3.11 Lower Difficult Run – Subwatershed Condition

3.11.1 Subwatershed Characteristics

The Lower Difficult Run **subwatershed** has an area of approximately 2,451 **acres** (3.8 mi^2). The Lower Difficult Run subwatershed is located in the northeast part of the Difficult Run watershed with portions in Great Falls National Park, The stream, which is approximately 9.3 miles long, flows in an easterly direction from the confluence with Wolftrap Creek to the outlet of the watershed where Difficult Run flows into the Potomac River in Great Falls National Park.The approximate northern boundary is near the intersection of Georgetown Pike (Virginia 193) and Leigh Mill Road (Virginia 683). Towlston Road (Virginia 676) lies along the eastern boundary while the southern border runs parallel to Leesburg Pike (Virginia 7).

Refer to DFDFL_1 for a map of the Lower Difficult Run subwatershed highlighting the Subwatershed Characteristics including, existing **land use**, **flood limit**, **wetlands**, **resource protection areas** and **stormwater management**.

3.11.2 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 Lower Difficult Run subwatershed is the least developed subwatershed in the Difficult Run Watershed. Fifty-eight percent of the Lower Difficult Run subwatershed is developed as low-density or estate residential. Another 30 percent is open space or parks. Major parks that fall either partially or wholly within the subwatershed include Difficult Run Stream Valley Park, Colvin Run Mill Park, and Great Falls National Park. Ten historical sites lie within the subwatershed. Two percent of the subwatershed is developed for commercial use. The majority of the commercial development is in the southernmost portion of the subwatershed, and radiates northward from Leesburg Pike (Virginia 7). There are 166 acres, or 7 percent of the subwatershed, in transportation use such as roads and highways.

Total **impervious** area for the subwatershed, which includes all roads, parking lots, residential driveways and buildings, is approximately 227 acres, or 9 percent of the total subwatershed area. A summary of subwatershed land use can be found in Table 3.17.

Table 3.17 Existing and Future Land Use

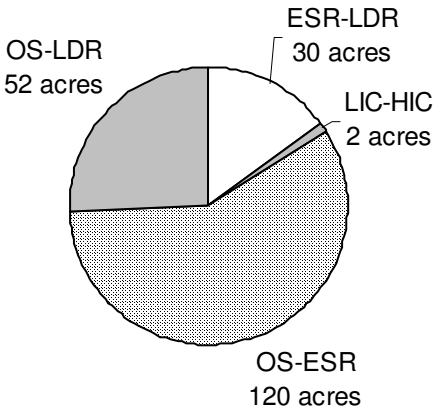
Land Use Type	Existing		Future		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Open space, parks, and recreational areas	740.04	30%	568	23%	-172	-7%
Golf Course	0	0%	0	0%	0	0%
Estate residential	801.9	33%	891	36%	89	4%
Low-density residential	604.6	25%	687	28%	83	3%
Medium-density residential	69.988	3%	70	3%	0	0%
High-density residential	3.2763	0%	3	0%	0	0%
Low-intensity commercial	12.81	1%	11	0%	-2	0%
High-intensity commercial	1.5704	0%	4	0%	2	0%
Industrial	8.2443	0%	8	0%	0	0%
Institutional	34.169	1%	34	1%	0	0%
Transportation	166.25	7%	166	7%	0	0%
Water	7.6927	0%	8	0%	0	0%
Total	**2,451**	**100%**	**2,451**	**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.

Changes between existing land use and future land use are projected in the open space, estate and low-density residential categories. There is a projected 7 percent loss in the open space category, with increases in the estate residential and low-density residential categories (4 percent and 3 percent respectively).

According to Figure 3.15, 120 acres are projected to shift from open space in the existing land use to estate residential in the future land use. Fifty-two acres are projected to shift from open space to low-density residential. These cumulative 172 acres of open space that are projected to shift to higher intensity use are not guaranteed to become developed - it suggests that these areas of open space can be used for development/ redevelopment in the future. Thirty acres in the Lower Difficult Run subwatershed are projected to shift from estate residential in the existing land use to low-density residential in the future land use. This illustrates a small demand for more housing in the Lower Difficult Run subwatershed.

Figure 3.15: Changed Land Use



3.11.3 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 15 stormwater management facilities within the Lower Difficult Run subwatershed. Eighty-five percent of the Lower Difficult Run subwatershed is not served by any stormwater management facility. Ten percent of the total area has quantity control only and the remaining 5 percent receives both **quantity and quality control,** meaning both the amount of water and the pollutants in the water are controlled.

Lower Difficult Run is the least developed subwatershed in Difficult Run, however there is a gap between the amount of developed land (70 percent) and the amount of land containing stormwater management (15 percent). A list of all stormwater management facilities in the Lower Difficult Run subwatershed is 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 15 **outfall** pipes discharging into the Lower Difficult Run subwatershed during the Stream Physical Assessment. All were within 200 feet of the channel, and ranged in size from 12 to 18 inches. Stormwater from all of the pipes was causing at least minor to moderate erosion. Two pipes were identified with erosion downstream and some undermining of the structures. They are shown below in Photos 3.22 and 3.23.

Photo 3.22 Erosion at outfall pipe located near Mill Creek Landing (DFDF003.P001).

Photo 3.23 Erosion at outfall pipe located off of Hidden Creek Drive (DFDF020.P004).

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. During the Stream Physical Assessment, field crews located 30 stream crossings in the Lower Difficult Run subwatershed. Five of the crossings were having a moderate impact on stream condition. These crossings do not pose an immediate threat to the roadway or other structures, but should be inspected periodically. All

other stream crossings were having a minimal impact on the stream condition. Two crossing with erosion are shown below in Photos 3.24 and 3.25.

Photo 3.24 Located near Leigh Mill Road has downstream and upstream bank erosion and minor bed erosion (DFDF019.C001).

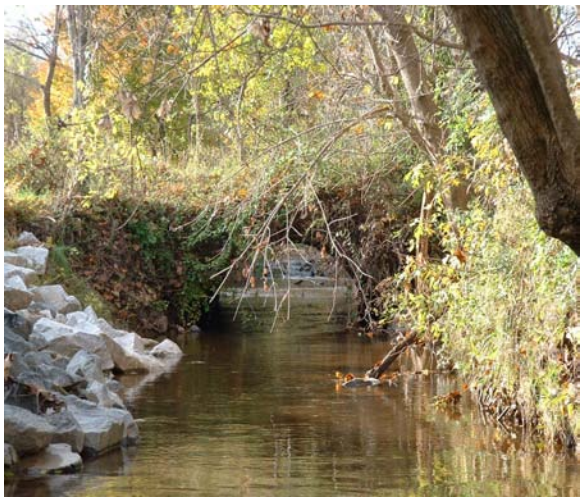


Photo 3.25 Upstream and downstream bank erosion at Leesburg Pike (DFCR001.C001).

Soils

Soils found in the Lower Difficult Run subwatershed belong primarily to the Glenelg – Elioak – Manor association. This association consists of rolling and hilly landscapes, which can generate rapid **runoff**, and **micaceous** soils, which are erodible. The **groundwater** is fairly shallow with numerous natural springs. The subwatershed contains 69 percent of the B hydrologic soil group with Glenelg silt loam being the dominant soil type (31 percent). B soils and the Glenelg soil type are compatible with **infiltration** practices and may provide potential stormwater management sites. There are 27 acres of land with unclassified soils in the subwatershed. Soils that cover at least 20 acres within the subwatershed can be found in Appendix A.

3.11.4 Geomorphology

There are approximately 9.3 miles (49,185 feet) of stream in the Lower Difficult Run subwatershed. Most of this total 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. Six reaches (3.8 miles) were not assessed due to unsafe conditions, or because the stream system was comprised of wetlands and ponds.

The mainstem channel is Type II where the beginning stages of incision and degradation are present. The tributaries are a combination of Type II, III and IV. Type III channels are generally unstable and actively widening while Type IV channels are in the recovery stages and are stabilizing. Thirty-six percent of the total stream length is Type II, 23 percent is Type III, and 9 percent is Type IV. The channel substrate is generally a mixture of silt, sand and gravel. Boulder and bedrock are the dominant substrate on the mainstem downstream of Georgetown Pike.

Fifty-three percent of the stream length is 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 was a total of 8,375 feet of erosion

identified in the subwatershed at 20 specific erosion locations. Fifty-five percent of the erosion sites (nine points) were having a severe impact on the stream channel, instream habitat or infrastructure. Several of the erosion areas have a high restoration potential. Two of the areas with the highest restoration potential are shown in Photos 3.26 and 3.27, which are candidates for stream restoration S85 and S84 respectively.

Photo 3.26 Severe erosion that could pose a threat to road safety along Route 7 to the east of Carpers Farm Way (DFCR001.E001).

Photo 3.27 Erosion located between Old Dominion Drive and Georgetown Pike (DFDF011.E001).

There are 10 obstruction sites located within the Lower Difficult Run subwatershed, most of which are trees and debris. Six of the obstruction sites are thought to be impacting fish movement within the stream. Of these six, one of the sites is on a downstream reach of the mainstem of Difficult Run (Photo 3.28) and has the potential for impacting a large majority of the entire Difficult Run watershed, as this is the only way for fish to get upstream to the rest of the watershed. This site is candidate site S86.

A second site impacting fish passage is located at the downstream end of one of the longer tributaries to mainstem Difficult Run (Photo 3.29). This site is candidate site S86.

Photo 3.28 Stream blockage located near Old Dominion Drive (DFDF002.T002).

Photo 3.29 Stream blockage near Ramey Lane cul-de-sac (DFDF019.T001).

There were three ditches found in the subwatershed, two of which were discharging **stormwater.** Significant erosion was occurring in the ditch. There were two sanitary utility lines that were crossing the stream and partially buried. They were creating little, if any, impact on the stream. However, there was also a fiber optic utility line within the stream banks that was causing moderate erosion by impeding flow.

3.11.5 Stream Habitat and Water Quality

Field crews conducted an assessment of the streams within the Lower Difficult Run subwatershed in the fall of 2002. All assessed 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.

- Of the assessed reaches, 57 percent has Poor and Very Poor habitat for aquatic insects and fish, and 43 percent has Good or Fair habitat for aquatic insects and fish.
- There is 23,450 feet, or 24 percent of the total stream, of **riparian buffer** encroachment (this length includes left and right banks combined). Of this total, 18,350 feet (78 percent) is a combination of **pervious** surfaces, 3,700 feet (16 percent) is a combination of impervious surfaces, and the remaining 1,400 feet (6 percent) is some combination of impervious and pervious surfaces.
- Forty-six percent of the buffer encroachment length has no or low restoration potential due to the type of land use adjacent to the stream. Fifty-five percent of the length has moderate to high restoration potential. Much of the buffer encroachment is having an impact on stream character. Twenty-five percent of the areas with buffer encroachment are having a significant impact. An example of the impact by deficient buffer is shown below in Photo 3.30, which is located between Hidden Creek Drive and Forestville Drive. This area is a candidate site for restoration S88.

Photo 3.30 Buffer impact on a tributary west of Hidden Creek Drive (DFDF020.B001).

- There was one dumpsite found in the subwatershed. It did not appear to contain toxic material and was having little effect on the stream system.

3.11.6 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 Lower 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 identifies areas that will need additional management measures.

The Lower Difficult Run subwatershed is 9 percent impervious. The land use consists mostly of low density residential and estate residential. Within catchment DFDF0045 there is a small area of high density residential at Colvin Run Road and Robindale Drive. This, along with the other residential areas, is a likely contributor to the elevated levels of **nitrogen** and **phosphorus** loading on this **catchment**. Refer to DFDFL_4 for the catchment locations.

The highest volume of runoff occurs at a higher concentration of medium density residential areas than the rest of the subwatershed, in catchment DFDF6701, around Leesburg Pike and Middleton Ridge Road. Results are shown in Table 3.18.

Table 3.18 Existing and Future Modeling

Lower Difficult Run Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFDF0043	E	2.86	0.13	25.4	1.4	0.3
	F	2.9	0.13	26.2	1.4	0.3
	C	1%	0%	3%	0%	0%
DFDF0045	E	3.18	0.12	32.1	1.6	0.3
	F	3.47	0.13	32.9	1.6	0.3
	C	9%	8%	2%	0%	0%
DFDF0047	E	1.74	0.13	16.7	0.9	0.2
	F	1.75	0.13	16.8	0.9	0.2
	C	1%	0%	1%	0%	0%
DFDF0049	E	1.34	0.13	9.4	0.5	0.1
	F	1.4	0.13	9.5	0.5	0.1
	C	4%	0%	1%	0%	0%
DFDF0051	E	1.61	0.1	12.1	0.7	0.1
	F	1.66	0.11	12.4	0.7	0.1
	C	3%	10%	2%	0%	0%
DFDF0053	E	1.41	0.08	14.1	0.7	0.1
	F	1.49	0.08	14.5	0.7	0.1
	C	6%	0%	3%	0%	0%
DFDF0055	E	1.26	0.1	9.2	0.5	0.1
	F	1.24	0.1	9.0	0.5	0.1
	C	-2%	0%	-2%	0%	0%
DFDF0057	E	1.31	0.13	16.4	0.8	0.1
	F	1.31	0.13	16.4	0.8	0.1
	C	0%	0%	0%	0%	0%

Lower Difficult Run Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFDF5901	E	1.13	0.1	7.7	0.4	0.1
	F	1.19	0.1	7.9	0.4	0.1
	C	5%	0%	3%	0%	0%
DFDF5902	E	1.53	0.1	11.2	0.6	0.1
	F	1.56	0.1	11.3	0.6	0.1
	C	2%	0%	1%	0%	0%
DFDF6102	E	2.2	0.12	23.3	1.3	0.2
	F	2.57	0.13	28.0	1.5	0.3
	C	17%	8%	20%	15%	50%
DFDF6501	E	2.64	0.18	25.2	1.4	0.3
	F	2.75	0.18	26.6	1.5	0.3
	C	4%	0%	6%	7%	0%
DFDF6701	E	4.28	0.15	46.4	2.3	0.4
	F	4.77	0.16	62.2	3.1	0.5
	C	11%	7%	34%	35%	25%

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

While most catchments are expected to have minor or negligible for all parameters, two catchments are projected to have the highest percent increase in pollutants: DFDF6701 and DFDF6102. In DFDF6701, the increase is most likely because of the expected change of some estate residential areas into low-density residential areas. DFDF6102 has a large area of open space changing to low-density residential which will increase both peak flow and runoff. The increases in land use intensity in these areas are projected to increase the runoff and pollutant loading to the streams in those catchments.

3.11.7 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. The flows at this site exceed the capacity of the culvert. 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.

Three crossings in the subwatershed were overtopped with existing flows, as shown in Table 3.19. 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 3.19 Culvert Hydraulic Modeling

Culvert	Crossing		Flood Year						
			100	50	25	10	5	2	1
58	Along Leesburg Pike	E	x	x	x	x	x	x	x
59	Leesburg Pike	E	x	x	x	x	x	x	x
72	Leigh Mill Road	E	x	x	x	x	x	x	x

E – Existing conditions results, x – indicates overtopping

Culvert #58 (Photo 3.31) overtopped for all events. From the photos, this culvert appears to be under a gravel drive, possibly a driveway or access road, and will be classified as a local road. Local roads are required to pass the 10-year event.

Culvert #59 (Photo 3.32) overtopped for all events. Leesburg Pike is a primary road, which is required to pass the 25-year event.

Photo 3.31 Lower Difficult Run Mainstem along Leesburg Pike

Photo 3.32 Lower Difficult Run Mainstem at Leesburg Pike

Culvert #72 (Photo 3.33) overtopped for all events also. Leigh Mill Road carries through traffic and is thus considered a primary road. Primary roads should pass the 25-year event.

Photo 3.33 Lower Difficult Run Mainstem at Leigh Mill Road

3.11.8 Candidate Sites for Improvements

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

S84 A tributary of the Difficult Run mainstem is identified as having localized severe erosion with a high restoration potential and buffer encroachment by adjacent lawns between Old Dominion Drive and Georgetown Pike (Photo 3.27).

S85 The Colvin Run tributary has severe erosion (Photo 3.26) that could impact the safety of Carpers Farm Way and is missing buffer on both sides of the stream.

S86 The Stream Physical Assessment identified an obstruction affecting fish passage (Photo 3.29), which could possibly affect the entire Difficult Run watershed.

S87 The Stream Physical Assessment identified Very Poor habitat and severe erosion over half of the reach located at the end of Peacock Station Road.

S88 The stream between Hidden Creek Drive and Forestville Drive was identified during the assessment as having a severe obstruction, a pipe with moderate erosion and 800 feet of erosion with “moderate” restoration potential, and missing buffer over approximately half of the reach (Photo 3.30).

S89 The Stream Physical Assessment identified this site, located at the confluence of Captain Hickory Run and Difficult Run, as having areas of erosion ranging from moderate to severe as well as missing buffer.

Hydrology and Water Quality

D09 (Catchment DFDF6102) While the runoff and pollutants in this catchment are below average, there are several reaches that have severe erosion, notably at S88, including the reach immediately downstream of the outlet.

D10 (Catchment DFDF6501) This catchment has average runoff and peak flow for the subwatershed and average pollutant runoff. The stream within and immediately downstream of this catchment is incised.

D76 (Catchment DFDF5901) This site has conditions below the average for the subwatershed for runoff flows and pollutant loads. The stream is incised and has some unstable banks due to erosion in the catchment.

C15 (Catchment DFDF6701) This site has higher than average nitrogen and phosphorus loadings from runoff. Peak flows and runoff volume are the highest in the subwatershed. The stream within and immediately downstream of the catchment has Poor habitat.

C53 (Catchment DFDF0047) This site has conditions similar to the average for the subwatershed for runoff flows and pollutant loads. Just before the confluence with Captain Hickory Run, the stream has severe erosion, a buffer deficiency, and is incised, as noted by S89.

Flooding

F58 The crossing along Leesburg Pike was overtopped for all events. Since it is classified as a local road, the culvert should pass the 10-year event (Photo 3.31).

F59 The crossing of Leesburg Pike was overtopped for all events. Classified as a primary road, this bridge should pass the 25-year event (Photo 3.32).

F72 The bridge on Leigh Mill Road overtopped for all events. It is also classified as a primary road, so it must pass the 25-year event (Photo 3.33).

Preservation

P23 (Catchment DFDF6102) Along the stream in this catchment, changes are projected to take place from open space to low-density residential. There is also some land changing from open space to estate residential. The majority of the modeled parameters are expected to double from the existing to the future conditions.

P24 (Catchment DFDF6501) This catchment is projected to have changes from open space to low density residential land use. Four out of five parameters modeled are expected to more than double.

3.12 Lower 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 3.20 below is a list of all projects proposed in this subwatershed.

Table 3.20 Recommendations for Lower Difficult Run

Project #	Project Type	Candidate Site
DF9009A	Pond Retrofit	D-09
DF9009B	Pond Retrofit	D-09
DF9009C	Drainage Retrofit	D-09
DF9010A	Culvert Retrofit	D-10
DF9010B	Culvert Retrofit	D-10
DF9010C	Culvert Retrofit	D-10
DF9010D	Drainage Retrofit	D-10
DF9010E	Stream Restoration	D-10
DF9076A	Culvert Retrofit	D-76
DF9076B	Pond Retrofit	D-76
DF9284	Stream Restoration	S84
DF9285	Stream Restoration	S85
DF9289	Stream Restoration	S89
DF9515A	Culvert Retrofit	C15
DF9515B	Culvert Retrofit	C15

3.12.1 Regional Pond Alternative Projects

D09 (DFDF6102)

Site Investigation and Projects:

DF9009A (Pond Retrofit) This project would retrofit an existing farm pond to not only treat more of the upstream area, but also to provide water quality improvements upstream of this pond and increase the detention time for peak flow attenuation. Some of these water quality improvements may include forebays, constructed wetlands, and aquatic fringe vegetation.

DF9009B (Pond Retrofit) This project would modify an existing stormwater management facility to increase the detention volume and potentially provide more water quality treatment. This project would be similar to DF9009A with additional improvements suggested: replace the existing corrugated metal pipe riser with a multi-stage concrete riser system to improve performance and install a forebay between the existing pond and the roadway to provide additional sediment and nutrient removal.

DF9009C (Drainage Retrofit) These distributed projects would provide protection, such as additional riprap, plunge pools, or structural energy dissipaters, to the transitions from paved channel to natural channel.

D10 (DFDF6501)

Site Investigation and Projects:

DF9010A (Culvert Retrofit) This project would retrofit the culvert under Forestville Drive to increase detention time and reduce peak flow rates, thus reducing erosive flows downstream.

DF9010B (Culvert Retrofit) This project would retrofit the culvert under Trotting Horse Lane to increase detention time and reduce erosive flows. This will also allow sedimentation to reduce pollutants.

DF9010C (Culvert Retrofit) This project would involve redesigning the existing dry pond facility upstream of Tackroom Lane to not only treat the local runoff, but the stream that now flows beneath the current facility as well.

DF9010D (Drainage Retrofit) These distributed projects would provide protection to the transitions from paved channel to natural channel in the form of additional riprap, plunge pools, or structural energy dissipaters.

DF9010E (Stream Restoration) This stream reach has become incised from the downstream culvert installation. Grade controls and step pools would be constructed, and the streambed would be raised in places to reconnect with the floodplain.

D76 (DFDF5901)

Site Investigation and Projects:

DF9076A (Culvert Retrofit) The topography upstream of Falls Run Road is ideal for detention storage due to the wide, flat floodplain and the grade difference between the roadway and the stream. This facility would use the floodplains to settle suspended solids.

DF9076B (Pond Retrofit) The farm pond at this location was not designed as a stormwater management facility. This project would include grading out the existing pond, installing an outlet structure and an embankment, and planting wetland vegetation for nutrient uptake.

3.12.2 Catchment Improvement Projects

C15 (DFDF6701)

Site Investigation and Projects:

DF9515A (Culvert Retrofit) This project consists of using the roadway embankment of Leesburg Pike to allow time for sediments to settle out of the water. Wetland vegetation will aid the sedimentation and nutrient uptake.

DF9515B (Culvert Retrofit) This project consists of using the roadway embankment of Locust Hill Drive to allow time for sediments, and possibly other pollutants, to settle out of the water.

3.12.3 Stream Restoration Projects

S84

Site Investigation and Projects: The site investigation showed a highly erosive and deeply incised stream with poorly defined bed forms. Several failing stone and concrete water diversion structures are located in the lower portion of the reach.

DF9284 (Stream Restoration) Bed features would be created to resemble stepped streambed morphology and the streambanks would be reshaped and stabilized. A floodplain bench would be excavated. The diversion structures would be removed.

S85

Site Investigation and Projects: The site investigation showed a straightened stream running along the embankment of the Leesburg Pike. Streambanks are steep and the stream is severely incised. The streambed is embedded with fine sediments. The right side of the stream is in pasture.

DF9285 (Stream Restoration) The stream would be relocated away from the Leesburg Pike embankment with a stable pattern, dimension and profile utilizing the available pastureland to create a meandering stream. The proposed streambanks and bed would be stabilized using natural channel structures.

S86

Site Investigation and Projects: The site investigation showed that the previously identified obstruction was mostly cleared and did not significantly impede flow. No project was identified.

S87

Site Investigation and Projects: The site investigation showed raw but moderately stable streambanks and moderate to severe incision in the straight and steep upper portion of the reach. The middle reach was slightly to moderately incised and had moderate to high sinuosity and some floodplain re-establishment. Downstream, two instream recreational ponds are largely filled and provide some control of sediments. Downstream of the ponds, the reach is largely in the Difficult Run floodplain. Access issues, wetland impacts, forest clearing and steep slopes outweigh the benefits of reduced sediment export from bank erosion by restoring the upstream reach, so no project was identified.

S88

Site Investigation and Projects: The site investigation found a significant buffer impairment. No erosion mitigation project was identified because potential project benefits did not justify the construction impacts that would be incurred. Buffer restoration and obstruction removal were included with the watershed-wide projects.

S89

Site Investigation and Projects:

DF9289 (Stream Restoration). The stream erosion would be repaired with moderate regrading and bank protection structures on the meanders, and the buffer would be revegetated.

3.12.4 Preservation

Improvement Goals for all Preservation Sites

Preservation goals for all the areas described above 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 the areas listed below are described in Chapter 4.

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