3.29 Piney Branch – Subwatershed Condition

3.29.1 Subwatershed Characteristics

The Piney Branch **subwatershed** is one of the larger subwatersheds, and has an area of approximately 2,475 **acres** (3.87 mi^2). Chainbridge Road (Virginia 123) runs near the southern boundary. Beulah Road (Virginia 675) runs approximately along the northeast boundary line. Meadowlark Road (Virginia 677) provides the approximate northern boundary of the subwatershed.

There are approximately 8 miles of stream in the Piney Branch subwatershed. The streams flow generally in a northwesterly direction until Piney Branch joins the mainstem of Difficult Run in the Difficult Run Stream Valley Park.

Refer to DFPB_1 for a map of the Piney Branch subwatershed highlighting the Subwatershed Characteristics including, existing land use, **flood limit**, **wetlands**, **resource protection areas** and **stormwater management**.

3.29.2 Existing and Future Land Use

The type and density of land use in a subwatershed can affect the downstream water quality and stream condition. While each land use type introduces issues to the natural stream system, more intense land use types, such as high-density residential, commercial and industrial, can have high levels of **impervious** surface and contribute **runoff** and **pollutants** to the stream system. Less intense types such as open space and estate residential are generally less impervious, have more natural vegetation and therefore have less impact on stream quality.

The Piney Branch subwatershed is one of the most densely developed subwatersheds found within the Difficult Run **watershed**. Twenty-six percent is developed as low-density or estate residential, while 6 percent of the subwatershed is developed for commercial or industrial uses. The most common **land use** in this subwatershed is medium-density residential at 35 percent. Much of the development is found concentrated along Chainbridge Road (Virginia 123) in the southern portion of the subwatershed, generally in the Town of Vienna, and along the Washington and Old Dominion Railroad Trail. A summary of land use within the subwatershed can be found in Table 3.52.

Transportation use, such as roads and highways, make up 330 acres, or 13 percent of the overall subwatershed. Total **impervious** area for the subwatershed, which includes all roads, parking lots, residential driveways and buildings, is approximately 565 acres, or 23 percent of the total subwatershed area.

Seventeen percent of the land in the subwatershed is preserved for open space or parks. Major parks include North Side Park, Eudora Park, the majority of Clarks Crossing Park, a portion of Tamarack Park, Symphony Hills Park, Glyndon Park, Peterson Lane Park, and the fields and grounds of various schools. There are eight historical sites within the subwatershed.

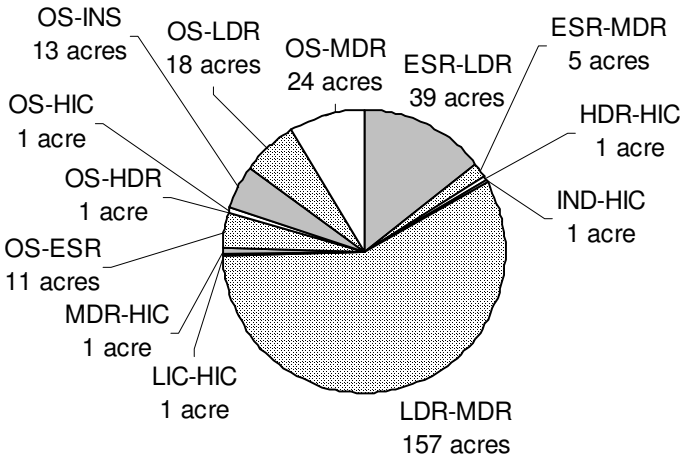
Table 3.52 Existing and Future Land Use

Land Use Type	Existing		Future		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Open space, parks, and recreational areas	417	17%	349	14%	-68	-3%
Golf Course	0	0%	0	0%	0	0%
Estate residential	64	3%	31	1%	-33	-1%
Low-density residential	570	23%	470	19%	-100	-4%
Medium-density residential	857	35%	1042	42%	185	7%
High-density residential	22	1%	22	1%	0	0%
Low-intensity commercial	27	1%	26	1%	-1	0%
High-intensity commercial	72	3%	77	3%	5	0%
Industrial	47	2%	46	2%	-1	0%
Institutional	68	3%	81	3%	13	1%
Transportation	330	13%	330	13%	0	0%
Water	0	0%	0	0%	0	0%
Total	**2,475**	**100%**	**2,475**	**100%**		**0%**

Changes in the land use that result in higher intensity uses in the future can present problems for streams. For example, if the land use shifts from open space to high-intensity commercial use, additional buildings, roadways and parking lots may replace the forest and open fields and impact stream condition.

When comparing existing land use to future land use, there are several land use changes. The notable changes are projected in the open space, low-density residential, and medium-density residential land use categories. Losses projected in the open space (-3 percent), estate residential (-1 percent), and low-intensity residential (-4 percent) should be compensated with gains in the medium-density residential (+7 percent) and institutional (+1 percent) categories.

Figure 3.24: Changed Land Use



According to Figure 3.24, 157 acres are projected to shift from low-density residential in the existing land use to medium-density residential in the future land use. Thirty-nine acres are projected to shift from estate residential in the existing land use to low-density residential in the future land use. These large transfers indicate a potential for an increase in additional housing in the Piney Branch subwatershed. Twenty-four acres are projected to shift from open space to

a medium-density residential use. In fact, 68 acres, or 25 percent of all land use changes, are projected to shift from open space in the existing land use to some form of residential or commercial use in the future. This does not guarantee that the open space will become developed. This open space area can be used for development/ **redevelopment** in the future.

3.29.3 Existing Stormwater Management

Stormwater management provides treatment of otherwise uncontrolled runoff to reduce the harmful effects of increased stormwater flows and stormwater runoff pollution. County records indicate that there are nine **stormwater management facilities** within the Piney Branch subwatershed. Eighty-five percent of the Piney Branch subwatershed is not served by any stormwater management facility. Twelve percent of the total area has quantity control only and the remaining 3 percent receives both **quantity and quality control**.

The difference between the amount of total developed area in the subwatershed (62 percent) and the area served by stormwater management (15 percent) indicates a potential for impairment due to uncontrolled stormwater and a possible need for additional management efforts, specifically in the industrial, commercial and and low-density residential areas. A list of all stormwater management facilities in the Piney Branch subwatershed can be found in Appendix D.

Outfalls

The storm drainage system connects the developed portions of the land to the stream system. Stormwater outfalls are located where the stormwater system ends and the natural channel begins. Outfalls may be sources of pollutants and excessive stormflow from pipes can cause erosion at the outfall and downstream. During the Stream Physical Assessment, field crews located 24 **outfall** pipes discharging into the Piney Branch mainstem and tributaries. None of these pipes were considered to be having an impact on stream character, nor were they creating any type of **erosion**.

Stream Crossings

Stream crossings, such as bridges and culverts are often locations of erosion and flooding. The combination of aging structures and frequently high stormwater levels can cause downstream stream stability problems and habitat impairment. Results from the Stream Physical Assessment identified 21 crossings in the Piney Branch subwatershed. The majority (62 percent) were concrete bridges, while an additional 20 percent were footbridges made of wood or metal. None of the crossings were creating significant erosion or degrading the instream habitat and none warrant repair.

3.29.4 Soils

Soils found in the Piney Branch subwatershed belong primarily to the Glenelg – Elioak – Manor association. This association consists of rolling and hilly landscapes which can result in rapid **runoff** and **micaceous** soils, which are erodible. The **groundwater** is fairly shallow with numerous natural springs. The subwatershed contains 33 percent of the B hydrologic soil group with Glenelg silt loam being the dominant soil type (15 percent). Zones with Glenelg, Manor and Elioak soils may be compatible with infiltration practices. There are 1278.2 acres of land with unclassified soils in the Piney Branch subwatershed. Soils that cover at least 20 acres within the subwatershed can be found in Appendix A.

3.29.5 Geomorphology

Streams in the Piney Branch subwatershed were assessed and assigned a **Channel Evolution Model** classification as part of the Stream Physical Assessment. The classification indicates the stream channel's physical condition and stability as a response to disturbances such as upstream land use changes. A total of 42,430 linear feet (approximately 8 miles) of stream are in the Piney Branch subwatershed. Of this length, ten reaches (4,539 feet) were not assessed because they were piped **channels**, had no water, were too small, or too channelized.

The majority (93 percent) of the channel has a gravel **substrate**. The remaining portions are primarily silt and sand. All of the reaches are Type III, which is indicative of an actively widening stream channel. There was one erosion point of moderate to severe erosion of approximately 300 feet. It is candidate site S110 and is shown in Photo 3.87. Refer to DFPB_3 for the stream classifications.

Photo 3.87 Streambank erosion just upstream from confluence with Difficult Run, west of Fosbak Drive (DFPB002.E001)

Photo 3.88 Obstruction point, mostly trees and debris, at the end of Corsica Street. (DFPB015.T001).

Photo 3.89 Sanitary line crossing the stream above the baseflow (DFPB010.U001).

All of the eight stream blockages were made up of trees and debris. Some had additional concrete and sediment. One-half of the obstructions had only minor impacts on the stream, causing some erosion. Thirty-eight percent of the obstructions were causing a greater impact on the stream condition. The example shown in Photo 3.88 is candidate site S134.

There was one sanitary line of approximately 10" that was crossing the stream above the base flow. The sanitary line is shown above in Photo 3.89 and is candidate site S111. Much of the stream length (74 percent) has high erosion potential during **flood** events.

3.29.6 Stream Habitat and Water Quality

All stream reaches are of moderate to high slope and are generally characterized as having a predominance of **riffle** and **run** stream type. The stream reaches have the following stream habitat and water quality characteristics as taken from the Stream Physical Assessment, which provides a one time visual inspection. Field crews conducted that assessment in the fall of 2002.

- In the assessed reaches, 67 percent is considered to have Fair habitat for aquatic insects and fish, and 33 percent has Good habitat. The mainstem between Verdict Drive and the confluence with Difficult Run makes up the majority of Good habitat.
- There is 35,400 feet, approximately 42 percent of the total stream length, of **riparian buffer** encroachment (this length includes left and right banks combined). Of this, 25,550 feet (72 percent) is lawn, and 2,300 (6.5 percent) is pavement. The remaining buffer encroachment area is some combination of lawn, meadow, trees and pavement. Eighty-two percent of the buffer encroachment length has no or low restoration potential due to existing infrastructure, however; 18 percent of the length has moderate to high restoration potential. Most of the percent of the buffer encroachment had only minimal impact, suggesting that the stream character may be changed slightly by adjacent use. Two of the areas with pavement buffer encroachment appear to present a greater impact and are shown in Photo 3.90 and 3.91.

Photo 3.90 Buffer impact in North Side Park (DFPB024.B002).

Photo 3.91 Buffer impact in the Somerset community at the end of Mill Street (DFPB024.B003).

- Sixty-five percent of the assessed stream length had between 50 percent and 70 percent of both stream banks covered by vegetation. Typically this vegetation is scattered grasses, shrubs and forbs. Twenty-five percent of the assessed stream length had a variety of vegetation and covered 70 percent to 90 percent of the stream bank surface.

3.29.7 Hydrology and Water Quality Modeling

The water quality and quantity were modeled for each subwatershed and **catchment** in the Difficult Run watershed to provide estimates that can be used for planning. The models

used in Piney Branch incorporate data on the amount, character and location of the land use, impervious cover, topography, vegetation, streams and stormwater management to generate estimates of water quality and quantity in the streams. Water quality modeling includes **pollutant loading** estimates for total **nitrogen** (TN), total **phosphorus** (TP) and total **suspended solids** (TSS). Because changes in land use effect the amount of runoff, streamflow, the quantity modeling estimates the amount of runoff generated by the land during rainfall and the peak streamflow or **discharge** that results.

Modeling of future conditions generally uses the same data inputs and estimates the same parameters but does so with future land use information. The future land use is a prediction of how land use would change based on the current zoning designations and the Comprehensive Plan. The difference between the existing and future model results identifies areas that will need additional management measures.

The Piney Branch subwatershed is covered by almost 23 percent impervious surface. This impervious surface is highly concentrated in the headwaters of the subwatershed. Over one-third of Piney Branch is medium or high-density residential land use, followed by 10 percent commercial and industrial. The southern part of Piney Branch subwatershed encompasses part of the Town of Vienna.

Catchment DFPB0001, located in the vicinity of Maple Avenue and the W&OD Trail, has several commercial, industrial, and high-density residential areas. Refer to DFPB_4 for the catchment locations. Because runoff from commercial, industrial, and high-density residential areas has a higher chance of carrying **pollutants** than lower density residential or open space, **catchment** DFPB0001 has the second worst modeled water quality in the subwatershed. The other southern-most catchment is DFPB9801, found between Malcolm Road and Maple Avenue, has the highest nitrogen loading in the subwatershed. DFPB9801 has a high percentage of commercial area, so it also has the highest runoff volume per year and peak in the subwatershed because there is more impervious area associated with commercial areas than residential areas. Results can be seen in Table 3.53.

Table 3.53 Existing and Future Modeling

Piney Branch Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFPB0001	E	6.89	0.18	138.5	6.3	0.9
	F	7.26	0.19	154.9	7.1	1.1
	C	5%	6%	12%	13%	22%
DFPB0002	E	5.56	0.25	81.5	4.4	0.8
	F	5.74	0.26	89.9	4.8	0.9
	C	3%	4%	10%	9%	13%
DFPB0004	E	2.4	0.13	24.9	1.4	0.3
	F	2.49	0.13	30.3	1.6	0.3
	C	4%	0%	22%	14%	0%
DFPB0005	E	1.85	0.15	17.1	0.9	0.2
	F	1.92	0.15	22.9	1.2	0.2
	C	4%	0%	34%	33%	0%

Piney Branch Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFPB9501	E	2.97	0.13	25.6	1.4	0.3
	F	3.7	0.12	37.6	2.0	0.4
	C	25%	-8%	47%	43%	33%
DFPB9601	E	3.26	0.14	28.6	1.5	0.3
	F	3.41	0.14	36.1	1.9	0.3
	C	5%	0%	26%	27%	0%
DFPB9701	E	4.32	0.15	64.7	3.5	0.7
	F	5.04	0.17	87.3	4.7	1.0
	C	17%	13%	35%	34%	43%
DFPB9801	E	6.14	0.27	128.1	5.5	0.8
	F	6.75	0.3	149.3	6.4	1.0
	C	10%	11%	17%	16%	25%
DFPB9802	E	4.59	0.2	67.0	3.4	0.6
	F	4.94	0.21	75.5	3.9	0.7
	C	8%	5%	13%	15%	17%
DFPB9803	E	3.18	0.16	35.6	2.0	0.4
	F	3.71	0.16	54.1	2.8	0.5
	C	17%	0%	52%	40%	25%
DFPB9901	E	4.19	0.15	63.5	3.5	0.7
	F	4.4	0.15	69.0	3.8	0.8
	C	5%	0%	9%	9%	14%

E – Existing conditions results, F – Future conditions results, C – Change between existing and future shown as a percentage of the existing condition. Value is based on unrounded figures

Future model results show moderate increases in flows and runoff pollutant loads from all catchments in the subwatershed. In the more developed areas, this is due to changes from low density to medium density residential. In the less developed areas, forecast changes from open space or estate residential to low density residential is the cause.

3.29.8 Hydraulic Modeling

Hydraulic modeling combines topography with information concerning the stream system, the stream crossings and culverts to estimate the depth and speed of flow within the stream for various storm events. The model results indicate where overtopping of culverts may occur. These culverts are over-capacity and do not allow all of the flow required to pass without flooding. These sites can present a hazard and are considered candidate sites for improvement, further study and possibly a project to replace or retrofit the culvert.

One culvert in the subwatershed overtopped with existing flows, as shown in Table 3.54. Road crossings that experience overtopping are listed in Appendix F and it is anticipated that improvements will be pursued with VDOT independent of the watershed planning process.

Table 3.54 Culvert Hydraulic Modeling

Culvert	Crossing		Flood Year						
			100	50	25	10	5	2	1
25-A	Lawyers Road	E	x	x	x				

E – Existing conditions results, x – indicates overtopping

Culvert #25-A (Photo 3.92) overtopped for the 25, 50, and 100-year events. Lawyers Road has a classification of "primary," which requires the culvert to pass the 25-year event.

Photo 3.92 Piney Branch tributary at Lawyers Road.

3.29.9 Candidate Sites for Improvements

Based on the review of the assessment data and modeling results, the most serious problem areas in the Piney Branch subwatershed are listed below. Refer to DFPB_4 for site numbers and locations. (S - stream sites, C - catchment sites, D – unconstructed regional pond replacement sites, F – flooding sites, and P – preservation sites).

<u>Streams</u>

S110 The Stream Physical Assessment survey indicated that there was severe streambank erosion just upstream from confluence with Difficult Run, west of Fosbak Drive (Photo 3.87).

S111 During the Stream Physical Assessment, field crews noted an exposed sanitary line that should be examined and corrected (Photo 3.89).

S112 During the Stream Physical Assessment survey, riparian buffer was noted as being encroached upon by lawns and pavement. The Stream Physical Assessment survey indicated that streambank erosion was severe or extreme, channel was widening, and habitat was Poor to Very Poor.

S134 The site is located downstream of and within catchments with high runoff volume and near obstructions identified during the Stream Physical Assessment (Photo 3.88).

Hydrology and Water Quality

C29 (Catchment DFPB9701) This catchment has average peak flow velocities, but they are significant enough to cause scour and erosion along stream banks and at outfalls. Also, the existing pond at the top of the stream shows signs of excessive flows and the spillway appears to be in use often.

C30 (Catchment DFPB0001) This catchment has one of the highest modeled pollutant load for both nitrogen and phosphorus. It also has one of the highest runoff volumes and peak flows.

C66 (Catchment DFPB0002) This catchment has one of the highest modeled runoff volumes and peak flows. It also has higher than average pollutant loads.

D27 (Catchment DFPB9501) This catchment has below average pollutant loading, peak flows, and runoff volume. This is the site of unbuilt regional pond D-27.

D29 (Catchment DFPB9802) This catchment has average peak flow. This is a moderately developed area and the higher peak flows could contribute to the loss of buffer at S134 within the catchment. This is the site of unbuilt regional pond D-29.

D73 (Catchment DFPB9801) This catchment has one of the highest runoff volumes, peak flows, and pollutants loads in the subwatershed. The high peak flows could potentially contribute to the loss of buffer at S134 and outlet erosion at D-29. This is the site of unbuilt regional pond D-73.

D74 (Catchment DFPB9901) This catchment has moderate runoff volume and peak flow. Most of the stormwater network is piped with outfalls in close proximity to one another. The flow could potentially contribute to the exposure of the utility at S111. This is the site of unbuilt regional pond D-74.

Flooding

F25A The crossing of Lawyer's Road was overtopped for 25-year and greater events. Since it is classified as a primary road, the culvert should pass the 25-year event (Photo 3.92).

Preservation

No preservation candidate sites were identified for this subwatershed.

3.30 Piney Branch - Subwatershed Plan Action

In the previous subwatershed condition section, information from stream assessments, monitoring studies, and watershed modeling was presented to identify the location and severity of watershed impairments. For the subwatershed action plan section that follows, the candidate sites for improvement are discussed in terms of the specific impairment, a description of the project, and the goal of the project. Table 3.55 below is a list of all projects proposed in this subwatershed.

Table 3.55 Recommendations for Piney Branch

Project #	Project Type	Candidate Site
DF9027A	Culvert Retrofit	D-27
DF9027B	Drainage Retrofit	D-27
DF9029A	Drainage Retrofit	D-29
DF9029B	New Pond	D-29
DF9073A	LID Retrofit	D-73
DF9073B	Drainage Retrofit	D-73
DF9073C	Pond Retrofit	D-73
DF9074A	Drainage Retrofit	D-74
DF9129	Pond Retrofit	C29
DF92110	Stream Restoration	S110
DF9729	Drainage Retrofit	C29
DF9730	Drainage Retrofit	C30
DF9830	LID Retrofit	C30

3.30.1 Regional Pond Alternative Projects

D27 (DFPB9501)

Site Investigation and Projects:

DF9027A (Culvert Retrofit) This project would use two existing roadway embankments to create detention ponding areas. The primary goal of these retrofits will be to provide storage for channel protection.

DF9027B (Drainage Retrofit) These distributed projects are designed to provide energy dissipation at outfalls where the piped storm drain systems or paved channels discharge to a natural channel. Additionally, paved roadside ditches will be replaced with dry swale systems with an underdrain to provide water quality treatment.

D29 (DFPB9802)

Site Investigation and Projects:

DF9029A (Drainage Retrofit) These projects found throughout the catchment are designed to provide adequate energy dissipation where the drainage network discharges into the floodplain. Options include drop structures, plunge pools, bioengineering, or larger stone.

DF9029B (New Pond) This project is a modified regional pond at the original D-29 site, designed to store runoff for channel protection and reduce erosive streamflows downstream.

D73 (DFPB9801)

Site Investigation and Projects:

DF9073A (LID Retrofit) This project would consist of retrofitting both Madison High School and Flint Hill Elementary School with low impact development structures to reduce runoff volume and pollutant loads as close to the source as possible. Possible improvements include reduction of impervious surface, bioretention, swales, green roofs, and inlet filters.

DF9073B (Drainage Retrofit) The project is intended to replace a concrete channel and an armored, straightened stream with more natural drainage. The upstream flume would be removed and replaced with a dry swale. The lower reach would be reconstructed as a natural stream channel with step pools to reduce flow velocity

DF9073C (Pond Retrofit) This projects consists of redirecting the stream into an already existing farm pond, forming an in-stream pond. The proposed retrofit would consist of reconstructing the diversion structure and providing a riser for outlet control to allow the pond to function as water quality treatment for the first flush.

D74 (DFPB9901)

Site Investigation and Projects:

DF9074A (Drainage Retrofit) This project would consist of adding outlet protection as well as stream stabilization to several reaches throughout the catchment to reduce the scour and erosion within the channels.

3.30.2 Catchment Improvement Projects

C29 (DFPB9701)

Site Investigation and Projects:

DF9129 (Pond Retrofit) This project would consist of reconstructing an existing pond by installing a new, multi-stage riser and excavating to maximize storage within the facility boundaries. Grading a flat area at the base of the riser will create a wet marsh that will promote vegetative uptake of nutrients and settling of sediment.

DF9729 (Drainage Retrofit) This project would consist of energy dissipation at outfalls to reduce scour and erosion in the stream.

C30 (DFPB0001)

Site Investigation and Projects:

DF9730 (Drainage Retrofit) This project would consist of energy dissipation at outfalls to reduce scour and erosion in the stream.

DF9830 (LID Retrofit) This project consists of onsite LID retrofits along Maple Avenue and the W&OD Trail designed to reduce runoff volume and pollutant loads

as close to the source as possible. Possible improvement measures include reduction of impervious surface, bioretention, swales, and inlet filters.

C66 (DFPB0002)

Site Investigation and Projects: Field investigation of this catchment revealed no areas where improvements can be implemented, so no projects are identified for this catchment.

3.30.3 Stream Restoration Projects

S110

Site Investigation and Projects: The site investigation showed a straightened portion of Piney Branch adjacent to railroad bed converted to a pedestrian trail. The bank was artificially stabilized adjacent to the railroad bed. The reach is slightly incised. One project was identified.

> *DF92110 (Stream Restoration)* The proposed restoration would stabilize one reach with imbricated rip-rap to protect the trail, and reconstruct another to provide a pattern, dimension, and profile more consistent with a natural system.

S111

Site Investigation and Projects: The site investigation showed an exposed sanitary line. The stream reach was relatively stable and the pipe did not appear to pose a significant risk. Additional rock placement around the pipe as ongoing maintenance would provide further protection, but no specific project was identified for the watershed management plan.

S112

Impairment: [sample verbiage] At the time of the Stream Physical Assessment, deficient buffers were noted; however, field investigations conducted during the watershed plan development process indicate that these areas don't appear to warrant a restoration project at this time.

S134

Site Investigation and Projects: The site investigation showed a small area of the buffer that was mowed. However, it is located within a gas easement and would most likely need to be maintained in its current state. No project was identified.

3.30.4 Preservation

No preservation candidate sites were identified for this subwatershed.