

3.21 The Glade – Subwatershed Condition

3.21.1 Subwatershed Characteristics

The Glade **subwatershed** is one of the smaller subwatersheds in the Difficult Run watershed. It has an area of approximately 853 **acres** (1.33 mi²). It is located in central Fairfax County. Much of the watershed lies between Glade Drive, which forms the northern boundary, and Lawyers Road (Virginia 673), which lies along the southern subwatershed divide. The subwatershed extends from Reston Parkway (Virginia 602) on the western edge to Hunter Station Road (Virginia 677) at the downstream end.

The Glade subwatershed is located in the west-central area of the Difficult Run watershed. The single 3.8 mile stream flows in an easterly direction to the confluence with Snakeden Branch.

Refer to DFGL_1 for a map of the Glade subwatershed highlighting the Subwatershed Characteristics including, existing **land use, flood limit, wetlands, resource protection areas** and **stormwater management**.

3.21.2 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 Glade subwatershed is moderately densely developed. Twenty-nine percent of the Glade subwatershed is developed as low-density or estate residential, and 22 percent is developed as medium-density residential. Only 2 percent of the subwatershed is developed for high-density residential, commercial or industrial uses. The majority of the more developed area is along Lawyers Road (Virginia 673) and the major arterial Glade Drive. There are 106 acres used for transportation rights-of-way (12 percent of the subwatershed).

Total **impervious** area for the subwatershed, which includes all roads, parking lots, residential driveways and buildings, is approximately 138 acres, or 16 percent, of the total subwatershed area. Twenty-nine percent of the subwatershed is open space although no major developed parks or recreational facilities exist. No historical sites lie within the subwatershed. A complete summary of land use within the subwatershed can be found in Table 3.37.

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.

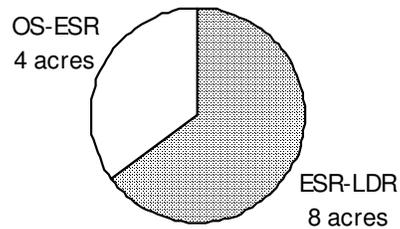
Table 3.37 Existing and Future Land Use

Land Use Type	Existing		Future		Change	
	Acres	Percent	Acres	Percent	Acres	Percent
Open space, parks, and recreational areas	250	29%	246	29%	-4	-1%
Golf Course	0	0%	0	0%	0	0%
Estate residential	26	3%	23	3%	-4	0%
Low-density residential	225	26%	233	27%	8	1%
Medium-density residential	190	22%	190	22%	0	0%
High-density residential	20	2%	20	2%	0	0%
Low-intensity commercial	12	1%	12	1%	0	0%
High-intensity commercial	4	0%	4	0%	0	0%
Industrial	0	0%	0	0%	0	0%
Institutional	19	2%	19	2%	0	0%
Transportation	106	12%	106	12%	0	0%
Water	0	0%	0	0%	0	0%
Total	853	100%	853	100%	0%	0%

The Glade subwatershed had the least amount of change between existing and future land use projections in Difficult Run. There is a projected 1 percent increase in low-density residential acreage and a projected 1 percent decrease in open space.

According to Figure 3.20, 8 acres are projected to shift from estate residential in the existing land use to low-density residential in the future land use, and 4 acres were projected to shift from open space to estate residential in the future land use.

Figure 3.20: Changed Land Use



3.21.3 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 four **stormwater management facilities** within The Glade subwatershed. Ninety-two percent of the subwatershed is not served by any stormwater management facility. Eight percent of the total area has quantity control only. There is no area within the subwatershed that receives both **quantity and quality control**.

The difference between the amount of total developed area in the subwatershed (69 percent) and the area served by stormwater management (8 percent) indicates a possible need for additional management efforts, particularly in the industrial and low and medium density residential areas that border most of the stream length. Additional information on the location of the stormwater management facilities in the Glade 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 did not locate any **outfall** pipes that were having a significant impact on the stream.

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. Seventeen of the 21 stream crossings in The Glade subwatershed are wooden footbridges. All but two crossings have very little impact on stream character. The two with more significant impact are wooden footbridges where the flow is creating moderate bank erosion. The erosion was not significant enough to warrant further study or restoration. The crossings are shown in Photos 3.64 and 3.65.

3.21.4 Soils

Soils found in The Glade 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 78 percent of the B hydrologic soil group with Glenelg silt loam being the dominant soil type (66 percent). B soils and the Glenelg soil type are compatible with infiltration practices and may provide potential stormwater management sites. There are 0.6 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.



Photo 3.64 Wooden bridge where stream flow is causing moderate erosion. Located just off of Bassett Lane (DFGL008.C004).



Photo 3.65 Wooden bridge where stream flow is causing moderate erosion. Located just west of Steeplechase Drive (DFGL008.C001).

3.21.5 Geomorphology

There are approximately 3.7 miles (19,427 feet) of stream in The Glade subwatershed that 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. One reach (928 feet), near the north end of Howland Drive, was not assessed because it was not a natural stream channel.



Photo 3.66 Located north of Lawyers Road between Pegasus Lane and Charlestown Lane (DFGL005.E001).

The stream channel **substrate** is primarily a mix of cobble and gravel with some sand present. Fifty-one percent of the total reach length is Type III, which is indicative of an unstable channel that is actively widening as a response to changes in the flow. The remaining 45 percent of assessed channel is Type IV, which is the beginning of stream stabilization after disturbance.

There were only two specific erosion locations noted in the subwatershed. Both were considered to be of moderate impact. These are located just downstream of a candidate stream restoration site S26. An example of the erosion is shown in Photo 3.67.

There are ten stream blockages, primarily comprised of downed trees. Eight of these blockages are likely restricting movement of fish within the stream system and can block passage. Only one obstruction is thought to have a severe impact. This obstruction of trees and debris is located on an upstream reach near Stirrup Road, upstream of the candidate stream restoration area S26 (see Photo 3.68).



Photo 3.67 Erosion north of Lawyers Road near Pinoak Lane (DFGL006.E001)



Photo 3.68 Obstruction of trees and debris near Stirrup Road. (DFGL008.T001)

There were no **headcuts**, areas of distinct stream bed elevation change due to erosion, and no dumpsites within the subwatershed at the time of assessment. There were 14 ditches, of which the flows in four were causing some moderate erosion. One ditch located just downstream of a potential restoration site should be addressed with the stream restoration site.

The field crew found a total of five partially exposed utility lines in the subwatershed, which can pose potential problems for both the stream and the utility lines. One utility line of an unknown type was completely exposed. This utility line is located just off of Stirrup Road on an upstream reach of the subwatershed and is a candidate restoration site S104 (Photo 3.69).



Photo 3.69 Utility line located just off of Stirrup Road on an upstream reach of the subwatershed (DFGL009.U001).

3.21.6 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.

- Of the assessed reaches, 71 percent is considered Fair habitat for aquatic insects and fish, 18 percent is considered Poor, and 8 percent is Excellent. The reach considered Excellent habitat is the most downstream reach near The Glade's confluence with Snakeden Branch.
- There were no points along the stream that were considered to have deficient **riparian buffer**.

3.21.7 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 The Glade 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 Glade subwatershed has an impervious cover of 16 percent. This subwatershed runs parallel to and just north of Lawyers Road west of the intersection with Hunter Station Road. The land use is mostly composed of low and medium-density residential areas with open space around the stream.

Catchment DFGL0002, found from Steeplechase Drive east to Soapstone Drive, has the highest modeled pollutant loadings. Refer to DFGL_4 for the catchment locations. The highest runoff volume is found between Reston Parkway and Steeplechase Drive north of Lawyers Road, which is catchment DFGL0001. Results are in Table 3.38.

Table 3.38 Existing and Future Modeling

The Glade Catchments		Runoff Volume (in/yr)	Peak (cfs/ac)	TSS (lb/ac/yr)	Runoff TN (lb/ac/yr)	Runoff TP (lb/ac/yr)
DFGL0001	E	3.63	0.12	56.9	2.8	0.5
	F	3.63	0.12	56.9	2.8	0.5
	C	0%	0%	0%	0%	0%
DFGL0002	E	3.49	0.13	51.3	2.6	0.5
	F	3.49	0.13	51.6	2.6	0.5
	C	0%	0%	1%	0%	0%
DFGL0004	E	2.93	0.14	33.3	1.8	0.4
	F	2.97	0.15	34.3	1.9	0.4
	C	1%	7%	3%	6%	0%

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

There is less land use change set to take place in this subwatershed than in most subwatersheds. There are only a few areas of open space changing to estate residential or estate residential changing to low-density residential.

3.21.8 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. 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.

Two stream crossings were modeled in the subwatershed; neither was overtopped with existing flows.

3.21.9 Candidate Sites for Improvements

Based on the review of the assessment data and modeling results, the most serious problem areas in The Glade subwatershed are listed below. Refer to DFGL_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

- S26 The Stream Physical Assessment identified a significant portion of the stream, including this reach, which has erosion causing unstable banks (Photo 3.67).
- S104 A utility line was found in the stream along with unstable banks caused by erosion (Photo 3.69).

Hydrology and Water Quality

- C40 (Catchment DFGL0001) Pollutant loads and flows are higher than the subwatershed average. S26, with unstable banks and erosion, is located downstream of this catchment

3.21.10 Reston Watershed Plan Assessment

The assessment covered the mainstem of The Glade down to the lowest reaches that were not assessed because they were primarily beaver habitat and no stream improvements were expected to be proposed. Results of the physical assessments and hydraulic modeling are discussed below, with a reference to the equivalent catchment areas defined in the Difficult Run Watershed Plan.

The Glade (DFGL0001, DFGL0002, upstream half of DFGL0004)

Reston Plan Problems with bank erosion were found during the assessment. The percentage of streambanks affected increased downstream, with 10 to 20 percent eroded in DFGL0001, 30 to 50 percent in DFGL0002, and 35 percent in DFGL0004. Exposed utilities were also found. Hydraulic modeling showed that 35 out of 40 cross-sections had erosive velocities from the 1-year storm; however, only 2 of these were highly erosive.

Difficult Run Plan The Stream Physical Assessment for this project found similar results, with active widening through DFGL0001 and DFGL0002, and more than 60 percent of the streambanks unstable for the entire length of the mainstem assessed in the Reston Plan.

The stream reach with the highest percentage of erosion was selected as candidate site S26. The catchment upstream of this site was a high priority and was selected for stormwater management project investigation as candidate site C40.

3.22 The Glade - 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 3.39 below is a list of all projects proposed in this subwatershed.

Table 3.39 Recommendations for The Glade

Project #	Project Type	Candidate Site
DF92104	Streambank Stabilization	S104
DF9540A	Culvert Retrofit	C40
DF9540B	Culvert Retrofit	C40
DF9740	Drainage Retrofit	C40

3.22.1 Regional Pond Alternative Projects

There are no proposed regional pond sites.

3.22.2 Catchment Improvement Projects

C40 (DFGL0001)

Site Investigation and Projects:

DF9540A (Culvert Retrofit) This project would consist of a culvert retrofit on the upstream side of Steeplechase Road at the outlet to this catchment. This retrofit would be designed to reduce erosive flows downstream by extended detention of smaller storms, and allow for settling and vegetative uptake of pollutants.

DF9540B (Culvert Retrofit) This project would consist of a culvert retrofit on the upstream side of Colts Neck Road where the north branch of this tributary crosses. This retrofit would be designed as an extended detention dry pond with a sediment forebay and micropool with the primary goal of reducing erosive flows downstream, and secondarily to allow for settling and biological uptake of nutrients.

DF9740 (Drainage Retrofit) This project would include the removal of all concrete ditch conveyance channels with dry swales and the improvement of outfall protection throughout the catchment. The primary impact of this project would be to reduce erosive velocities, promote infiltration into the ground, and provide a slower, less destructive drainage system to convey runoff to receiving streams.

3.22.3 Stream Restoration Projects

S26

Site Investigation and Projects: The site investigation showed raw banks and moderate to severe incision. The stream had good pool variability and stable riffle bed features. The stream is largely recovered with some floodplain re-development. Constraints associated with utilities and wetland impacts outweigh the benefits of a bank stabilization project, so no project was identified.

S104

Site Investigation and Projects: The site investigation found three pieces of disconnected reinforced concrete stormwater pipe in the stream. The pipes have created an obstruction that has initiated streambank erosion. One project was identified

DF92104 (Streambank Stabilization) The stream would be realigned with a new pattern and profile to be more stable with the existing flow regime. The obstruction would be removed as part of this project. **Portions of this project may be constructed or superseded by Reston Association work in this stream channel.**

3.22.4 Preservation

No preservation candidate sites were identified for this subwatershed.

3.22.5 Reston Watershed Plan Recommendations for The Glade

Structural measures were recommended for drainage areas of the mainstem of The Glade. Specific locations within these areas were not identified. The recommendations included the following:

Stormwater Attenuation

Reston Plan (10 structures) These projects are designed to detain and reduce the peak flow from the channel-forming discharge, reducing scour at outfalls. Smaller versions of these types of attenuation systems at unspecified storm sewer inlets are also proposed.

Difficult Run Plan Culvert retrofit projects DF9540A and DF9540B in this plan are similar to the Reston Plan attenuation structures.

Floodplain Spreaders

Reston Plan (10 structures) These projects are designed to divert stormwater from paved ditches and storm sewers and allow it to flow over the floodplain at much lower energy levels.

Difficult Run Plan Floodplain spreaders are a potential solution for the drainage retrofits at outfalls described in project DF9740A in this plan.

Check Dams

Reston Plan (10 structures) These projects provide stabilization for intermittent streams by creating step pools which lower the erosive velocity.

Difficult Run Plan There are no equivalent projects specifically called out in this plan, although these techniques could be used as part of the drainage retrofits described project DF9740A in this plan.

Stream Restoration

Reston Plan (4,000 feet) The Reston Plan proposes restoration of up to 4,000 feet of stream throughout The Glade.

Difficult Run Plan Candidate site S26 was assessed in the field but restoration potential outweighed the constraints associated with access and construction. Project DF92104 would remove stream blockages and restore 920 feet of unstable streambanks.