Feasibility Report for
Bassett Creek Restoration Project - Reach 1

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Bassett Creek Watershed Management Commission

September 2010

Feasibility Report for Bassett Creek Restoration Project—Reach 1

Golden Valley, Minnesota

Prepared for
Bassett Creek Watershed Management Commission

September 2010

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of Minnesota.

____

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1.0 Executive Summary

1.1 Background

In January 2007 the Bassett Creek Watershed Management Commission's Technical Advisory Committee recommended that the Commission add stream channel restoration projects to the Commission's 10-year Capital Improvements Program (CIP). The restoration projects included the Main Stem of Bassett Creek, the North Branch of Bassett Creek, the Sweeney Lake Branch of Bassett Creek, and Plymouth Creek. The Commission completed a draft Resource Management Plan (RMP) in April 2009 (updated July 2009) that included several stream restoration projects. Bassett Creek Reach 1 was one of the stream projects included in the RMP; the project includes the restoration of a reach from Wisconsin Avenue to the Golden Valley-Crystal boundary (approximately 1,600 feet upstream of Highway 100) (see **Figure 1**, Location Map). Restoration of this reach is included in the Commission's CIP for design and construction in 2011; however only a portion of the reach identified in the CIP is included in this feasibility study. Therefore, Bassett Creek Reach 1 has been broken into three subreaches (Figure1). The two subreaches included here—Subreach 1 from Wisconsin Avenue to Rhode Island Avenue and Subreach 3 from Duluth Street to the Golden Valley-Crystal border—cover approximately 6,300 feet of the total of approximately 15,800 feet in Reach 1. Subreach 2 includes the remaining 9,500 feet between Rhode Island Avenue and Duluth Street.

1.2 General Project Description and Estimated Cost

The potential stabilization measures identified for implementation in this reach consist of the following:

- removal of trees and vegetation,
- grading reaches of stream bank,
- stabilizing storm sewer outfalls that discharge into the channel,
- establishing new vegetation on areas disturbed by construction,
- installing a variety of stream stabilization measures to address erosion problems, including riprap, biologs, cross vanes, j-vanes, live stakes, live fascines, and vegetated reinforced soil slope (VRSS).

The Reach 1 (Subreaches 1 and 3) construction costs are estimated to be $580,200. A detailed cost estimate is included in **Section 4.3**. Temporary construction easements are not included in the cost estimate at this time, but they are not expected to significantly increase the total cost. The proposed restoration work within the City of Golden Valley is on a mix of public and private property. Approximately half of Subreach 3 is located on public property within the Bassett Creek Nature Area. The remainder of Subreach 3 and all of Subreach 1 is on private property and will require temporary construction easement acquisitions to complete construction.

1.3 Recommendations

The Commission's CIP includes restoration of Subreach 1 and Subreach 3 of Bassett Creek Reach 1, with design and construction to begin in 2011. The stabilization of this reach will provide water quality improvement by 1) repairing actively eroding sites; and 2) preventing erosion at other sites by installing preemptive measures to protect existing stream banks. This project is relatively cost efficient because no permanent easements will be required.

It is recommended that the restoration of Subreaches 1 and 3 of Bassett Creek Reach 1 proceed into the design and construction phase. It is also recommended that the Bassett Creek CIP be revised to reflect the revised cost estimate for Subreaches 1 and 3.

2.0 Background and Objective

2.1 Goals and Objective

Subreaches 1 and 3 of Bassett Creek Reach 1 have erosion problems in at least 15 locations. The objective of this study is to review the feasibility of implementing measures to stabilize the stream banks and storm sewer outfalls on these two subreaches of Bassett Creek Reach 1and to provide conceptual designs and cost estimates of measures that could potentially be used at each of the 15 erosion sites.

Stream Stabilization

The City of Golden Valley has recognized the importance of addressing stream erosion and sedimentation issues; however, funding limitations have prevented repair of these sites to date. With the availability of funding from the BCWMC, repair of these sites can now proceed.

The City of Golden Valley has completed periodic erosion inventories along Bassett Creek, beginning in 2003. The latest inventory identified 11 erosion sites in Subreaches 1 and 3, all with moderate erosion. As stated earlier, Barr staff added four sites (Sites 7, 9, 10, and 12) with minor to moderate erosion or the potential for erosion problems in the near future. One of the sites identified as moderate erosion was reclassified as severe erosion.

The goals of the stream stabilization project are to:

- Stabilize eroding banks to improve water quality.
- Preserve natural beauty along Bassett Creek and contribute to the natural habitat and species diversification in place by planting eroded areas with native vegetation.
- Prevent future channel erosion along the creek and the resultant negative water quality impact of such erosion on downstream water bodies.

Considerations

- Restoration must minimize floodplain impacts. Several businesses and residences are located near the creek, so it is critical to ensure the proposed project does not increase flood elevations that impact these properties.

- Maintain existing floodplain storage and cross sectional areas.

2.2 Background

2.2.1 Reach Description

Bassett Creek Reach 1 (**Figure 1**) extends for approximately 15,800 feet from Wisconsin Avenue downstream to the Golden Valley-Crystal city boundary. Two subreaches are included in this feasibility study. The first (Subreach 1) is approximately 2,100 feet, extending from Wisconsin Avenue to Rhode Island Avenue. The second subreach (Subreach 3) is approximately 4,200 feet, extending from Duluth Street to the Golden Valley – Crystal city boundary. Land use immediately adjacent to Subreach 1 is a mix of high density residential (apartments and condominiums) and commercial/industrial. Land use immediately adjacent to Subreach 3 is predominantly single family residential.

Barr Engineering (Barr) staff walked the reach in July 2010 and identified a total of seven sites on Subreach 1 and eight sites on Subreach 3 that require stabilization to address bank erosion, scour, and/or bank failure. Of the 15 sites, six have minor erosion, seven have moderate erosion, and two have severe erosion problems. The total length of bank erosion is approximately 890 feet. Photos of each of the erosion sites are found in Appendix A. The bank failures along this reach appear to be caused by a combination of natural stream erosion processes and problems associated with changing watershed hydrology. Even when cities incorporate best management practices (BMPs) to minimize the impacts of increased runoff, development still fundamentally changes the hydrology of the watershed. The BMPs commonly used reduce the impacts of urban development on streams receiving stormwater runoff, but physical changes and increased rates of erosion occur.

In addition to the problem erosion sites, there are three locations where trees have fallen across the stream. Fallen trees in streams are a natural occurrence and play a vital role in some natural stream processes. They can act as grade control and provide structure. However, they can contribute to an increase in localized erosion, which is the reason why one of the trees is recommended for removal. There are also 13 storm sewer outfalls within the two subreaches. One of the storm sewer outfalls has some significant erosion problems adjacent to it and is included in restoration at one of the problem erosion sites. The rest of the storm sewer outfalls appeared to be stable and do not need any modifications or stabilization to prevent increased erosion in the foreseeable future.

Implementation of the project will require coordination between the BCWMC and the City of Golden Valley to ensure long term project success. Most importantly, the City of Golden Valley will need to assist in the maintenance of the streambank stabilization measures, particularly providing maintenance of the vegetation, since poor vegetation management practices are a common cause of bank failures. A major aspect of the vegetation maintenance will be the cities working with the private landowners to ensure that the plantings and maintenance meets the objectives of stream bank stabilization effort while considering the landowners' needs.

2.2.2 Past Documents and Activities Addressing this Reach

City Erosion Inventories

The City of Golden Valley completed erosion inventories and assessments on the Bassett Creek Main Stem as it flows through the City. The City updates its inventory annually.

City staff completed the inventories by walking the length of Bassett Creek and identifying, locating, and documenting sites of significant bank erosion and sediment deposition, as well as the presence of obstructions, storm sewer outlet structures, and other utilities within the stream channel. Documentation included location of the site on aerial photographs, notes on the details of each site, and a digital photograph of each site.

The inventories included an estimate of the extent of erosion, measured as a percent of the entire bank that was eroding, and each site was classified as minor (less than 25%), moderate (25 – 50%), and severe (more than 50%). Typically, the causes of erosion were related to the following:

- concentrated runoff from parking lots, streets, and open channel drainage
- storm sewer outfalls discharging above the normal water level of the creek
- surface runoff across exposed unvegetated slopes, steep slopes, or shaded slopes
- areas where turf is maintained to the edge of the creek with no vegetative buffer area.

Additionally, the inventories identified problems with utility structures, including

- rusty corrugated metal pipes
- broken or cracked concrete pipes
- pipes separated at the joints
- flared end sections that have been removed or fallen into disrepair due to erosion
- buried pipe outlets
- significant deposition at the outlet of a structure
- debris blocking a structure
- protruding pipes and outlets located above the normal water level of the creek

The City of Golden Valley's erosion inventory identified five erosion sites within Subreach 1 and six erosion sites within Subreach 3, for a total of 11 erosion sites. All sites for these two subreaches were classified as having a moderate erosion problem. There were also four obstructions, including two on each sub-reach, and 24 utility structures, including 15 utility structures on Subreach 1 and nine utility structures in Subreach 3, identified in the erosion inventory. When Barr staff reviewed the reach in 2010, four additional sites were identified as having minor to moderate erosion problems or the potential for erosion problems in the near future. Combining the 11 sites identified by the cities and the four sites added by Barr staff brings to 15 the number of sites along the reach.

BCWMC

As part of the *Bassett Creek Main Stem Watershed Management Plan* (2000), the BCWMC estimated the sediment and phosphorus loading to Bassett Creek from channel erosion. Three erosion scenarios were evaluated for increased loadings resulting from three levels of channel erosion - minor, moderate, and severe. The most likely scenario for Bassett Creek was between the moderate and severe scenarios with approximately ten percent of the stream channel suffering from erosion. Similar scenarios were used to estimate the additional loading of phosphorus to Bassett Creek.

The study results indicated that moderate channel erosion could contribute an additional 1,000,000 pounds of suspended sediments annually (increase from approximately 500,000 pounds to 1,500,000 pounds) and 50 pounds of phosphorus annually (increase from approximately 2,650 pounds to 2,700 pounds) to the Main Stem of Bassett Creek. The study results also showed that stabilizing the Main Stem of Bassett Creek could reduce total phosphorus (TP) loads by an estimated 96 pounds per year and total suspended solids (TSS) loads by an estimated 200,000 pounds per year.

More recent computations completed for this feasibility study show that restoring this reach of Bassett Creek could reduce TP loads by an estimated 60 pounds per year and TSS loads by an estimated 105,000 pounds per year.

The BCWMC Watershed Management Plan recognized the need to restore stream reaches damaged by erosion or affected by sedimentation. The BCWMC established a fund to cover the costs of channel stabilization projects. However, the fund as authorized was insufficient to cover the costs of all of the identified projects. In January 2007 the BCWMC's Technical Advisory Committee recommended that the Commission add stream channel restoration projects to the Commission's ten-year CIP. The BCWMC then went through a process to identify potential channel restoration projects by stream reach, prepared cost estimates for the restoration of the reach, prioritized the restoration projects, and added the larger projects to the CIP. These restoration projects included the Main Stem of Bassett Creek, the North Branch of Bassett Creek, the Sweeney Lake Branch of Bassett Creek, and Plymouth Creek. These reaches of the creek have experienced increased stream bank erosion, streambed aggradation, or scour. These erosion and aggradation processes are a combination of natural processes, and increased runoff volumes and higher peak discharges in these reaches of the creek that occur with urban development in the watershed. The sediment load from the erosion and scour increases phosphorus loads to downstream water bodies, decreases the clarity of water in the stream, destroys aquatic habitat, and reduces the discharge capacity of the channel. The Commission added several of these channel restoration projects to their long range CIP in May of 2007, including Reach 1 of Bassett Creek.

The BCWMC completed a draft Resource Management Plan (RMP) in April 2009 (updated July 2009) for water quality improvement projects within the Bassett Creek watershed scheduled for design and construction between 2010 and 2016. The goal of the RMP was to streamline the permitting process with the U.S. Army Corps of Engineers (USACE) for all of the projects. The RMP provided concept designs for stabilizing the stream banks along this reach of Bassett Creek as well as background information about impacts to wetlands, threatened and endangered species, and cultural and historical resources. The entire Reach 1 of Bassett Creek was included in the RMP, including the two subreaches included in this feasibility study. Relevant information from the RMP is included in this feasibility study.

Table 1 presents the restoration projects included in the RMP, along with their estimated start dates and costs.

Table 1 Channel Restoration Projects added to CIP and included in the RMP

Creek Project	Target Project Start	Estimated Project Cost[1]
Plymouth Creek, Reach 1 (PC-1)	2010	$965,200
Bassett Creek Main Stem, Reach 2	2010	$780,000
Bassett Creek Main Stem, Reach 1	2011	$715,000
North Branch	2013	$660,000
Plymouth Creek, Reach 2 (PC-2)	2015	$559,000

[1] Costs as estimated in revised 2009 CIP

In 2008, the City of Golden Valley completed the Commission's first channel restoration project – the Sweeney Lake Branch, King Hill Area project. This project involved restoration of approximately

600 feet of the upstream end of the Sweeney Lake Branch of Bassett Creek. The Plymouth Creek, Reach 1 and Bassett Creek Main Stem, Reach 2 projects are currently underway.

3.0 Site Characteristics

3.1 Bassett Creek Watershed

The watershed area tributary to this reach of Bassett Creek is approximately 16,000 acres and includes approximately 64% of the entire BCWMC watershed. The upstream watershed drains all or portions of Plymouth, Minnetonka, Medicine Lake, New Hope, St. Louis Park, Crystal and Golden Valley. Existing land use includes approximately forty percent single-family residential; twenty-eight percent commercial/industrial; seven percent highway; seven percent parks and undeveloped land; four percent multi-family residential; and water surface area over the remaining land area.

3.2 Stream Characteristics

Reach 1 of the Bassett Creek Main Stem (**Figure 1**) extends for approximately 15,800 feet from Wisconsin Avenue to the Golden Valley – Crystal border. Two subreaches are included in this feasibility study. The first (Subreach 1) is approximately 2,100 feet from Wisconsin Avenue to Rhode Island Avenue. The second subreach (Subreach 3) is approximately 4,200 feet from Duluth Street to the Golden Valley – Crystal city boundary. The stream is relatively shallow in most places except for occasional deep pools. Submergent vegetation was observed along much of Subreach 1; fish, crayfish, and frogs were observed in the creek in both subreaches. The riparian vegetation for Subreach 1 varied considerably between its two banks. The right bank (looking downstream) contained a healthy mix of native trees and shrubs, including willow, cottonwood, poplar and maples. However, the left bank was largely overgrown with buckthorn. The riparian vegetation in Subreach 3 varied from turf grass to native trees and shrubs, depending on how each landowner managed the vegetation.

Barr staff walked the reach to further investigate the scale and severity of the erosion problems for this feasibility study. Barr staff reviewed the previously documented erosion sites and identified additional sites. The sites added by Barr staff are, for the most part, minor erosion sites. These sites were added to the feasibility study as it is more cost effective to fix minor repairs before they become severe, particularly if a contractor is under contract and on-site to complete repairs to adjacent sites.

3.3 Site Access

Access to most of the sites in Subreach 1 will be relatively easy, due to the presence of large parking lots that are near the creek. Access to any site would require minimal clearing of vegetation between the parking lot and the creek. Access for sites within the Bassett Creek Nature Area (between Duluth

Street and Westbrook Road) in Subreach 3 will also be relatively easy. A few sites are located very close to Duluth Street and will be easy to access through the nature area. Other sites located further away from Duluth Street can still be accessed through the nature area or an easement could be acquired to access the sites via a shorter route across private or commercial property. Site access on the northern half of Subreach 3 will be more difficult because most of the sites are located on private property. Access to each site will require crossing private property and restoring the property at the end of the project.

3.4 Wetlands

The wetlands associated with Subreaches 1 and 3 in the Main Stem of Bassett Creek were delineated in accordance to the COE Wetland Delineation Manual and Midwest Regional Supplement. The delineation and assessment was necessary in order to meet the requirement of a Section 404 Permit and the Wetland Conservation Act. The assessment also included the use of the Minnesota Routine Assessment Method (MnRAM 3.0), which is a comprehensive ranking system designed to help qualitatively assess functions and values associated with Minnesota wetlands for the purpose of managing local wetland resources.

Four wetlands totaling approximately 8.84 acres were identified and field delineated. These are primarily floodplain forest riparian wetlands which border the Main Stem for the extent of the study area, and are separated by roads. In addition, MNRAM functional wetland assessments were also performed. The wetlands generally scored low in many environmental criteria. Final design should minimize wetland impacts. A full summary of the wetland delineation, including figures and field data sheets, is in Appendix B.

3.5 Cultural and Historical Resources

A reconnaissance survey of Subreaches 1 and 3 was completed in June 2010 to determine if any sites may require further investigation for cultural or historical importance. The survey was completed by reviewing historical aerial photographs, interviewing local residents, and walking the relevant reaches to observe conditions on the ground. The survey found approximately ten sites with enough archeological potential that justify further investigation before any construction disturbance to the area. Therefore, funds will need to be budgeted during design to further investigate any areas which may be disturbed. If possible, disturbance of areas with highest potential for archeological potential should be avoided or minimized. The full report of the archeological reconnaissance survey, including figures, is included in Appendix C.

4.0 Potential Improvements

4.1 Description of Potential Improvements

As described in Section 1.2, the project along Reach 1 of Bassett Creek consists of a variety of stream stabilization measures to address erosion problems. **Figures 2a** and **2b** show the 15 stabilization sites and **Table 2** lists the potential stabilization measures for each site. The following paragraphs describe the potential stream stabilization practices proposed for this reach. There are dozens of stream restoration techniques that can be used, although not all of them would be practicable or applicable to the stream erosion problems on Bassett Creek. The techniques discussed below and included in the conceptual design are among commonly used techniques. Those included in the concept design were selected for their functionality and the expectation that most contractors have had experience with installation of the technique. The final design will determine the most appropriate measures to use at each individual site to meet the objectives of all parties involved. The final design could include techniques not included in these concept designs.

Riprap

Riprap (also called stone toe protection) is used to protect the toe of the stream bank. In-stream riprap typically consists of cobble-sized rock (six inches to 12 inches in diameter). The riprap is keyed in to the streambed and extends up the bank to approximately the bankfull level elevation. The bankfull level is the elevation of the water in the channel during a 1.5-year return frequency runoff event. In some cases, this level may be below the top of the stream bank. Riprap is typically used in conjunction with planting of the upper banks to provide full bank protection. Riprap is especially effective in heavily shaded areas, where it is difficult to establish vegetation. **Figure 3** illustrates this practice.

Cross Vanes

Cross vanes (or constructed riffles) are drop structures, which are typically constructed of boulders and rocks to flatten the slope of the channel and reduce the velocity of the flow in the channel. Cross vanes extend across the creek bottom, and are embedded in each bank. Cross vanes direct the main flow to the center of the stream to reduce bank erosion. **Figure 4** illustrates this practice.

J-Vanes

J-vanes (also called rock vanes) are constructed of boulders embedded into the creek bottom. The vanes are embedded in the stream bank and are oriented upstream to direct the flow away from that bank. J-vanes typically occupy no more than one-third of the channel width. **Figure 5** illustrates this practice.

Vegetated Reinforced Slope Stabilization (VRSS)

VRSS is a bioengineering method that combines rock, geosynthetics, soil, and plants to stabilize steep, eroding banks. VRSS typically involves protecting layers of soil with a blanket or geotextile material creating "soil lifts" (also called "soil pillows") and planting or seeding native vegetation on the slope. The vegetation's root systems provide the long-term slope stabilization. **Figure 6** illustrates this practice.

Pipe Outlet Stabilization

Pipe outlet stabilization measures vary according to specific site circumstances and problems. At most sites, additional rock riprap is needed at the pipe outlet. In other cases, pipe realignment and/or lowering of the pipe may be needed to correct existing problems, prevent future erosion, and prevent pipe failure. **Figure 7** illustrates this practice.

Biologs

Biologs are natural fiber rolls made from coir fiber that are laid along the toe of the stream bank slope to stabilize the toe of the stream bank. Biologs 10 – 22 inches in diameter are typically used. Because they are made of natural fiber, vegetation can grow on the biologs. When needed, grading of the stream bank slope above the biolog is used to create a more stable slope (2:1 to 3:1). **Figure 8** illustrates this practice.

Live Stakes

Live stakes are dormant stem cuttings, typically willow and dogwood species. They are collected and installed during the dormant season (late fall to early spring) and grow new roots and leaves, quickly and cheaply establishing woody vegetation on a stream bank. The willows and dogwoods grow into stands that provide long lasting bank protection. **Figure 9** illustrates this practice.

Live Fascines

Live fascines also use dormant willow and dogwood cuttings collected and installed during the dormant season. In this case, the cuttings are bundled together and planted in a row parallel to the stream flow. They can be effective in reducing sheet erosion along a slope because a portion of the fascine extends above the ground surface. The willows and dogwoods grow into linear stands of shrubs that provide long lasting bank protection. **Figure 10** illustrates this practice.

Site Grading

In many places, the eroding bank will be graded to a 3:1 slope. This provides a stable slope that will not naturally slough and it provides a surface that is flat enough on which vegetation can be planted or seeded.

Table 2 Potential stabilization measures at each site.

Site #	Station	Potential Stream Stabilization Practices[1]	Photos[2]
1	14+00	Install biolog for additional toe protection. Install shade tolerant shrubs. Remove four trees. Plant shady woods mix of native grasses and extent into turf grass in the lawn.	1, 2
2	18+00	Install VRSS to stabilize steep slope. Remove eight trees during VRSS installation.	3, 4
3	24+00	Grade bank to a 3:1 slope. Install riprap for toe protection. Seed bank with native grasses.	5
4	25+50	Install two j-vanes. Grade bank to a 2:1 slope. Install biolog. Remove six trees. Plant shade tolerant shrubs and grasses.	6, 7
5	40+00	Grade bank to 2:1 slope. Install biolog for toe protection. Plant shrubs and trees. Remove eight trees.	8, 9
6	48+50	Grade bank to 3:1 slope Install riprap for toe protection. Install two j-vanes. Remove two trees. Seed bank with native vegetation and cease mowing to top of bank.	10
7[3]	49+00	Fill in eroded channel with excess material from grading at other sites. Install riprap at both ends of the eroded channel. Install live fascines on bank above riprap. Remove four trees.	11, 12
8	49+75	Install riprap for toe protection. Install two j vanes. Install biologs and live stakes. Remove 12 trees.	13
9[3]	149+00	Replace flared end section. Install riprap around flared end section. Remove four trees.	14
10[3]	151+50	Install two cross-vanes. Install biolog. Install live stakes in the bank. Remove three trees.	15, 16
11	156+50	Remove fallen tree. Install live stakes in eroding bank	17, 18
12[3]	160+00	Remove buckthorn. Install biolog and live stakes. Remove three trees.	19

Site #	Station	Potential Stream Stabilization Practices[1]	Photos[2]
13	161+50	Install biolog. Install live stakes. Install fascines. Remove two trees.	20
14	164+50	Fill in eroded bank. Install riprap at toe Install turf reinforcement mat to handle flows from parking lot. Remove six trees.	21
15	169+00	Fill in eroded bank. Install riprap at toe Install turf reinforcement mat to handle flows from parking lot. Remove eight trees.	22

[1] All sites will be planted or seeded with native grasses, shrubs, and trees. The final design phase will determine which practices will be used at each site and may or may not use the practices specified in this table.

[2] Photos are located in Appendix A

[3] Sites added by Barr Engineering

4.2 Project Impacts

4.2.1 Easement Acquisition

Construction easements will be required to complete the stabilization work for this project because the majority of the erosion sites occurring are located on private property. Estimates for the construction easements are not included in this feasibility study.

4.2.2 Permits Required for Project

The proposed project will require 1) a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (COE) and Section 401 certification from the Minnesota Pollution Control Agency (MPCA), 2) compliance with the Minnesota Wetland Conservation Act, and 3) a Public Waters Work Permit from the Minnesota Department of Natural Resources (MNDNR). The proposed project should also follow the MPCA's guidance document for managing dredged materials.

Section 404 Permit

The COE regulates the placement of fill into wetlands, if the wetlands are hydrologically connected to a Waters of the United States, under Section 404 of the Clean Water Act (CWA). In addition, the COE may regulate all proposed wetland alterations if any wetland fill is proposed. The MPCA may be involved in any wetland mitigation requirements as part of the CWA Section 401 water quality certification process for the 404 Permit.

The Bassett Creek project was included in the *Resource Management Plan for Bassett Creek Watershed Management Commission Water Quality Improvement Projects 2010 – 2016* submitted to the COE in April 2009 (revised in July 2009). The goal of the *Resource Management Plan* (RMP) is to complete on a conceptual level the COE permitting process for all of the projects proposed.

The COE 404 permit requires a Section 106 review for historic and cultural resources. The results of the archeological reconnaissance study are included as Appendix C. If more detailed information is requested by the State Historic Preservation Office (SHPO), then a Phase I Archaeological Survey may need to be completed. A Phase I Archaeological Survey can be completed in 45 days or less during the frost-free period. The COE staff anticipates that the 404 permit review and approval process could require 120 days to complete.

Minnesota Wetland Conservation Act

The Wetland Conservation Act (WCA) regulates the filling and draining of wetlands and excavation within Type 3, 4, and 5 wetlands. In addition, the WCA may regulate all types of wetland alteration if any wetland fill is proposed. The WCA is administered by local government units (LGU), which include cities, counties, watershed management organizations, soil and water conservation districts, and townships. Golden Valley is the LGU for the proposed project site. The Minnesota Board of Water and Soil Resources (BWSR) oversees administration of the WCA statewide.

The proposed project will only involve grading existing stream banks and other stream bank work. This type of work can generally be considered self mitigating and will not require wetland mitigation, but all work requires review by the LGU.

Public Waters Work Permit

The MNDNR regulates projects constructed below the ordinary high water level of public waters or public waters wetlands, which alter the course, current, or cross section of the water body. Public waters regulated by the MNDNR are identified on published public waters inventory (PWI) maps. Bassett Creek is a public water/water course, so the proposed work will require a MNDNR public waters work permit.

Subreach 1, from Wisconsin Avenue to Rhode Island Avenue, is a designated County Ditch (CD 23, 25, 30).

4.2.3 Other Project Impacts

Tree Loss

The proposed project includes the removal of approximately 71 trees. All of the trees are located in areas where bank grading or site access will be necessary. A detailed tree inventory should be completed during the final design process.

Water Quality Impacts

The proposed stabilization measures will result in a reduction of the sediment and phosphorus loading to Bassett Creek and all downstream water bodies, including the Mississippi River and Lake Pepin. As discussed in Section 2.2.2, stabilizing this reach is estimated to reduce TP loads by 60 pounds per year and TSS loads by 105,000 pounds per year.

4.3 Cost Estimate

The estimated project cost for the Bassett Creek Restoration Project is $580,200 for design and construction. The cost estimate uses the following assumptions:

- The cost estimate assumes an additional 50% of construction costs will be needed for final design, permitting, construction observation, and contingency.
- Construction easements will be necessary to construct the project; however the cost is expected to be negligible.
- The cost estimate includes the costs of testing stream bank material for hazardous compounds that would require them to be treated as dredged materials per MPCA regulations. For cost estimating purposes, it is assumed that hazardous compounds and pollution that will require special disposal of excavated stream bank material are present at some these sites and that 50% of the soil to be taken off site will require treatment.
- Additional work will be required to determine if cultural and/or historical resources are present at any project site.

A feasibility-level cost estimate for the project construction is included in **Table 3. Figures 2a** and **2b** shows the corresponding site numbers and stationing referenced in **Table 3**.

4.3.1 Temporary easements

The costs of obtaining temporary construction easements within the City of Golden Valley are often negligible, and no costs for temporary construction easements are included in this cost estimate. However, for Sites 11 – 15 located adjacent to commercial property, it may be the best interest of the City to acquire right-of-way access (or a permanent easement) to access the creek at these locations. Commercial properties often require a lengthy time period to complete easement issues, and a permanent easement will make it possible to access the creek at these locations whenever it is required. It will also provide an opportunity for the City to manage the riparian vegetation to eliminate invasive plant species. The estimated cost for right-of-way acquisition is $40,000.

4.3.2 Off-site sediment disposal

The cost estimate includes the costs of a Phase I assessment of the bank material for hazardous compounds that would require them to be treated as dredged materials per MPCA regulations. It is assumed that approximately one half of the excavated material (approximately 420 cubic yards) will require special disposal at an estimated costs of $24,700 (**Table 3**).

4.3.3 Wetland mitigation

As discussed in Section 4.2.2, stream bank restoration and repair is considered to be a self-mitigating wetland impact. Stream banks are considered to be wetlands and disturbing the banks as part of a restoration project is a temporary wetland impact. However, because the nature of stream bank repair and restoration is to create a stable bank that can support a riparian ecosystem, the impacts are considered to be self-mitigating. Therefore, stream bank restoration projects do not require an additional cost for wetland mitigation.

4.3.4 Tree replacement

The cost estimate (Section 4.3) assumes that trees will be replaced on a two-to-one (2:1) basis. It also assumes that the replacements will be made at the site where the original trees were removed. Therefore, if five trees are removed at a given site, then ten trees will be planted during site restoration. The two-to-one replacement ratio assumes that over time, there will be some tree loss due to natural causes (storm/wind damage, disease, etc) and natural competition.

4.3.5 Percentages of estimated construction costs

The cost estimate also assumes that 10% of the construction costs will be for mobilization and demobilization. This cost is included in the site subtotal for each site.

4.3.6 Archeological investigation

The Historical and Cultural report (Appendix C) identified several sites that justify additional investigation prior to disturbance during construction. The estimated cost for this investigation is $10,000.

4.3.7 Miscellaneous

Most sites include various miscellaneous items that are needed during construction. Such items include a rock construction entrance, a filter dike to control in-stream sediment disturbance, and restoration of access paths. Together, these items total approximately $6,000. Because some sites are close together, a single filter dike can be used to control in-stream sediment from multiple sites. Likewise, a single construction entrance and access path restoration can be used for multiple sites. Therefore, these items were not included in the cost estimate for each site.

The opinion of probable construction costs provided in this report is made on the basis of Barr's experience and qualifications, and represents our best judgment as experienced and qualified professionals familiar with the project. The cost opinion is based on project-related information available to Barr at this time and includes a conceptual-level design of the project.

4.4 Funding Sources

The City of Golden Valley proposes to use BCWMC capital improvement program (CIP) funds to pay for its portion of the project costs. BCWMC channel restoration projects are funded through the BCWMC's CIP and are paid for via an ad valorem tax levied by Hennepin County over the entire Bassett Creek watershed.

It is the policy of the City of Golden Valley that stream restoration on private land is to be completed on a 50% cost share basis with the land owner. Arrangements can be made with the landowner for their portion of the project costs, such as special assessment on the property to recover project costs over time.

4.5 Project Schedule

The design for this project is slated to begin in 2011. The construction work will likely be completed during the winter of 2011—2012. For project work to occur in 2011, the Commission must hold a public hearing and order the project in time for the Commission's submittal of its 2011 ad valorem tax levy request to Hennepin County by October 1, 2010. If project construction is to occur in fall or winter, it is recommended that the project bidding take place in the summer. This will allow contractors to acquire plants and seeds at a reasonable price for the required quantities. In the intervening time, the City will gather public input, conduct the environmental review, prepare the final design, and obtain permits.

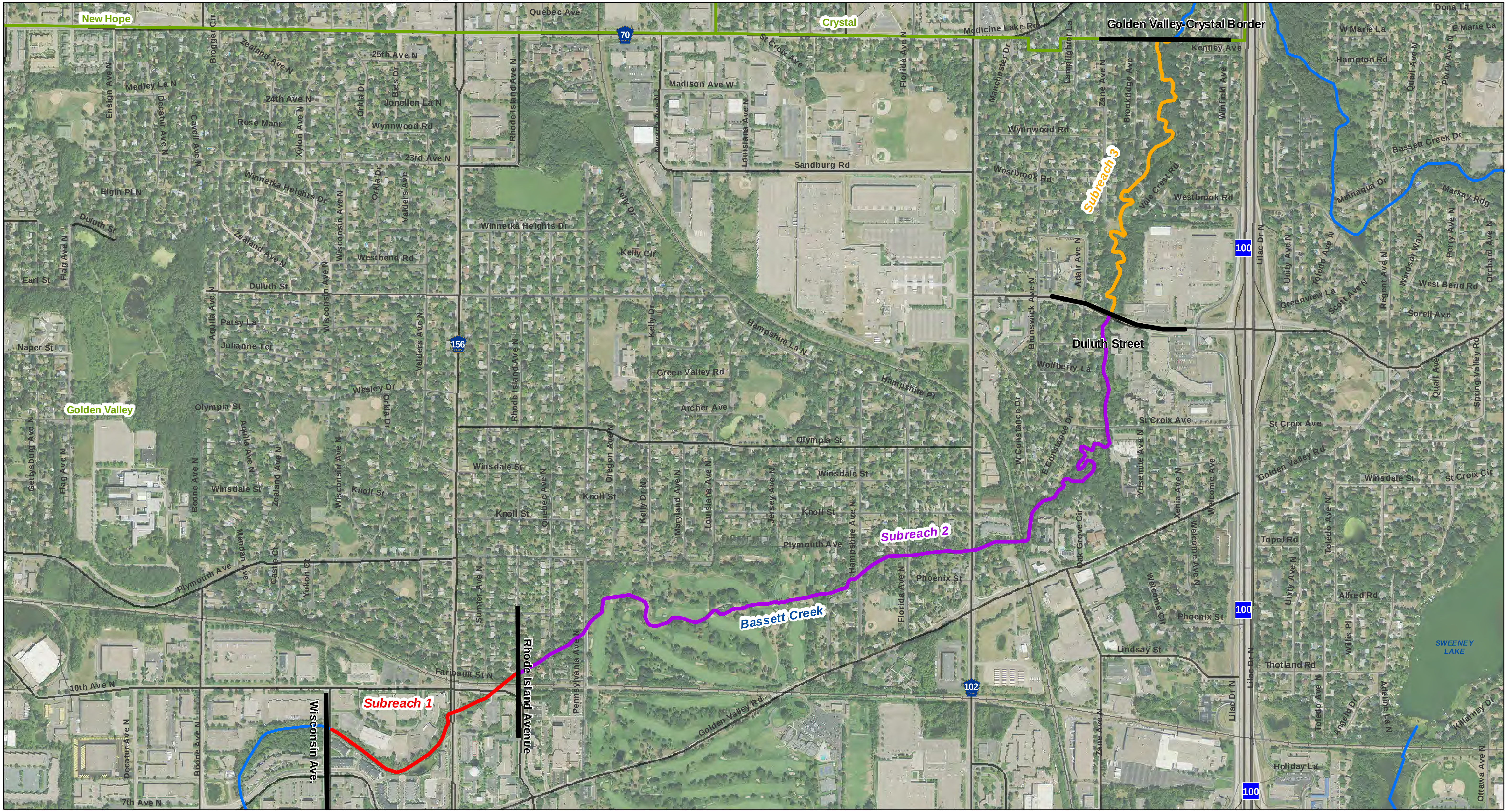
Table 3. Site Locations, Potential Stream Stabilization Practices, and Overall Cost Estimate for Bassett Creek Reach 1.

Site #	Downstream station (1)	Site length (feet)	Proposed stream stabilization practices	Site Subtotal
1	14+00	75	150' of biolog; remove 4 trees; shade-tolerant shrubs; shade-tolerant grass mix	$ 17,300
2	18+00	50	500 sq. ft of VRSS; remove 8 trees	$ 41,700
3	24+00	75	Grade banks to 3:1; riprap for toe protection; seed with native grasses.	$ 16,800
4	25+50	50	Grade bank to 2:1 slope; 2 j-vanes; 100' biolog; remove 6 trees; shade-tolerant shrubs and seed mix	$ 27,600
5	40+00	75	Grade bank to 2:1 slope; 150' biolog; remove 8 trees; plant trees and shrubs	$ 24,000
6	48+50	125	Grade bank to 3:1 slope; riprap for toe protection; remove 2 trees; native seeding	$ 22,600
7(3)	49+00	25	Fill eroded channel with material from site 6; 25' of riprap at each end of eroded channel; 25' of fascine above riprap; remove 4 trees	$ 17,600
8	49+50	100	2 j-vanes; riprap for toe protection; 200' biolog; 50 live stakes; remove 12 trees	$ 32,300
9(3)	149+00	10	Replace flared end section; riprap around new FES; remove 4 trees.	$ 16,900
10(3)	151+50	100	2 cross vanes; 200' biolog; 100 live stakes; remove 3 trees	$ 23,300
11	156+50	15	Remove fallen tree; 20 live stakes	$ 1,100
12(3)	160+00	100	Remove buckthorn; 200' biolog; 100 live stakes; remove 3 trees	$ 21,700
13	161+50	50	100' biolog; 100' live fascines; 50 live stakes; remove 2 trees	$ 15,900
14	164+50	20	200 sq ft of turf reinforcement mat; fill eroded bank; riprap at toe of eroded bank; remove 6 trees	$ 28,300
15	169+00	20	200 sq ft of turf reinforcement mat; fill eroded bank; riprap at toe of eroded bank; remove 8 trees	$ 29,900
			Phase 1 assessment for contaminated soils and off-site disposal	$ 16,400
			Subtotal	*$ 353,400*

Design, Permitting, and Administration (25%)	$ 88,350
Subtotal	*$ 441,750*
Construction Contingency (20%)	$ 88,350
Additional Cultural and Historical Investigation	$ 10,000
Right-of-Way acquisition	$ 40,000
Summation	**$ 580,200**

(1) Stream stationing: 0+00 at confluence with North Branch Bassett Creek
(2) All sites include restoration seeding and erosion control blanket for disturbed areas, and a 2:1 tree replacement as needed.
(3) Sites added by Barr Engineering

Figures



Legend

Bassett Creek Reach 1

- Subreach 1
- Subreach 2
- Subreach 3
- streams
- Municipal Boundaries

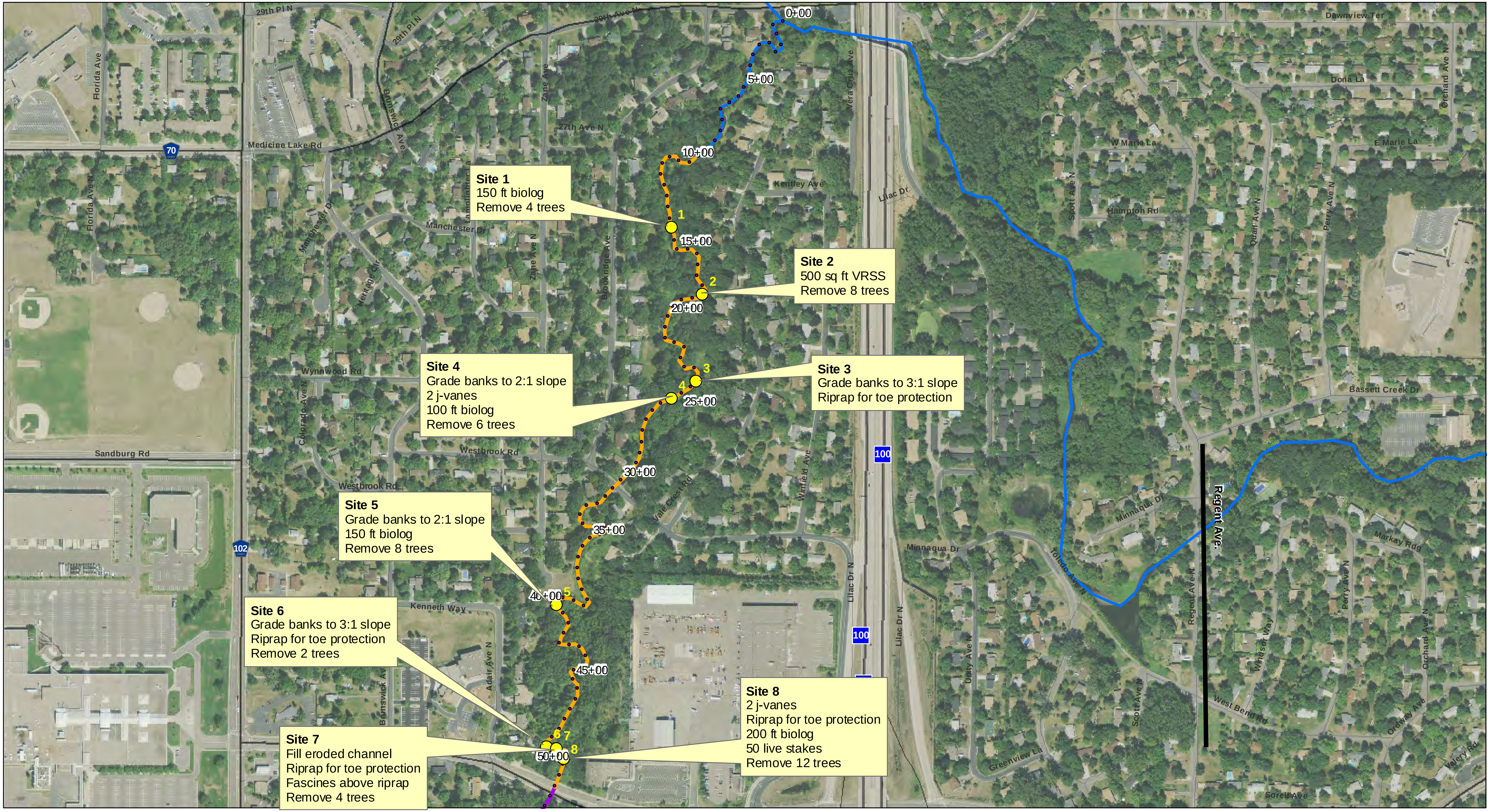
Bassett Creek Watershed Management Commission
www.bassettcreekwmo.org

1,000 500 0 1,000 Feet

N W E S

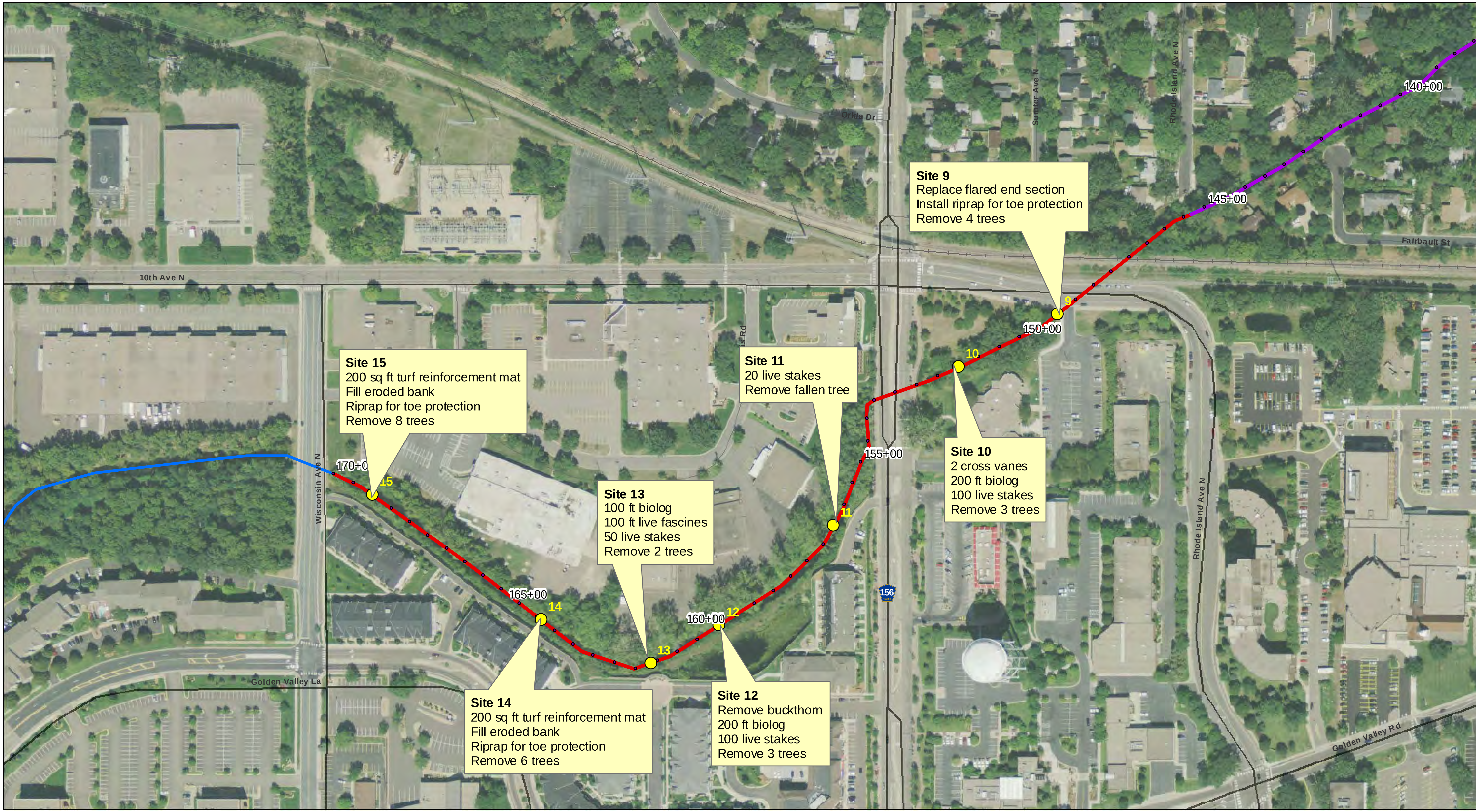
BASSETT CREEK MAIN STEM
REACH 1

Figure 1
Bassett Creek Restoration Project
Bassett Creek
Watershed Management Commission
August 2010



BASSETT CREEK EROSION SITES AND STATIONING FOR SUBREACH 3

Figure 2a
Bassett Creek Restoration Project
Bassett Creek Watershed Management Commission
August 2010



Bassett Creek Watershed Management Commission
www.bassettcreekwmo.org

200 100 0 200 Feet

N S E W

Legend

- Study Sites
- Subreach 1
- Subreach 2
- Subreach 3
- Streams

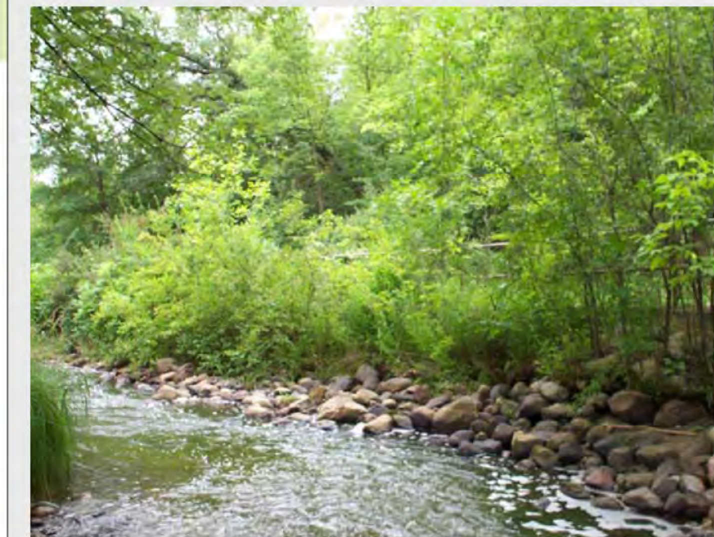
BASSETT CREEK EROSION SITES AND STATIONING FOR SUBREACH 1

Figure 2b
Bassett Creek Restoration Project
Bassett Creek Watershed Management Commission
August 2010

Stream Stabilization Plan

Stone Toe Protection is constructed from cobble-sized rock on the creek edges. It extends to approximately the bankfull level, which will protect the channel banks for flow events that occur every 1 to 2 years or less. The material will extend into the ground to resist scour. Coarse gravel is used to separate the larger rock material from underlying soil. Stone toe protection is typically used in conjunction with revegetation of the upper banks.

SIMILAR PROJECTS

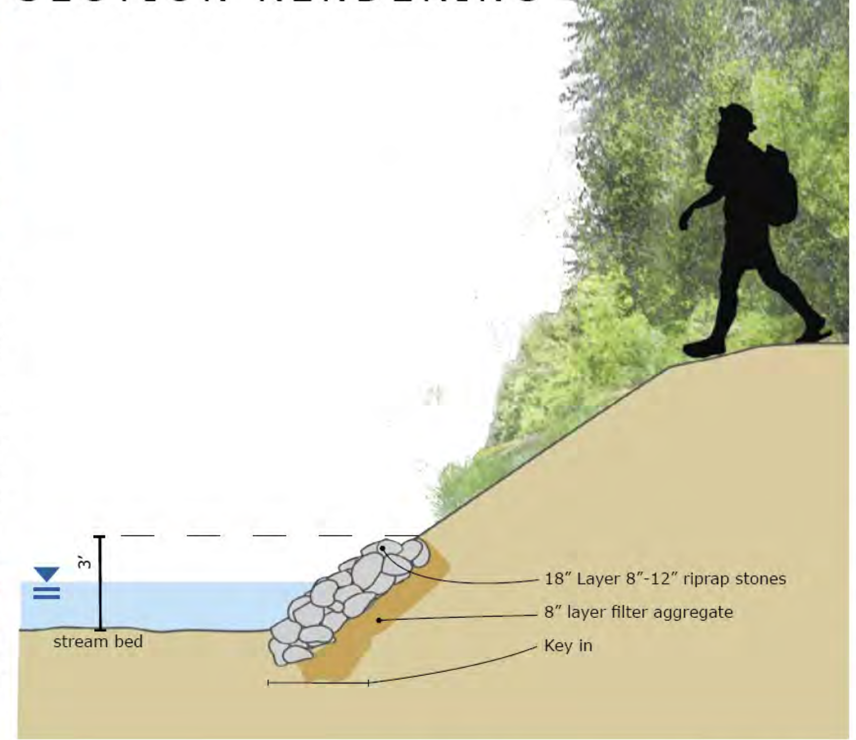


Stone toe protection has been used extensively in Nine Mile Creek's Lower Valley, in conjunction with deflector dikes, grade control measures and stabilization of large bank failures. Following the 1987 "super storm," the proposed design allowed the stream to continue its course while taking measures to protect areas where water flow was eroding valley walls. The resulting measures have stabilized the stream channel and valley walls while blending seamlessly with the natural environment.

EXISTING CONDITIONS

Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams. Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion. In many cases, it appears to be a part of the natural process of stream evolution. In places where the channel is confined by the valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

SECTION RENDERING



MATERIALS

Materials will consist of cobble-sized material with coarse gravel filter layer to provide separation from the underlying soil. Natural fieldstone material will be used.

Stone Toe Protection

Bank Protection

BARR

Figure 3

Stream Stabilization Plan

Grade control measures are used where channel downcutting has occurred. Various types of weirs are commonly used to provide grade control on streams, particularly in steeper systems. Weirs can be constructed of sheetpile, concrete, or natural materials such as rock. In most cases, natural rock is used to emulate natural riffles. Large boulders would comprise the core of the structure, with smaller rock material placed on the upstream and downstream sides of the boulders to provide a gradual transition to the channel.

The riffles will serve to raise the surface of the water profile, and will reconnect the stream to its floodplain areas. Following the installation of the riffles, pools will be created upstream of the riffles. However, these pools will fill with sediment over time, which will in effect raise the channel bottom to the desired elevation.

SIMILAR PROJECTS

Following the 1987 "super storm," a rapids was constructed on Nine Mile Creek downstream of the 106th Street Bridge. The rapids was one of several grade-control structures that were installed on a three-mile stretch of creek in the lower valley. The proposal allowed the stream to continue its course while taking measures to protect areas where water flow was eroding valley walls. Protection measures included applying porous deflector dikes, burying sheetpile walls parallel to the creek to prevent undercutting of slopes, installing weirs (rock or capped sheetpile) to limit stream-bed degradation, and improving storm-sewer outlets.

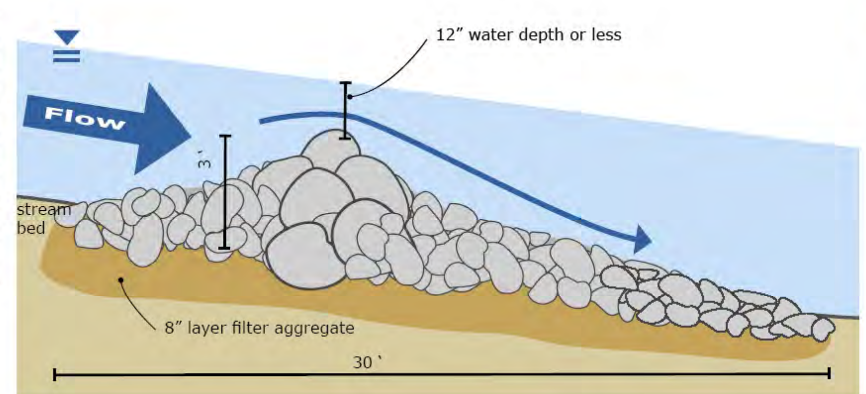
MATERIALS

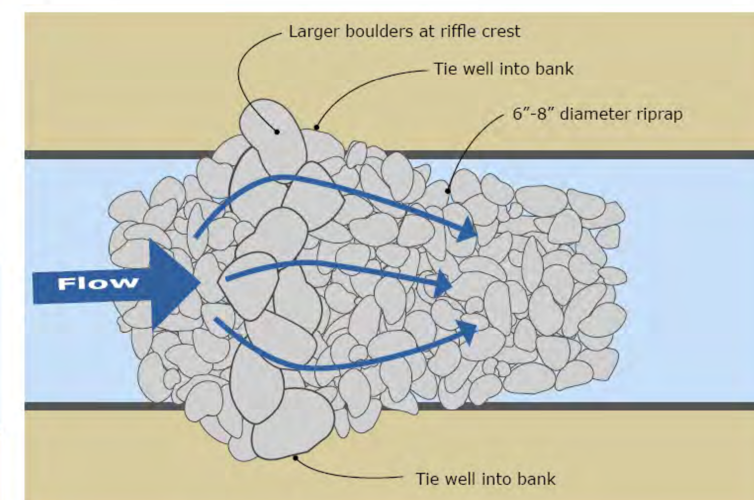
Materials will consist of various gradations of rock, ranging from large, 3-foot boulders to coarse gravel.

EXISTING CONDITIONS

Channel incision occurs when there is an imbalance between the sediment supply and the sediment carrying capacity of the stream. Erosion will occur when the sediment carrying capacity of a stream exceeds the sediment supply. In streams with cohesive banks and steep channel slope, the erosion will first occur primarily on the channel bottom because that is where the erosive forces are the strongest. As the channel deepens, the stream will gradually become wider as the banks eventually fail. The stream will gradually return to equilibrium; however, the process can take many years and significant amounts of erosion will occur during the process.

SECTION/PLAN RENDERING





Constructed Riffle

Grade Control

BARR

Figure 4

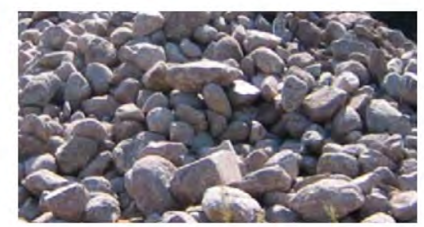
Stream Stabilization Plan

Rock vanes are constructed from boulders on the creek bottom. They function by diverting channel flow toward the center and away from the bank. They are typically oriented in the upstream direction and occupy no more than one third of the channel width. Vanes are largely submerged and inconspicuous. The rocks are chosen such that they will be large enough to resist movement during flood flows or by vandalism, with additional smaller rock material to add stability. Rock vanes function in much the same way as root wads in that they push the stream thalweg (zone of highest velocity) away from the outside bend. They also promote sedimentation behind the vane, which adds to the toe protection.

Vanes can also be constructed from both banks, forming an upstream-pointing "V." In this configuration, the vane protects both banks and also provides grade control.

MATERIALS

Materials will consist of various gradations of rock, ranging from large, 3-foot boulders to coarse gravel.



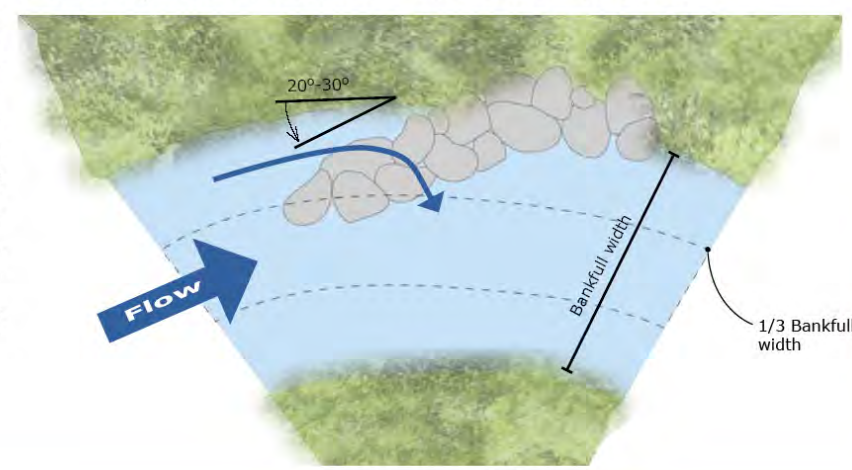
SIMILAR PROJECTS

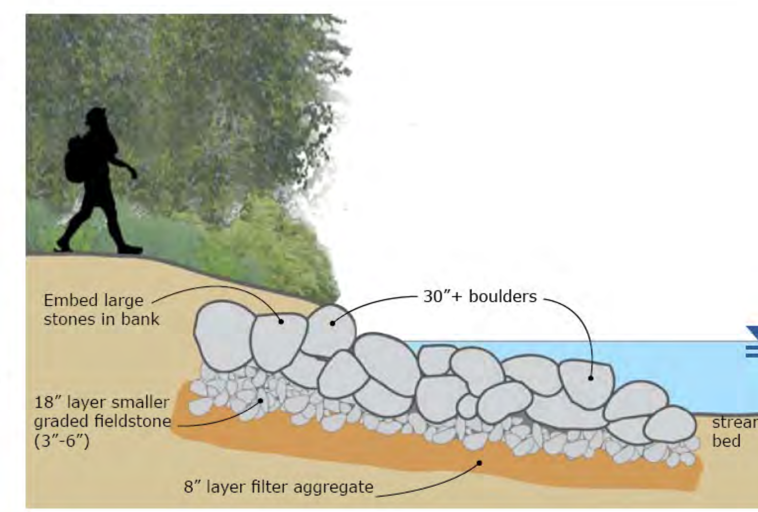
Here is an example of a stabilization project designed for a 1,000-foot long, 20-foot high streambank that was severely eroded. The channel was directed away from the bank toe by installing six rock vanes. The bank was planted with native vegetation and protected with erosion control blanket, while the terrace above the bank was graded to redirect surface runoff to a less vulnerable area. The restored streambank withstood significant flooding during 2001, and has become nicely vegetated (see picture above).

EXISTING CONDITIONS

Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams. Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion. In places where the channel is confined by the valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

PLAN/SECTION RENDERING





Rock Vanes

Bank Protection

BARR

Figure 5

Stream Stabilization Plan

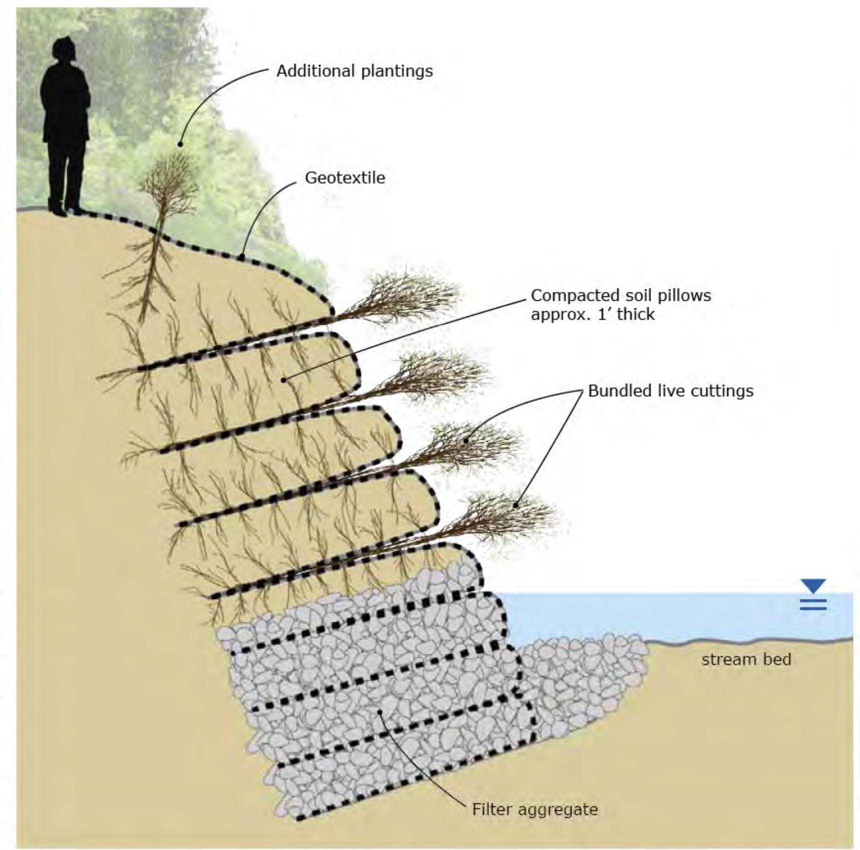
EXISTING CONDITIONS

Fluvial bank erosion is caused by water in the stream moving past the streambanks. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is the most common type of erosion that occurs in streams.

Virtually all streams experience this type of erosion as their flow path evolves over time. However, the rate of fluvial bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of fluvial bank erosion.

Soil Pillows are utilized in a bioengineering method known as Vegetated Reinforced Slope Stabilization (VRSS). The method combines rock, geosynthetics, soil and plants to stabilize steep, eroding slopes in a structurally sound manner. VRSS typically involves protecting layers of soils with a blanket or geotextile material (e.g. erosion control blanket) and vegetating the slope by either planting selected species (often willow or dogwood species) between the soil layers or by seeding the soil with desired species before it is covered by the protective material. In either case, with adequate light and moisture, the vegetation grows quickly and provides significant root structure to strengthen the bank. This method tends to be labor intensive and, therefore, relatively expensive.

SECTION RENDERING



In places where the channel is confined by the steep valley walls, however, fluvial bank erosion can lead to failure of the high banks. It can also undermine storm sewer inlets.

For sites where groundwater seepage is a problem and where it is desirable to maintain steep banks, soil pillows are a feasible solution.

SIMILAR PROJECTS

The Mill Creek Restoration Project utilized soil bioengineering design to stabilize 175 linear feet of severely eroding streambanks within the Caldwell Recreation Park in southeastern Ohio. The work included two 25-foot vegetated reinforced soil slope (VRSS) sections, two 50-foot fill bank sections protected with woven coir and direct woody plantings, and a 12.5-foot tie-in on the upstream and downstream end of streambank work area.

MATERIALS

Materials consist of graded rock for the lower layers of the structure and for internal drainage, if necessary. Geotextile fabric is used to wrap the soil. Plants, such as willow or dogwood, or seed mixture is used for planting in and between the soil pillows.

Soil Pillows

Bank Protection

BARR

Figure 6

Stream Stabilization Plan

Culvert Stabilization is somewhat unique to each situation, depending on the site circumstances. Most sites require additional rock placement with a granular filter layer (rather than filter fabric). Some cases may require re-alignment and/or lowering of the outlet to better align with the stream channel. Typically, outlets should be aligned in the downstream channel direction so that flow doesn't impinge on the opposite bank. It is usually desireable for the culvert to enter the stream at or just above the normal water level in order to minimze the potential for undercutting.

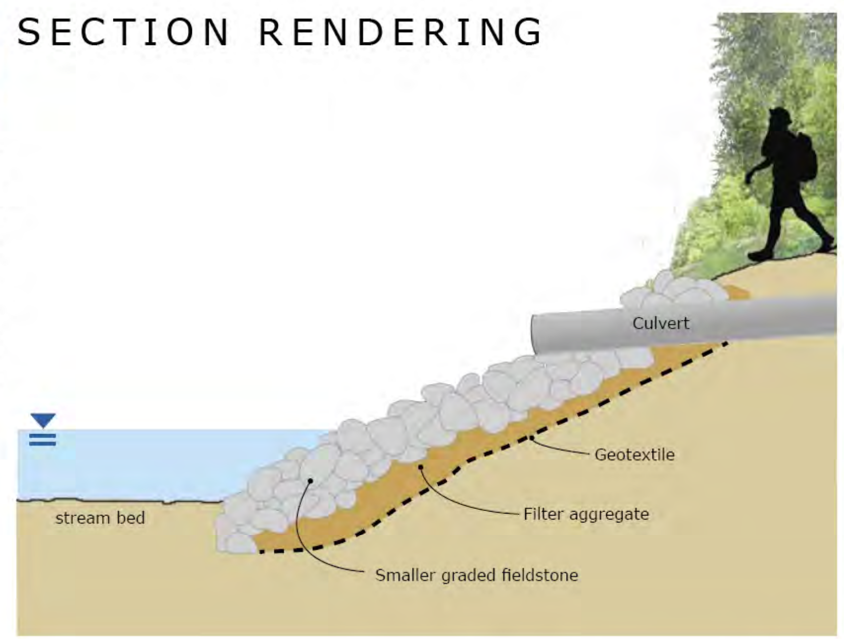
SIMILAR PROJECTS

There are many culvert stabilization designs used on various streams and rivers. Because they are often small projects, the work is often performed by local municipalities or completed as part of a larger project.

EXISTING CONDITIONS

Erosion is frequently observed at culvert outlets for a variety of reasons, including insufficient erosion protection at the culvert outlet, streambank erosion, and channel downcutting, which leaves the culvert perched above the channel. Filter fabric is often used at culvert outlets to separate riprap protection from underlying soils, however the fabric provides a slippery surface for the riprap, which commonly slides into the channel.

SECTION RENDERING



MATERIALS

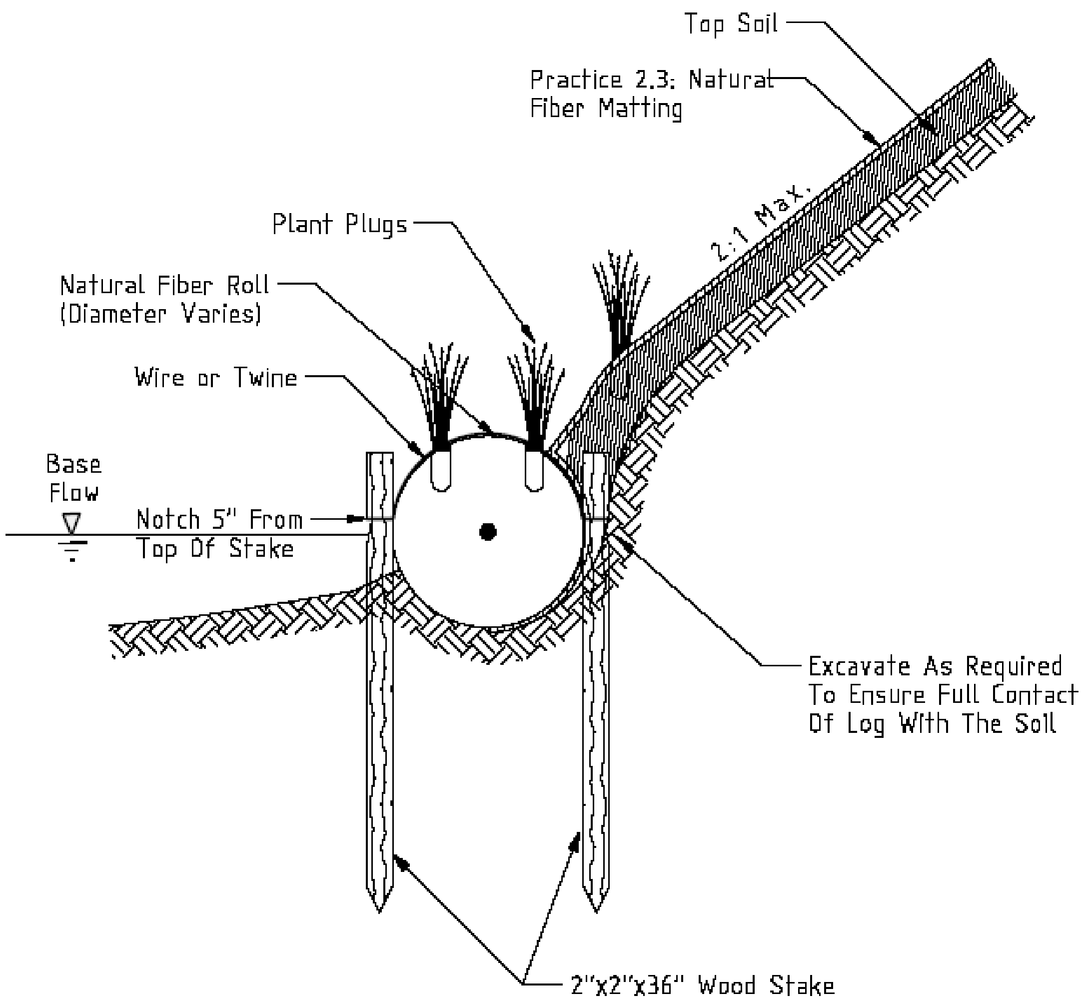
Materials consist of rock materials ranging from graded riprap (either fieldstone, or, for steep slopes, angular) and granular filter material (typically coarse gravel). If necessary, additional pipe, manholes and end sections may be necessary.

Culvert Stabilization

Bank Protection

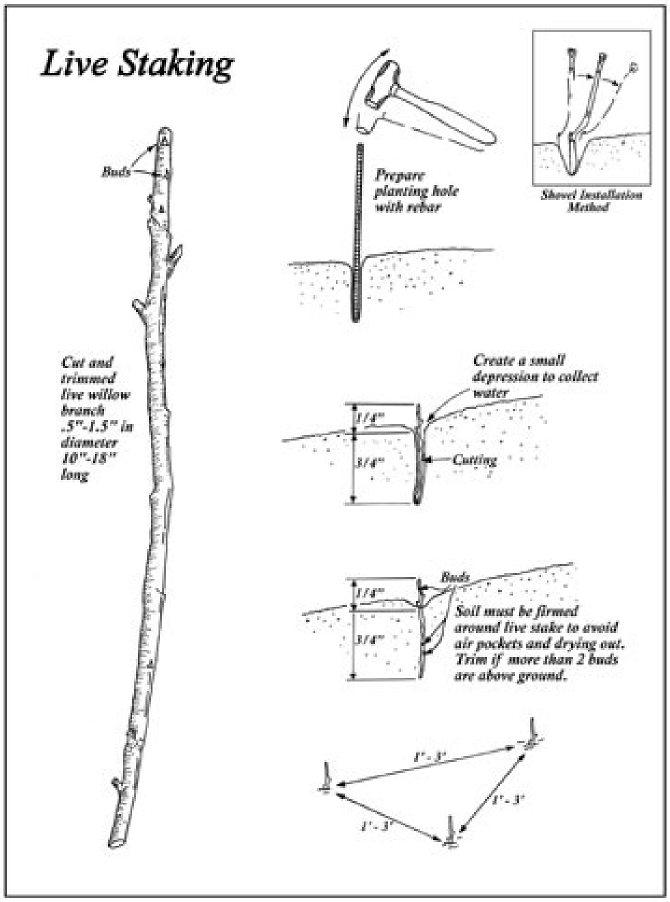
BARR

Figure 7



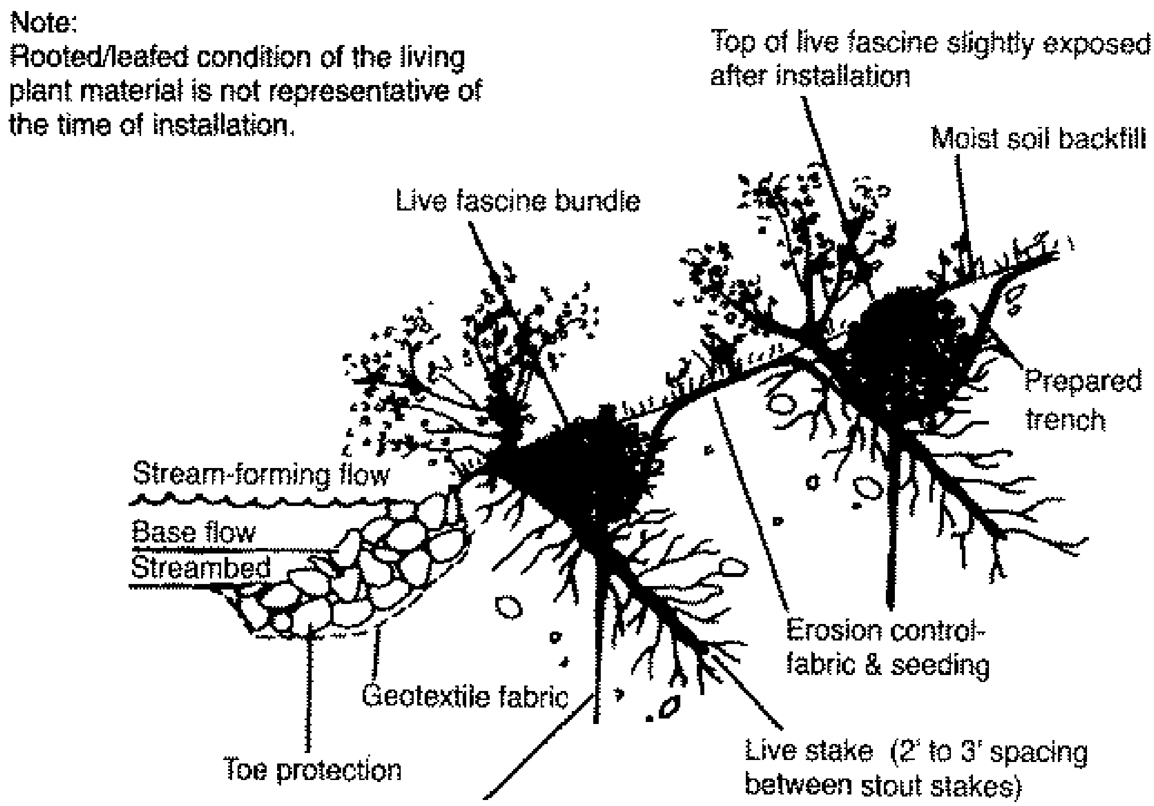
Source:
The Virginia Stream Restoration & Stabilization Best Management Practices Guide

Figure 8
Biolog Bank Protection
Bassett Creek Reach 1 Restoration Project
Bassett Creek Watershed Management Commission



Source: http://www.sf.adfg.state.ak.us/SARR/restoration/techniques/livestake.cfm

Figure 9
Live Stakes for Bank Protection
Bassett Creek Reach 1 Restoration Project
Bassett Creek Watershed Management Commission



Source: http://www.dnr.state.oh.us/water/pubs/fs_st/stfs14/tabid/4169/Default.aspx

Figure 10
Live Fascines for Bank Protection
Bassett Creek Reach 1Restoration Project
Bassett Creek Watershed Management Commission

Appendices

Appendix A

2010 Site Photos

Photo 1. *Site 1*. Minor to moderate erosion near the Golden Valley-Crystal border

Photo 2. *Site 1*. Minor to moderate erosion near the Golden Valley-Crystal border.

Photo 3. *Site 2*. Severely eroding bank.

Photo 4. *Site 2*. Severely eroding bank

Photo 5. *Site 3*. Minor bank erosion on an outside bank of a meander.

Photo 6. *Site 4*. Moderate to severe erosion.

Photo 7. *Site 4*. Moderate erosion.

Photo 8. *Site 5*. Moderate erosion.

Photo 9. *Site 5.* Moderate erosion.

Photo 10. *Site 6*. Minor bank erosion.

Photo 11. *Site 7*. Severe bank erosion with a new channel being cut through floodplain.

Photo 12. *Site 7*. Downstream end of new channel being cut.

Photo 13. *Site 8*. Minor bank erosion on an outside bank of a meander.

Photo 14. *Site 9*. Erosion around flared end section.

Photo 15. *Site 10.* Minor bank erosion with undercut trees.

Photo 16. *Site 10.* Minor bank erosion with undercut trees.

Photo 17. *Site 11*. Fallen tree.

Photo 18. *Site 11*. Minor bank erosion directly across from fallen tree.

Photo 19. *Site 12.* Minor bank erosion with severe buckthorn problem.

Photo 20. *Site 13.* Moderate bank erosion.

Photo 21. *Site 14.* Moderate bank erosion from concentrated parking lot runoff.

Photo 22. *Site 15.* Moderate bank erosion from concentrated parking lot runoff.

Appendix B

Wetland Delineation

Main Stem Bassett Creek Wetland Delineation Report for the Bassett Creek Feasibility Study

Bassett Creek Stream Restoration Project City of Golden Valley, MN

Prepared for
Bassett Creek Watershed Management Commission

August 2010

BARR

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Main Stem Bassett Creek
Wetland Delineation Report
Bassett Creek Feasibility Study
Bassett Creek Watershed Management Commission
City of Golden Valley, MN
August, 2010

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List of Appendices

1.0 Introduction

Barr Engineering Company (Barr) has completed the delineation and mapping of wetlands within two subreaches in the Main Stem of Bassett Creek (Main Stem) study area in accordance with the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (1987 Edition) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region* (2008). The study area is located within Sections 28, 31 and 32, Township 118N, Range 21W, in the City of Golden Valley, in Hennepin County, Minnesota. A location map is provided in Figure B-1. The extent of delineation and mapping includes two subreaches of the Main Stem. The first subreach (Subreach 1) is a ±2,100 foot long stretch which flows in a generally east-northeasterly direction and is bounded to the west by Wisconsin Avenue and to the east by Rhode Island Avenue. The second subreach (Subreach 3) is a ±4,200 foot long (0.8 mile) stretch which flows in a generally northerly direction and is bounded to the south by Duluth Street and to the north by the Golden Valley/Crystal city limit. Figures B-2a and B-2b provide aerial photography that covers both subreaches (study area). Barr Engineering identified and delineated four hydrologically-connected wetlands onsite. Details of the delineation methodology and wetland descriptions are reflected in later sections of this report.

Section 404 Permit

The proposed Bassett Creek Stream Restoration Project will require a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (COE). Under Section 404 of the Clean Water Act (CWA), the COE regulates the placement of fill into wetlands, if the wetlands are hydrologically linked to a water of the United States. The Main Stem of Bassett Creek is directly connected to the Mississippi River, a water of the United States. Additionally, the MPCA will likely be involved in any wetland mitigation requirements as part of the CWA Section 401 water quality certification process for the 404 Permit.

Minnesota Wetland Conservation Act

The Wetland Conservation Act (WCA) regulates the filling and draining of wetlands and excavation within Type 3, 4, and 5 wetlands. In addition, the WCA may regulate all types of wetland alteration if any wetland fill is proposed. The WCA is administered by local government units (LGU), which include: cities, counties, watershed management organizations, soil and water conservation districts, and townships. Golden Valley is the LGU for the proposed project site. The Minnesota Board of Water and Soil Resources (BWSR) oversees administration of the WCA statewide.

2.0 General Environmental Setting

The following sections describes mapped and documented data on the Main Stem Bassett Creek study area, including hydrology, available land cover data, and mapped soil units, and mapped wetland community information.

2.1 Hydrology

The Main Stem is one of several branches of Bassett Creek which make up the ±25,000 acre Bassett Creek Watershed. The Main Stem, upstream from its confluence with North Branch, is a small, winding, shallow stream located in a suburban-urban setting and drains portions of the cities of St. Louis Park, Plymouth, Crystal, New Hope, and Golden Valley. It begins in the City of Plymouth at Medicine Lake and flows in a general northeasterly direction before connecting with the southeast-flowing North Branch of Bassett Creek just upstream of Highway 100. From there, Bassett Creek flows southeast towards the City of Minneapolis where it discharges into the Mississippi River.

For Subreach 1, the topography at Wisconsin Avenue is 884 feet above mean sea level (AMSL). The elevation decreases to 880 feet (AMSL) at the point of crossing Rhode Island Avenue. For Subreach 3, the topography at Duluth Street is 856 feet AMSL. The elevation decreases to 844 feet (AMSL) at the point of crossing the Golden Valley/Crystal city limit. A 2-foot contour topographic map and USGS Quadrangle map are included as Figures B-3a, B-3b, and B-4, respectively.

2.2 Land Use/Land Cover

Subreach 1 occurs in an area of high-density industrial and commercial development with a high percentage of imperious surface. Subreach 3 occurs in medium and high-density single-family residential areas of Golden Valley. Other land uses surrounding Subreach 3 include business commercial and paved community trails. The stream crosses numerous residential streets and county highways and is typically abutted by the backyards of residential housing. In Subreach 3, a forested vegetation buffer is in place, but in Subreach 1, development tightly abuts the stream edge, providing little vegetative buffer. Available land cover data is presented in Figure B-5. Representative photographs of the land cover around the subreaches are attached in Appendix B-1.

2.3 Soils

According to the United States Department of Agriculture Natural Resources Conservation Service Soil Data Mart for Hennepin County, there are three major soil classifications that occur within the study area, which are depicted in Figure B-6 and are described below.

U1A - URBAN LAND-UDORTHENTS, WET SUBSTRATUM, COMPLEX, 0 TO 2 PERCENT SLOPES

Component: Urban land (80%)

The Urban land component is mainly commercial, industrial or residental areas with 65 to 100 percent of the map unit covered by impervious surfaces. The majority of the area was originally occupied by wet depressional soils, mineral or organic.

Component: Udorthents, wet substratum (20%)

The Udorthents, wet substratum component is comprised of fill material placed in wet depressional areas to match the adjoining upland landscape. Because of the variability of the components in this map unit, interpretations for specific uses are not available and onsite investigation is needed.

L6A - BISCAY LOAM, 0 TO 2 PERCENT SLOPES

The Biscay component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on swales. The parent material consists of outwash. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during April. Organic matter content in the surface horizon is about 6 percent. This soil meets hydric criteria.

L30A - MEDO SOILS, DEPRESSIONAL, 0 TO 1 PERCENT SLOPES

Slopes are 0 to 1 percent. This component is on depressions on outwash plains. The parent material consists of organic material over outwash. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during April, May, June. Organic matter content in the surface horizon is 65-70 percent. This soil meets hydric criteria.

2.4 National Wetlands Inventory

United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) database was consulted for the presence of wetlands within the study area. According to NWI data, which was mapped in the 1980s in the State of Minnesota, two wetlands occur within the study area, including forested and shallow marsh wetlands. The mapped NWI wetlands align somewhat with actual site conditions, but generally over-estimate actual wetland extent in Subreach 1 and under-estimate wetland extent in Subreach 3. Below are the descriptions for the Cowardin (1979) classification codes, as shown in Figure B-7.

PFO1C - Palustrine forested, broad-leaved deciduous, seasonally flooded

PUBF - Palustrine, unconsolidated bottom, semi-permanently flooded

2.5 Public Waters Inventory

The DNR Public Waters Inventory (PWI, a.k.a. Protected Waters Inventory) database was consulted for the presence of wetlands or other surface waters in or near the study area receiving statutory protection. Subreach 1 of Main Stem of Bassett Creek is considered a PWI Altered-Natural Watercourse. Subreach 3 is considered a PWI Natural Watercourse (Figure B-7).

3.0 Wetland Delineation

3.1 Wetland Delineation and Classification Methods

This assessment was designed to evaluate the ecological conditions and characteristics of the study area to identify wetlands and other surface waters that may be claimed as jurisdictional by federal and/or state agencies. The study area included all areas 75 feet from both sides of the stream centerline. All wetlands and surface waters wholly or partially within this study area were delineated. Wetlands that entirely occur outside of the study area were not delineated.

Before field investigations, desk-top preliminary data was collected and reviewed. National Wetlands Inventory mapping is a useful off-site tool in identifying the possible presence of wetlands. Other data available included aerial photography, topographical data, and soils data. Field investigations were conducted on July 8 and August 9, 2010 by Barr to identify and delineate jurisdictional wetland boundaries on the property.

The delineation was conducted according to the Routine On-Site Determination Method specified in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (1987 Edition) and the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region* (2008). The two subreaches in the study area were traversed on foot and field delineated.

In determining the jurisdictional wetland boundaries, the three jurisdictional wetland qualifiers, wetland hydrology, hydrophytic vegetation, and hydric soils were examined as evidence of wetland presence or absence. Wetlands and adjacent upland data on hydrology, vegetation, and soils were recorded in *Wetland Determination Data Form – Midwest Region* data sheets, which are included in Appendix B-2. Because the wetlands are relatively homogeneous, data points were completed for only a few representative wetlands. The wetland boundaries were recorded using a Trimble Global Positioning System with sub-meter accuracy. The wetland boundaries were then mapped using ArcMap 9.0 Geographic Information System software. Photo documentation of typical wetlands encountered along the Main Stem subreaches is provided in Appendix B-1.

Soil profiles were excavated with the use of a Dutch auger, typically up to a depth of 18-20 inches below the ground surface or when definitive hydric soil indicators were encountered. The soil sample points reported in Appendix B-2 were located close to the water-ward extent of the wetland line, for the wetland data point, and close to the land-ward extent of the wetland line for the upland data point.

The soil profiles from each boring were examined for hydric soil indicators according to the *Pocket Guide to Hydric Soil Field Indicators* (Wetland Training Institute 2004). Soil colors were determined with the aid of a Munsell® soil color chart. Soil textures were determined by feel. The hydrologic conditions within the immediate vicinity of each soil boring were documented.

Vegetative plots were established for herbaceous layers, and when possible, in a nested fashion with shrub and tree layers, within each wetland and adjacent upland data point. The plant species at each sample location were identified and their wetland indicator status (for Region 3) was noted (Reed 1988; USDA 2010). Efforts were made to meet the Army Corps Delineation Manual plot size requirements for each stratum, but due to wetland shape and size and steep site topography, rectangular plots were often created, but still covered a suitable percentage of wetland area. Dominant species were determined by use of the 50/20 rule.

The delineated wetlands habitat types were classified using the U.S. Fish and Wildlife Service Circular 39 System (U.S. Fish and Wildlife 1956) and the U.S. Fish and Wildlife Service Cowardin System (Cowardin *et al*. 1979).

3.2 Delineation Results

With few exceptions, the Bassett Creek Main Stem study area is abutted by riparian wetlands. The wetlands contiguous to, and which include, the Main Stem stream channel are, in most cases, floodplain forested wetlands, best described as Type 1 "Seasonally flooded basins or flats" under the Circular 39 System or PFO1A "palustrine forested, broad-leaved deciduous, temporarily flooded" under the Cowardin System. The individual wetland polygons are an artificial product of one contiguous wetland system becoming separated by roadways. These wetlands remain hydrologically connected by large under-road culverts. The four wetlands encountered and delineated in the two subreaches total ±8.84 acres; ±1.18 acres of wetlands occur in Subreach 1 and ±7.66 acres of wetlands occur in Subreach 3. In addition, two stormwater ponds were encountered and delineated. SW-1 is located adjacent to Wetland A and totals ±0.54 acres, and SW-2 is located adjacent to Wetland C and totals ±0.03 acres. Although all wetlands in the study area occur in conjunction with the Main Stem, hydrologic indicators were not always encountered, even close to the stream channel. However, in most cases, secondary hydrologic indicators were present, such as floodplain geomorphic setting and the FAC-neutral test. The wetland delineation results are presented in Figures 8 through 10.

The following sections describe each wetland in additional detail.

3.2.1 Wetland A (Subreach 1)

Wetland A totals ±1.16 acres (Figure B-8). It is surrounded by urban development including apartment buildings, office buildings, and light industrial development. The topography is typically steep. The top of bank ranges from 12-15 feet from toe of slope, with a slope of 45 degrees or steeper. Typically, there is a 2 foot high or higher nearly-vertical drop off from the bank to the water. In some areas, the bank contains a narrow, nearly level terrace.

An upland only data point was recorded in Wetland A (SB-11 in Appendix B-2), as shown on Figure B-8. A corresponding wetland data point was not recorded because the steep topography of the bank in subreach 1 creates upland conditions nearly to the water's edge. A narrow 1-2 foot wide strip of unvegetated mudflat often fringes the open water channel, which without further investigation, meets the definition of wetland. Wetland A is very nearly comprised only of the stream channel itself and the narrow strips of abutting mudflats, where they occur. Little to no floodplain riparian forest abuts the channel. The uplands surrounding the wetland are highly dominated by common buckthorn, but can also consist of wetland species (FAC or wetter) at the upland/wetland line, including box elder, eastern cottonwood and black willow; however, no hydric soils were found, and evidence of hydrology is absent. During flood events, it is reasonable to believe that the stream banks inundate, but not of a duration sufficient to develop wetland characteristics. The upland data point was located in a strip of nearly level terrace as described above. The ground cover was dominated with buckthorn seedlings. Soils are uniformly 10YR 4/2 in color to a depth of at least 20 inches, and are silty clay in texture; no redoximorphic or other hydric soil indicators were observed. No primary hydrologic indicators were noted, though one secondary indicator, "geomorphic position" could arguably be met.

3.2.2 Wetland B (Subreach 1)

Wetland B is a small (±0.02 acre) segment of the Main Stem, surrounded by roads, public library, and parking lot (Figure B-8). Like Wetland A, the topography is relatively steep, and transitions from upland to wetland at the waterline. The vegetation is as described above for Wetland A.

3.2.3 Wetland C (Subreach 3)

Wetland C is a long and winding, unbroken stretch of riparian floodplain forest, totaling ±3.31 acres. In the middle of this stretch of Main Stem, the stream diverges around a small island. This subreach is surrounded by single-family residential housing to the west and commercial development to the east, occurring at abrupt higher topography than the wetland and stream channel. A community bike trail follows the stream on the easterly side. The vegetative buffer here is wider than other areas of the Main Stem outside of the study area. The one mapped NWI wetland refers to a constructed backyard pond that connects to the stream channel.

Box elder is the most common species in the canopy. Large eastern cottonwood trees are also common and scattered throughout. Other typical canopy species include American elm, silver maple, and green ash. In the shrub layer, buckthorn can be problematic, often occurring in high densities. Other shrubby vegetation largely consists of young forest canopy species listed above, along with occasional red-osier dogwood, black willow, sumac, mulberry, and elderberry. The ground cover under dense forest canopy is often dominated by jewelweed, stinging nettle, American horehound, and Virginia creeper. In more open areas, the ground cover consists of reed canary grass, garlic mustard, bird's foot trefoil, giant goldenrod, and Canada goldenrod.

Wetland and upland data points were recorded in Wetland C (SB-7 and SB-8 in Appendix B-2), as shown on Figure B-9. Wetland C is a seasonally flooded riparian forest (Type 1; PFOA), dominated by box elder trees and common buckthorn shrubs. At the data point, the ground cover was dominated with jewelweed. Soils are 10YR 2/1 in color to a depth of 18 inches, with 25% redoximorphic features from 8-18 inches; loamy sand in texture; and meets the Sandy Redox hydric soil criteria. Wetland C met the "saturated" primary hydrologic indicators.

3.2.4 Wetland D (Subreach 3)

Wetland D is also a long and winding, unbroken stretch of riparian floodplain forest, totaling ±4.35 acres (Figure B-10). This subreach is surrounded by single-family residential housing along both sides of the channel, often occurring at abrupt higher topography. A community bike trail follows the stream on the easterly side. Vegetation in Wetland D is the same as described above for Wetland C.

4.0 MNRAM Assessment

The Minnesota Routine Assessment Method (MnRAM 3.0) is a comprehensive ranking system designed to help qualitatively assess functions and values associated with Minnesota wetlands for the purpose of managing local wetland resources. Full methodology guidance is available online (BWSR 2009). Some of the criteria evaluated and numerically ranked include vegetative diversity, water quality, fish and wildlife habitat, recreational value, and restoration potential. Functions are ranked from .001 to 1.0, signifying low to high values. When a wetland function has exceptional quality, it is given a score of 2.0.

While performing MNRAM assessments, wetlands in the study area were grouped and assessed together according to proximity and similarity in habitat and community type. In MNRAM, each assessment is given a unique "wetland name" created from the section, township, and range the assessment occurred in, followed by the sequential number of the assessment. Below are the wetland names noted in the MNRAM assessment summary sheets and the wetlands that were grouped together for each assessment.

27-118-21-31-001: Wetlands A and B

27-118-21-28-001: Wetlands C and D

The MNRAM summary sheets are presented in Appendix B-3. In general, the wetlands scored relatively low. This is mainly due to the urbanized setting, limited upland buffer, nuisance and exotic species, and problems inherent to the stream itself such as stream bank erosion and degraded water quality from stormwater drainage.

5.0 Summary

The wetlands associated with two subreaches in the Main Stem of Bassett Creek were delineated in accordance to the COE Wetland Delineation Manual and Midwest Regional Supplement. Four wetlands totaling approximately 8.84 acres were identified and field delineated. Wetlands A and B are primarily limited to the extent of Main Stem stream channel and are surrounded by steep upland banks. Wetlands B and C consist of the stream channel and bordering floodplain forest riparian wetlands. These wetlands are hydrologically connected via culverts, but are geographically separated by roads. In addition, MNRAM functional wetland assessments were also performed. The wetlands generally scored low in most environmental criteria.

6.0 References

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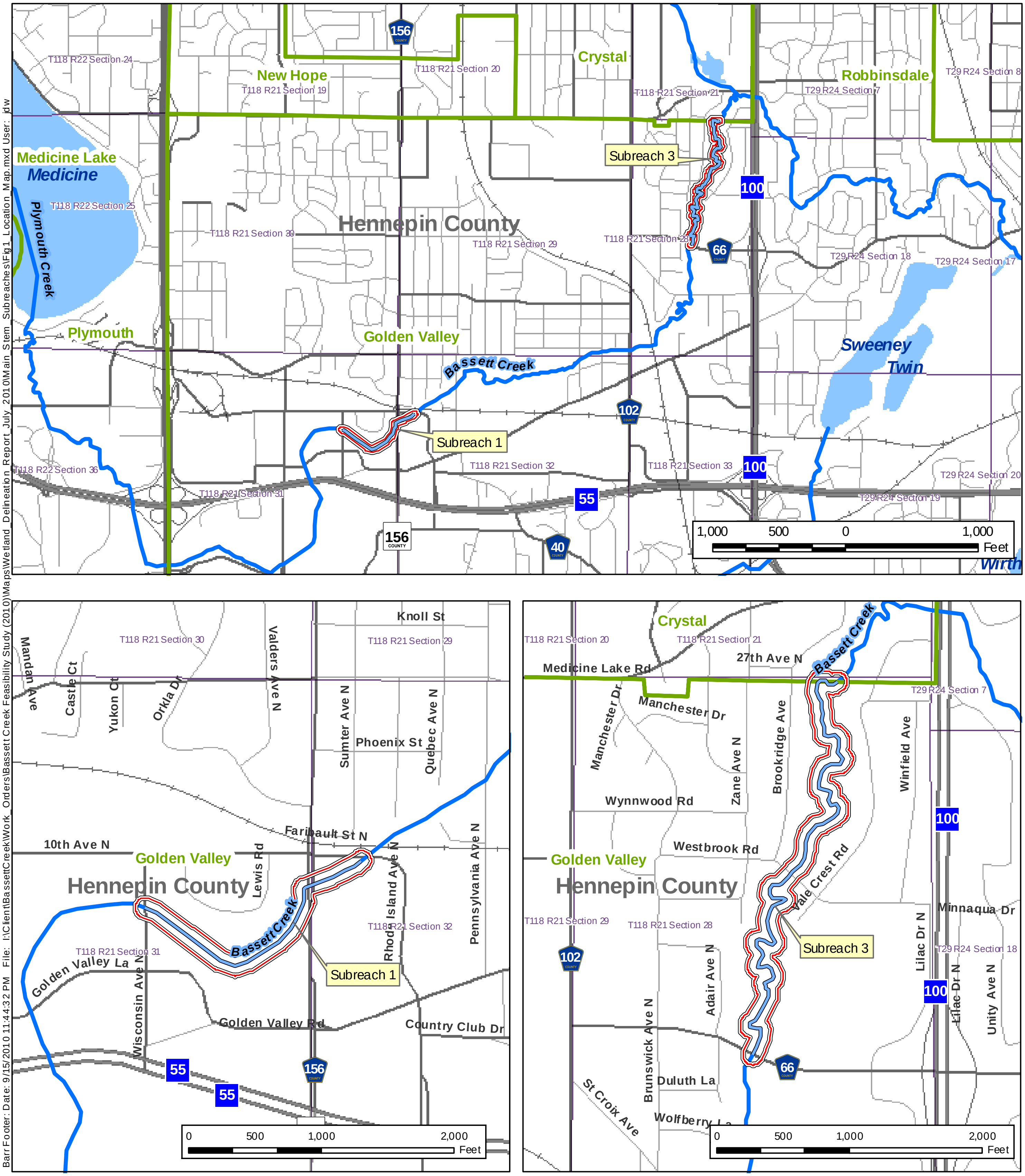
Figures



Subreaches

Main Stem Study Areas

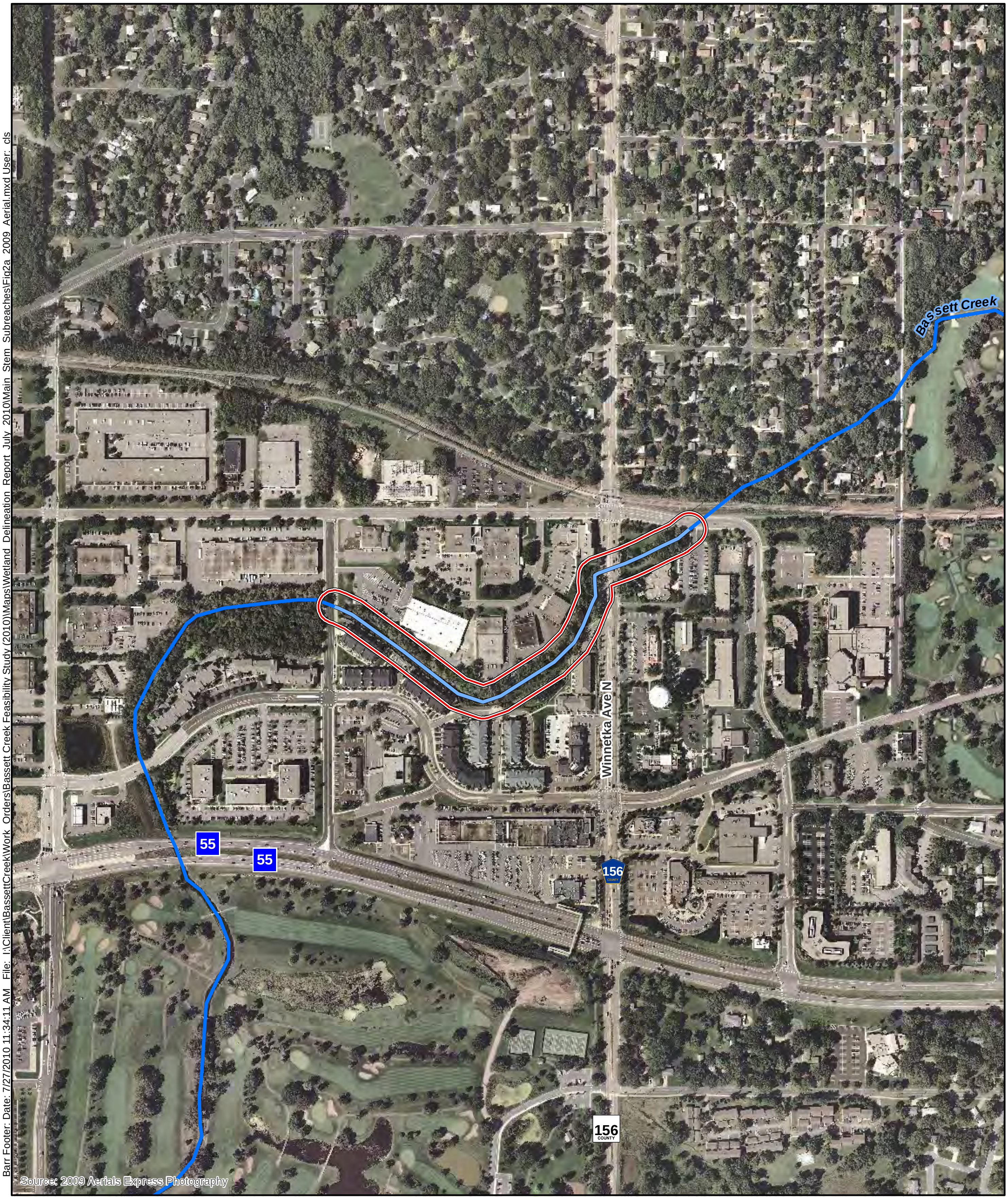
Creek Channels

N W E S

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-1
LOCATION MAP
Bassett Creek Watershed
Management Commission
August 2010

BARR



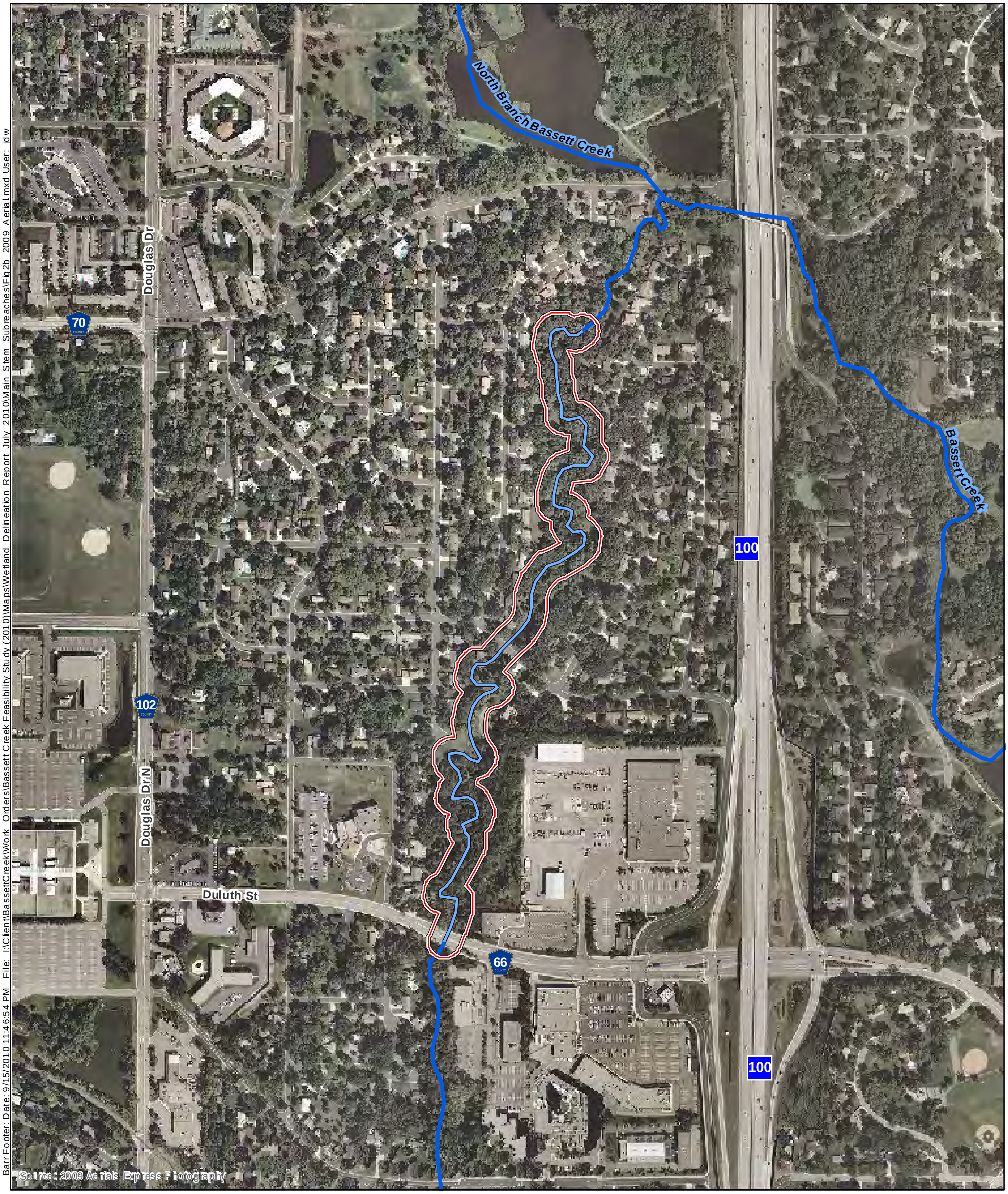
Subreach 1
Main Stem Study Area
Creek Channels

N
W E
S

600 300 0 600
Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-2a
2009 AERIAL PHOTO
Subreach 1
Bassett Creek Watershed
Management Commission
August 2010



Subreach 3

Main Stem Study Area

Creek Channels

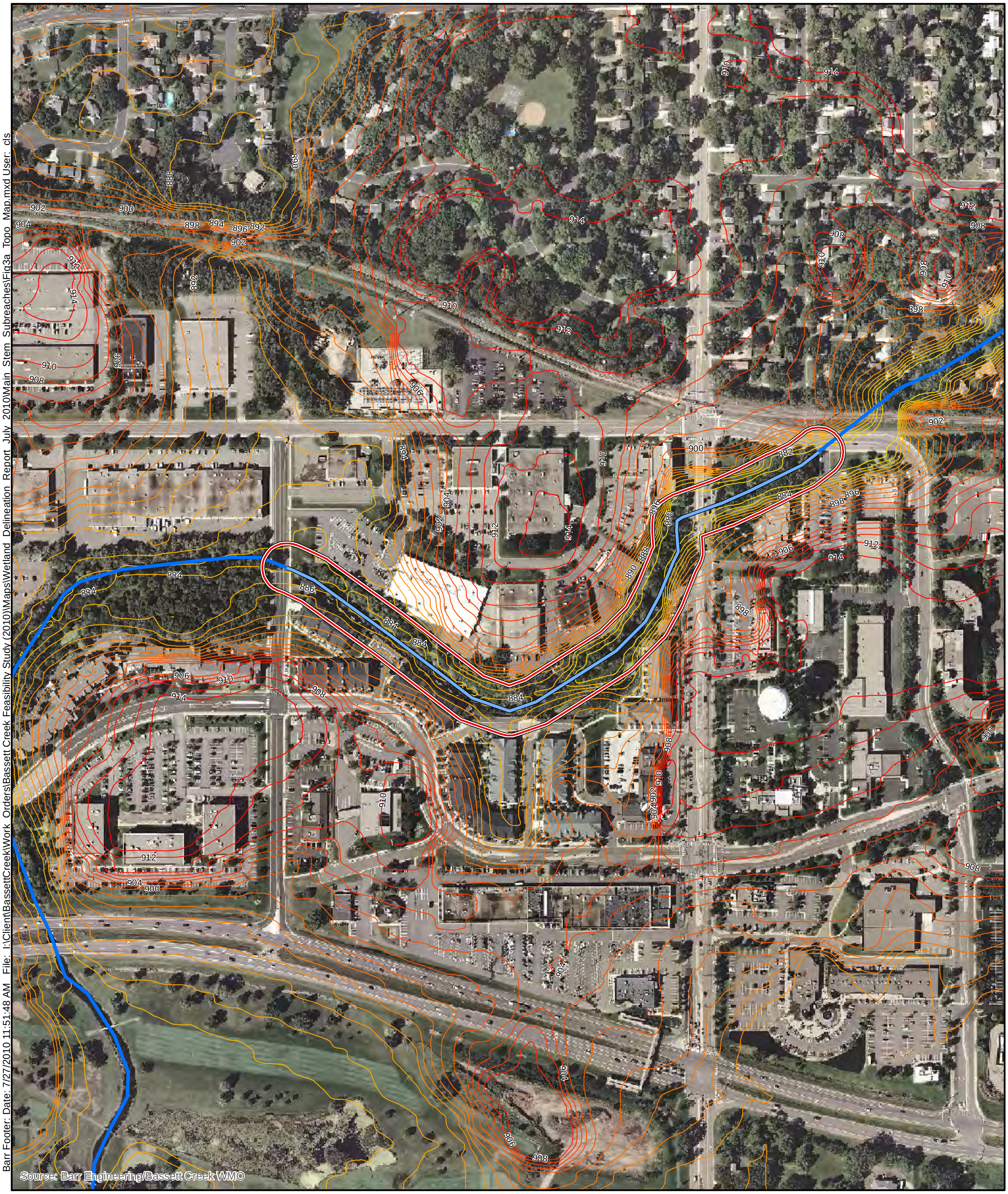
N
W E
S

600 300 0 600 Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-2b
2009 AERIAL PHOTO
Subreach 3
Bassett Creek Watershed
Management Commission
August 2010

BARR



Subreach 1

Main Stem Study Area

Creek Channels

N
W E
S

400 200 0 400
Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-3a
TOPOGRAPHIC MAP
Subreach 1
Bassett Creek Watershed
Management Commission
August 2010

BARR

Subreach 3

Main Stem Study Area

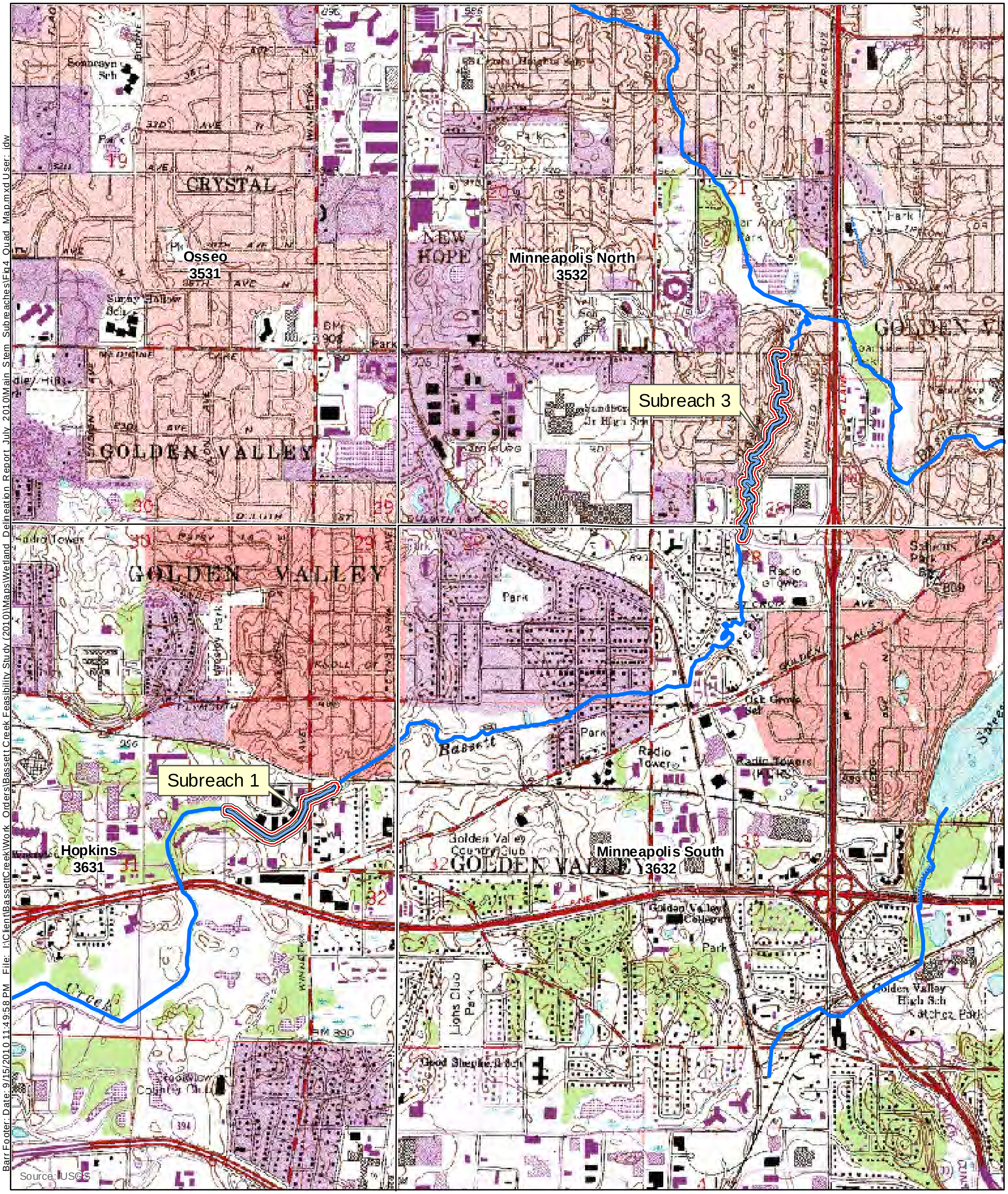
Creek Channels

N
W E
S

400 200 0 400 Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-3b
TOPOGRAPHIC MAP
Subreach 3
Bassett Creek Watershed
Management Commission
August 2010



Subreaches

Main Stem Study Area

Creek Channels

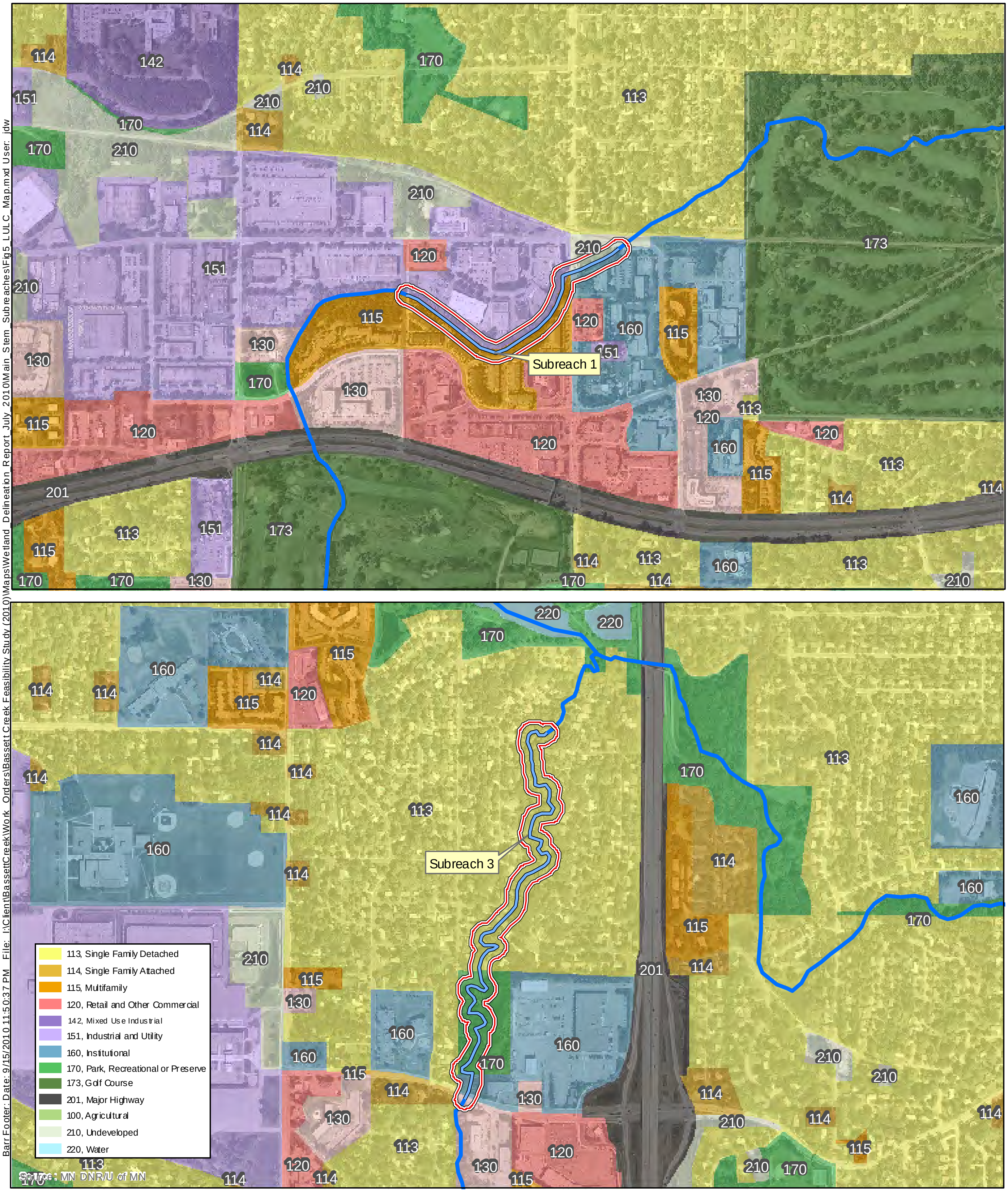
N
W E
S

2,000 1,000 0 2,000
Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-4
QUAD MAP
Bassett Creek Watershed
Management Commission
August 2010

BARR



Subreaches

Main Stem Study Areas

Creek Channels

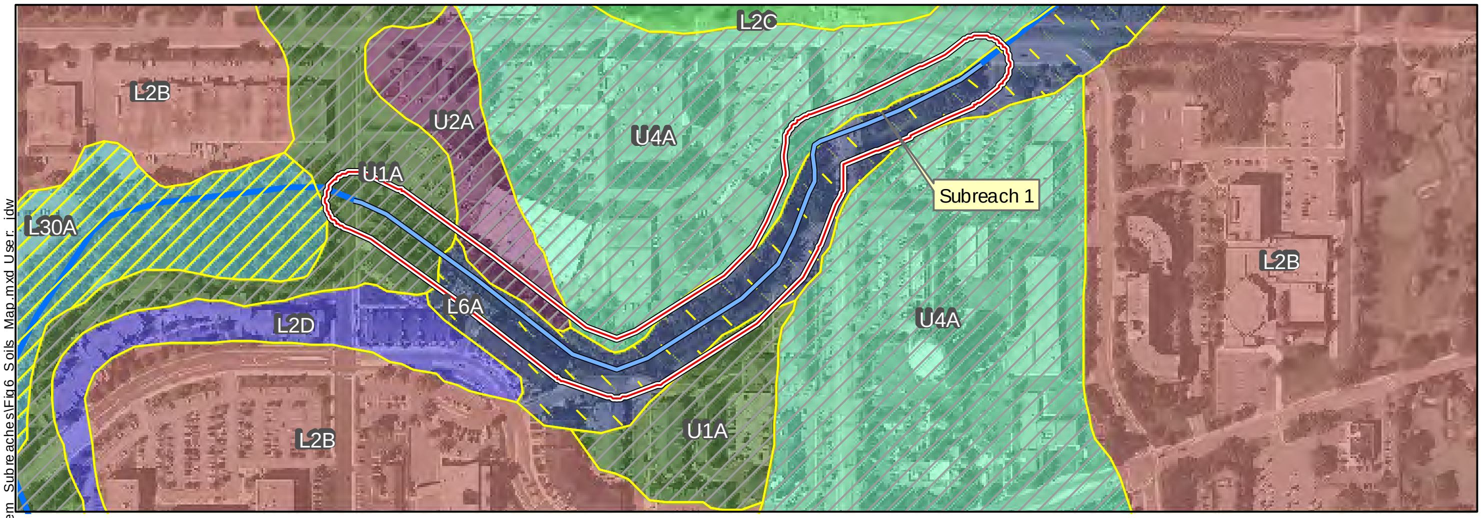
N
W E
S

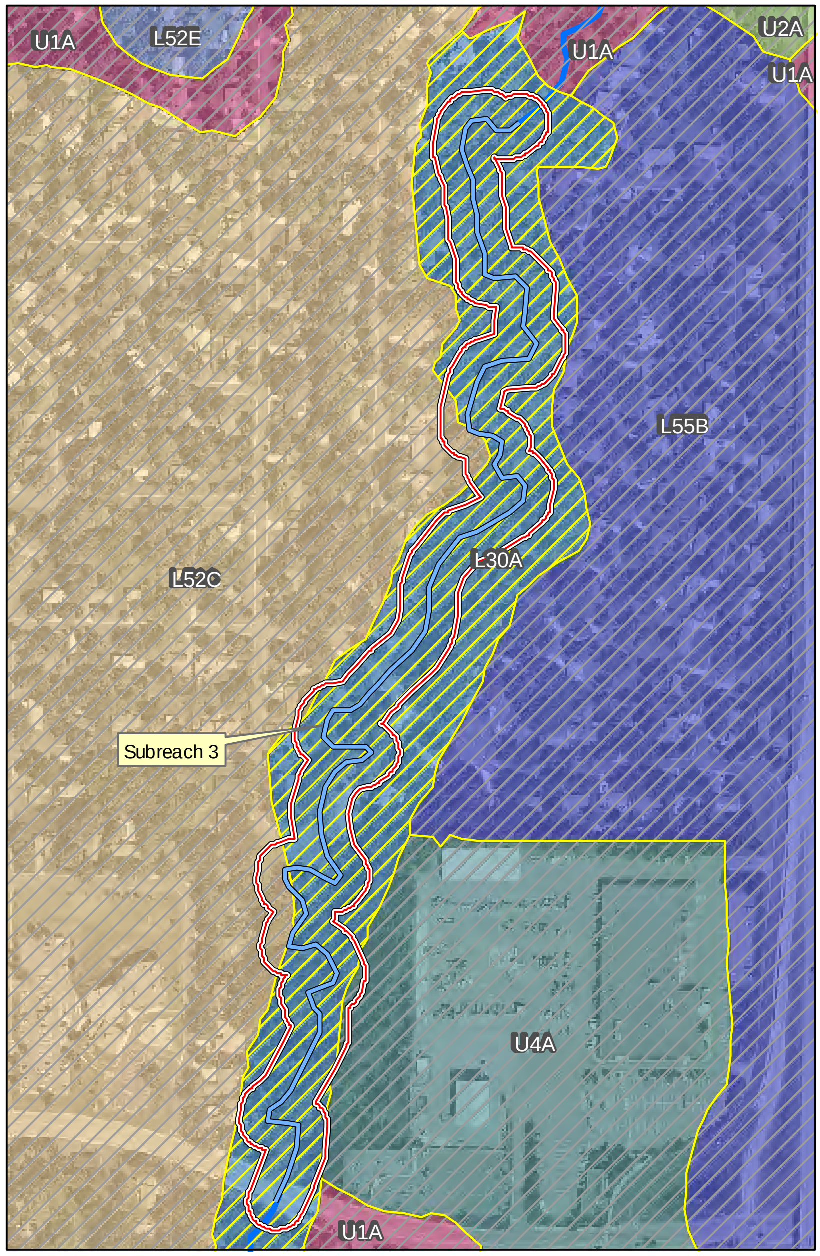
1,000 500 0 1,000 Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-5
2005 LAND COVER MAP
Bassett Creek Watershed
Management Commission
August 2010

BARR





Mapped Soil Units

- L2B, Malardi-Hawick complex, 1 to 6 percent slopes
- L2C, Malardi-Hawick complex, 6 to 12 percent slopes
- L2D, Malardi-Hawick complex, 12 to 18 percent slopes
- L30A, Medo soils, depressional, 0 to 1 percent slopes
- L52C, Urban land-Lester complex, 2 to 18 percent slopes
- L52E, Urban land-Lester complex, 18 to 35 percent slopes
- L55B, Urban land-Malardi complex, 0 to 8 percent slopes
- L6A, Biscay loam, 0 to 2 percent slopes
- U1A, Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes
- U2A, Udorthents, wet substratum, 0 to 2 percent slopes
- U4A, Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes

Soil Hydric Rating

- All Hydric
- Not Hydric
- Partially Hydric
- Unknown Hydric

Source: USDA NRCS

- Subreaches
- Main Stem Study Areas
- Creek Channels

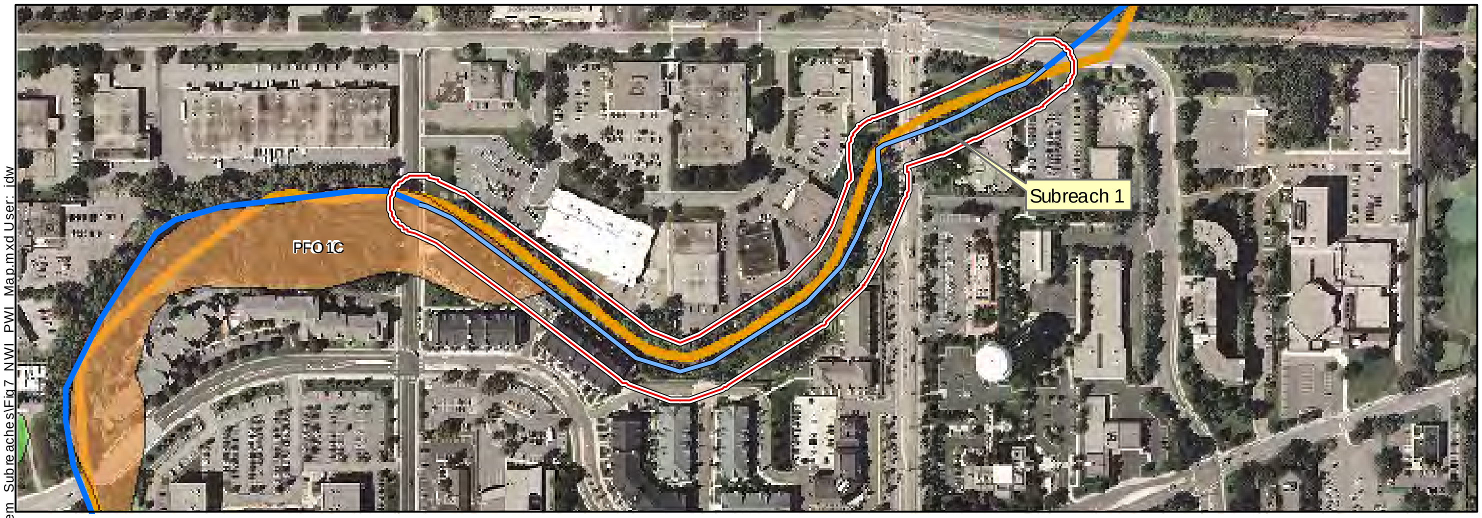
N W E S

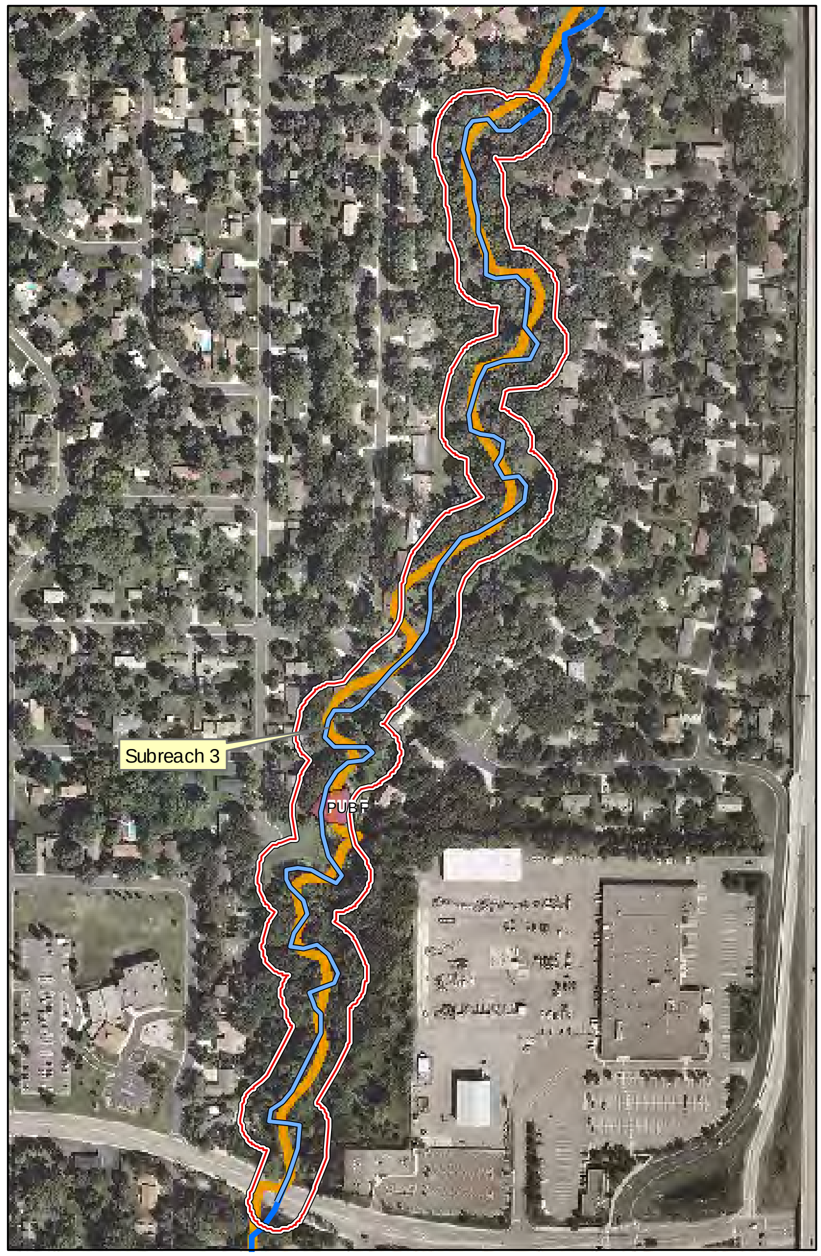
600 300 0 600 Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

BARR

Figure B-6
SOILS MAP
Bassett Creek Watershed
Management Commission
August 2010





Public Water Inventory Watercourse

National Wetland Inventory

Circular 39 Wetlands

- Deep marsh
- Shallow marsh
- Shallow open water
- Wooded swamp

Source: USFWS

Subreaches

Main Stem Study Areas

Creek Channels

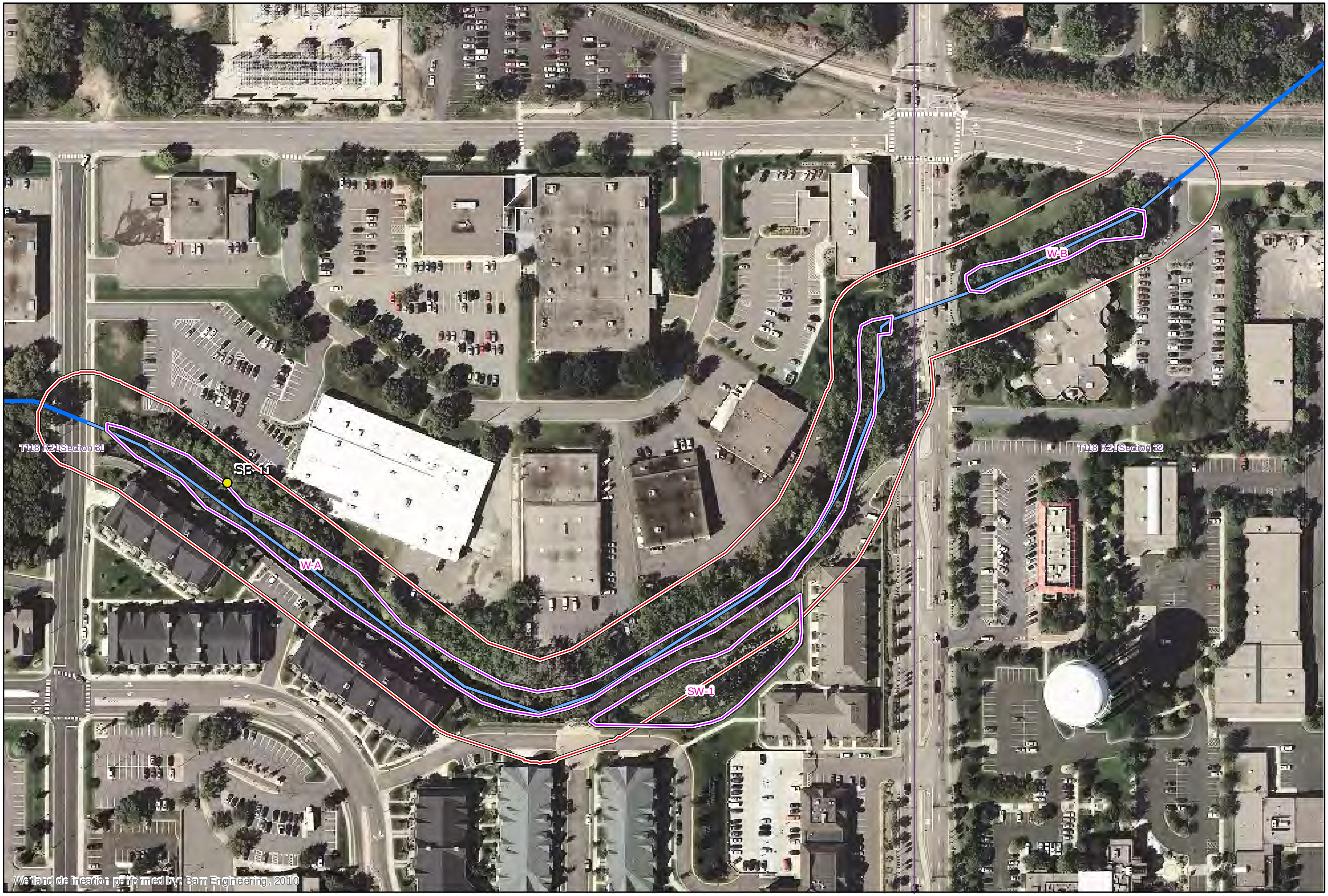
N W E S

600 300 0 600 Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

BARR

Figure B-7
NATIONAL WETLAND INVENTORY AND PUBLIC WATERS INVENTORY MAP
Bassett Creek Watershed Management Commission
August 2010



Wetland Delineation

Data point

Subreach 1

Main Stem Study Area

Creek Channels

N

W

E

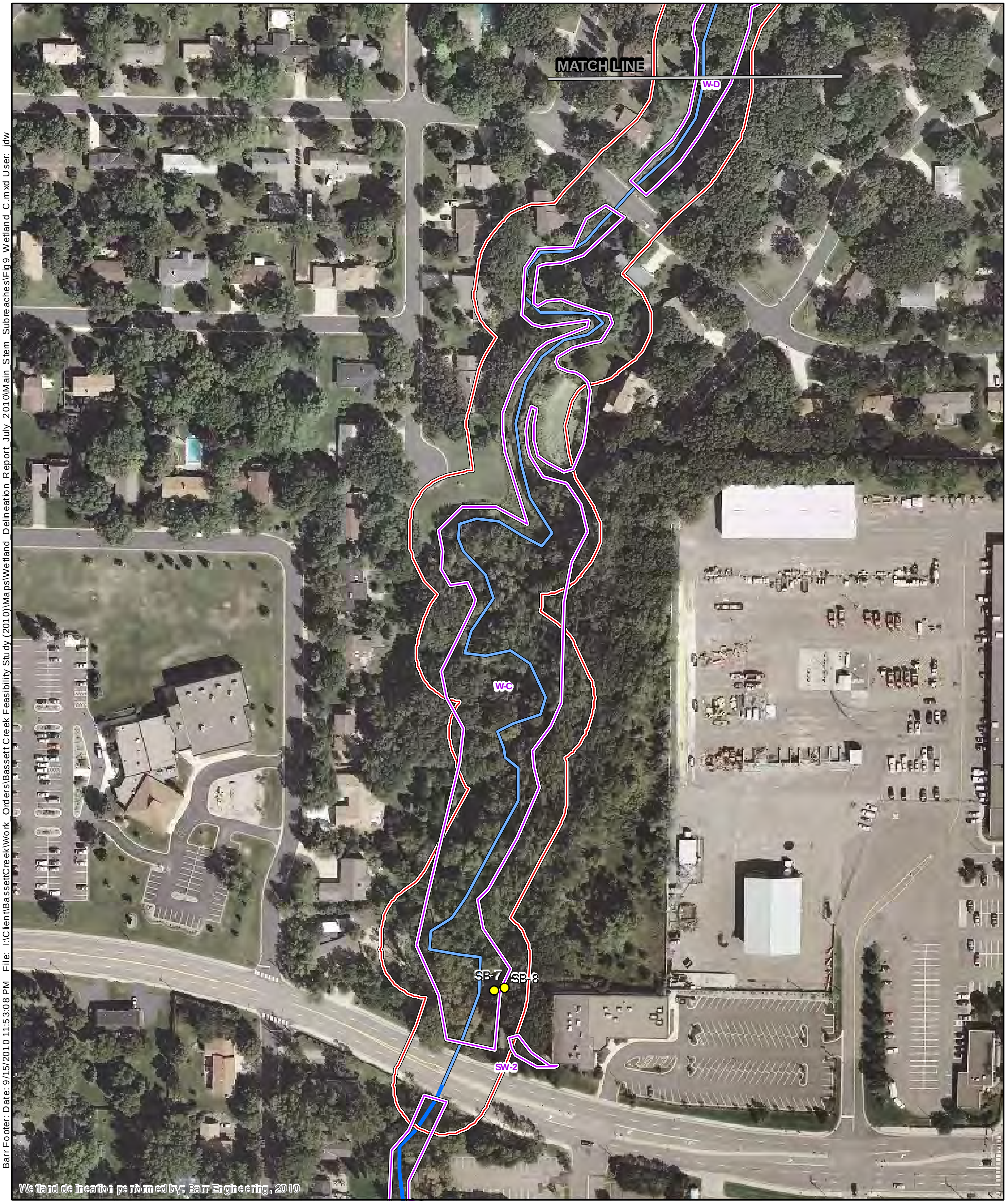
S

200 100 0 200

Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-8
WETLANDS A AND B
Bassett Creek Watershed
Management Commission
August 2010



Data Points
Wetland Delineation
Subreach 3
Main Stem Study Area
Creek Channels

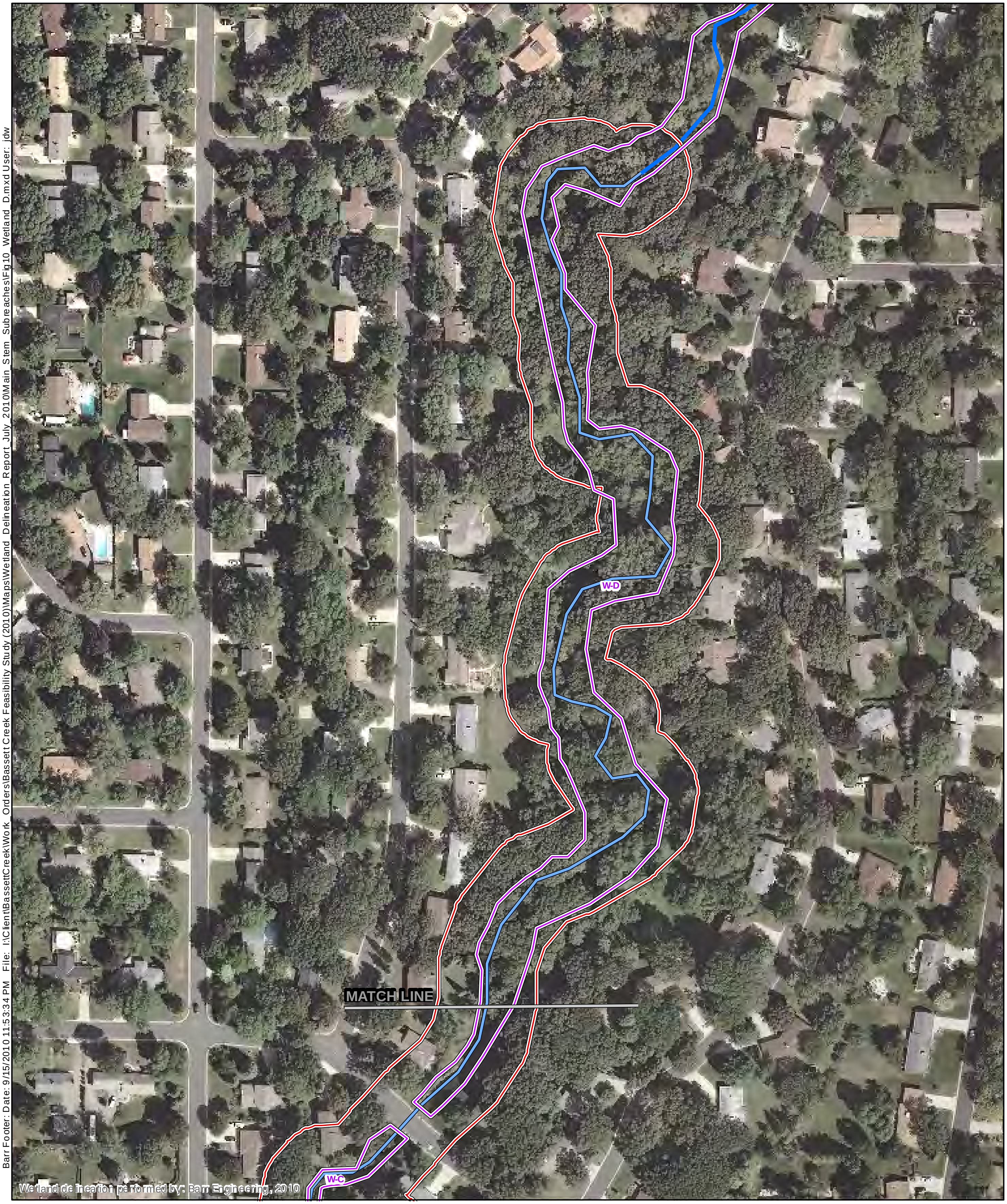
N
W E
S

200 100 0 200
Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

BARR

Figure B-9
WETLAND C
Bassett Creek Watershed
Management Commission
August 2010



Wetland Delineation
Main Stem Study Area
Subreach 3
Creek Channels

N
W E
S

200 100 0 200
Feet

MAIN STEM
BASSETT CREEK
WETLAND DELINEATION

Figure B-10
WETLAND D
Bassett Creek Watershed
Management Commission
August 2010

Appendix

Appendix B-1

Site Photographs

Photo 1: Wetland A. View of Creek and surrounding vegetation.

Photo 2: Wetland A. View of transition from upland to wetland at Data point SB-9.

Photo 3: Surface Water 1. Storm water pond located adjacent to Wetland A.

Photo 4: Wetland B. View of Creek, steep stream bank, and typical vegetation.

Photo 5: Wetland C. View of Creek with excavated marsh in background.

Photo 6: Wetland C. View of Creek and wetland at Data point SB-7.

Photo 7: Surface Water 2. Small storm water pond adjacent to Wetland C.

Photo 8: Wetland D. View of floodplain.

Appendix B-2

Wetland Data Forms

WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site:	Bassett Creek	Applicant/Owner:	BCWMC	City/County:	Golden Valley/Hennepin	State:	MN	Sampling Date:	07/09/10
Sampling Point:	SB7	Section:	28	Township:	118	Range:	21	Investigator(s):	GMH
Land Form:	Hillslope	Local Relief:		Slope %:		Soil Map Unit Name:	Medo		
Subregion (LRR):	M	Latitude:	472057	Longitude:	4982999	Datum:	Nad83, UTM Zone 15N		

NWI/Cowardin Classification: PFOA

Circular 39 Classification: 1

Eggers & Reed (primary): Floodplain Forest

Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Eggers & Reed (quaternary):

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil No Hydrology No significantly disturbed?

Are vegetation No Soil No Hydrology No naturally problematic?

Are "normal circumstances" present? Yes

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present?	Yes
Hydric soil present?	Yes
Wetland hydrology present?	Yes
Is the sampled area within a wetland?	Yes

Remarks (explain any answers if needed):

VEGETATION

	Species	Absolute % Cover	Dominant Species?	Indicator Status *
	Tree Stratum (Plot Size: 30')			
1.	Acer saccharinum	10	No	FACW
2.	Fraxinus nigra	10	No	FACW
3.	Acer negundo	50	Yes	FACW
4.		0		
	Total Cover:	70		
	Sapling/Shrub Stratum (Plot Size: 30')			
1.	Rhamnus cathartica	75	Yes	FACU
2.	Sambucus nigra ssp. canadensis	5	No	FACW
3.		0		
4.		0		
5.		0		
	Total Cover:	80		
	Herb Stratum (Plot Size: 5')			
1.	Lycopus americanus	20	No	OBL
2.	Impatiens capensis	75	Yes	FACW
3.	Phalaris arundinacea	10	No	FACW
4.		0		
5.		0		
6.		0		
7.		0		
8.		0		
	Total Cover:	105		
	Woody Vine Stratum (Plot Size: 5')			
1.	Parthenocissus quinquefolia	5	Yes	FAC
2.	Vitis riparia	5	Yes	FACW
	Total Cover:	10		

* In USFWS Region 3, which includes all of MN

% Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	5	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	80.00%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:	
OBL Species	20	X 1	20	
FACW Species	165	X 2	330	
FAC Species	5	X 3	15	
FACU Species	75	X 4	300	
UPL Species	0	X 5	0	
Column Totals:	265	(A)	665	(B)
Prevalence Index = B/A =			2.5	

Hydrophytic Vegetation Indicators:

Yes	Dominance Test is >50%
No	Prevelance Index ≤ 3.0 [1]
No	Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
No	Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? Yes

Remarks:
(include photo numbers here or on a separate sheet)

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: SB7

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 4	10YR 2/1	100					loamy sand	
2.	4 - 8	10YR 2/1	50	10YR 5/2	25			loamy sand	
3.	4 - 8			10YR 3/3	25				
4.	8 - 18	10YR 3/2	50	10YR 3/1	25			loamy sand	
5.	8 - 18			10YR 4/3	25				
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Stratified Layers (A5)
- [ ] 2 cm Muck (A10)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Mucky Mineral (S1)
- [ ] 5 cm Mucky Peat or Peat (S3)
- [ ] Sandy Gleyed Matrix (S4)
- [x] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Loamy Mucky Mineral (F1)
- [ ] Loamy Gleyed Matrix (F2)
- [ ] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- [ ] Coast Prairie Redox (A16)
- [ ] Iron-Manganese Masses (F12)
- [ ] Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): Type: Depth (inches): -

Hydric soil present? Yes

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [x] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift Deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [ ] Water-Stained Leaves (B9)
- [ ] Aquatic Fauna (B13)
- [ ] True Aquatic Plants (B14)
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres on Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Thin Muck Surface (C7)
- [ ] Gauge or Well Data (D9)
- [ ] Other (explain in remarks)

Secondary Indicators (minimum of two required)

- [ ] Surface Soil Cracks (B6)
- [ ] Drainage Patterns (B10)
- [ ] Dry-Season Water Table (C2)
- [ ] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [ ] Stunted or Stressed Plants (D1)
- [x] Geomorphic Position (D2)
- [x] FAC-Neutral Test (D5)

Field Observations:

- Surface water present? [ ] Surface Water Depth (inches):
- Water table present? [ ] Water Table Depth (inches):
- Saturation present? (includes capillary fringe) [x] Saturation Depth (inches): 15

Wetland hydrology present? Yes

Recorded Data: [ ] Aerial Photo [ ] Monitoring Well [ ] Stream Gauge [ ] Previous Inspections **Describe:**

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Bassett Creek | Applicant/Owner: BCWMC | City/County: Golden Valley/Hennepin | State: MN | Sampling Date: 07/09/10

Sampling Point: SB8 | Section: 28 | Township: 118 | Range: 21 | Investigator(s): KSW

Land Form: Hillslope | Local Relief: | Slope %: | Soil Map Unit Name: Medo

Subregion (LRR): M | Latitude: 472061 | Longitude: 4983000 | Datum: Nad83, UTM Zone 15N

NWI/Cowardin Classification: upland | Circular 39 Classification: upland

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil No Hydrology No significantly disturbed?

Are vegetation No Soil No Hydrology No naturally problematic?

Are "normal circumstances" present? Yes

Eggers & Reed (primary): Upland

Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present?	Yes
Hydric soil present?	No
Wetland hydrology present?	No
Is the sampled area within a wetland?	No

Remarks (explain any answers if needed):

VEGETATION

	Tree Stratum (Plot Size: 30')	Absolute % Cover	Dominant Species?	Indicator Status *
1.	Fraxinus pennsylvanica	30	Yes	FACW
2.	Quercus alba	2	No	FACU
3.		0		
4.		0		
	Total Cover:	32		

	Sapling/Shrub Stratum (Plot Size: 30')	Absolute % Cover	Dominant Species?	Indicator Status *
1.	Rhamnus cathartica	20	Yes	FACU
2.	Fraxinus pennsylvanica	20	Yes	FACW
3.		0		
4.		0		
5.		0		
	Total Cover:	40		

	Herb Stratum (Plot Size: 5')	Absolute % Cover	Dominant Species?	Indicator Status *
1.	Phalaris arundinacea	3	No	FACW
2.	Solidago canadensis	20	Yes	FACU
3.	Rhamnus cathartica	20	Yes	FACU
4.	Poa palustris	5	No	FACW
5.	Cirsium arvense	2	No	FACU
6.	Leonurus cardiaca	5	No	NO
7.	Medicago lupulina	20	Yes	FAC
8.	Glechoma hederacea	20	Yes	FACU
	Total Cover:	95		

	Woody Vine Stratum (Plot Size: 5')	Absolute % Cover	Dominant Species?	Indicator Status *
1.	Parthenocissus quinquefolia	30	Yes	FAC
2.	Vitis riparia	2	No	FACW
	Total Cover:	32		

* In USFWS Region 3, which includes all of MN

% Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	7	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	57.14%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:	
OBL Species	0	X 1	0	
FACW Species	60	X 2	120	
FAC Species	50	X 3	150	
FACU Species	84	X 4	336	
UPL Species	0	X 5	0	
Column Totals:	194	(A)	606	(B)

Prevalence Index = B/A = 3.1

Hydrophytic Vegetation Indicators:

Yes	Dominance Test is >50%
No	Prevelance Index ≤ 3.0 [1]
No	Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
No	Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? Yes

Remarks: (include photo numbers here or on a separate sheet) Additional species include: 1 % Viola sp., 1% Rumex crispus, 2% Alliaria petiolata, 2% Ambrosia artemisiifolia

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: SB8

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth	Matrix		Redox Features					
	(inches)	Color (moist)	%	Color (moist)	%	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 10	10YR 4/2						sandy loam	
2.	10 - 30	10YR 4/3		10YR 4/2	20			sandy loam	
3.	30 - 36	10YR 2/1						loam	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 5 cm Mucky Peat or Peat (S3)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ Coast Prairie Redox (A16)
- ☐ Iron-Manganese Masses (F12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): Type: Depth (inches): -

Hydric soil present? No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Gauge or Well Data (D9)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface water present? ☐ **Surface Water Depth (inches):**

Water table present? ☐ **Water Table Depth (inches):**

Saturation present? (includes capillary fringe) ☐ **Saturation Depth (inches):**

Wetland hydrology present? No

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections **Describe:**

Hydrology Remarks: soil most at 36", dry above

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Bassett Creek
Applicant/Owner: BCWMC
City/County: Golden Valley/Hennepin
State: MN
Sampling Date: 08/09/10

Sampling Point: SB11
Section: 31
Township: 118
Range: 21
Investigator(s): GMH

Land Form:
Local Relief:
Slope %: 2
Soil Map Unit Name: Biscay loam

Subregion (LRR): M
Latitude: -93.384443
Longitude: 44.987692
Datum: decimal degrees

NWI/Cowardin Classification: upland
Circular 39 Classification: upland

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (If no, explain in remarks)

Are vegetation No Soil No Hydrology No significantly disturbed?

Are vegetation No Soil No Hydrology No naturally problematic?

Are "normal circumstances" present? Yes

Eggers & Reed (primary): Upland
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic vegetation present?	No
Hydric soil present?	No
Wetland hydrology present?	No
Is the sampled area within a wetland?	No

Remarks (explain any answers if needed):

VEGETATION

Tree Stratum (Plot Size:)	Absolute % Cover	Dominant Species?	Indicator Status *
1. Acer negundo	30	Yes	FACW
2. Rhamnus cathartica	10	Yes	FACU
3.	0		
4.	0		
Total Cover:	40		

Sapling/Shrub Stratum (Plot Size:)	Absolute % Cover	Dominant Species?	Indicator Status *
1. Rhamnus cathartica	100	Yes	FACU
2.	0		
3.	0		
4.	0		
5.	0		
Total Cover:	100		

Herb Stratum (Plot Size:)	Absolute % Cover	Dominant Species?	Indicator Status *
1. Parthenocissus quinquefolia	10	No	FAC
2. Rhamnus cathartica	80	Yes	FACU
3. Vitis riparia	1	No	FACW
4. Ulmus americana	1	No	FACW
5.	0		
6.	0		
7.	0		
8.	0		
Total Cover:	92		

Woody Vine Stratum (Plot Size:)	Absolute % Cover	Dominant Species?	Indicator Status *
1.	0		
2.	0		
Total Cover:	0		

* In USFWS Region 3, which includes all of MN

% Bare Ground in Herb Stratum: 0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	25.00%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	32	X 2	64
FAC Species	10	X 3	30
FACU Species	190	X 4	760
UPL Species	0	X 5	0
Column Totals:	232 (A)		854 (B)

Prevalence Index = B/A = 3.7

Hydrophytic Vegetation Indicators:

No	Dominance Test is >50%
No	Prevalence Index ≤ 3.0 [1]
No	Morphological Adaptations [1] (provide supporting data in vegetation remarks or on a separate sheet)
No	Problematic Hydrophytic Vegetation [1] (Explain)

[1] Indicators of hydric soil & wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic vegetation present? No

Remarks:
(include photo numbers here or on a separate sheet)

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: SB11

Profile Description: (Describe to the depth needed to document the indicator or confirm the abscence of indicators).

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 20	10YR 4/2						silty clay	
2.	-								
3.	-								
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (applicable to all LRRs, unless otherwise noted)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ 5 cm Mucky Peat or Peat (S3)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils [3]:

- ☐ Coast Prairie Redox (A16)
- ☐ Iron-Manganese Masses (F12)
- ☐ Other (explain in soil remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present): Type: Depth (inches): -

Hydric soil present? No

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Gauge or Well Data (D9)
- ☐ Other (explain in remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface water present? ☐ Surface Water Depth (inches):

Water table present? ☐ Water Table Depth (inches):

Saturation present? (includes capillary fringe) ☐ Saturation Depth (inches):

Wetland hydrology present? No

Recorded Data: ☐ Aerial Photo ☐ Monitoring Well ☐ Stream Gauge ☐ Previous Inspections **Describe:**

Hydrology Remarks: none

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Appendix B-3

MN RAM Assessment Summaries

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
27-118-21-28-001	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet), Riverine (within the river/stream banks), Slope, Floodplain (outside waterbody banks)	0.40	0.52	0.55	0.32	0.70
		Moderate	Moderate	Moderate	Low	High

Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Additional Information: Wetland Restoration Potential	Additional Information: Wetland Sensitivity to Stormwater and Urban Development	Additional Information: Additional Stormwater Treatment Needs
27-118-21-28-001	0.37	0.65	0.03	0.41	0.00	Combination Discharge, Recharge	0.00	0.10	0.32
	Moderate	Moderate	Low	Moderate	Not Applicable		Not Applicable	Moderate	Low

Wetland Community Summary

Wetland Name	Location	Vegetative Diversity/Integrity: Community: Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating
27-118-21-28-001	27-118-21-21-001	PFO1A	Type 1	Floodplain Forest	70	0.1	0.10	0.10	0.10
							Low	Low	Low
		R2UBG	Type 5	Shallow, Open Water Communities	20	0.1	0.10	0.10	0.10
							Low	Low	Low
		PEMF	Type 4	Deep Marsh	10	0.1	0.10	0.10	0.10
							Low	Low	Low
					100		0.10	0.10	0.10

☐

☑ *Denotes incomplete calculation data.*

Appendix C

Cultural and Historical Resources

REPORT ON PRELIMINARY RECONNAISSANCE SURVEY
CONDUCTED BY ARCHAEOLOGICAL RESEARCH SERVICES (ARS)
ALONG THE MAIN STEM OF BASSETT CREEK

CITIES OF CRYSTAL AND GOLDEN VALLEY, HENNEPIN COUNTY, MINNESOTA

During the week of June 14th, 2010, ARS conducted a pedestrian survey of two segments of Bassett Creek, i.e., the main stem between Wisconsin Avenue and Highway 100 and the north branch between 36th Avenue and Bassett Creek Pond.

A records and literature search that was completed in 2009 for the Basset Creek Watershed Management Commission (BCWMC) Resource Management Plan did not identify any known archaeological or historic resources along these two segments of the creek. [1] Nor, however, did it indicate that any systematic efforts had been made to survey these areas for cultural evidence. Consequently, as cultural resources are legally protected from adverse impact caused by publicly funded and/or licensed projects,[2] such survey efforts will presumably be required in order to determine how future management plans for Bassett Creek can ensure that archaeological evidence -- and possibly also above-ground historic features -- are adequately protected either through avoidance or mitigative data recovery.

In order to determine what areas along these two segments have archaeological and historic potential, ARS staff, under the direction of Christina Harrison:

1. compared current aerial photographs to earlier ones from the 1940s-1990s in order to determine changes in land use, vegetation patterns and, in some cases, topography;

2. interviewed property owners and other local residents likely to have knowledge about any past findings of archaeological/historic nature;

3. walked the entire length of the two segments inspecting both creek banks as well as any portions of the valley floor that may be impacted by future erosion control efforts.

---

1 Harrison, Christina, 2009. Cultural Resource Phase 1A Review Conducted for the Bassett Creek Watershed Management Commission Resource Management Plan, Hennepin County, Minnesota.

2 At the federal level, by Section 106 of the National Historic Preservation Act, within the state and its subdivisions, by the Minnesota Field Archaeology and the Minnesota Private Cemeteries Acts, as described in Harrison 2009.

Large scale aerial photographs of the survey areas were provided by Barr Engineering. Observations and recommendations were noted and referenced by subareas as indicated on the applicable aerial photographs, included in Appendix C as Main Stem Figures C01 to C06. Initial efforts to identify subareas by GPS readings proved too imprecise to be useful, due primarily to the usually quite dense foliage and frequently narrow, steep-sided topography of the valley.

In the following discussions and recommendations, standard Phase I testing refers to shovel testing at controlled intervals which may vary according to topographic and vegetational factors but should not exceed 10 meters/30 feet. Testing, recording and laboratory procedures should be in compliance with SHPO guidelines. As needed, recommendations should be provided for more intensive evaluative testing.

MAIN STEM FIGURE C01

Between the western end of the segment, at Wisconsin Avenue, and the point where the creek crosses Winnetka Avenue, the northern side of the creek has been developed for industrial and commercial use right up to the upper edge of the bank. Disturbance has clearly been quite major and the area appears completely lacking in archaeological potential.

Along the southern side of the same segment, where the terrain is higher, the construction of a massive brick retaining wall all along the creek has effectively eliminated all archaeological potential.

From Winnetka Avenue east/northeast to 10th Avenue, the apparently straightened creek is flanked by high, steep banks where areas of erosion exposure were inspected with negative results.

These negative results indicate that possible future efforts to mitigate erosion would not impact any significant cultural resources.

Between Pennsylvania Avenue N. and Idaho Avenue N., Bassett Creek bisects the Golden Valley Country Club, formed as the Golden Valley Golf Club in 1916 and first developed as a 9-hole course on 133 acres of pasture land, corn fields and swamp land north of the railroad tracks. Later expanded to 18 holes, the course was renovated in the late 1920s by A.W. Tillinghast whose design, following some course modifications made in the 1940s and 1960s, since has been restored.[3] Should future management actions involve full Section 106 review, this older northern part of the golf course may need to be researched and evaluated as a historic landscape.

As several segments of the creek bisect terrain that still appears fairly undisturbed, ARS staff conducted a visual inspection of both sides of the stream, making the following observations regarding the presence or absence of archaeological potential. Lettered creek segments are shown in appended Main Stem Figure C01.

Between A and B, the northwestern side of the creek encompasses a mostly undisturbed, wooded, approximately 3 to 6 feet high terrace which appears to have archaeological potential and warrants standard Phase I testing. The opposite side is an open, landscaped fairway which is separated from the creek by a grassy slope. It appears to have less archaeological potential and should only warrant testing if archaeological evidence is encountered on the northwestern side.

Between B and C, neither the landscaped fairway north of the creek, nor the mostly pronounced north-facing slope on the south side appear to have enough archaeological potential to warrant testing.

Between C and D, both sides of the creek have already been extensively riprapped for erosion control and appear unlikely to need further modification or archaeological survey.

The D to E segment begins with a culvert crossing under a landscaped fairway, then continues east through a fairly low area flanked on the south by wooded slope and on the north by landscaped fairway, neither of them considered to have archaeological potential.

Between E and F, the creek skirts the southern slope of a wooded knoll with several maintenance buildings. The south side of the creek is open, all landscaped grassy fairway. Both appear to have enough archaeological potential to warrant Phase I level testing on the most level spots along the creek

---

[3] Information provided on the Golden Valley Country Club web site.

Between F and G, parts of the creek flow through a fairly low area but several higher terraces on both sides appear level and undisturbed enough to warrant Phase I testing.

Between G and H, the creek appears to have been straightened and widened. Its western half is flanked by low terrain, its eastern half by higher but heavily landscaped fairways. Both appear to lack archaeological potential.

Between H and the east edge of the golf course, the creek again appears straightened and widened but it is now flanked by wooded, less disturbed higher terrain which warrants Phase I testing of all reasonable level areas along the upper bank.

MAIN STEM FIGURE C02

Between the golf course and Hampshire Avenue, most of the creek appears to have been straightened, now flowing between landscaped residential yards. Due to these modifications of the original terrain, the segment seems to lack archaeological potential.

As shown in the aerial photograph Figure C02, most of the creek between Hampshire Avenue and the railroad embankment east of Douglas Drive has been straightened. For the most part, it also flows through low, frequently quite poorly drained areas without any well defined level and high ground near the creek. However, between Hampshire and Florida Avenues and also a short distance east of the latter are a few low terraces that rise above the 870 elevation contour. These areas appear to be the only ones west of the railroad that warrant further visual inspection and possibly also supplementary Phase I testing.

Due east of the railroad embankment, as the creek turns sharply towards the north, it is flanked by the steep western slope of a pronounced knoll and, on the west, by a low creek plain, i.e. on both sides by areas completely lacking in archaeological potential.

MAIN STEM FIGURE C03

The creek segment between Areas A and B, continuing to skirt the base of a steep northwest-facing slope, is elsewhere flanked by low creek plain where it rarely comes into close proximity of any higher ground that may have invited historic use, the exception being the terrace indicated by the letter A. Although the latter may have been somewhat modified by the construction of a pedestrian trail and creek crossing, it still warrants Phase I testing.

North/northeast of Area B, the creek continues across the low, much meandered valley floor, again rarely touching any higher ground with archaeological potential except where the western bank abuts two landscaped residential yards south of St. Croix Avenue yards which, judging by the quite extensive use of boulder riprap, already have been much impacted by bank erosion. Should further erosion control be needed, any areas of potential impact would need Phase I testing.

Along the eastern bank, between Areas C and D, higher ground which may have invited historic use has since been too heavily modified by landscaping for the Colonial Acres complex to retain any archaeological potential.

North of St. Croix Avenue, between Areas D and E, east of the creek and west of Golden Valley Park, is a segment of original, fairly high creek bank which appears to have enough archaeological potential to warrant Phase I testing.

West of the creek, from St. Croix Avenue north, is nothing but low creek plain without archaeological potential. Potential is also lacking east of the creek, where a pedestrian trail follows what appears to be a completely man-made berm traversing low formerly meandered terrain all along the stream.

MAIN STEM FIGURE C04

As shown in the aerial photograph in Figure C04, the southern part of this creek segment follows a somewhat straightened course north towards Duluth Street, largely traversing low, poorly drained areas of flood plain, only coming close to higher terrain with enough archaeological potential to warrant testing at Areas A and B (both rather narrow terraces between the creek and a fairly pronounced slope up to residential yards) and C (a grassy, mostly mowed but apparently fairly natural, gradual slope up towards a residence).

East of the creek, Area D features the same raised trail and otherwise low terrain as the eastern bank discussed above for Figure 3 north of St. Croix Avenue, i.e. an area lacking archaeological potential. In Area E, between the creek and a large parking lot, is a strip of fairly natural upper bank that warrants full Phase I review.

North of Duluth Street, Areas F and G, due west and east of the creek, have both been too heavily landscaped to retain archaeological potential.

Along the east side of the creek, Area H, following the base of a pronounced westward slope, features remnants of a lower terrace which, in spite of fairly serious bank erosion, still have enough archaeological potential to warrant Phase I review.

Between Areas F and J, the west side of the creek is flanked by a fairly wide stretch of much meandered, low creek plain. Only Area I features slightly higher terrain that warrants further Phase I review.

Area J encompasses a peninsula-shaped terrace which directly overlooks the creek and is being impacted by fairly severe vertical bank erosion. Although partly modified by landscaping, the area warrants full Phase I review.

East of the creek, Area K features nothing but low, much meandered creek plain without archaeological potential.

MAIN STEM FIGURE C05

Area A encompasses a fairly level to gently sloping terrace that directly overlooks the creek and, though partially landscaped, still may have considerable archaeological potential. Some erosion control measures in the form of boulder riprap and native plantings are already in place but Phase I testing should precede any further reshaping of the bank.

Area B appears to be a mostly man-made berm but this assumption needs to be verified through Phase I testing.

Areas C and D are terraces directly adjacent to the meandering course of the creek. Both warrant full Phase I review.

Other creek segments south of Westbrook Road all traverse low, much meandered creek plain without archaeological potential.

North of Westbrook Road, as the valley narrows between increasingly steep bluff slopes, the creek generally traverses low, marshy segments of the floodplain, rarely coming close to any higher terrain except for a couple of fairly steeply sloped residential yards and then a few stretches of steep basal bluff slope all areas without archaeological potential.

MAIN STEM FIGURE C06

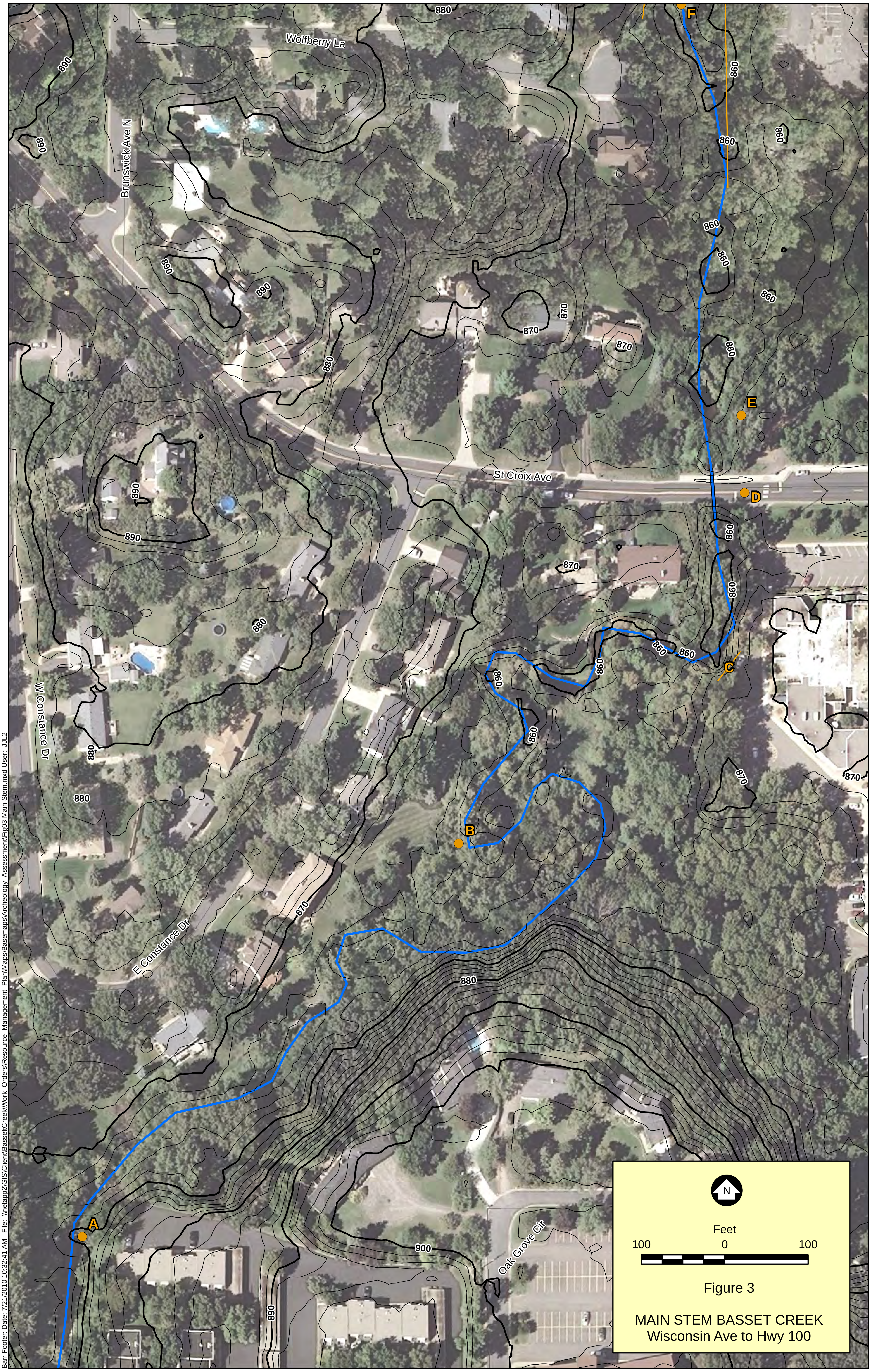
The southern two thirds of this segment is similar in character to the northern part of the Figure C05 segment but in this case, the steep-sided valley still features a few areas where terraces between the creek and the base of the bluff are wide enough to have invited historic use. Indicated as Areas A to B, they all have enough archaeological potential to warrant full Phase I review.

Further north, between Areas C and F, the west side of the creek features either low creek plain or higher but fairly steeply sloping terrain. Elsewhere, i.e. within Areas E, F and H, the banks of the creek abut a series of residential yards which are high and level enough to have archaeological potential and need further review.

Area G encompasses a stretch of high ground which appears to have been seriously modified by the construction of 29th Avenue on a raised embankment as well as a culvert connecting the creek and the ponds north of the avenue. Visual inspection of the current land surface and numerous subsoil exposures indicated a complete lack of archaeological potential.

Plymouth Ave
Oregon Ave
Kelly Dr N
Maryland Ave N
Louisiana Ave N
Jersey Ave
Pennsylvania Ave N
Idaho Ave N
Dault St
Bassett Creek
A
B
C
D
E
F
G
H
N
Feet
100 0 100 200
Figure 1
MAIN STEM BASSET CREEK
Wisconsin Ave to Hwy 100

Barr Footer: Date: 6/17/2010 12:01:22 PM File: \\netapp2\GIS\Client\BassettCreek\Work Orders\Resource Management Plan\Maps\Basemaps\Cultural Survey\Fig02 Main Stem.mxd User: TJA



Wolfberry La
Brunswick Ave N
St Croix Ave
W Constance Dr
E Constance Dr
Oak Grove Cir
A
B
C
D
E
F
N
Feet
100 0 100
Figure 3
MAIN STEM BASSET CREEK
Wisconsin Ave to Hwy 100

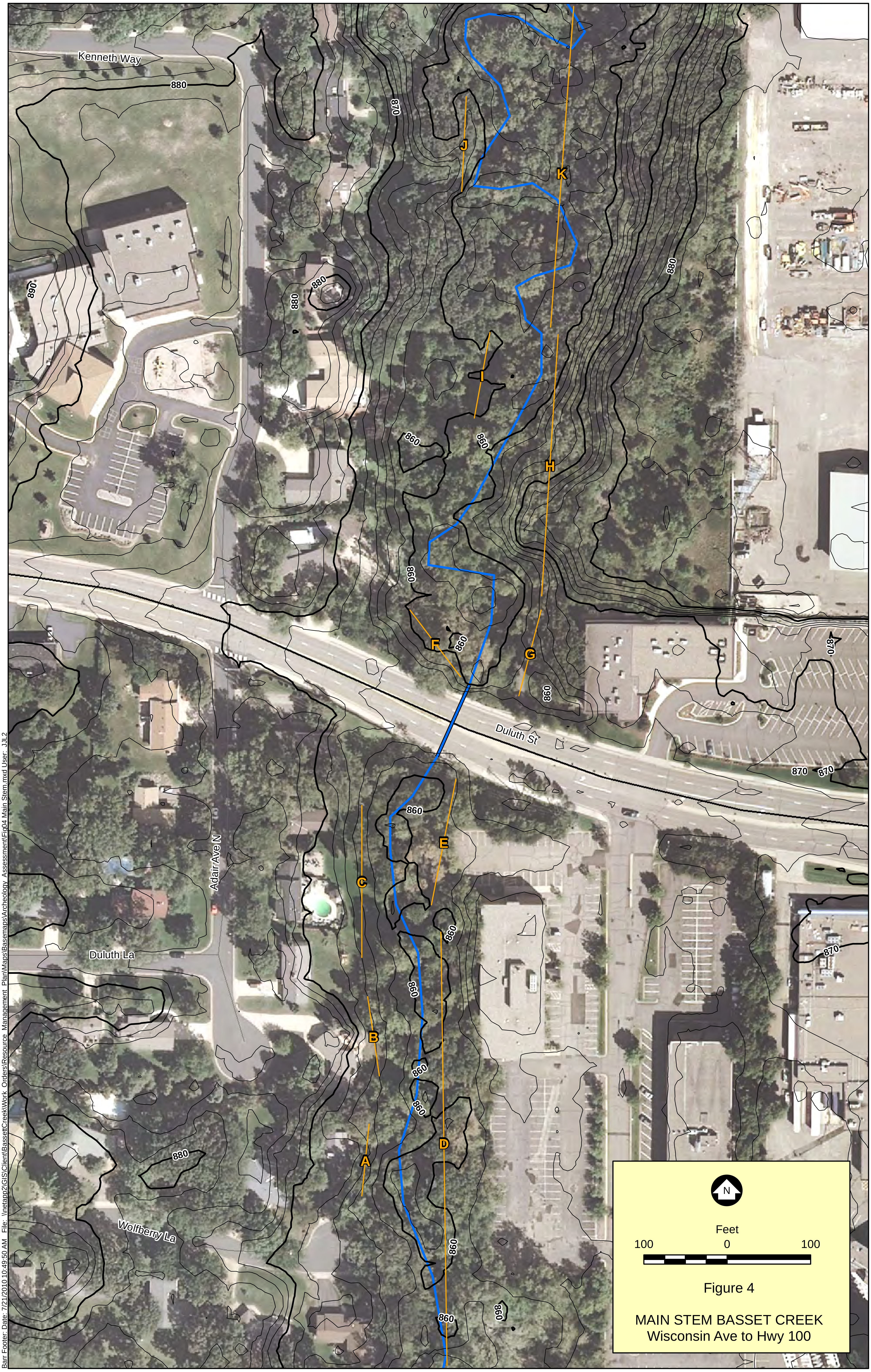


Figure 4

MAIN STEM BASSET CREEK
Wisconsin Ave to Hwy 100

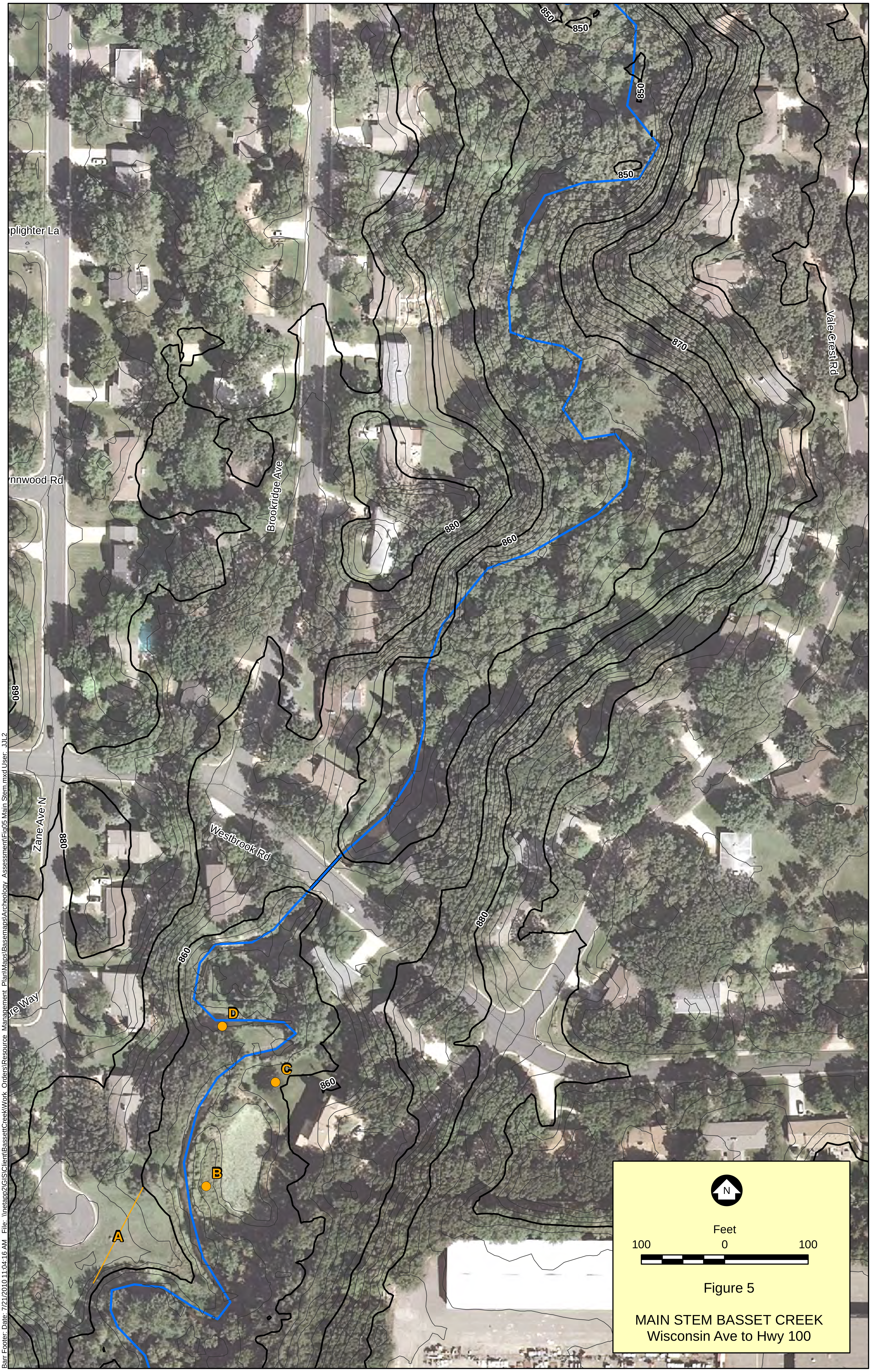


Figure 5

MAIN STEM BASSET CREEK
Wisconsin Ave to Hwy 100

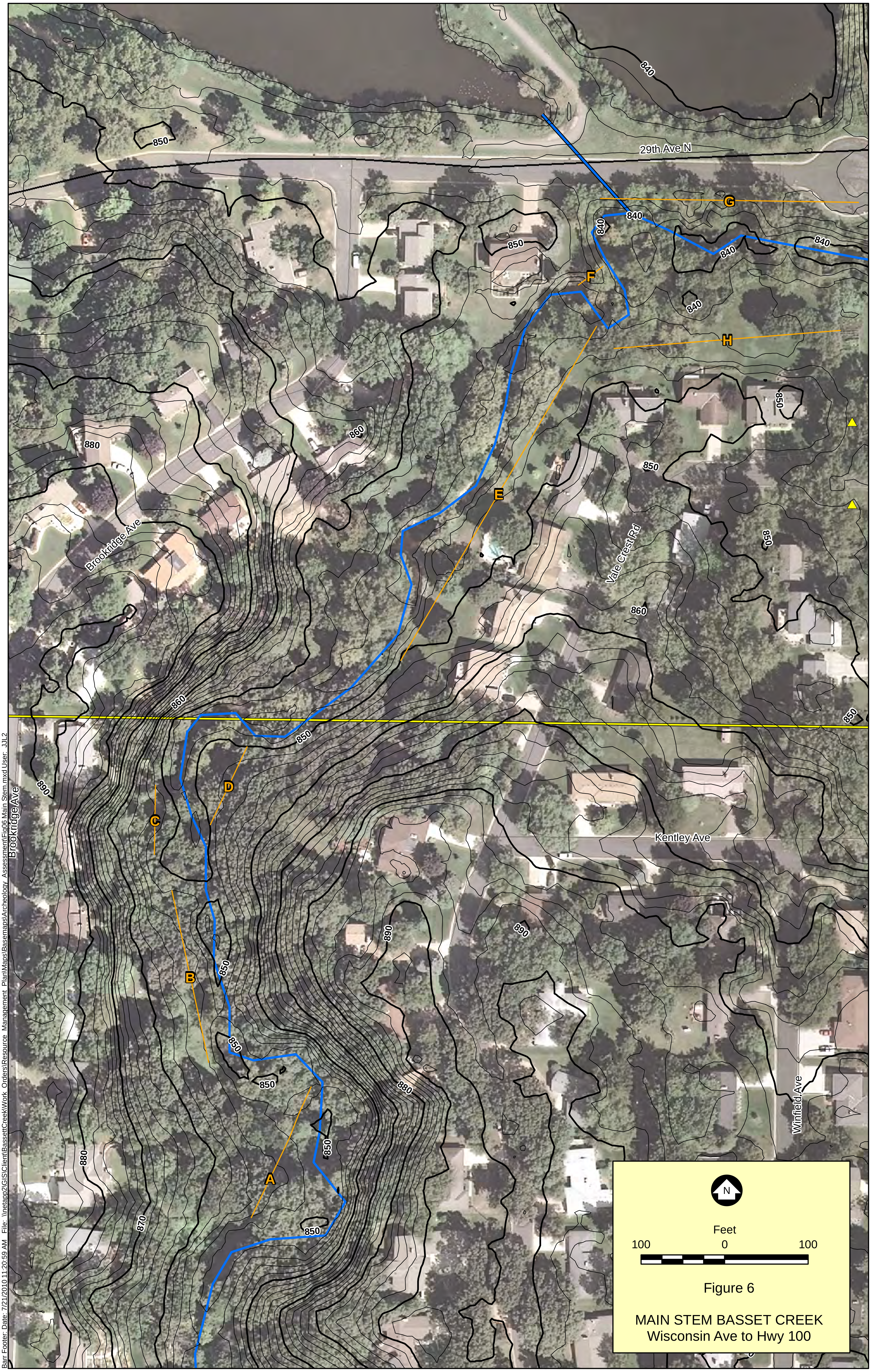


Figure 6

MAIN STEM BASSET CREEK
Wisconsin Ave to Hwy 100