ACCOTINK CREEK STREAM STABILITY ASSESSMENT AND PRIORITIZATION PLAN

FINAL REPORT

City of Fairfax, Virginia

October 22, 2007

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I. EXECUTIVE SUMMARY

RK&K conducted a stream assessment of the Accotink Creek stream system within the City of Fairfax in the spring of 2007 to capture the scale and extent of stream bank erosion in the Accotink Creek watershed as well as develop a prioritization plan for future restoration activities based upon observed conditions. The scope did not include assessments of Daniels Run. The ultimate goal of the study was to provide a five-year plan and associated budget to maximize near future restoration efforts.

Background investigation was initiated including a review of past studies focusing on the City's streams and their stability and health. Field assessments were then performed on reaches in the study area. During field investigations, the streams in the study area were divided into reaches of similar geomorphic and hydraulic characteristics. A total of 31 reaches resulted with an average length of 1200 LF. Assessments were conducted using the Bank Erodibility Hazard Index (BEHI) method to quantify the stream bank scour potential. Also, visual assessments of stream accessibility, impacted properties and natural resources and nearby utilities were made and documented.

Once all reaches were assessed, BEHI scores were totaled and reach locations were mapped. It was found that over 85% of studied stream reach length had at least a high potential for stream bank degradation and over half of all stream reaches were found to be at very high or extreme risk for stream bank degradation. It is evident from these results that stream bank erosion is a major impact on the stability and overall health of the City's streams.

The results of the BEHI assessment were analyzed along with data on the feasibility of construction and public sentiment for all the studied reaches. A prioritization analysis was performed using this data producing eight reaches of high priority. Previously restored reaches in need of repairs due to recent storm damages were also included in this priority listing to produce a total of ten priority reaches: four from the South Reach, two from the North Reach, one from the Dale Lestina tributary, one from the Main Stem, and two from the Daniels Run area.

Three levels of restoration were assumed for a cost analysis; light, moderate and full. A range of costs were associated with each level of effort. Light restoration involves restoring short reaches of stream using low-cost efforts targeted at protecting nearby properties, resources or utilities. Full restoration includes grading back banks, using in-stream structures to control lateral and vertical migration, and producing comprehensive planting plans. Moderate restoration incorporates aspects of light and full restoration.

Once the priority reaches were identified and restoration efforts spelled out, two five-year budgetary scenarios were developed using two funding levels: $200,000 per year and $500,000 per year. The cost assumed for restoration at each reach was estimated by incorporating the severity of bank erosion along with feasibility of the site. Areas impacting citizens were first targeted with funds. Previously restored reaches that had been damaged were then targeted, and finally all other areas identified by bank severity were included. The results were broken down by budget scenario. While the smaller funding scenario effectively covered areas impacting citizens, the higher funding provided for a more comprehensive restoration plan. By stream length, 65% more bank restoration and six times more full restoration is possible with the higher funding budget scenario.

Other related topics, including stormwater management retrofit, stream monitoring and outside funding sources were discussed.

II. INTRODUCTION

The City of Fairfax (the City) is located in the Accotink Creek watershed in northern Virginia. Accotink Creek and its major tributaries account for approximately 10 miles of streams within the City Limits. Since 1994, the City has completed full restoration projects on approximately 2.2 miles of stream and has stabilized approximately 3.8 miles of stream, accounting for 68% of stream within the City boundary. In late June/early July 2006, significant rain events led to severe erosion of the stream bed and banks in several locations, including in areas previously restored by the City. Study and possible restoration of these damaged areas is necessary to stabilize the stream and address effects to water quality, aquatic life, forest, and private property.

RK&K has been selected by the City to provide design services for stream bank restoration along Accotink Creek, specifically on its North Reach, South Reach, and Main Stem. This report represents the preliminary stream ranking portion of RK&K's efforts. Assessment methods used to rank these streams include a visual assessment of the stream bed and banks, photographic documentation, Bank Erosion Hazard Index (BEHI) assessment, review of past watershed and stream studies, and a decision matrix that includes economic, social, and ecological factors.

III. GOALS

The primary goals of the stream assessment and prioritization report of Accotink Creek and its tributaries are to assess the current condition of stream bank stability and to prioritize stream reaches for restoration. Prioritization is influenced by the following factors: stream degradation, public/private easements, access, ancillary effects to trees and other resources, aesthetic concerns, cost/benefit assessment, and public/private sentiment.

IV. BACKGROUND

The City is located in the Accotink Creek Watershed, within the larger Potomac-Shenandoah watershed. Approximately 10 miles of stream channel exist within the city, with Accotink Creek serving as the major drainage body. The South Reach of Accotink originates in the southwest and flows in a northeast direction. The North Reach originates in the northern section of the city and flows in an easterly direction, where it meets Dale Lestina tributary before joining the South Reach of Accotink Creek. Draper Drive tributary begins in the northern section of the city, flowing south until its confluence with the Main Stem just before flowing under Lee Highway. Daniels Run, which is not assessed in this project per City direction, begins in the southern section of the city and flows northeast until its confluence with the Main Stem. Accotink Creek then flows under Pickett Road and leaves the City of Fairfax.

The project area is located in the City in northeastern Virginia entirely within the Piedmont. Topography in the project area ranges from 280 feet above MSL to approximately 490 feet above MSL. The landscape throughout the project area is generally flat, with a few low, wide ridges and narrow, steep-sided stream valleys. Elevations along the streams comprising the watershed range from 285 to approximately 380 feet above MSL. Most of the soils in this region are well drained hydric soils with moderate permeability and erodability.

The dominant land cover classes are deciduous forest, open space development, and low to medium intensity development. Though the stream corridor is mostly surrounded by low intensity land use, some sections of Accotink Creek are surrounded by heavy commercial development with no floodplain area. The overall urbanized nature of the watershed, along with the aforementioned infringement on floodplain areas, has led to increased stormwater flows into Accotink Creek, resulting in widespread instability of stream bed and banks, excessive sediment loading, and degradation of water quality. The location of these streams within the City of Fairfax is shown in Figure 1.

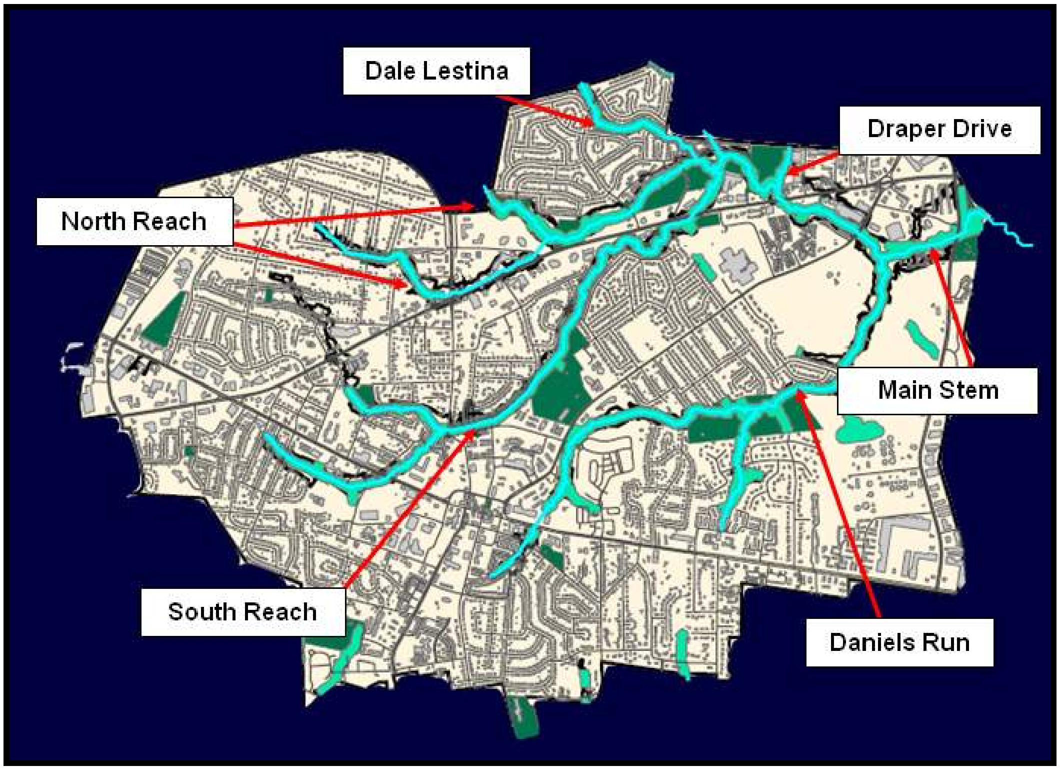

Figure 1: Accotink Creek's Tributaries *(adapted from City of Fairfax GIS data layers)*

IV.A. Biological and Physical Assessment

A stream survey was conducted by the Louis Berger Group, Inc. and Gannett Fleming, Inc. in October 2002 to assess the physical and biological health of streams located in the City of Fairfax. The Stream Visual Assessment Protocol, developed by the USDA was utilized to evaluate and quantify biological conditions in the streams. Physical conditions include channel condition, hydrologic alteration, riparian zone vegetation, vegetative protection, and bank stability. Biological and habitat conditions include sediment deposition, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover, riffle embeddedness, and macroinvertebrates observed.

According to the report, the City of Fairfax has restored 68% of its streams. Even after this amount of restoration, only one percent of the reaches examined remain in excellent physical condition, while 26% have a score of good, 9% a score of fair, and 65% score of poor. It should be noted that most stream reaches with a good physical score are in areas where Fairfax has recently completed restoration projects. From Figure 5, the worst conditions, excluding Daniels Run, are located on the lower Main Stem and lower South Reach. The upper Main Stem, especially near the confluence of the North Reach with the South Reach, is in the best condition.

Though physical conditions of the streams are improving, the biological conditions have not been restored yet. No stream reaches were given a score of excellent or good, with 20% recieving a score of fair and 80% receiving a score of poor. The lower Main Stem of Accotink Creek seems to be in the worst condition, as affirmed in the previous section.

Overall stream health also was calculated in the report using the aforementioned physical, biological, and habitat assessments. In the study, no stream reaches were given an overall stream health score of excellent. Three percent of the streams were given an overall score of good, 20% received a score of fair, and 77% were given a score of poor. Aside from Daniel's Run, the South reach and lower Main Stem of Accotink Creek are in the worst condition. The Overall result scores are seen in Figure 2.

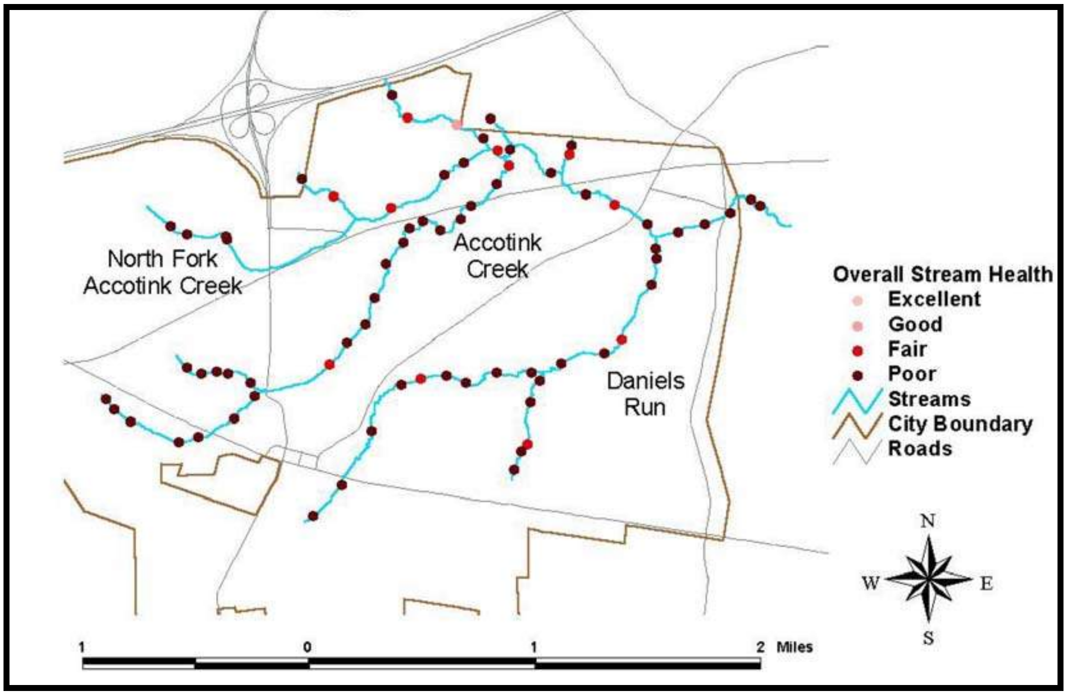

Figure 2: Overall Stream Health in the City of Fairfax ***(Adapted from City of Fairfax, 2002)***

V. METHODS

An assessment of present and potential erosion in the Accotink Stream system began in early spring of 2007. Reaches were identified based on channel features and assessed using visual observations and the Bank Erodability Hazard Index (BEHI). Detailed methods follow.

V.A. Reach Identification

To describe and assess the stream system, it was necessary to break the streams into reaches. Reach breaks were made based upon changes in channel size and shape, slope, and vegetative patterns. Often, breaks were made at road crossings based on the influence that these crossings have on stream systems. A total of 31 reaches were identified. Average reach length was 1200 LF.

The reaches are identified by their tributary; "SR" designates the reaches in the South Reach, "NR" designates the reach in the North Reach; "MS" designates the Main Stem; "DDT" designates reaches in the Draper Drive tributary; and "DLT" designates reaches in the Dale Lestina tributary. The number immediately following the tributary (i.e., SR**1**) designates each branch within the tributary network, and the three-digit number following the tributary identification (i.e., SR1-**001**) designates the specific reach within each tributary branch.

V.B. Visual Assessment

Visual assessment and photographic documentation of the stream was conducted to record the current conditions of the stream and to substantiate the BEHI scores given to a particular reach. Photographs taken along the stream include both upstream and downstream views, bank erosion conditions, riparian vegetation, and the condition of previous restoration efforts. At least two pictures were taken in each reach, with extra pictures denoting areas of significance. Appendix A contains photographs of each reach. Other site-specific features were noted, such as the adequacy of access to the reach, mature tree population, debris in the stream (natural or manmade), direct impacts to property, and nearby utilities that could potentially affect stream improvement work done on the reach.

V.C. Bank Erosion Hazard Index (BEHI)

Stream channels react to changes in watershed conditions. The changes include land use alterations (increased impervious cover), impacted riparian buffer areas, and increased obstructions to stream flow (i.e., culverts and bridges). The typical reaction process is for the stream channel to lower its channel bottom (if possible) then widen causing banks to erode. This erosion can become excessive for banks composed of non-cohesive materials, such as sand, silt, and gravel.

The BEHI is an empirically developed methodology created to quickly assess and predict stream bank erosion potential based upon key features that are associated with bank erosion. Initial observations in Accotink Creek watershed revealed stream banks were severely eroded and composed of predominantly non-cohesive material. Also, many downstream areas were aggrading due to high sediment loads. It was evident that stream bank erosion is a major factor affecting stream stability in the study area, so the BEHI methodology, which focuses specifically on stream bank erosion, was used to provide results that illustrate, quantifiably, the range of bank erosion severity.

This procedure consists of the assessment of several sensitive variables, including ratio of bank height to bankfull height, ratio of root depth to bank height, weighted root density (percent density times the ratio of root depth to bank height), bank angle, surface protection, bank material, and bank stratification. Figure 3 provides a graphical representation of these features and associated values. Each category value has a corresponding index value that standardizes scores to a scale of 5-50+, with 5-9.5 rated as very low, 10-19.5 as low, 20-29.5 as moderate, 30-39.5 as high, 40-45 as very high, and 46-50+ as extreme.

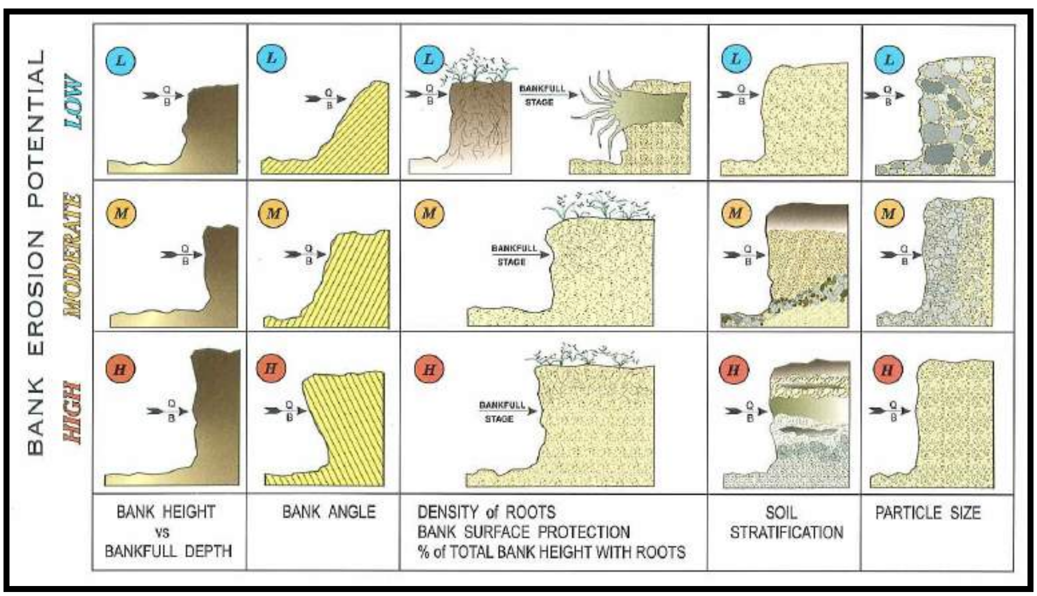

Figure 3: Bank Erosion Potential Factors ***(Rosgen, 1996)***

BEHI assessments were conducted on Accotink Creek on January 16-19, 2007. The field effort was intended to be quick so that the entire system could be assessed in a short period of time. This allows comprehensive "calibration" so the assessor's scoring is as objective as possible. BEHI scores characterize the reaches rather than using a more in-depth study of individual banks that would be delineated and characterized for more precise erosional rate predictions. This study was intended to be expanded to include more precise assessment once potential restoration reaches were selected. Summary score sheets and result mapping are included in Appendices B and C.

VI. RESULTS OF ASSESSMENT

VI.A. Bank Erosion Hazard Index

BEHI scores were determined, with results reflecting the initial observations of excessive stream bank erosion. Only one reach was found to have low bank erosion potential and three other reaches were found to have moderate potential. The remaining 27 reaches (85% of the total reaches observed) have a high, very high, or extreme bank erosion potential. A more descriptive measure of the extent of bank erosion in the study area is the amount of total stream length in each category. Table 1 illustrates the distribution of bank erosion severity by stream length.

Table 1: Extreme or Very High BEHI-rated Stream Reach Lengths

BEHI Rating	*Stream Length (LF)*	*% of Total Stream Length*
Low	325	0.8%
Moderate	3,145	8.0%
High	13,020	33.2%
Very High	13,245	33.7%
Extreme	9,510	24.2%
	Total = 39,245	

BEHI ratings of very high and extreme are considered critically unstable. Table 1 shows over half of the stream length assessed in this study falls into this category. This result illustrates that stream bank erosion is a major concern for streams in the Accotink Creek watershed within City limits. Even when these systems reach a point of dynamic equilibrium, the rate of lateral migration may continue to erode stream banks at a high rate. High bank erosion can lead to further downstream sedimentation problems at culverts and bridge crossing. Also, pollutants such as phosphorus, nitrogen and heavy metals may adsorb on to sediment particles that are flushed out to downstream water bodies, such as the Potomac River and Chesapeake Bay. The distribution of BEHI scores are shown in Figure 4. Summary sheets of extreme and very high BEHI ratings are included in Appendix D.

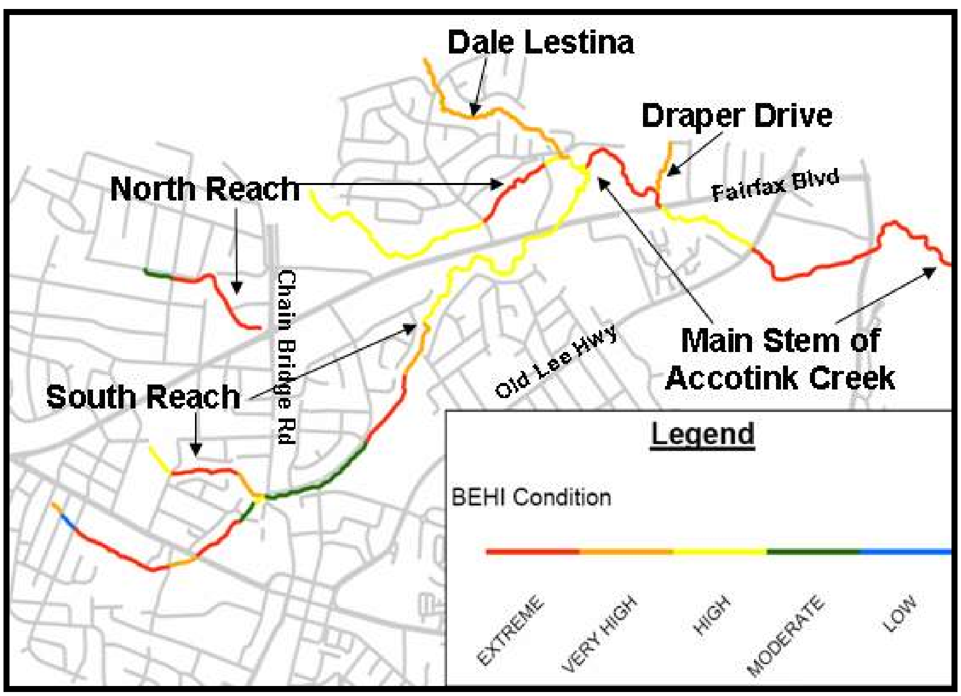

Figure 4: BEHI Score Distribution

VI.B. Feasibility Inventory
In this study, feasibility is a combination of both ease of access to the stream corridor as well as site specific constraints on construction work, such as utilities that are near or that cross the stream. Construction access is a key factor when planning stream stabilization or restoration efforts. Having locations with wide and flat areas for proper construction equipment ingress and egress can greatly reduce construction costs. In the same way, a stream corridor that is impinged upon by sanitary sewer crossings and manholes and other utilities is constrictive and difficult to work within. More constraints in, and near, a stream lead to less freedom in design and may limit the space required to adequately construct the appropriate stream stabilization measures.

VI.C. Citizen Concerns
Another factor considered was public sentiment for stream improvements. A number of reaches are degraded to the point where citizens have become directly impacted. Concerns commonly associated with stream impacts include tree loss, severe bank erosion, flooding, and debris in the stream. Information was provided by the City regarding these concerns, which is reflected in the mapping provided in Appendix B.

VI.D. Costs
Costs for design and construction services were estimated for all reaches. These costs were generalized based upon the severity of erosion as well as other site-specific constraints, such as access, that were observed in the field.

For the purposes of this analysis, costs were broken into three ranges based upon the level of restoration required:

- **Full Restoration: $450-$600 per LF**
- **Moderate Restoration: $250-$450 per LF**
- **Light Restoration: $50-$250 per LF**

Full stream restoration includes activities such as:

- **Laying back the stream banks** to reduce near-bank shear stress over long, continuous reaches
- **Installing in-stream structures** (cross-vanes, imbricated walls) to control vertical and lateral migration
- **Adjusting planform configuration of stream**
- **Planting native, non-invasive vegetation** to enhance aesthetics and reinforce bank stability

Moderate restoration includes many aspects of full restoration; however this work would be less intensive. Fewer in-stream structures would be used and the extent of laying back banks would be reduced. Also, this work would most likely not include alteration of the planform configuration.

Light restoration emphasizes vegetative solutions and would focus structural controls in portions of the stream that are directly impacting nearby homeowners or citizens, such as armoring an outside bend of badly eroded stream bank. It should be noted that these are generalized estimates to be used for planning and budgeting purposes only.

VII. FUTURE PLAN

VII.A. Prioritization Ranking
Due to the large number of severely impacted stream reaches relative to funding that is available to address stream erosion problems in the City, it is necessary to maximize the impact of available funds. The best way to maximize the impact of funding is by developing a priority ranking of stream projects based upon key factors. In this analysis, the key factors are: BEHI ranking (stream bank erosion severity), Feasibility (access, utilities,

easements), and Public Sentiment (citizen concerns). These factors take several viewpoints into account: objective and scientific (BEHI), practical and constructable (feasibility), and political (public sentiment). Finding restoration projects that intersect the optimal values for each factor will provide the top priority projects. Ideally, these top priority projects will be streams that are the most severely impacted, are the most feasible, have the most positive public sentiment view, and cost the least. In reality, however, projects that are the most impacted require the most restoration effort, and therefore, cost the most. Also, if the most impacted streams are not directly impacting residents, should these streams be the top priority? The analysis will balance the need to address public sentiment using light restoration with larger, more costly full restoration efforts. Table 2 shows a layout of the key factors in prioritization.

Table 2: Extreme or Very High BEHI-rated Stream Reaches and Priorities

Reach ID	Location	Feasibility	Citizen Concerns	BEHI Rating
SR1-001	Rust Hill Pl.	High	No	High
SR1-002	Meadow Bridge Ln.	High	No	Moderate
SR1-003	Main Street Green Condos	Low	No	Extreme
SR1-004		Very Low	No	Extreme
SR1-005	Railroad Avenue	Very Low	No	Extreme
SR1-006	Fairfax Cemetery	Very Low	No	Very High
SR1-007	Fairfax Nursing Center	Fair	No	Extreme
SR1-008	Autumn Woods	High	No	Extreme
SR1-009		Fair	No	Low
SR1-010		Very High	No	Very High
SR2-001	Keith Ave. Park	High	No	High
SR2-002	Springmann Dr.	Low	Yes	Extreme
SR2-003	North of Tusico Ct.	Fair	No	Very High
SR3-001	Kenmore Dr.	Very High	No	Moderate
SR3-002	Jean St.	High	Yes	Very High
SR3-003	Spring Lake Terr.	Very Low	Yes	Very High
SR3-004		Very Low	Yes	Very High
SR3-005	Lower Spring Lake Terr.	Fair	No	High
SR3-006	Stafford Dr.	Fair	No	High
SR3-007	S. Ranger Rd. Park	Fair	No	High
NR1-001	Howerton Ave.	Fair	No	Moderate
NR1-002	Howerton & Orchard	High	No	Very High
NR2-001	Ranger Rd.	High	No	High
NR2-002	Mosby Woods	High	Yes	Extreme
NR2-003	N. Ranger Rd. Park	High	Yes	High
MS1-001	Draper Dr. Park	Very High	No	Very High
MS1-003	Fairfax Blvd/Old Lee Hwy	High	No	High
MS1-004	Old Pickett Dr.	High	Yes	Extreme
MS1-005	Thaiss Park	High	Yes	Extreme
DDT1-001	Draper Dr.	High	No	Very High
DLT1-001	Dale Lestina Park	Low	Yes	Very High

An initial analysis of factors highlights five reaches that have high feasibility, impacted citizens, and are considered to be critically unstable. Three of these reaches (SR3-002, NR2-002 AND NR2-003) are tied to citizen concerns regarding impacts to property due to erosion, debris, and downed trees. The remaining two reaches (MS1-004 AND MS1-005; in grey) are larger stream systems that would be more costly to restore and the citizen concerns have been primarily related to flooding issues over Pickett Road. Restoration or stabilization of these stream reaches will not alleviate this flooding potential, so it is recommended that these reaches not be included in the priority of reaches to be targeted for restoration.

The three yellow highlighted reaches (SR3-002, NR2-002, AND NR2-003) should be considered the top priority reaches. We recommend that work performed in SR3-002 include full restoration due to the extensive nature of the impacts on the stream. The accessibility of the project coupled with the facts that the upstream reach has been previously restored and the reach is on publicly-owned land makes this area a very good candidate for restoration. The lower portion of the reach (600 LF) is the most impacted, so it is recommended that light restoration be concentrated at the tight meander bend located in this area. NR2-002 is a lengthy (1500 LF) reach between Plantation Parkway and Stafford Drive. This area is a priority for the City as it has been an area historically impacted by downed trees, debris, and flooding. Again, this area is accessible and publicly-owned with high citizen concerns, which makes it another candidate for full restoration. Light restoration is recommended to focus on the tight meander bend located approximately 500 LF upstream from Stafford Drive. Lastly, NR2-003 exhibits excessive lateral migration tendencies and citizen concerns about fallen trees have surfaced. As with NR2-002, this is a good candidate for both comprehensive restoration or spot fixes at tight meander bends.

A second analysis was performed to filter all other reaches where citizens have expressed concern. These reaches are highlighted orange and include SR3-003, SR3-004, DLT1-001, and SR2-002. All of these reaches have low or very low feasibility, mostly due restricted access, utilities, or property ownership issues. The first two reaches (SR3-003 and 004) are located immediately downstream of SR3-002. Both of these reaches require full restoration, as opposed to spot fixes, due to the distributed nature of the stream impacts. DLT1-001 was the subject of multiple citizen concerns, focusing on trees debris and stream bank erosion. This reach should be targeted for localized stabilization to remove this debris and provide bank stabilization immediately up and downstream of Ranger Road. These reaches should also be considered for priority projects.

VII.B. Repair Recommendations

Criteria other than erosion severity, feasibility, public sentiment, and cost play into prioritization of projects. The City has been involved with stream restoration and stabilization since the mid-1990's. Reaches previously restored are shown in Figure 5. These restored areas have been observed by City officials over the last decade. Through this observation several reaches have been identified as having continuing stream stability problems. Since these areas were previously restored only light restoration and maintenance is required on most instances to allow these restored reaches to perform as originally designed.

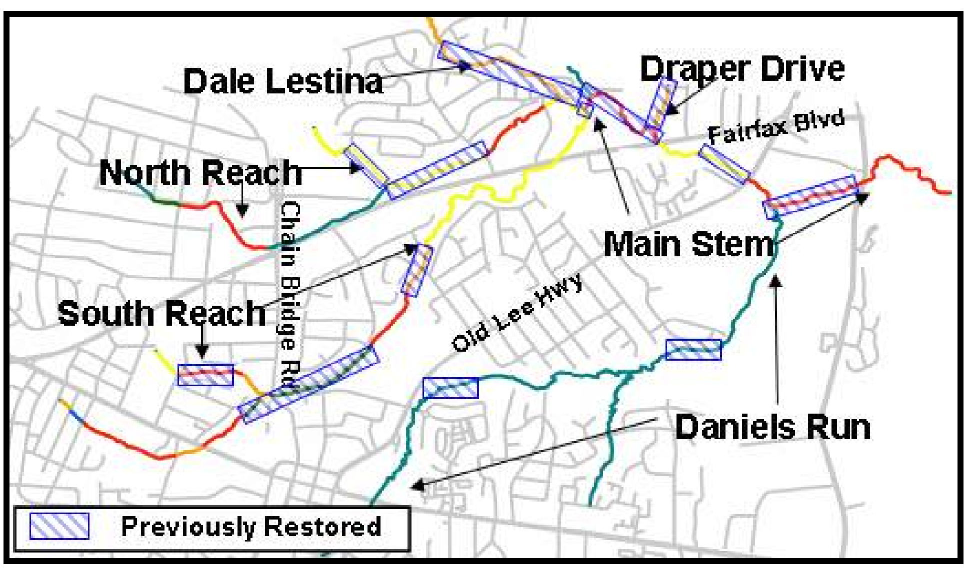

Figure 5: Previously Restored Areas on Accotink Creek

The Daniels Run tributary was not assessed in this study; however, sections of this stream were impacted during the June 26, 2006 storm event. Two reaches in particular are located immediately adjacent to the Daniels Run Elementary School. Both reaches are approximately 350 LF and are adjacent to each other. The upper reach was previously stabilized using primarily Filtrexx socks, which are 12”-18” diameter tubes of filter fabric filled with compost, straw, or other suitable material. These tubes are normally placed parallel to the stream at key locations in the stream, such as the toe. These measures provide short-term stream bank protection. Normally, plantings are placed directly into the tubes, which should provide long-term stability for the stream bank after the filter fabric biodegrades. Figure 6 shows an example of this application at the Daniels Run site.

Figure 6: Filtrexx Socks at Daniels Run

As Figure 6 illustrates, plantings have not become established, although many of the tubes are still stable and in-place. This reach can be stabilized by identifying areas of local destabilization and a comprehensive planting plan to reinforce the Filtrexx systems already in place. This reach requires light restoration. Portions of the downstream reach have been previously stabilized (near a pedestrian bridge). This reach is experiencing severe bank erosion, as is evident in the near-vertical 5-6 foot high banks. This reach will require a greater effort than the upper reach. Moderate restoration should be assumed for this area. Any work done in these reaches should incorporate public educational components and be integrated into the restoration work performed previously on school grounds.

Another area known to be impacted is MS1-003, which is located between Fairfax Boulevard and Old Lee Highway. This 1900 LF reach was previously restored; however, it was severely impacted by the June, 2006 storm event. This stream is accessible and design services would be minimal – similar to the upper Daniels Run level of effort. Construction efforts would be considered light restoration and be focused on fixing previously-installed in-stream structures and addressing other areas of local erosion problems, as noted in the design documents. This area, as well as the Daniels Run elementary site, should be included on the list for priority reaches for restoration.

In summation, it is our recommendation that priority be given to restoring/stabilizing the following reaches:

- SR3-002 (Jean Street)
- NR2-002 (Mosby Woods)
- NR2-003 (North Ranger Road Park)
- SR3-003 and 004 (Spring Lake Terrace)
- DLT1-001 (Dale Lestina Park)
- SR2-002 (Springmann Drive)
- MS1-001 (Fairfax Boulevard/Old Lee Highway)
- Daniels Run Elementary

The locations for these reaches are shown in Figures 7 and 8.

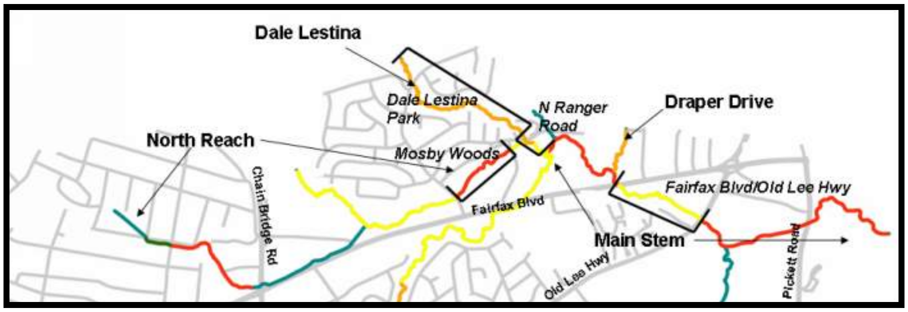

Figure 7: Priority Restoration Areas on the North Reach and Main Stem

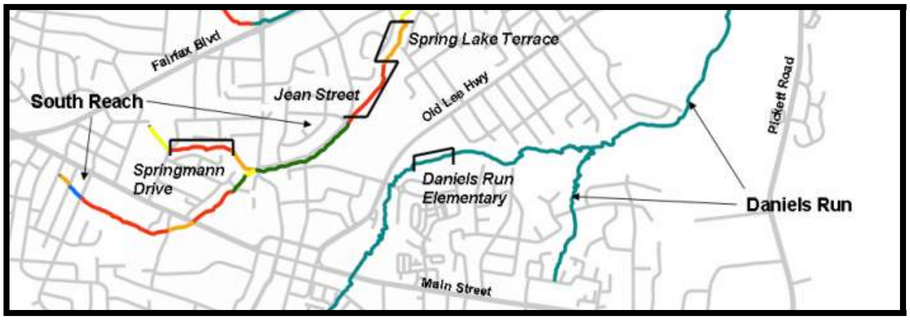

Figure 8: Priority Restoration Areas on the South Reach and Daniels Run

VII.C. Budget Recommendations over 5 years

The priority reaches have been identified, but a systematic plan to address each reach is required to determine future budgetary requirements. The goal of this analysis is to maximize the amount of restoration with assumed funding quantities. This analysis assumes two scenarios over a 5-year window, an annual available budget of $200,000 and an annual available budget of $500,000. Larger projects are more cost-effective since a significant portion of construction costs are associated with mobilization efforts; however, limited budgets inhibit large construction projects.

$200,000 Annual Budget

Light restoration is emphasized in this scenario in order to perform restoration at more locations, which allows more flexibility to focus on addressing citizen concerns. In this scenario there will be years of no action in order to accumulate the funds required to tackle larger projects. Table 3 shows the details for this budget scenario. The locations of restoration for this scenario are shown in Figure 9.

Table 3: 5-Year Plan and $200,000 Budget

Year	*Reach ID*	*Location*	*Restoration*	*Cost ($/LF)*	*Length (LF)*	*Total Cost*	*Subtotal*
Year 1	SR3-002	Lower Jean Street	Moderate	$250	600	$150K	$202.5K
	N/A	Upper Daniels Run Elementary	Light	$150	350	$52.5K	
Year 2	MS1-003	Fairfax Blvd/Old Lee Hwy	Light	$150	1300	$195K	$195K
Year 3	N/A	N/A	None	$0	0	0	$0
Year 4	SR3-003/4	Spring Lake Terrace	Full	$450	900	$405K	$405K
Year 5	DLT1-001	Dale Lestina Park	Light	$200	300	$60K	$205K
	NR2-003	N. Ranger Road Park	Light	$150	300	$45K	
	NR2-002	Mosby Woods	Moderate	$250	400	$100K	

The $200,000 budget scenario allows for 4,150 LF of total restoration over five years at the following intensities:

- 2,250 LF of light restoration
- 1,000 LF of moderate restoration
- 900 LF of full restoration

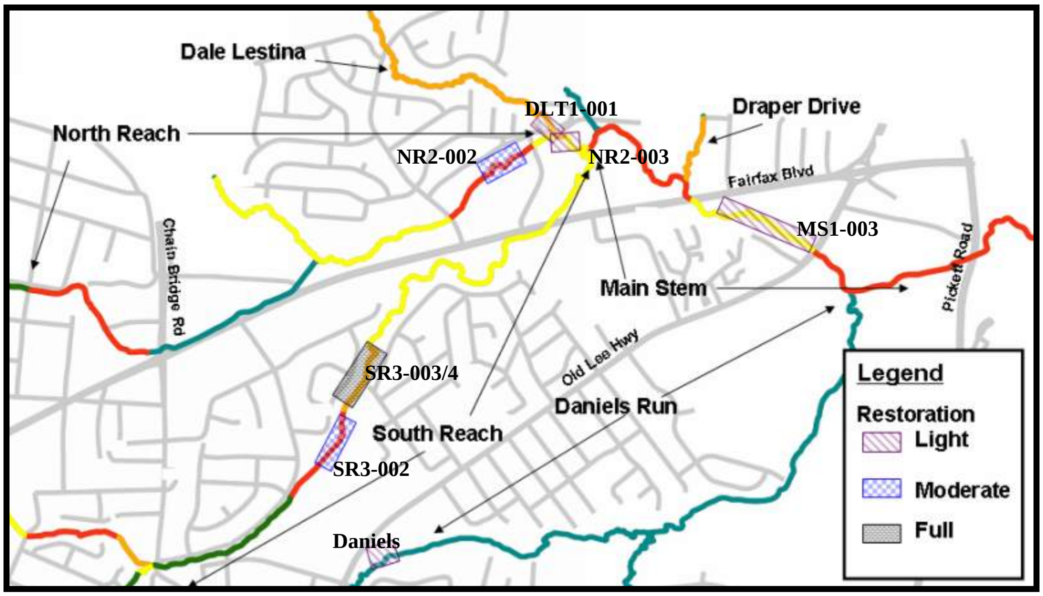

Figure 9: Restoration Efforts under a $200,000 per Year Budget over 5 Years

$500,000 Annual Budget

Along with addressing citizen concerns, the larger budget emphasizes full and moderate restoration efforts as well. Table 4 shows the details for this budget scenario. The locations of restoration for this scenario are shown in Figure 10.

Table 4: 5-Year Plan and $500,000 Budget

Year	*Reach ID*	*Location*	*Restoration*	*Cost ($/LF)*	*Length (LF)*	*Total Cost*	*Subtotal*
Year 1	SR3-002	Lower Jean St.	Moderate	$400	600	$240K	$495K
	MS1-003	Fairfax Blvd/Old Lee Hwy	Light	$150	1300	$195 K	
	DLT1-001	Dale Lestina Park	Light	$200	300	$60K	
Year 2	SR3-003/4	Spring Lake Terrace	Full	$450	1000	$450 K	$502.5K
	N/A	Upper Daniels Run Elementary	Light	$150	350	$52.5 K	
Year 3	NR2-002	Mosby Woods	Full	$450	1100	$495 K	$495K
Year 4	NR2-003	N. Ranger Road Park	Light	$200	300	$60 K	$492.5K
	N/A	Lower Daniels Run Elementary	Moderate	$400	350	$140K	
	SR3-002	Upper Jean Street	Full	$450	650	$292.5 K	
Year 5	SR2-002	Springmann Drive	Full	$500	1000	$500K	$500K

The $500,000 budget scenario allows for 6,950 LF of total restoration over five years at the following intensities:

- 2,250 LF of light restoration
- 950 LF of moderate restoration
- 3,750 LF of full restoration

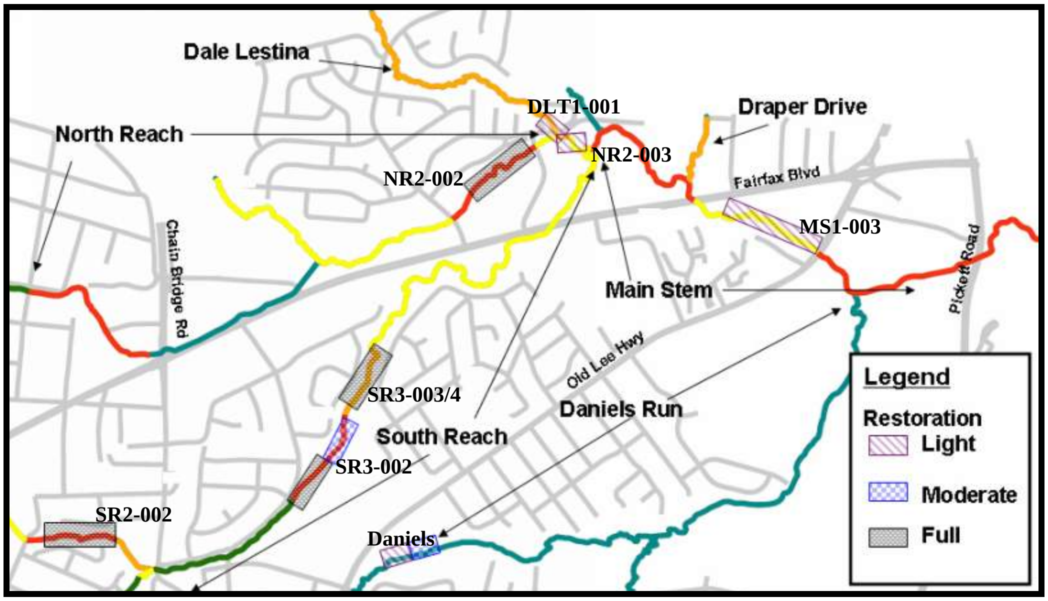

Figure 10: Restoration Efforts under a $500,000 per Year Budget over 5 Years

A comparison of the amount of restoration and the distribution of the level of restoration shows the differences between the two scenarios. Over 65% more restoration is provided in the higher funding scenario. Also, over six times the amount of full restoration is associated with the higher funding scenario. In both scenarios; however, citizen concerns are addressed.

VIII. OTHER CONSIDERATIONS

There are other actions that can be taken along with stream restoration efforts to complement these projects. These include a stormwater retrofit program, stream monitoring program, and outside funding sources to offset costs or provide additional funding for restoration efforts.

VIII.A. Stormwater Retrofit Program

Current stormwater regulations provide not only for water quantity control, but also for water quality treatment and stream protection. However, much of the City's growth occurred in the 1960's and 70's, when the stormwater philosophy at that time stressed flood control. Therefore, a significant amount of the stormwater facilities in the City did not provide controls beyond water quantity management. Other municipalities in the Northern Virginia region with similar problems have initiated retrofit programs in order to repair aging stormwater ponds and provide or enhance water quality treatment and stream protection by re-grading pond footprints, adding water quality features (micropools, wetland plantings, etc.) and new control structures aimed at improving pond performance. A program of this nature will protect restored sections of streams as well as provide enhanced water quality benefit, which could possibly be credited for in the City's MS4 permit.

VIII.B. Stream Monitoring Program

The City has already invested significantly in stream restoration efforts. As the City prepares to restore more streams, a comprehensive monitoring plan targeted at past and future restoration efforts could provide quantifiable evidence on the benefits of these efforts towards stream stability and functionality. Monitoring can provide insight on more successful design measures and construction techniques as well as allowing the City to be proactive in repairing any damaged reaches to minimize impacts on the public safety of citizens as well as stream functionality. The specifics of the monitoring plan can reflect City priorities and any required metrics called out in permitting documents (VPDES, etc.).

VIII.C. Outside Funding

Outside funding sources, such as grants and cost-sharing with neighboring communities should be considered when developing budgets for restoration efforts. These grants include the Virginia Water Quality Improvement Fund, the U.S. Fish and Wildlife Service Small Watershed Grants Program, and other similar programs. Also, stream mitigation has recently surfaced in Virginia as an alternative method for municipalities to perform restoration. This is a relatively new topic, so further analysis would be required in order to fully understand the dynamics of stream mitigation banking.

IX. SOURCES

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APPENDIX A

PHOTOS OF ALL STUDY REACHES

Accotink DDT1_001_A 2/22/2007

Accotink DDT1_001_B 2/22/2007

Accotink DDT1_001_C 2/22/2007

Accotink DDT1_001_D 2/22/2007

Accotink DDT1_001_F 2/22/2007

Accotink DLT_001_A 2/22/2007

Accotink SR3_006_A 2/22/2007

Accotink SR3_006_B 2/22/2007

Accotink SR3_007_A 2/22/2007

Accotink SR3_007_B 2/22/2007

Accotink SR3_007_C 2/22/2007

Accotink SR3_007_D 2/22/2007

Accotink SR3_005_I 2/22/2007

Accotink SR3_005_J 2/22/2007

Accotink SR3_005_K 2/22/2007

Accotink SR3_005_L 2/22/2007

Accotink SR3_005_M 2/22/2007

Accotink SR3_005_N 2/22/2007

Accotink SR3_005_B 2/22/2007

Accotink SR3_005_C 2/22/2007

Accotink SR3_005_D 2/22/2007

Accotink SR3_005_F 2/22/2007

Accotink SR3_005_G 2/22/2007

Accotink SR3_005_H 2/22/2007

Accotink SR3_004_D 2/22/2007

Accotink SR3_004_F 2/22/2007

Accotink SR3_004_G 2/22/2007

Accotink SR3_004_H 2/22/2007

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Accotink SR3_005_A 2/22/2007

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Accotink SR3_003_C 2/22/2007

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Accotink SR3_002_D 2/22/2007


Accotink SR2_003_F 2/22/2007


Accotink SR2_003_G 2/22/2007


Accotink SR2_003_H 2/22/2007


Accotink SR2_003_I 2/22/2007


Accotink SR2_003_J 2/22/2007


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Accotink SR2_002_A1 2/22/2007

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Accotink SR1_009_A 2/22/2007

Accotink SR1_009_B 2/22/2007

Accotink SR1_010_A 2/22/2007

Accotink SR1_004_F 2/22/2007

Accotink SR1_005_A 2/22/2007

Accotink SR1_005_B 2/22/2007

Accotink SR1_006_A 2/22/2007

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Accotink SR1_007_A 2/22/2007


Accotink SR1_003_B 2/22/2007


Accotink SR1_004_A 2/22/2007


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Accotink SR1_004_C 2/22/2007


Accotink SR1_004_D 2/22/2007


Accotink SR1_004_E 2/22/2007

Accotink NR2_003_D 2/22/2007

Accotink SR1_001_A 2/22/2007

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Accotink SR1_002_B 2/22/2007

Accotink SR1_003_A 2/22/2007


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Accotink NR2_002_E 2/22/2007


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Accotink NR2_003_B 2/22/2007


Accotink NR2_003_C 2/22/2007

Accotink NR2_000_A (EATON) 2/22/2007

Accotink NR2_000_B (EATON) 2/22/2007

Accotink NR2_001_A 2/22/2007

Accotink NR2_001_B 2/22/2007

Accotink NR2_002_A 2/22/2007

Accotink NR2_002_B 2/22/2007


Accotink NR1_001_C 2/22/2007


Accotink NR1_001_D 2/22/2007


Accotink NR1_002_A 2/22/2007


Accotink NR1_002_B 2/22/2007


Accotink NR1_002_C 2/22/2007


Accotink NR1_002_D 2/22/2007

Accotink MS1_005_G 2/22/2007

Accotink NR1_000_A 2/22/2007

Accotink NR1_000_B 2/22/2007

Accotink NR1_000_C 2/22/2007

Accotink NR1_001_A 5/21/2007

Accotink NR1_001_B 2/22/2007

Accotink MS1_005_A 2/22/2007

Accotink MS1_005_B 2/22/2007

Accotink MS1_005_C 2/22/2007

Accotink MS1_005_D 2/22/2007

Accotink MS1_005_E 2/22/2007

Accotink MS1_005_F 2/22/2007

Accotink MS1_004_G 2/22/2007

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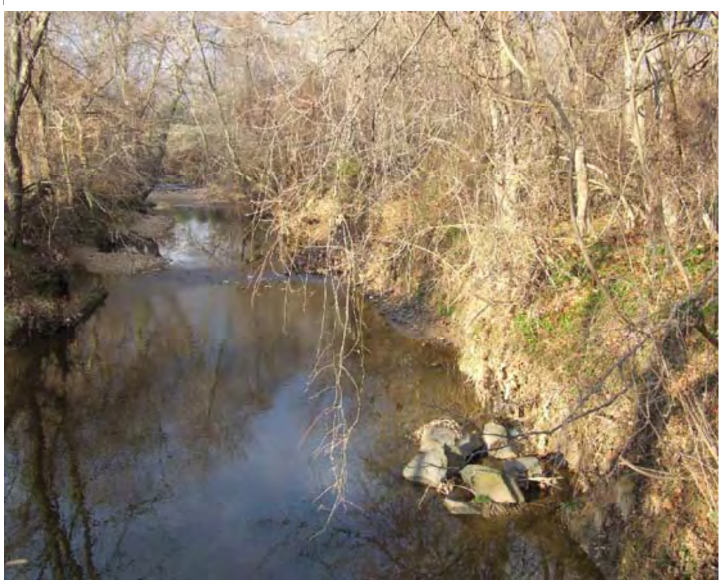

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Accotink MS1_001_C 2/22/2007

Accotink MS1_001_D 2/22/2007

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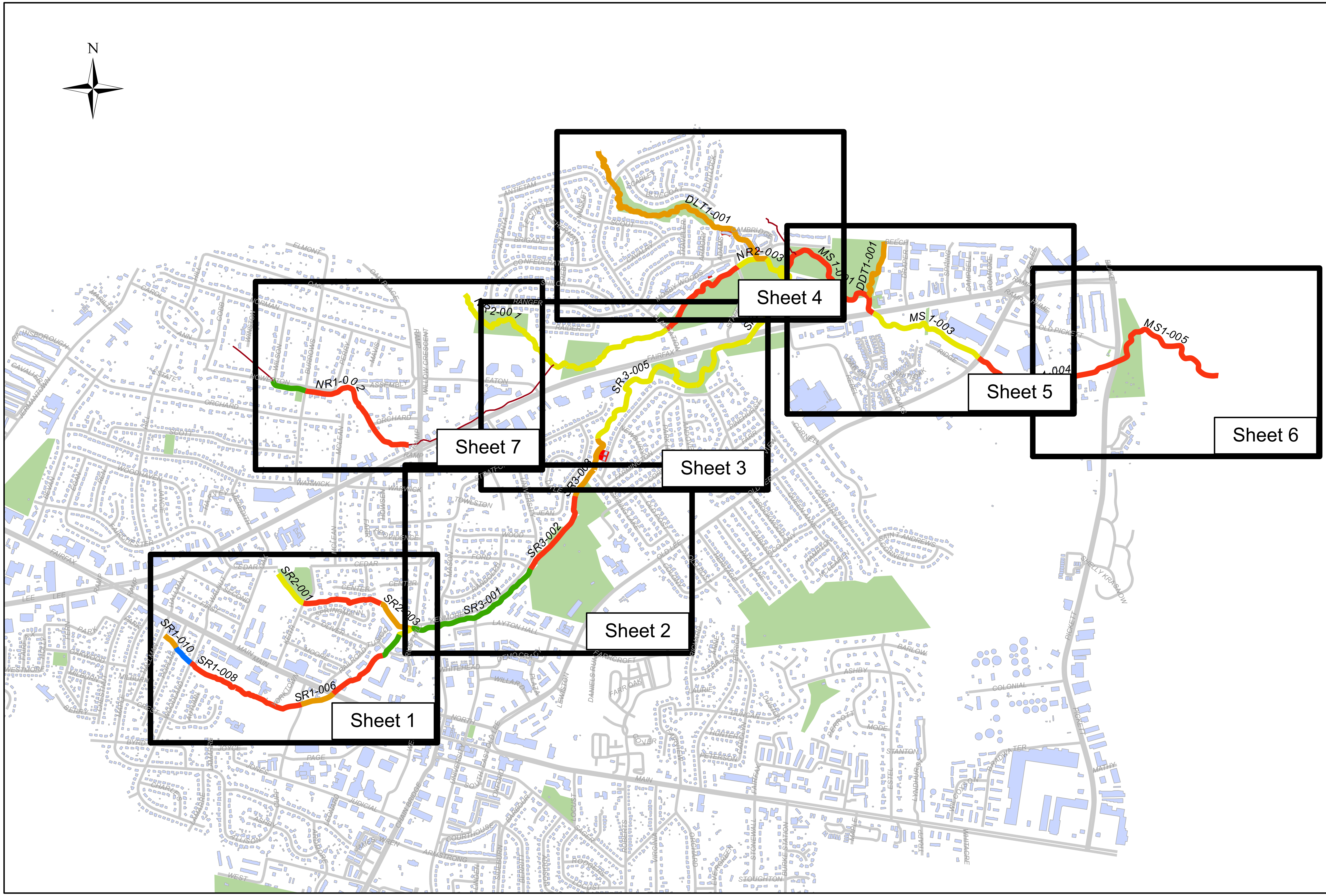
Accotink SR3_007_E 2/22/2007

APPENDIX B

STREAM ASSESSMENT
&
BEHI RESULTS MAPPING



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Key Sheet
Scale: 1"=1500'

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CITY OF FAIRFAX, VIRGINIA
STREAM ASSESSMENT AND INVENTORY
STREAM RESTORATION DESIGN SERVICES
ACCOTINK CREEK

STREAM ASSESSMENT AND BEHI RESULTS

H SCALE: 1" = 1500'
V SCALE: N/A
COUNTOUR: N/A
DATE: May 22, 2007
DESIGNED: DWB
DRAFTED: SPB
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: Key Sheet

RK &K

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ACCOTINK CREEK

STREAM ASSESSMENT AND BEHI RESULTS
Sheet 1

H SCALE: 1" = 300'
V SCALE: N/A
COUNTOUR: N/A
DATE: Jun 06, 2007
DESIGNED: DWB
DRAFTED: SPB
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: 1 of 7

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STREAM ASSESSMENT AND BEHI RESULTS

Sheet 2

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V SCALE: N/A
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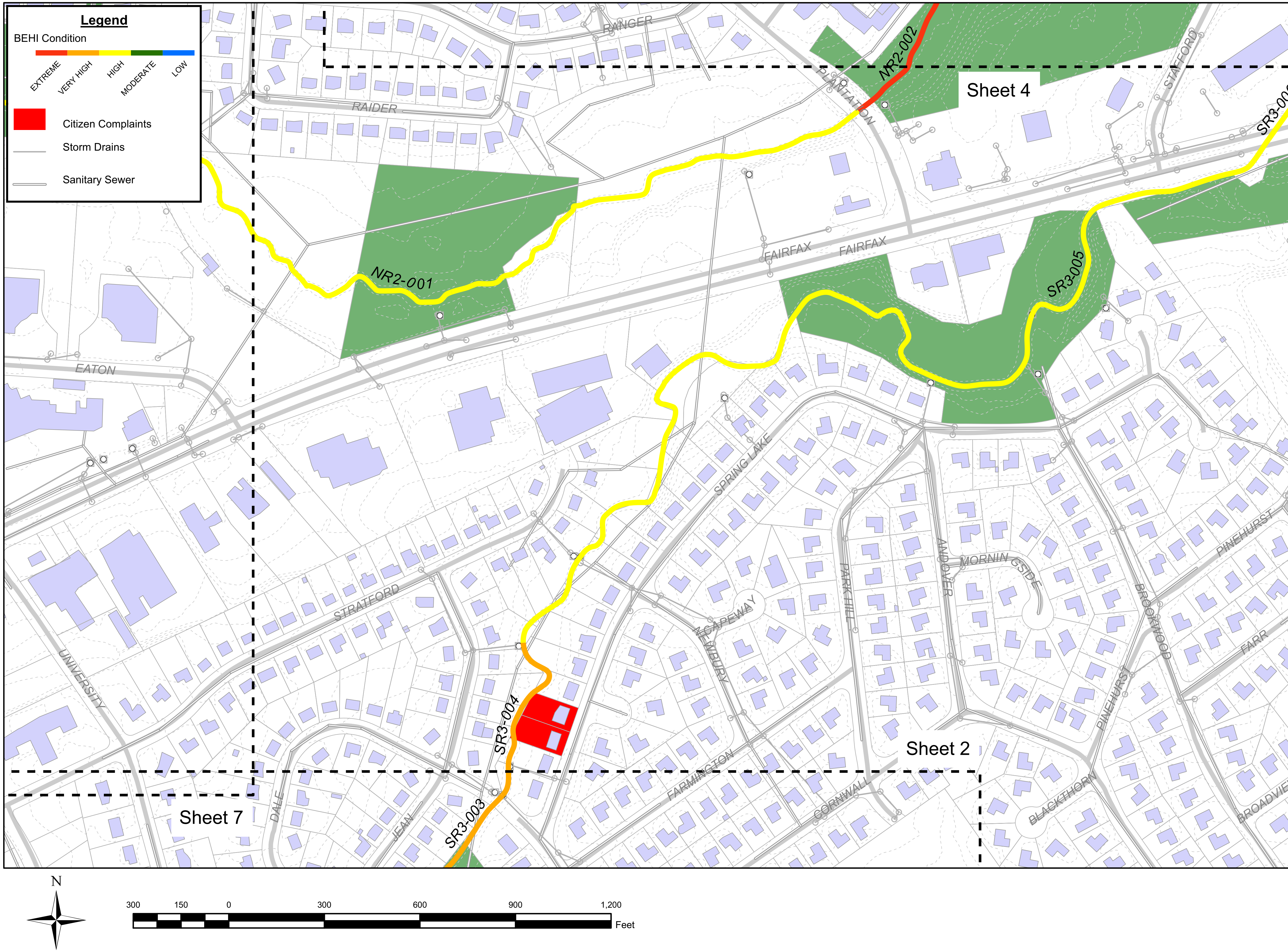
PROJECT #: 406-150-1

SHEET: 2 of 7



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STREAM ASSESSMENT AND BEHI RESULTS
Sheet 3

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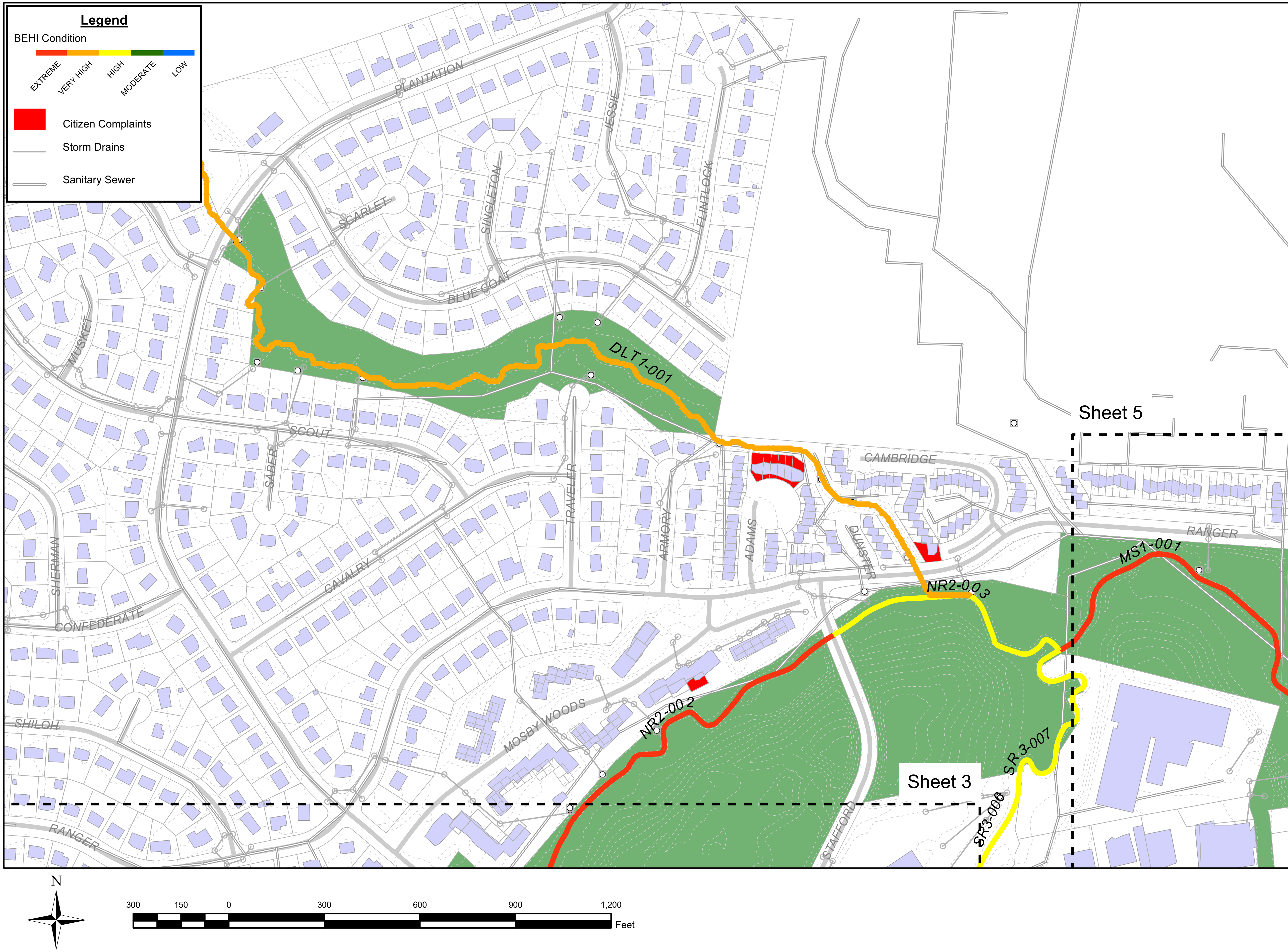
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: 3 of 7



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STREAM ASSESSMENT AND BEHI RESULTS

Sheet 4

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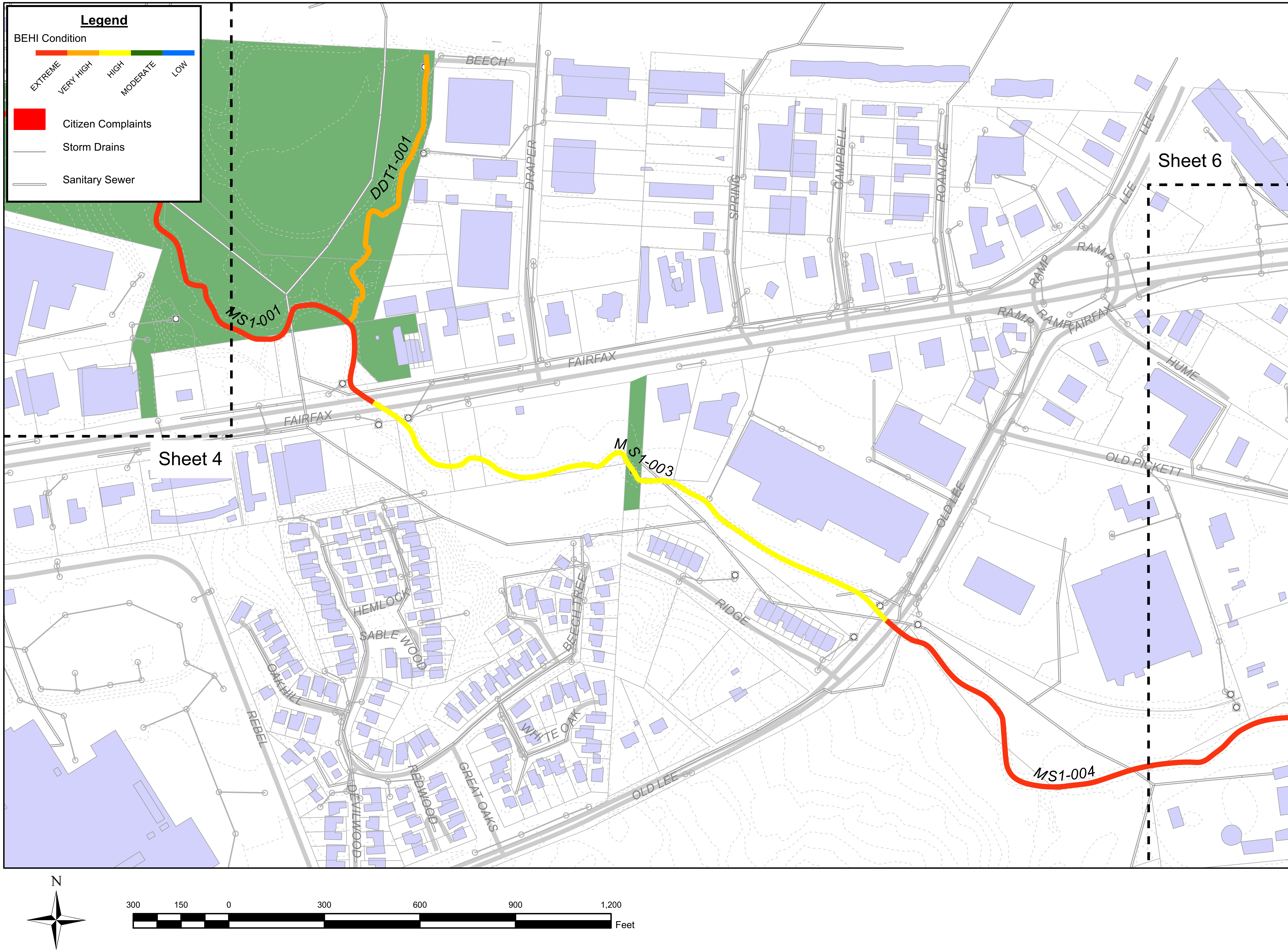
DESIGNED: DWB
DRAFTED: SPB
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: 4 of 7



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STREAM ASSESSMENT AND BEHI RESULTS
Sheet 5

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V SCALE: N/A
COUNTOUR: N/A
DATE: Jun 06, 2007
DESIGNED: DWB
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PROJECT #: 406-150-1
SHEET: 5 of 7

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CITY OF FAIRFAX, VIRGINIA
STREAM ASSESSMENT AND INVENTORY
STREAM RESTORATION DESIGN SERVICES
ACCOTINK CREEK

STREAM ASSESSMENT AND BEHI RESULTS
Sheet 6

H SCALE: 1" = 300'
V SCALE: N/A
COUNTOUR: N/A
DATE: Jun 06, 2007
DESIGNED: DWB
DRAFTED: SPB
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: 6 of 7

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STREAM RESTORATION DESIGN SERVICES
ACCOTINK CREEK

STREAM ASSESSMENT AND BEHI RESULTS

Sheet 7

H SCALE: 1" = 300'
V SCALE: N/A
COUNTOUR: N/A
DATE: Jun 06, 2007
DESIGNED: DWB
DRAFTED: SPB
CHECKED: DWB

PROJECT #: 406-150-1

SHEET: 7 of 7

APPENDIX C

SUMMARY TABLE OF BEHI SCORING RESULTS

Summary BEHI Results by Reach

Reach ID	Bank Height / Bankfull Height	Index	Root Depth / Bank Height	Index	Weighted Root Density	Index	Bank Angle	Index	Surface Protection	Index	Materials	Stratification	Total	Condition
DDT1-001	8.00	10.00	0.125	8.2	8.1	8.7	50	3.4	75.0	2.3	5.0	5.0	42.5	Very High
DLT1-001	8.00	10.00	0.188	7.4	5.6	8.9	50	3.4	80.0	1.9	5.0	5.0	41.5	Very High
MS1-001	5.00	10.00	0.200	7.2	9.0	8.6	85	7.0	50.0	4.3	10.0	5.0	52.0	Extreme
MS1-003	3.50	10.00	0.210	7.2	15.0	7.9	85	7.0	80.0	1.9	0.0	5.0	39.0	High
MS1-004	3.50	10.00	0.430	4.6	27.9	6.2	100	8.3	35.0	5.5	10.0	5.0	49.5	Extreme
MS1-005	3.50	10.00	0.286	6.1	5.7	8.9	100	8.3	15.0	7.9	5.0	5.0	51.0	Extreme
NR1-001	5.00	10.00	0.400	4.9	24.0	6.7	75	4.4	80.0	1.9	0.0	0.0	28.0	Moderate
NR1-002	8.00	10.00	0.125	8.2	3.1	10.0	90	7.9	20.0	7.2	10.0	5.0	58.5	Extreme
NR2-001	3.00	10.00	0.330	5.6	20.0	7.2	55	3.7	65.0	3.1	10.0	0.0	39.5	High
NR2-002	4.50	10.00	0.220	6.9	6.7	8.8	85	7.0	20.0	7.2	5.0	5.0	50.0	Extreme
NR2-003	4.50	10.00	0.220	6.9	15.6	7.8	55	3.7	70.0	2.7	5.0	0.0	36.0	High
SR1-001	4.00	10.00	0.500	3.9	35.0	5.5	45	3.2	70.0	2.7	5.0	0.0	30.5	High
SR1-002	2.67	8.80	0.500	3.9	40.0	5.1	35	2.7	80.0	1.9	5.0	0.0	27.5	Moderate
SR1-003	4.67	10.00	0.143	8.0	4.3	10.0	75	4.4	25.0	6.5	7.0	5.0	51.0	Extreme
SR1-004	5.33	10.00	0.125	8.2	1.3	10.0	90	7.9	0.0	10.0	7.0	5.0	58.0	Extreme
SR1-005	6.67	10.00	0.050	10.0	1.0	10.0	90	7.9	5.0	10.0	5.0	5.0	58.0	Extreme
SR1-006	9.33	10.00	0.143	8.0	8.6	8.6	55	3.7	70.0	2.7	5.0	5.0	43.0	Very High
SR1-007	6.67	10.00	0.100	8.5	2.0	10.0	85	7.0	20.0	7.2	5.0	7.0	54.5	Extreme
SR1-008	10.00	10.00	0.100	8.5	1.5	10.0	90	7.9	5.0	10.0	5.0	5.0	56.5	Extreme
SR1-009	2.67	8.80	0.750	2.7	75.0	2.4	45	3.2	90.0	1.5	0.0	0.0	18.5	Low
SR1-010	5.00	10.00	0.200	7.2	16.0	7.8	55	3.7	80.0	1.9	5.0	5.0	40.5	Very High
SR2-001	4.00	10.00	0.250	6.6	15.0	7.9	70	5.0	60.0	3.5	5.0	0.0	38.0	High
SR2-002	4.00	10.00	0.375	5.2	22.5	6.9	65	4.4	65.0	3.1	10.0	7.0	46.5	Extreme
SR2-003	3.50	10.00	0.286	6.1	14.3	8.0	80	5.9	65.0	3.1	5.0	5.0	43.0	Very High
SR3-001	2.00	7.90	0.500	3.9	37.5	5.3	45	3.2	90.0	1.5	0.0	0.0	22.0	Moderate
SR3-002	6.00	10.00	0.167	7.7	5.8	8.9	90	7.9	40.0	5.1	10.0	10.0	59.5	Extreme
SR3-003	4.90	10.00	0.100	8.5	3.0	10.0	60	3.9	45.0	4.7	5.0	0.0	42.0	Very High
SR3-004	3.00	10.00	0.667	3.1	26.7	6.3	90	7.9	50.0	4.3	7.0	5.0	43.5	Very High
SR3-005	2.25	8.20	0.556	3.6	33.3	5.6	80	5.9	70.0	2.7	0.0	5.0	31.0	High
SR3-006	2.67	8.80	0.375	5.2	24.4	6.6	90	7.9	50.0	4.3	0.0	0.0	33.0	High
SR3-007	2.67	8.80	0.250	6.6	15.0	7.9	50	3.4	70.0	2.7	7.0	0.0	36.5	High

APPENDIX D

SUMMARY SHEETS
OF
"EXTREME" & "VERY HIGH" BEHI RATINGS

Site No.: SR1-003

Site Score: 51.0, “Extreme”

Location: Behind Main Street Green Condos

Site Description: Drainage Area ≈ 416 acres ±

The reach is just upstream of condo community. There appears to be only one commercial property that would be impacted. Recent bank repairs were attempted on the east side of the channel. The stream is heavily incised with high banks. There is one sanitary sewer crossing.

Citizen Concerns: None known.

Access: Access is problematic. Residential condo community access to the reach and downstream would be impacted.

Site No.:	SR1-004
Site Score:	58.0, "Extreme"
Location:	Behind Main Street Green Condos

Site Description:	Drainage Area ≈ 462 acres ± Three commercial properties border this reach. This reach is a very tight and narrow corridor and extremely incised. The sanitary sewer appears to parallel the stream along this reach. Recent sanitary work was performed by the City at Main Street.
Citizen Concerns:	None known.
Access:	Access is extremely poor. There is no direct access. The stream banks are steep. It would be difficult to engineer access for performing instream work.

Site No.:	SR1-005
Site Score:	58.0, "Extreme"
Location:	Railroad Ave., north of Main Street

Site Description:	Drainage Area ≈ 427 acres ± The reach is just upstream of SR1-004, towards Main Street. It is differentiated from SR1-004 due to a long concrete retaining wall. The west bank is actively eroding but constrained by the automobile dealer parking lot. The stream channel is very incised.
Citizen Concerns:	None known.
Access:	Access is extremely poor. There is no direct access due to property issues, close proximity of buildings, and steep stream banks. It would be difficult to engineer access for performing instream work.

Site No.: SR1-006

Site Score: 43.0, “Very High”

Location: City of Fairfax Cemetery, from Judicial Dr. to Main St.

Site Description: Drainage Area ≈ 375 acres ±

There is limited bank erosion due to the backwater condition at the Main Street culvert. This is a short reach (500 ft. ±) that is deeply incised. The stream abuts three commercial properties on Main Street (north) and the cemetery on the south bank. The sanitary sewer line parallels the stream and crosses it at least once.

Citizen Concerns: None known.

Access: There are limited access and restoration opportunities due to the graveyard and road/culvert infrastructure. The access points are high traffic volume areas.

Site No.:	SR1-007
Site Score:	54.5, "Extreme"
Location:	Behind Fairfax Nursing Center, spans to Judicial Dr.

Site Description:	Drainage Area ≈ 292 acres ±
	This reach is just downstream of SR1-008. It is deeply incised, most likely from a backwater condition at the Judicial Drive culvert. The reach spans four properties of the medical complex. There is new construction occurring at the lower end of the reach on the north side of the stream.
Citizen Concerns:	None known.
Access:	Access is fair, with availability at the ends of the reach at Judicial Drive.

Site No.: SR1-008

Site Score: 56.5, "Extreme"

Location: Autumn Woods, behind Crest St. and Autumn Ct.

Site Description: Drainage Area ≈ 274 acres ±

This reach primarily spans one property (Fairfax Medical Center). The sanitary sewer is located on both sides of stream channel. It is deeply incised with a foot bridge from the nursing center located at the mid-point of the approximately 1,000 ft. reach.

Citizen Concerns: None known.

Access: Access is good from Woodland Avenue. This is the major access point for the entire reach. There is also a path contiguous to the stream length which seems to be city owned.

Site No.: SR1-010

Site Score: 40.5, "Very High"

Location: Autumn Woods, from Hallman St. to Poplar St.

Site Description: Drainage Area ≈ 150 acres ±

This is the first reach of the southern tributary to be above ground. There is erosion from a storm drain outfall. A park-like walkway to the south side of the channel allows adequate space for work. The sanitary sewer is offset approximately 50 feet from the channel.

Citizen Concerns: None known.

Access: There is clear access along walkway, which appears to be city owned. There would be little impact to the adjacent residential areas.

Site No.:	SR2-002
Site Score:	46.5, "Extreme"
Location:	behind Springmann Dr., from Keith Ave. to Railroad Ave.


Site Description:	Drainage Area ≈ 275 acres ± Approximately 24 residential homes are impacted from severe erosion on the rear of their properties. The stream channel is highly impacted, with random ad-hoc bank revetment located throughout the reach. Midway through the reach, there is a large bamboo stand, which is followed by a tortuous meander. The sanitary sewer crosses the stream at least twice. This reach is very narrow.
Citizen Concerns:	Citizen voiced concern about exposed iron rebar, which was once used to pin biologs in the stream.
Access:	Access is limited to either end of the reach. The area is completely residential.

Site No.: SR2-003

Site Score: 43.0, "Very High"

Location: North of Tusico Ct., from the gap in Center St. to Chain Bridge Rd.

Site Description: Drainage Area ≈ 275 acres ±

This reach extends to the confluence with SR1 and appears to impact only two parcels with no structures on them. The sanitary sewer parallels the stream to south. Downstream, the bridge at Chainbridge Road creates a backwater condition.

Citizen Concerns: None known.

Access: Relatively simple access with the exception of a high traffic entry point on downstream end. However, private property is surrounding the reach, making construction potentially problematic.

Site No.: SR3-002

Site Score: 59.5, “Extreme”

Location: Jean St., along E Calvin Van Dyck Park

Site Description: Drainage Area ≈ 950 acres ±

Up to 9 private properties are potentially affected due to erosion on the west side of the reach. Layton Hall and St. Leos School are on the east side of the reach. The surroundings are primarily residential, with the sanitary sewer running parallel to the stream on the east side. SR3-001 is in better condition than this reach due to recent restoration efforts. This reach is overwidened and has high banks

Citizen Concerns: There is knowledge of concerns on Jean Street, though details are not known.

Access: Access is good. The distance of the reach from structures on residential and school property is at least 100 feet.

Site No.: SR3-003

Site Score: 42.0, "Very High"

Location: Spring Lake Terrace, along Jean St. between the two intersections of Jean St. and Dale Dr., ends at Spring Lake Terrace

Site Description: Drainage Area ≈ 950 acres ±

The reach begins immediately upstream of a foot bridge at Jean Street. Backwater from the bridge may reduce erosion potential in this area. Approximately 6 residential properties are located to the west of the stream, with parkland located to the east. There is one sanitary sewer crossing. This reach has steep banks, with ad-hoc armoring on the stream banks.

Citizen Concerns: There are numerous concerns about past and present flooding.

Access: The reach is surrounded by residential neighborhoods, making access problematic. One or two residential properties may be directly affected by construction due to access from their lawns. Access from the east side of the reach is potentially problematic due to steep banks.

Site No.:	SR3-004
Site Score:	43.5, "Very High"
Location:	Spring Lake Terrace, from Dale Dr. and Jean St. to a court on Spring Lake Terrace


Site Description:	Drainage Area ≈ 975 acres ± The stream reach is similar to SR2-002. This is a residential area, with 11 residential lots bordering the reach. The sanitary sewer is to the west of the stream channel. It is a very narrow corridor with random bank revetment that utilizes anything, from broken concrete to gabion mattresses.
Citizen Concerns:	Citizens voiced concerns about large fallen trees and flooding.
Access:	Access is challenging due to the very narrow corridor and its location in a residential neighborhood. Construction would impact multiple property owners.

Site No.: NR1-002

Site Score: 58.5, “Extreme”

Location: Howerton Ave. and Orchard St., from Burrows Ave. to Chain Bridge Rd.


Site Description: Drainage Area ≈ 182 acres ±

The reach begins downstream of Cobbdale Park and crosses approximately 11 residential properties. A sanitary sewer crosses the stream about 3 times. This reach is incised and has extremely active banks with one tight meander that is accelerating erosion.

Citizen Concerns: None known.

Access: Access is good with only a few residential homes at the end of Orchard Street that would be impacted from construction. New construction appears to have been initiated at McLean Avenue.

Site No.: NR2-002

Site Score: 50.0, "Extreme"

Location: Mosby Woods Dr., from Plantation Pkwy. to Stafford Dr.

Site Description: Drainage Area ≈ 180 acres ±

This reach is located mostly on one parcel of City parkland. The north side of the stream is a residential area called Mosby Woods Condos. There appears to be one sanitary sewer crossing. This reach is overwidened and has poor floodplain access. Substantial mature forest exists on both sides of the stream channel. There is evidence of extensive flooding in the area.

Citizen Concerns: There have been numerous concerns raised with regard to past and present flooding.

Access: Access is relatively simple. The stream could be accessed with limited direct impact to residents. One potential challenge is due to possible necessary tree removal to gain access to the reach.

Site No.: MS1-001

Site Score: 52.0, “Extreme”

Location: South side of Draper Drive Park, from Ranger Rd. to Lee Hwy.

Site Description: Drainage Area ≈ 2,200 acres ±

This reach is located mostly within park land. Prior restoration efforts appear to have no affect on stream stability. The stream banks are active, and many instream structures are not functioning as designed. This reach is overwidened and has poor floodplain access. Sanitary sewer crossings occur in three locations and then the line parallels the reach for approximately 500 feet.

Citizen Concerns: None known.

Access: Access very good with little or no impact to residential homes. One potential challenge is due to possible necessary tree removal to gain access to the reach.

Site No.:	MS1-004
Site Score:	49.5, "Extreme"
Location:	Old Pickett Dr., from Old Lee Hwy. to Pickett Rd.

Site Description:	Drainage Area ≈ 4,800 acres ±
	This reach is overwidened and shows evidence of frequent flooding. The area is mostly commercial, with no residential buildings. The sanitary sewer parallels the stream and crosses at least twice. There is some sewer protection located in the stream.
Citizen Concerns:	Concerns have been raised about flooding, particularly the overtopping of Pickett Road.
Access:	Access to the stream channel is relatively simple. There would be no impacts to residential areas from construction. However, work within this reach could be problematic due to multiple infrastructure impacts.

Site No.: MS1-005

Site Score: 51.0, “Extreme”

Location: Thaiss Park, east of Pickett Rd.

Site Description: Drainage Area ≈ 4,960 acres ±

This reach, though within a park, is located in a mostly industrial area that would have little or no direct impact to residential areas. Large active sand bars and woody debris continually block the channel and bridge at Pickett Road. This channel is overwidened and very tortuous downstream of Pickett Road. There is the appearance of extensive flooding, which often exceeds the banks. The sanitary sewer crosses the stream channel at least twice.

Citizen Concerns: Concerns have been raised about flooding, particularly the overtopping of Pickett Road.

Access: Access to the channel is relatively easy. Cost and liability of extensive work within this reach could be problematic due to large flows through this area and multiple infrastructure impacts.

Site No.:	DDT1-001
Site Score:	42.5, “Very High”
Location:	Draper Drive, east side of Draper Drive Park, from Beech Dr. to Lee Hwy.

Site Description:	Drainage Area ≈ 400 acres ± The stream is located mostly within Draper Drive Park. There are approximately 6 commercial properties to east of the stream, but they are not directly impacted from erosion. No sanitary sewer line is located near the stream channel. Previous restoration efforts have provided some protection.
Citizen Concerns:	None known.
Access:	Relatively simple access with the only impacts from construction being on park land. There may be enough acreage to not impact the use of ball fields during construction.

Site No.: DLT1-001

Site Score: 41.5, "Very High"

Location: Dale Lestina Park, from Rt. 66 to Ranger Rd.

Site Description: Drainage Area ≈ 275 acres ±

The reach is mostly contained within Dale Lestina Park and Villa D'Este Park. Previous restoration efforts are showing signs of erosion. The upper end of the reach is not constrained by adjoining residents. The downstream end passes through a narrow channel between Cambride Station town home communities.

Citizen Concerns: Concerns have been raised about the eroding stream bank and tree debris.

Access: Access at the downstream end is very tight due to the limited width between townhomes. The upper end has more extensive open area, but there may be problems during construction due to necessary tree removal.