3.31 Little Difficult Run – Subwatershed Condition

3.31.1 Subwatershed Characteristics

The Little Difficult Run **subwatershed** has an area of approximately 2,590 **acres** (4.05 mi^2). The western most boundary runs along the Reston Parkway (Virginia 602). The northern most boundary runs along Lawyers Road (Virginia 673). The southern most boundary lies south of Stuart Mill Road (Virginia 669). The eastern most boundary is where Stuart Mill Road (Virginia 669) makes a hairpin turn southward.

There are just over 10 miles of stream in the Little Difficult Run subwatershed. The streams flow in a northeasterly direction. South Fork Run joins Little Difficult Run near Mattox Creek Road. Further downstream Little Difficult Run joins the mainstem of Difficult Run in Polo Place.

Refer to DFLD_1 for a map of the Little Difficult Run subwatershed highlighting the Subwatershed Characteristics including, existing **land use**, **flood limit**, **wetlands**, **resource protection areas** and **stormwater management**.

3.31.2 Existing and Future Land Use

The Little Difficult Run subwatershed consists of mainly low density development. The density is equally dispersed throughout the subwatershed. Most of the land uses are residential. Fifty-five percent of the land is developed as low-density or estate residential while only one percent of the subwatershed is developed for commercial or industrial uses. There is no major concentration of development in this subwatershed. It is equally dispersed around the Fox Mill District Park and portions of the Difficult Run Stream Valley Park.

Transportation use, such as roads and highways, make up for 196 acres, or 8 percent of the overall subwatershed. Total **impervious** area for the subwatershed, which includes all roads, parking lots, residential driveways and buildings, is approximately 272 acres, or 11 percent of the total subwatershed area.

Thirty percent of the land in the subwatershed is preserved for open space or parks. Major parks include Fox Mill District Park and the Little Difficult Run Stream Valley Park. One historical site lies within the subwatershed.

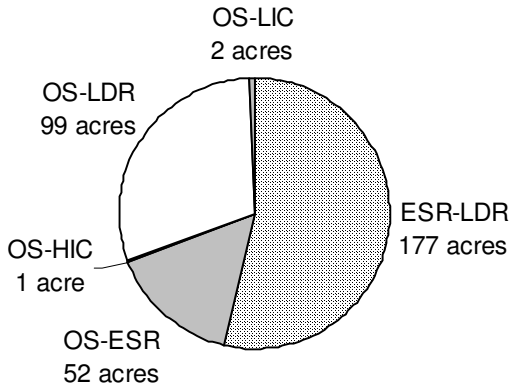
When comparing existing land use to future land use, there are few land use changes. The notable changes are projected in the open space, estate residential, and low-density residential land use categories. Losses projected in the open space (-6 percent) and estate residential (-5 percent) categories will be met with gains in the low-density residential (+11 percent) category. This shift shows the demand for higher-density housing in the Little Difficult Run subwatershed. A summary of land use within the subwatershed can be found in Table 3.56.

Table 3.56 Existing and Future Land Use

Land Use Type	Existing		Future		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Open space, parks, and recreational areas	777	30%	624	24%	-153	-6%
Golf Course	0	0%	0	0%	0	0%
Estate residential	564	22%	438	17%	-126	-5%
Low-density residential	857	33%	1133	44%	276	11%
Medium-density residential	161	6%	162	6%	0	0%
High-density residential	0	0%	0	0%	0	0%
Low-intensity commercial	10	0%	12	0%	2	0%
High-intensity commercial	4	0%	4	0%	1	0%
Industrial	2	0%	2	0%	0	0%
Institutional	16	1%	16	1%	0	0%
Transportation	196	8%	196	8%	0	0%
Water	3	0%	3	0%	0	0%
Total	**2,590**	**100%**	**2,590**	**100%**		**0%**

One-hundred and seventy-seven acres are projected to shift from estate residential in the existing land use to low-density residential in the future land use. Ninety-nine acres are projected to shift from open space in the existing land use to low-density residential in the future land use. This does not guarantee that the open space will become developed; it suggests that these areas of open space can be used for development/redevelopment to a higher-density use in the future.

Figure 3.25: Changed Land Use



3.31.3 Existing Stormwater Management

County records indicate that there are eight stormwater management facilities within the Little Difficult Run subwatershed. Eighty-six percent of the Little Difficult Run subwatershed is not served by any stormwater management facility. Eleven percent of the total area has quantity control only and the remaining three percent receives both **quantity and quality control**.

The difference between the amount of total developed area in the subwatershed (70 percent) and the area served by stormwater management (14 percent) indicates a potential for impairment due to uncontrolled stormwater and a possible need for additional management efforts, specifically in the industrial, commercial and medium-density residential areas. A list of all stormwater management facilities in the Little Difficult Run 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 11 **outfall** pipes discharging into the Little Difficult Run subwatershed. Most of the pipes were causing minor or no erosion to the streambed or banks; however, one pipe discharging from a neighborhood road was creating major erosion.

Photo 3.93 Pipe near the end of Checkerberry Court near Blue Smoke Trail (DFLD014.P001)

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 results indicate 42 crossings in the Little Difficult Run subwatershed at the time of assessment. The majority (55 percent) of the crossings were circular pipe culverts. Most of the crossings (74 percent) had no significant impact on stream condition, while 24 percent were having some impact on the stream, such as evidence of erosion or sedimentation downstream. One of the concrete circular crossings, shown in Photo 3.94, has sedimentation problems upstream and downstream of the culvert that could block the stream flow and cause a flooding hazard.

Photo 3.94 Crossing under Fox Mill Road north of Shady Mill Lane. Crossing has excessive sedimentation (DFLD015.C002).

3.31.4 Soils

Soils found in the Little Difficult Run 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 74 percent of the B hydrologic soil group with Glenelg silt loam being the dominant soil type (57 percent). Zones with Glenelg, Manor and Elioak soils may be compatible with infiltration practices. There are 8.62 acres of land with unclassified soils in the Little Difficult Run subwatershed. Soils that cover at least 20 acres within the subwatershed can be found in Appendix A.

3.31.5 Geomorphology

The streams in Little Difficult Run were assessed and assigned a **Channel Evolution Model** classification as part of the Stream Physical Assessment. There are a total of 53,502 linear feet (approximately 10 miles) of stream in the Little Difficult Run subwatershed. Of this length, two reaches (3,073 feet) were not assessed because they were a concrete drainage ditch with **riprap**, and a pond / wetland. Refer to DFLD_3 for the stream classifications.

Most **channels** (68 percent) were classified as Type III, which indicates an unstable channel that is actively widening in response to changes in stream flow.stream channel. The remaining 32 percent of the reaches are Type IV, which is the onset of channel stabilization. The majority (88 percent) of the reaches have a gravelly **substrate**. The remaining reach substrates are dominated by sand, silt or cobble.

Photo 3.95 Eroding bank directly north of the terminus of Hollybrook Place in the Hollybrook subdivision (DFLD004.E001).

Photo 3.96 Erosion area at the end of Millstream Court, in Little Difficult Run Stream Valley Park (DFLD024.E001).

Photo 3.97 Erosion located on the mainstem of Little Difficult Run, directly east of Colt Run Road in the Roan Stallion Estates subdivision (DFLD013.E001).

Photo 3.98 Headcut located northwest of Fox Mill District Park in the Fox Mill Woods subdivision. Directly east of the intersection of Steeplechase Drive and Aintree Lane (DFLD023.H001).

Sixty percent of the total stream length was moderately unstable with high erosion potential during flood events. Forty percent of the stream length was moderately stable with only

slight potential for erosion at flood stages. There were four specific stream erosion points noted in the Little Difficult Run subwatershed. The combined length of the erosion points is approximately 230 feet. Three of the erosion points are considered severe indicating that erosion may be damaging property and causing instream degradation. All erosion points are considered to have moderate to high restoration potential. These erosion points are shown in Photos 3.95 to 3.97. Photo 3.95 is candidate site S115, 3.96 is candidate site S113, and 3.97 is candidate site S114. There was one **headcut** identified as having a significant impact with a height of 2.5 feet (Photo 3.98).

All but one of the 17 stream blockages was made up of trees and debris. The remaining obstruction was a beaver dam. Sixty-five percent of the obstructions appeared to be restricting fish movement within the stream system, while the rest did not. Streamflow around and over the obstructions is causing only minor amounts of erosion in the majoirity of the obstructed areas, while 23 percent of the obstructed channels are experiencing more significant erosion which can negatively affect the instream habitat. The obstructions have the potential to create flooding problems within the stream system and potentially affect buildings near the stream.

3.31.6 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 and winter of 2003.

- Of the assessed reaches, 60 percent have Fair habitat for aquatic insects and fish, 29 percent have Good habitat, and 21 percent have Poor habitat.
- There are 14,450 feet of **riparian buffer** encroachment in the subwatershed (this length includes left and right banks combined). Of this total, 9,900 feet (69 percent) is a combination of **pervious** surfaces, 1,050 feet (7 percent) is a combination of different impervious surfaces, and the remaining 3,500 feet (24 percent) is some combination of impervious and pervious surfaces. Photos 3.99 above (which is candidate site S116) and 3.100 (which is candidate site S36) and 3.101 below show examples of buffer encroachment.

Photo 3.99 Severe buffer encroachment (in background) Little Difficult Run Stream Valley Park, directly south of Stuart Mill Road on the mainstem (DFLD011.B001)

- Forty-eight 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. Fifty-two percent of the assessed stream length had a variety of vegetation, and covered 70 to 90 percent of the streambank surface.

Photo 3.100 Buffer encroachment in the Little Difficult Run Stream Valley Park. Directly east of Mill Road and Stuart Mill Road (DFLD003.B001).

Photo 3.101 Buffer impact in the Hollybrook community, directly north of the terminus of Hollybrook Place, mainstem of Little Difficult Run (DFLD003.B002).

3.31.7 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 Little Difficult Run 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 identify that will need additional management measures.

In Little Difficult Run subwatershed, over half of the land use is a lower density residential. Approximately 11 percent of the land is covered by impervious surface. This low imperviousness helps this subwatershed have below average pollutant loads for Difficult Run. See DFLD_4 for the catchment locations.

The poorest rating for water quality in this subwatershed is DFLD9401, located around the intersection of Soapstone Drive and Foxclove Road. DFLD0002, around the western end of Westwood Hills Drive, has one of the highest amounts of runoff volume in the subwatershed, along with DFLD9701 in the Blueberry Farm area between Lawyers Road and Fox Mill Road. Results can be seen in Table 3.57.

Table 3.57 Existing and Future Modeling

Little Difficult Run Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFLD0001	E	1.64	0.12	16.0	0.9	0.2
	F	2.66	0.14	31.8	1.7	0.3
	C	62%	17%	99%	89%	50%
DFLD0002	E	2.07	0.11	22.4	1.2	0.3
	F	2.2	0.12	24.2	1.3	0.3
	C	6%	9%	8%	8%	0%
DFLD0003	E	2.31	0.12	21.5	1.2	0.2
	F	2.58	0.13	26.2	1.4	0.3
	C	12%	8%	22%	17%	50%
DFLD0004	E	1.61	0.1	15.1	0.8	0.2
	F	1.61	0.1	15.1	0.8	0.2
	C	0%	0%	0%	0%	0%
DFLD0005	E	0.92	0.14	6.6	0.3	0.1
	F	1.07	0.14	7.2	0.4	0.1
	C	16%	0%	9%	33%	0%
DFLD0006	E	1.61	0.09	13.5	0.7	0.2
	F	1.69	0.09	14.3	0.8	0.2
	C	5%	0%	6%	14%	0%
DFLD0007	E	1.93	0.12	14.2	0.8	0.2
	F	1.94	0.12	14.4	0.8	0.2
	C	1%	0%	1%	0%	0%
DFLD0008	E	2.01	0.16	16.0	0.9	0.2
	F	2.03	0.16	16.4	0.9	0.2
	C	1%	0%	2%	0%	0%
DFLD9201	E	1.81	0.11	15.8	0.9	0.2
	F	1.84	0.11	16.1	0.9	0.2
	C	2%	0%	2%	0%	0%
DFLD9301	E	1.98	0.12	23.7	1.3	0.3
	F	2.05	0.13	24.0	1.3	0.3
	C	4%	8%	1%	0%	0%
DFLD9401	E	2.75	0.13	32.8	1.8	0.4
	F	2.75	0.13	32.8	1.8	0.4
	C	0%	0%	0%	0%	0%
DFLD9501	E	2.39	0.13	41.9	2.0	0.3
	F	2.39	0.13	41.9	2.0	0.3
	C	0%	0%	0%	0%	0%
DFLD9601	E	2.5	0.13	33.7	1.7	0.3
	F	2.5	0.13	33.7	1.7	0.3
	C	0%	0%	0%	0%	0%
DFLD9701	E	2.68	0.1	28.1	1.5	0.3
	F	2.98	0.11	33.7	1.8	0.3
	C	11%	10%	20%	20%	0%

Little Difficult Run Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFLD9801	E	1.84	0.14	15.5	0.8	0.2
	F	2.86	0.16	31.1	1.7	0.4
	C	55%	14%	101%	113%	100%
DFLD9901	E	2.36	0.13	22.7	1.2	0.2
	F	3.17	0.15	32.6	1.8	0.4
	C	34%	15%	44%	50%	100%

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

The future modeling results show an increase in flow and runoff **pollutants** in all catchments. The large increases in both runoff volume and runoff pollutants, which occur in DFLD0001, DFLD9801, and DFLD9901, are due to a large amount of estate residential and open space changing into low-density residential land use.

3.31.8 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. 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.

Seven culverts in the Little Difficult Run subwatershed overtopped for at least one storm event. These are shown in Table 3.58. 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 3.58 Culvert Hydraulic Modeling

Culvert	Crossing		Flood Year						
			100	50	25	10	5	2	1
3	Stuart Mill Road DS	E	X	x	x	x	x	x	
6	Colt Run Road	E	X	x	x	x	x	x	x
12	Polo Pointe Drive	E	X	x	x				
13	Fox Mill Road North	E	X	x	x	x	x	x	
15-B	Stuart Mill Road US	E	X	x	x	x	x		
16	Fox Mill Road South	E	X	x	x	x	x		
30	Westwood Hills Drive	E	X	x	x	x	x		

E – Existing conditions results, x – indicates overtopping

Culvert #3 (Photo 3.102) overtopped for all events except the one-year. Stuart Mill Road can be considered a primary road, which requires it to pass the 25-year event.

Culvert #6 (Photo 3.103) overtopped for all events. Colt Run Road is a residential access road, classified as local, requiring the culvert to pass the 10-year event. This culvert is candidate site F06.

Photo 3.102 Little Difficult Run at Stuart Mill Road

Photo 3.103 Little Difficult Run at Colt Run Road

Culvert #12 (Photo 3.104) overtopped for the 25, 50, and 100-year events. The culvert at Polo Pointe Drive, a local road, is required to pass the 10-year event. This culvert is not a candidate site.

Culvert #13 (Photo 3.105) overtopped for all events except the one-year. Fox Mill Road is a primary road, and is therefore required to pass the 25-year event.

Photo 3.104 Little Difficult Run tributary at Polo Pointe Drive.

Photo 3.105 Little Difficult Run mainstem at Fix Mill Road North

Culvert #15-B (Photo 3.106) overtopped for all events except the one and two-year. Stuart Mill Road, as mentioned above, can be considered a primary road, requiring it to pass the 25-year event.

Culvert #16 (Photo 3.107) overtopped for all events except the one and two-year. Fox Mill Road, also mentioned above, can be considered a primary road and must pass the 25-year event.

Culvert #30 (Photo 3.108) overtopped for all events except the one and two-year. The

Photo 3.106 Little Difficult Run mainstem at Stuart Mill Road

Photo 3.107 Little Difficult Run mainstem at Fox Mill Road South

culvert at Westwood Hills Drive, a local road, is expected to pass the 10-year event.

Photo 3.108 Little Difficult Run tributary at Westwood Hills Drive

3.31.9 Candidate Sites for Improvements

Based on the review of the assessment data and modeling results, the most serious problem areas in the Little Difficult Run subwatershed are listed below. Refer to DFLD_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).

Streams

S36 There are significant riparian buffer impacts over 1,000 feet in length in the Little Difficult Run Stream Valley Park directly east of Mill Road and Stuart Mill Road (Photo 3.100).

S65 The reach between two overtopping culverts (culvert 13 and culvert 30) is exhibiting poor bank stability and has several crossing impacts.

S113 Erosion area at the end of Millstream Court, in Little Difficult Run Stream Valley Park (Photo 3.96).

S114 Erosion located on the mainstem of Little Difficult Run, directly east of Colt Run Road in the Roan Stallion Estates subdivision (Photo 3.97).

S115 Stream Physical Assessment found erosion and riparian buffer problems north of the terminus of Hollybrook Place in the Hollybrook subdivision (Photo 3.95)

S116 Buffer encroachment on the mainstem of Little Difficult Run along Stuart Mill Road in the Difficult Stream Valley Park (Photo 3.99).

Hydrology and Water Quality

D23 (Catchment DFLD0008) This site has better than average conditions for the subwatershed and for Difficult Run as a whole for runoff flows and pollutant loads. It was selected because it is a proposed site for a regional pond.

D39 (Catchment DFLD0002) This site has conditions similar to the average for the subwatershed for runoff flows and pollutant loads. It was selected because it is a proposed site for a regional pond.

D43 (Catchment DFLD9501) This site has higher than average nitrogen and phosphorus loadings from runoff. Peak flows and runoff volume are average. There are no critical stream problems within the area or immediately downstream. It was selected because it is a proposed site for a regional pond.

D58 (Catchment DFLD9801) This site has better than average conditions for the subwatershed and for Difficult Run as a whole for runoff flows and pollutant loads. There are no stream restoration sites downstream, however there are two culverts that are being overtopped. It was selected because it is a proposed site for a regional pond.

D61 (Catchment DFLD9401) Water quality and runoff volumes are slightly worse than the average for the subwatershed. Stream conditions within the drainage area and immediately downstream are relatively good.

D69 (Catchment DFLD9601) This site has average conditions for the subwatershed and for Difficult Run as a whole for runoff flows and pollutant loads. Field investigation showed no critical stream degradation within the drainage area or downstream.

D71 (Catchment DFLD0001) This site has average conditions for the subwatershed for runoff flows and pollutant loads. There is an area of streambank erosion downstream at site S113.

C64 (Catchment DFLD9701) This site has average pollutant loads and runoff flows in comparison with the subwatershed, and better than the average for the whole watershed. There is no significant stream degradation within the catchment or immediately downstream.

Flooding

F03 The bridge carrying Stuart Mill Road over the Mainstem of Little Difficult Run overtops for all events except the 1-year storm. It is required to pass the 25-year event (Photo 3.102).

F06 The culvert conveying Mainstem of Little Difficult Run under Colt Run Road overtops for all events. It is required to pass the 10-year event (Photo 3.103).

F13 The culvert conveying a tributary of Little Difficult Run under Fox Mill Road overtops for all events except the 1-year storm. It is required to pass the 25-year event (Photo 3.105).

F15B The culvert conveying Little Difficult Run under Stuart Mill Road overtops for all events except the 1-year and 2-year storms. It is required to pass the 25-year event (Photo 3.106).

F16 The culvert conveying a tributary of Little Difficult Run under Fox Mill Road overtops for all events except the 1-year and 2-year storms. It is required to pass the 25-year event. (Photo 3.107).

F30 The culvert conveying a tributary of Little Difficult Run underThoroughbred Road overtops for all events except the 1-year and 2-year storms. It is required to pass the 20-year event (Photo 3.108).

Preservation

P05 (Catchment DFLD9801) This catchment has very high increases from existing to future conditions for many of the modeled results including runoff volume, total suspended solids, nitrogen and phosphorus.

P06 (Catchment DFLD0001) This catchment has very high increases from existing to future conditions for many of the modeled results including total suspended solids, nitrogen and phosphorus. The area includes a large percentage of open space.

P07 (Catchment DFLD9901) This catchment has moderate increases from existing to future conditions for many of the modeled results including total suspended solids, nitrogen and phosphorus. The area includes a large percentage of open space.

3.32 Little Difficult Run - 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 3.59 below is a list of all projects proposed in this subwatershed.

Table 3.59 Recommendations for Little Difficult Run

Project #	Project Type	Candidate Site
DF9023A	Pond Retrofit.	D-23
DF9039A	Culvert Retrofit.	D-39
DF9039B	Drainage Retrofit.	D-39
DF9043A	Drainage Retrofit	D-43
DF9043B	Pond Retrofit	D-43
DF9043C	LID Retrofit	D-43
DF9058A	Culvert Retrofit	D-58
DF9058B	Culvert Retrofit	D-58
DF9061A	Culvert Retrofit	D-61
DF9061B	Drainage Retrofit	D-61
DF9061C	Culvert Retrofit	D-61
DF9061D	Pond Retrofit	D-61
DF92114	Stream Restoration	S114
DF9236	Stream Restoration	S36
DF9265	Stream Restoration	S65

3.32.1 Regional Pond Alternative Projects

D23 (DFLD9201)

Site Investigation and Projects: The site investigation showed few opportunities for retrofits in this low-density residential neighborhood. One project was identified:

> *DF9023A (Pond Retrofit)* This project is a retrofit of an existing dry facility at the outfall of the catchment. Retrofits would include installing a multi-stage riser for extended detention.

D39 (DFLD0002)

Site Investigation and Projects: The site investigation found relatively good conditions in the streams and outfalls within this drainage area, including the stream channel at the outlet of the watershed. There are few opportunities for onsite stormwater management or LID retrofits in the residential land uses that predominate.

> *DF9039A (Culvert Retrofit)* The project includes two small culvert retrofits on the south side of Westwood Hills Drive. The project would provide channel protection to reduce erosive discharge rates and provide an opportunity for water quality treatment.

DF9039B (Drainage Retrofit) 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 structures.

D43 (DFLD9501)

Site Investigation and Projects:

DF9043A (Drainage Retrofit) This project is designed to reduce scour at outfalls where the piped storm drain system discharges to a natural channel. Improvements would consist of energy dissipation through riprap, plunge pools, or structures.

DF9043B (Pond Retrofit) This is a retrofit of an existing in-stream dry pond between the cul-de-sacs of Wild Cherry Place and Black Fir Court. The retrofit would incorporate a retrofit riser structure. For channel protection storage, the low-flow orifice should be modified to detain the 1-year storm.

DF9043C (LID Retrofit) The project involves coordinating with the Fox Mill Swim and Tennis Club to construct a biofiltration swale adjacent to the parking lot. The existing grass swale exhibits active erosion. This retrofit could serve as a community education and outreach project.

D58 (DFLD9801)

Site Investigation and Projects:

DF9058A (Culvert Retrofit) This project is located at the upstream side of Thoroughbred Road. It should be designed along with project DF9058B to reduce some of the peak flows from the drainage area.

DF9058B (Culvert Retrofit) The retrofit is located upstream of the crossing at Folkstone Road. An upstream embankment along with a retrofit of the culvert would provide a dry pondfor channel protection.

D61 (DFLD9401)

Site Investigation and Projects:

DF9061A (Culvert Retrofit) This project is located at the bottom of the catchment where the stream crosses Stuart Mill Road. It would be designed primarily for water quality treatment using extended detention on the floodplain.

DF9061B (Drainage Retrofit) This project is designed to provide energy dissipation at outfalls where the piped storm drain system discharges to a natural channel. Improvements would consist riprap, plunge pools, or bioengineered structures.

DF9061C (Culvert Retrofit) This culvert retrofit project would consist of a redundant embankment to create a backwater storage area at Foxclove Road, with the primary goal of reducing erosive flows downstream. The upstream area is forested so a dry detention facility is proposed.

DF9061D (Pond Retrofit) The project would retrofit a dry pond with the addition of a multi-stage riser to provide channel protection storage.

D69 (DFLD9601)

Site Investigation and Projects: The stream valley through the site is heavily wooded with no suitable locations for stormwater management ponds or onsite LID retrofits. No projects were identified for this site.

D71 (DFLD0001)

Site Investigation and Projects: The stream valley through the site is heavily wooded with no suitable locations for stormwater management ponds or onsite LID retrofits. No projects were identified for this site.

3.32.2 Catchment Improvement Projects

C64 (DFLD9701)

Site Investigation and Projects: The stream valley through the site is heavily wooded with no suitable locations for stormwater management ponds or onsite LID retrofits. No projects were identified for this site.

3.32.3 Stream Restoration Projects

S-36

Site Investigation and Projects: The site investigation found moderate to severe bank erosion, lack of riffle pool bed morphology, and slight to moderate incision. Some areas adjacent to the stream lacked a forested riparian buffer. One stream restoration project was identified.

> *DF9236 (Stream Restoration)* The proposed restoration would involve excavating a new floodplain and re-meandering the stream to provide a pattern, dimension, and profile more consistent with a natural stream. This would prevent further mass erosion associated with channel widening and bank failure, would improve instream habitat, and provide access to a functional floodplain. The new floodplain would be planted with native woody vegetation and grasses. A forested buffer would be established. *S-36 and S-115 would be combined as a single project*.

S-65

Site Investigation and Projects: The site investigation found areas of missing buffer and erosion on the west side of Fox Mill Road. The east side was forested with areas of localized erosion.

> *DF9265 (Stream Restoration)* The proposed restoration would involve excavating a floodplain bench and reshaping the streambanks on the west side and immediately downstream of Fox Mill Road. A forested buffer would be established to the extent possible in the riparian zone. Further downstream, restoration benefits would not outweigh the construction impacts to the forest.

S-113

Site Investigation and Projects: The site investigation found one area of severe bank erosion less than 100 feet in length. Given the short length of the impairment and significant access constraints, no project was identified. The bank erosion would be addressed by the proposed culvert retrofit (DF9406 below) located upstream of Colt Run Road.

S-114

Site Investigation and Projects: Site investigations found that the stream is severely incised with raw streambanks. However, the stream has re-established a good riffle pool sequence and has a clearly defined aquatic channel. One stream restoration project was identified.

> *DF92114 (Streambank Stabilization)* The proposed project would involve grading the eroded streambanks and excavating a floodplain bench at the channel forming elevation. The new floodplain would be planted with native woody vegetation and grasses.

S-115

Site Investigation and Projects: Work for this site would be combined with project DF9236.

S-116

Site Investigation and Projects: Buffer restoration will be completed as part of the watershed-wide projects. No project was identified.

3.32.4 Preservation

Improvement Goals for all Preservation Sites

Preservation goals for all the candidate sites include reducing runoff volume, peak flows, and pollutant loads by preserving open space and forested land in key areas of the catchment such as headwaters.

Site Investigation and Projects

No site investigation was undertaken for preservation projects, and no specific proposals have been made for each area. Actions and policy changes needed to implement preservation for all candidate sites are described in Chapter 4.