3.37 Rocky Branch – Subwatershed Condition

3.37.1 Subwatershed Characteristics

The Rocky Branch **subwatershed** has an area of approximately 2,167 **acres** (3.39 mi^2) with its eastern boundary running closely along Chain Bridge Road (Virginia 123). The southern boundary touches I-66, and the northern boundary is approximately located at the intersection of Vale Road (Virginia 672) and Hunter Mill Road (Virginia 674). The western boundary is approximately the Difficult Run Stream Valley Park.

There are almost 9 miles of stream in the Rocky Branch subwatershed. They flow in a northwesterly direction until they join with the mainstem of Difficult Run. Rocky Branch is composed of two major tributaries.

Refer to DFRB_1 for a map of the Rocky Branch subwatershed highlighting the Subwatershed Characteristics including, existing **land use**, **flood limit**, **wetlands**, **resource protection areas** and **stormwater management**.

3.37.2 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 development in the Rocky Branch subwatershed is moderately dense. Fifty percent is developed as low-density or estate residential while 3 percent of the subwatershed is developed for commercial or industrial uses. The most common land use in this subwatershed is low-density residential, which makes up 36 percent of the total. Much of the development is found concentrated along Chain Bridge Road (Virginia 123) in the southern portion of the subwatershed, and along Hunter Mill Road (Virginia 674).

Transportation use, such as roads and highways, make up 223 acres, or 10 percent of the overall subwatershed. Total impervious area for the subwatershed, which includes all roads, parking lots, residential driveways and buildings, is approximately 376 acres, or 17 percent of the total subwatershed area.

Fifteen percent of the land in the subwatershed is preserved for open space or parks. Major parks include Tattersall Park, Oak Marr Park, Oakborough Square Park, Ashlawn Park, and a portion of Kemper Park. There are two historical sites within the subwatershed.

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. A summary of land use within the subwatershed can be found in Table 3.68.

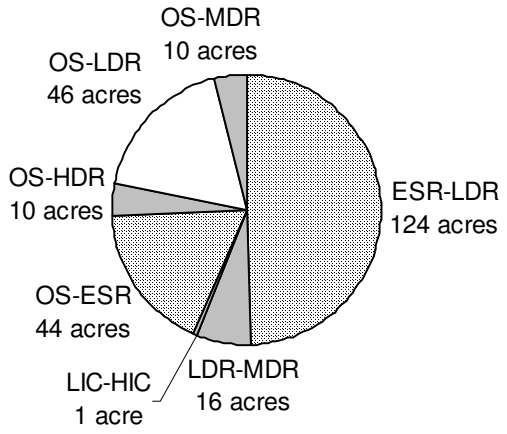
Table 3.68 Existing and Future Land Use

Land Use Type	Existing		Future		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Open space, parks, and recreational areas	322	15%	213	10%	-109	-5%
Golf Course	71	3%	71	3%	0	0%
Estate residential	296	14%	215	10%	-80	-4%
Low-density residential	780	36%	934	43%	154	7%
Medium-density residential	268	12%	293	14%	26	1%
High-density residential	53	2%	62	3%	10	0%
Low-intensity commercial	7	0%	6	0%	-1	0%
High-intensity commercial	64	3%	65	3%	1	0%
Industrial	0	0%	0	0%	0	0%
Institutional	84	4%	84	4%	0	0%
Transportation	223	10%	223	10%	0	0%
Water	0	0%	0	0%	0	0%
Total	**2,167**	**100%**	**2,167**	**100%**		**0%**

When comparing existing land use to future land use, there are several land use changes. The notable changes are projected in the open space, estate residential, and low-density residential land use categories. Losses projected in the open space (-5 percent) and estate residential (-4 percent) categories are balanced with gains in the low-density residential (+7 percent) and medium-density residential (+1 percent) categories. This suggests that there is a demand to increase the density of the housing base in the Rocky Branch subwatershed.

According to Figure 3.28, 124 acres are projected to shift from estate residential in the existing land use to low-density residential in the future land use. A total of 110 acres, or 44 percent of all land use changes, are projected to shift from open space in to a residential use. This open space area can be used for development/ redevelopment in the future if and when the need presents itself.

Figure 3.28: Changed Land Use



3.37.3 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 33 **stormwater management facilities** within the Rocky Branch subwatershed. Seventy-five percent of the Rocky Branch subwatershed is not served by any stormwater management facility. Twenty percent of the total area has quantity control only and the remaining 5 percent receives both **quantity and quality control**. A list of all stormwater management facilities in the Rocky 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. Field crews located seven **outfall** pipes during the Stream Physical Assessment discharging into the Rocky Branch tributaries. No pipes had significant impact, such as erosion or water quality issues, on the stream channel

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. The Stream Physical Assessment fieldwork identified 34 stream crossings in Rocky Branch, all of which were in adequate condition and have less than a moderate impact on the stream's integrity. The majority of the crossings (approximately 44 percent) were footbridges.

3.37.4 Soils

Soils found in the Rocky 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 42 percent of the B hydrologic soil group with Glenelg silt loam being the dominant soil type (28 percent). Zones with Glenelg, Manor and Elioak soils may be compatible with infiltration practices. Soils that cover at least 20 acres within the subwatershed can be found in Appendix A.

3.37.5 Geomorphology

All 8.7 miles (46,291 feet) of stream channels in the Rocky 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. Refer to DFRB_3 for the stream classifications.

Photo 3.123 Erosion point on a tributary off of the mainstem of Rocky Branch. East of Oakton Ridge Court in the Oakton Mill Estate subdivision (DFRB010.E001)

Fifty-six percent of the reaches are Type III, which is indicative of an actively widening stream channel. Thirty-seven percent are Type II, which indicates the active incistion and the remainder of the reaches (7 percent) is Type IV, which is the stage where the stream is recovering and developing a new floodplain.The dominant substrate in the majority (78 percent) of reaches is a combination of gravel and silt. The dominant substrate types in the remaining 22 percent of reaches are sand (17 percent) and clay (4 percent).

There were 15 erosion points of approximately 12,095 feet noted in the subwatershed. Seventy-one percent of the erosion points are having a severe impact on stream condition.

Eighty-one percent of the stream length was classified as moderately unstable with high erosion potential during flood events. Seventeen percent of the stream length was moderately stable with only slight potential for erosion at flood stages. Several of the erosion points are shown in Photos 3.123 to 3.126. Photos 3.123, 3.127 and 3.130 are candidate site S127. Photos 3.125 and 3.126 are candidate site S128. Photo 3.128 is candidate site S128. Candidate site S130 is shown in Photos 3.124 and 3.131.

Photo 3.124 Erosion point on the west side of Hunter Mill Road at the intersection with Conejo Land (DFRB012.E001).

Photo 3.125 On a tributary northwest of the cul-de-sac of Westhurst Court in the Windsong community. (DFRB015.E001).

Photo 3.126 On a tributary northwest of the cul-de-sac of Westhurst Court in the Windsong community. (DFRB015.E002).

Photo 3.127 Obstruction on a tributary to Rocky Branch, directly east of Oakton Ridge Court in the Oakton Mill Estates (DFRB010.T001).

There were eight stream blockages made up mostly of trees and debris. Twenty-five percent of the obstructions appeared to be restricting fish passage. Sixty-three percent of the obstructions were causing moderate erosion to the stream. One obstruction was causing greater than moderate erosion. This one is shown above in Photo 3.127 (candidate site S128)

3.37.6 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 winter of 2002/2003.

Photo 3.128 Buffer impairment south of Miller Road in the Flint Hill Lower and Middle Campus (DFRB004.B001)

Photo 3.129 Buffer encroachment on a tributary south of Marbury Road in the Hunting Hills subdivision (DFRB016.B002).

- Of the assessed reaches, 59 percent has Poor habitat for aquatic insects and fish. There are 25,505 feet of **riparian buffer** encroachment (this length includes left and right banks combined). Of this, 18,800 feet (74 percent) is a combination of **pervious** surfaces, and the remaining 6,705 feet (26 percent) is some combination of impervious and pervious surfaces. Seventy-eight percent of the length has moderate to high restoration potential. Eight reaches, or 34 percent of the buffer encroachment length was severe enough that the stream conditionwas being degraded. Several buffer impacts are shown in Photos 3.128 to 3.131. Photo 3.129 is candidate site S130.
- Seventy-one percent of the stream had some channelization present. In 28 percent of the stream, there were some minor alternations to the channel, but no recent evidence of alteration activities.

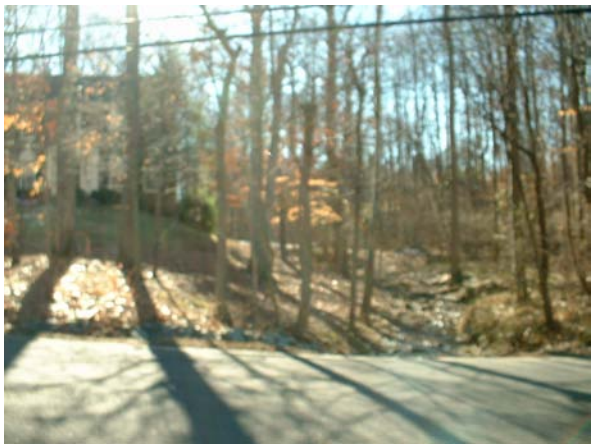


Photo 3.130 Buffer impairment south of Miller Road in the Windsong community (DFRB014.B001).

Photo 3.131 West side of Hunter Mill Road, south of intersection with Conejo Lane (DFRB012.B001)

- Forty-seven percent of the 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. Forty percent of the stream length had a variety of vegetation and covered 70 percent to 90 percent of the stream bank surface. Thirteen percent of the stream length had less than 50 percent of the stream bank covered by vegetation.

3.37.7 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 Rocky 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.

In the Rocky Branch subwatershed, over 17 percent of the land is covered by impervious surface. More than 50 percent of the subwatershed is either low density or estate residential land use. There are also a few commercial areas located in the southern part of the subwatershed as well as high-density residential areas.

The nitrogen and phosphorus loading rates are highest in **catchment** DFRB0005, located to the east of Hunter Mill Road and Marbury Road. Refer to DFRB_4 for the catchment locations. The highest amount of nitrogen from runoff comes from this catchment, which contains mostly medium-density residential areas around Lake Vale Estates and Vienna Glen, as well as a high-density residential area along Chain Bridge Road. The phosphorus

levels fluctuate with the nitrogen levels throughout the catchment. Catchment DFRB0004 has the highest runoff volume probably due to the lack of open space, along with the abundance of medium and low-density residential land use. Refer to Table 3.69 for the results.

Table 3.69 Existing and Future Modeling

Rocky Branch Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFRB0001	E	1.73	0.16	20.8	1.0	0.2
	F	1.96	0.17	24.9	1.2	0.2
	C	13%	6%	20%	20%	0%
DFRB0002	E	2.22	0.15	18.9	1.0	0.2
	F	2.36	0.16	20.6	1.1	0.2
	C	6%	7%	9%	10%	0%
DFRB0004	E	3.99	0.13	50.3	2.7	0.6
	F	4.12	0.14	53.3	2.8	0.6
	C	3%	8%	6%	4%	0%
DFRB0005	E	4.19	0.13	63.1	3.2	0.6
	F	4.47	0.14	69.5	3.5	0.7
	C	7%	8%	10%	9%	17%
DFRB0006	E	3.19	0.12	42.8	2.2	0.4
	F	3.37	0.12	46.9	2.5	0.5
	C	6%	0%	10%	14%	25%
DFRB0007	E	2.67	0.1	26.9	1.4	0.3
	F	2.87	0.11	30.0	1.6	0.3
	C	7%	10%	12%	14%	0%
DFRB0008	E	2.35	0.16	16.5	0.9	0.2
	F	2.47	0.16	17.6	0.9	0.2
	C	5%	0%	7%	0%	0%
DFRB9801	E	4.78	0.12	84.0	3.4	0.5
	F	4.99	0.13	91.7	3.8	0.5
	C	4%	8%	9%	12%	0%
DFRB9802	E	2.29	0.16	22.7	1.3	0.3
	F	2.45	0.16	25.1	1.4	0.3
	C	7%	0%	11%	8%	0%
DFRB9901	E	5.72	0.15	106.6	4.3	0.5
	F	6.27	0.17	123.3	5.0	0.6
	C	10%	13%	16%	16%	20%

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.

Modeling results for future conditions show moderate increases in pollutant loads and in runoff volume in all catchments, most due to increases in residential density on already developed parcels.

3.37.8 Hydraulic Modeling Results

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. The capacity of the culverts is not enough that flow passes 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 was overtopped with existing flows, as shown in Table 3.70. 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 3.70 Culvert Hydraulic Modeling

			Flood Year						
Culvert	Crossing		100	50	25	10	5	2	1
17	Miller Road (663)	E	x	x	x	x	x		

E – Existing conditions results, x – indicates overtopping

Culvert #17 (Photo 3.132) overtopped for events less frequent than the 5-year storm. This can be classified as a local road, which means the culvert should be able to pass the 10-year event.

Photo 3.132 Rocky Branch tributary at Miller Road

3.37.9 Candidate Sites for Improvements

Based on the review of the assessment data and modeling results, the most serious problem areas in the Rocky Branch subwatershed are listed below. Refer to DFRB_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>

S47 The Stream Physical Assessment identified the entire reach from the confluence with Difficult Run to the upstream reaches at Oakton Glen Road as having Poor habitat, low bank stability, and a widening channel.

S127 The Stream Physical Assessment identified Poor habitat, 2700 feet of buffer impact and over 1,000 linear feet of erosion along Miller Road (Photo 3.128).

S128 The entire length from the confluence with Difficult Run to the headwaters has a combination of bank erosion, Poor habitat and a widening channel. The reach traverses the Oakton Mill Estates, Miller Heights, and Windsong Communities (Photos 3.123, 3.127 and 3.130).

S129 A small tributary to one of the major Rocky Branch tributaries with Poor habitat, low bank stability, and approximately 400 linear feet of severe erosion (Photo 3.125 and 3.126).

S130 The Stream Physical Assessment located approximately 1,000 feet of buffer encroachment in the Hunter Hills community. The reach appears to be on an agricultural land use (Photo 3.129).

S131 The Stream Physical Assessment identified the reach as having poor bank stability, Poor habitat, buffer impacts, eroding banks and several crossings (Photo 3.124 and 3.131).

Hydrology and Water Quality

D30 (Catchments DFRB0004 and DFRB0005) These two catchments have some of the highest levels of runoff volume, peak flows, and runoff pollutant loads in the subwatershed. While no candidate stream sites are downstream, the entire tributary through these catchments and downstream was found to have severe erosion, widening, and Poor habitat.

D31 (Catchments DFRB9801 and DFRB9802) Runoff hydrology is relatively high and pollutant loadings are among the lower in the subwatershed. Streams within these catchments are undergoing erosion and widening, particularly at site S130.

D36 (Catchment DFRB0001) Runoff volume and peaks are high in this catchment. Streams within the catchment are undergoing erosion and incision, and peak flows are contributing to stream degradation downstream.

C39 (Catchment DFRB9901) Model results were about average for the subwatershed. The catchment includes highly impervious areas of Oakton built with either no stormwater management or scattered quantity control practices. Streams through the catchment are eroding, have Poor habitat, and degraded buffers.

Flooding

F17 The crossing of Miller Road was overtopped for 5-year and greater events. Since it is classified as a local road, the culvert should pass the 10-year event (Photo3.132).

Preservation

P02 (DFRB0008) This catchment has the best modeled water quality in the subwatershed, but shows runoff pollutant loads more than doubling between existing and future conditions.

P03 (DFRB9901) Model results show Catchment site C39 would have the worst runoff pollutant loads of the subwatershed under future conditions.

3.38 Rocky 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 3.71 below is a list of all projects proposed in this subwatershed.

Table 3.71 Recommendations for Rocky Branch

Project #	Project Type	Candidate Site
DF9030A	Pond Retrofit	D-30
DF9030B	Drainage Retrofits	D-30
DF9031A	Pond Retrofit	D-31
DF9031C	LID Retrofit	D-31
DF9036A3	Pond Retrofit	D-36
DF9139	Pond Retrofit	C39
DF92130	Stream Restoration	S130
DF92131	Stream Restoration	S131
DF9839	LID Retrofit	C39

3.38.1 Regional Pond Alternative Projects

D30 (DFRB0004 and DFRB0005)

Site Investigation and Projects: The field investigation showed few opportunities for onsite stormwater management retrofits because of the relatively dense residential neighborhoods in this catchment. Much of the area is managed by stormwater management facilities. One pond retrofit, a new pond, and a drainage retrofit project were proposed.

> *DF9030A (Pond Retrofit)* The existing dry pond at the end of Martinhoe Court can be converted into a shallow wetland with vegetation throughout for water quality improvement. The project would retrofit the facility to improve water quantity treatment with a modified riser structure.
>
> *DF9030B (Drainage Retrofits)* This project consists of reconfiguring outfalls or retrofitting energy dissipation structures to reduce scour and erosion where flows from the storm drainage system enter the stream. Improvements would consist of energy dissipation through riprap, plunge pools, or bioengineered structures.

D31 (DFRB9801 and DFRB9802)

Site Investigation and Projects: Two existing ponds, which could be upgraded for water quality treatment, were identified during the field investigation, along with a site for an LID retrofit.

> *DF9031A (Pond Retrofit)* There is an existing dry pond at the outlet of the drainage area, which can be retrofit for channel protection and water quality treatment, using the existing impoundment structure and a weir across the upstream side.

DF9031C (LID Retrofit) This project is located at the intersection of Oakton Ridge Circle and Oakton Ridge Court. It consists of replacing a grass swale with a bioswale designed to provide infiltration, filtration, and nutrient uptake.

D36 (DFRB0001)

Site Investigation and Projects: The site investigation identified a pond retrofit project that could improve stream conditions below the drainage area.

DF9036A3 (Pond Retrofit) This project receives direct runoff drainage from a residential community as well as draining the remainder of the catchment. The project would provide sediment settling and nutrient removal in the form of forebays and increased detention of high frequency storms.

3.38.2 Catchment Improvement Projects

C39 (DFRB9901)

Site Investigation and Projects: Field visits showed impairments from excess nutrients in the stream, along with the ones described above. Two projects are proposed to improve catchment conditions.

DF9839 (LID Retrofit) This project consists of onsite LID retrofits distributed throughout the catchment, 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.

DF9139 (Pond Retrofit) This project is located near the intersection of Rosehaven Street and Jermantown Road and consists of creating detention by constructing a multi-stage riser. Focus would be on increasing storage volume for channel protection and minimizing impacts to surrounding buildings.

3.38.3 Stream Restoration Projects

S47

Site Investigation and Projects: The site investigation showed slight bank erosion, slight incision and good riffle pool morphology. The reach appears to be recovering and access, forest clearing, and wetlands are significant restraints, so no project was identified.

S127

Site Investigation and Projects: The site investigations showed moderately unstable stream banks with some widening and floodplain benching and stable bed features. Forest clearing and wetland impacts would be required for implementation. The constraints outweigh opportunities associated with streambank stabilization. No project was identified. The pond retrofit project (DF9036A3) located directly downstream should accommodate the remaining sediment until the stream fully recovers.

S128

Site Investigation and Projects: The site investigation found some bank erosion associated with outer meander bends, moderate floodplain development and stable bed features. As the channel appears to be recovering, no project was identified.

S129

Site Investigation and Projects: The site investigation found unstable and eroding banks, moderate incision and widening, and three **headcut**s at the upstream end of the reach. The

stream is still actively downcutting. However, severe wetlands, forest clearing, and access constraints make a project unfeasible, so no project was identified.

S130

Site Investigation and Projects: The site investigation showed vertical eroding stream banks, moderate to severe incision, and straight plan form. The streambed was primarily one long run and lacked riffle pool morphology. One project was identified

> *DF92130 (Streambank Restoration)* The proposed restoration would involve re-meandering the stream to provide a pattern, dimension, and profile more consistent with a natural stream. A forested buffer would be established. Existing fences would have to be set back to implement the project.

S131

Site Investigation and Projects: The site investigation showed vertical eroding stream banks and moderate to severe incision. The streambed was primarily one long run and lacked riffle pool morphology. One project was identified

> *DF92131 (Streambank Restoration)* The proposed restoration would involve re-meandering the stream to provide a pattern, dimension, and profile more consistent with a natural stream. A forested buffer would be established. Existing homeowner landscaping would have to be removed to implement the project.

3.38.4 Preservation

No preservation candidate sites were identified for this subwatershed.