquifers and provide storage for the aquifer system. Aquifers and confining units penetrated by the test wells are shown in the generalized hydrogeologic section in figure 2, and the hydrogeologic characteristics of these units are briefly described in table 1.

Aquifers penetrated by the test wells include (from shallow to deep) the Surficial, Piney Point, Aquia, Magothy, Upper Patapsco, and Lower Patapsco aquifers. Intervening confining units include the Chesapeake, Nanjemoy, Brightseat, Upper Patapsco, Middle Patapsco, and Arundel confining units. The Surficial aquifer is used by some older, shallow wells throughout the study area. The Piney Point and Aquia aquifers are used predominantly in Calvert and St. Mary's Counties. The Magothy, Upper Patapsco, and Lower Patapsco aquifers are currently used primarily in Charles County, but are being developed in Calvert and St. Mary's Counties.

The Patuxent aquifer, which is the deepest freshwater aquifer in Southern Maryland, underlies the Arundel confining unit, and rests on the bedrock surface beneath most of the study area. The Patuxent aquifer is currently used for water supply only in the northwestern part of the study area, and was not included in this study.

The deepest well drilled in Southern Maryland, at Lexington Park, reached bedrock at 2,623 ft below land surface or 2,515 ft below sea level (Hansen and Wilson, 1984). At this site (and perhaps elsewhere in the study area) the Patuxent aquifer may be underlain by thin remnants of the Waste Gate Formation, a brackish-water, silty sand that rests on the bedrock surface. The Waste Gate Formation thins updip to zero-thickness by onlap of younger units, and is largely restricted to the lower Delmarva Peninsula. Neither the Waste Gate Formation nor the underlying bedrock units are considered potential water sources in Southern Maryland (tab. 1).

Acknowledgments

Cooperative funding for this study was provided by the County Commissioners of Calvert, Charles, and St. Mary's Counties; the Maryland Department of Natural Resources; and the U.S. Department of the Interior, Geological Survey. Additional funding was provided by the Chesapeake Ranch Water Company[1]. Sites for test-well drilling were provided by the Calvert County Department of Public Works, Charles County Public Schools, Chesapeake Ranch Water Company, Maryland Department of Natural Resources, and the St. Mary's County Metropolitan Commission.

Field data were collected by Nadine Calis, Karen Jennings, Brandon Fewster, Barbara Cooper, and David Bolton, all of the Maryland Geological Survey. Stephen Curtin, of the U.S. Geological Survey, performed geophysical logging of some test wells. Donajean Appel of the Maryland Geological Survey assisted in preparation of the tables and other aspects of the report. The report was reviewed by Donajean Appel, David Bolton, Harry Hansen, and Claire Richardson of the Maryland Geological Survey, and Michael Smigaj of the U.S. Geological Survey (USGS). Special thanks go to the homeowners in Calvert, Charles, and St. Mary's Counties who patiently endured around-the-clock test-drilling operations in their neighborhoods.

WELL DRILLING AND CONSTRUCTION

Test-well borings were drilled to depths ranging from 1,600 to 1,667 ft below land surface (tab. 2), using the direct rotary method. Wells CA Db 96, CH Bg 17, and SM Dd 72 were drilled by A. C. Schultes of Maryland, Inc., and wells CA Fd 85, CH Cg 24, and SM Bc 39 were drilled by Sydnor Hydrodynamics, Inc. Drill cuttings were collected at changes of drill rods (20-foot intervals), and in some wells, samples were also collected at mid-rod lengths (10-foot intervals). Descriptions of sediments were recorded by the well drillers (tabs. 3 through 8),

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[1] The Chesapeake Ranch Water Company changed its name to The Chesapeake Water Association in November, 2004. The community of Chesapeake Ranch Estates is generally referred to as Chesapeake Ranch in this report.

based on drill cuttings and the response of the drilling rig to different sediment types. Drilling fluid was circulated for up to several hours to allow drill cuttings to reach the surface before proceeding to the next depth interval; however, some recirculation and mixing of sediments between intervals was unavoidable.

After each borehole was drilled to final depth, the drilling fluid was thinned and geophysical logs were run. Screen intervals were determined based on sediment logs and geophysical logs. The test wells were constructed with 4-inch diameter steel casing and 4-inch wire-wound stainless steel well screens. Diagrams showing well construction features are shown in figures 3 through 5. The boreholes for the two Upper Patapsco wells (CA Db 96 and CH Cg 24), were plugged below the well screens to prevent flow between the Upper and Lower Patapsco aquifers. Screened intervals were gravel packed, and the annular space outside the well casings was grouted using either cement grout or a mix of cement and bentonite. A ten-foot section of blank casing was installed below the deepest screen section in each well to allow settling of sediment without clogging the well screen. The 4-inch well casing was extended about 2 ft above land surface. After the grout was properly cured, each well was developed using compressed air and high-pressure jetting to remove fine-grained material from the well casing and screen openings.

In wells CA Db 96 and CH Cg 24, which were screened in the Upper Patapsco aquifer, the sandy intervals that were eventually screened were exposed to drilling fluid for extended periods of time as the boreholes were drilled to final depth. The sands screened in well CH Bg 17 were also exposed to drilling fluid for an extended period due to well-construction problems. These time periods ranged up to several weeks, and probably resulted in extensive invasion of the sands with drilling fluid, and led to difficulties in thoroughly developing the wells. Incomplete well development may have decreased well yields in these wells.

An aquifer test was performed for each well, and water samples were collected for chemical analyses during the pumping phase of the aquifer test. Drilling equipment was then removed and the drill site restored to previous conditions. A 6-inch steel protective casing was cemented in place to protect the 4-inch well casing from damage, and was extended about 3 ft above land surface. The altitude of the top of each well casing was surveyed from a nearby benchmark, except for well CH Bg 17, which was surveyed from a stream gage that had previously been surveyed for altitude. Land-surface elevation at some wells was altered during final grading in site restoration. Land-surface elevation at well CA Db 96 may also have been altered during construction of a highway bypass for Prince Frederick. Grading is not expected to affect the altitude of the top of the well casing, which was used as a datum for water-level measurements.

HYDROGEOLOGIC DATA

Lithologic Descriptions

Descriptive lithologic logs of drill cuttings were recorded by geologists on site (tabs. 9 through 14). Samples were washed using a 250-micron sieve, examined with a hand lens and described. Selected samples were examined in detail in the laboratory using a binocular microscope. Samples were dried, stored in envelopes, and archived. Color designations (e.g. 7.5YR 3/4) were made on moist material using Munsell soil color charts (Munsell Color Company, 1975). The on-site lithologic logs were aggregated for similar intervals into composite lithologic descriptions (tabs. 9 through 14). Original on-site logs are on file at the Maryland Geological Survey. Depths are in feet below land surface; dimensions of sediment grains, fossils, and rock fragments are in millimeters (mm). Formation determinations are based on lithologic data, geophysical logs, palynological data, regional cross sections, and structure-contour maps. Consequently, not all formation contacts correspond to changes in lithology in the on-site logs.

Most of the sediment samples were contaminated with up-hole material because of mixing in the fluid column and recirculation through the mud pump. In addition, much of the clayey material was pulverized by the drill bit and combined with the drilling fluid, and is under-represented in the descriptions of drill cuttings. These problems tend to increase with drilling depth. In particular, glauconite grains (and to a lesser extent shell fragments) were present in most of the samples; however, glauconite has not been documented in the Magothy or Patapsco Formations in outcrops or core holes in Maryland. It is likely that the occurrence of glauconite and shell fragments in samples from these formations is a result of recirculation and contamination from shallower intervals (particularly the Aquia and Piney Point Formations) where glauconite is common. For these reasons, drill cuttings, no matter how carefully collected and described, are not fully representative of in situ sediment materials, and should be used with caution.

Geologist's logs (tabs. 9 through 14) of the Patapsco Formation show extreme lithologic variability. The Upper Patapsco and Lower Patapsco aquifers contain significant clay and silt proportions, both intermixed and interlayered with the sands. The Upper Patapsco and Middle Patapsco confining units contain significant sandy layers, some of which may be used for water supply. Fine-grained sediments exhibit a wide range of textures and colors. Coarse-grained sediments range from fine sand to coarse gravel (and possibly pebbles and cobbles), and range in color from gray to reddish-brown. Sands are predominantly iron-stained quartz grains, but include a wide variety of accessory grains, and some cemented intervals.

Palynologic Analyses

Selected sediment samples were analyzed for fossil pollen, spore, and plankton assemblages to estimate age and depositional environment of the selected intervals. These palynologic analyses aided in the correlation of hydrogeologic units throughout the study area. Unwashed sediment samples were sent to Dr. Gilbert Brenner (Consulting Palynologist, New Paltz, New York) for analysis. Because drill cuttings were used in the analysis (core samples were not obtained during drilling), samples were significantly contaminated with material from shallower intervals, and age dating was based on the first occurrence of diagnostic forms, working downward in the section. The palynologic analyses in tables 15 through 18 are edited from Dr. Brenner's reports, in which the Arundel and Patapsco Formations are subdivided into five palynozones based on criteria discussed in Brenner (1963) and Doyle and Robbins (1977). In this system, the Arundel Formation is subdivided into Palynozones I and IIA, and the Patapsco Formation is subdivided into Palynozones IIB, IIC, and III.

The sediment samples used for palynologic analysis were selected from four of the six test wells, and ranged in depth from 520 to 1,650 ft below land surface. Seven of the 32 samples were barren (did not yield datable palynomorphs). Age determinations ranged from Paleocene (Aquia Formation) to Lower Cretaceous, Early Albian, Palynozone I (Arundel Formation). Shallower intervals were not selected for analysis because the biostratigraphy of these intervals has already been established (Hansen, 1996).

Geophysical Logs

Geophysical logs were run in the uncased boreholes after they were drilled to final depth. Geophysical logs shown in figures 6 through 11 include natural gamma, spontaneous potential, multi-point resistivity (including 16-inch and 64-inch electrode spacings) and single-point resistance. Other logs were run on some wells, including 8-inch resistivity, 32-inch resistivity, and lateral resistivity, and are on file at the Maryland Geological Survey. The spontaneous-potential log for well CA Db 96 shows an atypical signature, and appears to have malfunctioned for this well. The geophysical logs for wells CA Db 96 and CH Bg 17 (figs. 12 and 14) were run by A. C. Schultes; logs for wells CA Fd 85, CH Cg 24 and SM Bc 39 (figs. 13, 15 and 16) were run by Sydnor Hydrodynamics; the log for well SM Dd 72 (fig. 17) was run by USGS.

Geophysical logs can be used to determine generalized sediment types in boreholes. Gamma radiation generally is higher in clays and silts, and lower in sands and gravels; resistivity and resistance generally are lower in clays and silts, and higher in sands and gravels. The logs were used to determine optimal intervals for screening the test wells. Additionally, the logs were used in conjunction with geophysical logs from other wells in the region for stratigraphic correlation and sand-thickness estimates (Drummond, 2007).

Aquifer Tests

After each test well was constructed and developed, an aquifer test was performed, which included a 24-hour constant-discharge pumping phase followed by a 24-hour recovery phase. The discharge rate was held constant for each test within a few gallons per minute (gpm). Discharge was monitored using an orifice meter, and checked periodically using a totalizing flow meter, and a 55-gallon barrel and stopwatch. Withdrawal rates in the six wells ranged from 56.3 to 82.5 gpm, and specific capacities ranged from 1.51 to 4.52 gallons per minute per foot (gpm/ft) (tab. 2). Graphs showing drawdown and recovery data for the six aquifer tests are shown in figures 12 through 17.

Transmissivities calculated using the Cooper-Jacob straight-line method (Drummond, 2007) for the Upper Patapsco aquifer range from 380 to 1,100 feet squared per day (ft^2/d), and for the Lower Patapsco aquifer range from 200 to 4,000 ft^2/d (tab. 2). Analysis was complicated in four of the six wells (CA Db 96, CA Fd 85, CH Bg 17, and SM Dd 72) by significant nonlinearities in the semi-logarithmic plots. The nonlinearities are attributed primarily to heterogeneity in aquifer sediments and variable thickness of sand layers. Drummond (2007) provides a detailed discussion of the interpretation of aquifer-test results.

Water-Quality Analyses

Water samples for chemical analysis were obtained from an in-line spigot for each well during the last several hours of the withdrawal phase of the aquifer test. Chemical analyses were performed by the USGS for all wells, and also by private laboratories for all wells except SM Dd 72. Field personnel from the Maryland Geological Survey, USGS, and the private laboratories collected the water samples and performed field tests for pH, alkalinity, and specific conductance. Well CA Db 96 was resampled on February 4, 2003 because of a misplaced sample bottle in the initial sampling. Chemical analyses performed by the USGS laboratory are shown in table 19.

Water-quality analyses included major ions, nutrients, iron, manganese, fluoride, arsenic, radon, and selected field parameters (pH, alkalinity, and specific conductance). Water quality in all of the test wells appears to be suitable for most purposes, including human consumption. No U.S. Environmental Protection Agency Maximum Contaminant Levels (MCL's) were exceeded in the analyses, although not all regulated constituents were tested. The Secondary Maximum Contaminant Levels (SMCL's) for iron (300 micrograms per liter [μg/L]) and manganese (50 μg/L) were exceeded only in well CA Db 96. Arsenic concentrations were 0.3 μg/L for wells CA Db 96 and CH Cg 24, which are screened in the Upper Patapsco aquifer, and were below detection limits (0.2 to 0.3 μg/L) for the wells screened in the Lower Patapsco aquifer. Total dissolved solids (residue on evaporation at 180° C) for the six test wells ranged from 127 to 267 milligrams per liter (mg/L).

Water Levels

Automatic water-level recorders were installed on the test wells, which recorded water levels at intervals of 15 minutes (SM Bc 39), 30 minutes (CH Bg 17), or 60 minutes (CA Db 96, CA Fd 85, CH Cg 24, and SM Dd 72) until removal in August 2005. Hand-held water-level measurements were obtained during site visits to service the recorders, and continue on a semi-annual basis. Minimum daily water levels from automatic measurements and hand-held measurements are shown in figures 18 through 20.

Water levels measured in the test wells between July 2001 and September 2007 range from 14.38 to 61.81 ft below sea level. Water levels in all of the test wells show steady declines over their periods of record, and the rates of decline range from about 1.2 feet per year (ft/yr) in wells CA Fd 85 and SM Dd 72, both screened in the Lower Patapsco aquifer, to about 2.8 ft/yr in well CH Bg 17, also screened in the Lower Patapsco aquifer. Water levels in all wells display barometric fluctuations, and well SM Dd 72 displays a semi-diurnal tidal fluctuation. Well SM Dd 72 is about ½ mile from Breton Bay, which is a tidal estuary. Wells CA Db 96 and CH Cg 24, both screened in the Upper Patapsco aquifer, display distinct seasonal water-level fluctuations of about one foot, that are probably caused by seasonal variations in pumpage. The other wells, all screened in the Lower Patapsco aquifer, display less distinct seasonal water-level fluctuations.

CONCLUSIONS

Six test wells drilled into the Upper Patapsco and Lower Patapsco aquifers provide hydrogeologic data that are critical in the regional analysis of the water-bearing potential of the Coastal Plain aquifer system in Southern Maryland. Sampling of sediments and aquifer testing indicate extreme variability in lithology and hydraulic properties of these aquifers. Geophysical logs and palynologic analyses were used to define the extent and characteristics of the Patapsco aquifers and confining units in areas of Southern Maryland where data were sparse. These data also facilitated correlation with equivalent hydrogeologic units in other areas of Maryland and adjoining states. Water-quality testing indicates that water in the Upper and Lower Patapsco aquifers is of good quality and can probably be used for most purposes. Water-level monitoring in the test wells has helped define potentiometric surfaces in the Patapsco aquifers, and indicates downward trends ranging from about 1.2 to 2.8 ft/yr.

REFERENCES

Brenner, G.J., 1963, The spores and pollen of the Potomac Group of Maryland: Maryland Department of Geology, Mines, and Water Resources, Bulletin 27, 215 p.

Curtin, S.E., and Dine, J.R., 1995, Ground-water level data in Southern Maryland, 1946-94: Maryland Geological Survey Basic Data Report No. 21, 365 p.

Doyle, J.A., and Robbins, E.I., 1977, Angiosperm pollen zonation of the continental Cretaceous of the Atlantic Coastal Plain and its application to deep wells in the Salisbury Embayment: Palynology, vol. 1, p. 43-78.

Drummond, D.D., 2005, Water-supply potential of the Coastal Plain aquifers in Calvert, Charles, and St. Mary's Counties, Maryland, with emphasis on the Upper Patapsco and Lower Patapsco aquifers: Maryland Geological Survey Administrative Report, 70 p.

______ 2007, Water-supply potential of the Coastal Plain aquifers in Calvert, Charles, and St. Mary's Counties, Maryland, with emphasis on the Upper Patapsco and Lower Patapsco aquifers: Maryland Geological Survey Report of Investigations No. 76, 226 p.

Hansen, H.J., 1996, Hydrostratigraphic framework of the Piney Point-Nanjemoy aquifer and Aquia aquifer in Calvert and St. Mary's Counties, Maryland: Maryland Geological Survey Open-File Report No. 96-02-8, 45 p.

Hansen, H.J., and Wilson, J.M., 1984, Summary of hydrogeologic data from a deep (2,678 ft.) well at Lexington Park, St. Mary's County, Maryland: Maryland Geological Survey Open-File Report No. 84-02-1, 61 p.

McCartan, Lucy, 1989, Geologic map of St. Mary's County: Maryland Geological Survey, scale 1:62,500.

Munsell Color Company, Inc., 1975, Munsell Soil Color Charts: Baltimore, Maryland

Letter to SMCMC, March 4, 2009

KCI TECHNOLOGIES

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March 4, 2009

Mrs. Jacquelyn V. Meiser, Esq., Director
St. Mary's County Metropolitan Commission
43990 Commerce Avenue
Hollywood, Maryland 20636

Subject: Hughesville Business Area Water & Sewer Interconnections
PGM # VCI 09-0016
KCI JO # 01083704

Dear Mrs. Meiser,

KCI is currently under contract with the Charles County Department of Planning and Growth Management to perform a Water and Sewer Study which will evaluate alternatives for public water and sewer services to the Hughesville Business District. The area is currently served by private water and septic with the exception of 13 commercial lots located along MD Business Route 5, which discharge to a combined septic system operated by the Hughesville Sanitary Commission. Due to high groundwater in the area, failing well and septic systems will be abandoned once public water and sewer services are provided. An Overflow Elevation of 340 will ideally provide a pressure range of 65-85psi for the Hughesville Business District.

On January 14, 2009, John Meyers, of the KCI Environmental Engineering Division, contacted Chet Frederick, Chief Engineer St. Mary's County Metropolitan Commission, regarding KCI's interest in evaluating the option of a water service interconnection between Hughesville and St. Mary's County Metropolitan Commission System. Mr. Frederick indicated that he is in the process of acquiring land for a new well and water tank on Golden Beach Road, proximal to the area. He suggested contacting your office to discuss this alternative further.

Thus, we would like to schedule a meeting at your earliest convenience, to discuss the possibility of water and sewer service from SMCMC, together with Dan Ichniowski from your office along with Aaron Hamm and Cathy Hardy, representing Charles County Department of Planning and Growth Management. KCI will present estimated flows of the Hughesville Business Area at the meeting. Thank you for your time, and we will be contacting you to schedule a meeting.

Sincerely,

John R. Kovacs

John R. Kovacs, P.E.
Senior Project Manager

Mr. Kovacs's Direct Dial Number: (410) 316-7911
Fax Number: (410) 316-7935

Attachments: Study Area Boundary

JRK/kak

Cc: Dan Ichniowski, Metcom
Aaron Hamm, Charles Co.
John Stevens, Charles Co.
Cathy Hardy, Charles Co.
Tim Wolfe, KCI
File

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Letters to/from MDE

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March 23, 2009

Mr. Stephen Luckman, Chief
Municipal Surface Discharge Permits Division
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Subject: Hughesville Business Area Sewer System
PGM # VCI 09-0016
KCI JO # 01083704

Dear Mr. Luckman,

KCI is currently under contract with the Charles County Department of Planning and Growth Management (PGM) to perform a Water and Sewer Study which will evaluate alternatives for public water and sewer services to the Hughesville Priority Funding Area (PFA) (see attached plan).

KCI would like to verify with MDE, Municipal Surface Discharge Permits Division, that Charles County PGM can pursue the option of surface water discharge for this Study (Alternative 3 described below), that the outfall can be located within the stream prior to Gilberts Pond (assumed to be named Gilberts Creek), and clarification of surface water discharge effluent limits for this proposed discharge along with MDE monitoring requirements.

The Hughesville PFA is currently served by private wells and septic with the exception of 13 commercial lots located along MD Business Route 5. These 13 commercial lots are served by an absorption field, which is privately owned and maintained by Hughesville Sanitary Commission. The system is currently operating at approximately 90% of the total capacity. The system consists of terra cotta collection pipes and excessive inflow and infiltration is an issue of concern. The system's operational problems are resulting in water quality issues; the system cannot be expanded to meet current or future needs and thus will need to be phased out once public water and wastewater facilities are developed.

Due to high groundwater in the area, existing wells and failing septic systems will be abandoned once public water and sewer services are provided.

KCI submitted a 30% Study Report to Charles County PGM on March 5, 2009, which described three alternatives for public sewer systems (proposed specifically to serve The Hughesville Priority Funding Area only), including:

1. Construction of a packaged treatment plant with an onsite disposal system. The wastewater treatment plant and disposal system shall be sited on a large tract of open land which the County will have to obtain by fee-simple acquisition. This Alternative presents difficulty in finding an adequate site large enough for the design flow, which the property owner is willing to release to the County.

2. Construction of a main Sewage Pump Station along Route 231, which will pump to an interconnection with St. Mary's County Metropolitan Commission (South along Old Leonardtown Road) or to a Charles County existing wastewater treatment facility with capacity to accommodate the Hughesville Village Flows (North along Old Leonardtown Road). Possible treatment plants include the Town of La Plata Wastewater Treatment Facility and the County owned Mattawoman Treatment Plant. The difficulty with this Alternative includes required upgrades of the existing trunk sewers, pump stations and wastewater treatment capacity to accept the flows from Hughesville.

3. Construction of a packaged treatment plant and effluent pump station which will convey flow to an off-site perennial stream. The treatment plant solids will be pumped periodically and the treatment plant effluent will be discharged to an off-site perennial stream; specifically to nearby Gilberts Creek or Gilberts Pond. The effluent pump station discharge forcemain will be installed along Rte 231 within County right-of-way and along private property adjoining the stream outfall. The quantity of right-of way required along the stream will be dependent on the location of the surface water discharge allowed by Maryland Department of the Environment, as it relates to MDE's 303d List for Nutrient Impairments and TMDLs.

At the 30% Study Report level, KCI has not yet developed cost comparisons or quantity take offs. With each of the three alternatives being analyzed, the initial infrastructure will be sized and built to support the existing Village Core (see attached plan for location) flow with provisions to support additional package treatment units and increased pumping capacity to accommodate build-out flow from the Village Core and eventually build out flow from the entire Hughesville Village PFA. Estimates of the three flow phases include (in round numbers):

Flow Phases	Average Daily Flow	Peak Daily Flow (x 4.0)
1. Existing Village Core	28,000 gpd	110,000 gpd
2. Build-out Village Core	90,000 gpd	360,000 gpd
3. Build-out Hughesville	160,000 gpd	640,000 gpd

Please call at your earliest convenience to discuss. If you would prefer, the County and KCI will also be available to meet at your earliest convenience. Thank you for your time and attention to

M:\2008\01083704\Corresp\MDE surface Discharge Letter 03-23-09.doc this project. KCI is concurrently contacting Dr. Ching-Tzone Tien, MDE Groundwater Discharge Permits Division, to discuss Alternative 1 above.

Sincerely,

John R. Kovacs, P.E.
Senior Project Manager

Mr. Kovacs's Direct Dial Number: (410) 316-7911
Fax Number: (410) 316-7935

Attachments: Hughesville Business Area Water/Sewer Study 30% Report Text
Sewer Alignment Alternative S-3

JRK/kak

Cc: Aaron Hamm, Charles Co.
John Stevens, Charles Co.
Cathy Hardy, Charles Co.
Tim Wolfe, KCI
File

M:\2008\01083704\Corresp\MDE surface Discharge Letter 03-23-09.doc

MARYLAND DEPARTMENT OF THE ENVIRONMENT
MDE 1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101

RECEIVED
JUN 01 2009
KCI TECHNOLOGIES, INC.

May 26, 2009

Mr. John R. Kovacs, Senior Project Manager
KCI Technologies
936 Ridgebrook Road
Sparks, MD 21152

Subj: Hughesville Business Area Sewer System, Charles County

Dear Mr. Kovacs:

This is in response to your recent letter concerning the possibility of a possible surface discharge upstream of Gilbert Pond, and effluent limits for such a discharge. Please be aware that providing possible effluent limits for a surface does not mean that the Department would not still prefer the other options which you mentioned of a packaged plant with onsite disposal or a pumping stations connecting into the La Plata or the Mattawoman collection systems.

The most critical problem for a proposed surface discharge is the lack of nutrient allocation for Hughesville under the Chesapeake Bay Tributary Strategy. Additionally, this would be a new discharge into the Wicomico River watershed, which is on the 303(d) list of impaired waterbodies for nutrients (a TMDL has not yet been done). Another potential problem would be from the proposed discharge point, which is upstream of Gilbert Pond. We would have to do a detailed analysis for the effect of a new discharge on eutrophication, which would likely result in the need for a very strict phosphorus limit, most likely 0.1 – 0.3 mg/l TP.

The following limits are for planning purposes only, and are subject to the proposed facility being added to the County Water and Sewer Plan, to the public participation process, and to additional more detailed analysis if an application consistent with the County Plan is received. The total nitrogen (TN) allocations are based on a credit of 4.6 lbs/year TN for connecting an <u>existing</u> EDU further than 1000' from a perennial stream. If any of the existing EDUs are closer than 1000', then 7.5 lbs/yr TN will be allowed.

1) Village Core- 27,363 gpd / 250 gpd/EDU = 109 EDUs. At 4.6 lbs/yr TN/EDU, TN = 501 lbs/yr.
2) Hughesville – 124 residential units + 32,264 gpd commercial / 250 gpd/EDU = 353 EDUs. At 4.6 lbs/yr TN/EDU, TN = 1624 lbs/yr.

Please note that connecting existing septic systems do not provide any phosphorus allocations. These may be obtained by trading with another wastewater treatment plant in the watershed, by purchasing nonpoint source phosphorus credits from a web-based nutrient exchange which is expected to be available later this year, or possibly by subtracting part of the nitrogen credits obtained from connecting the septic systems at a ratio of ~1 phosphorus credit for each 10 nitrogen credits.

Other permit limits will be determined depending on exact flow and outfall locations. They are likely to be-

BOD_5 – 10 mg/l or less maximum monthly average
SS – 30 mg/l maximum monthly average
Ammonia – 2 – 4 mg/l maximum monthly average
Dissolved oxygen – 5 -6 mg/l minimum at any time
pH – 6.5 – 8.5
E. coli – 126 counts/100 ml maximum monthly log mean
Total residual chlorine – non-detectable

If you have any questions or need any additional information, please do not hesitate to contact me at any time at (410) 537-3672. Again, we strongly encourage you to explore the other two options which would not require a surface discharge.

Yours truly,

Stephen Luckman, Chief
Municipal NPDES Permits Division

cc: Edwal Stone
Ching-Tzone Tien

KCI TECHNOLOGIES

ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS
936 Ridgebrook Road • Sparks, MD 21152 • Phone 410-316-7800 • Fax 410-316-7885

March 23, 2009

Dr. Ching-Tzone Tien, Chief
Groundwater Discharge Permits Division
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Subject: Hughesville Business Area Sewer System
PGM # VCI 09-0016
KCI JO # 01083704

Dear Dr. Tien,

KCI is currently under contract with the Charles County Department of Planning and Growth Management (PGM) to perform a Water and Sewer Study which will evaluate alternatives for public water and sewer services to the Hughesville Priority Funding Area (PFA) (see attached plan).

KCI would like to verify with MDE, Groundwater Discharge Permits Division, that Charles County PGM can pursue the option of groundwater discharge for this Study (Alternative 1 described below) assuming a site proves to be adequately sized to handle this project,and clarification of groundwater discharge effluent limits for this proposed discharge along with MDE monitoring requirements. KCI would also like to discuss treatment technologies and disposal methods that MDE would recommend at this preliminary stage.

The Hughesville PFA is currently served by private wells and septic with the exception of 13 commercial lots located along MD Business Route 5. These 13 commercial lots are served by an absorption field, which is privately owned and maintained by Hughesville Sanitary Commission. The system is currently operating at approximately 90% of the total capacity. The system consists of terra cotta collection pipes and excessive inflow and infiltration is an issue of concern. The system's operational problems are resulting in water quality issues; the system cannot be expanded to meet current or future needs and thus will need to be phased out once public water and wastewater facilities are developed.

Due to high groundwater in the area, existing wells and failing septic systems will be abandoned once public water and sewer services are provided.

KCI submitted a 30% Study Report to Charles County PGM on March 5, 2009, which described three alternatives for public sewer systems (proposed specifically to serve The Hughesville Priority Funding Area only), including:

1. Construction of a packaged treatment plant with an onsite disposal system. The wastewater treatment plant and disposal system shall be sited on a large tract of open land which the County will have to obtain by fee-simple acquisition. This Alternative presents difficulty in finding an adequate site large enough for the design flow, which the property owner is willing to release to the County.

2. Construction of a main Sewage Pump Station along Route 231, which will pump to an interconnection with St. Mary's County Metropolitan Commission (South along Old Leonardtown Road) or to a Charles County existing wastewater treatment facility with capacity to accommodate the Hughesville Village Flows (North along Old Leonardtown Road). Possible treatment plants include the Town of La Plata Wastewater Treatment Facility and the County owned Mattawoman Treatment Plant. The difficulty with this Alternative includes required upgrades of the existing trunk sewers, pump stations and wastewater treatment capacity to accept the flows from Hughesville.

3. Construction of a packaged treatment plant and effluent pump station which will convey flow to an off-site perennial stream. The treatment plant solids will be pumped periodically and the treatment plant effluent will be discharged to an off-site perennial stream; specifically to nearby Gilberts Creek or Gilberts Pond. The effluent pump station discharge forcemain will be installed along Rte 231 within County right-of-way and along private property adjoining the stream outfall. The quantity of right-of way required along the stream will be dependent on the location of the surface water discharge allowed by Maryland Department of the Environment, as it relates to MDE's 303d List for Nutrient Impairments and TMDLs. The difficulty with this Alternative includes a high level of treatment technology and a potentially excessive distance to the stream outfall.

At the 30% Study Report level, KCI has not yet developed cost comparisons or quantity take offs. With each of the three alternatives being analyzed, the initial infrastructure will be sized and built to support the existing Village Core (see attached plan for location) flow with provisions to support additional package treatment units and increased pumping capacity to accommodate build-out flow from the Village Core and eventually build out flow from the entire Hughesville Village PFA. Estimates of the three flow phases include (in round numbers):

Flow Phases	Average Daily Flow	Peak Daily Flow (x 4.0)
1. Existing Village Core	28,000 gpd	110,000 gpd
2. Build-out Village Core	90,000 gpd	360,000 gpd
3. Build-out Hughesville	160,000 gpd	640,000 gpd

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Please call at your earliest convenience to discuss. If you would prefer, the County and KCI will also be available to meet at your earliest convenience. Thank you for your time and attention to this project. KCI is concurrently contacting Mr. Stephen Luckman, MDE Municipal Surface Discharge Permits Division, to discuss Alternative 3 above.

Sincerely,

John R. Kovacs, P.E.
Senior Project Manager

Mr. Kovacs's Direct Dial Number: (410) 316-7911
Fax Number: (410) 316-7935

Attachments: Hughesville Business Area Water/Sewer Study 30% Report Text
Sewer Alignment Alternative S-1

JRK/kak

Cc: Aaron Hamm, Charles Co.
John Stevens, Charles Co.
Cathy Hardy, Charles Co.
Tim Wolfe, KCI
File

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MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
MDE 410-537-3000 • 1-800-633-6101

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Shari T. Wilson
Secretary

Robert M. Summers, Ph.D.
Deputy Secretary

RECEIVED
JUL 23 2009
KCI TECHNOLOGIES INC

July 22, 2009

John R. Kovacs, P.E.
Senior Project Manager
KCI Technologies
936 Ridgebrook Road
Sparks, MD 21152

Re: Hughesville Business Area Water/Sewer Study
Charles County

Dear Mr. Kovacs:

This is to confirm our telephone conversation on July 21, 2009 regarding the effluent quality limitations for groundwater discharge via a spray irrigation system for the referenced project. You selected spray irrigation as the tentative disposal method for determining the effluent limitations.

You were referred to Table 1 of the "MDE Guidelines for Land Treatment of Municipal Wastewaters" where the effluent quality limitations for a spray irrigation system (slow rate system) can be determined. If you have any questions regarding the MDE Land Treatment Guidelines, please let me know.

Sincerely,

Ching-Tzone Tien

Ching-Tzone Tien, Ph.D., P.E., Chief
Groundwater Discharge Permit Division

RK

CHARLES COUNTY GOVERNMENT
Department of Planning & Growth Management

Melvin C. Beall, Jr., P.E.
Director

Michael K. Hinchy
Assistant Director

Administration
Ph: 301-645-0627
Ph: 301-870-3935
Fax: 301-638-0807

Capital Services
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Codes, Permits & Inspection Services
Building
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Inspections
Ph: 301-645-0700
Fax: 301-645-0575

Planning
Ph: 301-645-0540
Ph: 301-870-3896
Fax: 301-645-0638

Resource and Infrastructure Management
Ph: 301-645-0689
Fax: 301-638-2403

24-Hour Permit Status Inquiry
301-645-0600

March 31, 2010 Regular Mail & Certified

Turner A. Edelen, Trustee, et al
C/O Alan B. Edelen
5870 Olivers Shop Road
Bryantown, Maryland 20617-2230

Re: Hughesville Business Area Water/Sewer Study – VCI 09-0016
Tax Map 35 Grid 3 Parcel 107

Dear Mr. Edelen:

The purpose of this letter is to notify you that Charles County has hired KCI Technologies to conduct a feasibility study for public water and wastewater facilities in the Hughesville area. Engineers and technical support staff under our employ or consultant personnel under our direction need to temporarily enter upon your property to evaluate the topography of the land.

We are therefore notifying you for entry, which could be as early as April 7, 2010, and request your cooperation. The privilege of entering onto your property is provided for by the Annotated Code of Maryland, 12-111 of Real Property Article.

Please be assured that our personnel have been instructed to take every possible precaution to assure that your property is not damaged in any way during the performance of this land evaluation. To further assist us, it would be helpful if the property owners would point out to our field personnel any conditions on your property that might not be readily apparent.

Since the purpose of the entry is to assess the topography, our field personnel may not be able to answer some of your questions concerning the proposed improvements, because the final design often cannot be determined until after all of the data has been collected, compiled, and analyzed.

A written response to this letter is not necessary. If however, you have questions concerning this project, please direct them to Aaron Hamm, Charles County's Project Manager at 301-645-0509. If you or any other representatives object to this entry please contact Mr. Hamm by no later than 4:30 pm on April 6, 2010. However, for scheduling purposes, notification of your consent would be greatly appreciated prior to this date.

Your cooperation with KCI Technologies and their sub-consultants, as agents for Charles County is greatly appreciated. Thank you.

Sincerely,

John H. Stevens
Chief of Capital Services

cc: Sue Greer, Deputy County Attorney
Aaron Hamm, Project Manager
Diane Shelton, ROW Agent
Project Files

F:\HOME\PGMS1\CS\CIP\PROJECTS\Hughesville BusinessArea Water-Sewer Study\ROW Documents\ROE Notification letter Edelen, Turner, Trustee, et al_033110.doc

Charles and Donna Harrigan
5401 Bryantown Road
Waldorf, Maryland 20601
301-752-1668

April 14, 2010 Certified Return Receipt Mail

Mr. John H. Stevens, Chief of Capital Services
Charles County Government
Department of Planning & Growth Management
PO Box 2150
La Plata, Maryland 20646

RECEIVED
APR 16 2010
Scanned 4/16
CAPITAL SERVICES

Re: Hughesville Business Area Water/Sewer Study- VCI 09-0016
Tax Map 25 Grid 21 Parcel 103

Dear Mr. Stevens,

In receipt of your letter dated March 31, 2010 we would like to put the County on notice that our property located at 5401 Bryantown Road Waldorf, Maryland 20601 is encumbered by the Rural Legacy Easement and Mitigation Easements filed with the MDE.

The Rural Legacy Perpetual Conservation Easement was entered into for land preservation in September 2001. The use for which you would like to enter the property for evaluation for water and sewer is inconsistent with the terms of the easement(s).

Notification of your request has been forward to the Attorney Generals Office, 580 Taylor Ave. E4 Annapolis, Maryland 21401 as required by the easement.

Sincerely,

Charles & Donna Harrigan

Charles and Donna Harrigan

Cc: Attorney Generals Office/ copy letter County

William B. and Carol A. Edelen, Trustees
13395 Trotter Road
P. O. Box 245
Bryantown, Maryland 20617-0245

Turner A. Edelen, Trustee
13405 Trotter Road
Bryantown, Maryland 20617

Alan B. and Florence B. Edelen
5870 Oliver Shop Road
Bryantown, Maryland 20617

April 19, 2010

Mr. John H. Stevens, Chief of Capital Services
Charles County Government
Department of Planning & Growth Management
P. O. Box 2150
La Plata, Maryland 20646

Re. Hughesville Business Area Water/Sewer Study – VCI 09-0016
Tax Map 35 Grid 3 Parcel 107

Dear Mr. Stevens:

In receipt of your letter dated March 31, 2010, we would like to put the County on notice that our property located in Bryantown, Maryland, is encumbered by the Rural Legacy Easement with the MDE.

The Rural Legacy Perpetual Conservation Easement was entered into for land preservation in December 2006. (See below.) The use for which you would like to enter the property for evaluation for water and sewer is inconsistent with the terms of the easement. We signed off on this preservation to protect this land from any type of development or any use other than what is outlined in the Rural Legacy regulations.

> *MALPF File #08-07-33: District Recordation*
>
> *On June 26, 2007, the Maryland Agricultural Land Preservation Foundation approved the establishment of an agricultural land preservation district on your property. This document was recorded in the land records of Charles County on August 22, 2007, under Liber 06429, folio 0079.*

Our land not only adjoins the Zekiah Watershed/Swamp, but the Zekiah Swamp runs through our property boundaries. Why would you even consider putting any type of sewage treatment facility in this area? In these economic times when the state of Maryland and Charles County have no money, why would a survey of this type be planned in an area that is protected under the above Watershed area and Rural Legacy Program?

Notification of your request has been forwarded to the Attorney General's Office, 580 Taylor Avenue, Annapolis, Maryland 21401 as required by the easement.

Sincerely,

William B. Edelen — Alan B. Edelen — Turner A. Edelen

William B. Edelen   Alan B. Edelen   Turner A. Edelen

CC: Attorney General's Office

CHARLES COUNTY GOVERNMENT
Department of Planning & Growth Management

Charles County Commissioners
Wayne Cooper, President
Edith J. Patterson, Ed.D., V.P.
Reuben B. Collins, II
Samuel N. Graves, Jr.
Gary V. Hodge

Rebecca B. Bridgett, Ed. D.
County Administrator

Melvin C. Beall, Jr., P.E.
Director

Administration
Ph: 301-645-0627
Ph: 301-870-3935
Fax: 301-638-0807

Capital Services
Ph: 301-645-0641
Fax: 301-396-5836

Codes, Permits & Inspection Services
Building
Ph: 301-645-0692
Ph: 301-870-3935
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Fax: 301-645-0575

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Ph: 301-645-0540
Ph: 301-870-3896
Fax: 301-645-0638

Resource and Infrastructure Management
Ph: 301-645-0689
Fax: 301-638-2403

24-Hour Permit Status Inquiry
301-645-0600

April 26, 2010

Charles and Donna Harrigan
5401 Bryantown Road
Waldorf, Maryland 20601

Re: Hughesville Water & Sewer
Feasibility Study

Dear Mr. and Mrs. Harrigan,

Thank you for your letter dated April 19, 2010 that was sent in response of our March 31, 2010 letter. Your letter notified us that your property (Tax Map 25, Grid 21, Parcel 103) was encumbered by a Rural Legacy easement. This encumbrance on your property was made known by our Right-of-Way staff prior to sending the letter to you requesting permission for the County's consultant to access your property. We are aware of the Rural Legacy Program's encumbrance on your land, and the associated limitations associated therewith. We are only trying to gain some basic preliminary information on your land.

To further clarify the intent of entering onto your property, the objective for the Hughesville Business Area Water & Sewer Study is to identify and rank all "possible" water and sewer alternatives to support economic development in the Hughesville area. To accomplish this, the County's consultant (KCI) determined that a treatment plant will be needed to treat the wastewater generated from existing and future development in Hughesville. Due to the volume of wastewater, KCI also determined that large tracts of land will be necessary to dispense the treated effluent from the wastewater treatment plant. The Study identified a minimum land area of 50 acres and your property met this land area requirement along with having the soil characteristics based on a preliminary soils analysis. To further assess your property's viability as a suitable alternative for a spray site, a review of the topography of the land is necessary. If the topography is found suitable, your property will be listed in the study as a possible site.

While identifying potential land disposal sites, KCI discovered that the aforementioned property was encumbered by a Rural Legacy Easement. KCI informed us that the proposed use may not violate Rural Legacy guidelines as there are methods to apply spray and drip irrigation to wooded areas with negligible clearing of the woods, thus leaving the Rural Legacy intact with minimal impact to the property. Consequently, your property was not removed from further consideration.

Should you have any additional questions or need additional information please do not hesitate to contact me at (301)396-5847 or via email at stevensj@charlescounty.org.

Sincerely,

John H. Stevens
Chief of Capital Services

JHS:js:k

cc: Senator Thomas Middleton
Wayne Cooper, County Commissioner President
Rebecca R. Bridgett, County Administrator
Melvin C. Beall, Director of PGM

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MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

May 3, 2010

Mr. Melvin Beall, Jr.
Director
Charles County Dept. of Planning & Growth Mangement
P.O. Box 2150
LaPlata, MD 20646

RE: Hughesville Business Area Water/Sewer Study

Dear Mr. Beall:

The Maryland Department of Natural Resources Rural Legacy Program recently received letters from the Harrigan and Edelen families regarding a potential public water and wastewater facility in the Zekiah Rural Legacy Area. The families were contacted by the Charles County Government, Department of Planning & Growth Management in March and informed that their properties were being considered as sites for this new facility. Both of these properties fall within the Zekiah Rural Legacy Area, and both are encumbered by Rural Legacy Conservation Easements, held by Charles County, for which the County, with the approval of the Maryland Board of Public Works and the Rural Legacy Board, paid a total of $997,189.00 in Grant funds.

The Rural Legacy Program was created to protect Maryland's working farms and forests as well as vital ecological resources. The County's proposal to convert these two working farms, containing over 325 acres, to use for a wastewater facility runs counter to the spirit, intent, and purpose of the Rural Legacy program. Furthermore, the terms of the easements do not allow the grantors to voluntarily submit to a third party use of the property for a public utility, and as a Sponsor of the Area and a Grantee of the Easement, Charles County should not be considering these parcels, or any parcels inside the Zekiah Rural Legacy Area boundary, for uses that are incompatible with the Rural Legacy program.

After consultation with the Office of the Attorney General, it is my understanding that the Rural Legacy Grant Agreements provide for several remedies if a Sponsor fails to uphold its stewardship duties, including withholding Grant funds, debarring the Sponsor from applying for future funds, and initiating legal action to enforce the terms of the Grant Agreement and/or the Easement. I strongly urge you to reconsider the location of this facility, and I look forward to your reply.

Sincerely,

Meredith Lathbury
Director, Land Acquisition and Planning Unit

RECEIVED
MAY - 7 2010
Planning & Growth
Management

cc: Joe Gill, DNR
Roger Medoff, OAG
Kristin Saunders-Evans, DNR
Tom McCarthy, DNR
Stacy Schaefer, DNR
Charles Rice, Charles County
John H. Stevens, Charles County
William B. Edelen, et al Trustees
Donna Harrigan

CHARLES COUNTY GOVERNMENT
Department of Planning & Growth Management

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Melvin C. Beall, Jr., P.E.
Director

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Fax: 301-645-0638

Resource and Infrastructure Management
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Fax: 301-638-2403

24-Hour Permit Status Inquiry
301-645-0600

May 17, 2010

Meredith Lathbury, Director
Land Acquisition and Planning Unit
Maryland Department of Natural Resources
580 Taylor Avenue
Annapolis, MD 21401

Subject: **Hughesville Business Area Water/Sewer Study**

Dear Ms. Lathbury,

Thank you for your letter dated May 3, 2010 regarding use of the property within the Rural Legacy Program as a potential site for treated water for the Hughesville Village Community. The County regards highly its participation in the Rural Legacy program as we recognize the significance of preserving the rural aesthetics of Charles County for the enjoyment of our citizens for many years to come. Allow me to provide a brief background on the nature of the Hughesville Business Area Water/Sewer Study with hopes of dispelling any concerns you have over the County insensitivity to the sprit, intent, and purpose of the Rural Legacy program.

This study is a continuation of the Hughesville Village Revitalization Plan adopted by the County Commissioners on May 2, 2007 and demonstrates the County Commissioners' commitment to revitalize the Hughesville Village to attract new business development to the corridor. The Hughesville Village Revitalization Plan recommended water & sewer infrastructure as one of the top priorities for the plan's implementation.

The County's consultant, KCI's initial interest in entering the Edelen and Harrigan properties was to assess the property's viability as a suitable spray irrigation site for treated water from a proposed wastewater treatment facility. I want to be clear that the County never intended to construct a wastewater treatment facility on Rural Legacy properties, only an irrigation system. Due to the volume of wastewater and the requirements set forth by the Maryland Department of Environment (MDE), a minimum land area of 50 acres is necessary for spray irrigation systems from wastewater treatment plants, requiring focus on large tracts of land. Additionally, the Soil Survey of Charles County published by the US Department of Agriculture Soil Conservation Service, identify soil types suitable for slow rate disposal of treated wastewater (i.e. Spray irrigation), immediately within the boundaries of the two properties in question.

Spray irrigation is a slow rate land treatment system, which implies that the treated wastewater is uniformly applied to the surface of the receiving site with the understanding that the treated wastewater will infiltrate into the soil profile. As the treated water moves through the soil, most of the remaining organic and inorganic constituents are removed, either taken up by plants or immobilized within the soil matrix. A complete vegetative cover is required for effective treatment. In addition, spray irrigation is permitted and can co-exist with cultivated farmland crops, providing a nutrient source for crop growth and reducing withdrawal on the groundwater table by providing an alternate to irrigation via groundwater wells. Spray irrigation can also be constructed within wooded areas with minimal disturbance of the woods.

KCI's correspondence with MDE regarding spray irrigation proved to be encouraging, with many examples of large spray irrigation systems around the State and around the County, for example at Cobb Island, Southern Pre-Release Center and the Town of Centerville. MDE has a very strict approval and permitting process for wastewater treatment spray irrigation disposal systems. Further, please note that MDE provides very stringent buffer requirements for treated wastewater which is discharged via spray irrigation, which was taken into account when identifying the two properties in question, with regard to proximity to waterways and houses.

KCI's correspondence with the County in February 2010 indicated that they were working with the County's Rural Legacy Program staff and with the Department of Natural Resources, to build a spray irrigation system on Rural Legacy Easements with the proper approval and adherence to guidelines. KCI understood that industrial or commercial uses are prohibited and agriculture operations must not be impeded within Rural Legacy Easements. KCI believed that this was achievable. Consequently, based on advice of our consultant and the information noted above, we proceeded to contact the two property owners you referenced in your letter, knowing they had Rural Legacy Easements. That contact was made with the intent and belief that the proposed spray irrigation would not compromise the protection of working farms or forest as well as the vital ecological resources contained therein. Therefore, we did not believe that the addition of a proposed spray field would be incompatible with the Rural Legacy Program nor did we view such activity as inconsistent with our stewardship duties.

We wish to inform you that with the help of the Charles County Health Department, KCI learned of other properties closer to the Hughesville Village core that have soils suitable for a discharge site. These properties are now being considered as alternatives in lieu of the Edelen and Harrigan properties. We have already notified the owners of the Edelen and the Harrigan properties of such.

If you have any further questions on this matter, please feel free to contact me at (301)645-0693.

Sincerely,

Melvin C. (Chuck) Beall, Jr., P.E.
Director

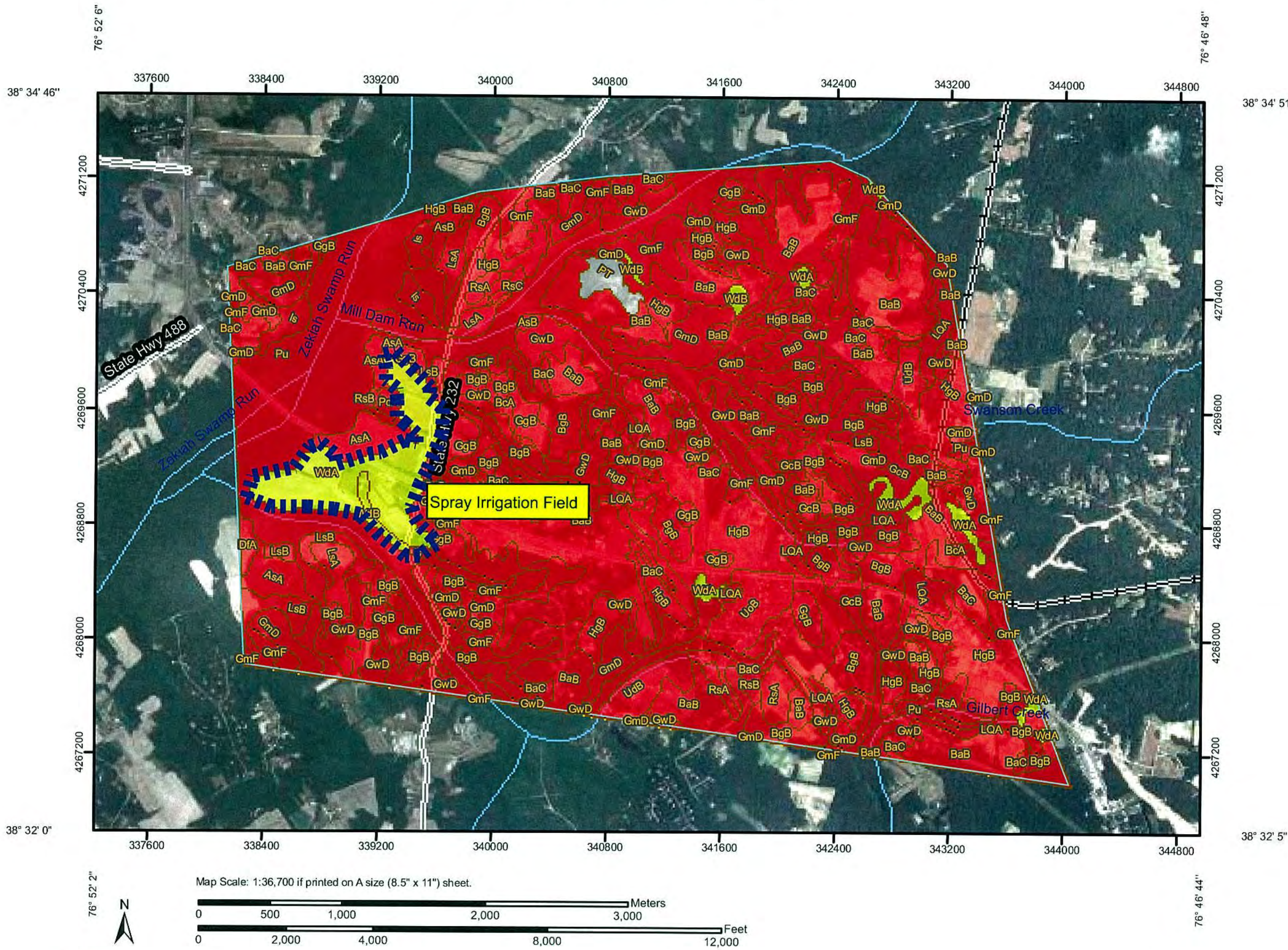
MCB:JHS/jrk/kak/

Cc: John Stevens, Chief Capital Services
Steven Ball, Director of Planning
Charles Rice, Planner IV
Joe Gill, DNR
Roger Medoff, OAG
Kristin Saunders-Evans, DNR
Tom McCarthy, DNR
Stacey Schaefer, DNR
Project File

F:\HOME\PGMS1\ADM\Shared documents\Correspondence\L_Draft_M Lathbury_DNR_Hughesville Area W&S Study-Rural Legacy.docx

Slow Rate Treatment of Wastewater, Soil Map

Charles County, Maryland



Map Scale: 1:36,700 if printed on A size (8.5" x 11") sheet.

Meters	0	500	1,000	2,000	3,000
Feet	0	2,000	4,000	8,000	12,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:36,700 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 18N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Charles County, Maryland
Survey Area Data: Version 6, Mar 9, 2009

Date(s) aerial images were photographed: 6/21/2005; 6/15/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Slow Rate Treatment of Wastewater

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AsA	Annemessex silt loam, 0 to 2 percent slopes	Very limited	Annemessex (60%)	Depth to saturated zone (1.00)	84.6	1.8%
				Too acid (1.00)		
			Dodon (25%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Elkton, undrained (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Filtering capacity (0.99)		
				Too acid (0.99)		
				Slow water movement (0.99)		
			Quindocqua, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.99)		
				Slow water movement (0.15)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AsB	Annemessex silt loam, 2 to 5 percent slopes	Very limited	Annemessex (70%)	Depth to saturated zone (1.00)	16.0	0.3%
				Too acid (1.00)		
			Dodon (15%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Elkton, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Filtering capacity (0.99)		
				Too acid (0.99)		
				Slow water movement (0.99)		
			Quindocqua, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.99)		
				Slow water movement (0.15)		
			Piccowaxen (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (0.99)		
				Slow water movement (0.85)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
BaB	Beltsville silt loam, 2 to 5 percent slopes	Very limited	Beltsville (70%)	Depth to cemented pan (1.00)	807.2	17.1%
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Aquasco (10%)	Depth to saturated zone (1.00)		
				Depth to cemented pan (1.00)		
				Too acid (1.00)		
				Slow water movement (0.94)		
			Reybold (10%)	Too acid (1.00)		
			Lenni, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		
			Grosstown (5%)	Too acid (1.00)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
BaC	Beltsville silt loam, 5 to 10 percent slopes	Very limited	Beltsville (70%)	Depth to cemented pan (1.00)	163.5	3.5%
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Too steep for surface application (0.92)		
			Grosstown (15%)	Too acid (1.00)		
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Reybold (5%)	Too acid (1.00)		
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Hoghole (5%)	Filtering capacity (1.00)		
				Too acid (0.99)		
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Aquasco (5%)	Depth to saturated zone (1.00)		
				Depth to cemented pan (1.00)		
				Too acid (1.00)		
				Slow water movement (0.94)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
BcA	Beltsville-Aquasco complex, 0 to 2 percent slopes	Very limited	Beltsville (50%)	Depth to cemented pan (1.00)	6.1	0.1%
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Aquasco (40%)	Depth to saturated zone (1.00)		
				Depth to cemented pan (1.00)		
				Too acid (1.00)		
				Slow water movement (0.94)		
			Lenni, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		
			Reybold (5%)	Too acid (1.00)		
BgB	Beltsville-Grosstown-Woodstown complex, 0 to 5 percent slopes	Very limited	Beltsville (35%)	Depth to cemented pan (1.00)	369.8	7.8%
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Grosstown (30%)	Too acid (1.00)		
			Reybold (10%)	Too acid (1.00)		
			Issue (5%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (0.60)		
				Filtering capacity (0.01)		
			Quindocqua, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.99)		
				Slow water movement (0.15)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
DfA	Dodon fine sandy loam, 0 to 2 percent slopes	Very limited	Dodon (70%)	Too acid (1.00)	9.4	0.2%
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Marr (20%)	Too acid (1.00)		
			Annemessex (10%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
GcB	Galestown-Hammonton complex, 0 to 5 percent slopes	Very limited	Galestown (50%)	Filtering capacity (1.00)	59.0	1.2%
				Too acid (1.00)		
			Hammonton (40%)	Filtering capacity (1.00)		
				Too acid (0.99)		
				Depth to saturated zone (0.99)		
			Woodstown (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Potobac (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (1.00)		
GgB	Grosstown gravelly silt loam, 2 to 5 percent slopes	Very limited	Grosstown (80%)	Too acid (1.00)	101.4	2.1%
			Woodstown (20%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
GmD	Grosstown-Marr-Hoghole complex, 5 to 15 percent slopes	Very limited	Marr (30%)	Too acid (1.00)	435.5	9.2%
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.78)		
				Filtering capacity (0.01)		
			Grosstown (30%)	Too acid (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.78)		
			Hoghole (15%)	Filtering capacity (1.00)		
				Too steep for surface application (1.00)		
				Too acid (0.99)		
				Too steep for sprinkler irrigation (0.78)		
			Dodon (10%)	Too acid (1.00)		
				Too steep for surface application (1.00)		
				Depth to saturated zone (0.99)		
				Too steep for sprinkler irrigation (0.78)		
				Filtering capacity (0.01)		
			Beltsville (10%)	Depth to cemented pan (1.00)		
				Slow water movement (1.00)		
				Too steep for surface application (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Issue (5%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (0.60)		
				Filtering capacity (0.01)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
GmF	Grosstown-Marr-Hoghole complex, 15 to 40 percent slopes	Very limited	Marr (30%)	Too steep for surface application (1.00)	337.3	7.1%
				Too steep for sprinkler irrigation (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.01)		
			Grosstown (30%)	Too acid (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
			Hoghole (15%)	Filtering capacity (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Too acid (0.99)		
			Potobac (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (1.00)		
			Dodon (10%)	Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Beltsville (5%)	Depth to cemented pan (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (1.00)		
				Slow water movement (1.00)		
				Too acid (1.00)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
GwD	Grosstown-Woodstown-Beltsville complex, 5 to 15 percent slopes	Very limited	Woodstown (30%)	Too steep for surface application (1.00)	389.2	8.2%
				Depth to saturated zone (0.99)		
				Too acid (0.99)		
				Too steep for sprinkler irrigation (0.78)		
				Filtering capacity (0.01)		
			Grosstown (30%)	Too acid (1.00)		
				Too steep for surface application (1.00)		
				Too steep for sprinkler irrigation (0.78)		
			Beltsville (20%)	Depth to cemented pan (1.00)		
				Slow water movement (1.00)		
				Too steep for surface application (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Reybold (10%)	Too steep for surface application (1.00)		
				Too acid (1.00)		
				Too steep for sprinkler irrigation (0.78)		
			Issue (5%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (0.60)		
				Filtering capacity (0.01)		
			Lenni, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
HgB	Hoghole-Grosstown complex, 0 to 5 percent slopes	Very limited	Hoghole (45%)	Filtering capacity (1.00)	528.7	11.2%
				Too acid (0.99)		
			Grosstown (30%)	Too acid (1.00)		
			Reybold (15%)	Too acid (1.00)		
			Woodstown (10%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
Is	Issue silt loam, occasionally flooded	Very limited	Issue (80%)	Depth to saturated zone (1.00)	44.0	0.9%
				Flooding (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.01)		
			Woodstown (10%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Potobac (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (1.00)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
LQA	Lenni and Quindocqua soils, 0 to 2 percent slopes	Very limited	Lenni, undrained (50%)	Ponding (1.00)	108.8	2.3%
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		
			Quindocqua, undrained (30%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Filtering capacity (0.99)		
			Annemessex (10%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
			Beltsville (5%)	Depth to cemented pan (1.00)		
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Liverpool (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
LsA	Liverpool silt loam, 0 to 2 percent slopes	Very limited	Liverpool (80%)	Too acid (1.00)	49.8	1.1%
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		
			Piccowaxen (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (0.99)		
				Slow water movement (0.85)		
			Elkton, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Filtering capacity (0.99)		
				Too acid (0.99)		
				Slow water movement (0.99)		
			Woodstown (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
LsB	Liverpool silt loam, 2 to 5 percent slopes	Very limited	Liverpool (75%)	Too acid (1.00)	51.5	1.1%
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		
			Piccowaxen (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (0.99)		
				Slow water movement (0.85)		
			Annemessex (10%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
			Elkton, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Filtering capacity (0.99)		
				Too acid (0.99)		
				Slow water movement (0.99)		
PcA	Piccowaxen loam, 0 to 2 percent slopes	Very limited	Piccowaxen (80%)	Ponding (1.00)	6.9	0.1%
				Depth to saturated zone (1.00)		
				Too acid (0.99)		
				Slow water movement (0.85)		
			Liverpool (10%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		
			Lenni, undrained (10%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		
PT	Pits, gravel	Not rated	Pits, gravel (100%)		23.8	0.5%

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
Pu	Potobac-Issue complex, frequently flooded	Very limited	Potobac (70%)	Ponding (1.00)	746.8	15.8%
				Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (1.00)		
			Issue (25%)	Depth to saturated zone (1.00)		
				Flooding (1.00)		
				Too acid (1.00)		
			Lenni, undrained (5%)	Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Flooding (1.00)		
				Too acid (1.00)		
				Slow water movement (0.96)		
RsA	Reybold silt loam, 0 to 2 percent slopes	Very limited	Reybold (90%)	Too acid (1.00)	49.7	1.1%
			Woodstown (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
			Liverpool (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		
RsB	Reybold silt loam, 2 to 5 percent slopes	Very limited	Reybold (90%)	Too acid (1.00)	8.7	0.2%
			Woodstown (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Filtering capacity (0.01)		
			Liverpool (5%)	Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Slow water movement (0.96)		

Slow Rate Treatment of Wastewater— Summary by Map Unit — Charles County, Maryland						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
RsC	Reybold silt loam, 5 to 10 percent slopes	Very limited	Reybold (80%)	Too acid (1.00)	5.5	0.1%
				Too steep for surface application (0.92)		
				Too steep for sprinkler irrigation (0.06)		
			Beltsville (10%)	Depth to cemented pan (1.00)		
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
				Too steep for surface application (0.92)		
			Issue (10%)	Depth to saturated zone (1.00)		
				Too acid (1.00)		
				Flooding (0.60)		
UdB	Udorthents, loamy, 0 to 5 percent slopes	Very limited	Udorthents, loamy (90%)	Too acid (1.00)	57.8	1.2%
				Slow water movement (0.50)		
				Depth to saturated zone (0.02)		
UoB	Urban land-Grosstown complex, 0 to 5 percent slopes	Very limited	Grosstown (40%)	Too acid (1.00)	51.6	1.1%
			Beltsville (10%)	Depth to cemented pan (1.00)		
				Slow water movement (1.00)		
				Too acid (1.00)		
				Depth to saturated zone (0.99)		
WdA	Woodstown sandy loam, 0 to 2 percent slopes	Somewhat limited	Woodstown (70%)	Depth to saturated zone (0.99)	198.1	4.2%
				Too acid (0.99)		
				Filtering capacity (0.01)		
WdB	Woodstown sandy loam, 2 to 5 percent slopes	Somewhat limited	Woodstown (70%)	Depth to saturated zone (0.99)	19.0	0.4%
				Too acid (0.99)		
				Filtering capacity (0.01)		
Totals for Area of Interest					**4,729.0**	**100.0%**

Slow Rate Treatment of Wastewater— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	4,488.7	94.9%
Somewhat limited	217.0	4.6%
Null or Not Rated	23.8	0.5%
Totals for Area of Interest	**4,729.0**	**100.0%**

Description

Slow rate treatment of wastewater is a process in which wastewater is applied to land at a rate normally between 0.5 inch and 4.0 inches per week. The application rate commonly exceeds the rate needed for irrigation of cropland. The applied wastewater is treated as it moves through the soil. Much of the treated water may percolate to the ground water, and some enters the atmosphere through evapotranspiration. The applied water generally is not allowed to run off the surface. Waterlogging is prevented either through control of the application rate or through the use of tile drains, or both.

Soil properties are important considerations in areas where soils are used as sites for the treatment and disposal of organic waste and wastewater. Selection of soils with properties that favor waste management can help to prevent environmental damage.

Municipal wastewater is the waste stream from a municipality. It contains domestic waste and may contain industrial waste. It may have received primary or secondary treatment. It is rarely untreated sewage. Food-processing wastewater results from the preparation of fruits, vegetables, milk, cheese, and meats for public consumption. In places it is high in content of sodium and chloride. The effluent in lagoons and storage ponds is from facilities used to treat or store food-processing wastewater or domestic or animal waste. Domestic and food-processing wastewater is very dilute, and the effluent from the facilities that treat or store it commonly is very low in content of carbonaceous and nitrogenous material; the content of nitrogen commonly ranges from 10 to 30 milligrams per liter. The wastewater from animal waste treatment lagoons or storage ponds, however, has much higher concentrations of these materials, mainly because the manure has not been diluted as much as the domestic waste. The content of nitrogen in this wastewater generally ranges from 50 to 2,000 milligrams per liter. When wastewater is applied, checks should be made to ensure that nitrogen, heavy metals, and salts are not added in excessive amounts.

The ratings are based on the soil properties that affect absorption, plant growth, microbial activity, erodibility, and the application of waste. The properties that affect absorption include the sodium adsorption ratio, depth to a water table, ponding, available water capacity, saturated hydraulic conductivity (Ksat), depth to bedrock or a cemented pan, reaction, the cation-exchange capacity, and slope. Reaction, the sodium adsorption ratio, salinity, and bulk density affect plant growth and microbial activity. The wind erodibility group, soil erosion factor K, and slope are considered in estimating the likelihood of wind erosion or water erosion. Stones, cobbles, a water table, ponding, and flooding can hinder the application of waste. Permanently frozen soils are unsuitable for waste treatment.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect agricultural waste management. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

MDE Guidelines for Land Treatment of Municipal Wastewaters, July 2003

MARYLAND DEPARTMENT OF THE ENVIRONMENT

GUIDELINES

FOR

LAND TREATMENT

OF

MUNICIPAL WASTEWATERS

(NOT OFFICIAL TEXT)

PURPOSE

The purpose of these guidelines is to provide information regarding the State of Maryland's coordinated approach to the land treatment of municipal wastewater. Major emphasis is placed on site selection and evaluation, and the procedures followed in processing applications for land-treatment systems regulated by State Groundwater Discharge Permits. The criteria presented in the guidelines apply primarily to municipal wastewaters. However, these criteria may also be helpful to individuals involved in the development of land-treatment systems for the treatment and disposal of other organic wastewaters. All criteria reported in this manual are subject to exception, and changes will be considered on a case-by-case basis. Deviation from the criteria reported herein must be discussed with the Maryland Department of the Environment prior to the incorporation of the deviations into written documents such as Facilities Plans or design processes.

This document is not intended to function as a "cookbook" for design engineers, nor is it intended to suppress the state-of-the-art by enacting overly restrictive guidelines. It is, however, intended to function as a guide for private developers or municipalities and their consultants. In summary, it is hoped that the guidelines will expedite the implementation of land-treatment systems, where appropriate, while safeguarding the integrity of surface and groundwaters of the State.

INTRODUCTION

Ever since the first community was established, man has had to face the problem of regional waste disposal in one form or another. In the past, surface waters provided a means of disposal. The relatively large volume of surface water usually contained in rivers located adjacent to the communities diluted the discharged wastes and transported them away from the point (or points) of entry.

As the communities grew into towns and towns into cities, the volume of wastes requiring disposal grew accordingly. The increased waste load exerted an ever-increasing stress on the surface waters to assimilate this waste. In many waterways throughout the United States and other parts of the World, the assimilative capacity has been exceeded, producing in many cases, a state of accelerated eutrophication.

Along with man's increasing numbers has come both a more thorough understanding of his environment and significant technological advances. Sewage treatment plants are now capable of producing effluent of a much higher quality than ever before. Unfortunately, as the level of treatment increases, so does the cost. From a water-resources management standpoint, discharging treated municipal wastewater directly into surface waters has two major disadvantages. First, although treated and disinfected, most wastewaters contain relatively high levels of nitrogen, phosphorous, and organics in various forms. Unless advanced treatment is performed, these constituents contribute to the eutrophic progression of the receiving waters.

Second, the waters collected in a particular basin are typically used by a municipality located within that basin and transported to a sewage treatment plant also located within that basin.

However, once the sewage is treated, it is discharged into a surface waterway and removed from the basin. Consequently, the water supply basin is never recharged by water collected within that basin and must rely entirely upon natural rainfall for recharge.

An alternative method of wastewater treatment and disposal has been used for at least a century, although only recently to any significant degree. This alternative is referred to as land treatment. The technique involves the application of treated wastewater to the land surface in any of several methods. The three most common methods of application are: 1) spray irrigation, 2) overland flow, and 3) rapid infiltration. Through the physical, chemical, and biological mechanisms operating in the soil, several important benefits can be obtained by using land treatment. The three most important benefits are: 1) the concentrations of BOD, total suspended solids, bacterial and viral organisms, as well as the nutrients responsible for the acceleration of eutrophication are all greatly reduced as the wastewater infiltrates and percolates through the soil profile; 2) the nutrients removed by the soil can be available to support or increase the growth of vegetation occupying the site; and 3) the renovated wastewater percolates through the soil profile and recharges the groundwater system.

Based upon studies conducted by universities and government agencies, land treatment has proven to be both a feasible and an effective method of renovating and recycling wastewater. So wide has been its acceptance that the Environmental Protection Agency, through amendments PL 92-500 and PL 95-217 to the Federal Water Pollution Control Act, has required that land treatment be evaluated during the waste treatment Facilities Planning stage. **On October 1, 2002, Section 9-303.1 of the Annotated Code of Maryland became effective. It stipulates that the Department shall encourage the use of reclaimed water as an alternative to discharging wastewater effluent into surface waters and authorizes the Department to establish buffer and setback requirements for the use of reclaimed water.** These measures are not intended to force municipalities into using land treatment techniques, but is intended more to insure that techniques aimed at recycling and reuse of wastewater receive appropriate attention.

REQUIREMENTS OF LAND TREATMENT

Basically, there are two types of requirements for land treatment of municipal and agricultural wastewaters: pre-application treatment and site requirements.

Pre-application treatment requirements pertain to the quantity and quality of the effluent or treated wastewater that is to be applied to the land. The wastewater constituents of most importance to land treatment are BOD (biochemical oxygen demand), SS (suspended solids), pH, total and fecal coliforms, dissolved salts, and nitrogen compounds. Generally, these constituents, more than any others, determine how effective land treatment will be in renovating wastewater and what effect the wastewater will have on the soils and ultimately the groundwaters of the state.

Site requirements are expressed in terms of geologic, soil, and hydrologic characteristics that have a direct or indirect influence on the ability of a site to renovate and recycle wastewater. All three characteristics are interrelated and are at least as important as effluent requirements in affecting the success or failure of a land-treatment system. For each type of land treatment, there exists an optimum geology-soils-hydrology scheme or combination. A scheme that works well for one type of land treatment may not work at all for another type.

In the following sections, each of the major types of land treatment will be discussed along with the important effluent and site requirements that must be satisfied to ensure its effectiveness as a treatment process. Table 2 is located at the end of the sections and contains a summary of the site requirements for the major types of land treatment.

Slow Rate

The term "slow rate" applies to all systems that uniformly apply treated wastewater to the surface of the receiving site with the understanding that the wastewater will infiltrate into a percolate through the soil profile. Once the wastewater enters the soil, one of four consequences will be realized: (1) it will eventually return to the surface through capillarity and be lost to evaporation, (2) it will be taken up by plant roots and be lost to transpiration, (3) it will be stored within the soil and produce a change in soil moisture, or (4) it will percolate downward until the groundwater table is encountered. As the wastewater moves through the soil, most of the organic and inorganic constituents are removed, some of which will be decomposed and taken up by plants while others will be immobilized within the soil matrix.

Examples of slow-rate systems are as follows:

1. piped irrigation

    a. spray irrigation
    b. bubbling pipe irrigation
    c. drip irrigation

2. open channel irrigation

    a. ridge and furrow
    b. flooding

Minimum pre-application treatment requirements for slow-rate systems are given in Table 1.

Table 1. Minimum pre-application treatment requirements for various land treatment systems[a]

Parameter	Slow Rate		Overland Flow	Rapid Infiltration
	Class I	**Class II**		
Biochemical Oxygen Demand (5 day)	70 mg/l	**10 mg/l**	**70** mg/l	**Case by case**
Suspended Solids	90 mg/l	**10 mg/l**	90 mg/l	**Case by case**
Fecal Coliform [b] (MPN per 100 mL)	200 3 (golf courses)	**3**	200	**Case by case**
pH	6.5 - 8.5	**6.5-8.5**	6.5 - **8.5**	6.5-**8.5**

a In areas where site characteristics are marginal for land treatment, the above effluent requirements may be more severe. **Effluent can be sampled prior to discharging to the storage pond.**

b Higher levels of treatment and disinfection may be required under certain conditions.

<u>Site requirements for slow-rate systems are as follows:</u>

<u>Soils</u>

1. minimum of four 4 feet depth to groundwater or bedrock, except on the Eastern Shore where a minimum of 2 feet should exist between the soil surface and the groundwater table.
2. moderately slow to moderately rapid permeability (0.2 to 6 inches per hour) in the most restrictive soil horizon.
3. U.S.D.A. textures ranging from clay loams to sandy loams.
4. Moderately well to excessively well drained.

<u>Slopes</u>

Slopes not to exceed 15% on cultivated lands and 25% on uncultivated (forested) lands. **For underground drip irrigation systems<u>, higher sloped areas may be acceptable, if system installation is feasible and seepage at lower elevations can be eliminated</u>.**

<u>Vegetation</u>

A complete vegetational cover is required. It can be natural, as in the case of forest, or it can be planted, as in the case of cultivated fields.

Buffer

Class I Effluent

A minimum buffer zone of 200 feet shall be provided between the wetted perimeter of spray irrigation areas and property lines, waterways, roads, etc. For residential properties, parks, and other areas where people congregate, a 500-foot buffer between the wetted perimeter and structures on these properties shall be provided. A reduction of these buffer zone widths by up to 50% will be considered where it is demonstrated that an adequate windbreak will be provided to prevent spray from carrying beyond the irrigation area.

Class II Effluent

The buffer zone widths shall be 25 feet from property lines, housing structures, public roads and streams, 50 feet from schools and playgrounds, and 100 feet to potable wells and water intakes.

Other Types of Slow Rate Systems

Slow rate systems not generating aerosols, such as a drip irrigation system and a ridge and furrow system, will have a minimum buffer zone of 50 feet from property lines, housing structures and public roads, and 100 feet to potable wells and streams.

Storage

A means for wastewater storage must be provided at each slow rate system to accommodate flows generated during those periods when the treated wastewater cannot be applied to the land. Since climatic influences vary geographically, storage capacity requirements will be dependent upon the location of the system. However, a minimum of 60 days storage should be provided for all spray irrigation systems receiving wastewater flows throughout the year. **A minimum of 30 days storage should be provided for all underground drip irrigation systems receiving wastewater throughout the year.**

Application rates and loading cycles

The application rate or hydraulic-loading rate of a given system is dependent upon both the effluent and site characteristics. However, application rates for slow-rate systems generally range between 0 and 2 inches per week on an annual average basis. Slow-rate systems generally operate on a one-day load, six-day rest cycle. **To determine the application rate suitable to the soil type at the proposed site, infiltration tests should be conducted. Infiltration tests should be conducted by using the Double-Ring Infiltrometer Method or the Basin Infiltration Method outlined in the Appendix A. The application rate shall not be greater than 4% of the steady infiltration rate**

measured from the Double- Ring Infiltrometer or shall not be greater than 10% of the steady infiltration rate measured from the Basin Infiltration test. Other infiltration test methods comparable to the above two methods may be acceptable upon approval by the Department.

Reserved Area

For a spray irrigation system, a reserved area of 25% of the total wetted field area shall be provided to allow for future reduction in the application rate, if necessary. For an underground drip irrigation system, a reserved area of 100% of the total wetted field area shall be provided.

Overland Flow

The term "overland flow" applies to all systems that uniformly apply wastewater through the use of pipes or surface trenches to the sloped surface of the receiving site with the understanding that the wastewater will move laterally along the surface of the soil and be collected at the lowest point along the travel by drainage tile, surface trenches, or other collection structures. After collection, the renovated wastewater is recycled through the overland system a second time, or discharged directly into surface water, or land applied. The wastewater is renovated by physical, chemical, and biological processes present at the soil-vegetation interface as it flows in a thin film down the relatively impermeable slope.

Minimum pre-application treatment requirements for overland flow systems are given in Table 1.

Site requirements for overland-flow systems are as follows:

Soils

1. minimum of 6 to 12 inches in depth.
2. very slow to moderately slow permeability (0.06 to 0.2 inches per hour).
3. U.S.D.A. textures ranging from clays to heavy clay loams.

Slope

Slopes should range from a minimum of 2% to a maximum of 8%.

Vegetation

A complete vegetational cover is required. It can be natural, as in the case of forest, or it can be planted, as in the case of cultivated fields.

Buffer

All types of overland flow systems should be surrounded by a minimum buffer zone of 50 feet.

Storage

A means of wastewater storage must be provided at each land-treatment system to accommodate flows generated during those periods when the treated wastewater cannot be applied to the land (e.g., frozen soil conditions, rain storms, etc.). Since climatic influences vary geographically, storage capacity requirements will be dependent upon the location of the system. However, a minimum of 60 days storage must be provided for all systems receiving wastewater flows throughout the year.

Reserved Area

Same as slow-rate system.

Application rates and loading cycles

The application rate or hydraulic loading rate of a given system is dependent upon both the effluent and site characteristics. Typical application rates for overland flow systems range from 2.5" to 8" per week for secondary effluent. Loading cycles for overland-flow systems generally range from 6 to 8 hours on and 16 to 18 hours off, for 5 to 6 days per week, depending upon the time of year.

Rapid Infiltration

The term "rapid infiltration" applies to all systems that apply wastewater through the use of excavated and/or bermed structures to subsurface soils under a positive hydraulic head with the understanding that the applied wastewater will move in a predominately vertical direction through the soil until the groundwater table or bedrock is encountered. The wastewater is renovated by physical, chemical, and biological processes present in the soils through which it moves. In rapid-infiltration systems, over 90 percent of the wastewater applied eventually reaches and recharges the groundwater. The remainder is lost to evaporation or is stored in the soils beneath the structure and above the underlying groundwater table.

Minimum pre-application treatment requirements for the rapid-infiltration systems are given in Table 1.

Site requirements for rapid-infiltration systems are as follows:

Soils

1. a minimum of 10 feet of unsaturated soil between the bottom of the infiltration pond and the underlying groundwater or bedrock.
2. moderately rapid to very rapid permeability (2.0 to 20 inches per hour).
3. U.S.D.A. textures ranging from sandy loams to sands.

Buffer

All types of rapid infiltration systems should be surrounded by a minimum buffer zone of 50 feet.

Reserved Area

Same as slow-rate system.

Application rates and loading cycles

The application rate or hydraulic loading rate of a given system is dependent upon both the effluent and site characteristics. In general, application rates for standard rapid infiltration systems range from 5 to 100 inches per week. The systems are typically loaded for 1 to 2 days then allowed to rest for 1 to 14 days, depending upon the hydraulic conductivity of the soils and the depth to groundwater. **Determination of application rate is the same as slow-rate system described in the previous section.**

Table 2. Summary of site requirements for various types of land treatment.

Site Requirements	Land-Treatment Processes		
	Slow Rate	Overland Flow	Rapid Infiltration
Soils			
Depth to Groundwater	4 ft. min. 2 ft. min. (Eastern Shore)	Not Critical	10 ft. min. (standard)
Permeability	mod. slow to mod. rapid	very slow to mod. slow	mod. rapid to very rapid
USDA Texture Class	clay loam to sand loam	clay to heavy clay loam	sandy loam to sand
Slopes	15% max. for cult. 25% max. for uncult.	2-8%	--
Buffer Requirements			
to property lines, roads, etc.	**Class I effluent, 200 ft. for spray, 50 ft. for drip. 25 ft for Class II effluent**	50 ft.	50 ft.
to buildings	**Class I effluent, 500 ft. for spray, 50 ft. for drip. 25 ft for Class II effluent**	50 ft.	50 ft.

Site Requirements	Land-Treatment Processes		
	Slow Rate	Overland Flow	Rapid Infiltration
to potable wells and water intakes	**100 feet**	**100 feet**	**100 feet**
Storage	**60 days min. for spray irrigation and 30 days for drip irrigation**	--	--
Application Rates	0-2 in./week	2.5-16 in./week	5-100 in./week
Loading Cycles	1 day load, 6 days rest	6-8 hrs. load, 16-18 hrs. rest	1-2 days load, 1-14 days rest

STATE AND COUNTY COORDINATED APPROACH TO LAND TREATMENT

Systems involved in the land treatment of municipal wastewater fall within the administrative jurisdiction of the Maryland Department of the Environment. In addition, each county government had the responsibility of evaluating any new development with respect to incorporation of the new development into their Ten-Year Comprehensive Water and Sewerage Plan.

The Maryland Department of the Environment regulates the development and operation of land-treatment systems through the Groundwater Discharge Permit Program and regulates the design, funding, and installation of land-treatment systems through their construction permit program.

A hypothetical situation has been developed to clarify the procedures involved in obtaining State and County authorization for the development, design, installation, and operation of land-treatment systems. The following example applies to both privately and publicly owned facilities.

Hypothetical Situation

A community has increased in size to such a point that their sewage treatment plant, which ultimately discharges into a nearby river, can no longer handle the increased flows. Consequently, the community is faced with an expansion and possible upgrading of their treatment facility. An engineering consultant is employed by the community to develop a Facilities Plan for the new sewage treatment plant. An important phase of the Facilities Plan is to investigate and evaluate the feasibility and cost effectiveness of land treatment as an alternative to surface discharge. The following is an outline of the major steps to be followed by the consultant and community planners:

Step	Directors
1.	Contacts State (Maryland Department of the Environment) and local agencies for information regarding land-treatment systems.

Step	Directors
2.	Acquires soils information from Soil Conservation Service and other pertinent information necessary to identify prospective land-treatment sites.
3.	Acquires necessary permission from appropriate landowners for site evaluations.
4.	Sends a letter to the Maryland Department of the Environment requesting a site evaluation. The letter includes the following: a. map(s) of proposed area(s) in scale of 1 inch equals 200 feet or larger scale; b. project flows; c. acreage of site(s); d. proposed application rate(s).
5.	Sets up preliminary site visit. The Project Manager request that a backhoe be available for preliminary site evaluation (at applicants expense). Based upon outcome of preliminary site evaluation, the Project Manager will make one of three recommendations: 1) that site is acceptable; 2) that site is conceptually acceptable, but a more detailed hydrogeologic study must be completed (at applicants expense); or 3) that site is not acceptable for land treatment. An outline for the comprehensive hydrogeologic study can be found in Appendix **B**. The detailed study is conducted by a qualified consultant chosen by the applicant.
6.	If conceptual approval is given for a particular site by the project manager, **The applicant may proceed with a hydrogeologic study and addresses the items outlined in Appendix B in a hydrogeological report**. At the same time, an application should be filed to appropriate County agencies for the inclusion of the project in the County Ten-Year Water and Sewerage Plan and any other appropriate planning and zoning programs.
7.	**Upon completion of a hydrogeologic study, the applicant shall forward a copy of the hydrogeologic report to the Department for review and approval. At the same time, the applicant may file a groundwater discharge permit application to the Department. If the State approves the hydrogelogical report, the project manager may proceed to prepare the draft permit. However, a tentative determination by the Department based on the conditions of the draft permit will not be published in a local paper for public comment until the County notifies the Department that the project is intended to be incorporated into the County Master Water and Sewerage Plan. If a public hearing is requested after publication of a tentative determination, the Department may schedule a hearing.** At the public hearing, all pertinent testimony, both for and against the permit, will be taken by the hearing officer. If information is presented at the hearing which indicates that the land treatment system will result in adverse effects on the environment or public health, the permit may be modified or canceled. If no adverse information is presented, the permit will be finalized and issued, usually for a period of 5 years.

Step	Directors
8.	After the applicant receives a State Groundwater Discharge Permit, appropriate applications should be made to the Maryland Department of the Environment for a State Construction Permit.

The preceding procedure will be followed whether it be in relation to a waste treatment Facilities Plan (as in the above hypothetical situation), an investigation resulting from an enforcement action taken against a violator unable to meet State Surface Water Discharge Permit requirements, a new privately owned development, or any other application for a permit to discharge wastewaters into the groundwater of the State via land treatment.

The comprehensive outline for the hydrogeologic study (given in Appendix A) is presented as a guide. The actual information that will be requested in the detailed study for any given project will depend upon the volume of wastewater, and the effluent and site characteristics of the project.

Two important parameters of any land-treatment system are the water and nutrient balances. The major components of a water balance are natural precipitation wastewater loading, and surface runoff. An example of the calculation of a water balance is given in Appendix **C.**

In some land-treatment systems, the nutrient input and not the hydraulic input is the deciding factor as to whether the system will have a detrimental effect on the environment. Nitrogen generally seems to be the most limiting nutrient with respect to groundwater quality. For this reason, an example of a nitrogen balance is given in Appendix **D. To meet the drinking water standard of nitrate, a 10 mg/l nitrogen concentration in the percolate should be used for nitrogen balance calculations. However, groundwater discharge that may impact impaired surface water body, the Department will determine the nitrogen input from the percolate on a case by a case basis.**

There are many different methods used to calculate both water and nitrogen balances. Those described in the Appendices are two of the more common methods.

Besides water and nitrogen balances, where a land treatment system receives wastewater containing heavy metals from industrial discharges, a study to evaluate the potential impact of heavy metal discharge on groundwater quality must be conducted.

1.0 Monitoring Networks:

One of the basic or prime objectives of a monitoring program is to detect existing groundwater degradation caused by disposal of municipal wastewater. Where a potential for contamination exists, an assessment of the problem must be made to determine control strategies for a particular disposal site. Groundwater monitoring will play an important part in assessing and providing long-term verification of the integrity of the system.

2.0 Monitoring Design:

The following data should be carefully evaluated in designing a monitoring network: 1) groundwater flow direction; (2) location of nearby private wells; (3) subsurface geology including the hydraulic conductivity and porosity of each soil and rock formation; (4) present or future effects of domestic or commercial pumping on the flow system; and (5) existing groundwater quality. The existing groundwater quality would serve as a basis for later comparison. Analysis should include dissolved solids, nitrate, total phosphorus, and total nitrogen, depending on the chemical composition of waste.

2.1 Recommendations:

To detect groundwater contamination, a monitoring-well network should consist of the following:

2.1.1 At least two wells, adjacent to the Property line downgradient from the disposal site, which are screened from the seasonally high groundwater table downward 15 feet.

2.1.2 Monitoring wells (at least one) completed in an area upgradient from the disposal site so that it will not be affected by potential contaminants.

3.0 Specifications for Installation of Groundwater Monitoring Wells

Each monitoring well must be constructed utilizing 4" I.D., schedule 40, PVC pipe or casing satisfactory to the Department.

All related permits must be obtained before wells are installed by a well driller licensed by the State of Maryland in accordance with all laws and regulations.

The well shall be gravel packed to at least five feet above the top of the screen unless multiple aquifers are affected.

The screened interval must consist of at least 15 feet of schedule 40, 4" (103 mm), slotted PVC well screen.

Wells must penetrate a minimum of 15 feet below the groundwater table.

The well shall be continuously pressure grouted from top of gravel pack to ground surface. The well shall also be developed and disinfected prior to sampling according to Maryland well construction regulations, COMAR 26.04.04

A copy of the well completion report must be submitted to the Maryland Department of the Environment.

4.0 Additional Monitoring:

Whenever the original monitoring network indicates groundwater degradation, steps must be taken to determine cause and if necessary the corrective measures taken. These measures may include construction of additional wells to determine lateral and vertical extent of contamination direction, rate of movement, dilution and attenuation, etc. Further quantitative studies can be performed to determine the exact nature of contamination. These studies will aid in determining the proper corrective measures needed to abate the problem.

5.0 Sampling Techniques:

The primary concern in sample withdrawal methods is to obtain a representative sample of groundwater. Stagnant water shall be removed so that the sample collected is fresh. Normally three volumes of stagnant water are pumped out prior to taking samples. Withdrawal methods may include pumps, compressor air, or boilers.

To protect against collection of non-representative, stagnant-water sample withdrawal, the guidelines and techniques outlined in EPA's Procedures Manual for GW Monitoring at S.W. Disposal Facilities pp. 220-237 "Sample Withdrawal, Storage and Preservation" is helpful. Other useful references for sample collection and preservation are also included in the references section.

6.0 Monitoring Frequency:

Monitoring frequency for a disposal site may be influenced by a number of factors and thus will be addressed on a case-by-case basis through individual State groundwater discharge permits.

REFERENCES

Culp, R.L., G.M. Wesner, and G.L. Culp (1978). "Handbook of Advanced Wastewater Treatment," Van Nostrand Reinhold Company.

Delaware Department of Natural Resources and Environmental Control (1981). "Field Manual for Ground Water Sampling," Dover, Delaware.

Sopper, W.E. and L.T. Kardos (1973). "Recycling Treated Municipal Wastewater and Sludge through Forest and Cropland," pp. 479. The Pennsylvania State University Press, University Park and London.

Standard Methods for the Examination of Water and Wastewater (1981), 15th ed., American Public Health Association.

Stone, J.E. (1976) "Land Application of Wastes: Nitrogen Considerations". Module 15. Educational Program. Cornell University, New York State College of Agriculture and Life Sciences, Ithaca, New York.

U.S. Environmental Protection Agency, U.S. Army Crops of Engineers, and U.S. Department of Agriculture (1977). "Process Design Manual for Land Treatment of Municipal Wastewater." EPA 625/1-77-008 (COE EM 1110-1-501).

U.S. Environmental Protection Agency (1987), "Handbook, Ground Water", EPA 625/6-87/016.

U.S. Environmental Protection Agency, U.S. Army Crops of Engineers, U.S. Department of Interior, and U.S. Department of Agriculture (1981). "Process Design Manual for Land Treatment of Municipal Wastewater." EPA 625/1-81-013 (COE EM 1110-1-501).

ASTM (1997), " ASTM Standards Related to On-Site Septic Systems", ASTM Publication Code No. 03-418197-38.

APPENDICES

Appendix A
Outline for Soil Infiltration Test

The Maryland Department of the Environment incorporates by reference herein as Appendix A the following documents:

1. The American Society for Testing and Materials' (ASTM) Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer (Designation D-3385-94, ASTM Publication Code No. 03-418197-38, 1997); and

2. US EPA "Process Design Manual – Land Treatment of Municipal Wastewater" (EPA 625/1-81-013, October 1981)

Item No. 1 may be obtained from ASTM by calling (610) 832-9585, or order online at http://www.astm.org. Alternatively, the official text of this document may be reviewed at the Maryland Department of the Environment's main office. Please call for an appointment at (410) 537-3662.

The text of Item No. 2 has transcribed on the following pages. To order an official copy of the EPA publication logon to http://www.epa.gov/OWM/secttre.htm

Excerpted from: **US EPA, "Process Design Manual – Land Treatment of Municipal Wastewater", EPA 625/1-81-013, October, 1981**

3.4.1 Flooding Basin Techniques

Pilot-scale infiltration basins represent an excellent technique for determining vertical infiltration rates. The larger the test area is, the less the relative error due to lateral moisture movement will be and the better the estimate. Where such basins have been used, the plots have generally ranged from about 0.9 m^2 (10 ft^2) to 0.1 ha (0.25 acre). In some cases, pilot basins of large scale (2 to 3.2 ha or 5 to 8 acres) have been used to determine infiltration rates and demonstrate feasibility with the thought of incorporating the test basins into a subsequent full-scale system [16]. Figure 3-6 is a photograph of a pilot basin.

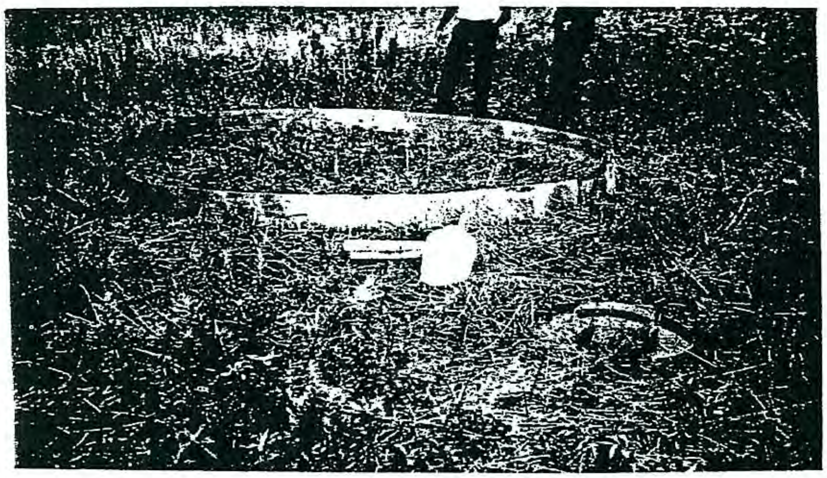


FIGURE 3-6
FLOODING BASIN USED FOR MEASURING INFILTRATION

The Corps of Engineers has used flooding basin tests to determine infiltration rates on three existing land treatment sites [17]. Basins of 6.1 m (20 ft) and 3 m (10 ft) diameter were used and it was concluded that the 3 m (10 ft) diameter basin was large enough to provide reliable infiltration data. About 4 man-hours were required for completing an installation and less than 1,000 L (265 gal) of water would probably be adequate to complete a test. As this testing procedure will undoubtedly become more widely adopted, Figures 3-7 and 3-8 are included to show the details of installation [18].

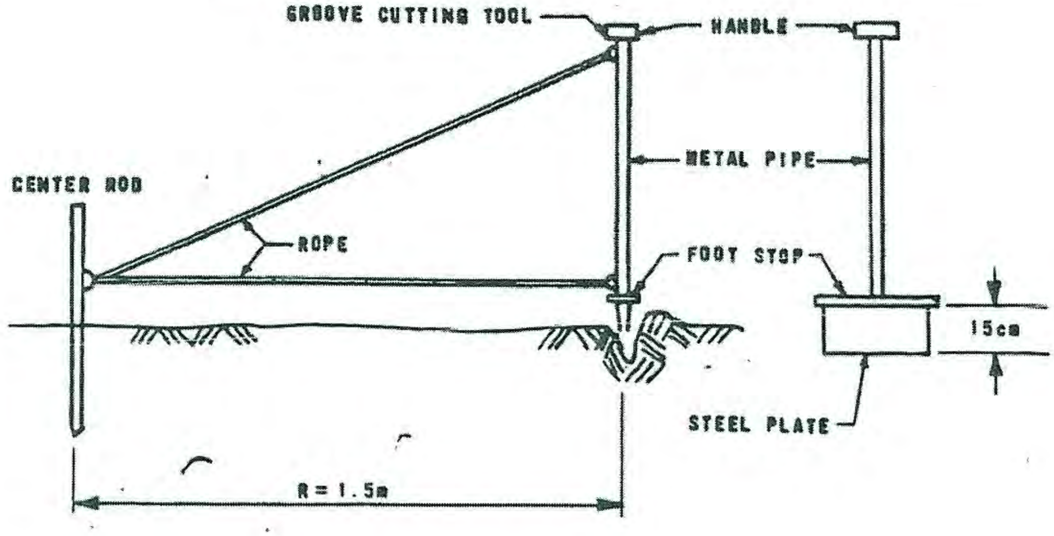


FIGURE 3-7
GROOVE PREPARATION FOR FLASHING (BERM) [18]

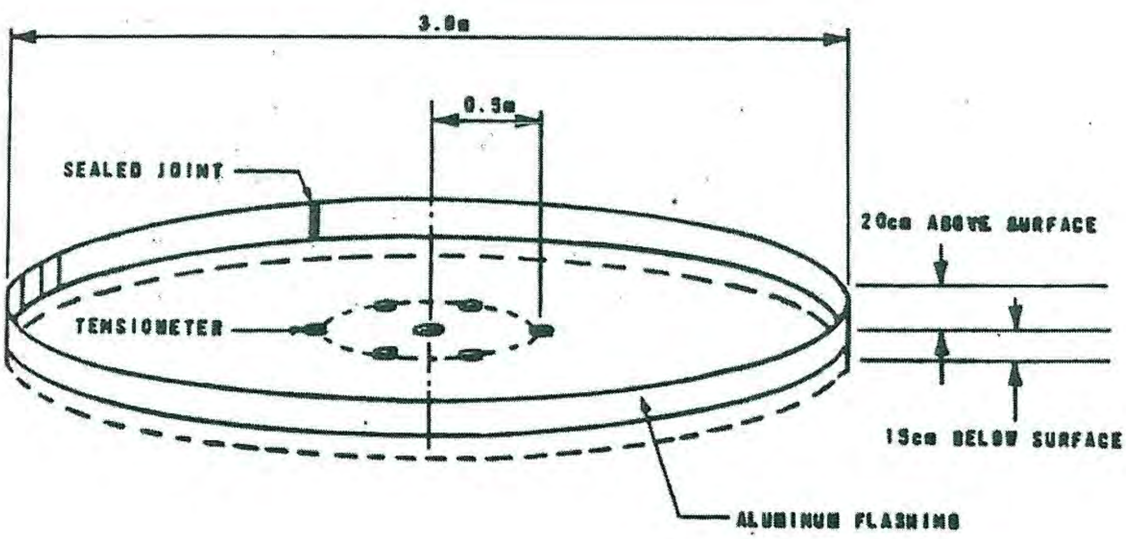


FIGURE 3-8
SCHEMATIC OF FINISHED INSTALLATION [18]

An important assumption in any flooding type infiltration test is a saturated (or nearly so) condition in the upper soil profile. Thus, an essential part of this method is the installation of a number of tensiometers within the test area at various depths to verify saturation by their approach to a zero value of the matric potential, before obtaining any head drop (water level) measurements. In the Corps of Engineers studies, six tensiometers were installed in a 1 m (3.3 ft) diameter circle concentric with the center of the 3 m (10 ft) diameter test basin as shown in Figure 3-8. Table 3-4 gives their suggested depths of placement in a soil of well-developed horizons; however, any reasonable spacing above strata of lower conductivity, if such exist, should be adequate. In soils lacking well-developed horizons, a uniform spacing down to about 60 cm (24 in.) should suffice. A seventh tensiometer installed at a depth of about 150 cm (60 in.) is also suggested, but is not critical.

TABLE 3-4
SUGGESTED VERTICAL PLACEMENT OF
TENSIOMETERS IN BASIN INFILTROMETER TESTS [18]

No.	Soil horizon	Placement
1	A	Midpoint of A
2	B	1/5 distance between A/B and B/C interfaces
3	B	2/5 distance between A/B and B/C interfaces
4	B	3/5 distance between A/B and B/C interfaces
5	B	4/5 distance between A/B and B/C interfaces
6	C	15 cm below B/C interface

Following installation and calibration of the tensiometers, a few preliminary flooding events are executed to achieve saturation. Evidence of saturation is the reduction of tensiometer readings to near zero through the upper soil profile. Then a final flooding event is monitored to derive a cumulative intake versus time curve. A best fit to the data plotted on log-log paper allows calculation of the infiltration parameters, as shown in Figure 3-9. Subsequent observation of tensiometers can then provide data on profile drainage.

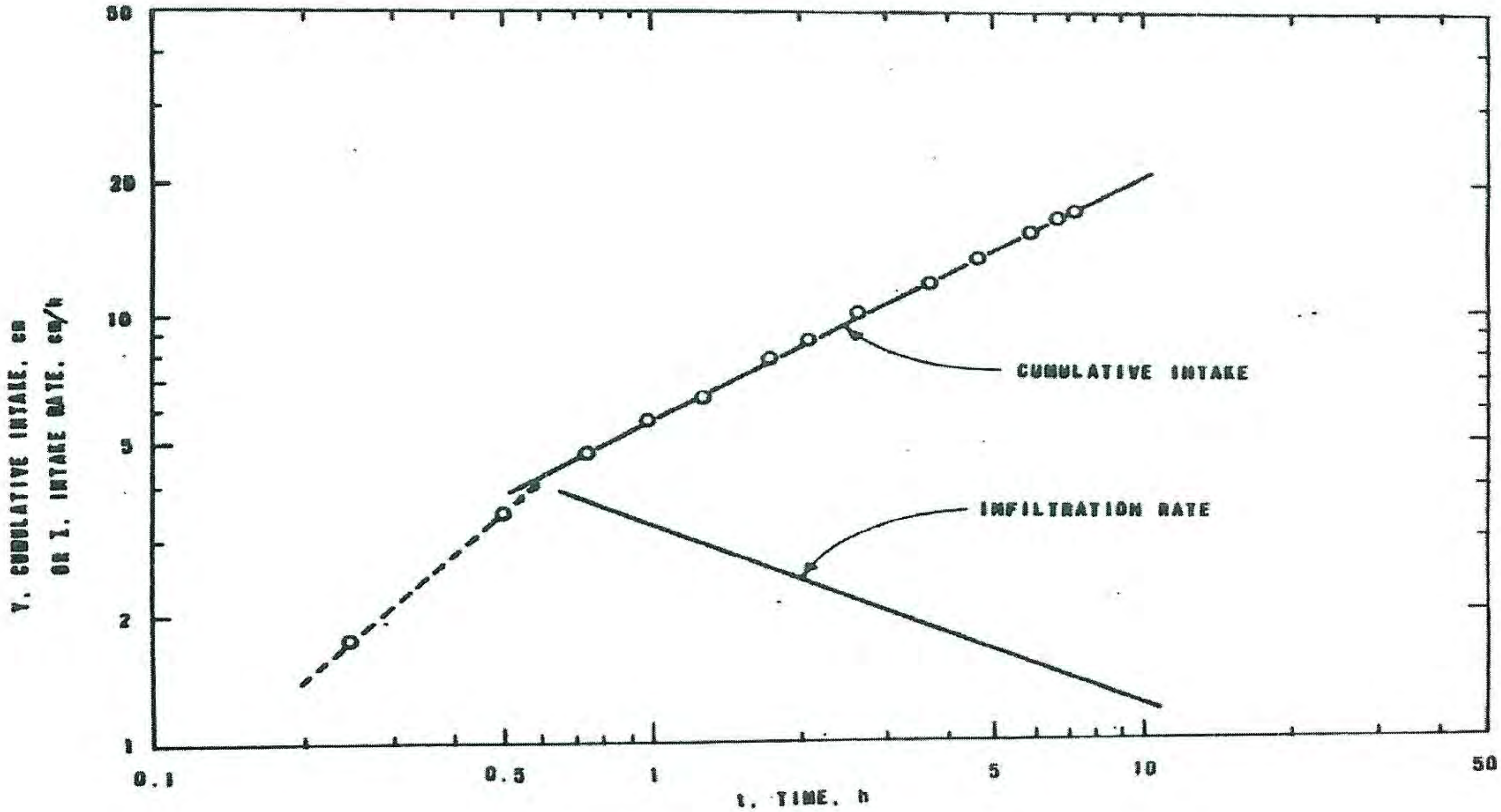


FIGURE 3-9
INFILTRATION RATE AND CUMULATIVE INTAKE DATA PLOT

Appendix B

Outline for Hydrogeologic Report

I. Site location and description

   A. Site location (provide maps with minimum scale of 1 inch equals 200 feet and a contour interval of no more than 5 feet)

   B. Areal extent of site (acres)

   C. Present land use

   D. Future land use

II. Description of land-treatment techniques

   A. Degree. of wastewater treatment to be employed prior to land treatment (i.e. primary, secondary, lagoons, etc.)

      1. Wastewater quality before treatment
      2. Wastewater quality after treatment

   B. Volume of treated wastewater to be discharged (MGD)

   C. Land-treatment techniques employed (i.e. spray irrigation, overland flow, rapid infiltration, well injection, etc.)

III. Geology, soils, and hydrology

   A. Geology of site and surrounding groundwater discharge area

      1. Rock or sediment types and formations
      2. Depths to bedrock and thickness of weathered or unconsolidated material
      3. Properties of bedrock and weathered or unconsolidated material
      4. Structural features
      5. Large-scale maps showing site characteristics
         a. Surficial geology
         b. Depth to bedrock and/or thickness of surficial material expressed in terms of contour lines
         c. Geologic cross-sections
      6. discussion of geologic materials and structural controls on the movement of infiltrating waters and groundwaters and the renovation of applied wastewaters.

B. Soils

1. Description of soil series present
2. List of soil mapping units and a copy of USDA Soil Survey maps
3. Discussion of available soil characterization and Soil Survey data regarding the movement and renovation of infiltrating wastewater.
4. Site-specific information from soil borings, test pits, etc.
    a. Depths of soils
    b. Textures of soils and substratum
    c. Description of water-related soil characteristics
        (1) Mottling
        (2) Perched Water
5. Large-scale maps (1 inch equals 200 feet or larger scale) with locations of all auger borings, test pits, etc. with corresponding logs
6. Discussion of soil-materials control on the movement and renovation of applied wastewaters

C. Hydrology

1. Regional climate
    a. Monthly precipitation
    b. Monthly temperature
    c. Monthly evapotranspiration
2. Surface phenomena
    a. Slope
    b. Vegetational cover type
    c. Description and location on suitable map of surface waters (ponds, lakes, streams, springs, existing water wells, sinkholes, etc.)
    d. Description of erosion present
    e. Water-quality inventory of existing water wells within 1/4 mile of site
3. Permeability of soils
    a. Infiltration capacity of surface soils
    b. Vertical hydraulic conductivity of subsurface soils
4. Type of aquifer(s) present (refer to COMAR **26.08.02.09** Groundwater Quality Standards)
5. Develop hydrologic balance for proposed site considering ultimate fate and disposition of both natural precipitation and wastewater
6. Maps showing highest and lowest depth to water table using both sea-level datum and land-surface datum (include groundwater flow lines on sea-level datum map)
7. Discuss groundwater mounding potential
8. Develop nitrogen balance from discharge site to groundwater table

IV. Plan of operation for facility

A. Application rates (inches per week and inches per hour)

B. Loading rates

1. Wastewater
2. Nitrogen
3. Phosphorus
4. BOD
5. Suspended solids

C. Holding pond specifications

D. Maintenance of land treatment area

V. Monitoring-surveillance system

A. Observation wells

1. Number
2. Location
3. Method of installation

B. Surface water stations (ponds, lakes, streams)

1. Number
2. Location
3. Method of sampling

VI. General comments

A. Summation of sites advantages and points of concern

B. Overall summation of hydrogeologic report

1. Will it work?
2. For how long?

Appendix C

Calculation of Hydrologic Balance

All hydrologic balances contain parameters which fall into one of two categories, supply or demand. In order for an equation to express accurately a hydrogeologic balance, the sum of the water-supply parameters must equal the sum of the water-demand parameters. The following is an example of a simplified hydrologic balance applicable to a land-treatment system:

$$P + Lw = ET + GW + SM + RO$$

where:

P = natural precipitation occurring on-site. For design purposes, the wettest year in the last 10 years of record should be used.
Lw = amount of wastewater applies to site.
ET = evapotranspiration losses from site.
GW = amount of water entering groundwater system beneath site.
SM = amount of moisture contained in soil profile on site.
RO = amount of surface runoff flowing from site.

In most land-treatment systems, surface runoff from the site is not permitted. Consequently, the runoff term (RO) in the previous hydrologic balance is usually omitted. Soil moisture changes, gains and losses, on an annual basis are thought to balance each other out. Consequently, soil moisture (SM) from year to year is considered relatively constant and, therefore, usually omitted from the hydrology equation.

The precipitation and temperature data required for the hydrologic balance can be obtained from regional climatological stations owned and operated by the Weather Bureau, U.S. Department of Commerce. These climatic stations are established throughout the continental U.S., and the data published monthly. The precipitation data (P) is directly used in the equation. The temperature data, along with the precipitation data, is used to calculate the potential evapotranspiration term (ET) in the equation. There are several methods commonly used to calculate potential ET. Most of them can be found in basic hydrology texts.

Estimating the wastewater application rate (hydraulic loading rate) of any land treatment system is one of the most difficult steps in the design process. The application rate is a function of the physical properties of the soil, depth to groundwater, and the nutrient balance of the site. Traditionally, the application rate for slow-rate systems has been based upon annual precipitation information. In most places of the northeastern U.S., annual precipitation ranges between 35 and 45 inches. Assuming that land treatment is performed during 9 months of the year, applying wastewater at a rate of 1 inch per week would approximately double the amount of water received by the site under natural conditions; 2 inches per week would approximately triple the amount.

Some scientists and engineers use the permeability of the soils to determine the wastewater application rate. However, this technique can result in over-estimating the ability of the soil to transmit the wastewater. Research has shown that soil permeability decreases when wastewater is used in place of potable water. Soil permeability has also been found to decrease over time, regardless of the water used. Just how much the permeability decreases over time is still open for discussion and depends upon a great many factors. Some of the more important factors affecting soil permeability are the physical and chemical properties of the soil, the amount and chemical composition of the wastewater, the climatology of the site, the vegetational cover type, and the management practices (e.g. crop harvesting) of the site. Activities affecting any one or more of these factors could result in a change in soil permeability, thus the sites ability to accommodate the applied wastewater.

In the past, the maximum application rate for the most commonly used technique, slow-rate, has been set at 2 inches per week. This rate was used in the research work conducted at Penn State University beginning in 1963 and continuing today. Little information has been collected elsewhere which suggests a relaxation of this maximum. In Maryland, an application rate of 2 inches per week is considered acceptable for soils ranging in texture from silt loams to sands. Application rates less than 2 inches per week are considered necessary for soil ranging in texture from silty clay looms to silty clays.

The actual application rate accepted by the Department of the Environment for any land-treatment system must consider not only the permeability of the soils but also the depth to groundwater and the nutrient balance of the site.

The groundwater term (GW) in the hydrologic balance is dependent upon the magnitudes of the precipitation, wastewater loading rate, and evapotranspiration terms. It is one of the more difficult terms of the balance to measure. Consequently, if it is not predetermined by a management plan, it is calculated using the hydrologic balance in a "check-book" type procedure.

The following example problem has been developed to demonstrate more fully the use of a hydrologic balance in a land-treatment system. The information that is given would be typical of that known about a system in the preliminary planning stages.

Example Problem

A small housing development located in Western Maryland has proposed a slow-rate land treatment system. The land-treatment system is to be responsible for handling only the municipal wastewater generated by the development. Several important hydrologic questions that need to be answered are: 1) what weekly application rate (loading rate) should be used, 2) how many acres of land will be required for the spray field, and 3) what is the total amount of water (wastewater plus precipitation) that will enter the underlying groundwater system?

The following information is known about the land-treatment system:

a) The average daily wastewater flow is 100,000 gallons.

b) The soils occupying the land treatment site are identified as Calvin channery loom. There are no impermeable layers or fragipans present in the profile, and the permeability of the horizons range from 0.6 to 2.0 inches per hour.

c) The site is and will continue to be used as pastureland.

d) Spray irrigation will begin each year in March and continue through the month of November for a total period of 275 days. Wastewater generated during the 90-day non-spray period will be held in a storage pond. The weekly loading cycle will consist of a one-day spray followed by a six-day rest period.

Question 1:

The soil present on the site is Calvin channery loam. There is neither an impermeable layer present in the soil profile nor any shallow groundwater present. Nutrient loading is not considered to be a problem. In light of these facts, the maximum application rate of 2 inches per week is considered acceptable for the site.

Question 2:

In order to determine the number of acres needed for the land-treatment system, the following equation was used:

$$A = \frac{Q \times 365 \times (E + F)}{27154 \times (365 - G) \times H}$$

where:

A = area in acres
Q = flow in gallons per day
E+F = loading cycle (loading plus rest periods) in days per week
E = loading period in days per week
F = rest period in days per week
G = storage requirement in days per year
H = application rate (loading rate) in inches per week

Conversion factors:

365 = days per year
27154 = gallons per acre-inch

Substituting the given information into the above equation yields:

$$A = \frac{100{,}000 \text{ gal/day} \times 365 \text{ days/year} \times (1+6) \text{ days/week}}{27154 \text{ gal/acre-inch} \times (365-90) \text{ days/year} \times 2 \text{ inches/week}}$$

A = 17.11 acres required for spray field (excluding buffers)

Question 3:

The hydrologic balance, previously given, was used to calculate the total amount of water (applied wastewater plus natural precipitation) that will enter the groundwater system beneath the spray field. The average monthly precipitation and temperature data were calculated using the most recent 10 years of data obtained at a nearby Weather Bureau climatic station. The Blaney-Criddle Method was used to estimate potential evapotranspiration for the site:

Calculation of potential evapotranspiration:

Blaney-Criddle Method

$$PET = KF$$

where:

PET = Potential ET in inches per unit area,
K = Crop-use coefficient,
F = Consumptive-use factor.

$$F = \frac{tp}{100}$$

where:

t = mean monthly temperature (°F),
p = percent of annual daytime hours occurring during each month of the year (Latitude for example site N 39", 30').

Month	Ave. Monthly Air Temp. (°F)	Percent Annual Daytime Hours	Veg. Consump. Use Coeff.	(Col 2 x Col 3)/100	Monthly PET (inches)
OCT	50.38	7.76	0.70	3.91	2.74
NOV	40.27	6.75	0.70	2.72	1.90
DEC	31.39	6.55	0.70	2.06	1.44
JAN	27.11	6.78	0.70	1.84	1.29

Month	Ave. Monthly Air Temp. (°F)	Percent Annual Daytime Hours	Veg. Consump. Use Coeff.	(Col 2 x Col 3)/100	Monthly PET (inches)
FEB	27.28	6.74	0.70	1.84	1.29
MAR	35.80	8.30	0.70	2.97	2.08
APR	47.33	8.94	0.70	4.23	2.96
MAY	57.62	9.99	0.70	5.76	4.03
JUN	65.19	10.03	0.70	6.54	4.58
JULY	69.18	10.17	0.70	7.04	4.93
AUG	68.21	8.52	0.70	5.81	4.07
SEPT	61.87	8.39	0.70	5.19	3.63

Calculation of water entering groundwater system:

The equation used to calculate the amount of water entering the groundwater system is as follows:

P + Lw = ET + GW

where:

P = natural precipitation, inches (conservatively, assuming 100% precipitation eventually recharging the groundwater flow)
Lw = wastewater loading, inches
ET = potential evapotranspiration, inches
GW = water entering groundwater, inches

Month	Natural Precip. (inches)	Wastewater loading (inches)	Potential ET (inches)	Entering Groundwater (inches)
OCT	2.63	8.67	2.74	3.61
NOV	2.29	8.67	1.90	9.06
DEC	3.04	--	1.44	1.6
JAN	2.57	--	1.29	1.28
FEB	2.10	--	1.29	0.81
MAR	3.08	8.67	2.08	9.67
APR	2.98	8.67	2.96	8.69
MAY	3.76	8.67	4.03	8.40
JUNE	3.01	8.67	4.58	7.10
JULY	345	8.67	4.93	7.39
AUG	3.25	8.67	4.07	7.85
SEPT	3.46	8.67	3.63	8.50

Month	Natural Precip. (inches)	Wastewater loading (inches)	Potential ET (inches)	Entering Groundwater (inches)
ANNUAL	35.87	78.03	34.94	78.96

The total amount of water entering the groundwater system beneath the spray field was calculated to be **78.96** inches per acre per year. To convert **78.96** inches per acre year to gallons per day, the following calculations are made:

$$\frac{(78.96\text{ acre-inches/year}) \times (27154\text{ gallons/acre-inch})}{365\text{ days/year}} = 5874.2\text{ gal/day}$$

APPENDIX D

Calculation of Nitrogen Balance

Nitrogen, especially in the nitrate (NO3) form, is considered to be one of the most limiting constituents of municipal wastewater with respect to land treatment systems. The nitrate ion possesses a negative charge, as do soil particles. Since like charges repel, the nitrate ions tend to leach down through the soil profile. High nitrate concentrations in drinking water pose a health problem, especially in infants. For this reason the Environmental Protection Agency has imposed a maximum concentration of 10 milligrams per liter of nitrate-nitrogen in their Drinking Water Standards.

The nitrogen balance in any soil-water-plant scheme is dependent on several inputs (sources) and outputs (sinks). The major nitrogen inputs of land-treatment systems are the amount of nitrogen contained in the wastewater that is applied to the site and the amount of nitrogen contained in the natural precipitation that falls on the site. The major nitrogen outputs or sinks of a land-treatment system are removal by crops (plant uptake), leaching losses, denitrification, and ammonia volatilization. The nitrogen mass balance developed by J.E. Stone (1976) for the above situation can be expressed as follows:

Total N in Wastewater	+	N in Precip.	=	N Removal in crops	+	Leaching Loss	+	Denitri-fication	+	Ammonia Volatilization

The above equation assumes: 1) that any short-term increase in nitrogen storage in the soil has already occurred, and 2) that there is no significant additions of nitrogen through nitrogen fixation by leguminous plants growing on-site.

When the nitrogen mass balance is combined with a simplified water balance (volume of water leaving site equaling precipitation plus wastewater loading minus evapotranspiration) and solved for the wastewater loading, the following equation is derived:

$$W = \frac{4.43C + a(P - ET) - cP}{y - a - y(d + n)}$$

where:

W = wastewater loading (acre-inch/acre-year)
C = removal of nitrogen in crop (lbs/acre-year)
a = allowable nitrogen concentration in percolation or runoff water (mg/L)
P = precipitation (acre-inch/acre-year)
ET = potential evapotranspiration (assumes that P + W will allow potential ET to be realized in all cases) (acre-inch/acre-year)
c = concentration of nitrogen in precipitation (mg/L)
y = concentration of nitrogen in wastewater (mg/L)
d = fraction of nitrogen which is denitrified ($\% \times 10^{-2}$)
n = fraction of nitrogen which is volatilized as ammonia ($\% \times 10^{-2}$)

For a more thorough explanation of the development and underlying assumption of the above equations, the reader is referred to Stone (1976).

Example Problem

A community located in the Piedmont region of the State is in the process of developing a spray-irrigation program for their treated municipal wastewater. The average annual precipitation and evapotranspiration values for the area are 40 and 28 inches, respectively. Determine how much wastewater, containing 25 mg/L total nitrogen, can be applied such that the soil leachate realized at the groundwater table will not exceed an average concentration of 10 mg/L total nitrogen (Public Drinking Water Standard). Assume that 275 lbs per acre per year of nitrogen will be taken up by a cover crop of reed canarygrass and removed from the site during harvesting. Natural precipitation contains an average concentration of 0.5 mg/L of nitrate-nitrogen. Since no site specific data are available, losses of nitrogen via denitrification and ammonia volatilization are assumed to be zero.

Substituting the appropriate values into the wastewater loading equation yields the following:

$$W = \frac{4.43(275) + 10(40 - 28) - 0.5(40)}{25 - 10}$$

W = 87.88 acre-inches/acre-year

Assuming the annual irrigation season extends from March through November (a period of approximately 40 weeks), the average weekly wastewater loading rate would be:

$$\frac{87.88 \text{ acre-inches/acre-year}}{40 \text{ weeks/yr}} = 2.20 \text{ acre-inches/acre-week}$$

The above weekly loading rate should be compared with the weekly loading rate calculated from the soil permeability data. The smaller loading rate of the two should be the one at which the system is operated.

For discharging treated wastewater into a groundwater system nearby a surface water body, a more stringent nitrogen concentration in the percolate may be required. The term "a", allowable nitrogen concentration in percolation may be 0 mg/l for an impaired surface water body. The wastewater loading rate (W) is reduced according to the following calculations.

$$W = \frac{4.43(275) + 0(40 - 28) - 0.5(40)}{25 - 0}$$

W = 47.93 acre-inches/acre-year

Assuming the annual irrigation season extends from March through November (a period of approximately 40 weeks), the average weekly wastewater loading rate would be:

$$\frac{47.93 \text{ acre-inches/acre-year}}{40 \text{ weeks/yr}} = 1.20 \text{ acre-inches/acre-week}$$

The above weekly loading rate should be compared with the weekly loading rate calculated from the soil permeability data. The smaller loading rate of the two should be the one at which the system is operated.

Letters to/from Utilities

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS
10 North Park Drive • Hunt Valley MD 21030-1846 • Phone 410-316-7800 • Fax 410-316-7817

December 10, 2008

Comcast
11800 Tech Rd.
Silver Spring, MD 20904

Attention: Trini Almida

Subject: Comcast Facility locations Charles County – Hugesville
KCI Job Order No. 01-083704

Dear Mr. Almida,

KCI Technologies, Inc. is preparing a Charles County water main replacement design in the village of Hugesville, Charles County, Maryland. We request any information which you have showing location of Comcast facilities in this area. Attached please find Charles County, Maryland ADC Map 15th Edition, Map 20 showing the area needed highlighted in Black. Also included is a Scaled Site plan with the areas needed highlighted and noted.

Please send this information to:

KCI Technologies, Inc.
10 North Park Drive
Hunt Valley, MD 21030
ATTN: John Kovacs

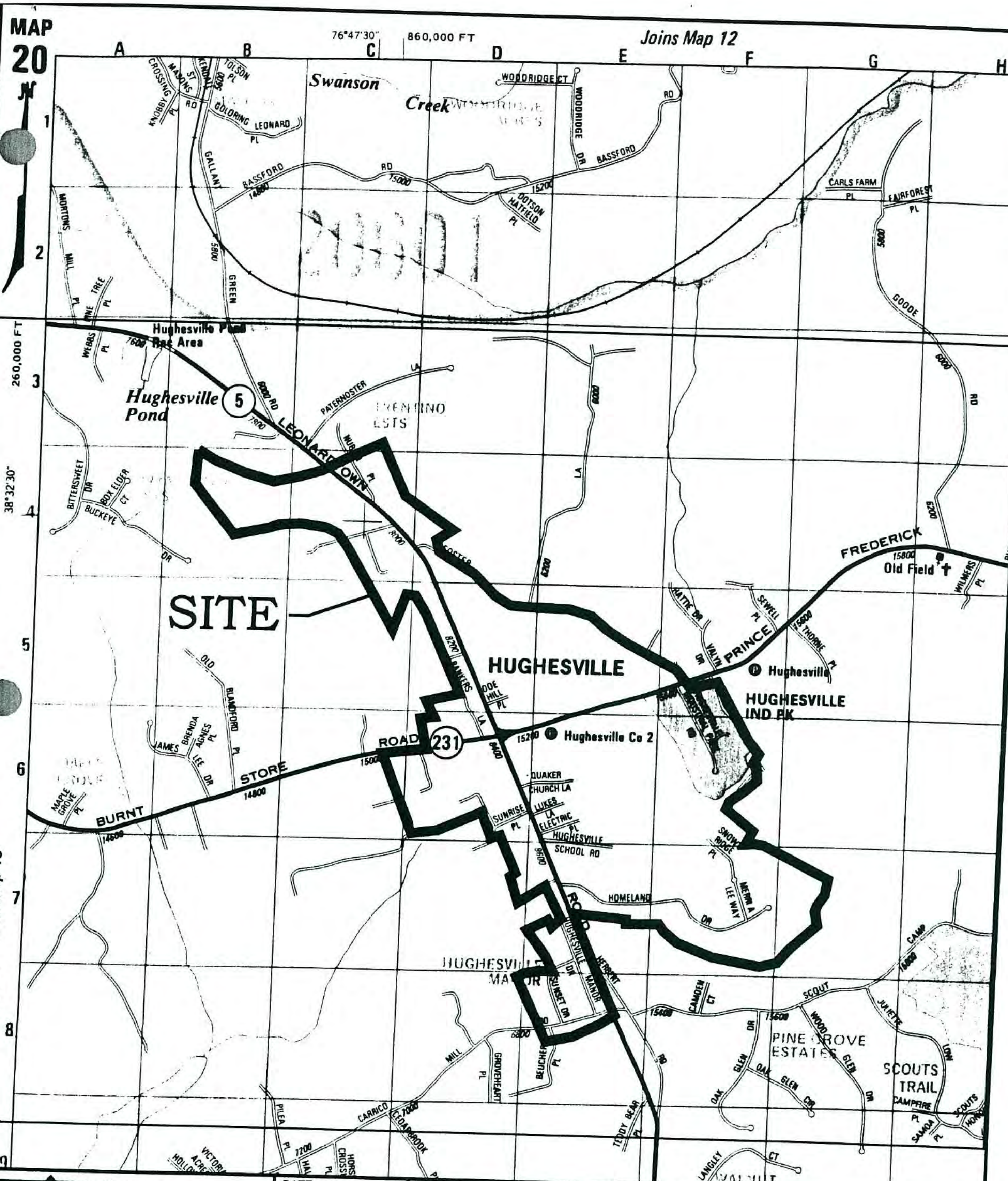
Thank you for your cooperation in this matter, and if you have any questions please call me at 410-316-7911

Sincerely,

John R. Kovacs, P.E.
Project Manager

Phone Number: 410-316-7911
Fax Number: 410-316-7935

M:/2008/01083702/utilities/COMCAST REQUEST.doc



KCI TECHNOLOGIES

Engineers
Planners
Scientists
Construction Managers

10 North Park Drive
Hunt Valley, MD 21030
Phone: (410) 316-7800
Fax: (410) 316-7817
www.kci.com

DATE	DEC 10, 2008
SCALE	1" = 2000'
DESIGNED BY	KK
DRAWN BY	KFJ

HUGESVILLE VICINITY MAP

2000 1000 0 2000

SCALE:
1" = 2000'

KCI TECHNOLOGIES

ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS
10 North Park Drive • Hunt Valley, MD 21030-1846 • Phone 410-316-7800 • Fax 410-316-7817

December 10, 2008

SMECO
P.O. Box 1937
Hugesville, MD 20637-1937

Attention: Mr. Mike Barringer

Subject: ~~Comcast~~ SMECO Facility locations Charles County – Hugesville
KCI Job Order No. 01-083704

Dear Mr. Barringer,

KCI Technologies, Inc. is preparing a Charles County water main replacement design in the village of Hugesville, Charles County, Maryland. We request any information which you have showing location of SMECO facilities and Transmission Mains in this area. Attached please find Charles County, Maryland ADC Map 15th Edition, Map 20 showing the area needed highlighted in Black. Also included is a Scaled Site plan with the areas needed highlighted and noted.

Please send this information to:

KCI Technologies, Inc.
10 North Park Drive
Hunt Valley, MD 21030
ATTN: John Kovacs

Thank you for your cooperation in this matter, and if you have any questions please call me at 410-316-7911

Sincerely,

John R. Kovacs, P.E.
Project Manager

Phone Number: 410-316-7911
Fax Number: 410-316-7935

M:/2008/01083702/utilities/SMECO REQUEST.doc

KCI TECHNOLOGIES

ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS
10 North Park Drive • Hunt Valley, MD 21030-1846 • Phone 410-316-7800 • Fax 410-316-7817

December 10, 2008

Verizon
2510 Riva Rd. 2nd Floor
Annapolis, MD 21401

Attention: Mr. Jim Cunningham

Subject: ~~Comcast~~ Verizon Facility locations Charles County – Hugesville
KCI Job Order No. 01-083704

Dear Mr. Almida,

KCI Technologies, Inc. is preparing a Charles County water main replacement design in the village of Hugesville, Charles County, Maryland. We request any information which you have showing location of Verizon facilities in this area. Attached please find Charles County, Maryland ADC Map 15th Edition, Map 20 showing the area needed highlighted in Black. Also included is a Scaled Site plan with the areas needed highlighted and noted.

Please send this information to:

KCI Technologies, Inc.
10 North Park Drive
Hunt Valley, MD 21030
ATTN: John Kovacs

Thank you for your cooperation in this matter, and if you have any questions please call me at 410-316-7911

Sincerely,

John R. Kovacs, P.E.
Project Manager

Phone Number: 410-316-7911
Fax Number: 410-316-7935

M:/2008/01083702/utilities/VERIZON REQUEST.doc

SMECO
Southern Maryland Electric Cooperative
P.O. Box 1937 Hughesville, MD 20637-1937
301•274•3111, 301•870•3906, 301•884•8146,
301•932•1450 TOLL FREE: 1•888•440•3311

RECEIVED
DEC 15 2008
KCI TECHNOLOGIES, INC.

December 11, 2008

Mr. John R. Kovacs, P.E.
KCI Technologies, Inc.
10 North Park Drive
Hunt Valley, Maryland 21030

R.E.: ~~Comcast~~ SMECO Facility locations Charles County - Hughesville
KCI Job No.: 01-083704

Dear Mr. Kovacs:

Attached you will find information regarding SMECO facilities in the planned project area.

If I can be of further assistance, please contact me at 301-274-4483.

Sincerely,

J. Michael Barringer

J. Michael Barringer, P.E.
Distribution Engineering Director

(301-645-3636
x4483)

enclosure

Mike,
Here is the drawing around Hugh. Substation. If you need a bigger area let me know. Thanks,
Kelli