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# Town of Hillsboro Wastewater Feasibility Study

Town of Hillsboro  
June 1, 2018



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TOWN OF HILLSBORO  
WASTEWATER FEASIBILITY STUDY

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## Abbreviations

AOSS	Alternative Onsite Sewage Systems
BNR	Biological Nutrient Removal (TN < 8 mg/L)
EDM	Engineering Design Manual
gpd	Gallons Per Day
hrs	Hours
LCCO	Loudoun County Codified Ordinance
lbs	Pounds
LPS	Low Pressure System
MBR	Membrane Bioreactor
NWP	Nationwide Permit
O&M	Operation & Maintenance
SBR	Sequencing Batch Reactor
SCAT	Sewage Collection and Treatment
SHDR	Sewage Handling and Disposal Regulations
SHPO	State Historic Preservation Office
SOA	State of the Art treatment (TN < 3.0 mg/L)
Sq. ft.	Square Feet
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VDH	Virginia Department of Health
WOUS	Waters of the United States

## Executive Summary

The Town of Hillsboro, located in Loudoun County, Virginia, is home to 129 residents with 65 parcels, 54 of which are occupied. The parcels are currently being served by individual, on-site wastewater disposal systems; such as septic systems, pump and haul, or other alternative systems. Many of these systems are approaching the end of their useful life and many of the existing systems cannot be replaced or expanded due to many factors such as the small lot sizes, poor soils, shallow rock, proximity to drinking water wells and preservation of the Historic District.

In recognition of the on-going problems and lack of a public wastewater system, Hillsboro applied for assistance via the Loudoun County Community Water and Wastewater Program and qualified for a feasibility study that will provide potential solutions.

This feasibility study analyzed wastewater collection, treatment and disposal solutions that the Town of Hillsboro can utilize as a basis for installing a community wastewater system.

Wastewater collection system options for the Town include a gravity system, a low pressure system or some combination of the two systems. It is recommended that the Town of Hillsboro install a low pressure sewer collection system that would serve each parcel within the town boundary. This system would be installed on individual properties and within the existing roadway right of ways and would pump raw sewage to the treatment or disposal location.

This study reviewed three (3) options for treatment and conveyance of sewage for the Town of Hillsboro. The three alternatives include a wastewater treatment plant with subsurface disposal, a wastewater treatment plant with surface water disposal, and a pump station with a connection to the Town of Purcellville. The evaluation of the three potential solutions take into account the existing system, proposed conveyance system, proposed treatment system, permitting requirements, capital costs, and operation and maintenance costs.

The study found the most feasible solution for the Town of Hillsboro is installation of a pump station that will convey the wastewater to the closest Town of Purcellville connection point. Estimated net present cost for the installation of a low pressure sewage collection system, pump station and force main with connection to the Town of Purcellville is approximately \$7.5 million with ongoing operation and maintenance of approximately \$22,000 per year.

## Study Criteria

### FEASIBILITY STUDY PURPOSE

The purpose of this study is to determine the feasibility of potential solutions to the Town of Hillsboro's wastewater issues. The scope of this study will consider the following components:

- The existing system
- Proposed conveyance systems
- Proposed treatment systems
- Land acquisition requirements
- Permitting requirements
- Capital costs and operation and maintenance costs

The information provided in this study may be utilized by the Town of Hillsboro as a basis for planning and design of a community sanitary sewer collection, treatment and disposal system.

### HILLSBORO OVERVIEW

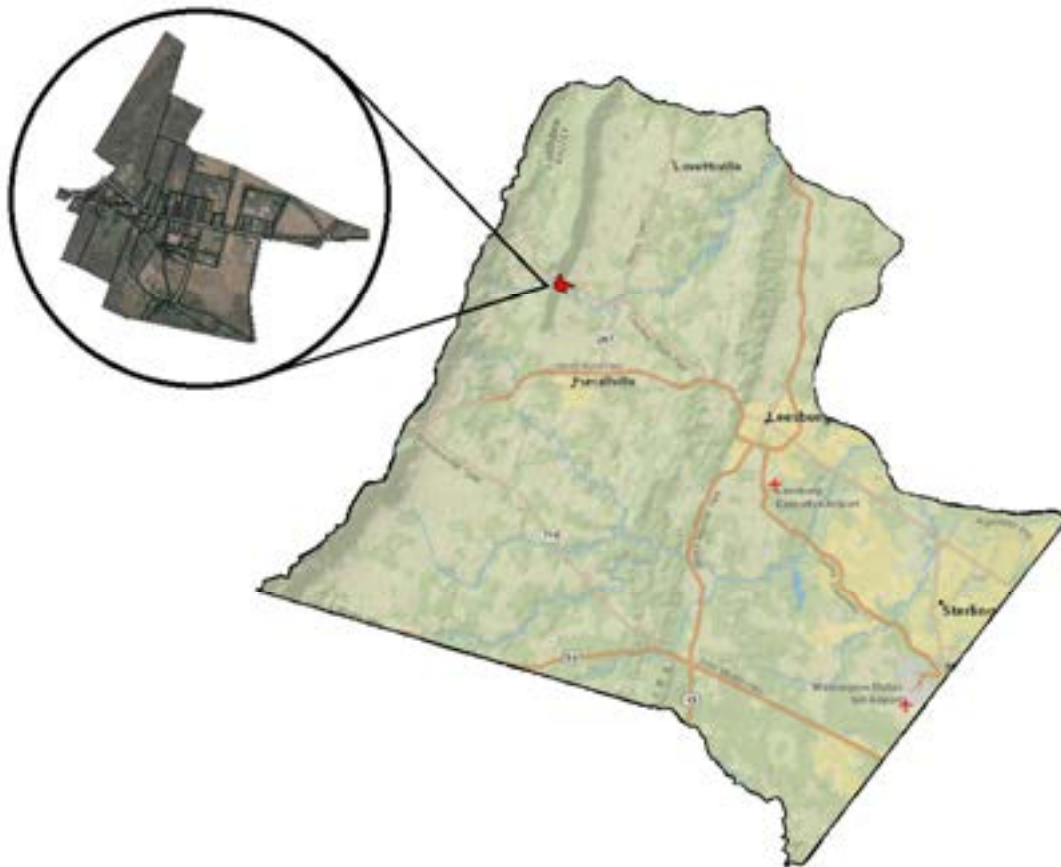


FIGURE 1: HILLSBORO LOCATION MAP

The Town of Hillsboro, established in 1802, is located in Loudoun County, Virginia, along Route 9 (Charles Town Pike). It is approximately eight miles northwest of Leesburg and five miles north of Purcellville as shown in Figure 1. It lies within the Catoctin Creek Watershed, which is a part of the Chesapeake Bay Watershed. Hillsboro is currently the smallest town in Loudoun County with just 129 residents and 65 parcels over a total area of approximately 170 acres. 54 of the parcels have homes or commercial buildings, however, not all are occupied and one is solely used for agricultural purposes.

Hillsboro currently has no public sanitary sewer system. The lots are currently being served by individual, on-site wastewater treatment facilities such as septic systems, pump and haul, or other alternative systems. The Town has stated that many of these systems are approaching the end of their useful life, failing, or contributing to environmental issues that may be impacting public health and water quality. 51 of the 54 parcels have been classified by the Town of Hillsboro as having inadequate sanitary treatment. Only 12% of the current facilities are less than 15 years old and 60% have had more than 30 years in operation, which is the typical life expectancy for such systems. Many individual systems cannot be replaced or expanded because of small lot sizes, with the median parcel area of 0.68 acres.

In 2016, the Town of Hillsboro submitted an application to the Loudoun County Community Water and Wastewater Program for assistance in addressing their current wastewater issues. This program, administered by Loudoun County in partnership with Loudoun Water, is designed to address community water and wastewater problems in Loudoun County, Virginia. The residents of Hillsboro recognize the need for action as 81% of the residents are in support of pursuit of this program. In August 2016, the Town was notified that it qualified for a feasibility study to assess potential solutions to the problems caused by the current inadequate septic systems as noted by the Town.

## APPLICABLE CODES AND STANDARDS

This section reviews the regulatory requirements for wastewater collection, treatment and disposal systems. These requirements must be followed in order to design and construct wastewater collection, treatment and disposal systems. This review focuses on regulations for community systems with flows between 10,000 to 40,000 gpd. The applicable codes and standards for this project include:

- Chapter 1066 of the Loudoun County Codified Ordinance (LCCO)
- Chapter 1067 of the Loudoun County Codified Ordinance (LCCO)
- Sewage Handling and Disposal Regulations (SHDR) developed by the Virginia Department of Health (VDH) (12VAC5-610)
- Regulations for Alternative Onsite Sewage Systems (AOSS) developed by the Virginia Department of Health (VDH) (12VAC5-613)
- Virginia Department of Environmental Quality (VDEQ) Sewage Collection and Treatment Regulations (SCAT)

### Chapter 1066 of the Loudoun County Codified Ordinance (LCCO)

Chapter 1066 of the LCCO provides detailed information for the permitting, design, and maintenance of onsite sewage treatment systems utilizing subsurface disposal in Loudoun County, Virginia. This code supplements Chapter 1067 of the LCCO and is applicable to the Town if the disposal method selected is a drainfield. Important requirements specific to Loudoun County are listed below:

- A permit from the Loudoun County Department of Health is required for installation, construction, and repair of onsite sewage treatment systems.
- 100% reserve absorption area sites are required for the repair, extension, or failure of the sewage treatment.

- Drainfields shall not be placed on slopes greater than 25%
- Table 1 lists the minimum setback distances for subsurface disposal facilities

**TABLE 1: MINIMUM SETBACK DISTANCES FOR SUBSURFACE FACILITIES**

<b>Structure/Topographic Feature</b>	<b>Minimum Distance (ft.)</b>
Wells (Water Sources)	100
Driveways	5
Impounded Waters	50
Streams	50
Property Lines	10
Basements	20
Top Edge of Banks and Cuts	20
Sinkholes, Perennial Sinking Streams	100

Chapter 1067 of the Loudoun County Codified Ordinance

The purpose of this chapter of the LCCO is to protect water quality, water supplies, and prevent the failure of non-conventional onsite sewage disposal systems in order to protect the health and safety of Loudoun County residents. The operation and maintenance requirements listed in this code are applicable to the Town of Hillsboro if a drainfield is selected as the disposal method. These requirements are specific to Loudoun County. A few requirements are listed below:

- Agreement approved by the County Attorney and executed by the Health Officer and property owner
- No non-conventional onsite sewage disposal system shall be permitted within a source water protection area
- Annual inspection by an individual licensed by the Virginia Department of Professional and Occupational Regulation or certified by the Virginia Department of Health

Sewage Handling and Disposal Regulations

The SHDR Regulations developed by the VDH assures that all sewage is handled and disposed of in a safe and sanitary manner. Listed below are key provisions that impact the Town of Hillsboro:

- Type III sewage disposal system (subsurface disposal) requires submission of an application, a preliminary conference with the local health department, and submission of formal plans, specifications, and design criteria are required to obtain a construction permit.
- Obtain a sewage handling permit that is issued by the commissioner. The application is directed to the district or local health department. The process includes an application, conference, initial inspection of equipment, approval of disposal site.

Alternative Onsite Sewage Systems

An Alternative Onsite Sewage System (AOSS) is a treatment works that does not result in a point discharge. The Regulations for AOSS developed by the VDH establish standards for the design, operation, performance, and maintenance of alternative onsite sewage systems. Specific requirements are listed below:

- Site and soil characterization is required.
- AOSS permits need to be renewed every five (5) years
- The site must shall not be flooded during the wet season

VDEQ Sewage Collection and Treatment Regulations

The SCAT regulations provided by the VDEQ govern the design, construction, and operation of sewage systems that serve more than one resident or a non-residential sewage source. These systems require:

- A preliminary engineering conference with VDEQ.
- A VPDES permit application to obtain a permit to build a new sanitary system (this may include a preliminary engineering report and drawings).
- A VDEQ permit to construct referred to as a Certificate to Construct (CTC).
- A VDEQ permit for operation referred to as a Certificate to Operate (CTO).

#### ADDITIONAL ENVIRONMENTAL PERMITTING NECESSARY TO CONSTRUCT

The North Fork Catoctin Creek that runs through the Town of Hillsboro is a jurisdictional Water of the United States (WOTUS). The project will require a crossing of the North Fork Catoctin Creek and its associated wetlands. In order to construct the crossing, a Nationwide General Permit (NWP 12) developed by the Army Corp of Engineers for utility crossings would be required if open cut installation is proposed. Once an alignment or solution has been selected a wetland delineation should be conducted to determine the scope of the project impacts. The NWP 12 permit typically allows for temporary impacts and does not typically require mitigation for less than 1/10 of an acre of impact. DEQ Clean Water Act 401 certification would be issued with the NWP 12. As the North Fork Catoctin Creek has over a 5 square mile drainage area (13 square miles), any crossing that is under, over or within the channel would require a subaqueous bed permit from the Virginia Marine Resources Commission (including directional drilling).

The proposed project alternatives are located within the Hillsboro historic district and will require an effect of determination consistent with Section 106 of the National Historic Preservation act. Typically this type of project will qualify for either a finding of no effect on the historic district, or a finding of no adverse effect from State Historic Preservation Office (SHPO). Any above ground facilities may require architectural view shed analysis and architectural treatments to obtain the no effect or no adverse effect determination and comply with Section 106. The section of Route 9 needed for the proposed wastewater system located in Hillsboro is currently being updated to include road and sidewalk improvements. The goal of the Town is to implement a new waterline and eventually the low pressure sewer main within the alignment of the proposed improvements. Provided the project remain within areas that have been previously disturbed, archaeological studies are not anticipated to be required.

The alignment utilized outside the existing Route 9 impacts two potential historic sites along the north bank of the North Fork of the Catoctin, beginning west of the Highwater Bridge, and extending approximately 100 feet is a stone lined mill race (44LD1705), the alignment should be shifted to avoid this resource depicted in Figure 2, and if avoidance is not feasible, archaeological surveys will likely be required. Additionally, the Highwater Bridge steel truss bridge (DHR ID 236-0045), shown in Figure 3, is also potentially historic and may require an architectural survey if it is not able to be avoided.



**FIGURE 2: HISTORIC SITES (44LD1705)**



**FIGURE 3: HIGHWATER BRIDGE (DHR ID 236-00445)**

Based on the VDEQ What's in My Backyard (WIMBY) database review, there were three reported residential fuel storage tank spills within the Town, but no major Resource Conservation and Recovery Act waste sites or Voluntary Remediation Program hazardous materials sites within the town limits. There is one historic gas station within the limits at the eastern corner of Highwater Road and Route 9, but no spills were noted in the data review. Further investigation should be conducted if the project alignment requires right of way from the former gas station property to determine the presence of historic underground storage tanks (USTs) or contamination.

## SEWAGE FLOW AND CHARACTERISTICS

A flow estimate is required to properly size the collection, treatment, and disposal system for the Town. Flow estimates are based on a number of factors, such as current and future population, current and future land use and densities, and current and future commercial/industrial uses. The VDEQ regulations state that per capita flow estimates be no less than 100 gallons per day (GPD). This average is assumed to include infiltration. A per capita average daily flow can deviate from the 100 gallons per day per person suggested by the VDEQ SCAT regulations. A description of the procedure used to establish the design flow shall be submitted to VDEQ during submission of the Certificate to Construct (CTC). VDEQ assumes that a typical household contains 3 to 3.5 people that contribute to an estimated flow of 300 to 350 gpd/household. Therefore, for this study, a flow projection of 350 gpd/household was used. The following flow projections provided by the VDEQ were used to calculate the flow projection in this report.

**TABLE 2: CONTRIBUTING SEWAGE FLOW ESTIMATES**

<b>Discharge Facility</b>	<b>Units</b>	<b>Flow (gpd)</b>	<b>Flow Duration (hrs)</b>
Residential	Per Person	100	24
School w/o showers w/ cafeteria	Per Person	10	8
Restaurants	Per Seat	50	16
Commercial/Office Space		The greater of 0.160 gpd/sq. ft. OR 30 person per acre	

The Town of Hillsboro currently consists of 54 parcels. 46 are classified as residential, 8 are classified as commercial, and one parcel is solely used for agriculture purposes. Not all of the 46 residential parcels are occupied. In order to estimate a design flow for sizing the system, three scenarios were considered.

- Scenario 1-: The Town remains as it is today but each parcel is occupied. This also assumes that each unit connects to the collection system.
- Scenario 2-: This scenario represents modest redevelopment of properties in the Town of Hillsboro. In addition to scenario 1, this scenario assumes that 20% of homes (9 parcels) are converted to commercial uses, such as restaurants or stores.
- Scenario 3-: This scenario represents modest growth in residents and properties in the Town. In addition to the first two scenarios, this scenario assumes that land currently used for agriculture, is rezoned to match the surrounding Loudoun County zoning, AR-1, which has a maximum density of 1 unit per 5 acres.

The flow projections for each scenario are outlined below:

**TABLE 3: FLOW PROJECTIONS**

	<b>Scenario 1</b>	<b>Scenario 2</b>	<b>Scenario 3</b>
<b>Residential Lots</b>	46	37	47
<b>Commercial Lots</b>	7	16	16
<b>Restaurants</b>	1	2	2
<b>Schools</b>	1	1	1
<b>Flow for Residential Lots (gpd)<sup>1</sup></b>	16,100	12,950	16,450
<b>Flow for Commercial Lots (gpd)<sup>2</sup></b>	3,170	5,090	5,090
<b>Flow for Restaurants (gpd)<sup>3</sup></b>	3,330	6,700	6,700
<b>Flow for Schools (gpd)<sup>4</sup></b>	500	500	500
<b>Total Flow (gpd)</b>	23,100	25,240	28,740

<sup>1</sup>Calculated using 350gpd per household

<sup>2</sup>Calculated using 0.16 gpd/sq. ft. The commercial square footage was estimated based on available GIS data.

<sup>3</sup>Calculated using 67 seats per restaurant

<sup>4</sup>Calculated using 10gpd per person for 151 people (Provided by Hillsboro Charter Academy) at 8 hours per day, per VDEQ SCAT Regulations

Further information on sewage flows is provided in Appendix A.

Dewberry developed three scenarios to represent sewage flows generated in Town which led to three different potential design flows outlined above. Although the flows calculated in Table 3 represent regulatory and typical design values, it is recommended that a design flow of 20,000 gpd be used for sizing the sewage collection and treatment system. The lower total flow better represents the anticipated flows from Hillsboro during initial startup because older, semi-rural communities, such as the Town of Hillsboro, typically generate sewage flows much less than 350 gpd per household. In addition, an oversized treatment system will be hard to operate and could potentially cause treatment failures.

The 20,000 gpd is based on the connection of all the parcels located in Hillsboro. If Hillsboro does not anticipate immediate connection of all residents to the collection and treatment system, the wastewater treatment method can be phased according to flow. It is not recommended to phase the collection system as upgrading the collection system would require excavation of the roadways and restoration costs.

### SEWAGE CHARACTERISTICS

The Town of Hillsboro is primarily residential with a few commercial properties. Therefore, the influent sewage loadings are expected to be primarily domestic wastewater which includes biological components (BOD5) and solids (TSS). The design requirements for the new sanitary sewer system are based on the accepted minimum design loadings presented in the VDEQ SCAT Regulations. A summary of the anticipated loading is shown in Table 4 with total loading calculated with the 20,000 gpd design flow.

**TABLE 4: MINIMUM FLOW AND LOADINGS**

<b>Discharge Facility</b>	<b>Contributing Design Units</b>	<b>BOD5<sup>1</sup> (lbs/day)</b>	<b>TSS<sup>1</sup> (lbs/day)</b>	<b>Flow<sup>1</sup> Duration (Hr)</b>
Dwellings	Per Person	0.2	0.2	24
Schools w/o showers w/ cafeteria	Per Person	0.025	0.025	8
Commercial	Per Person	0.2	0.2	16
Restaurants	Per Seat	0.2	0.2	16
<b>Total Loading (lbs/day)</b>		<b>54<sup>2</sup></b>	<b>54<sup>2</sup></b>	

<sup>1</sup>Values provided by the VA SCAT Regulations

<sup>2</sup>Calculated based on Scenario 1 in Table 3 using 3.5 people for each 46 residential home and commercial property, 151 people in the school (provided by the Hillsboro Charter Academy), and 67 seats per restaurant.

# Sewage Collection System

## SEWAGE COLLECTION SYSTEM ALTERNATIVES

There are three possible sewage collection system alternatives for the Town of Hillsboro. The alternatives include:

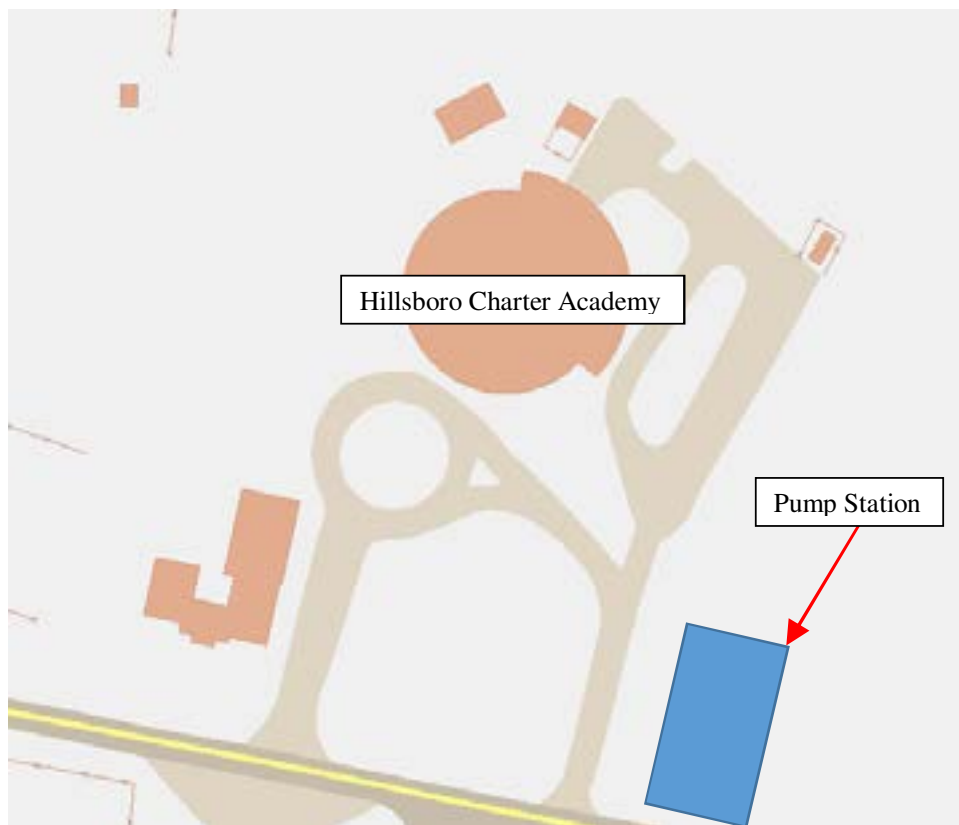
- Gravity Sewers  
Gravity sewers convey wastewater to a treatment facility by gravity making it heavily dependent on the topography of the area. These systems are commonly used in areas where households are spaced closely together. Gravity sewers do not require a power source, but require manholes for maintenance and lift stations to move waste from lower to higher elevations. Gravity systems are more costly to construct due to the need for waste to flow downhill and potentially much deeper pipe depths. Installation of a gravity sewer collection system will be challenging for the Town of Hillsboro based on the topography of the community. This option would require more easement acquisition, greater land disturbance, and deeper pipe depths. The construction requirements for this system must follow 12VAC5-610-870/930.
- Low Pressure Collection Systems (LPS)  
Low Pressure Collection Systems pump wastewater to the treatment facility in a pressurized pipe network. The pipes are located at shallow elevations and are good for areas with irregular terrain, rocky conditions, or high water tables. These systems typically require air release valves at high points, cleanouts at the end points, and isolation valves where pipes connect. These systems are limited to a working pressure of one (1) to four (4) feet of head at the distal end of the line. LPS are less expensive to construct than gravity sewers due to a shallower pipe depth, however, require power and maintenance. A LPS system will provide the Town of Hillsboro with flexibility for constructing the system and routing the collection piping through the Town. The construction requirements for this system follow 12VAC5-610-940.
- Combination  
Another option presented is a combination of a gravity system and a LPS. This would reduce the number of pumps required for a LPS as well as reduce the cost by avoiding excessive depth requirements typical of gravity sewers. Pumps would only be used at locations where the sewage cannot flow by gravity.

## RECOMMENDED COLLECTION SYSTEM

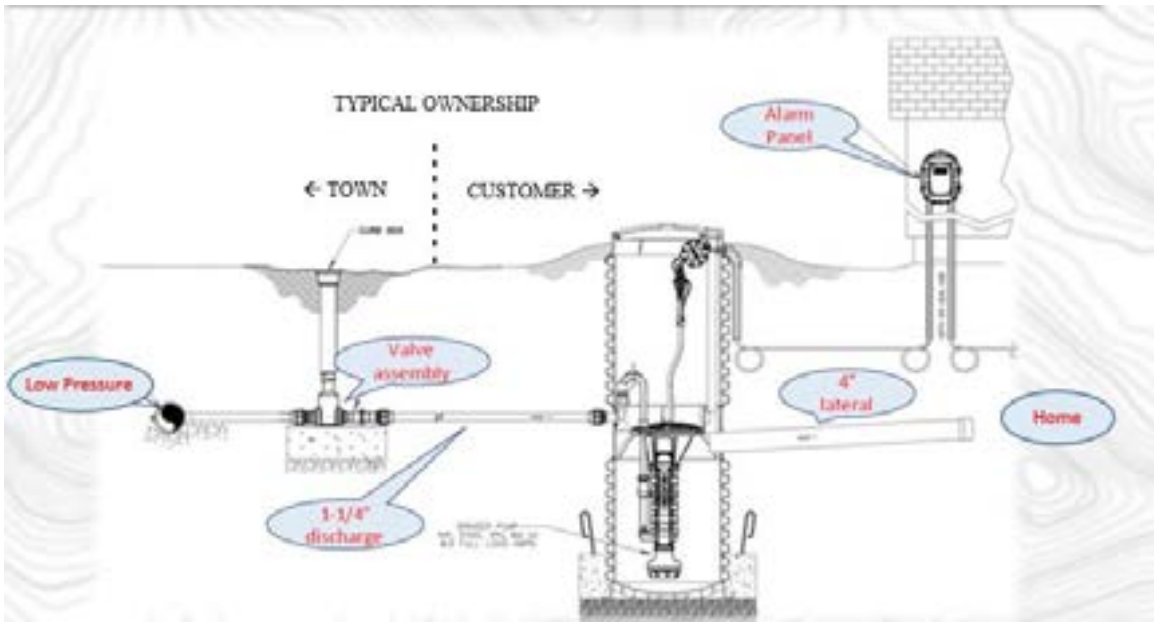
Based on Dewberry's analysis of the Town, which included the elevations and locations available, it is recommended that a low pressure sewage (LPS) collection system be utilized. LPS systems are shallow buried collection systems, which make it easier in areas with rocky soil and high groundwater tables. The Town has stated that there are parcels with inadequate septic systems. LPS systems eliminate the need for septic tanks by implementing a series of grinder pumps that convey sewage to a discharge point without pretreatment. LPS systems allow for flexibility in connection point locations and elevations and can easily be expanded for growing populations. These systems have an initial low capital cost and are easy to install. They require small diameter pipes that can be laid along existing roadways, sidewalks, lawns, driveways, and underground utilities. The pipe sizes range between 1¼-8 inches. There are three types of piping that are typically used—Sch. 40 PVC, SDR 21 PVC, SDR 11 HDPE. All three have adequate pressure ratings for the LPS.

LPS systems require grinder pumps, which pump finely ground slurry to small diameter lateral pressure piping. These pumps can discharge slurry at a rate between 9-11 gpm at a maximum pressure of 40 psi and turn on when the depth of sewage in the tank reaches a predetermined level. It is recommended that each individual property be equipped with a grinder pump system manufactured by Environment One (E/One) or approved equal. These pumps can be installed inside homes or outside homes in fiberglass structures. Figure 5 shows a typical grinder pump installation outside the home.

The design of a collection and conveyance system is based on several factors, including number of connections, estimated flow, connection point location and elevation, and discharge point location and elevation. Therefore, the ultimate treatment system location and/or discharge location will have significant impacts on the design. The sewage collection system recommended in this section assumed a discharge location on the Town property adjacent to the Hillsboro Charter Academy property that is owned by the County. The final design of the LPS system is dependent upon the location of the Town of Hillsboro's wastewater treatment or pump station. For the purpose of planning representative sizing of the LPS network, the discharge location was assumed to be near the Hillsboro Charter Academy as shown in Figure 4 where a pump station can be installed to convey sewage to its ultimate location.



**FIGURE 4: POTENTIAL LOCATION OF TERMINATION POINT**



**FIGURE 5: OUTDOOR GRINDER PUMP INSTALLATION DETAIL**

The LPS systems are able to be installed in phases and can be adapted to incorporate future users. This will allow Hillsboro to include phased connections of existing parcels and address projected population growth and construction of new buildings. Figure 5 depicts a typical grinder pump installation for a property. Cost for installation of these systems can vary depending on the location of the pump, discharge piping requirements and potential internal plumbing or electrical modifications.

Before final design of a LPS, topography, soil conditions, water table, applicable codes, discharge location, lot layout with structures, total number of lots, dwelling types, use and flow factors, and projected area development are needed.

#### PRELIMINARY COLLECTION SYSTEM PLANNING

A preliminary design of the Town collection network has been completed based on the assumption that either a wastewater treatment facility or a pumping station is placed in the vicinity of the Hillsboro Charter Academy as shown in Figure 4. The design also accounted for the topography of Hillsboro (from GIS data), lot layout (including structures), total number of lots, expected flows and dwelling type. It was assumed that each parcel would have its own grinder pump installed outside the building with main collection piping located within the roadways of the Town of Hillsboro. Where space was limited on properties, grinder pumps were assumed to be installed within building structure, either in a basement or crawl space. The preliminary grinder pump for each parcel was selected based on the location of the existing septic tank on the lot, distance from the main collection piping and distance from the building. An example layout of each parcel within the Town boundary is included as Appendix C. Appendix C is for visualization purposes only. A more detailed layout will need to be created in order to coordinate with existing facilities.

The preliminary LPS design includes 10 different pressure zones. The pipe diameter for the main collection piping was determined by the zone it is located in and the hydraulic capacity required for each line. The zones are set by the relationship between the accumulating total number of pumps in a system

to the predicted number that will periodically operate simultaneously. A zone is also distinguished where two or more sections of main join. The zones that were established for this study are illustrated in Figure 6.

**FIGURE 6: LPS ZONES**



The pipe sizes for the preliminary design range from 1 ¼ - 3 inches of SDR 21 PVC. SDR 21 PVC pipe is recommended based on capacity, strength, and friction loss characteristics. Table 5 lists the zone designations and pipe sizes.

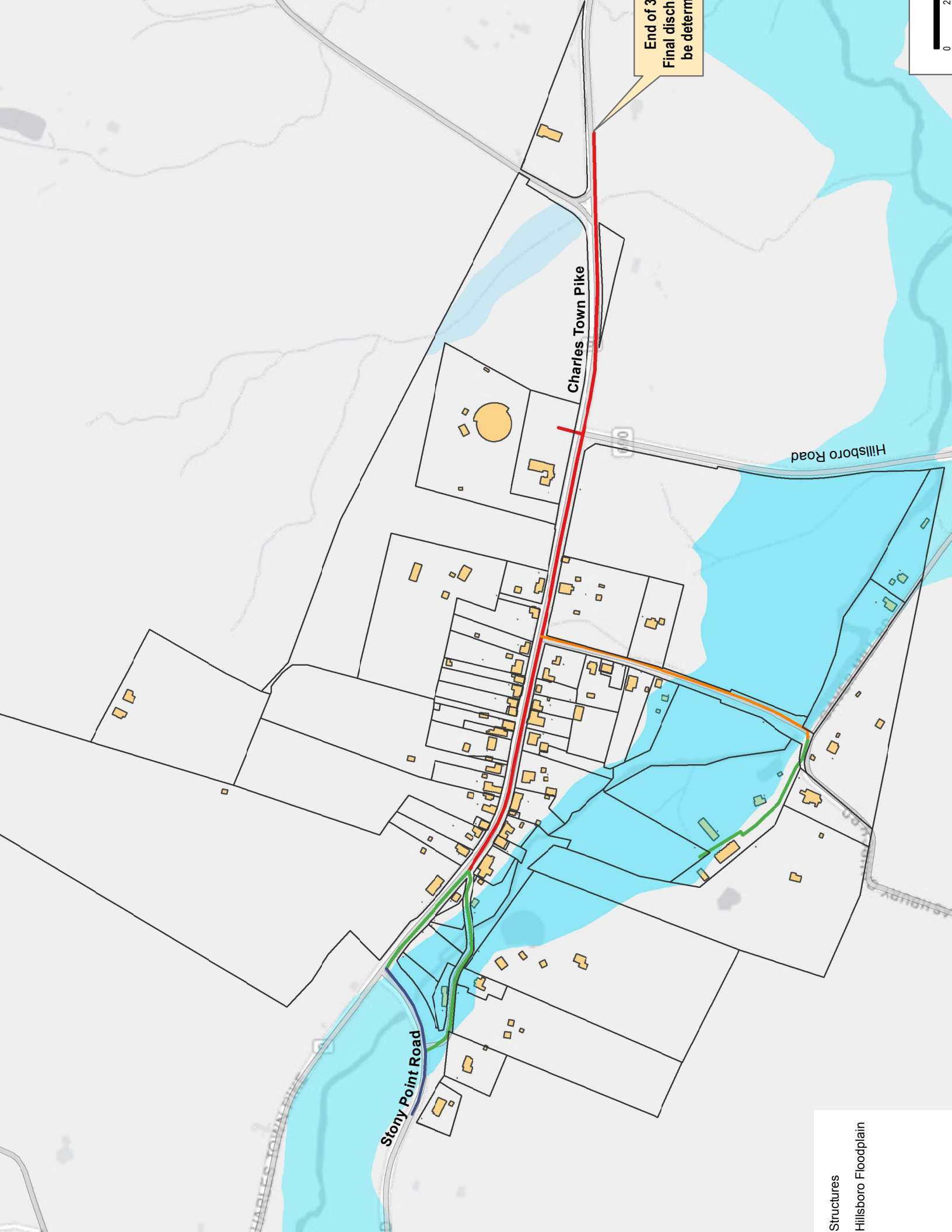
**TABLE 5: PRELIMINARY LPS PIPE DIAMETERS**

<b>Zone</b>	<b>Pipe Diameter (in.)</b>
1	1.25
2	2
3	2
4	3
5	2
6	1.25
7	2.5
8	3
9	1.5
10	3

A preliminary LPS layout was drawn to provide the Town with a general idea of the size and location of the system. This includes the location of the common mains, individual connections, and grinder pump locations. The grinder pump locations were placed near the locations of existing septic tanks on the parcels, if the information was available. If a parcel did not have a septic tank or the information was unavailable, the grinder pump was placed closest to the common main in that zone. The individual parcel connections were based off of the E/One zones in Appendix B. All individual connections are 1.25” in diameter. The connection layout took into account the distance to the common main, obstacles in the property, and location of the grinder pump. Implementing the LPS system may require homeowners to place the grinder pump in the basement of the home if there is not enough space on the property for the pump and connection. Example pump systems manufactured by E/One are included as Appendix B. These grinder pump systems are available for installation in fiberglass wet wells outside each individual home or in compact units that can be installed inside the home in basements or crawl spaces. Figure 7 shows a preliminary layout of the LPS collection network. Appendix B provides further analysis of the pipes, pumps, and zones. Extension of the sewer collection system to serve any property outside of the Town will require a variance from the County and significant time and effort to approve.

There are several other considerations that need to be included during design. This includes separation distances from utilities and minimum burial depth to avoid freezing. Prior to installation of any piping, design drawings, signed and sealed by a licensed Professional Engineer in the Commonwealth of Virginia shall be prepared.

**FIGURE 7: TOWN OF HILLSBORO PRELIMINARY LPS LAYOUT**



End of 3  
Final disch  
be determ

Charles Town Pike

Hillsboro Road

Stony Point Road

Structures  
Hillsboro Floodplain



# Sewage Treatment and Disposal

## SEWAGE TREATMENT AND DISPOSAL ALTERNATIVES

The Town of Hillsboro is an incorporated town located in the rural policy area of Loudoun County with existing individual treatment and disposal units that are in need of replacement. There are two primary options to providing centralized treatment for the Town. These options are construction of a wastewater treatment facility, owned and operated by the Town, or connection to a wastewater treatment facility located outside of the Town boundary. There are three (3) main alternatives utilizing these options for providing sewage treatment and disposal for the Town of Hillsboro. These alternatives are:

- Town of Hillsboro Owned and Operated Treatment Plant with Subsurface Disposal  
This would require the construction of a wastewater treatment plant (WWTP) in or near the Town of Hillsboro and the construction of a subsurface drainfield (or equal) in an area near the WWTP. A WWTP designed to treat 20,000 GPD of domestic sewage from the Town of Hillsboro would require a land area of approximately 0.5 acres. The drainfield required for disposing of this sewage would require approximately +/-4 acres of disposal area with an additional +/-20 acres of dilution area (depending on the treatment method) which is outlined in the “Wastewater Treatment Plant with Subsurface Disposal” section of this report. Finding the land area and acquiring the rights to construct this system is a primary challenge prior to construction.
- Town of Hillsboro Owned and Operated Treatment Plant with Surface Water Disposal  
This would require the construction of a WWTP in or near the Town of Hillsboro with the effluent discharging into the North Fork of Catoclin Creek. A WWTP designed to treat 20,000 GPD of domestic sewage from the Town of Hillsboro would require a land area of approximately 0.5 acres. The North Fork of Catoclin Creek is listed as an impaired stream by VDEQ and will require special authorization to discharge treated effluent to the waterway. In addition, nutrient credits will need to be negotiated and obtained for discharging effluent into the waterway.
- Town of Hillsboro Pump Station with connection to Town of Purcellville  
The Town of Purcellville owns and operates their own existing WWTP. The nearest collection piping for the Town of Purcellville is located approximately 4 miles south of the Town of Hillsboro at Purcellville’s Woodgrove High School. Construction of a pump station designed to convey 20,000 gpd of average daily flow would require approximately 0.25 acres of land and could be installed within the Town boundary. A force main would then need to be installed from the Town of Hillsboro, south on Hillsboro Road, for approximately 4 miles to convey sewage to the Town of Purcellville collection network.

There are several assumptions made for each of the treatment and disposal alternatives. These assumptions are as follows:

- Treatment Plant with Subsurface Disposal
  - Land is available for a drainfield and dilution area east of the Town and that the Owner of that property is willing to grant the Town rights to that land.
  - The soils on that land are suitable for a subsurface disposal system.
  - There is no existing groundwater nitrogen concentration in the area of the drainfield and dilution area.

- There are no other impacts that would prevent a drainfield or dilution area being placed on that property (i.e. wetlands, wells, rock outcroppings, etc...)
- The treatment plant would be located on the same property as the drainfield.
- Treatment Plant with Surface Water Disposal
  - Nutrient credits are available for purchase.
  - An outfall can be placed in the impaired stream.
  - The treatment system will need to treat to 3 mg/L of nitrogen (VDEQ 'state of the art' standard) to limit the amount of nutrient credits required for purchase and minimize the impact to the stream.
  - A 0.5 acre property is available for installing the treatment plant.
- Pump Station with connection to Town of Purcellville
  - The pump station would be located near the Hillsboro Charter Academy as shown in Figure 4.
  - Purcellville would accept a connection from the Town of Hillsboro.
  - Loudoun County would allow construction of a force main across the rural policy area.

Prior to design, confirmation of these assumptions would be required. Figure 8 below shows an approximate location for the treatment plant or pumping station. Coordination with the road project is recommended as planning, design, permitting, and construction move forward.



**FIGURE 8: HILLSBORO CHARTER ACADEMY AND TOWN PROPERTY WITH PROPOSED DISPOSAL ALTERNATIVES**

## TREATMENT PLANT OPTIONS

The Town of Hillsboro will need to design and install a WWTP that can meet or exceed effluent requirements prior to discharge. There are numerous types of treatment systems that can provide the Town of Hillsboro the necessary treatment level that can be applied to all disposal methods. Viable alternatives include the following options.

### Sequencing Batch Reactors (SBR)

SBR systems utilize a single reaction tank to treat sewage. These systems can operate as single train WWTP or have multiple trains. They are designed based on carbonaceous BOD removal or both carbonaceous and nitrogenous BOD removal. There are normally five phases in the cycle: fill, react, settle, decant, and idle. During the fill stage, raw wastewater enters the basin where it is mixed with settled biomass from the previous cycle. The basin is aerated to allow the oxidation and nitrification processes to occur. Once the reactions have taken place, aeration and mixing are suspended and the solids are allowed to settle. The treated wastewater is then discharged from the basin and directed to the next process. After the effluent is discharged, the basin 'idles' as it waits for another cycle to begin. Part of the solids that have settled are removed from the basin and disposed of as waste sludge while the rest is recycled back to the beginning of the process. SBR package plants are typically manufactured for flow rates between 10,000 GPD and 200,000 GPD, although flow rates can vary based on the system and manufacturer and have been installed successfully at flows as low as 1,000 GPD. They are suitable for areas with little land, stringent treatment requirements, and low wastewater flows. They are also suitable for areas that need nitrification, denitrification, and phosphorous removal. These systems can be modified to include continuous monitoring for DO, pH, and MLSS levels. Typical maintenance of SBRs include regular servicing of blowers (if installed, not necessary with all manufacturers), monthly inspection of the equipment, monthly greasing of the decanter and other suggested maintenance by the SBR package plant manufacturer.

SBR systems have a history of proven performance, with the earliest installations in the 1940s. They have a small foot print, can meet stringent treatment requirements, and can process small wastewater flows. SBR WWTPs are successful in treating waste that has high BOD loadings since the system allows for the increase in oxygen and modification of the different SBR cycle phases. The entire process occurs in a single tank and can be amended to increase nitrogen permit limits through its nitrification and denitrification processes. In terms of operation, SBR systems are flexible to the needs of the Owner. Many of the SBR systems in service are visited once or twice a week with monitoring and control occurring from remote locations. The process is easily adjustable in order to suit the influent characteristics making it easier for locations with increasing effluent permit requirements. In addition, the phased cycles can be programmed to account for low flows.

Although these systems are effective, there are disadvantages of SBRs that need to be considered. If advanced treatment is necessary ( $TN < 10 \text{ mg/L}$ ), additional process may be needed downstream to meet these requirements. Depending on the manufacturer, some SBR configurations have the potential to discharge floating or settled solids during the decant phase. To prevent solids from being discharged into the next process or drainfield, a filter may be required. The energy consumption of SBR systems are high due to the long aeration time. There is a higher level of maintenance and understanding associated with the advanced controls, automated switches, and automated valves associated with SBRs.

An SBR can be utilized by the Town to meet effluent limits for both subsurface discharging and surface water discharging treatment.

### Membrane Bio-Reactor (MBR)

MBR systems combine biological treatment with membrane filtration. This process allows for an advanced level of nutrient removal. A MBR treatment system is able to remove carbon, phosphorous, nitrogen, certain toxins, and certain bio-accumulative micro-contaminants. After the aeration process, wastewater flows through a submerged membrane that separates solids from liquid. Aeration devices are typically placed at the bottom of the membrane tank to provide air across the membrane. The air creates a cross flow parallel to the membrane to generate biomass degradation and limit build-up of sludge. The package plants can typically treat between 10,000 gpd and 500,000 gpd.

MBR systems do not require clarifiers and tertiary filtration. They can operate at high mixed liquor suspended solids (MLSS) concentrations (8,000-20,000 mg/L) which allows for high level treatment in small tankage. These WWTP produce high quality effluent that can exceed the highest reuse standards qualifying it for Class A Reuse water. The effluent from these plants typically have a total phosphorous level of less than 0.03 mg/L and a total nitrogen less than 3 mg/L. MBRs have a lower waste sludge production compared to other treatment systems due to the longer solids residence times. The package plants have a very small footprint and can easily be scaled as demand grows. The process cycles are also easy to modify making it easier for locations with low flows.

MBR treatment plants have a high operation, capital, and energy costs. The membrane operations can be complex with fouling of the membrane fiber being a major concern. Therefore, O&M costs involve membrane cleaning, fouling control, and membrane replacement. Energy costs are higher than other systems due to the need for air scouring to control the bacterial growth on the membrane, in addition, permeate pumps are required to pull the effluent through the membranes. Waste sludge in MBR systems typically have a lower settling rate than other conventional systems. This may require chemicals in order to produce waste acceptable for disposal. Small MBR systems are more susceptible to fouling and require additional design considerations and cleaning requirements. Cleaning the membranes can be done manually or automatically. Manual cleaning can take approximately 8 hours. Provisions will need to be made to properly handle and process the chemical cleaning solutions.

An MBR can be utilized by the Town to meet effluent limits for both subsurface discharging and surface water discharging treatment.

### Extended aeration

Extended Aeration plants apply biological treatment for the removal of biodegradable organic wastes under aerobic conditions. These systems consist of steel (or concrete) tanks that are compartmentalized into equalization (possibly), aeration, clarification, disinfection, and an aerated sludge holding/digestion segment. The influent wastewater should first be screened to remove large suspended, settleable, or floating solids before entering the treatment process. The wastewater then flows to the aeration chamber for mixing and aeration before flowing to the clarifier for settling. A portion of the settled material is returned back to the head of the plant. The waste not returned is removed to the sludge holding tank and disposed of offsite. The treated wastewater then flows over a weir into a collection channel before moving onto disinfection. If peak flows need to be equalized, an equalization basin can be added prior to the aeration basin. Extended aeration plants are designed based on average column of wastewater produced within a twenty-four hour period. Extended Aeration Package Plants are readily available and are generally manufactured to treat flow rates between 2,000 to 100,000 gpd. The smaller packaged plants arrive in one unit that is ready for installation upon arrival while larger plants ship the clarifier, aeration chamber, and disinfection system as separate units or are built in custom cast in place concrete tanks. The maintenance for these systems typically include checking the motors, gears, blowers, pumps, routine inspection of all equipment, and specific O&M actions suggested by the manufacturer.

Activated sludge processes have a history of proven success dating back to 1913. Extended aeration plants are suitable for areas that need nitrification removal as well as have organic loading and flow fluctuations due to a greater detention time. These package plants can be shipped in one or two pieces making it easy to install. They have a low sludge yield due to long sludge ages. These plants are relatively easy to operate and have low operational costs and time requirements. In addition, the capital costs for these plants are relatively low.

However, extended aeration plants do not achieve denitrification or phosphorous removal without an additional unit process like a denitrification filter after the clarifier. Stabilization of the plan is a long process and can take anywhere from two to four weeks after the plant is seeded with sludge from another wastewater treatment plant. These systems are hard to adapt to changing effluent requirements due to regulatory change and often struggle with varying influent flows. Extended aeration plants have a larger footprint than higher rate processes and utilize more energy due to aeration periods. Nitrogen concentration in the effluent can be a major concern with extended aeration plants if not operated properly.

While these systems can be designed to meet effluent limitations for both subsurface discharge and surface water discharge, it is recommended that this system not be considered for surface discharging due to expected strict effluent limitations.

#### Fixed Film

Integrated Fixed Film Activated Sludge (IFAS) systems combine conventional activated sludge with biofilm systems by combining the two technologies in a single reactor. The process has aerobic, anaerobic, and anoxic zones and an increased sludge retention time that allows for better nitrification compared to a simple suspended growth system. The media adds additional biomass within the reactor of an activated sludge process to increase treatment capacity without increasing the size of the system. The IFAS package plants can treat from 1,000 gpd to 3 million gpd. IFAS manufacturers offer different media that should be evaluated for the desired level of nitrogen removal.

IFAS systems offer a quick, low cost installation. They reduce lifetime operational and capital costs due to the low volume required and low power usage. These systems have a small footprint making it good for areas with limited land. An IFAS can provide adequate nitrogen, phosphorous, and BOD removal. These systems are able to phase-in additional units to add capacity or improve performance.

There are multiple of disadvantages associated with IFAS systems. They are unable to handle changing flow rates and wastewater loads. IFAS systems require low loadings, depending on the media and have the potential of odor problems. Some IFAS systems have a RAS component which can create operational complexity and requires regular operator attention. In design, it is important to consider potential clogs in the screens, excessive growth, and inadequate mixing. Fixed film systems provide owners lower capital costs and operation and maintenance coasts, however, will not be capable of meeting more stringent effluent limits.

A fixed film treatment system can be utilized by the Town to meet the TL-3 effluent limits ( $BOD \leq 10\text{mg/L}$  and  $TSS \leq 10\text{mg/L}$ ) required for a subsurface discharging treatment system.

## SUBSURFACE DISPOSAL

Subsurface disposal conveys treated effluent to a location with sufficient area and soil characteristics to support the planned flow. No detailed soil studies have been conducted, however, a conceptual soil investigation was conducted by Marsh & Legge Land Surveyors. A copy of the soil study and technical memorandum is included in Appendix D and E. The study indicated that there is not enough land area with suitable soils within the existing town boundary to provide the necessary area for a drainfield and dilution area. There is potentially viable land for a drainfield and dilution area east of the Town.

### Subsurface Disposal Requirements

The drainfield required for the Town, based on the conceptual soil investigation, would be approximately 75,000 square feet (2 Acres) with a percolation rate of seventy-five (75) minutes per inch. A reserve drainage area of equal size will be needed. This requires approximately 4 acres of land for the drainfield and reserve area. The drainfield will be a large alternative pretreated system with drip dispersal installed at eighteen (18) to twenty (20) inches below grade.

Nitrogen dilution buffer areas will need to surround the proposed drainfield site. These areas include in the mass drainfield system or reserve area. Unlike the mass drainfield system and reserve area, certain land uses are permitted on the buffer area.

A nitrogen dilution area is the land immediately adjacent to the sewage disposal system that is used to dilute nitrogen or other nutrients that occur in wastewater. The dilution area helps the system stay in compliance with the nutrient standards. This area is where rain can infiltrate into the soil and dilute the nitrate in the ground water. This area also provides some level of treatment. The dilution area required was calculated using the DGS method and is based on inches of rainfall per year, infiltration rate, pre-existing TN concentration, and design flow. According to 12VAC5-613-90.B, TN concentration in groundwater cannot exceed 5mg/L at the project boundary. The calculation accounts for average annual rainfall, acres available for dilution, daily sewage flows and the effluent concentration of nitrogen. Based on our preliminary analysis, a total land area of approximately 24.6 acres is needed for a dilution buffer which includes the 3-4 acres of land needed for the drainfield site and the reserve drainfield site if a fixed film treatment plant is used. This calculation was provided based on the 1988 report prepared by the Virginia Department of Health Bureau of Sewer and Water. The calculation shown below assumes an effluent nitrogen concentration of 15 mg/L which would be discharged from a fixed film media treatment system. Using these variables, the calculation can be summarized as follows:

#### Equation 1: Gallons of Dilution

$$(R) \times (D) \times (74)$$

*(R) = Absorbed Rainfall in Inches (50% of annual rainfall)*  
*(D) = Acres Available for Infiltration*  
 $(22) \times (24.6) \times (74) = 40,048.8 \text{ Gallons}$

#### Equation 2: Mass Balance

$$\frac{\text{Gallons of Wastewater}}{\text{Gallons of Wastewater} + \text{Gallons of Dilution}} \times \text{Concentration of Nitrogen}$$
$$\frac{20,000}{60,068.8} \times 15 \text{ mg/L} = 4.99 \text{ mg/L}$$

Approvals from property owners for this area would be required prior to design. There are land use limitations and setbacks that will need to be included in any land acquisition. Additional soil sampling and groundwater investigation will be necessary prior to final design or selection of a site.

Due to limited land availability and costs associated with land acquisition, the Town may utilize a treatment system with a higher level of nitrogen removal capabilities to reduce the effluent nitrogen entering the dilution area, thus reducing the amount of land area needed. One option for this would be to install a MBR treatment system that would discharge into a subsurface disposal field. Under this option, four (4) acres of land would still need to be obtained to install the drainfield and reserve. In addition, one (1) acre of land area for access roads, landscaping and setbacks is assumed. However, there would be no need for a dilution area outside of the drainfield since this system can produce effluent with less than 5 mg/L of total nitrogen. The calculation below shows that five (5) acres exceed required dilution area.

**Equation 3: Gallons of Dilution**

$$(R) \times (D) \times (74)$$

*(R) = Absorbed Rainfall in Inches (50% of annual rainfall)*

*(D) = Acres Available for Infiltration*

$$(22) \times (5) \times (74) = 8,140 \text{ Gallons}$$

**Equation 4: Mass Balance**

$$\frac{\text{Gallons of Wastewater}}{\text{Gallons of Wastewater} + \text{Gallons of Dilution}} \times \text{Concentration of Nitrogen}$$

$$\frac{20,000}{28,140} \times 3 \text{ mg/L} = 2.1 \text{ mg/L}$$

**Treatment requirements**

12VAC5-613 provides the detailed requirements for alternative onsite sewage systems per VDH. The requirements goal is to protect the groundwater so that the TN does not exceed 5mg/L at the project boundary. It is recommended to take background water samples of the three site options prior to selection. This will inform the Town and VDH of any pre-existing exceedances. The calculations above assume no background nitrogen is found in the area of the drainfield or dilution areas. Furthermore, VDH requires that the system must comply with a TN limit of 5 mg/L at the project area boundary and that the effluent quality from the treatment system be measured prior to the point of effluent application to the soil. Table 7 lists the effluent limits for subsurface disposal. With the following limits, the effluent must meet Treatment Level 3 (TL-3) Requirements of BOD<sub>5</sub> and TSS concentrations of less than or equal to 10 mg/L.

**TABLE 6: SUBSURFACE DISPOSAL EFFLUENT LIMITS**

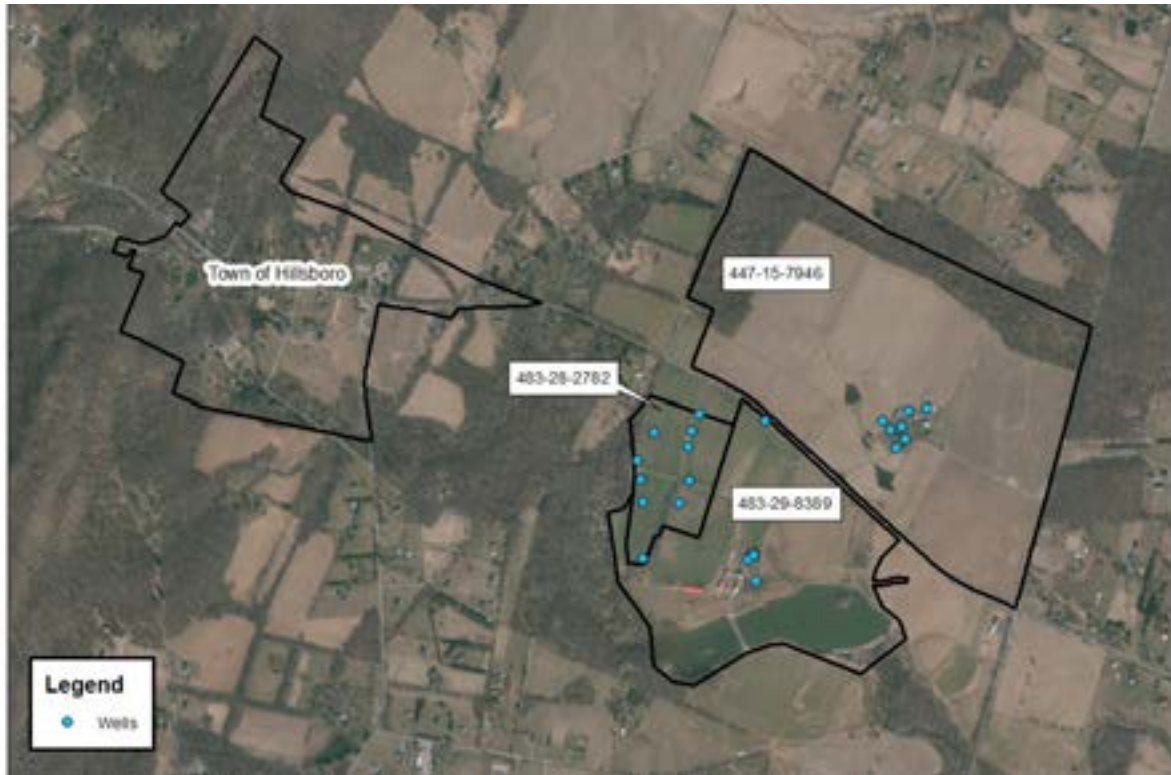
<b>Nutrient</b>	<b>Limit</b>	<b>Unit</b>
BOD <sub>5</sub>	≤ 5	mg/L
TSS	≤ 5	mg/L
Fecal Coliform	< +2.2	col/100ml as a geometric mean No sample exceeding 14 col/100ml
TN	< 5	mg/L

### Subsurface Disposal Location

To determine a potential site for a wastewater disposal system, Marsh & Legge conducted a conceptual soil investigation using available geospatial information on property east of Hillsboro. Eight (8) potential locations were identified as possible locations for a drainfield based on the best suitable landscapes and soils in this area. Each site that was analyzed had soils of the Purcellville series (23B). This type of soil is very deep and well drained. It has yellowish-red silty to loamy soil on gently sloping lands. The slopes for each site ranged from four (4) to nine (9) percent. 23B soils have a good potential for general development for a central water and sewer system as well as conventional septic tank drainfields. This soil is also classified as prime farmland.

The potential parcels that were evaluated include the Grubstake Tract—Pin 447-15-7946, CEA Farms Tract 1—Pins 483-49-2067, 483-28-2782, and 483-48-9016, CEA Farms Tract 2—Pin 483-29-8389, CEA Farms Tract 3—Pin 448-25-1566, and Cummings Tract—Pin 482-26-3545 as indicated in Figure 9. A few of these parcels have wells located on the property. A well must be at least 100 ft. away from the drainfield or the well would have to be abandoned, according to VDH regulations. Further investigation of the wells status will be needed. Of these eight (8) parcels, Grubstake Tract (447-15-7946) and CEA Farms (483-28-2782 & 483-29-8389) were selected as the best options as indicated in Figure 9.

**FIGURE 9: POTENTIAL PARCELS FOR SUBSURFACE DISPOSAL**



The soil investigation conducted by Marsh & Legge provided potential drainfield sites and reserve sites for each of the parcels that were investigated. The potential locations that were identified are illustrated in Appendix E. These locations were conceptually located to minimize the impact on the property. As mentioned above, further investigation of these locations will be needed. Table 6 provides a summary of the number of drainfield sites and reserve sites needed and the size requirement of each site for the three parcels.

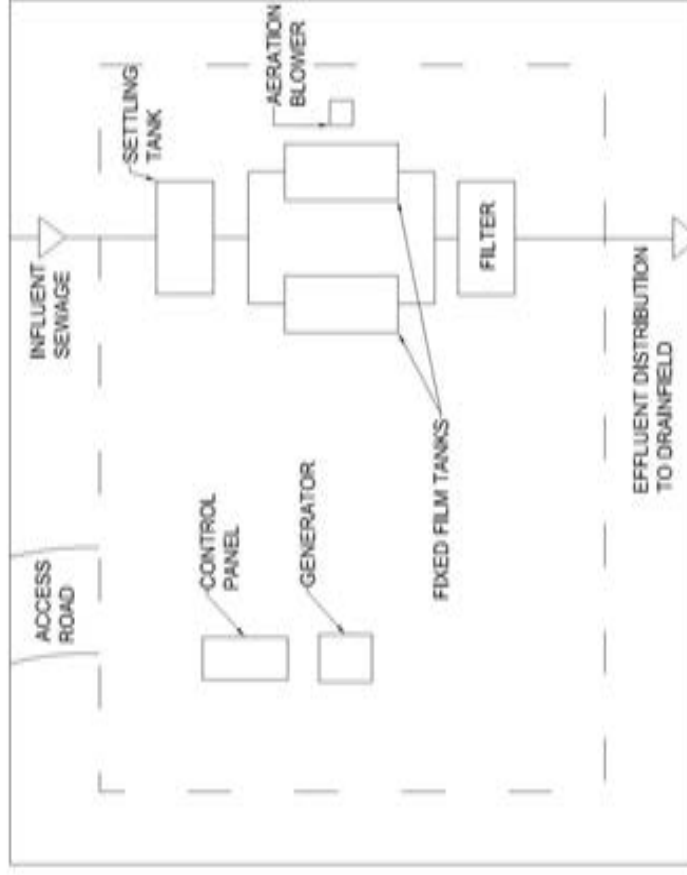
**TABLE 7: DRAINFIELD AND RESERVE DRAINFIELD CAPACITY**

<b>483-28-2782</b>				
<b>Site Type</b>	<b>Site</b>	<b>Area (ft<sup>2</sup>)</b>	<b>Total (ft<sup>2</sup>)</b>	<b>Total Acres</b>
Drainfield	Site A	32,000	82,000	3.63
	Site B	35,000		
	Site C	15,000		
Reserve Drainfield	Site D	30,000	76,000	
	Site E	20,000		
	Site F	26,000		
<b>483-29-8389</b>				
<b>Site Type</b>	<b>Site</b>	<b>Area (ft<sup>2</sup>)</b>	<b>Total (ft<sup>2</sup>)</b>	<b>Total Acres</b>
Drainfield	Site G	60,000	80,000	3.67
	Site H	20,000		
Reserve Drainfield	Site I	60,000	80,000	
	Site J	20,000		
<b>447-15-7946</b>				
<b>Site Type</b>	<b>Site</b>	<b>Area (ft<sup>2</sup>)</b>	<b>Total (ft<sup>2</sup>)</b>	<b>Total Acres</b>
Drainfield	Site L	50,000	76,000	3.58
	Site M	26,000		
Reserve Drainfield	Site N	35,000	80,000	
	Site O	25,000		
	Site P	20,000		

Recommended treatment for Subsurface Disposal

As outlined above, there are two (2) treatment systems recommended for subsurface disposal for the Town: a Fixed Film package treatment plant and a MBR package treatment plant. The treatment system that is recommended for subsurface disposal for the Town is a fixed film package treatment plant. Although the fixed film treatment requires a greater amount of land for the dilution area, the fixed film system is less complex in terms of operation and maintenance requirements compared to that of a MBR system. The fixed film treatment plant is also less costly than an MBR system. Fixed film treatment systems are able to provide TL-3 effluent and a MBR treatment system can meet more stringent effluent nitrogen limitations. The Town should also consider both options for subsurface disposal depending on land availability and cost, O&M complexity, and treatment system cost. Figure 10 provides an image of a fixed film system and a preliminary site layout.

FIGURE 10: FIXED FILM



**Approximate Dimensions:**  
Area: ~7200 SF  
Fixed Film Tanks: 16 x 8 ft.  
Settling Tank: 16 x 8 ft.  
Filter: 16 x 8 ft.  
Generator: 7 x 7 ft.

## SURFACE DISPOSAL

The Town of Hillsboro has the option of placing a WWTP for surface disposal at the assumed Charter school location or another parcel assumed to be located within the Town boundary to ease permitting and approvals. A surface disposal is the direct discharge of treated effluent to surface water. The nearest surface water to the Town is North Fork Catoctin Creek.

### Discharge Location and Permitting

North Fork Catoctin Creek runs directly through the Town of Hillsboro and is a tributary to the Potomac River. It is classified as a “Water of the United States (WOTUS)”. According to the Clean Water Act, surface water discharge to a WOTUS requires a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits control water pollution by regulating the discharge to surface water. The permit defines requirements for each discharger.

The VDEQ administers this program as the Virginia Pollutant Discharge Elimination System (VPDES). The permits are obtained through one of the seven regional DEQ offices. VPDES permits are required for all point source discharges to surface waters to limit pollutants entering streams, rivers, and bays and establish load allocations to each individual point source.

The VPDES permits include stringent nutrient limits for dischargers in the Chesapeake Bay drainage area.

### Nutrient Credits

In response to an EPA federal mandate, nutrient loading into the Chesapeake Bay is monitored and controlled. As part of this mandate, the Commonwealth of Virginia implemented the nutrient credit program that provided municipalities, utilities or private owners who discharge effluent (either point source or non-point source) into the Chesapeake Bay the ability to purchase credits in order to discharge nutrients. A nutrient credit is a specific nitrogen and phosphorous loading that a facility can discharge into a tributary of the Chesapeake Bay. Immediately upon implementation of this program, all credits were distributed and credits are no longer available for purchase from the State. However, a surface discharge by the Town of Hillsboro will require a nutrient credit, and this presents a major difficulty with the surface disposal option.

As part of the Chesapeake Bay mandate implementation, a nutrient credit trading program was established. The trading program allows existing credit owners (existing dischargers) to sell or trade (lease) nutrient credits for a 3 to 5 year period of time. There was no allowance for new dischargers. This means that per current regulations, there is no possible allocation available to Hillsboro through the State. Even if State rules are relaxed and allow Hillsboro to lease credits, it is not recommended for Hillsboro due to the uncertain market pricing and short-term horizon for lease of credits.

It is possible, that Hillsboro could find a credit available for purchase outside of the State run nutrient credit trading program. However, this is an exceedingly rare occurrence in Virginia. This purchase would be perpetual in nature and have no expiration. Owners that would sell their credits may include private industry that have reduced or eliminated discharge, or municipalities with significantly lower flows and nutrient loadings than anticipated. The facility is only allowed to purchase credits from another discharger within the same river basin.

The following equations summarize the pounds of nitrogen and phosphorous that the Town of Hillsboro will need to obtain credits for. The calculation assumes that a “State of the Art” (SOA) MBR system is installed.

Equation 5: Pounds of Nitrogen per Year

$$3 \frac{mg}{L} \times 0.02 \text{ MGD} \times 8.34 \frac{Lbs}{gal} \times 365 \frac{days}{year} = 182.6 \text{ lbs of TN}$$

Equation 6: Pounds of Phosphorus per Year

$$0.3 \frac{mg}{L} \times 0.02 \text{ MGD} \times 8.34 \frac{Lbs}{gal} \times 365 \frac{days}{year} = 18.3 \text{ lbs of TP}$$

There are currently no nutrient credits available for purchase and there is no guarantee that current credit holders will have credits available for purchase in the future. Furthermore, we do not believe leasing credits is a long-term, feasible solution for surface discharge. The market rate for nutrient credits vary greatly year to year and lease agreements may change after each period.

Treatment Requirements

Since the creek is classified as an impaired stream, and in order to limit the amount of nutrient credits that the Town of Hillsboro would need to purchase or lease (if available), it is assumed the treatment system will need to treat to what VDEQ classifies as ‘State of the Art’ (SOA) treatment levels, which includes 3 mg/L of nitrogen as a limit.

The VDEQ has a typical minimum recommended influent and effluent sampling program for sewage treatment works listed in the Sewage Collection and Treatment Regulations (SCAT) for all sewage treatment works. Table 8 lists the sampling recommendation for a treatment plant with a plant size between 1,100 – 40,000 gpd.

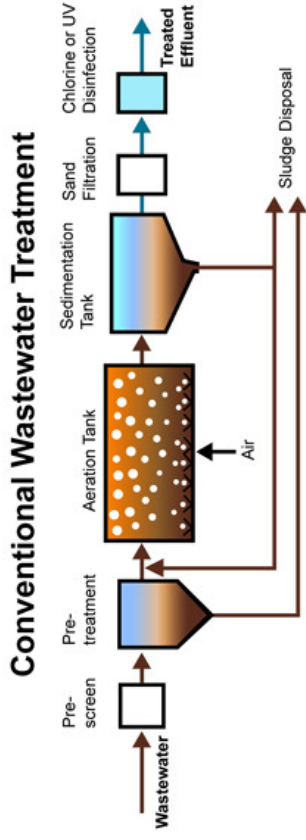
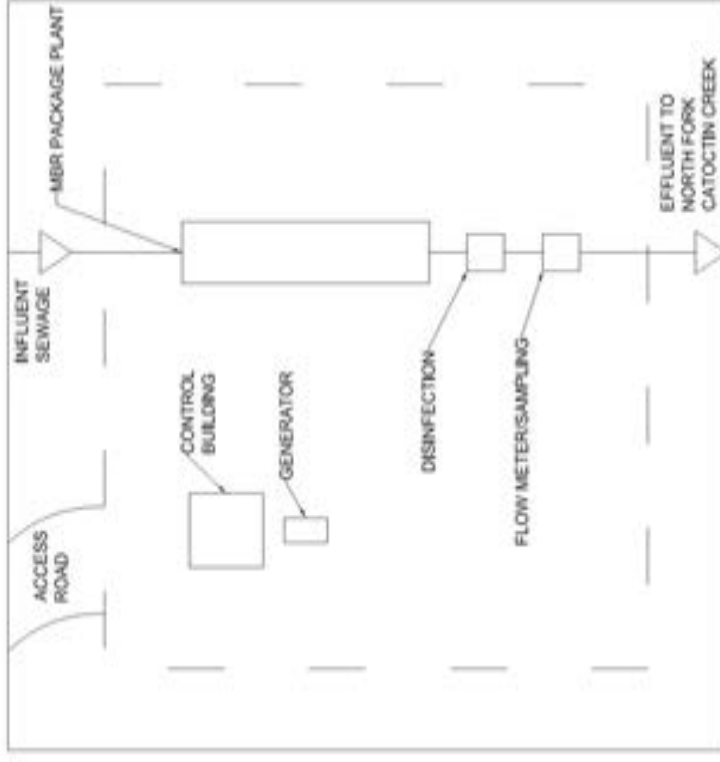
**TABLE 8: VDEQ SCAT RECOMMENDED INFLUENT AND EFFLUENT SAMPLING PROGRAM**

<b>Flow</b>	<b>Estimate</b>
BOD <sub>5</sub> , TSS, TKN	Grab 1/month
TN, TP	Grab 1/month
TRC, Contact tank	Grab 1/Day
Fecal Coliform	Grab 1/ month 10am-4pm
pH, DO, TRC Effluent	Grab 1/Day
WQS Parameters	Grab 1/month

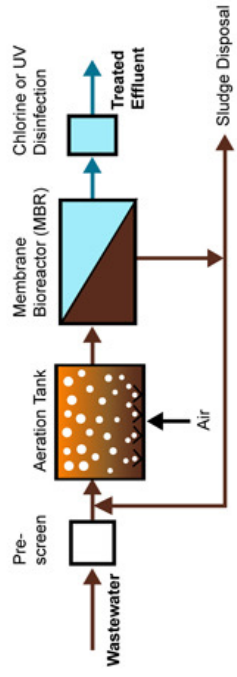
Recommended Treatment

The final selection of a treatment system will need to be determined during design when additional parameters regarding nutrient availability and stream sampling have been finalized. For the purpose of this study, it is assumed that State of the Art treatment levels would need to be met and a MBR treatment system will provide the Town with an advanced treatment system capable of meeting any effluent limitations that may be set forth in the discharge permit. Figure 11 provides an image of a MBR system and a preliminary site layout.

FIGURE 11: MEMBRANE BIOREACTOR



### Advanced Wastewater Treatment with MBR



Ionics Freshwater Ltd. 2010

**Approximate Dimensions:**  
 Area: ~8,400 SF  
 MBR Plant: 40 x 14 ft.  
 Disinfection Tank: 6 x 6 ft.  
 Flow Meter/Sampling: 6 x 6 ft.  
 Control Building: 12 x 12 ft.  
 Generator: 4 x 7 ft.

## PUMP STATION WITH CONNECTION TO PURCELLVILLE

The Town of Purcellville owns and operates the Basham Simms Wastewater Facility located on South 20th Street. The WWTP was built in 2002 and receives an average daily wastewater flow of 575,000 gpd. It utilizes a membrane biological reactor and ultraviolet radiation disinfection for advanced nutrient removal for surface discharge. The nearest collection piping for the Purcellville WWTP to Hillsboro is approximately four (4) miles south of the Hillsboro near Woodgrove High School. The Town of Purcellville would need to accept the connection and verify that the plant is able to treat an additional 20,000 gpd prior to design. The Town of Hillsboro would be required to negotiate connection fees to the Town of Purcellville to establish a connection.

FIGURE 12: BASHAM SIMMS WASTEWATER FACILITY

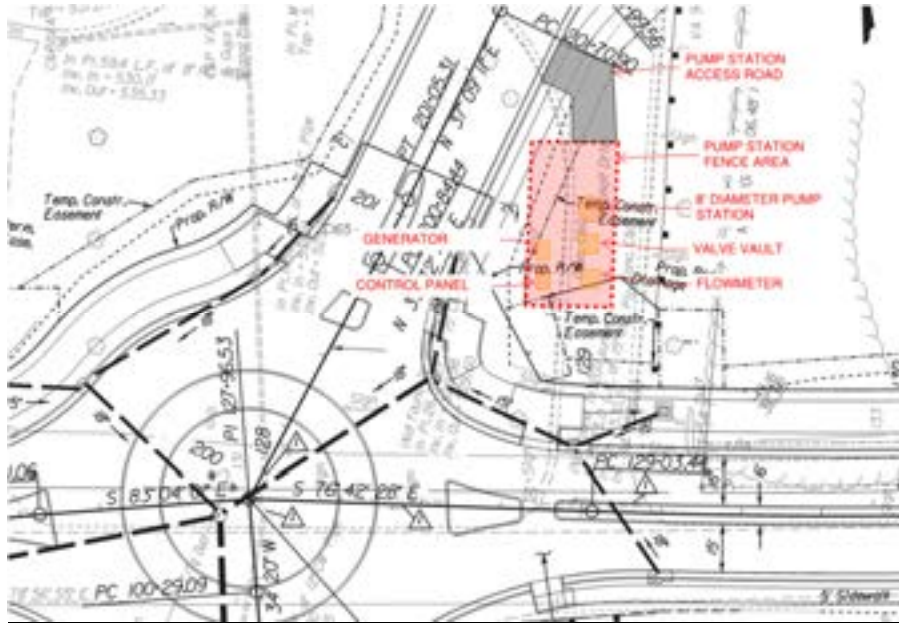


### Pump Station

A submersible duplex pump station located in the vicinity of the Hillsboro Charter Academy is required to convey the sewage to the Purcellville connection as indicated in Figure 4. The station will receive 20,000 gpd of average daily flow. VDEQ recommends applying a peaking factor of 3 for pump stations receiving with a population less than 10,000 people to account for peak flows and to provide an adequate safety margin. Therefore, the station will be designed to convey a peak daily flow of 60,000 gpd (42 gpm). Approximately 0.25 acres of land will be required for the station. An access road will lead into the site that will be enclosed with a fence and access gate. The site will include an 8' diameter precast concrete pump station, a valve vault, a flow meter vault, a control panel, and a generator. Figure 13 represents a preliminary sketch of a potential pump station in the vicinity of the Hillsboro Charter Academy after completion of the infrastructure project. The following layout was based off of the current plans for the Academy entrance.

The pump station invert will have a minimum burial of 4 ft. below ground surface at an estimated elevation of 520 ft. The Purcellville connection is approximately 22,500 ft. south along Hillsboro Rd. at an estimated elevation of 599 ft.

**FIGURE 13: PRELIMINARY PUMP STATION LAYOUT**



Pipe Layout

The force main can be constructed within the Hillsboro Road right of way and connect to the Purcellville sewage connection located near Woodgrove High School as indicated in Figure 14. The piping inside the pump station and vaults can be constructed out of 4" ductile iron pipe and be approximately 30 ft. in length. The force main along Hillsboro Rd. can be constructed out of 4" HDPE pipe and be approximately four miles long. The force main piping will be 4 ft. below the surface, as recommended for sewer piping outside of pavement.

**FIGURE 14: PRELIMINARY FORCE MAIN LAYOUT**



**Approximate Location of  
The Town of Hillsboro's Pump Station**

**Approximate Location of Force Main Tie-in**

STONY POINT RD

HONEY LOCUST LN

GAVER MILL RD

CHARLES TOWN PIKE

KOERNER LN

ASHBURY CHURCH RD

CHARTWELL LN

MOUNTAIN RIDGE LN

LONGMOOR FARM LN

SHORT HILL RD

GALLOP LN

PURCELLVILLE RD

LOCUST THICKET LN

HILL SBORO RD

ALLDER SCHOOL RD

ALLDER SCHOOL RD

Due to the undulating topography of Hillsboro Rd., the piping will experience high and low points. There are two (2) to three (3) points along the pipeline that may require an air release valve to release the air pockets that collect in the system. In pressurized pipeline, air tends to collect and form pockets at each high point in the system. The trapped air can cause pump failures, corrosion, flow issues, water surges, and pressure surges. In low points of the system, pressure tends to be less than that of the atmosphere and can cause pipes to collapse. These areas require a vacuum release valve that opens inward to let air into the system. There is one point along Hillsboro Road that may require a vacuum release valve. This valve will need to be placed where the pipeline passes under North Fork Catoclin Creek. Further investigation will be required if this option is selected. Appendix G provides a plan and profile view of Hillsboro Rd.

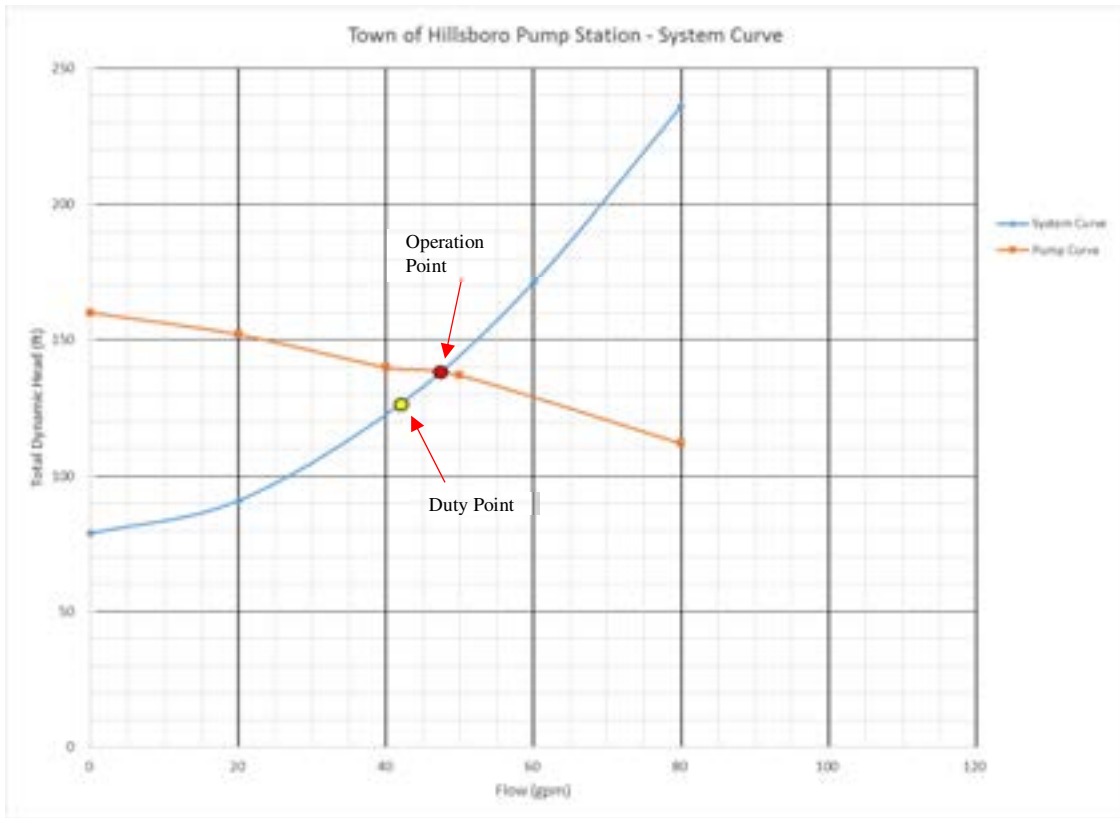
This force main would be located in Loudoun County's Rural Policy Area. This area is comprised of large and small farms, vineyards, home-based businesses, and historic areas. Loudoun County and its residents are working to protect and preserve this rural area. In order to implement the force main, the Town of Hillsboro will need Loudoun County approval to construct. The Rural Policy Area is also characterized by its narrow roads with significant horizontal and vertical curvatures. Hillsboro Rd. is a two (2) lane, high traffic road and will need a detailed traffic control plan. This will pose a design challenge to the construction of the force main alignment to Purcellville.

#### Pump Selection

Preliminary calculations were performed based on GIS topography and the force main layout shown above. The system will need to convey 60,000 gpd of peak flow (42 gpm) over a length of 22,500 ft. and overcome a static head of 79 ft. and 47.5 ft. of head losses from friction and pipe fittings. The total dynamic head (TDH) that the pump will need to overcome is approximately 127 ft. Given the TDH and flow, this will require a pump that can handle low flows and high head. Hydraulic calculations were performed in order to create a system curve based off of the TDH and flow shown in Figure 15, to determine if a suitable pump exists for this flow rate and headloss condition.

The preliminary pump selection is the Grundfos SEG.A15.55.2.60H Grinder Pump.

FIGURE 15: APPROXIMATE SYSTEM CURVE AND PUMP CURVE



Attachment F provides the Grundfos Grinder Pump cut sheet. Confirmation of the pump selection shall be completed during detailed design.

## Utility Management and Administration

The economic and technical feasibility related to construction of a wastewater system is a challenge. However, the long-term challenge and potentially the largest expense associated with the development of a wastewater utility include the development and planning of administration, finance, customer service and operations and maintenance. The creation of a wastewater utility is a significant process. The development of a utility administration structure was not directly included in the feasibility study and do not provide estimates of cost or time estimates required.

The administration would include communications, compliance reporting and regulatory affairs. Wastewater treatment plants are subject to County and State regulation including regular inspections, reporting and customer communications.

The financial aspect includes billing, accounting (audit), and financial planning. Long-term planning to support operations and maintenance will require investments and a reserve fund to support unplanned maintenance.

Customer service includes accounts, service issues, and possibly grinder pump coordination. Processes for opening and closing accounts, dealing with delinquent accounts and normal billing and service questions will need to be developed.

Operations and maintenance will include monitoring, sampling, reporting repairs, regular maintenance and possibly grinder pump servicing. This would likely be a contracted service requiring bidding and contract management.

The specific requirements of the utility will depend on the type of system installed. Any option with a treatment plant will require significant time and effort to setup and run. The option to pump to Purcellville will allow for a considerably more simple utility structure. It may be possible to develop a contract in which Purcellville assumes many of the utility tasks.

## Estimated Costs and Schedule

Planning-level project cost estimates were prepared for each proposed alternative. These estimates were based on recent construction costs for similar projects, as well as recent unit cost information provided by equipment and materials suppliers. Total construction cost will be subject to market conditions at the time of bidding. A typical allotment of 5% for permitting, 7.5% for engineering and 10% for overhead and profit was added to each sub-total. The final estimate is in line with a Class 4 (study or feasibility) estimate as defined by the Association for the Advancement of Cost Engineering. This class of estimate is defined by a variation range in line with the low (-20%) to high (+30%) values shown in tables.

As outlined above, the development of a utility administration structure was not included in the feasibility study. Costs and time for this would include the administration, finance, customer service and operations and maintenance. Costs developed assume there is no extension of the sewer collection system to serve any property outside of the Town boundary. Any extension will require a variance from the County and significant time and effort to approve. The specific requirements of the utility will depend on the type of system installed. Any option to pump to Purcellville will allow for a considerably more simple utility structure. It may be possible to develop a contract in which Purcellville assumes many of the utility tasks.

### COLLECTION SYSTEM COSTS

The capital costs for construction of the collection system have been identified in two parts. The first part is installation of the LPS main piping that would mainly be installed within the roadway right of ways. This cost includes excavation, restoration of pavement, LPS main piping, lateral piping to the property line, valve assembly installation, cleanouts and valves. It is assumed that the cost for installation this part would be shared by the Town of Hillsboro. After completion, every individual homeowner would need to connect their property to the LPS via connection to the valve assembly located at their property line. The second segment of capital costs includes installation of the LPS equipment on each individual property. The cost for each individual property may vary greatly based on the length of force main, depth of sewer, abandonment of existing septic systems and potential internal plumbing modifications. For the purpose of this study, \$25,000 has been used to estimate the cost for each individual parcel. It is anticipated that the cost for installation on each individual property will be the responsibility of the individual homeowner.

Table 9 provides the estimated capital costs for the collection system for both portions of work.

**TABLE 9: COLLECTION SYSTEM CAPITAL COSTS**

<b><u>Collection System Costs</u></b>				
<b>Low Pressure Sewer Main Installation</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
1.25" SDR 21 Sewer Installation	LF	1,425	\$ 45.00	\$ 64,125
1.5" SDR 21 Sewer Installation	LF	1,250	\$ 45.00	\$ 56,250
2" SDR 21 Sewer Installation	LF	1,510	\$ 47.00	\$ 70,970
2.5" SDR 21 Sewer Installation	LF	1,200	\$ 49.00	\$ 58,800
3" SDR 21 Sewer Installation	LF	1,915	\$ 52.00	\$ 99,580
Cleanouts	EA	5	\$ 750.00	\$ 3,750
Lateral Piping and Valve Assembly	EA	57	\$ 1,525.00	\$ 86,925
Road Restoration	LF	7,300	\$ 125.00	\$ 912,500
Sub-Total				\$ 1,352,900
Permitting				\$ 68,000
Engineering				\$ 101,000
Overhead & Profit				\$ 135,000
LPS Total				\$ 1,656,900
<b>Individual System Costs</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
Excavation	CY	11	\$ 20.00	\$ 220
Grinder Pump and Tank	EA	1	\$ 11,500.00	\$ 11,500
Connection Piping	LF	175	\$ 12.50	\$ 2,190
Septic System Abandonment	EA	1	\$ 3,500.00	\$ 3,500
Internal Plumbing Modification	EA	1	\$ 1,500.00	\$ 1,500
Restoration	EA	1	\$ 750.00	\$ 750
Sub-Total				\$ 20,000
Permitting				\$ 1,000
Engineering				\$ 2,000
Overhead & Profit				\$ 2,000
Home Owner Total				\$ 25,000
Total # of Parcels				54
Individual Total				\$ 1,350,000
Total				\$ 3,006,900
Low Range Estimate (-20%)				\$ 2,406,000
High Range Estimate (+30%)				\$ 3,909,000

\* Selection of another pump station location will affect the collection system cost. Cost for Sewer Main is approximately \$52,000 per LF.

The costs above assume that restoration is needed for installing the entire low pressure system. If this project occurs in conjunction with the roadway construction, there could be additional cost savings. The responsibility of these costs as it relates to the Town versus the individual homeowners will depend on the rules that will need to be established by the Town. Hillsboro has three (3) options in regards to the

purchase and installation of the grinder pump. The Town can purchase the grinder pump for each homeowner and have the owner pay for installation, the Town can purchase and install the grinder pump for each homeowner under an agreement, or the Town can have the homeowner pay for both the grinder pump and installation costs. Division of these costs will be up to the Town of Hillsboro.

#### O&M Costs

The LPS piping that makes up the overall system requires little maintenance, if designed properly. The system is self-flushing, however, some municipalities will develop a flushing program in order to remove sediment that builds up in the pipes over time and to maintain optimal performance.

Since the pipelines are pressurized, ground infiltration is usually not an issue, but the pump basins should be inspected periodically to make sure that surface or ground water is not entering the system. The Town will need to develop an operating and maintenance fund to conduct collection system maintenance as necessary.

Most grinder pumps require limited routine maintenance. These pumps have an average service life of 8-10 years before requiring any service. The typical service at the 8-10 year mark is replacement of worn parts (cutter wheel, stator, and shaft seal). The typical cost of repairs at the 8-10 year point is between \$500-\$700, which includes parts and labor. These pumps are designed to be in service for 15-20 years, however, if the pump needs to be replaced, the cost of a new pump is \$2,600.

The Town will have no operating costs as it relates to the grinder pump system as the homeowner will pay for the power cost. The typical operating cost for the residential station is approximately \$15 to \$50 dollars a year depending on the electricity costs for the area and the flow coming from each house. For example, a typical household grinder pump station requires approximately 200 kWh per year. For the Town of Hillsboro, each home would need to pay \$18.62 per year for the system to operate assuming an electricity cost of \$0.09/kWh.

### TREATMENT AND DISPOSAL COSTS

#### **Fixed Film Wastewater Treatment System with Subsurface Disposal**

The capital costs of the subsurface disposal system will depend on the site selected and configuration of the drainfield with a drip dispersal system. The cost estimate was made with the assumption that a fixed film package treatment plant would be installed. The capital costs are broken down into the cost of the package treatment plant with ancillary equipment and the subsurface disposal system.

The cost estimate below represents the total capital costs for installing the treatment plant, subsurface disposal system, and intermediate pump station for a flow of 20,000 gpd as well as the land acquisition costs. An intermediate pump station is incorporated into the costs since the final treatment and discharge location is undetermined. The pump station would be used to convey sewage to the treatment and subsurface disposal system if it is placed on a property other than the assumed Charter School location. The treatment plant alone (equipment only) will cost approximately \$190,000. The subsurface disposal system will require 25 acres of land. Four (4) acres will be used for the drainfield at a cost of \$25,000 per acre and an additional twenty-one (21) acres at a cost of \$25,000 per acre will be used for the dilution area with a land acquisition cost estimated at \$625,000. Approximately one acre is needed for an access road, fencing, and other site requirements. This acre can be part of the twenty-five (25) acres needed for the dilution area. The costs per acre were estimated based on past reports, prior work in the Town of Hillsboro, local property research, and coordination with Loudoun County personnel. This raises the total subsurface disposal system and packaged treatment plant cost to approximately \$2,072,000. It is

important to note that land costs are highly variable and subject to change. These estimates are for guidance only.

**TABLE 10: ESTIMATED CAPITAL COSTS FOR A FIXED FILM PACKAGE TREATMENT PLANT WITH SUBSURFACE DISPOSAL**

<b>Fixed Film WWTP with Subsurface Disposal</b>				
<b>Package Treatment Plant</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
Fixed Film Package Treatment Plant	LS	1	\$ 190,000	\$ 190,000
Treatment Plant Installation	LS	1	\$ 95,000	\$ 95,000
Control Building (w/ equipment)	LS	1	\$ 75,000	\$ 80,000
Intermediate Pump Station <sup>1</sup>	LS	1	\$ 135,000	\$ 135,000
Generator	EA	1	\$ 25,000	\$ 25,000
Site Work and Landscaping	LS	1	\$ 90,250	\$ 108,500
<b>Treatment System Total</b>				<b>\$ 633,500</b>
<b>Subsurface Disposal</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
Drainfield Installation	LS	1	\$ 52,000	\$ 52,000
Restoration/Landscaping	SF	3,750	\$ 18	\$ 67,500
Extension of Low Pressure Sewer <sup>2</sup>	LF	7,800	\$ 37.64	\$ 293,600
Road Restoration	SF	23,400	\$ 5.75	\$ 134,550
<b>Drainfield Total</b>				<b>\$ 547,650</b>
<b>Combined Total</b>				<b>\$ 1,181,150</b>
Permitting				\$ 59,000
Engineering				\$ 89,000
Overhead & Profit				\$ 118,000
Land Acquisition <sup>3</sup>	Acre	25	\$ 25,000	\$ 625,000
<b>Total</b>				<b>\$ 2,072,000</b>
<b>Low Range Estimate (-20%)</b>				<b>\$ 1,658,000</b>
<b>High Range Estimate (+30%)</b>				<b>\$ 2,694,000</b>

1 - Includes 8' diameter precast pump station installation, controls, and generator

2 - Force main installation from intermediate pump station, east towards drainfield area. Force main length to be determined by drainfield location and land availability.

3 - Land acquisition includes the 4 acres of drainfield and 1 acre to account for access road, drainfield buffer, etc.

The operational and maintenance costs associated with a wastewater treatment with a subsurface disposal involve the treatment system and pump station. Fixed film systems require daily maintenance in accordance with the operations permit. There is also an on-going maintenance of the media to ensure that it is able to provide proper treatment. The main operation and maintenance costs for the pump station involve general maintenance of the equipment, maintenance of the pump station facility, routine maintenance, and power costs. The following table summarizes the estimated O&M costs for a fixed film system and intermediate pump station.

TABLE 11: ESTIMATED YEARLY O&M COSTS FOR A FIXED FILM TREATMENT SYSTEM

<b><u>Estimated O&amp;M Costs for a Fixed Film System</u></b>		
<b>Estimated Maintenance Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
General Equipment Maintenance <sup>1</sup>	Per year	\$450
Facility Maintenance <sup>2</sup>	Per year	\$4,500
Intermediate Pump Station <sup>8</sup>	Per year	\$17,500
<b>Estimated Operational Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
Standard Operating Personnel <sup>3</sup>	\$/year	\$36,500
Routine Operation <sup>4</sup>	\$/year	\$5,200
Power Cost <sup>5</sup>	Per year	\$3,300
System Cleaning <sup>6</sup>	\$/year	\$9,600.00
Chemicals	\$/year	-
Sludge Hauling <sup>7</sup>	\$/year	\$5,000
<b>Total</b>		<b>\$82,050</b>
<b>Low Range Estimate (-20 %)</b>		<b>\$66,000</b>
<b>High Range Estimate (+30 %)</b>		<b>\$107,000</b>
<sup>1</sup> Includes costs associated with monthly, annual and semi-annual maintenance of treatment equipment		
<sup>2</sup> Includes maintenance costs associated with the treatment facility including leaf removal, grass trimming, etc...		
<sup>3</sup> Assumes 1 hour/day at \$100 per hour		
<sup>4</sup> Time spent in addition to standard maintenance to maintain technology specific equipment. Assumes 1 hour per week at \$100 per hour		
<sup>5</sup> Assumes 100kWh/day at \$0.09/kWh		
<sup>6</sup> Assumes 8 Hours/Month at \$100 per hour		
<sup>7</sup> Assumes \$2500/ haul of 5,000 gallons		
<sup>8</sup> Cost savings due to less travel time. Operator is also needed for on-site O&M of the MBR system		

### **MBR Wastewater Treatment System with Subsurface Disposal**

The cost estimate below represents the total capital costs for installing a MBR treatment plant, pump station, and subsurface disposal system for a flow of 20,000 gpd as well as the land acquisition costs. An intermediate pump station is incorporated into the costs since the final treatment and discharge location is undetermined. The pump station would be used to convey sewage to the treatment and subsurface disposal system if it is placed on a property other than the assumed Charter School location. The subsurface disposal system will require 5 acres of land. Four (4) acres will be used for the drainfield at a cost of \$25,000 and one (1) acre at a cost of \$25,000 will be used for the treatment plant, access road, fencing, and other site requirements. The additional one (1) acre is required since this option does not require a dilution area and the drainfield area cannot be disturbed. The costs per acre were estimated based on past reports, prior work in the Town of Hillsboro, local property research, and coordination with Loudoun County personnel. This raises the total subsurface disposal system and packaged treatment plant cost to approximately \$2,184,000. It is important to note that land costs are highly variable and subject to change. These estimates are for guidance only.

MBR systems require daily maintenance in accordance with the operations permit. These systems have automated controls that need to be monitored. The membranes used may foul. Membranes require regular cleaning. In addition, MBRs utilize a high pressure permeate pump to draw mixed liquor across their membrane for treatment. This permeate pump makes the system have a high energy demand. The main operation and maintenance costs for the pump station involve general maintenance of the equipment, maintenance of the pump station facility, routine maintenance, and power costs. The O&M costs associated with this option is illustrated in Table 13.

**TABLE 12: ESTIMATED CAPITAL COSTS FOR A MBR PACKAGE TREATMENT PLANT WITH SUBSURFACE DISPOSAL**

<b><u>MBR WWTP with Subsurface Disposal</u></b>				
<b>Package Treatment Plant and Ancillary Equipment</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
MBR Treatment Plant with Equipment	LS	1	\$ 500,000	\$ 500,000
Treatment Plant Installation	LS	1	\$ 250,000	\$ 250,000
Control Building (w/ equipment)	LS	1	\$ 105,000	\$ 105,000
Intermediate Pump Station <sup>1</sup>	LS	1	\$ 135,000	\$ 135,000
Generator	EA	1	\$ 35,000	\$ 35,000
Site Work and Landscaping	LS	1	\$ 108,500	\$ 108,500
Treatment System Total				\$ 1,133,500
<b>Subsurface Disposal</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
Drainfield Installation	LS	1	\$ 52,000	\$ 52,000
Restoration/Landscaping	SF	3,750	\$ 18	\$ 67,500
Extension of Low Pressure Sewer <sup>2</sup>	LF	7,800	\$ 37.64	\$ 293,600
Road Restoration	LF	23,400	\$ 5.75	\$ 134,550
Drainfield Total				\$ 547,650
Combined Total				\$ 1,681,150
Permitting				\$ 84,000
Engineering				\$ 126,000
Overhead & Profit				\$ 168,000
Land Acquisition <sup>3</sup>	Acre	5	\$25,000	\$ 125,000
<b>Total</b>				<b>\$ 2,184,000</b>
<b>Low Range Estimate (-20%)</b>				<b>\$ 1,747,000</b>
<b>High Range Estimate (+30%)</b>				<b>\$ 2,839,000</b>
1 - Includes 8' diameter precast pump station installation, controls, and generator				
2 - Force main installation from intermediate pump station, east towards drainfield area. Force main length to be determined by drainfield location and land availability.				
3 - Land acquisition includes the 4 acres of drainfield and 1 acre to account for access road, drainfield buffer, etc.				

**TABLE 13: ESTIMATED YEARLY O&M COSTS FOR A MBR TREATMENT SYSTEM FOR SUBSURFACE DISPOSAL**

<b><u>Estimated O&amp;M Costs for a MBR Treatment System</u></b>		
<b>Estimated Maintenance Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
General Equipment Maintenance <sup>1</sup>	Per year	\$450
Facility Maintenance <sup>2</sup>	Per year	\$4,500
Intermediate Pump Station <sup>8</sup>	Per year	\$17,500
<b>Estimated Operational Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
Standard Operating Personnel <sup>3</sup>	\$/year	\$36,500
Routine Operation <sup>4</sup>	\$/year	\$10,400
Power Cost <sup>5</sup>	Per year	\$10,676
System Cleaning <sup>6</sup>	\$/year	\$28,800
Chemicals	\$/year	\$2,500
Sludge Hauling <sup>7</sup>	\$/year	\$7,500
<b>Total</b>		<b>\$119,000</b>
<b>Low Range Estimate (-20%)</b>		<b>\$95,200</b>
<b>High Range Estimate (+30%)</b>		<b>\$154,700</b>
<sup>1</sup> Includes costs associated with monthly, annual and semi-annual maintenance of treatment equipment		
<sup>2</sup> Includes maintenance costs associated with the treatment facility including leaf removal, grass trimming, etc...		
<sup>3</sup> Assumes 1 hour/day at \$100 per hour		
<sup>4</sup> Time spent in addition to standard maintenance to maintain technology specific equipment. Assumes 2 hour per week at \$100 per hour		
<sup>5</sup> Assumes 325 kWh/day at \$0.09/kWh		
<sup>6</sup> Assumes 24 hours per month at \$100 per hour		
<sup>7</sup> Assumes \$2500/ haul of 5,000 gallons		
<sup>8</sup> Cost savings. Operator is also needed for on-site O&M of the MBR system		

**Wastewater Treatment Plant with Surface Disposal**

The capital costs of the wastewater treatment plant with surface disposal assumes an MBR treatment plant is installed and is capable of meeting strict nitrogen requirements. The costs are broken down into the cost of the package treatment plant with ancillary equipment and the effluent piping to the creek. An intermediate pump station is incorporated into the costs since the final treatment and discharge location is undetermined. The pump station could be used to convey sewage to the treatment plant if it is located on another property other than the assumed Charter School location or to the surface discharge location at North Fork Catoctin Creek.

The cost estimate below represents the costs for installing the treatment plant and the effluent piping to North Fork Catoctin Creek for a flow of 20,000 gpd.

**TABLE 14: ESTIMATED CAPITAL COSTS FOR A PACKAGE TREATMENT PLANT WITH SURFACE DISPOSAL**

<b><u>Wastewater Treatment Plant with Surface Disposal</u></b>				
<b>Package Treatment Plant and Ancillary Equipment</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
MBR Treatment Plant with Equipment	LS	1	\$ 500,000	\$ 500,000
Treatment Plant Installation	LS	1	\$ 250,000	\$ 250,000
Control Building (w/ equipment)	LS	1	\$ 105,000	\$ 105,000
Intermediate Pump Station <sup>1</sup>	LS	1	\$ 135,000	\$ 135,000
Force Main <sup>5</sup>	LF	500	\$ 75	\$ 37,500
Generator	EA	1	\$ 35,000	\$ 35,000
Site Work and Landscaping	LS	1	\$ 108,500	\$ 108,500
<b>Package Treatment Plant and Ancillary Equipment Total</b>				<b>\$ 1,171,000</b>
<b>Effluent Piping to Creek</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
Outfall Pipe Installation <sup>2,3</sup>	LF	3,400	\$ 80	\$ 272,000
Road Restoration	SF	4,800	\$ 5.75	\$ 27,600
Outfall Structure	LS	1	\$ 7,500	\$ 7,500
<b>Effluent Piping to Creek Total</b>				<b>\$ 307,100</b>
<b>Treatment Plant and Effluent Piping Total</b>				<b>\$ 1,478,100</b>
			Permitting	\$ 74,000
			Engineering	\$ 111,000
			Overhead & Profit	\$ 148,000
			Land Acquisition <sup>4</sup>	\$ 18,750
<b>Total</b>				<b>\$ 1,829,850</b>
<b>Low Range Estimate (-20%)</b>				<b>\$ 1,464,000</b>
<b>High Range Estimate (+30%)</b>				<b>\$ 2,379,000</b>
1 - Includes 8' diameter precast pump station installation, controls, and generator				
2 - Site work and landscaping includes excavation, the concrete foundation, and electrical service. Assumes open cut excavation costs for entire length of force main. Trenchless installation may be considered and could result in a potential cost savings.				
3 - Assumes no rock removal or excavation required.				
4 - Assumes treatment plant requires 0.5 acres and pump station requires 0.25 acres				
5 - Force main costs assume pumping to a treatment system in close proximity to the Town and the creek.				

Similar to MBR systems for subsurface disposal, MBR systems for surface disposal require daily maintenance in accordance with the operations permit. These systems have high energy costs. The main operation and maintenance costs include monitoring automatic controls, membranes cleaning, general maintenance of the equipment, maintenance of the pump station facility, routine maintenance, and power costs. The nutrient credits associated with surface discharge were incorporated into the yearly O&M costs because nutrient credit costs are uncertain and vary per year. Table 15 provides estimated yearly operation and maintenance costs for an MBR treatment system for surface disposal and intermediate pump station.

**TABLE 15: ESTIMATED YEARLY O&M COSTS FOR A MBR TREATMENT SYSTEM FOR SURFACE DISCHARGE**

<b>Estimated O&amp;M Costs for a MBR Treatment System</b>		
<b>Estimated Maintenance Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
General Equipment Maintenance <sup>1</sup>	Per year	\$450
Facility Maintenance <sup>2</sup>	Per year	\$4,500
Intermediate Pump Station <sup>8</sup>	Per year	\$17,500
<b>Estimated Operational Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
Standard Operating Personnel <sup>3</sup>	\$/year	\$36,500
Routine Operation <sup>4</sup>	\$/year	\$10,400
Power Cost <sup>5</sup>	Per year	\$10,676
System Cleaning <sup>6</sup>	\$/year	\$28,800
Chemicals	\$/year	\$2,500
Sludge Hauling <sup>7</sup>	\$/year	\$7,500
<b>Nutrient Credits<sup>9</sup></b>		
TN Credits	\$/year	\$730
TP Credits	\$/year	\$110
<b>Total</b>		<b>\$120,000</b>
<b>Low Range Estimate (-20 %)</b>		<b>\$96,000</b>
<b>High Range Estimate (+30 %)</b>		<b>\$156,000</b>

<sup>1</sup>Includes costs associated with monthly, annual and semi-annual maintenance of treatment equipment

<sup>2</sup>Includes maintenance costs associated with the treatment facility including leaf removal, grass trimming, etc...

<sup>3</sup>Assumes 1 hour/day at \$100 per hour

<sup>4</sup>Time spent in addition to standard maintenance to maintain technology specific equipment. Assumes 2 hour per week at \$100 per hour

<sup>5</sup>Assumes 325 kWh/day at \$0.09/kWh

<sup>6</sup>Assumes 24 hours per month at \$100 per hour

<sup>7</sup>Assumes \$2500/ haul of 5,000 gallons

<sup>8</sup>Cost savings. Operator is also needed for on-site O&M of the MBR system

<sup>9</sup>Nutrient credit costs were included in the O&M estimate costs since these costs are established on a year to year basis. Credit costs are uncertain. The estimate assumes that 1 lb of N costs \$4 and 1 lb of P costs \$6.

### **Pump Station with Connection to Purcellville**

The capital costs of a pump station with a connection to Purcellville includes the cost of the force main and the pump station.

The cost estimate below represents the capital costs for installing a pump station that delivers an average daily flow of 20,000 gpd to the closest collection point of the Purcellville wastewater treatment plant. The Town of Purcellville will require a connection fee based on the volume of sewage being conveyed and treated by the Town of Purcellville. The connection fee in Table 16 was based on sixty (60) 5/8" connections at the listed \$43,200 availability fee published by the Town of Purcellville. Discussions and negotiations with the Town of Purcellville should occur prior to the acceptance of this alternative.

**TABLE 16: ESTIMATED CAPITAL COSTS FOR A PUMP STATION WITH A CONNECTION TO PURCELLVILLE**

<b><u>Pump Station with Connection to Purcellville</u></b>				
<b>Force Main</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
4" HDPE Forcemain Installation <sup>1</sup>	LS	1	\$ 738,400	\$ 738,400
Air/Vac Valve	LS	3	\$ 5,000	\$ 15,000
Erosion & Sediment Control	LF	45,000	\$ 1.80	\$ 81,000
Road Restoration	SF	67,500	\$ 2.80	\$ 189,000
Stream Crossing <sup>2</sup>	LS	1	\$ 12,500	\$ 12,500
Forcemain Total				\$ 1,035,900
<b>Pump Station</b>				
<b>Item</b>	<b>Units</b>	<b>Quantity</b>	<b>Unit Price</b>	<b>Total</b>
8' Diameter Precast Pump Station Installation	LS	1	\$ 30,000	\$ 55,000
Site Work, Landscaping, and Restoration	LS	1	\$ 29,750	\$ 29,750
Generator	LS	1	\$ 25,000	\$ 25,000
Control Panel and Structure	LS	1	\$ 8,000	\$ 8,000
Pump Station Total				\$ 117,750
Combined Total				\$ 1,153,650
Permitting				\$ 58,000
Engineering				\$ 87,000
Contractor Overhead & Profit				\$ 115,365
Connection Fee to Purcellville <sup>3</sup>	LS	1	\$ 2,600,000	\$ 2,600,000
Land Acquisition	ACRES	0.25	\$ 25,000.00	\$ 6,250
<b>Total</b>				\$ 4,020,000
<b>Low Range Estimate (-20%)</b>				\$ 3,216,000
<b>High Range Estimate (+30%)</b>				\$ 5,226,000
1 - Includes excavation and backfill. Assumes open cut excavation costs for entire length of force main and no rock removal. Trenchless installation may be considered and could result in a potential cost savings.				
2 - Open cut crossing of the stream will require permitting through VDEQ, ACOE and Loudoun County.				
3 - Connection fees to Purcellville should be confirmed with the Town of Purcellville. Estimate is based on Purcellville's published availability fees.				

The main operation and maintenance costs for the pump station involve general maintenance of the equipment, maintenance of the pump station facility, routine maintenance, and power costs. Table 17 summarizes the estimated yearly O&M costs.

TABLE 17: ESTIMATED YEARLY O&M COSTS FOR A PUMP STATION

<b>Estimated O&amp;M Costs for a Pump Station</b>		
<b>Estimated Maintenance Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
General Equipment Maintenance <sup>1</sup>	Per year	\$200
Facility Maintenance <sup>2</sup>	Per year	\$2,160
<b>Estimated Operational Costs</b>		
<b>Item</b>	<b>Unit</b>	<b>Cost</b>
Standard Operating Personnel <sup>3</sup>	\$/year	\$9,000
Routine Operation <sup>4</sup>	\$/year	\$5,200
Power Cost <sup>5</sup>	Per year	\$5,000
<b>Total</b>		<b>\$22,000</b>
<b>Low Range Estimate (-20%)</b>		<b>\$17,600</b>
<b>High Range Estimate (+30%)</b>		<b>\$28,600</b>
<sup>1</sup> Estimated costs have been developed for a 20,000 GPD Pump Station with 2 submersible pumps, flow meter, control panel and structure, and generator.		
<sup>2</sup> Includes costs associated with monthly, annual and semi-annual maintenance of treatment.		
<sup>3</sup> Includes maintenance costs associated with the pump station facility including leaf removal, grass trimming, etc...		
<sup>4</sup> Time spent in addition to standard maintenance to maintain technology specific equipment. Assumes 1 hour/week at \$100 per hour		
<sup>5</sup> Assumes 150 kWh/day		

**Overall System Cost Summary**

A net present worth analysis has been calculated based on the capital costs and annual O&M costs outlined above over a 30 year life cycle with a 3% interest rate. The following table summarizes the net present cost of each alternative.

**TABLE 18: PRESENT WORTH ANALYSIS**

<b>Disposal Method</b>	<b>Connection to Purcellville</b>	<b>Surface Water Discharge</b>	<b>Subsurface Discharge</b>	<b>Subsurface Discharge</b>
<b>System</b>	Pump Station	MBR	Fixed Film	MBR
<b>Initial Capital Cost</b>	\$ 4,020,000	\$ 1,829,850	\$ 2,072,000	\$ 2,184,000
<b>Yearly O&amp;M Costs</b>	\$ 22,000	\$ 120,000	\$ 82,050	\$ 119,000
<b>LPS</b>	\$ 3,006,900	\$ 3,006,900	\$ 3,006,900	\$ 3,006,900
<b>Lifecycle (yrs)</b>	30	30	30	30
<b>Interest Rate</b>	3%	3%	3%	3%
<b>Net Present Cost</b>	\$ 7,460,000	\$ 7,190,000	\$ 6,690,000	\$ 7,520,000
<b>Key Points, Assumptions, Issues</b>	Contractual agreement and connection fees with Purcellville are unknown; O&M costs are low	Ability to obtain discharge permit is unknown; ongoing O&M costs very high	Ability and cost to obtain land for disposal is unknown; required acreage may change after soils evaluation; ongoing O&M costs high	Ability and cost to obtain land for disposal is unknown; required acreage may change after soils evaluation; ongoing O&M costs very high

\*Cost for the Connection to Purcellville includes a connection fee based on available information from the Town of Purcellville  
 \*Surface Water Discharge includes nutrient credits. Nutrient costs will depend on availability  
 \*Subsurface Discharge cost assumes 4 acres of land at \$25,000 and 21 acres of land at \$25,000

The 30-year planning level cost estimates developed for each alternative are within 10% of each other and no alternative is clearly least expensive. There are significant assumptions regarding land acquisition, obtaining nutrient credits and connection fees that may drive costs up or down for each alternative. As calculated, the subsurface disposal with a MBR is the most costly option followed by the connection to Purcellville, MBR with surface disposal and a subsurface disposal with a fixed film system. However, due to significantly lower O&M costs and significantly lower administrative requirements in setting up a utility, the connection to Purcellville is the most feasible option and is recommended for further planning and coordination.

## SCHEDULE

An implementation schedule is dependent on the design, permitting and approval process with outside stakeholders. The following schedule has been developed assuming an arbitrary notice to proceed date for design and assumes an alternative has been selected, land acquisition has been negotiated and connection agreements have been finalized.

Description	Approximate Date
Notice to Proceed with Design	NTP
Additional Survey Completed and Preliminary Design Initiated	92 days/13 weeks
Submit 60% Design Drawings and Specifications	245 days/ 35 weeks
Submit 100% Design Drawings and Specifications	334 days/ 48 weeks
Receive Necessary Approvals and Permits	365 days/52 weeks
Advertise for Bids	379 days/54 weeks
Award Contract and Issue Notice to Proceed	395 days/56 weeks
Pump Station Construction Completion	579 days/83 weeks
Force Main Completion – Construction Completed	639 days/91 weeks

## Recommendation

### SUMMARY OF RECOMMENDED SYSTEM

There are two (2) recommendations for the Town of Hillsboro sewer system. The first recommendation relates to the sewage collection system needed to collect and convey all sewage from the Town to a central location for further disposal. The second recommendation is the sewage disposal system that would be needed to treat or convey sewage from the Town to be disposed of in accordance with all local, state and federal regulations.

The most feasible sewage collection system for the Town of Hillsboro would be installation of a low pressure sewer system at each individual property within the Town boundary. A preliminary system has been recommended in the sections above. The estimated capital costs for construction of this complete system is \$3,006,900. Coordination with the roadway project may lower this total.

There are three (3) alternatives that were considered for treating and/or disposing the Town of Hillsboro's sewage. The alternatives outlined throughout this report were:

- Subsurface Disposal Wastewater Treatment Plant
- Surface Disposal Wastewater Treatment Plant
- Pump Station to Town of Purcellville

Based on the study, each of these alternatives have challenges that will need to be overcome prior to design and selection. These challenges can be summarized as follows:

Subsurface – Subsurface disposal requires large land areas if a fixed film treatment system is used. As mentioned above, acquiring the land drives up the cost of this option significantly. A SOA MBR system would require less land requirements, however, this treatment system is more costly and would require a higher level of O&M. Suitable soils and topography to install the necessary drainfield and dilution area also need to be considered. Based on the preliminary soil study performed as part of this report, there are no properties currently located within the Town boundary that are suitable for installation of this drainfield. The closest properties that are suitable for a drainfield are approximately 1.5 miles east of the Town. The Town has indicated that potential landowners with suitable properties have not been willing to grant the Town the necessary easements for installation of a drainfield. Without this land available and the high costs associated with it, a subsurface discharging facility is not recommended.

Surface – Surface disposal requires disposing treated effluent into the North Fork of Catoctin Creek. This is an impaired stream that may require state of the art treatment capabilities for discharging treated sanitary waste. As outlined above, the costs for this system are high and the yearly O&M costs may not be sustainable for the Town or its residents. Furthermore, the availability and cost of nutrient credits for surface discharge is uncertain. For this reason, a surface water treatment plant is not considered financially feasible for the Town.

Pump Station – Installation of a pump station requires approximately 0.25 acres of land inside the Town of Hillsboro. As mentioned above, it is recommended to place the station in the vicinity of the Hillsboro Charter Academy to convey the waste via force main along Hillsboro Road to the closest Purcellville connection. As outlined above, this alternative has the highest cost using the connection fees available for the Town of Purcellville but has the lowest O&M costs and requirements. This option requires coordination and negotiation with the Town of Purcellville for the allowance of a sewage connection. Connection fees will need to be agreed to between the Town of Hillsboro and the Town of Purcellville.

Therefore, the overall recommendation for the Town of Hillsboro is construction of a LPS system and a pump station and force main with a connection to the Town of Purcellville collection system. The costs associated for this system are summarized in the table below.

**TABLE 19: ESTIMATED COSTS FOR A LPS SYSTEM WITH PUMP STATION AND CONNECTION TO PURCELLVILLE**

Low Pressure Collection System	\$3,006,900
Pump Station & Force Main	\$4,020,000
Connection Costs	TBD
Total Capital Costs (LPS+PS)	\$7,026,900
Yearly O&M Costs	\$22,000
Net Present Costs*	\$7,460,000

\*Net Present cost is based on a 30 year lifecycle and 30% interest rate

Yearly O&M fees would be approximately \$22,000. If all 54 residents connect and pay sewer fees, the monthly cost to each homeowner for sewer service would be approximately \$35 per month. This cost does not include O&M fees that may be required by the Town of Purcellville for use of their water reclamation facility. These fees would be added to the cost outlined above.

It should also be noted that construction of any of these systems will require the Town of Hillsboro to manage a utility. The costs and time requirements for managing this utility have not been addressed as part of this feasibility study and should be considered by the Town moving forward.

## RECOMMENDED STEPS MOVING FORWARD

### 1. Funding

The Town will need to obtain funding from County, State, Federal or other sources. The County Health Department, Virginia Department of Environmental Quality and Department of Health may be able to assist with grants or loans.

### 2. Select treatment and disposal method

The Town of Hillsboro will need to select the treatment and disposal method they will implement using the information provided in this report and the recommendation above. The method selected will determine the level of treatment needed, the total cost of project, and the location of the treatment plant. It is recommended that the Town reach out to Purcellville to determine the feasibility of the pump station connection prior to proceeding with the potential treatment system.

### 3. Public Works/Wastewater Utility Planning

The Town of Hillsboro will need to establish a plan for administrative requirements, financial requirements, customer services, and operations and maintenance of the new wastewater collection and treatment system. Administrative tasks included communication between the utility and regulatory agencies for compliance reporting. Financial planning includes funding of the project, billing rates based on water consumption, and accounting. The Town will have to establish who is responsible for customer service issues for the home unit. The Town will also need to create an operations and maintenance program to monitor, repair, and operate the entire system.

### 4. Determine location

Once the treatment and disposal method is selected, the location of the systems will need to be determined. The treatment location and the disposal location will affect the LPS design as it serves as its termination point.

### 5. Final Design Documents

Once the disposal method has been selected and a location for the system has been determined, final design of the LPS system will need to occur. This includes preparation of design documents and permitting. Prior to installation of any collection or treatment system, a CTC must be obtained from the VDEQ. This will require submission of plans, signed and sealed by a licensed professional engineer in the Commonwealth of Virginia, along with a CTC application be submitted to VDEQ.

### 6. Construction

After receipt of the CTC from VDEQ, construction of the collection system and treatment system can commence.

### 7. Startup and Permitting

After construction has completed the systems will need to be started and tested. After testing, a CTO must be obtained by the VDEQ. This will require submission of operation and maintenance manuals

as well as as-built drawings. In addition, the Town may need to obtain a VPDES or VDH permit for discharging a new WWTP.

# APPENDIX A

**Hillsboro Feasibility Study; Flow Memorandum**



## MEMORANDUM

**Date:** July 10, 2017  
**To:** Darrin Geldert, P.E.– Loudoun Water  
**From:** Paul Longo, P.E. – Dewberry  
**Subject:** Hillsboro Feasibility Study Draft Technical Memorandum

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### **Purpose:**

The purpose of this technical memorandum is to provide a preliminary evaluation highlighting the flow projections of the Town of Hillsboro. These flow projections are a starting point to the design of potential solutions that will be utilized throughout the Hillsboro Wastewater Feasibility Report. The information provided in this memorandum may be utilized by the Town as a basis for designing a community sanitary sewer collection, treatment, and disposal system. This memorandum includes the following sections:

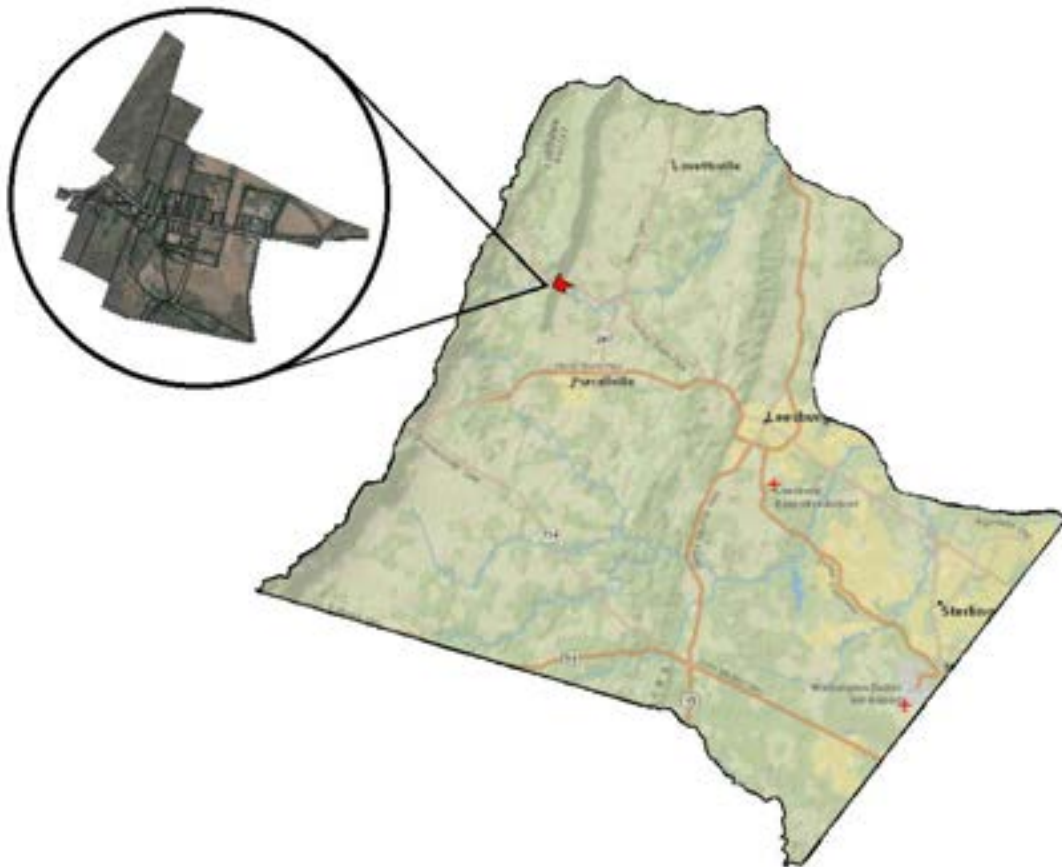
- Background Information
- Flow Analysis
- Pumping Station
- Assumptions
- Summary

### **Background Information:**

The Town of Hillsboro, established in 1802, is located in Loudoun County, Virginia, along Route 9 (Charles Town Pike). It is approximately eight miles northwest of Leesburg and five miles north of Purcellville as shown in Figure 1. It lies within the Catoctin Creek Watershed, which is part of the Chesapeake Bay Watershed. Hillsboro is currently the smallest town in Loudoun County with just 129 residents on 55 parcels over a total area of 171.77 acres.

Hillsboro currently has no public sanitary sewer system. The lots are currently being served by individual, on-site wastewater treatment facilities such as septic systems, pump and haul, or other alternative systems. Many of these systems are approaching the end of their useful life, failing, or contributing to wastewater issues that are impacting public health and water quality. 51 of the 54 parcels have been classified as having inadequate or failing sanitary treatment. Based on the application prepared by the Town of Hillsboro, 12% of the current facilities are less than 15 years old and 60% have had more than 30 years in operation. The individual systems cannot be replaced or expanded because of small lot sizes, with the median parcel area of 0.68 acres, and poor soils.

The North Fork Catoctin Creek, which flows through Hillsboro, is classified as an impaired stream by the Virginia Department of Environmental Quality for exceeding fecal coliform standards. In 2016, the Town of Hillsboro submitted an application to the Community Water and Wastewater Program for assistance in addressing their current wastewater issues. This program, administered by Loudoun County with assistance from Loudoun Water, is designed to address community water and wastewater problems in Loudoun County, Virginia. The residents of Hillsboro recognize the need for action as 84% of the residents are in support of pursuit of this program.



**Figure 1: Location of the Town of Hillsboro in Loudoun County, VA**

### **Flow Analysis:**

A flow estimate is required to properly size the collection and treatment systems for the Town. Flow estimates are based on a number of factors, such as current and future population, current and future land use and densities, and current and future commercial/industrial uses. Virginia Department of Environmental Quality (VDEQ) regulations state that per capita flow estimates be no less than 100 gallons per day (GPD).

Hillsboro is in a unique situation when it comes to estimating future population and land uses. Since it is an incorporated town, members of the Town Council regulate zoning and land use within the Town boundaries. Because Hillsboro is not subject to Loudoun County zoning, the Town Council can allow as much or as little growth as desired, therefore population estimates cannot be certain. In order to provide the best estimate, it is paramount to understand the vision and long term plan that the Town Council has for Hillsboro. To give the Town options, three scenarios of future population estimates have been provided, ranging from conservative to maximum build out and density. Each scenario incorporates the flow projections provided by the VDEQ. The values from the VDEQ used to calculate the projections are listed in Table 1.

Table 1: Contributing Sewage Flow Estimates

Discharge Facility	Units	Flow (gpd)	Flow Duration (hrs)
Residential	Per Person	100	24
School w/o showers w/ cafeteria	Per person	10	8
Restaurants	Per seat	50	16
Commercial/Office Space		The greater of 0.160 gpd/sq. ft. OR 30 persons per acre	

VA DEQ assumes that a typical household contains 3 to 3.5 people that contribute to an estimated flow of 300 to 350 gpd/household. The flow of 350 gpd/household is frequently used to provide a more conservative flow projection. This estimate has been adopted in design manuals of nearby Virginia Counties and municipalities, like Prince William County Service Authority and Loudoun Water. Other Virginia counties, like Fairfax County, have a similar flow projection of 370 gpd/household. For this particular study, a flow projection of 350 gpd/household will be used.

A summary of the three different scenarios used for population estimates are as follows:

- **Scenario 1-Existing Conditions:** The town remains as it is today but each parcel is occupied. This also assumes that each unit connects to the collection system.
- **Scenario 2-Minor Development:** This scenario will try to represent modest population growth and redevelopment of properties in the Town of Hillsboro. In addition to scenario 1, this scenario assumes that 20% of homes (9 parcels) are converted to commercial uses, such as restaurants or stores.
- **Scenario 3-Rezoning:** This scenario represents a maximum growth in residents and properties in the Town. In addition to the first two scenarios, this scenario assumes that land previously used for agriculture, is rezoned to match surrounding Loudoun County zoning, AR-1, which has a maximum density of 1 unit per 5 acres.

**Scenario 1-Existing Conditions**

The Town of Hillsboro currently consists of 54 parcels that are classified as 46 residential and 8 commercial uses. However, not all of the residential parcels are currently being used; one parcel is vacant, two are unoccupied, and two are unoccupied and in the process of bank foreclosure. The majority of the commercial properties are in use and consist of a utility, municipal building, elementary school, church, and two businesses. The other two commercial lots are either unoccupied seeking a renter, or vacant until the waste collection system is upgraded. Although several of the residential and commercial lots are unoccupied or vacant, this scenario assumes that each building has tenants and connects to the central collection system.

**Scenario 2-Minor Development**

With the introduction of a community sanitary sewer main, and completion of the infrastructure project, the Town may expect a growth in tourism and a small growth in commercial and residential use. Though the town is small, modest growth in commercial uses such as restaurants or boutiques would be reasonable. In addition to scenario 1, scenario 2 assumes 20% of the 46 residential parcels are converted to commercial uses to make a total of 17 commercial parcels. Under this scenario, the buildings are simply converted or retrofitted to meet their commercial need, we are not predicting increase in building footprint in the Town.

**Scenario 3-Rezoning**

As stated previously, the Town is in control of their zoning and land use regulations. Therefore, rezoning applications can be reviewed faster than they would be in Loudoun County. This also allows Hillsboro to be as developed as desired by the Town Council, within reason. However, based on preliminary conversations with the Town of Hillsboro, we believe that Hillsboro desires to retain a certain level of their historical and agricultural appeal as they expand. If the Town chose to permit development on current agricultural land, a reasonable approach would be to match surrounding adjacent Loudoun County zoning, AR-1. The intent of AR-1 is to maintain the rural characteristic of the area. AR-1 in Loudoun County permits a density of up to 1 home per 5 acres. Hillsboro currently has two parcels with the state use classified as Farm, with one used for solely farming. These parcels total to 48.73 acres used for agriculture. If these parcels are converted to developments with 5 acre lots, 10 homes would be added to Hillsboro. Scenario 3 assumes the addition of these 10 homes as well as a conversion of 20% residential to commercial, as mentioned in scenario 2.

**Flow Projections**

The design criteria mentioned above was applied to Scenarios 1, 2, and 3 in order to determine the flow projections for the Town of Hillsboro. The results are shown in Table 3.

**Table 3  
Flow Projections**

	<b>Scenario 1</b>	<b>Scenario 2</b>	<b>Scenario 3</b>
<b>Residential Lots</b>	46	37	47
<b>Commercial Lots</b>	7	16	16
<b>Restaurants</b>	1	2	2
<b>Schools</b>	1	1	1
<b>Flow for Residential Lots (gpd)<sup>1</sup></b>	16,100	12,950	16,450
<b>Flow for Commercial Lots (gpd)<sup>2</sup></b>	3,170	5,090	5,090
<b>Flow for Restaurants (gpd)<sup>3</sup></b>	3,330	6,700	6,700
<b>Flow for Schools (gpd)</b>	500	500	500
<b>Total Flow (gpd)</b>	23,100	25,240	28,740

<sup>1</sup>Calculated using 350gpd per household

<sup>2</sup>Calculated using 0.16 gpd/sq. ft.

<sup>3</sup>Calculated using 10gpd per person for 151 people (provided by Hillsboro Charter Academy) at 8 hours per day, per VDEQ SCAT Regulations

**Collection and Conveyance System:**

The design of a collection and conveyance system is based on several factors, including number of connections, estimated flow, connection point location and elevation and discharge point location and elevation. Therefore, the ultimate treatment system location and discharge location will have significant impacts on the design.

Based on the previous report prepared for the Town, and preliminary analysis of the elevations and locations available, it is recommended that a low pressure sewage collection system be utilized. This type of collection system allows flexibility of connection point locations and elevations since the system utilizes a series of pumps to lift sewage to the discharge point. However, the discharge point location and elevation impacts the design of the overall collection system.

At this point, the flows for the Town can be estimated utilizing one of the scenarios presented above, and the connection point locations and elevations can be estimated based on current development and projected connections. It is unknown where or how wastewater will be treated and discharged. One alternative being discussed is constructing a treatment facility and drain field east of the Town on Route 9. The Town is currently in discussion with different property owners about the potential to use their land.

The other alternatives being considered are pumping to Purcellville or construction of a treatment facility within the Town boundary. Since final discharge location is unknown, the low pressure collection system cannot be sized. If the Town wishes to have preliminary sizing of the collection system piping before final design, a discharge location must be assumed.

In order to mitigate these unknowns and complete the feasibility study, we recommend assuming a central pump station will be constructed on the east edge of Hillsboro as shown in Figure 2. This pumping station could then be used to send the wastewater to a treatment facility just outside the Town or sent to Purcellville. This allows for the preliminary sizing of the collection system, independent of the treatment facility location.

It should be noted, if designed and constructed, this pump station will be another facility that will be owned and operated by the Town. If the discharge location and elevation are changed, the collection system sizing may change.



**Figure 2: Potential Location for a Pumping Station**

**Assumptions:**

The flow analysis for the Town of Hillsboro is based off of the following assumptions:

- **Each parcel is occupied:** According to the Hillsboro water/wastewater solutions grant application and current Loudoun County parcel data, there are currently 9 parcels that are either unoccupied or vacant. Each scenario developed for this memorandum assumes that all parcels are occupied.
- **Each parcel connects to the new community sanitary sewer:** As stated in the Hillsboro water/wastewater solutions grant application, 12% of the properties have septic systems that are relatively new (under 15 years old). These parcels may not find it necessary to abandon an already working system and therefore forgo connecting. However, parcels may decide to connect to the community sewer system in the future. This memorandum assumes a 100% connection to the new system.
- **The Square footage of potential commercial properties:** Flow projection for commercial properties is based off of square footage. Therefore, for scenarios 2 and 3, the square footage of potential commercial properties were estimated to be 1500 sq. ft.
- **The number of seats in a restaurants:** The flow projection for restaurants is based off of the number of seats in the building. It was assumed that each restaurant had 100 seats.
- **Charter school is not expanding:** The Hillsboro Charter Academy currently has 132 students and 19 staff. Since it is a charter school, students are accepted based on an application process. Therefore, the school population is independent of any fluctuations in residential population. It is assumed that the school population stays at 151 people for the foreseeable future.
- **Town boundary remains as is:** The flow projections assume the town boundary remains as it is today.
- **Subdividing of parcels does not occur:** The flow projects and collection system design is based on the current number of parcels and structures. If parcels are further subdivided, and additional connections are made to the system, the collection system piping may need to be modified to accommodate additional flow. This can only be finalized during detailed design.

**Summary:**

The flow projections provided in this technical memorandum were based on an estimated flow of 350 gpd/house. However, 350 gpd/house is conservative when estimating peak flow based on prior experience. This estimate is based on an average of 3.5 people living in a home, per VA DEQ regulations of 100 gpd/person. However, this is more representative of newer, larger homes. As observed in Hillsboro, typical occupancy is lower than that of other residences, with an average of only 2.1 people per home. In addition, recent flow studies completed by Dewberry and Loudoun Water have indicated average daily flows from residential households to be 30%-40% less than the 350 gpd that is outlined in the design manuals of surrounding Virginia counties. Therefore, 350 gpd/household provides a conservative flow estimate.

Based on the information above, it is recommended that the Town of Hillsboro size a community sanitary sewer collection, treatment, and disposal system using scenario 1 with a design flow of 20,000 gpd. As an incorporated town, Hillsboro will need to determine the appropriate rates and/or fees associated with connecting to the collection system, the capital costs for the equipment and construction, and ongoing maintenance costs. The feasibility study report will outline recommendations for phasing the construction of the sewage collection and treatment system to account for phased development and connection to the collection system.

# APPENDIX B

**E/One Sewer Systems**

**Pressure Sewer Preliminary Design Analysis; E-One**



Environment One Corporation

**Pressure Sewer Preliminary  
Design Analysis**

**For**

**Town of Hillsboro  
Loudoun County, VA**

**Prepared For:**  
**Dewberry**

**Tel:**

**Fax:**

**Prepared By: Mark Wehland**

**September 6, 2017**

**Town of Hillsboro  
Loudoun County, VA**

**Prepared by :** Mark Wehland

**On:** September 6, 2017

**Notes :**

Zone Layout:

Zone 1 - Stoney Point Road To Rt. 9 (Parcels 996,783)

Zone 2 - Rt. 9; Between Stoney Point & Highwater Roads (Parcels 104,016, 808,407,602,Empty Lot)

Zone 3 - Highwater Road; Between Stoney Point & Rt. 9 (Parcels 445,997,730,495,295)

Zone 4 - Rt.9; Between Highwater & Gaver Mill Roads (Parcels 692,385,689,784,075,168,857,674,053,369,766,665,817,413,497,306,093,603,8295,708,885, 498,101,597,296,993,034,800,527)

Zone 5 - Ashbury Church Road; West of Gaver Mill Road (Parcels 721,286,673,041,426)

Zone 6 - Gaver Mill Road; East of Ashbury Church Road (Parcels 530,707)

Zone 7 - Gaver Mill Road; Between Ashbury Church & Rt. 9 (Parcels 991,721,711,833,747,510)

Zone 8 - Rt. 9; Between Gaver Mill & Hillsboro Roads (Parcels 975,133,903,089,163)

Zone 9 - Rt. 9; Between Hillsboro United Methodist & Hillsboro Road (Parcels 347,545)

Zone 10 - Common Forcemain to Proposed Central Pump Station near Old Stone School.

<<<<< END OF NOTES >>>>>

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By: Mark Wehland  
 Town of Hillsboro  
 Loudoun County, VA  
 September 6, 2017

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Gals/day per Pump	Max Flow Per Pump (gpm)	Max Sim Ops	Max Flow (GPM)	Pipe Size (inches)	Max Velocity (FPS)	Length of Main this Zone	Friction Loss Factor (ft/100 ft)	Friction Loss This Zone	Accum Fric Loss (feet)	Max Main Elevation	Minimum Pump Elevation	Static Head (feet)	Total Dynamic Head (ft)
This spreadsheet was calculated using pipe diameters for: SDR21PVC																	
1.00	2.00	2	2	300	11.38	2	22.75	1.25	4.14	640.00	5.10	32.63	69.63	547.00	536.00	11.00	80.63
2.00	4.00	6	8	300	11.85	3	35.20	2.00	3.11	550.00	1.98	10.87	37.00	547.00	514.00	33.00	70.00
3.00	4.00	5	5	300	11.39	3	34.18	2.00	3.02	700.00	1.87	13.10	39.23	547.00	506.00	41.00	80.23
4.00	8.00	30	43	300	12.51	6	73.42	3.00	2.99	970.00	1.17	11.35	26.13	547.00	518.00	29.00	55.13
5.00	7.00	5	5	300	12.20	3	36.59	2.00	3.24	260.00	2.12	5.52	36.25	532.00	506.00	26.00	62.25
6.00	7.00	2	2	300	10.04	2	20.09	1.25	3.66	785.00	4.05	31.78	62.51	532.00	484.00	48.00	110.51
7.00	8.00	6	13	300	11.91	4	46.93	2.50	2.83	1,200.00	1.33	15.95	30.73	532.00	494.00	38.00	68.73
8.00	10.00	5	61	300	13.87	7	85.84	3.00	3.50	845.00	1.56	13.21	14.78	532.00	522.00	10.00	24.78
9.00	10.00	2	2	300	12.61	2	25.22	1.50	3.48	1,250.00	3.15	39.37	40.94	532.00	520.00	12.00	52.94
10.00	10.00	0	63	0	14.90	7	85.92	3.00	3.50	100.00	1.57	1.57	1.57	532.00	532.00	0.00	1.57

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Town of Hillsboro  
Loudoun County, VA

Prepared By:  
Mark Wehland

September 6, 2017

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (inches)	Gallons per 100 lineal feet	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR21PVC										
1.00	2.00	2	1.25	9.15	640.00	58.59	600	10.24	2.34	300
2.00	4.00	8	2.00	18.84	550.00	103.63	2,400	23.16	1.04	4.62
3.00	4.00	5	2.00	18.84	700.00	131.90	1,500	11.37	2.11	2.28
4.00	8.00	43	3.00	40.90	970.00	396.69	12,900	32.52	0.74	3.35
5.00	7.00	5	2.00	18.84	260.00	48.99	1,500	30.62	0.78	1.24
6.00	7.00	2	1.25	9.15	785.00	71.86	600	8.35	2.87	3.33
7.00	8.00	13	2.50	27.60	1,200.00	331.22	3,900	11.77	2.04	5.42
8.00	10.00	61	3.00	40.90	845.00	345.57	18,300	52.96	0.45	2.54
9.00	10.00	2	1.50	12.07	1,250.00	150.88	600	3.98	6.04	0.51
10.00	10.00	63	3.00	40.90	100.00	40.90	18,900	462.15	0.05	6.09
										0.05

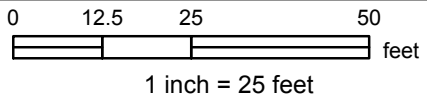
# APPENDIX C

**The Town of Hillsboro Map Book**

# 37032 GAVER MILL RD



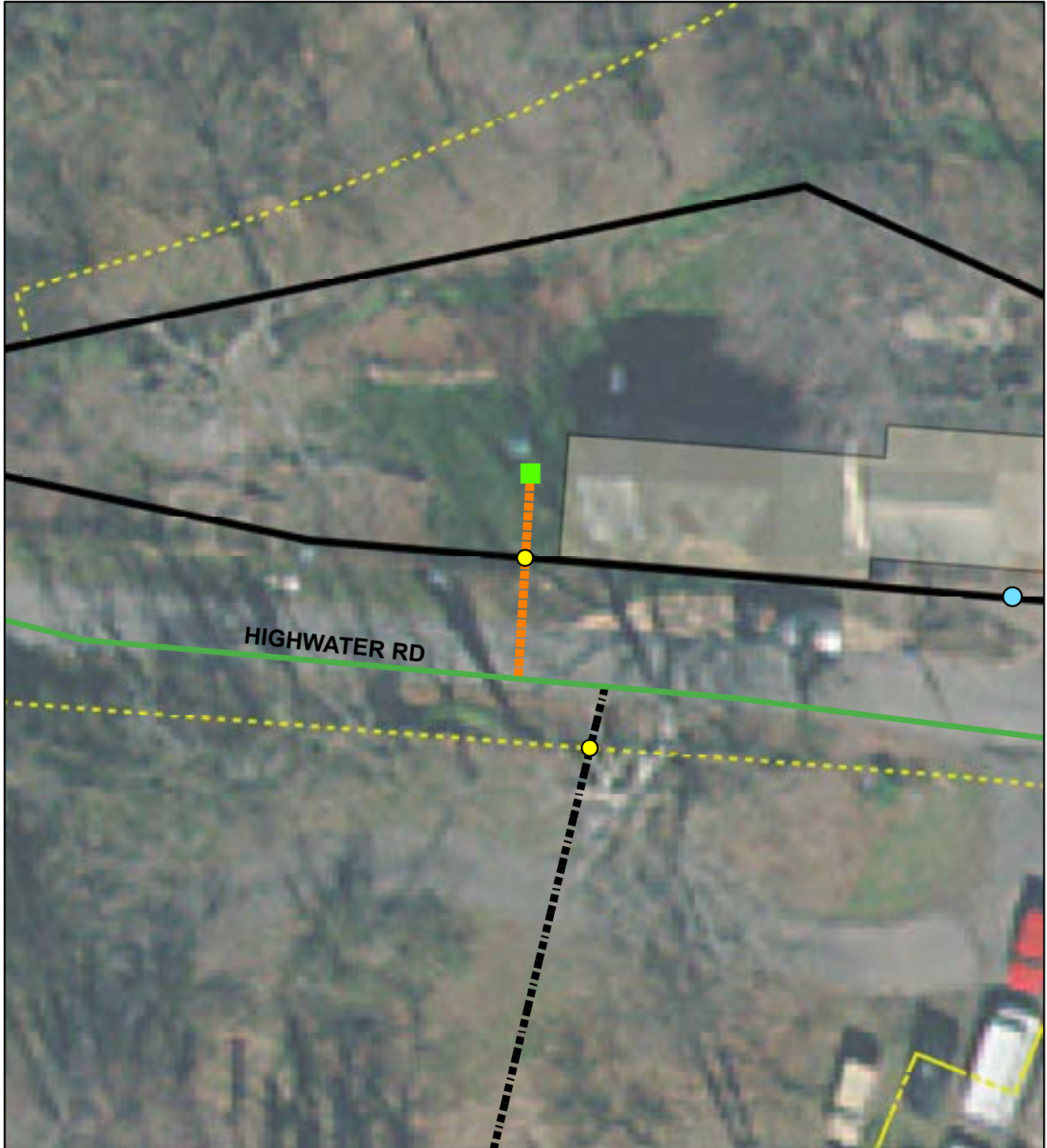
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries















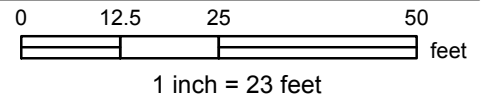
Town of Hillsboro  
Grinder

Parcel ID: 483456707000





-  1.25" Pipe
-  2.5" Pipe
-  2" Pipe
-  3" Pipe
-  Valve Assembly
-  Grinder Pump
-  Wells
-  Proposed House Connection
-  Other House Connections
-  Buildings
-  Current Parcel
-  Parcel Boundaries



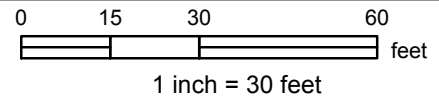
Town of Hillsboro  
Grinder

Parcel ID: 517298495000

# 36877 HIGHWATER RD



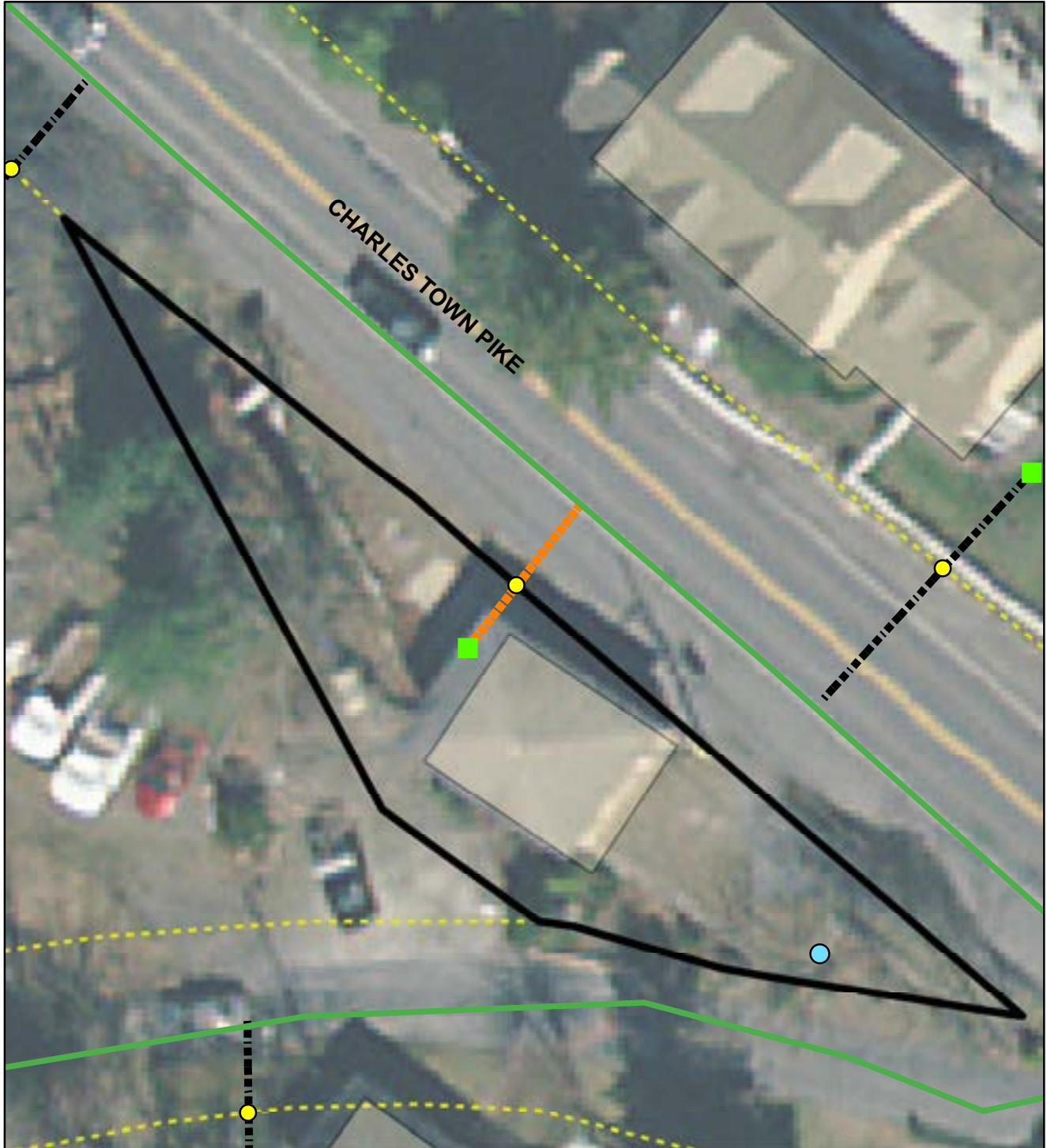
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



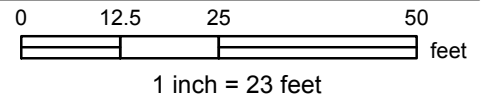
Town of Hillsboro  
Grinder

Parcel ID: 517197997000

# 36923 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



Town of Hillsboro  
Grinder

Parcel ID: 517201407000

# 36906 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

0 12.5 25 50 feet  
1 inch = 25 feet

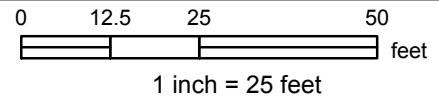
Town of Hillsboro  
Grinder

Parcel ID: 517304602000

# 36936 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

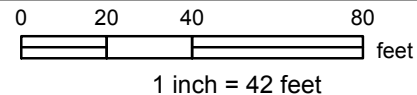


Town of Hillsboro  
Grinder

Parcel ID: 517203817000



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



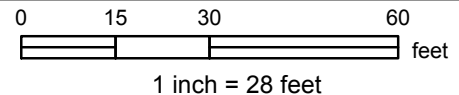
## Town of Hillsboro Grinder

Parcel ID: 482153510000

# 36933 GAVER MILL RD



- 1.25" Pipe
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- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



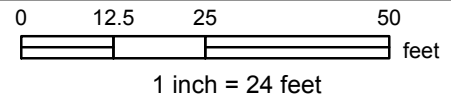
Town of Hillsboro  
Grinder

Parcel ID: 517109711000

# 37028 GAVER MILL RD



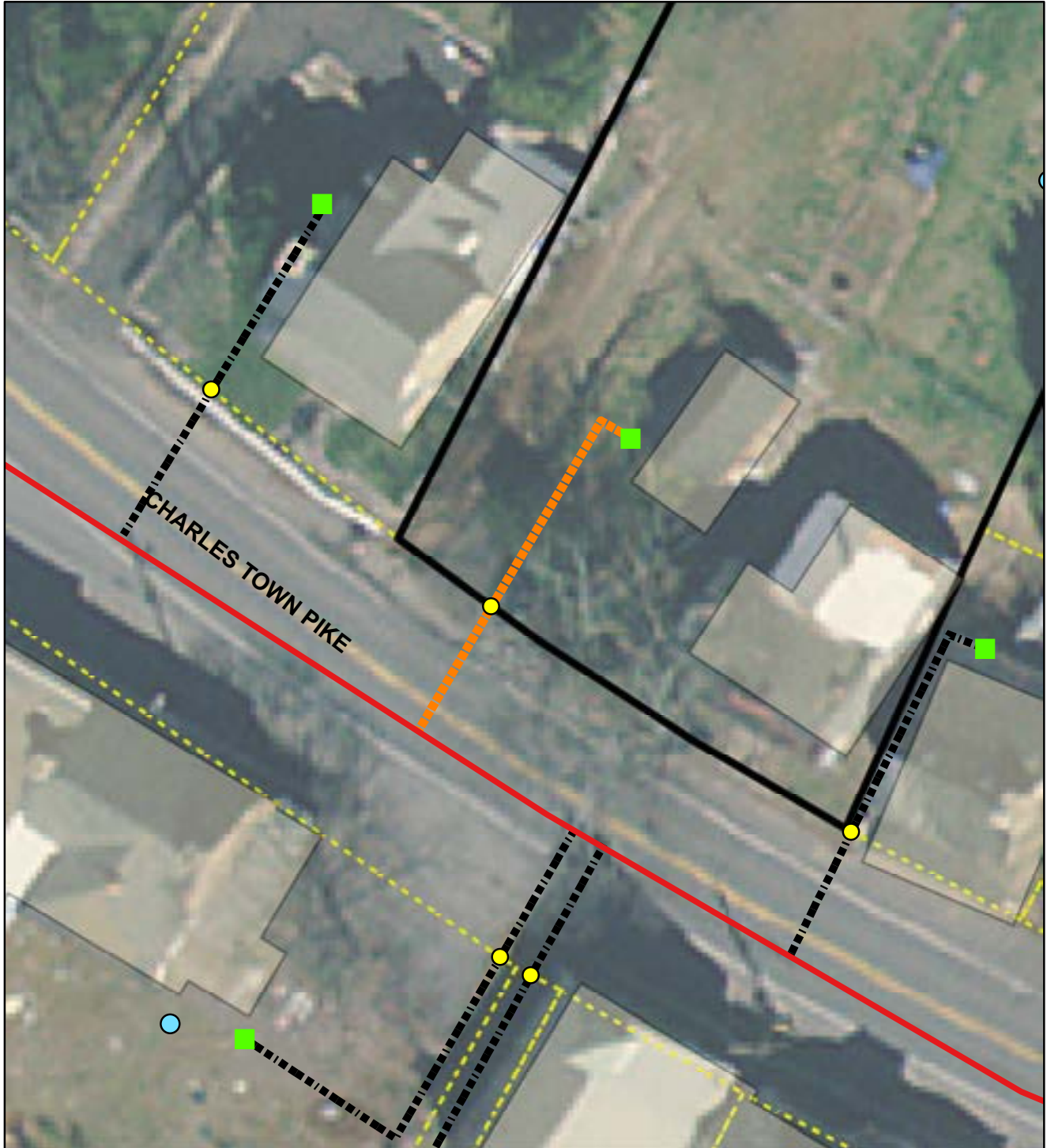
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



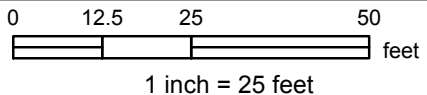
Town of Hillsboro  
Grinder

Parcel ID: 483452530000

# 36944 CHARLES TOWN PIKE



- 1.25" Pipe
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- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

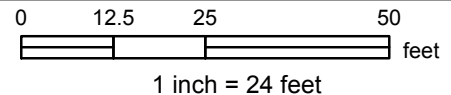


Town of Hillsboro  
Grinder  
Parcel ID: 517204413000

# 37030 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



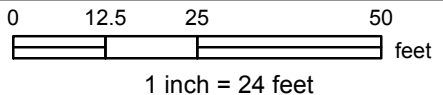
Town of Hillsboro  
Grinder

Parcel ID: 482153089000

# 37004 CHARLES TOWN PIKE



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- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

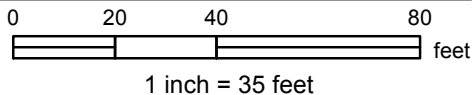


Town of Hillsboro  
Grinder  
Parcel ID: 482150597000

# 36978 CHARLES TOWN PIKE



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- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



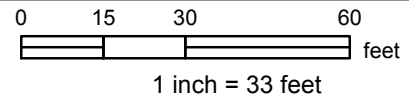
Town of Hillsboro  
Grinder  
Parcel ID: 517108295000



# 36974 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



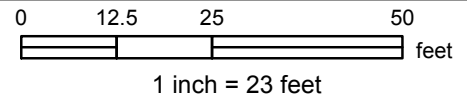
Town of Hillsboro  
Grinder

Parcel ID: 517207603000

# 36970 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



Town of Hillsboro  
Grinder

Parcel ID: 517209527000

# 36960 CHARLES TOWN PIKE















- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

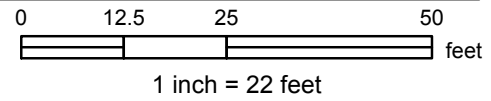
0 15 30 60 feet  
1 inch = 31 feet

Town of Hillsboro  
Grinder

Parcel ID: 517206306000



-  1.25" Pipe
-  2.5" Pipe
-  2" Pipe
-  3" Pipe
-  Valve Assembly
-  Grinder Pump
-  Wells
-  Proposed House Connection
-  Other House Connections
-  Buildings
-  Current Parcel
-  Parcel Boundaries



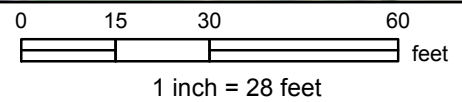
Town of Hillsboro  
Grinder

Parcel ID: 517101295000

# 36939 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



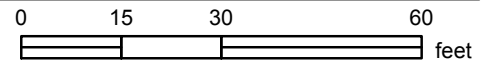
Town of Hillsboro  
Grinder

Parcel ID: 517102692000

# 36945 CHARLES TOWN PIKE



- 1.25" Pipe
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- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

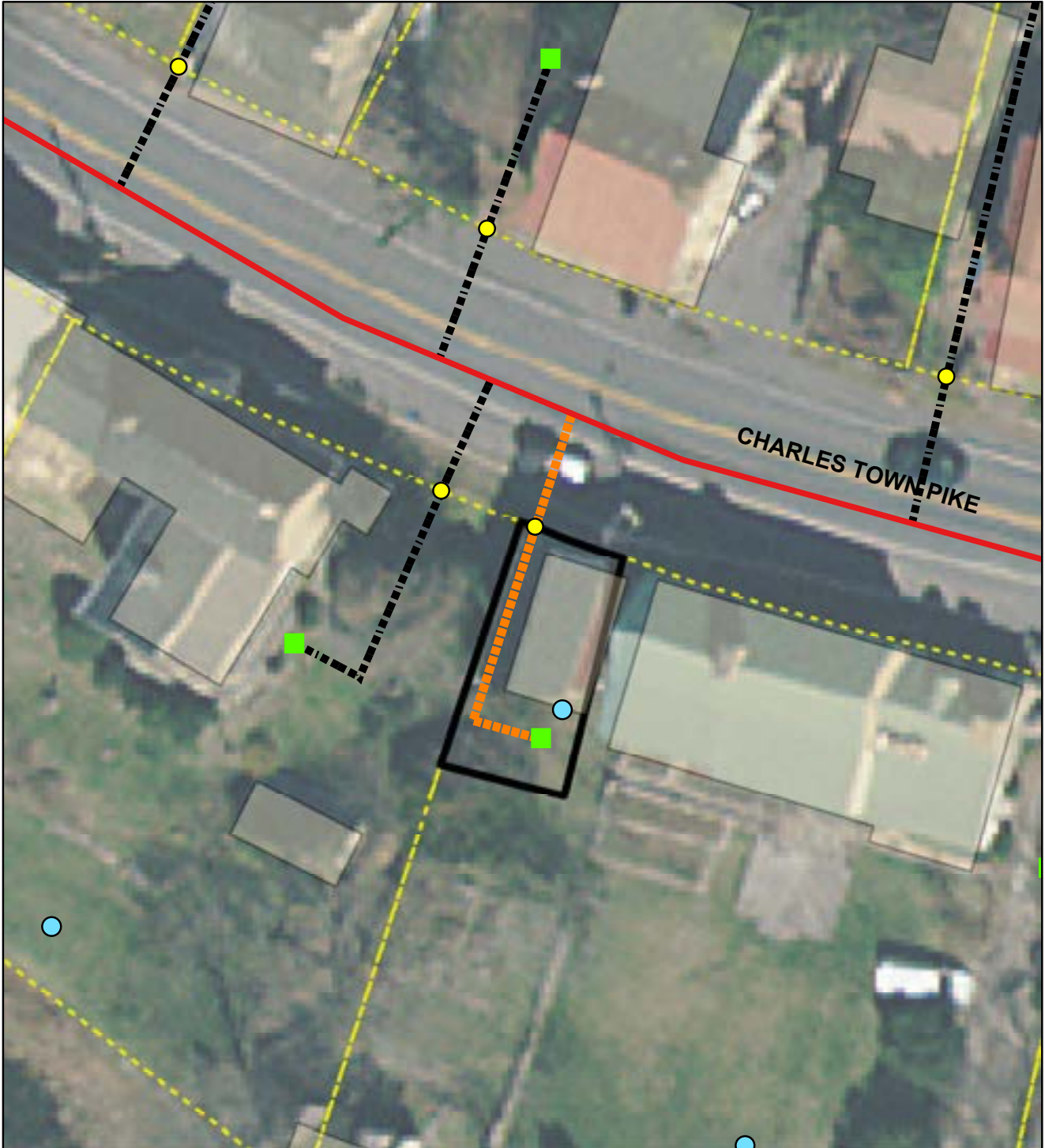


1 inch = 27 feet

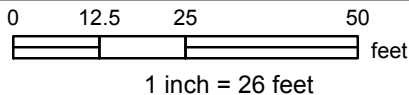
## Town of Hillsboro Grinder

Parcel ID: 517103385000

# 36955 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

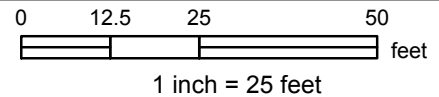


Town of Hillsboro  
Grinder  
Parcel ID: 517104784000

# 36959 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



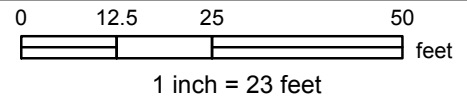
Town of Hillsboro  
Grinder

Parcel ID: 517105075000

# 36975 CHARLES TOWN PIKE



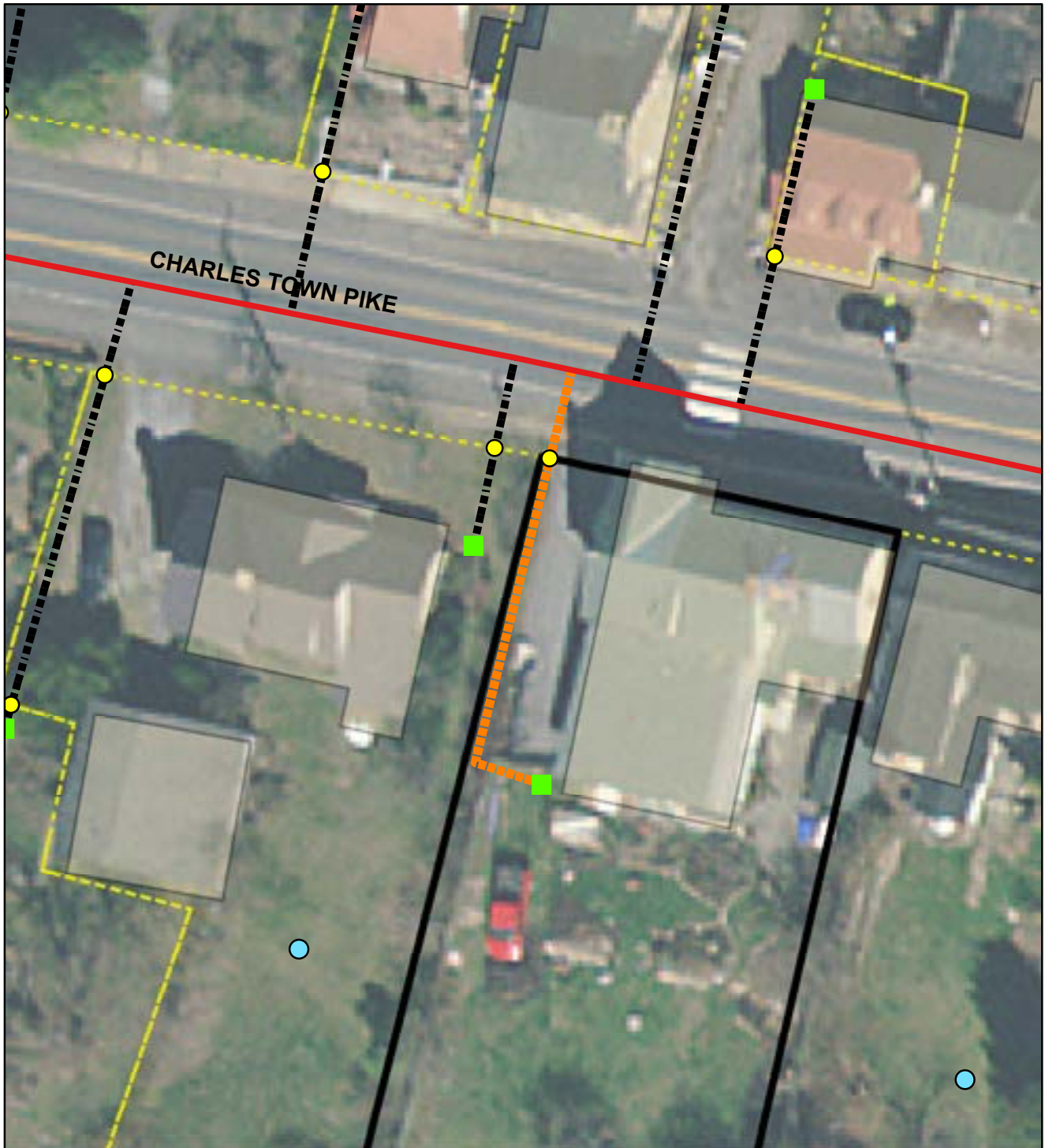
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- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



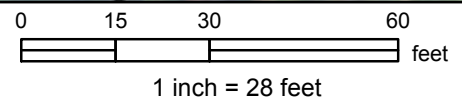
Town of Hillsboro  
Grinder

Parcel ID: 517107674000

# 36985 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



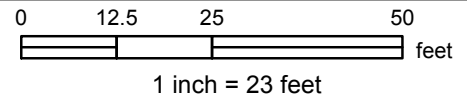
Town of Hillsboro  
Grinder

Parcel ID: 517108369000

# 36997 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



Town of Hillsboro  
Grinder

Parcel ID: 517109766000



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- ▭ Current Parcel
- Parcel Boundaries

0 15 30 60  
feet  
1 inch = 32 feet

Town of Hillsboro  
Grinder

Parcel ID: 517293996000

# 36905 HIGHWATER RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

0 15 30 60 feet  
1 inch = 30 feet

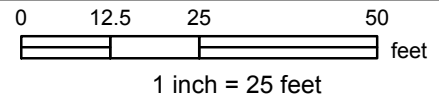
Town of Hillsboro  
Grinder

Parcel ID: 517199730000

# 36951 CHARLES TOWN PIKE



- 1.25" Pipe
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- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

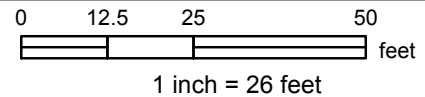


Town of Hillsboro  
Grinder

Parcel ID: 517104183000



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



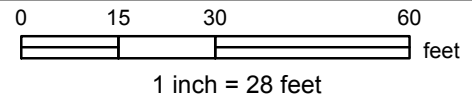
Town of Hillsboro  
Grinder

Parcel ID: 517100833000

# 36925 GAVER MILL RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



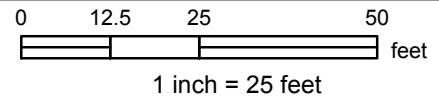
Town of Hillsboro  
Grinder

Parcel ID: 482151326000

# 36929 GAVER MILL RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



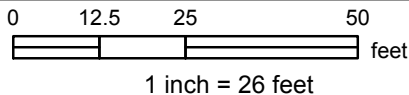
Town of Hillsboro  
Grinder

Parcel ID: 517109721000

# 15245 ASHBURY CHURCH RD

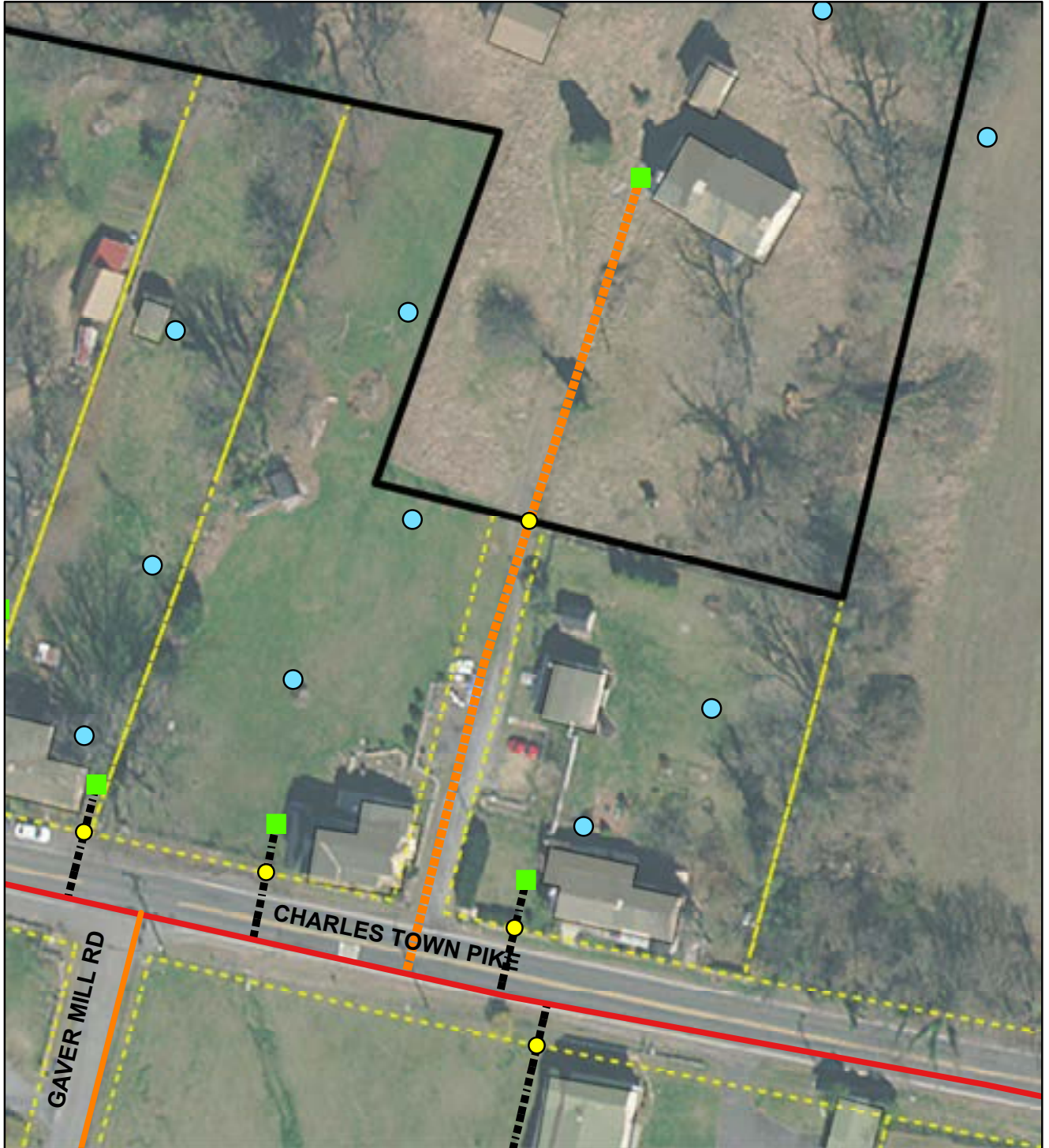


- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

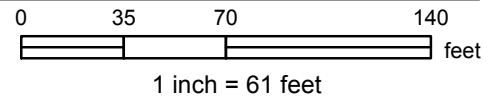


Town of Hillsboro  
Grinder  
Parcel ID: 518406286000

# 37034 CHARLES TOWN PIKE



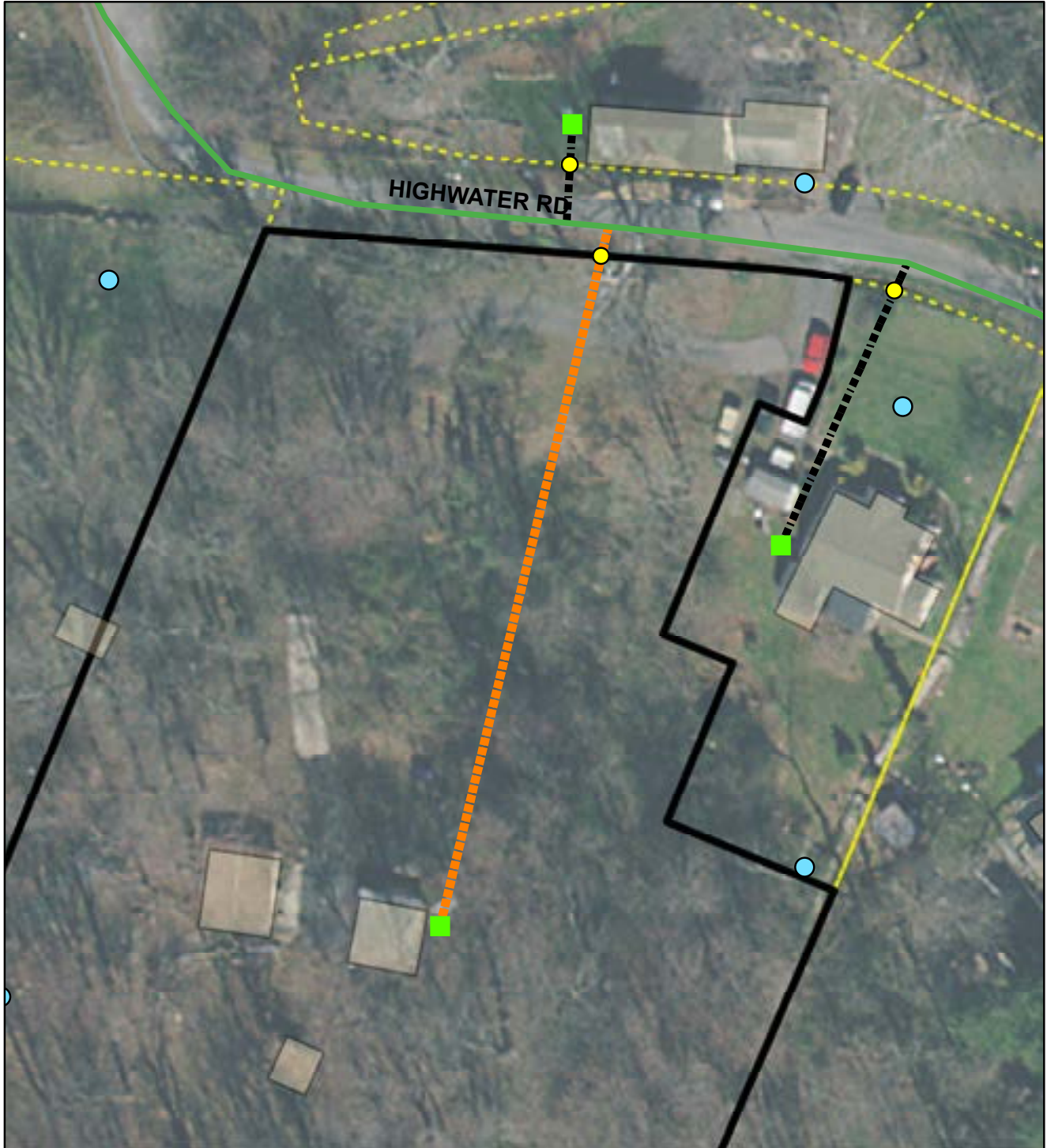
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



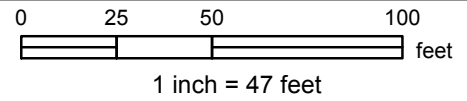
Town of Hillsboro  
Grinder

Parcel ID: 482253903000

# Address Unknown - Refer to Parcel ID



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



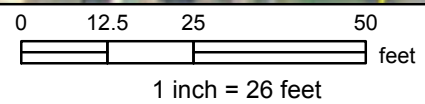
Town of Hillsboro  
Grinder

Parcel ID: 517196445000

# 36990 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



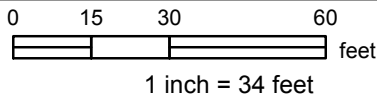
Town of Hillsboro  
Grinder

Parcel ID: 517108885000

# 36996 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

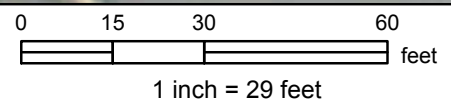


Town of Hillsboro  
Grinder  
Parcel ID: 517109498000

# 37098 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



Town of Hillsboro  
Grinder

Parcel ID: 482150554000

# 36982 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

0 15 30 60 feet  
1 inch = 30 feet

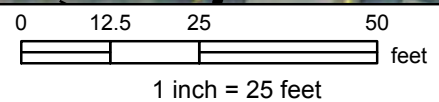
Town of Hillsboro  
Grinder

Parcel ID: 517208708000

# 36952 CHARLES TOWN PIKE



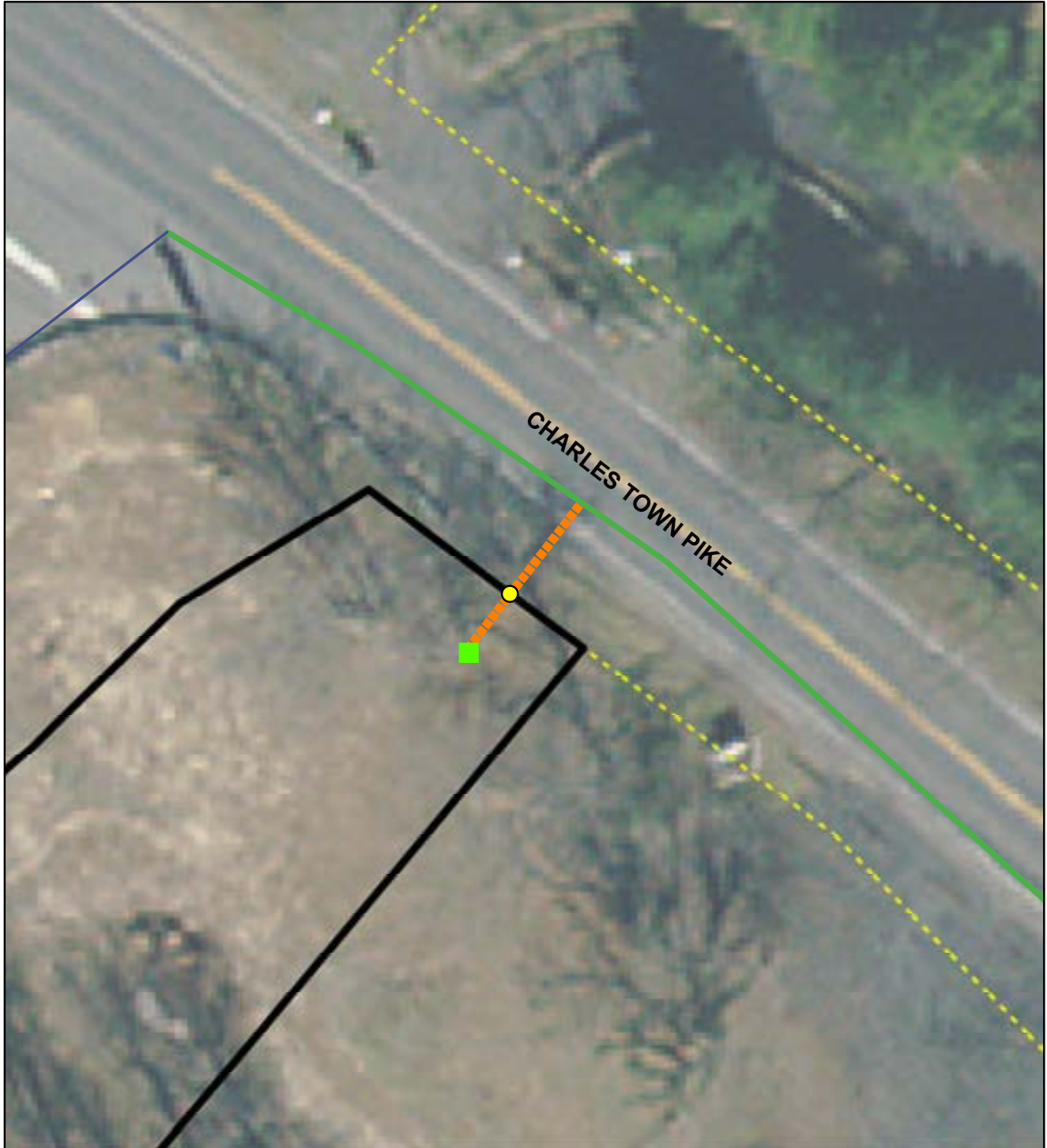
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



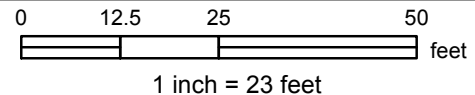
Town of Hillsboro  
Grinder

Parcel ID: 517104497000

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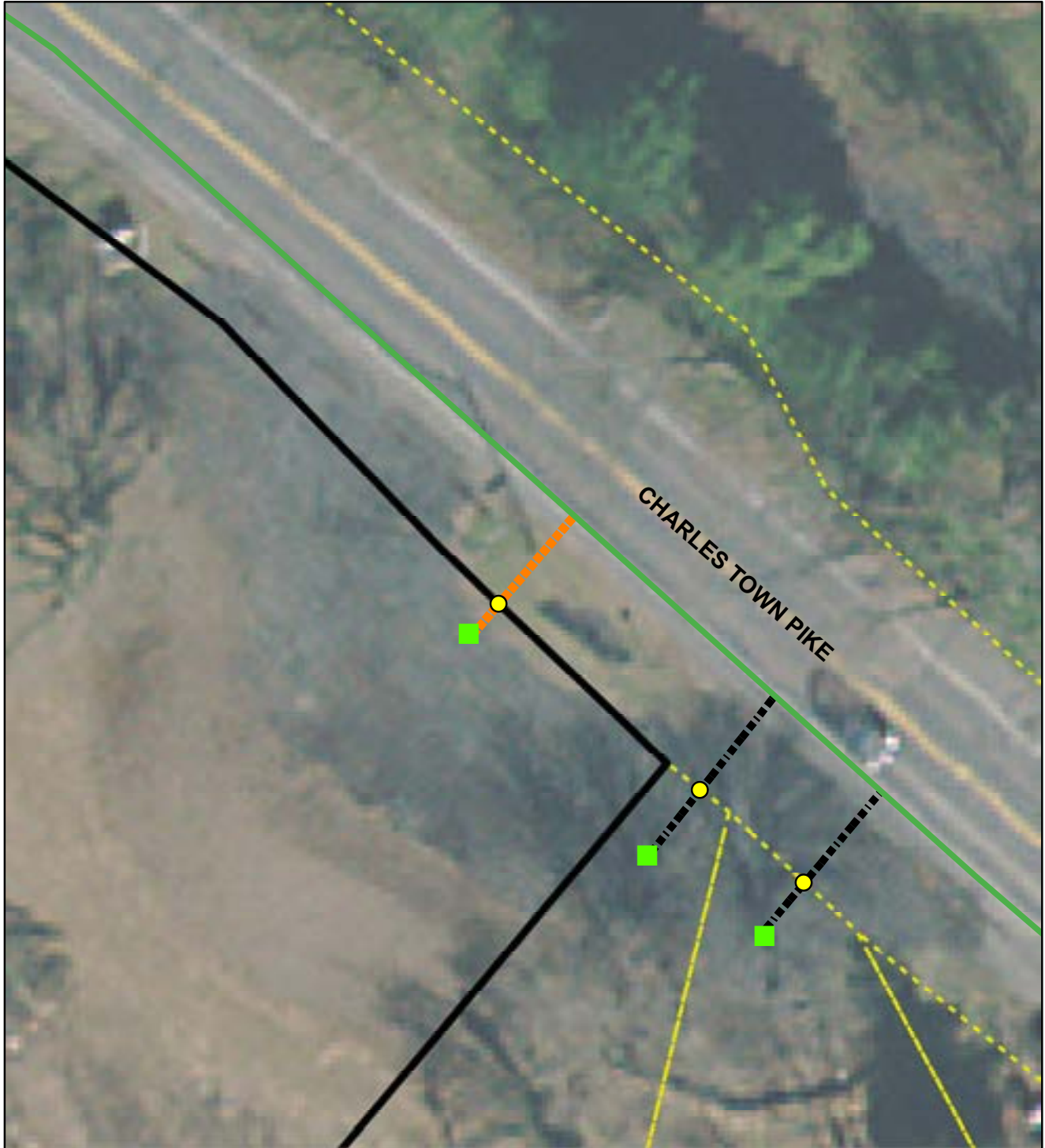


- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

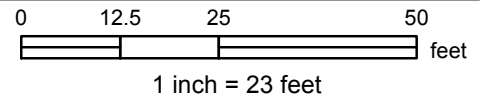


Town of Hillsboro  
Grinder  
Parcel ID: 517299104000

# Address Unknown - Refer to Parcel ID



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



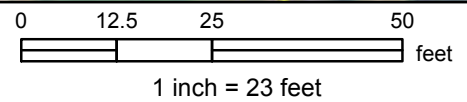
Town of Hillsboro  
Grinder

Parcel ID: 517299016000

# Address Unknown - Refer to Parcel ID



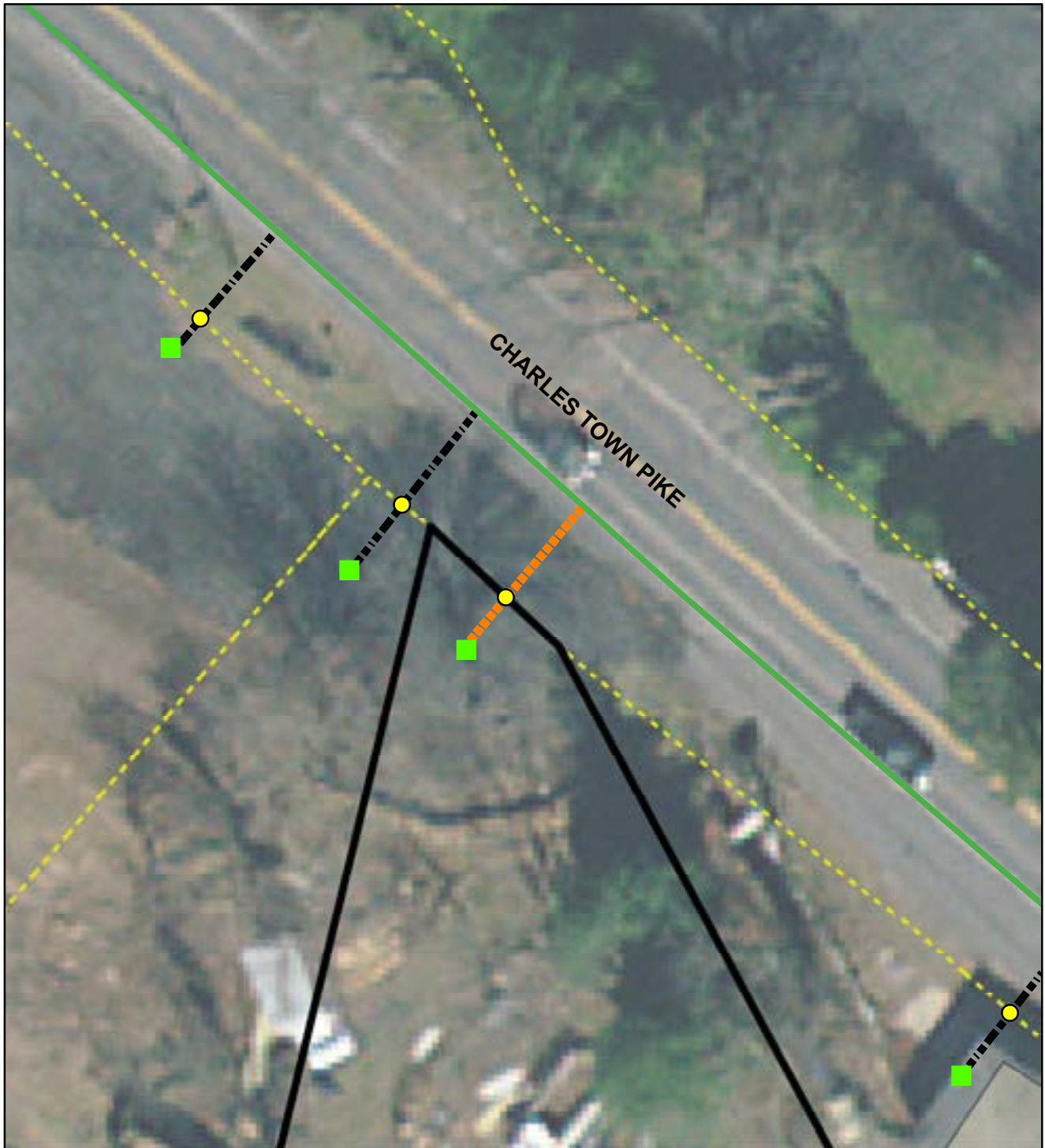
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



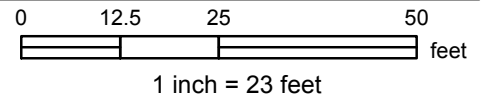
Town of Hillsboro  
Grinder

Parcel ID: 517299808000

# 36929 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



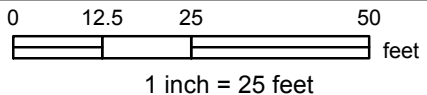
Town of Hillsboro  
Grinder

Parcel ID: 517101295000

# 15245 ASHBURY CHURCH RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

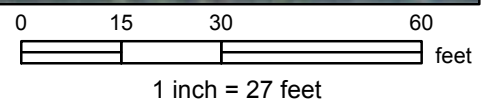


Town of Hillsboro  
Grinder  
Parcel ID: 517104721000

# Address Unknown - Refer to Parcel ID



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



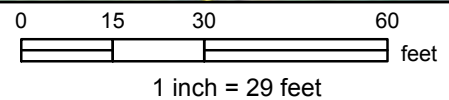
Town of Hillsboro  
Grinder

Parcel ID: 517108991000

# Address Unknown - Refer to Parcel ID



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



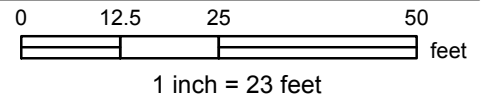
Town of Hillsboro  
Grinder

Parcel ID: 517106857000

# 36963 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



Town of Hillsboro  
Grinder

Parcel ID: 517106168000

# 37010 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

0 15 30 60 feet  
1 inch = 28 feet

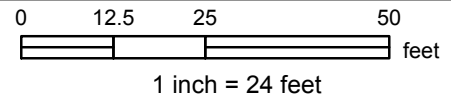
Town of Hillsboro  
Grinder

Parcel ID: 482151296000

# 37016 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



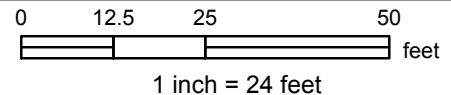
Town of Hillsboro  
Grinder

Parcel ID: 482151993000

# 37042 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



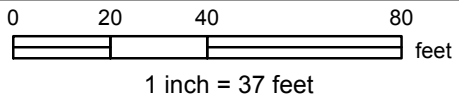
Town of Hillsboro  
Grinder

Parcel ID: 482155163000

# 37091 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



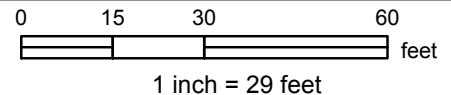
Town of Hillsboro  
Grinder  
Parcel ID: 483455975000



# 36995 GAVER MILL RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries

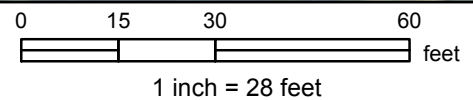


Town of Hillsboro  
Grinder  
Parcel ID: 518409426000

# 15255 ASHBURY CHURCH RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



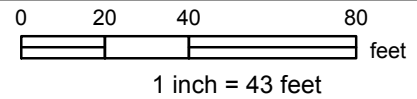
Town of Hillsboro  
Grinder

Parcel ID: 518406041000

# 15259 ASHBURY CHURCH RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



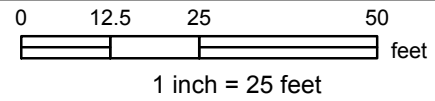
Town of Hillsboro  
Grinder

Parcel ID: 518402673000

# 15245 ASHBURY CHURCH RD



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



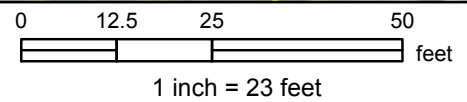
Town of Hillsboro  
Grinder

Parcel ID: 518406286000

# 36991 CHARLES TOWN PIKE



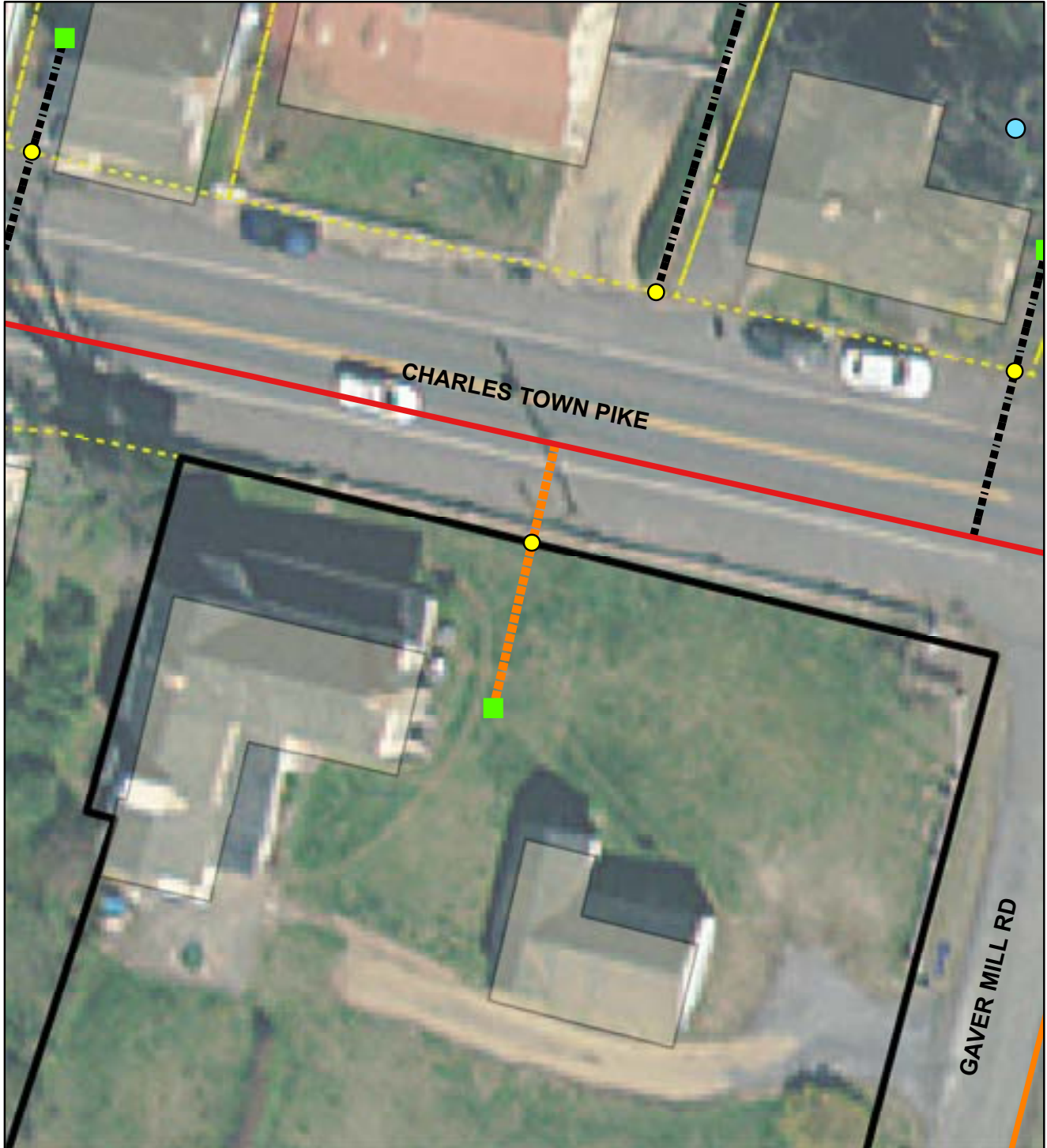
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



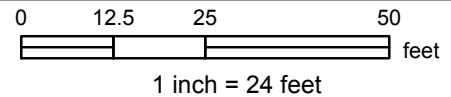
Town of Hillsboro  
Grinder

Parcel ID: 517108053000

# 36905 GAVER MILL RD



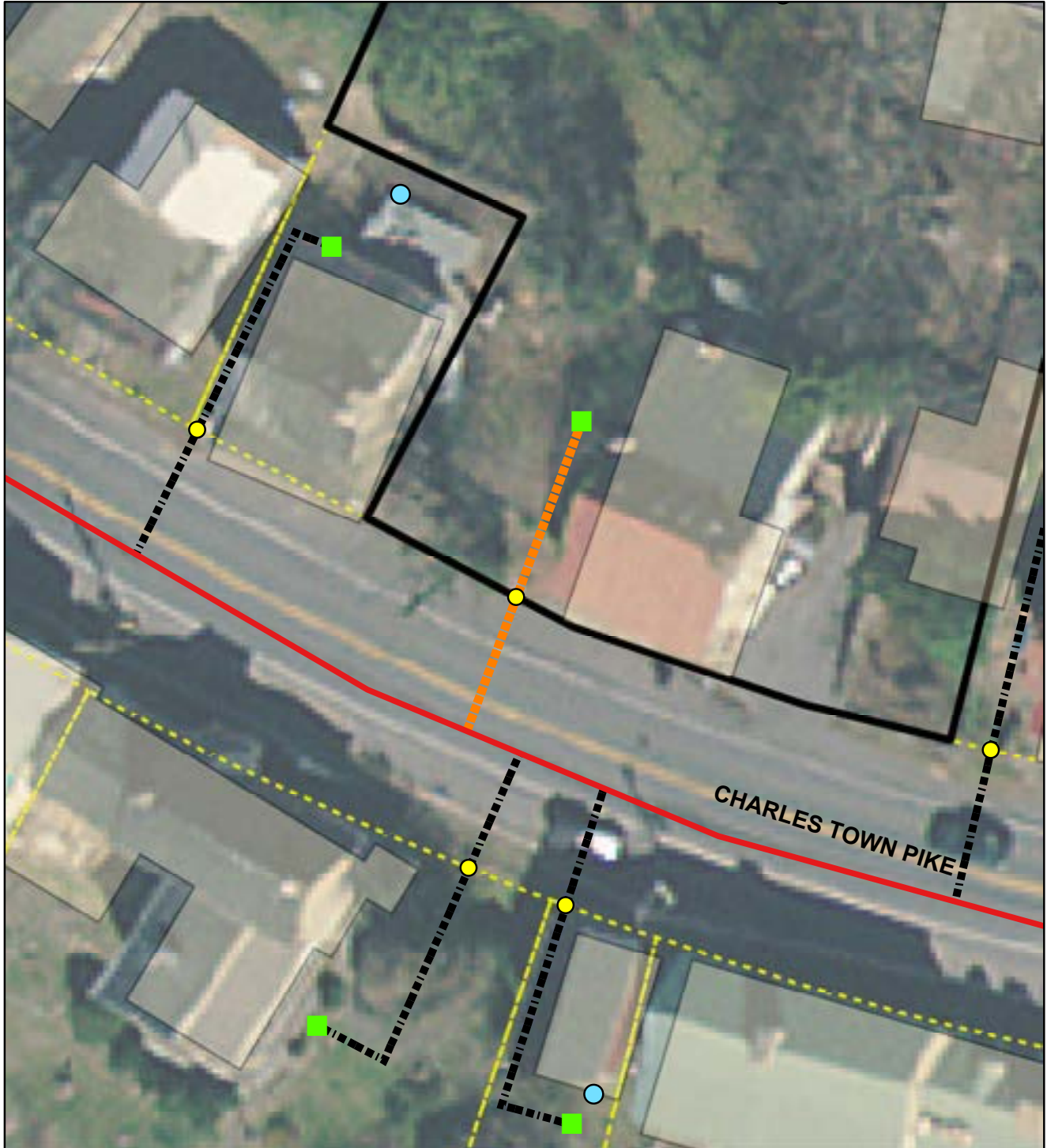
- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



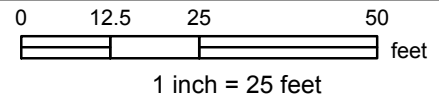
Town of Hillsboro  
Grinder

Parcel ID: 482150665000

# 36956 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries



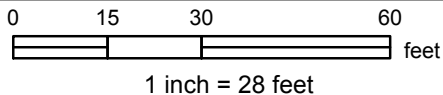
Town of Hillsboro  
Grinder

Parcel ID: 517207034000

# 37055 CHARLES TOWN PIKE



- 1.25" Pipe
- 2.5" Pipe
- 2" Pipe
- 3" Pipe
- Valve Assembly
- Grinder Pump
- Wells
- Proposed House Connection
- Other House Connections
- Buildings
- Current Parcel
- Parcel Boundaries


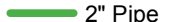
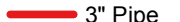










Town of Hillsboro  
Grinder

Parcel ID: 482154133000



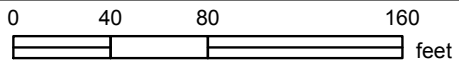


-  2.5" Pipe
-  2" Pipe
-  3" Pipe
-  Valve Assembly
-  Grinder Pump
-  Wells
-  Proposed House Connection
-  Other House Connections
-  Buildings
-  Current Parcel
-  Parcel Boundaries


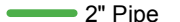
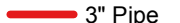








0 30 60 120 feet  
1 inch = 59 feet

Town of Hillsboro  
Grinder

Parcel ID: 517309800000



1 inch = 73 feet

-  2.5" Pipe
-  2" Pipe
-  3" Pipe
-  Valve Assembly
-  Grinder Pump
-  Wells
-  Proposed House Connection
-  Other House Connections
-  Buildings
-  Current Parcel
-  Parcel Boundaries

# Town of Hillsboro Grinder

Parcel ID: 482173347000

# APPENDIX D

**Marsh & Legge Land Surveyors, P.L.C.**

**Soil Survey**

## ***MARSH & LEGGE LAND SURVEYORS, P.L.C.***

560 North Loudoun Street, Winchester, VA 22601 ■ 540-667-0468 ■ Fax: 540-667-0469 ■ E-mail: office@marshandlegge.com

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### **DRAINFIELD POTENTIAL SUMMARY**

**(Grubstake Tract – PIN 447-15-7946)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the east of Hillsboro on the northerly side of Route 9 and the easterly side of Purcellville Road (Grubstake property - PIN 447-15-7946).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

Suitable soils for drainfield and reserve drainfield sites were found on side slopes on this parcel. (See exhibits showing potential drainfield areas dated July 12, 2017.) The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

The 100% reserve drainfield site is required in the *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code. This area is not installed but is set aside and preserved in case the installed drainfield fails to function properly. The reserve drainfield area is used as a repair installation site for the original drainfield. Limitations on the reserve drainfield include no physical disturbance (i.e., driveways, permanent structures, underground utilities, etc.).

The mass drainfield required for this project would be a large alternative pretreated system with drip dispersal installed at 18 to 20 inches. A pretreated wastewater system refers to treatment works designed to prepare sewage for disposal in a soil medium. After the septic tank effluent has been pretreated (cleaned up), it is dispersed into the drainfield area. A pump

is used to dose the dispersal field consisting of drip tubing installed into the soil. The microorganisms living in the soil also help to clean up the effluent.

Nitrogen dilution buffer areas will be required around the proposed drainfield sites (to be determined by Dewberry). The dilution buffer area is a requirement in the regulations to protect the ground water from exceeding nitrate concentration levels considered to be safe. It is where rain can infiltrate into the soil and dilute the nitrate in the ground water. No installation of the mass drainfield system or land disturbance occurs in the buffer area. No structures can be built on the dilution area for the life of the mass drainfield. Ground water monitoring wells may be required for this project as determined by the Virginia Department of Health's discretion. The monitoring wells would be used for testing (fecal coliform organisms, nitrates, etc.) to ensure that ground water is not adversely impacted by the drainfield system.

Fencing may be required around the proposed drainfield, reserve drainfield, and other onsite system components.

**SUMMARY OF SOIL CHARACTERISTICS AND USE POTENTIAL**

**(Grubstake Tract – PIN 447-15-7946)**

Soils of the Purcellville series (23B) were mapped on this property in the conceptual drainfield areas. They are very deep and well drained. They formed in residuum derived from diorite, biotite schist and greenstone schist in the Blue Ridge Uplands. Slopes ranged from 4 to 9 percent. Inclusions of soils shallower to rock may occur in this mapping unit. This soil is listed as good potential for conventional septic tank drainfields in the *Interpretive Guide to the Use of Soil Maps, Loudoun County, Virginia*.

## DRAINFIELD CAPACITY

(Grubstake Tract – PIN 447-15-7946)

The projected sewage flows for the Hillsboro project are as follows:

54 lots at 370 gallons per day (GPD), three-bedroom house per lot = 20,000 GPD

Size requirements for the mass drainfield are approximately 75,000 square feet of dispersal area (percolation rate of 75 minutes per inch)

### Potential Drainfield Sites:

Site L:	100' x 500' = 50,000 square feet
Site M:	100' x 260' = 26,000 square feet
Total:	76,000 square feet

### Potential 100% Reserve Drainfield Sites:

Site N:	100' x 350' = 35,000 square feet
Site O:	100' x 250' = 25,000 square feet
Site P:	100' x 200' = 20,000 square feet
Total:	80,000 square feet

Proposed dispersal method for the mass drainfield is drip irrigation with an installation depth of approximately 18 to 20 inches.

Fencing may be required around the proposed drainfield, proposed reserve drainfield and other onsite system components.

Proposed drainfields and reserve drainfields were conceptually located in one area to minimize the impact on this property. This parcel has many more potential drainfield sites not shown.

There are no known existing wells or drainfields that will impact the location of the proposed mass drainfield site.

This information is preliminary and may change with a detailed soil evaluation and site analysis.

***MARSH & LEGGE LAND SURVEYORS, P.L.C.***

*560 North Loudoun Street, Winchester, VA 22601 ■ 540-667-0468 ■ Fax: 540-667-0469 ■ E-mail: office@marshandlegge.com*

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**DRAINFIELD POTENTIAL SUMMARY**

**(CEA Farms, Tract 1)**

**(PIN 483-49-2067, PIN 483-28-2782 and PIN 483-48-9016)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the east of Hillsboro on the southerly side of Route 9 (CEA Farms, Tract 1 - PIN 483-49-2067, 483-28-2783 and 483-48-9016).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

Suitable soils for drainfield and reserve drainfield sites were found on side slopes on this parcel. (See exhibits showing potential drainfield areas dated July 12, 2017.) The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

The 100% reserve drainfield site is required in the *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code. This area is not installed but is set aside and preserved in case the installed drainfield fails to function properly. The reserve drainfield area is used as a repair installation site for the original drainfield. Limitations on the reserve drainfield include no physical disturbance (i.e., driveways, permanent structures, underground utilities, etc.).

The mass drainfield required for this project would be a large alternative pretreated system with drip dispersal installed at 18 to 20 inches. A pretreated wastewater system refers to treatment works designed to prepare sewage for disposal in a soil medium. After the septic tank effluent has been pretreated (cleaned up), it is dispersed into the drainfield area. A pump

is used to dose the dispersal field consisting of drip tubing installed into the soil. The microorganisms living in the soil also help to clean up the effluent.

Nitrogen dilution buffer areas will be required around the proposed drainfield sites (to be determined by Dewberry). The dilution buffer area is a requirement in the regulations to protect the ground water from exceeding nitrate concentration levels considered to be safe. It is where rain can infiltrate into the soil and dilute the nitrate in the ground water. No installation of the mass drainfield system or land disturbance occurs in the buffer area. No structures can be built on the dilution area for the life of the mass drainfield. Ground water monitoring wells may be required for this project as determined by the Virginia Department of Health's discretion. The monitoring wells would be used for testing (fecal coliform organisms, nitrates, etc.) to ensure that ground water is not adversely impacted by the drainfield system.

Fencing may be required around the proposed drainfield, reserve drainfield, and other onsite system components.

**SUMMARY OF SOIL CHARACTERISTICS AND USE POTENTIAL**

**(CEA Farms, Tract 1)**

**(PIN 483-49-2067, PIN 483-28-2782 and PIN 483-48-9016)**

Soils of the Purcellville series (23B) were mapped on this property in the conceptual drainfield areas. They are very deep and well drained. They formed in residuum derived from diorite, biotite schist and greenstone schist in the Blue Ridge Uplands. Slopes ranged from 4 to 9 percent. Inclusions of soils shallower to rock may occur in this mapping unit. This soil is listed as good potential for conventional septic tank drainfields in the *Interpretive Guide to the Use of Soil Maps, Loudoun County, Virginia*.

## DRAINFIELD CAPACITY

(CEA Farms, Tract 1)

(PIN 483-49-2067, PIN 483-28-2782 and PIN 483-48-9016)

The projected sewage flows for the Hillsboro project are as follows:

54 lots at 370 gallons per day (GPD), three-bedroom house per lot = 20,000 GPD

Size requirements for the mass drainfield are approximately 75,000 square feet of dispersal area (percolation rate of 75 minutes per inch)

### Potential Drainfield Sites:

Site A:	100' x 320' = 32,000 square feet
Site B:	100' x 350' = 35,000 square feet
Site C:	100' x 150' = 15,000 square feet
Total:	82,000 square feet

### Potential 100% Reserve Drainfield Sites:

Site D:	100' x 300' = 30,000 square feet
Site E:	100' x 200' = 20,000 square feet
Site F:	100' x 260' = 26,000 square feet
Total:	76,000 square feet

Proposed dispersal method for the mass drainfield is drip irrigation with an installation depth of approximately 18 to 20 inches.

Fencing may be required around the proposed drainfield, proposed reserve drainfield and other onsite system components.

Proposed drainfields and reserve drainfields were conceptually located in one area to minimize the impact on this property.

There are no known existing wells or drainfields that will impact the location of the proposed mass drainfield site.

This information is preliminary and may change with a detailed soil evaluation and site analysis.

## ***MARSH & LEGGE LAND SURVEYORS, P.L.C.***

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### **DRAINFIELD POTENTIAL SUMMARY**

**(CEA Farms, Tract 2)**

**(PIN 483-29-8389)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the east of Hillsboro on the southerly side of Route 9 (CEA Farms, Tract 2 - PIN 483-29-8389).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

Suitable soils for drainfield and reserve drainfield sites were found on side slopes on this parcel. (See exhibits showing potential drainfield areas dated July 12, 2017.) The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

The 100% reserve drainfield site is required in the *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code. This area is not installed but is set aside and preserved in case the installed drainfield fails to function properly. The reserve drainfield area is used as a repair installation site for the original drainfield. Limitations on the reserve drainfield include no physical disturbance (i.e., driveways, permanent structures, underground utilities, etc.).

The mass drainfield required for this project would be a large alternative pretreated system with drip dispersal installed at 18 to 20 inches. A pretreated wastewater system refers to treatment works designed to prepare sewage for disposal in a soil medium. After the septic tank effluent has been pretreated (cleaned up), it is dispersed into the drainfield area. A pump

is used to dose the dispersal field consisting of drip tubing installed into the soil. The microorganisms living in the soil also help to clean up the effluent.

Nitrogen dilution buffer areas will be required around the proposed drainfield sites (to be determined by Dewberry). The dilution buffer area is a requirement in the regulations to protect the ground water from exceeding nitrate concentration levels considered to be safe. It is where rain can infiltrate into the soil and dilute the nitrate in the ground water. No installation of the mass drainfield system or land disturbance occurs in the buffer area. No structures can be built on the dilution area for the life of the mass drainfield. Ground water monitoring wells may be required for this project as determined by the Virginia Department of Health's discretion. The monitoring wells would be used for testing (fecal coliform organisms, nitrates, etc.) to ensure that ground water is not adversely impacted by the drainfield system.

Fencing may be required around the proposed drainfield, reserve drainfield, and other onsite system components.

**SUMMARY OF SOIL CHARACTERISTICS AND USE POTENTIAL**

**(CEA Farms, Tract 2)**

**(PIN 483-29-8389)**

Soils of the Purcellville series (23B) were mapped on this property in the conceptual drainfield areas. They are very deep and well drained. They formed in residuum derived from diorite, biotite schist and greenstone schist in the Blue Ridge Uplands. Slopes ranged from 4 to 9 percent. Inclusions of soils shallower to rock may occur in this mapping unit. This soil is listed as good potential for conventional septic tank drainfields in the *Interpretive Guide to the Use of Soil Maps, Loudoun County, Virginia*.

**DRAINFIELD CAPACITY**

**(CEA Farms, Tract 2)**

**(PIN 483-29-8389)**

The projected sewage flows for the Hillsboro project are as follows:

54 lots at 370 gallons per day (GPD), three-bedroom house per lot = 20,000 GPD

Size requirements for the mass drainfield are approximately 75,000 square feet of dispersal area (percolation rate of 75 minutes per inch)

Potential Drainfield Sites:

Site G:	100' x 600' = 60,000 square feet
Site H:	100' x 200' = 20,000 square feet
Total:	80,000 square feet

Potential 100% Reserve Drainfield Sites:

Site I:	100' x 600' = 60,000 square feet
Site J:	100' x 200' = 20,000 square feet
Total:	80,000 square feet

Proposed dispersal method for the mass drainfield is drip irrigation with an installation depth of approximately 18 to 20 inches.

Fencing may be required around the proposed drainfield, proposed reserve drainfield and other onsite system components.

Proposed drainfields and reserve drainfields were conceptually located in one area to minimize the impact on this property.

There are no known existing wells or drainfields that will impact the location of the proposed mass drainfield site.

This information is preliminary and may change with a detailed soil evaluation and site analysis.

## ***MARSH & LEGGE LAND SURVEYORS, P.L.C.***

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### **DRAINFIELD POTENTIAL SUMMARY**

**(CEA Farms, Tract 3)**

**(PIN 448-25-1566)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the east of Hillsboro on the southerly side of Route 9 (CEA Farms, Tract 3 - PIN 448-25-1566).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

Suitable soils for drainfield and reserve drainfield sites were found on side slopes on this parcel. (See exhibits showing potential drainfield areas dated July 12, 2017.) The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

The 100% reserve drainfield site is required in the *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code. This area is not installed but is set aside and preserved in case the installed drainfield fails to function properly. The reserve drainfield area is used as a repair installation site for the original drainfield. Limitations on the reserve drainfield include no physical disturbance (i.e., driveways, permanent structures, underground utilities, etc.). **The 100% reserve drainfield requirement could not be achieved on this parcel. Conceptually, only a 40% reserve drainfield site was located (see Page 4 and exhibit, July 12, 2017).**

The mass drainfield required for this project would be a large alternative pretreated system with drip dispersal installed at 18 to 20 inches. A pretreated wastewater system refers

to treatment works designed to prepare sewage for disposal in a soil medium. After the septic tank effluent has been pretreated (cleaned up), it is dispersed into the drainfield area. A pump is used to dose the dispersal field consisting of drip tubing installed into the soil. The microorganisms living in the soil also help to clean up the effluent.

Nitrogen dilution buffer areas will be required around the proposed drainfield sites (to be determined by Dewberry). The dilution buffer area is a requirement in the regulations to protect the ground water from exceeding nitrate concentration levels considered to be safe. It is where rain can infiltrate into the soil and dilute the nitrate in the ground water. No installation of the mass drainfield system or land disturbance occurs in the buffer area. No structures can be built on the dilution area for the life of the mass drainfield. Ground water monitoring wells may be required for this project as determined by the Virginia Department of Health's discretion. The monitoring wells would be used for testing (fecal coliform organisms, nitrates, etc.) to ensure that ground water is not adversely impacted by the drainfield system.

Fencing may be required around the proposed drainfield, reserve drainfield, and other onsite system components.

**SUMMARY OF SOIL CHARACTERISTICS AND USE POTENTIAL**

**(CEA Farms, Tract 3)**

**(PIN 448-25-1566)**

Soils of the Purcellville series (23B) were mapped on this property in the conceptual drainfield areas. They are very deep and well drained. They formed in residuum derived from diorite, biotite schist and greenstone schist in the Blue Ridge Uplands. Slopes ranged from 4 to 9 percent. Inclusions of soils shallower to rock may occur in this mapping unit. This soil is listed as good potential for conventional septic tank drainfields in the *Interpretive Guide to the Use of Soil Maps, Loudoun County, Virginia*.

**DRAINFIELD CAPACITY**

**(CEA Farms, Tract 3)**

**(PIN 448-25-1566)**

The projected sewage flows for the Hillsboro project are as follows:

54 lots at 370 gallons per day (GPD), three-bedroom house per lot = 20,000 GPD

Size requirements for the mass drainfield are approximately 75,000 square feet of dispersal area (percolation rate of 75 minutes per inch)

Potential Drainfield Sites:

Site K1:	100' x 150' = 15,000 square feet
Site K2:	100' x 400' = 40,000 square feet
Site K3:	100' x 250' = 25,000 square feet
Total:	80,000 square feet

Potential 40% Reserve Drainfield Site:

Site K4:	100' x 300' = 30,000 square feet
Total:	<b>30,000 square feet</b>

Proposed dispersal method for the mass drainfield is drip irrigation with an installation depth of approximately 18 to 20 inches.

Fencing may be required around the proposed drainfield, proposed reserve drainfield and other onsite system components.

Proposed drainfields and reserve drainfields were conceptually located in one area to minimize the impact on this property.

There are no known existing wells or drainfields that will impact the location of the proposed mass drainfield site.

This information is preliminary and may change with a detailed soil evaluation and site analysis.

## **MARSH & LEGGE LAND SURVEYORS, P.L.C.**

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### **DRAINFIELD POTENTIAL SUMMARY**

**(Cummings Tract – PIN 482-26-3545)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the north of Hillsboro on the northerly side of Route 9 (Cummings property - PIN 482-26-3545).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

Suitable soils for drainfield and reserve drainfield sites were found on side slopes on this parcel. (See exhibits showing potential drainfield areas dated July 12, 2017.) The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

The 100% reserve drainfield site is required in the *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code. This area is not installed but is set aside and preserved in case the installed drainfield fails to function properly. The reserve drainfield area is used as a repair installation site for the original drainfield. Limitations on the reserve drainfield include no physical disturbance (i.e., driveways, permanent structures, underground utilities, etc.).

The mass drainfield required for this project would be a large alternative pretreated system with drip dispersal installed at 18 to 20 inches. A pretreated wastewater system refers to treatment works designed to prepare sewage for disposal in a soil medium. After the septic tank effluent has been pretreated (cleaned up), it is dispersed into the drainfield area. A pump

is used to dose the dispersal field consisting of drip tubing installed into the soil. The microorganisms living in the soil also help to clean up the effluent.

Nitrogen dilution buffer areas will be required around the proposed drainfield sites (to be determined by Dewberry). The dilution buffer area is a requirement in the regulations to protect the ground water from exceeding nitrate concentration levels considered to be safe. It is where rain can infiltrate into the soil and dilute the nitrate in the ground water. No installation of the mass drainfield system or land disturbance occurs in the buffer area. No structures can be built on the dilution area for the life of the mass drainfield. Ground water monitoring wells may be required for this project as determined by the Virginia Department of Health's discretion. The monitoring wells would be used for testing (fecal coliform organisms, nitrates, etc.) to ensure that ground water is not adversely impacted by the drainfield system.

Fencing may be required around the proposed drainfield, reserve drainfield, and other onsite system components.

**SUMMARY OF SOIL CHARACTERISTICS AND USE POTENTIAL**

**(Cummings Tract – PIN 482-26-3545)**

Soils of the Purcellville series (23B) were mapped on this property in the conceptual drainfield areas. They are very deep and well drained. They formed in residuum derived from diorite, biotite schist and greenstone schist in the Blue Ridge Uplands. Slopes ranged from 4 to 9 percent. Inclusions of soils shallower to rock may occur in this mapping unit. This soil is listed as good potential for conventional septic tank drainfields in the *Interpretive Guide to the Use of Soil Maps, Loudoun County, Virginia*.

## DRAINFIELD CAPACITY

(Cummings Tract – PIN 482-26-3545)

The projected sewage flows for the Hillsboro project are as follows:

54 lots at 370 gallons per day (GPD), three-bedroom house per lot = 20,000 GPD

Size requirements for the mass drainfield are approximately 75,000 square feet of dispersal area (percolation rate of 75 minutes per inch)

Potential Drainfield Sites:

Site Q:	100' x 220' = 22,000 square feet
Site R:	100' x 250' = 25,000 square feet
Site S:	100' x 300' = 30,000 square feet
Total:	77,000 square feet

Potential 100% Reserve Drainfield Sites:

Site T:	100' x 400' = 40,000 square feet
Site U:	100' x 200' = 20,000 square feet
Site V:	100' x 200' = 20,000 square feet
Total:	80,000 square feet

Proposed dispersal method for the mass drainfield is drip irrigation with an installation depth of approximately 18 to 20 inches.

Fencing may be required around the proposed drainfield, proposed reserve drainfield and other onsite system components.

Proposed drainfields and reserve drainfields were conceptually located in one area to minimize the impact on this property.

There are no known existing wells or drainfields that will impact the location of the proposed mass drainfield site.

This information is preliminary and may change with a detailed soil evaluation and site analysis.

***MARSH & LEGGE LAND SURVEYORS, P.L.C.***

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**DRAINFIELD POTENTIAL SUMMARY**

**(Sanderson Tract - PIN 482-18-7447)**

This conceptual soil investigation was conducted using available Loudoun County GIS information on property to the east of Hillsboro on the northerly side of Route 9 (Sanderson property - PIN 482-18-7447).

Potential onsite wastewater disposal (drainfield) sites were determined by selecting the "best" suitable landscapes (topography) with the "best" suitable soils found in this study area. These sites were determined using the Virginia Department of Health's *Sewage Handling and Disposal Regulations* and Chapter 1066 of the Loudoun County Code.

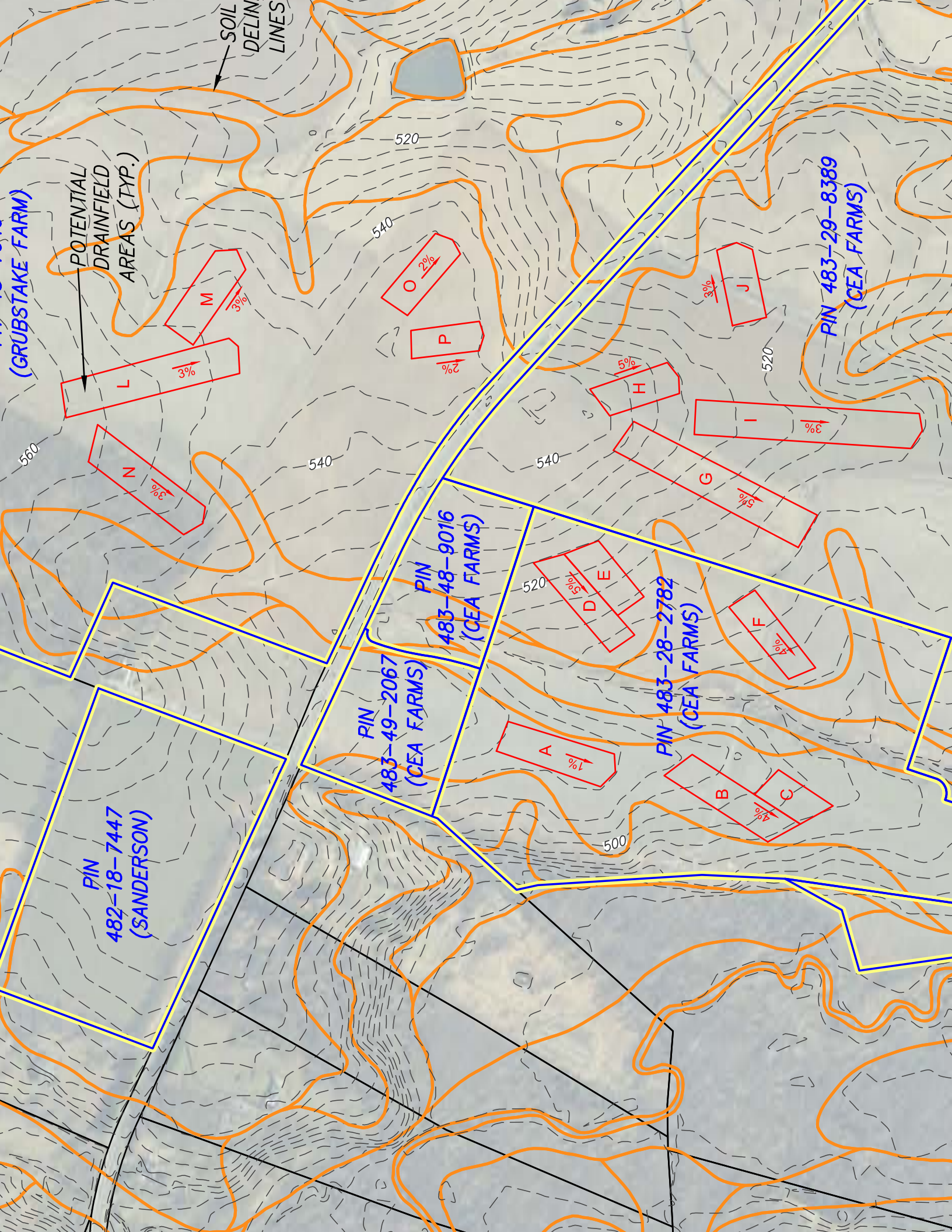
Suitable soils for drainfield and reserve drainfield sites were found on side slopes and ridge tops on this parcel. The capacity for the drainfield site is 20,000 gallons per day (includes 100% reserve drainfield requirements – additional 20,000 gallons per day).

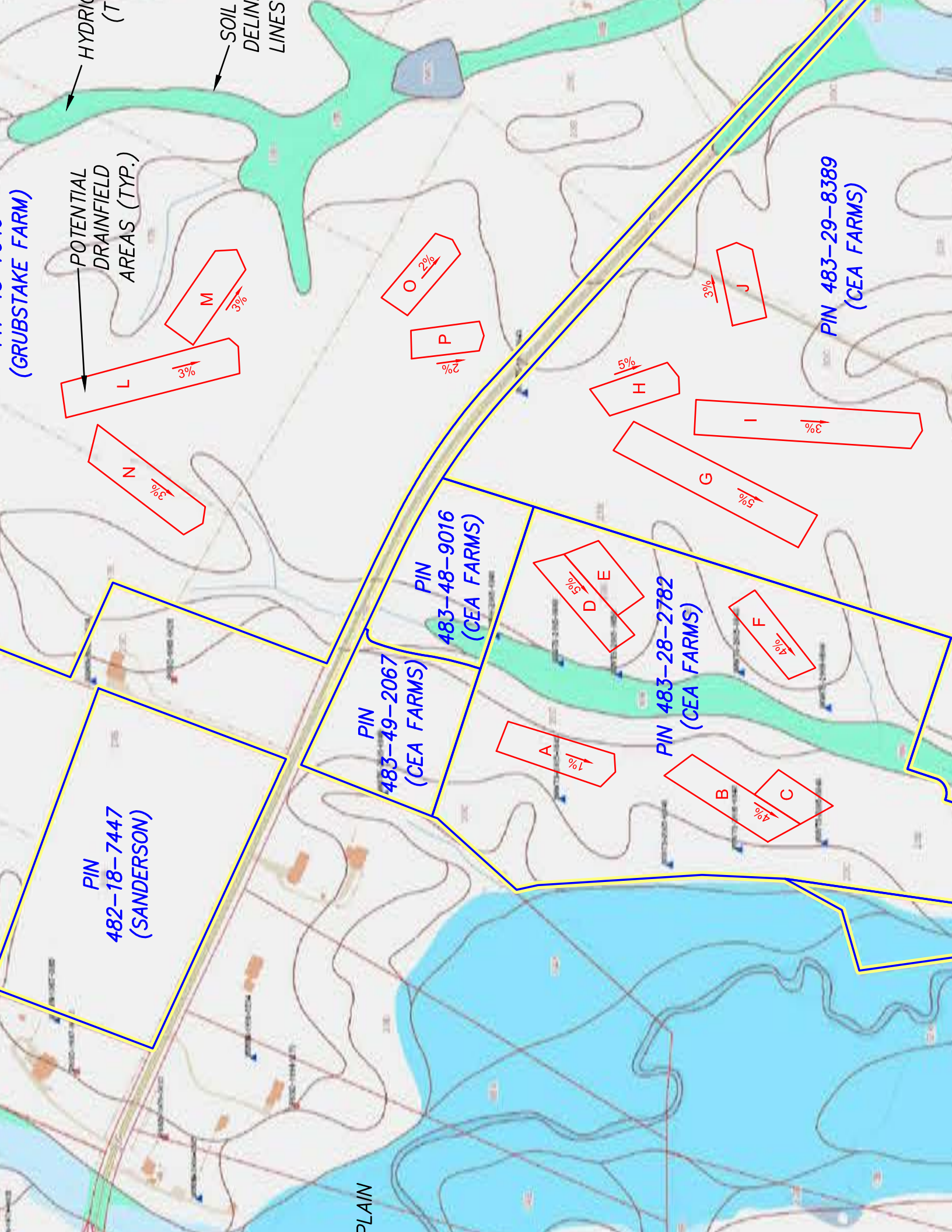
**Potential drainfield and reserve drainfield sites are not shown on this parcel. The parcel is not large enough to support a mass drainfield system of this magnitude.**

# APPENDIX E

**Marsh & Legge Land Surveyors, P.L.C.**

**Hillsboro Exhibits**





(GRUBSTAKE FARM)

POTENTIAL DRAINFIELD AREAS (TYP.)

HYDRIC (T)

SOIL DELIN LINES

PIN 483-29-8389 (CEA FARMS)

PIN 483-48-9016 (CEA FARMS)

PIN 483-49-2067 (CEA FARMS)

PIN 483-28-2782 (CEA FARMS)

PIN 482-18-7447 (SANDERSON)

PLAIN

M 3%

L 3%

N 3%

O 2%

P 2%

H 5%

J 3%

I 3%

G 5%

D 5%

F 4%

A 1%

B 4%

C 4%

# APPENDIX F

**Grundfos Grinder Pump Cut Sheet**

PROJECT: _____	UNIT TAG: _____	QUANTIT : _____
REPRESENTATIVE: _____	TYPE OF SERVICE: _____	DATE: _____
ENGINEER: _____	SUBMITTED BY : _____	DATE: _____
CONTRACTOR: _____	APPROVED BY : _____	DATE: _____
	ORDER NO.: _____	DATE: _____

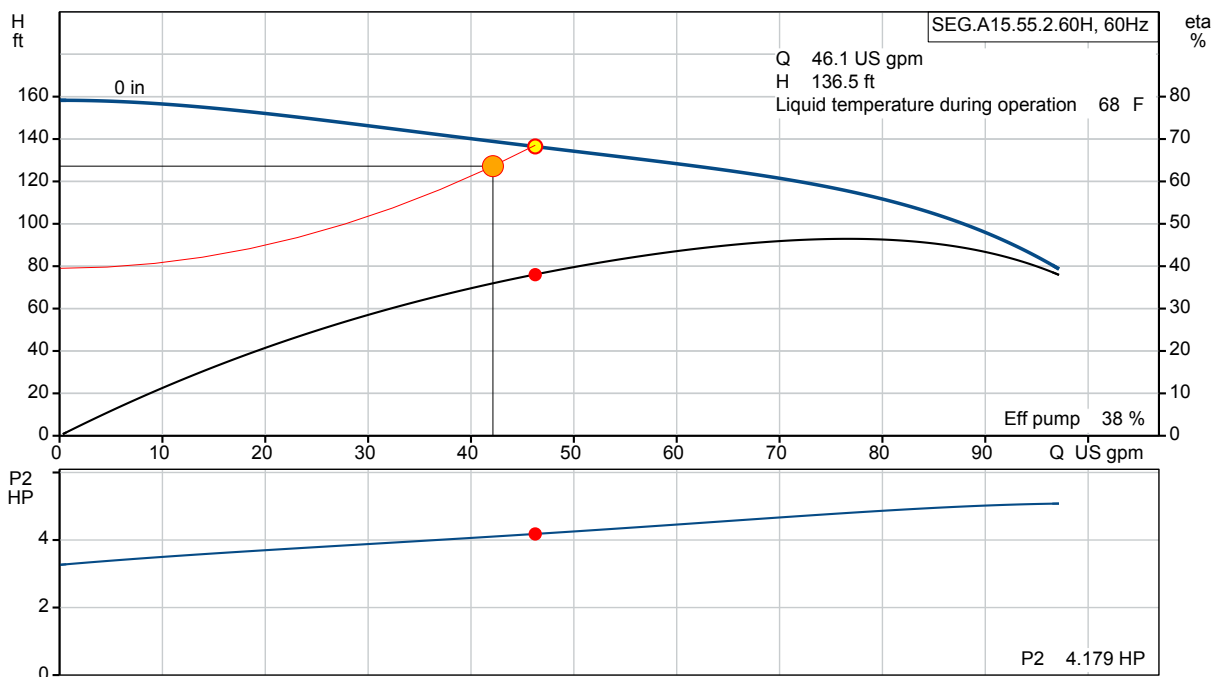


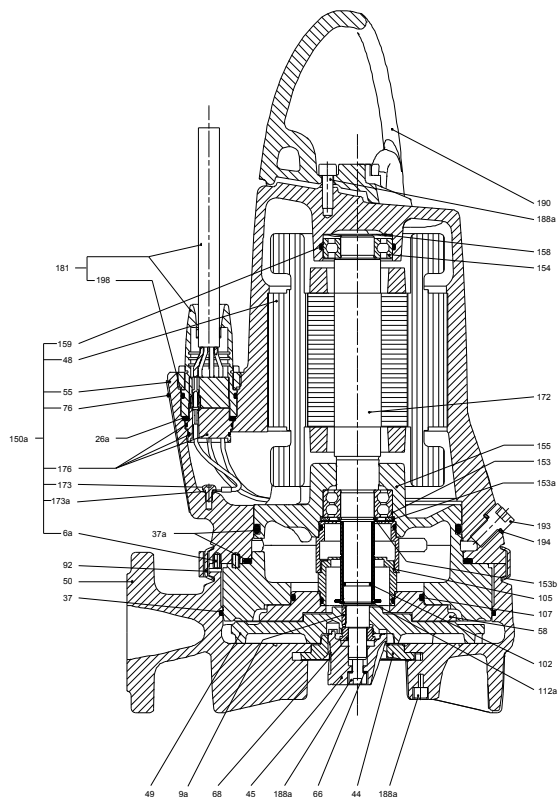
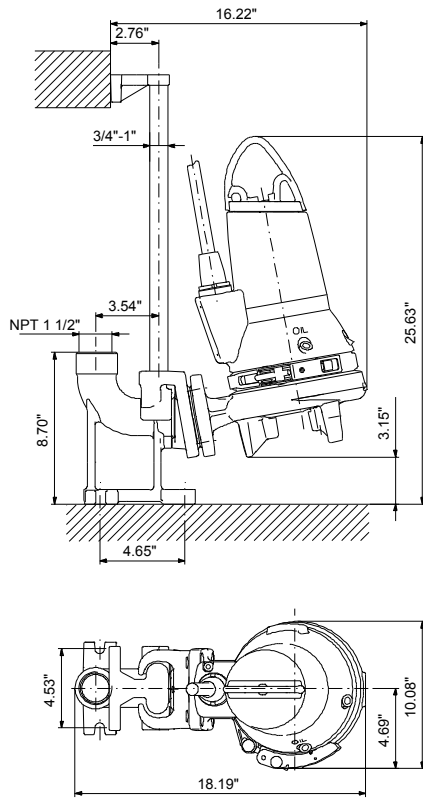
### SEG.A15.55.2.60H

Grinder pumps

Product photo could vary from the actual product

Conditions of Service		Pump Data		Motor Data	
Flow:	46.1 US gpm	Maximum operating pressure:	87 psi	Rated voltage:	460 V
Head:	136.5 ft	Liquid temperature range:	32 .. 104 F	Main frequency:	60 Hz
Efficiency:	32.3 %	Maximum ambient temperature:	104 F	Number of poles:	2
Liquid:	Water	Approvals:	PA-I	Enclosure class:	IP68
Temperature:	68 F	Flange standard:	ANSI	Insulation class:	F
NPSH required:	32.81 ft	Product number:	98280875	Motor protection:	THERMAL SWITCH
Viscosity:	1 cSt			Thermal protection:	external
Specific Gravity:	1.002				





**Materials:**  
 Pump housing: Cast iron  
 EN1561 EN-GJL-200  
 ASTM A48 30B  
 Impeller: Cast iron  
 EN1561 EN-GJL-200  
 ASTM A48 30B

Position	Count	Description																																
	1	<p><b>SEG.A15.55.2.60H</b></p>  <p style="text-align: center;">Product photo could vary from the actual product</p> <p>Product No.: <a href="#">98280875</a></p> <p>Grundfos SEG pumps are submersible pumps with horizontal discharge port, specifically designed for pressurized pumping of wastewater with discharge from toilets. The SEG pumps are equipped with a grinder system, grinding destructible solids into small pieces so that they can be led away through pipes of a relatively small diameter.</p> <p>The surface of the pump is smooth to prevent dirt and impurities from sticking to the pump. The pump is primarily made of cast iron. The clamp securing the motor to the pump housing is made of stainless steel to prevent corrosion and allow for ease of service of the pump. The power cable of the pump also incorporates wires for the thermal sensors in the motor winding. The cable connection is a plug solution. The totally sealed plug connection prevents moisture from entering the pump through the cable in case of cable breakage or adverse and/or careless handling of the pump cable.</p> <p>The pump must be connected to a control box or a controller.</p> <p>The pump has been tested by CSA.</p> <p><b>Controls:</b></p> <table> <tr> <td>Moisture sensor:</td> <td>with moisture sensors</td> </tr> <tr> <td>AUTOADAPT:</td> <td>NO</td> </tr> </table> <p><b>Liquid:</b></p> <table> <tr> <td>Pumped liquid:</td> <td>Water</td> </tr> <tr> <td>Liquid temperature range:</td> <td>32 .. 104 F</td> </tr> <tr> <td>Liquid temperature during operation:</td> <td>68 F</td> </tr> <tr> <td>Density:</td> <td>62.4 lb/ft</td> </tr> <tr> <td>inematic viscosity:</td> <td>1 cSt</td> </tr> </table> <p><b>Technical:</b></p> <table> <tr> <td>Actual calculated flow:</td> <td>46.1 US gpm</td> </tr> <tr> <td>Resulting head of the pump:</td> <td>136.5 ft</td> </tr> <tr> <td>Type of impeller:</td> <td>Grinder System</td> </tr> <tr> <td>Primary shaft seal:</td> <td>SIC/SIC</td> </tr> <tr> <td>Secondary shaft seal:</td> <td>CARBON/CERAMICS</td> </tr> <tr> <td>Approvals on nameplate:</td> <td>PA-I</td> </tr> <tr> <td>Curve tolerance:</td> <td>ANSI/HI11.6:2012 3B2</td> </tr> </table> <p><b>Materials:</b></p> <table> <tr> <td>Pump housing:</td> <td>Cast iron</td> </tr> <tr> <td></td> <td>EN1561 EN-GJL-200</td> </tr> </table>	Moisture sensor:	with moisture sensors	AUTOADAPT:	NO	Pumped liquid:	Water	Liquid temperature range:	32 .. 104 F	Liquid temperature during operation:	68 F	Density:	62.4 lb/ft	inematic viscosity:	1 cSt	Actual calculated flow:	46.1 US gpm	Resulting head of the pump:	136.5 ft	Type of impeller:	Grinder System	Primary shaft seal:	SIC/SIC	Secondary shaft seal:	CARBON/CERAMICS	Approvals on nameplate:	PA-I	Curve tolerance:	ANSI/HI11.6:2012 3B2	Pump housing:	Cast iron		EN1561 EN-GJL-200
Moisture sensor:	with moisture sensors																																	
AUTOADAPT:	NO																																	
Pumped liquid:	Water																																	
Liquid temperature range:	32 .. 104 F																																	
Liquid temperature during operation:	68 F																																	
Density:	62.4 lb/ft																																	
inematic viscosity:	1 cSt																																	
Actual calculated flow:	46.1 US gpm																																	
Resulting head of the pump:	136.5 ft																																	
Type of impeller:	Grinder System																																	
Primary shaft seal:	SIC/SIC																																	
Secondary shaft seal:	CARBON/CERAMICS																																	
Approvals on nameplate:	PA-I																																	
Curve tolerance:	ANSI/HI11.6:2012 3B2																																	
Pump housing:	Cast iron																																	
	EN1561 EN-GJL-200																																	



Company name:

Created by:

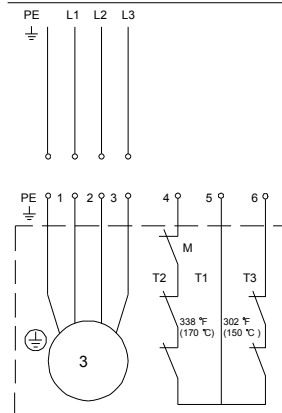
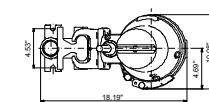
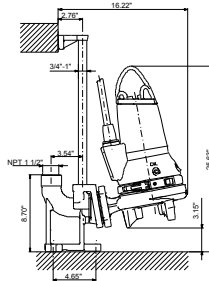
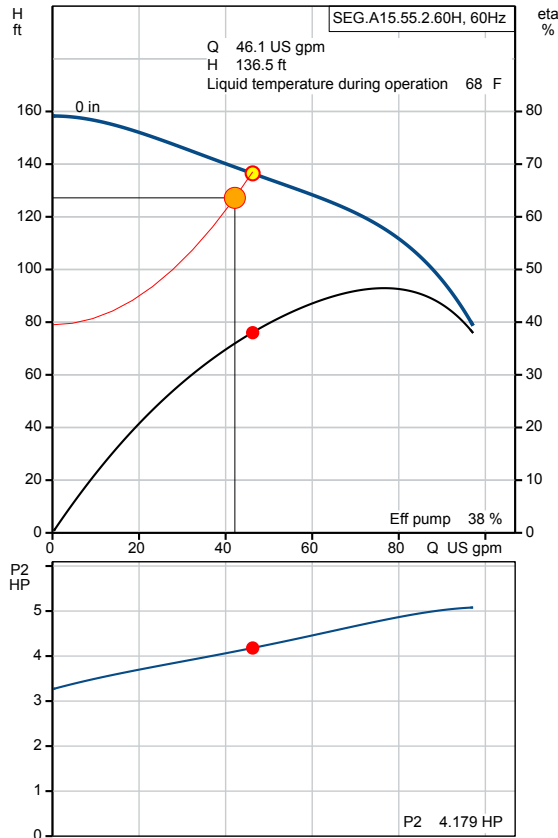
Phone:

Date:

1/23/2018

Position	Count	Description
		ASTM A48 30B Impeller: Cast iron EN1561 EN-GJL-200 ASTM A48 30B
		<b>Installation:</b> Maximum ambient temperature: 104 F Maximum operating pressure: 87 psi Flange standard: ANSI Pipework connection: 1 1/2" /2" Size of outlet port: 1 1/2 inch Pressure stage: PN 10 Maximum installation depth: 32.81 ft Auto-coupling: 98245788
		<b>Electrical data:</b> Power input - P1: 5.1 kW Rated power - P2: 5.5 HP Main frequency: 60 Hz Rated voltage: 3 x 460 V Voltage tolerance: 6/-10 % Max starts per. hour: 30 Rated current: 8 A Starting current: 43 A Rated current at no load: 2.1 A Cos phi - power factor: 0,9 Cos phi - p.f. at 3/4 load: 0,88 Cos phi - p.f. at 1/2 load: 0,8 Rated speed: 3452 rpm Moment of inertia: 0.622 lb ft Motor efficiency at full load: 0.79 % Motor efficiency at 3/4 load: 0.8 % Motor efficiency at 1/2 load: 0.77 % Number of poles: 2 Start. method: direct-on-line Enclosure class (IEC 34-5): IP68 Insulation class (IEC 85): F Explosion proof: no Length of cable: 33 ft Cable type: SEOOW 600V Type of cable plug: NO PLUG
		<b>Others:</b> Net weight: 106 lb

Description	Value
<b>General information:</b>	
Product name:	SEG.A15.55.2.60H
Product No.:	98280875
EAN:	5711492381489
<b>Technical:</b>	
Actual calculated flow:	46.1 US gpm
Max flow:	96.9 US gpm
Resulting head of the pump:	136.5 ft
Head max:	158.1 ft
Type of impeller:	Grinder System
Primary shaft seal:	SIC/SIC
Secondary shaft seal:	CARBON/CERAMICS
Approvals on nameplate:	PA-I
Curve tolerance:	ANSI/HI11.6:2012 3B2
<b>Materials:</b>	
Pump housing:	Cast iron EN1561 EN-GJL-200 ASTM A48 30B
Impeller:	Cast iron EN1561 EN-GJL-200 ASTM A48 30B
<b>Installation:</b>	
Maximum ambient temperature:	104 F
Maximum operating pressure:	87 psi
Flange standard:	ANSI
Pipework connection:	1 1/2" /2"
Size of outlet port:	1 1/2 inch
Pressure stage:	PN 10
Maximum installation depth:	32.81 ft
Inst dry/wet:	SUBMERGED
Auto-coupling:	98245788
<b>Liquid:</b>	
Pumped liquid:	Water
Liquid temperature range:	32 .. 104 F
Liquid temperature during operation:	68 F
Density:	62.4 lb/ft <sup>3</sup>
kinematic viscosity:	1 cSt
<b>Electrical data:</b>	
Power input - P1:	5.1 kW
Rated power - P2:	5.5 HP
Main frequency:	60 Hz
Rated voltage:	3 x 460 V
Voltage tolerance:	6/-10 %
Max starts per. hour:	30
Rated current:	8 A
Starting current:	43 A
Rated current at no load:	2.1 A
Cos phi - power factor:	0,9
Cos phi - p.f. at 3/4 load:	0,88
Cos phi - p.f. at 1/2 load:	0,8
Rated speed:	3452 rpm
Moment of inertia:	0.622 lb ft
Motor efficiency at full load:	0.79 %
Motor efficiency at 3/4 load:	0.8 %





**Company name:**

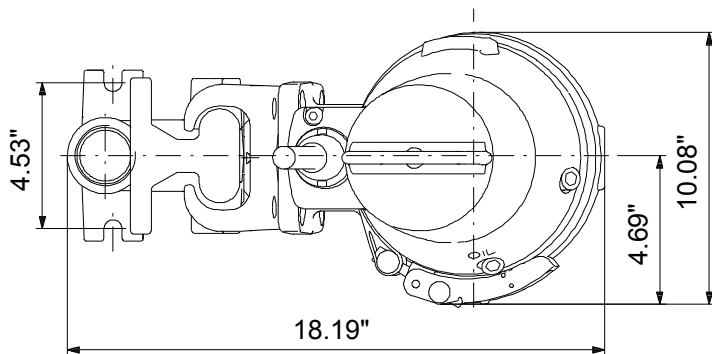
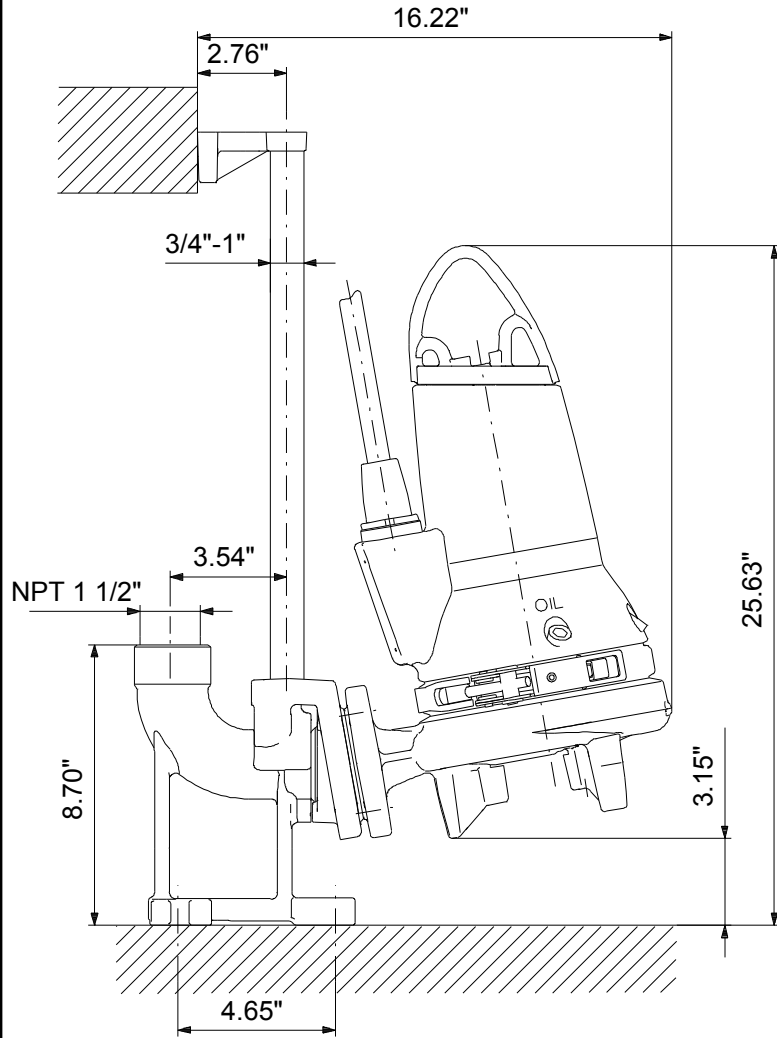
**Created by:**

**Phone:**

**Date:** 1/23/2018

Description	Value
Motor efficiency at 1/2 load:	0.77 %
Number of poles:	2
Start. method:	direct-on-line
Enclosure class (IEC 34-5):	IP68
Insulation class (IEC 85):	F
Explosion proof:	no
Motor protection:	THERMAL SWITCH
Thermal protec:	external
Length of cable:	33 ft
Cable type:	SEOOW 600V
Type of cable plug:	NO PLUG
<b>Controls:</b>	
Control box:	not included
Additional I/O:	External
Moisture sensor:	with moisture sensors
AUTOADAPT:	NO
<b>Others:</b>	
Net weight:	106 lb
Sales region:	Namreg

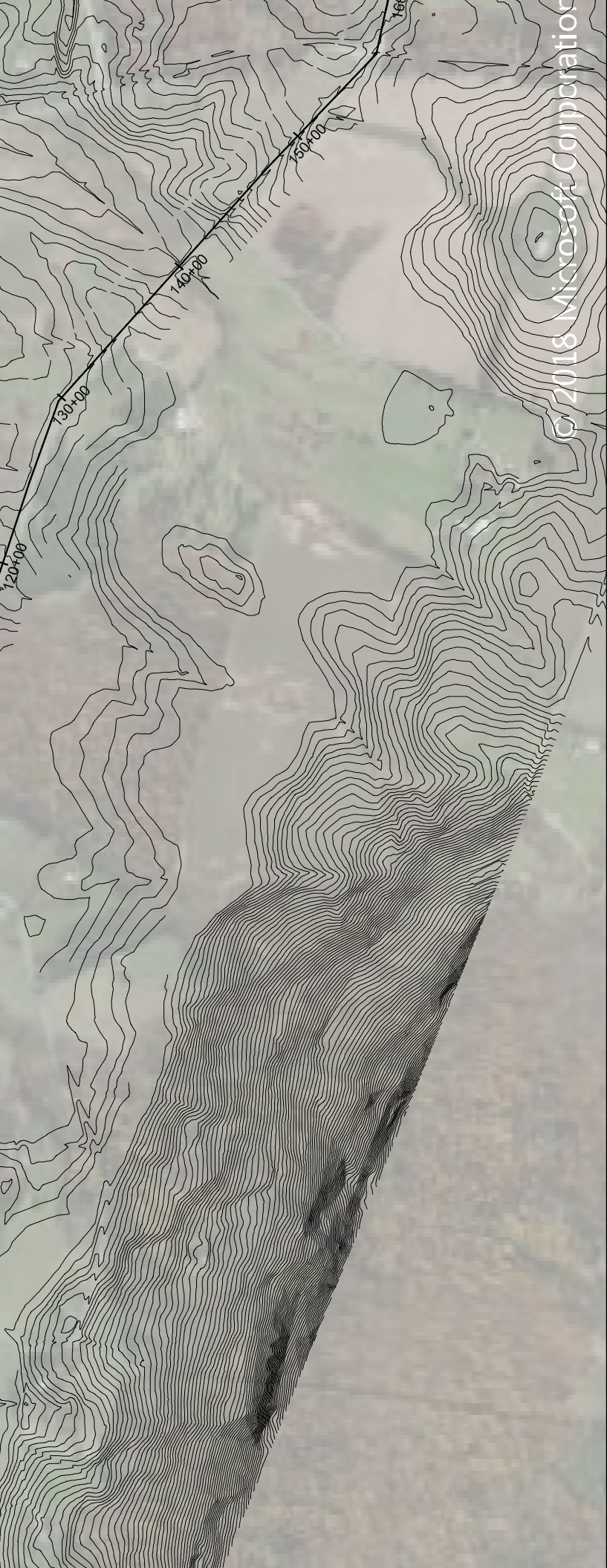
## 98280875 SEG.A15.55.2.60H 60 Hz



Note! All units are in mm unless otherwise stated.  
Disclaimer: This simplified dimensional drawing does not show all details.

# APPENDIX G

**Hillsboro Rd. Plan and Profile View**



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**PLAN VIEW**  
1" = 750'

