Engineer's Report for Lower Riley Creek Stabilization Project

RPBCWD Reach E, Site D3, and LMRWD Reach

Eden Prairie, MN

Prepared for
Riley Purgatory Bluff Creek Watershed District and
Lower Minnesota River Watershed District

October 2016

RPBCWD Reach E

LMRWD Reach

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Certifications

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.

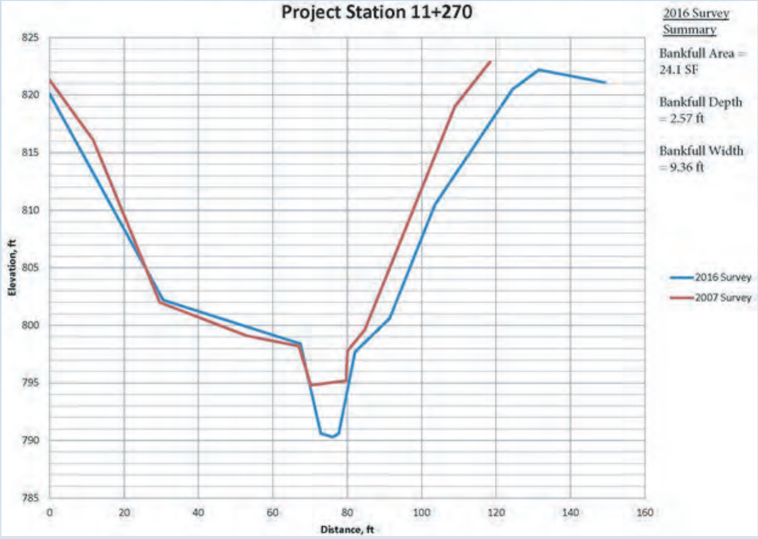
Scott Sobiech PE #: 41338	October 26, 2016 Date
Jeff Weiss PE #: 48031	October 26, 2016 Date

ENGINEER'S REPORT FOR LOWER RILEY CREEK STABILIZATION PROJECT

RILEY CREEK REACH E & SITE D3

The Riley Purgatory Bluff Creek Watershed District has identified portions of the Riley Creek Lower Valley as high priority for streambank stabilization. This study evaluates options for stabilizing locations of Riley Creek identified as Reach E and Site D3. The purpose of this study is to assess streambank stabilization measures to address the MPCA's identified turbidity impairment within this reach of Riley Creek. The streambank stabilization measures will reduce erosion and improve water quality.

CROSS SECTION COMPARISON



Site D3 is experiencing significant bank erosion that is likely contributing sediment loads to Riley Creek. A comparison of surveyed cross sections shows that the channel has degraded since the 2007 survey as it is currently both deeper and wider. The cause of the initial instability within this reach is likely the gradual increase in runoff volume and increased peak runoff rates generated by a developing watershed.

HYDRAULIC PARAMETERS

Design Condition	Discharge, cfs[a]	Velocity, fps[b]	Flow Depth, ft[c]	Shear Stress, lb/ft[d]
Existing Conditions (2-year Event)	110	2	5.9	2.1
Existing Conditions (100-year Event)	869	7	11.0	3.8

(a) 2016 Riley Creek PCSWMM Hydrologic/Hydraulic Model
(b) Approximated from representative cross section, proposed conditions velocity not calculated
(c) Based on 2016 survey for existing conditions and approximate bed raise of 3-ft for proposed conditions
(d) Calculated as T=yDS, where T is shear stress, y is specific weight of water, D is flow depth, S is channel slope

STUDY GOALS AND OBJECTIVES

- Examine the reach and determine the causes of erosion.
- Review the feasibility of implementing streambank stabilization measures along these segments of Riley Creek to reduce erosion and improve water quality.
- Complete assessments for the potential impact to wetlands and determine the impacts to permitting.
- Complete a Phase I Environmental Assessment to determine the likelihood of contamination and the potential need to avoid or treat contaminated sites during construction activities.
- Complete a Phase I Cultural and Historical Assessment to determine the likelihood of the presence of cultural or historical sites within the project area and the potential to need to avoid such sites or complete additional investigations prior to the start of construction activities.
- Develop conceptual designs for stabilizing the eroding areas.
- Provide an opinion of costs for conceptual design options to stabilize the streambanks, minimizing erosion.

Reach E has a deeply incised channel. As such, floods flows are concentrated in and near the main channel. This confinement results in faster flows and increases erosion potential within that reach. Site D3 is a ravine feature that conveys intermittent runoff from several residential lots to Riley Creek via a storm sewer outfall near the start of the ravine. Past agricultural practices and current runoff from the residential lots has resulted in an increase of both volume and runoff rate to the ravine. The increased volume and rate is exasperated by the steep channel slope of the ravine. The existing storm sewer outlet includes riprap and geotextile, which has currently failed, resulting in further erosion near the storm sewer outlet. The invert of the ravine is actively eroding because the flows are highly confined by tall banks, resulting in the creation of several large scarps.

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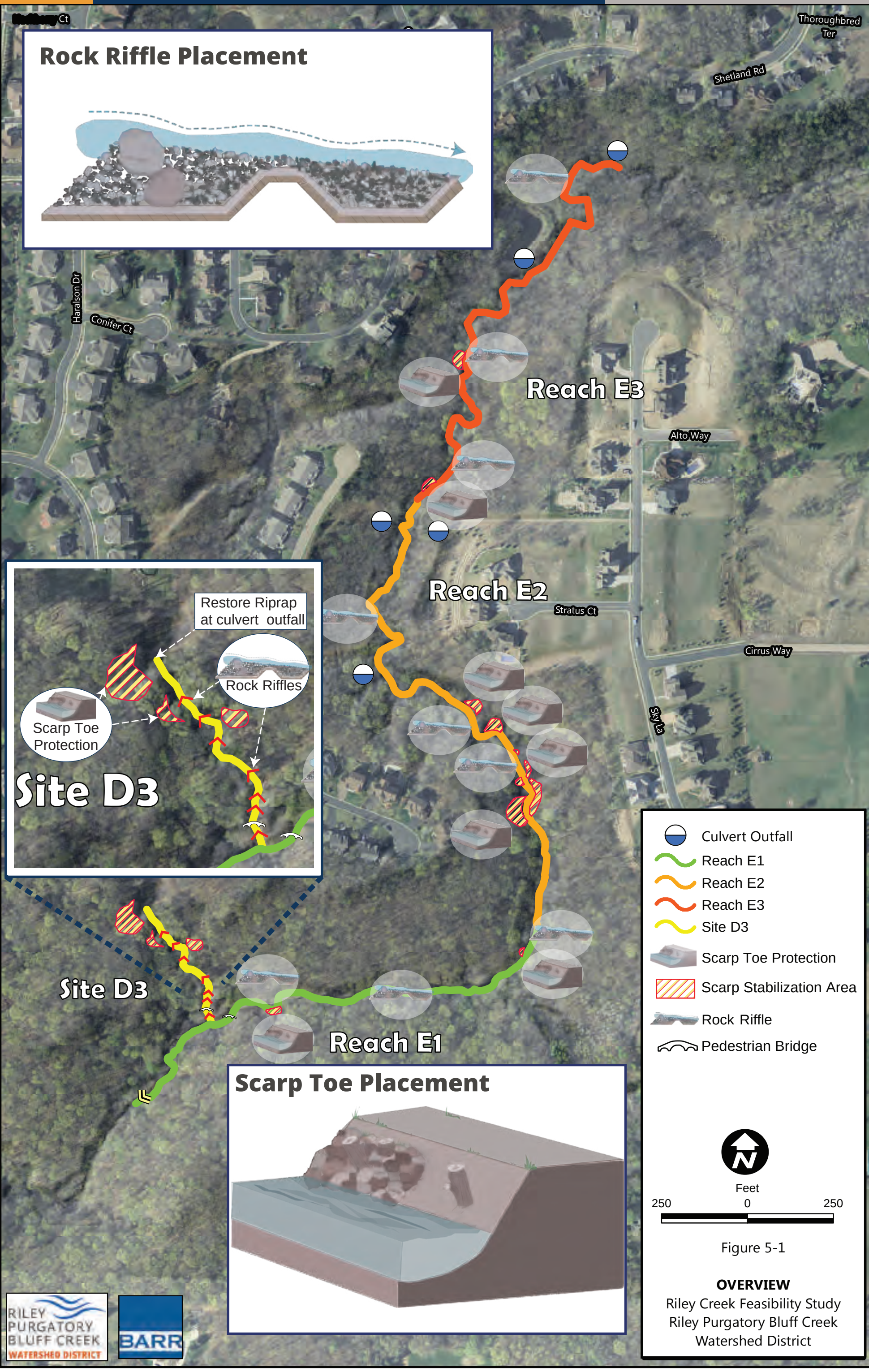
RILEY PURGATORY BLUFF CREEK WATERSHED DISTRICT



Recommended Stabilization Measures

- Site D3: Alternative B
  - Stabilize Site D3 by restoring the riprap outfall, stabilizing the scarp surfaces and scarp toe, and adding 8 rock riffles
- Reach E1, E2, and E3: Alternative A2 for all reaches
  - Construct 10 rock riffles in channel of Riley Creek Reach E to provide grade control, reconnect stream with floodplain, and recreate pool-riffle sequence in channel
  - Stabilize toe of 11 major scarps using cedar pilings and trees removed within Reach E
  - Install root wads, rock vanes, and log vanes to provide additional toe protection and in-stream habitat
  - Stabilize scarp surface through grading and establishing vegetation
  - Improve existing culvert outfalls where necessary to match newly raised channel bed

	RPBCWD Reach E and D3
Estimated TSS Reduction (lbs/yr)	2,193,700
Estimated TP Reduction (lbs/yr)	1,261
Cost of Construction (range)[1, 2]	$1,515,000 ($1,288,000 – $1,818,000)
TSS Cost/benefit ($/lb reduced)[3]	$0.05
TP cost/benefit ($/lb reduced)[3]	$84

[1] Range includes costs for: construction; engineering, design, permitting, and construction observation; legal assistance; construction contingency.
[2] Methodology and assumptions used for cost estimates are discussed in Section 4. Detailed cost estimates for all stabilization alternatives considered for this study are provided in Appendix J.
[3] Represents 20-year annualized cost.

Stabilization of site D3, and along Reach E are identified in the Overall Water Management Plan of the Riley-Purgatory-Bluff Creek Watershed District (as amended) and are a necessary and feasible project to reduce the total phosphorus (TP) and total suspended sediment (TSS) loading reductions while limiting impacts to the surrounding environment. Stabilization and restoration of the stream channel, banks, and eroding scarps within the project area would reduce stream bank erosion and, therefore, reduce TSS and TP loading to Riley Creek (which is on the MPCA's impaired waters list) and all downstream water bodies, including Grass Lake, the Minnesota River, the Mississippi River, and Lake Pepin. The recommended alternatives for Reach E (Alternative A2) and Site D3 (Alternative B) have estimated total annualized pollutant reduction costs of $84 per pound TP and $0.05 per pound TSS. (Please see table on right)

ENGINEER'S REPORT FOR LOWER MINNESOTA REACH STABILIZATION PROJECT

RILEY CREEK REACH

Scouring on the downstream side of Flying Cloud Drive is representative of active erosion in Riley Creek

HYDRAULIC PARAMETERS

Design Condition	Discharge, cfs[1]	Velocity, fps	Flow Depth, ft[3]	Shear Stress[2], lb/ft[2]
Existing Conditions (2-year Event)	170	3.7	2.8	0.5
Existing Conditions (100-year Event)	991	6.5	5.6	1.2

(1) 2016 Riley Creek PCSWMM Hydrologic/Hydrailic Model
(2) Calculated as T=yDS, where T is shear stress, y is specific weight of water, D is flow depth, S is channel slope

The Lower Minnesota River Watershed District has identified Riley Creek as a high priority for stabilization. This study evaluates options for stabilizing Riley Creek between the jurisdictional boundary and Grass Lake. The purpose of this study is to assess streambank stabilization measure to begin addressing the MPCA's identified turbidity impairment within this reach of Riley Creek by reducing erosion and improving water quality.

STUDY GOALS AND OBJECTIVES

- Examine the reach and determine the causes of erosion.
- Review the feasibility of implementing streambank stabilization measures along these segments of Riley Creek to reduce erosion and improve water quality.
- Complete assessments for the potential impact to wetlands and determine the impacts to permitting.
- Complete a Phase I Environmental Assessment to determine the likelihood of contamination and the potential need to avoid or treat contaminated sites during construction activities.
- Complete a Phase I Cultural and Historical assessment to determine the likelihood of the presence of cultural or historical sites within the project area and the potential to need to avoid such sites or complete additional investigations prior to the start of construction activities.
- Develop conceptual designs for stabilizing the eroding areas.
- Provide an opinion of costs for conceptual design options to stabilize the streambanks, minimizing erosion.

The Riley Creek channel within this reach gradually transitions from Flying Cloud Drive to Grass Lake. The upper third is moderately incised and moderately entrenched with some eroding banks. The middle third is a primarily stable channel with easy access to a floodplain. The lower third is essentially an alluvial fan with a poorly defined main channel and evidence of the channel frequently migrating across the landscape

Beginning mid-reach, Riley Creek becomes more connected with its floodplain. As flood flows are able to expand into the floodplain, the velocity in the channel drops and the flow in the channel has a reduced sediment carrying capacity. When this happens, the sediment is deposited in the channel and the channel gradually fills up with sediment. The Minnesota River is also a major contributor of sediment to lower Riley Creek as the channel within the portion of the reach is located within the 10-year flood elevation for the Minnesota River. The Minnesota River has a high sediment load and deposits a significant amount of sediment on the floodplain during flood events, so sediment deposition from the Minnesota River may also contribute to channel filling in the LMRWD Reach.

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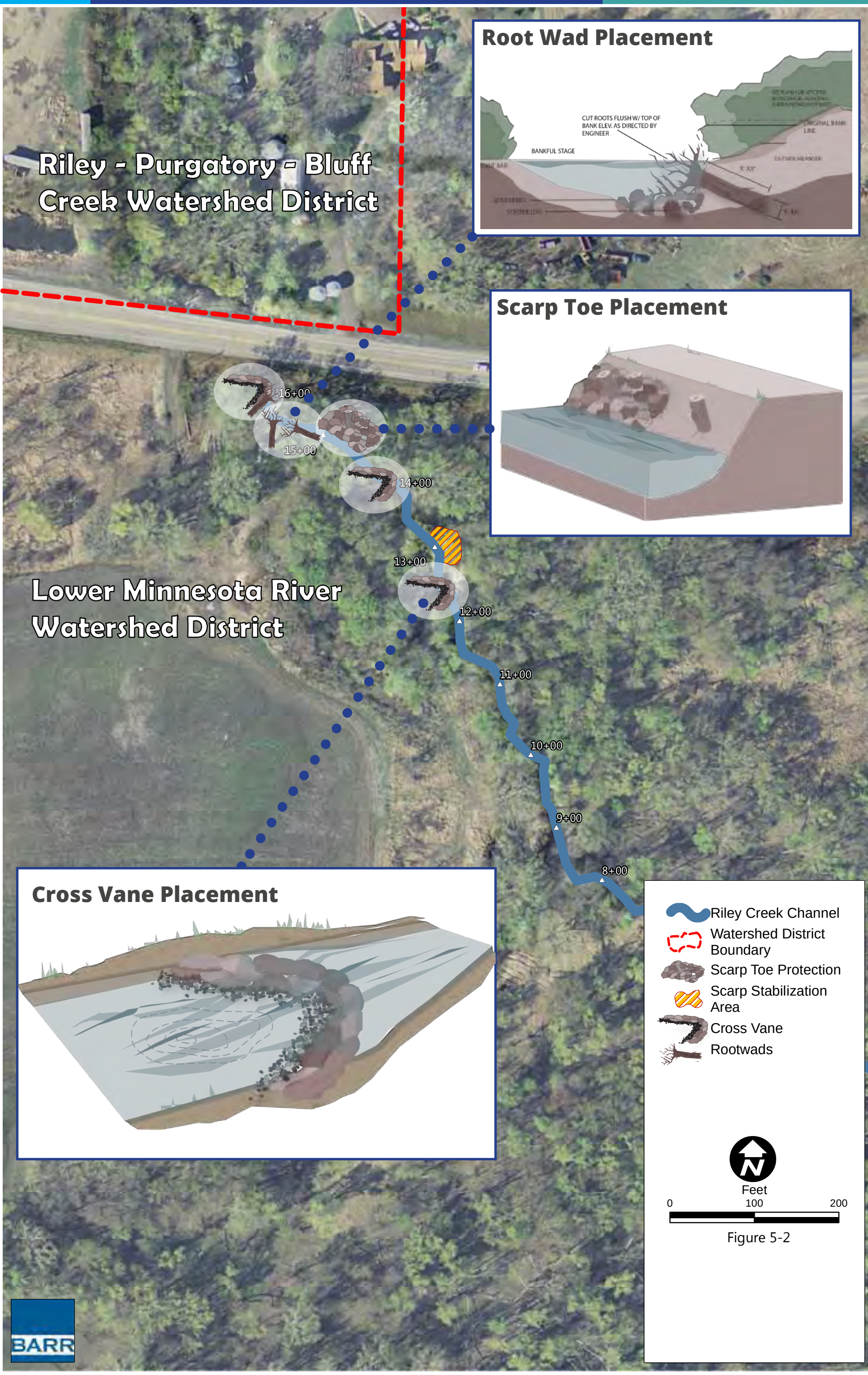

Recommended Stabilization Measures

- Alternative A
- Grade tall, eroding banks immediately downstream of Flying Cloud Drive;
- Install rock vanes and root wads to provide toe protection on the graded banks while providing in-stream habitat.

Estimated TSS Reduction (lbs/yr)	268,000 (228,000-322,000)
Estimated TP Reduction (lbs/yr)	$105
Cost of Construction (range)[1, 2]	$268,000 (228,000-322,000)
TSS cost/benefit ($/lb reduced)[3]	$0.10
TP cost/benefit ($/lb reduced)[3]	$178

[1] Range includes costs for: construction; engineering, design, permitting, and construction observation; legal assistance; construction contingency.

[2] Methodology and assumptions used for cost estimates are discussed in Section 4. Detailed cost estimates for all stabilization alternatives considered for this study are provided in Appendix J.

[3] Represents 30-year annualized cost.

Stabilization of the portion of Riley Creek downstream of Flying Cloud Drive is a necessary and feasible project to reduce the total phosphorus (TP) and total suspended sediment (TSS) loadings to Riley Creek, Grass Lake and the Minnesota River. The stabilization efforts align with the goals listed in the Lower Minnesota River Watershed District Watershed management Plan to protect, preserve and restore surface water quality, to manage erosion and control sediment discharge, and maintain and improve navigation and recreational use of the Lower Minnesota River. Stabilization and restoration of the stream channel and banks within the project area would reduce stream bank erosion and, therefore, reduce TSS and TP loading to Riley Creek (which is on the MPCA's impaired waters list) and all downstream water bodies, including Grass Lake, the Minnesota River, the Mississippi River, and Lake Pepin. The recommended stabilization alternatives the estimated total annualized pollutant reduction costs are per pound TP and per pound TSS.

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1.0 Introduction and Objectives

This Engineer's Report summarizes the proposed actions for stabilization of two reaches of Lower Riley Creek in Eden Prairie, Minnesota (Figure 1-1). It is prepared under the direction of the Board of Managers of the Riley Purgatory Bluff Creek Watershed District (RPBCWD) and the Board of Managers of the Lower Minnesota River Watershed District (LMRWD).

The upstream reach, Reach E, is located in the middle of the Riley Creek Lower Valley and is within the Riley Purgatory Bluff Creek Watershed District (RPBCWD) jurisdictional boundary. The downstream reach, Lower Minnesota River Watershed District (LMRWD) Reach, is located just downstream of Flying Cloud Drive (County Road 61) and is within the LMRWD boundary. Both reaches of Riley Creek have been identified as high priority reaches to stabilize by their respective watershed districts, and the Districts agreed to assess the feasibility of stabilization options in a combined effort in order to more effectively and efficiently use resources.

1.1 Assessment Goals and Objectives

The purpose of this report is to assess streambank stabilization and restoration measures to begin addressing the Minnesota Pollution Control Agency's (MPCA's) identified turbidity impairment along the portion of Riley Creek between Dell Road and Grass Lake by reducing erosion and improving water quality. The goals and objectives of this study, across both reaches, are to:

1. Examine the reach and determine the causes of erosion;
2. Review the feasibility of implementing streambank stabilization measures along these segments of Riley Creek to reduce erosion and improve water quality;
3. Complete assessments for the potential impact to wetlands and determine the impacts to permitting;
4. Complete a Phase I Environmental Assessment to determine the likelihood of contamination and the potential need to avoid or treat contaminated sites during construction activities;
5. Complete a Phase I Cultural and Historical assessment to determine the likelihood of the presence of cultural or historical sites within the project area and the potential to need to avoid such sites or complete additional investigations prior to the start of construction activities;
6. Develop conceptual designs for stabilizing the eroding areas;
7. Provide an opinion of costs for conceptual design options to stabilize the streambanks, minimizing erosion.

Barr Footer: ArcGIS 10.4, 2016-10-07 11:04 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Feasibility_Study\Fig 1-1 - Riley Creek Project Overview Map.mxd User: jrv

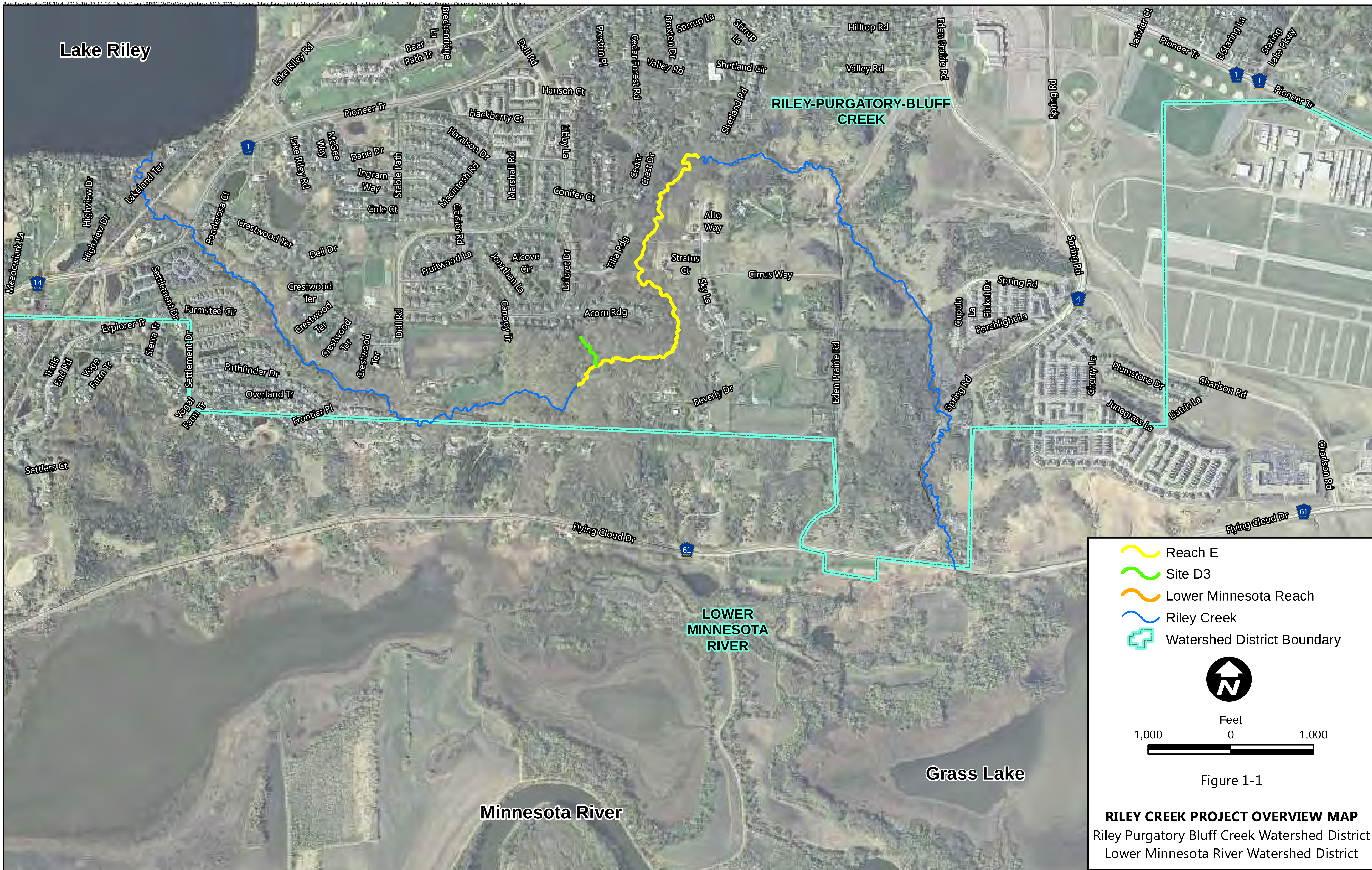

Figure 1-1

RILEY CREEK PROJECT OVERVIEW MAP

Riley Purgatory Bluff Creek Watershed District

Lower Minnesota River Watershed District

1.2 Project Area

The Riley Creek watershed to the WOMP station downstream of Flying Cloud Drive is approximately 10-square miles in Eden Prairie and Chanhassen. It has mild topography in the upper and middle portions of the watershed, and then becomes steep within the Riley Creek Lower Valley. The existing watershed land use is dominated by low density residential zones, and the expected future land use will likely maintain the same land use pattern. Riley Creek originates from Lakes Lucy and Ann in Chanhassen and flows though Lake Susan, Rice Marsh Lake, and Lake Riley before it descends through the Lower Valley. The Riley Creek Lower Valley begins at Lake Riley and extends approximately 25,700 feet before flowing into Grass Lake and then the Minnesota River. Each project reach is further described below and photos of each study reach are provided in Appendix A.

1.2.1 Reach E and Site D3 Characteristics

Reach E (Figure 1-2), which was designated in a 2007 study of the Riley Creek Lower Valley (Reference (1)), has a deeply incised channel with limited floodplain and is dramatically different from the reaches immediately upstream and downstream. The narrow valley limits the ability of flood flows to spread out into a floodplain, thereby keeping flood flows concentrated in and near the main channel.

In this reach, the slope varies from less than 0.25 percent to greater than 1 percent. Channel slopes greater than 1 percent can contribute to higher velocities and increased erosion. In a channel that is in equilibrium with its watershed, bankfull flows (~1.5-year flood events) fill the channel, and flows larger than bankfull begin to spill into the adjacent floodplain. In its current state, the channel can contain flows as great as the 100-year event, thereby concentrating velocities within the channel, which can lead to increased erosion. A comparison of surveyed data from 2007 and 2016 (See Section 3.1.1) indicates that the channel bed has lowered by one to five feet during this period. Continued erosion of the channel bed at similar rates is anticipated, with migration of headcuts upstream, unless the stream is stabilized.

Reach E is located within the Riley Creek Conservation Area (RCCA) in Eden Prairie, Minnesota. The RCCA is entirely on City-owned property covered by a natural landscape with a healthy forest and dense canopy throughout the project area. No houses or other structures are immediately adjacent to the creek within the study area; however, beyond the park extents the landscape is primarily residential developments. Non-native species, such as buckthorn, have started invading portions of the understory.

Reach E of Riley Creek was divided into three sub-reaches based on unique characteristics of the specific sub-reach (Figure 1-2). For each sub-reach, the following discussion includes a brief description of the site characteristics and the issues to be addressed.

- **Sub-reach E1** extends from the upstream limits of the study area (Station 90+00) to where the Riley Creek floodplain significantly constricts (Station 108+00). This reach consists of significant degradation of the channel bed and a knick point, or head cut, at approximate Station 4+50.
- **Sub-reach E2** consists of a segment of the stream from Station 108+00 to 120+00 that is confined by tall bluffs. The erosion within this reach has resulted in significant toe erosion of valley slopes and several scarps, one of which is large enough to spot from some satellite images,

Figure 1-2

OVERVIEW
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

and has resulted in the realignment of one of the RCCA's hiking trails. One culvert outfall is located within the project reach.

- **Sub-Reach E3** extends Station 120+00 to 141+00 and consists of significant degradation of the channel bed. The overbanks of this sub-reach have significant buckthorn. Three culvert outfalls are located within Sub-reach E3. A stormwater pond is also present in the left overbank and must maintain its design storage volume.

Site D3 (Figure 1-2) is a ravine feature that conveys intermittent runoff to Riley Creek from adjacent parkland and the back half of seven residential lots along Laforet Drive and Acorn Ridge. The ravine is visible in historic imagery where it started at the corner of agricultural land. The ravine appears to be longer than it is in current conditions, so the upstream end of the ravine may have been partially filled. The current drainage area consists of the back of seven residential lots; however it is possible the contributing drainage area was reduced when the current development was built. Historical imagery shows the ravine at Site D3 develop at the corner of agricultural fields (See Figure 2-3), and a clearly visible ravine has a drainage area larger than the current drainage area. Even though the contributing drainage area has likely been reduced, active erosion remains present within the ravine and likely contributes to the sediment load in Riley Creek. Runoff collected near the top of the current ravine is conveyed through a short storm sewer pipe and discharges within the ravine. Some riprap was installed during the culvert outfall for erosion protection, but the erosion protection was not extended further downstream in the ravine.

1.2.2 LMRWD Reach Characteristics

The LMRWD Reach (Figure 1-3) has a variety of stream characteristics. The upstream extent of this reach is where the stream begins the transition from the Lower Valley to the Minnesota River floodplain. The stream gradually transitions from a moderately incised reach with moderately tall, eroding banks immediately downstream of Flying Cloud Drive to an actively migrating channel before discharging into Grass Lake within the Minnesota River floodplain. As the creek transitions into the Minnesota River floodplain, flood flows are able to spread out into the floodplain, so flow velocity decreases and suspended sediment in the flow is deposited. This contributes to the alluvial fan upstream of Grass Lake, as well as channel migration with new channels being formed and old channels filling in. Because, this study reach is located entirely within the Minnesota River 100-year floodplain, sediment is also deposited from the Minnesota River, which directly or indirectly impacts on Riley Creek.

The vegetation immediately adjacent to this reach also transitions along the reach. There are trees in the upper third of the reach where the channel is incised, followed by a mix of grasses (mostly reed canary grass) and sparse trees in the middle third, and then dominated by grasses in the lower third that constitutes the alluvial fan. A portion of the adjacent land is agricultural.

1.3 Impairment Status

The MPCA maintains a list of impaired waters for the state of Minnesota. A body of water is considered impaired if it fails to meet one or more of the state's water quality standards. Waters that are not able to meet their designated uses due to exceeding water quality standards are considered impaired. Lower

Riley Creek, from Lake Riley to the Grass Lake is included on the MPCA's 2016 Inventory of Impaired Waters (MPCA, 2016). The identified pollutant or stressor for this reach of Riley Creek is turbidity, with aquatic life as the affected designated use.

States must develop a list of impaired waters that require total maximum daily load (TMDL) studies and routinely coordinate with the U.S. Environmental Protection Agency (EPA) for study approval. A TMDL study identifies the maximum amount of a certain pollutant that a body of water can receive without violating water quality standards and allocates that amount to the pollutant's sources. The MPCA began a TMDL study for this impaired reach of Riley Creek in 2014 and is targeted to complete the study in 2019.

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1.4 Past Studies

1.4.1 Lake Riley Outlet Improvements and Riley Creek Lower Valley Stabilization Feasibility Study (2007)

The 2007 Lake Riley Outlet Improvements and Riley Creek Lower Valley Stabilization Feasibility Study (Reference (1)). It examined physical watershed characteristics, hydrologic and hydraulic modeling, watershed slopes, soil types, imperviousness, channel geometry and geomorphology, and erosion processes. The report identified Reach E and Site D3 along the Lower Valley of Riley Creek as high priorities to begin addressing erosion and associated water quality impairments. Specifically, a significant headcut had migrated through the reach, resulting in an incised channel and severely eroding banks. Excerpts from the report relevant to the study reaches is provided in Appendix B.

1.4.2 Creek Restoration Action Strategy (2015)

The RPBCWD completed the Creek Restoration Action Strategy (CRAS) in 2015 (Reference (2)), which created a scoring system to compare restoration potential of all creek reaches within the RPBCWD (i.e. Riley Creek, Purgatory Creek, and Bluff Creek). The creeks were divided into 80 reaches, and the highest scores correspond to the greatest need for stabilization. Reach E of Riley Creek was tied for the highest Tier I CRAS score, which considered the fundamental factors that drive most stream restoration projects including infrastructure risk, stream stability, stream habitat, and water quality. After considering Tier II CRAS categories (public education opportunities, overall watershed benefits, partnerships, and the cost of stabilization per pound of phosphorus "saved"), this reach was tied for the second highest overall score.

As part of the initial scoring of the CRAS, each creek reach was assessed by walking the stream and taking notes and photos. The assessment completed in 2015 by RPBCWD staff noted similar things as was noted in the 2007 Lake Riley Outlet Improvements and Riley Creek Lower Valley Stabilization Feasibility Study (Reference (1)). RPBCWD staff observed a deeply incised and entrenched channel with large, steep eroding valley walls, with one erosion location measured as approximately 50 feet wide and 40 feet tall. RPBCWD staff also noted that the headcuts documented in the 2007 report have migrated upstream such that the upstream reach is also incised and entrenched. The write-up and photos from this assessment can be found in Appendix C.

1.4.3 Strategic Resources Evaluation (2014)

The LMRWD completed a strategic resources evaluation (SRE) in 2014 to assess critical resource areas and recommend management strategies (Reference (3)). The downstream-most portion of Riley Creek, which is within the LMRWD, was included in the SRE. The SRE identified erosion at outside bends where undercut banks and exposed tree roots were observed and also at the downstream end of the box culvert under Flying Cloud Drive, i.e. the upstream portion of this reach. An excerpt from the SRE relevant to the LMRWD reach is presented in Appendix D.

2.0 Problem Identification

In May 2016, site assessments were completed to take measurements and photos to compare current creek conditions to those recorded in the 2007 survey. Potential direct causes of erosion were also considered.

2.1 Geomorphic Assessment

2.1.1 Assessment Methodology

The geomorphic assessment generally followed guidelines and techniques included in the Rosgen classification system (Reference (4)). Rosgen classification uses multiple measurements and ratios to classify a given stream into one of eight different stream types (Figure 2-1). Streams that fall into each stream type typically share many characteristics. One or more measurements that are inconsistent with typical or expected values can help indicate if a stream is stable or unstable.

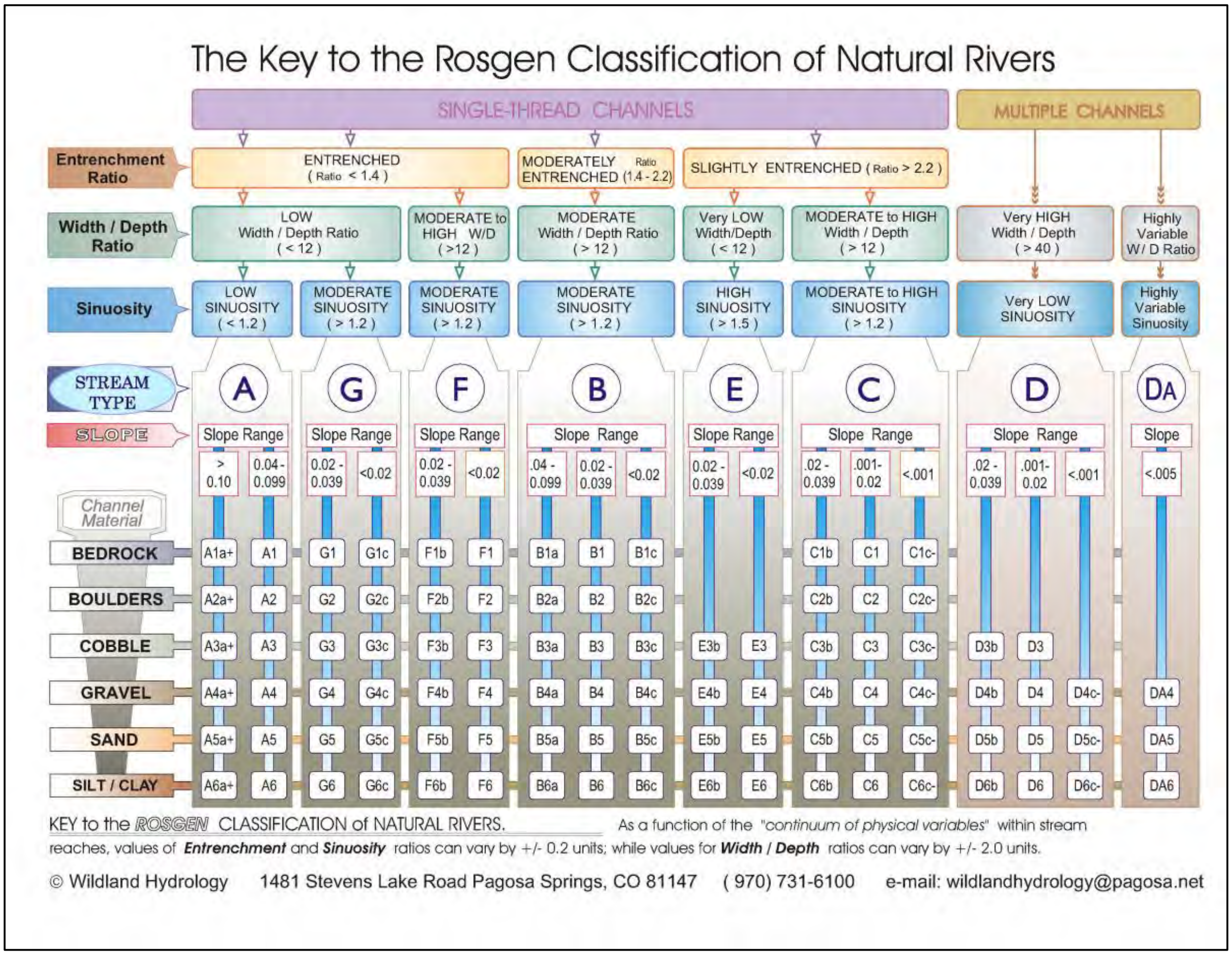

Figure 2-1 Rosgen classification system key (from Reference (4))

As can be seen in Figure 2-1, the Rosgen classification system is dependent on the entrenchment ratio, the width to depth ratio, sinuosity, slope, and bed material. The entrenchment ratio and width-to-depth ratio both use dimensions from the bankfull level for each channel. Bankfull is generally defined as the depth at which flow in the channel just begins to spill into the adjacent floodplain. The flow that results in a bankfull depth is typically between the 1- and 2-year recurring flows, although the exact frequency is dependent on each stream and watershed characteristics. The 1.5-year recurring flow is often used to estimate bankfull flows. The key components of the Rosgen classification system are briefly summarized below:

- *Entrenchment ratio* is the ratio between the bankfull width and the flood prone width. The flood prone width is defined as the width of the floodplain at twice the bankfull depth. This ratio helps described how confined the stream is within its floodplain. A large value indicates a wide floodplain, and a small value indicates a small floodplain.
- The *width-to-depth ratio* is the ratio between the bankfull width and bankfull depth. It provides information about the channel shape.
- *Sinuosity* is the stream length divided by the valley length and provides information about how much the stream meanders through the landscape.
- *Slope* is the average channel slope through the study area.
- *Bed material* characterizes the dominant material and size of material on the channel bottom.

All channel types can be stable in the right site characteristics. In the Twin Cities and central Minnesota, the most common stable channels are Type C and Type E channels. Type C channels are often found in forested areas whereas E channels are often found with grassy riparian areas.

2.1.2 Reach E

Several cross sections were surveyed in 2016. Bankfull indicators found were generally well below the tops of the banks, which typically suggests that the channel is incised. Table 2.1 shows the range of key components of the Rosgen classification system estimated from the field survey.

Table 2.1 Summary of Rosgen classification values for Reach E

Variable	2016 Survey Range
Entrenchment Ratio	1.2 – 6.1
Width-to-Depth Ratio	3.5 – 6.1
Sinuosity	1.2
Slope	0.25% - 1%
Bed Material	Sand

Based on the data in Table 2.1, Reach E is sometimes a Rosgen Type B channel and sometimes a Rosgen Type G channel. Type B channels are primarily found on moderately steep to gently sloping terrain, with the predominant landform seen as a narrow and moderately sloping basin. Type B channels can be stable and are moderately entrenched, display a low channel sinuosity, and often exhibit a streambed that resembles rapids. Type G channels are also known as “gully” stream types found in a variety of landscape settings. G-type channels are entrenched, narrow, and deep with low to moderate sinuosity. Unless containing bedrock and boulder channel materials, G channels have very high bank erosion rates and high sediment supply (Reference (5)). In the 2007 study, multiple cross sections in the reach immediately upstream from this reach of Riley Creek were Rosgen Type C channels, which is the type of channel that would be most expected in this setting. Type C channels have well developed floodplains, can be slightly entrenched, and are relatively sinuous.

Stream survey data was collected in 2016 and compared to similar data collected in 2007 to verify the stream geomorphic changes during this time period. The 2007 survey was conducted during the winter months and included limited data in the upstream portions of the reach below the ice. However, the points available below the ice clearly show that the channel bed has lowered in the upper portions of the reach (approximately the upper 2,500 feet of the reach) while remaining fairly unchanged in the lower section. This survey data correlates with field observations of active erosion and head cutting in the upper section of the study reach. A comparison of cross sections (Figure 2-2) also shows that the channel has lowered since the 2007 survey as it is currently both deeper and wider. Detailed figures showing surveyed locations, longitudinal profile comparison, and all cross section comparisons are included in Appendix E.

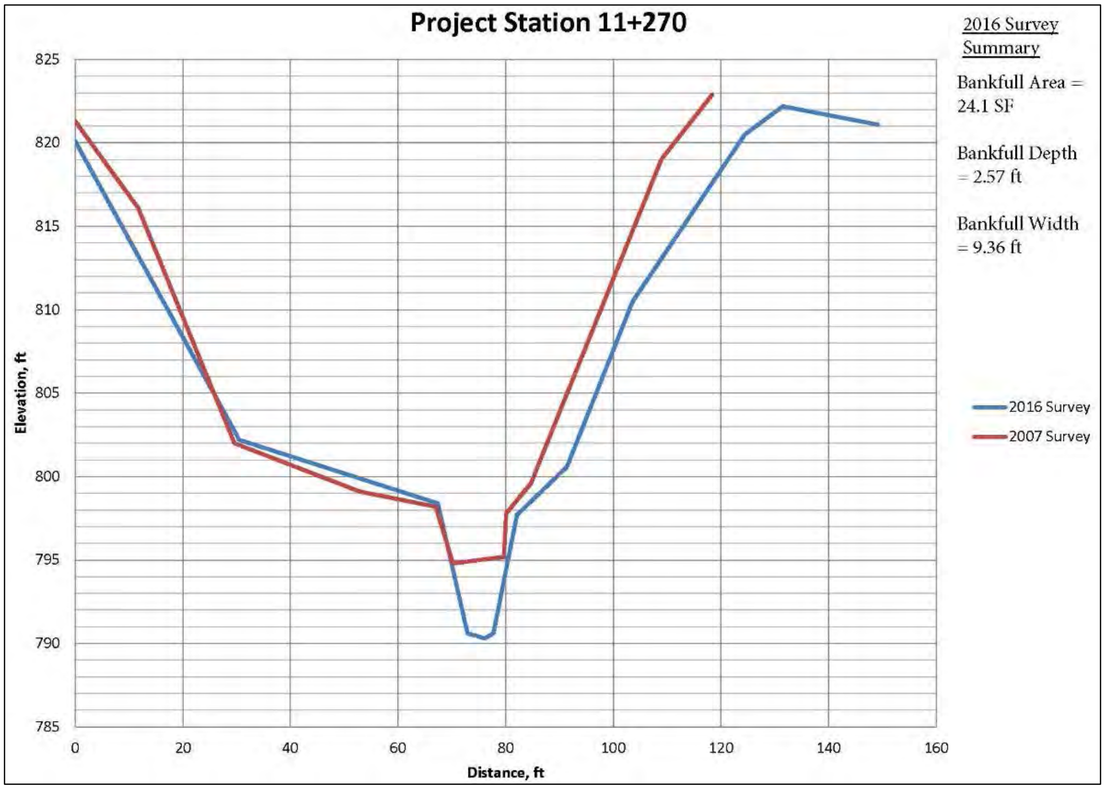

Figure 2-2 Reach E Cross Section Comparison Example

Channel dimensions and ratios were not summarized for Site D3 because the Rosgen classification system is not applicable to this ravine due to the extremely ephemeral nature of this channel. The cause of erosion at Site D3 is flashy stormwater runoff from adjacent residential and park property to a ravine.

2.1.3 LMRWD Reach

The channel within this reach gradually transitions from Flying Cloud Drive to Grass Lake. The upper third is moderately incised and moderately entrenched with some eroding banks. The middle third generally exhibits stable channel dimensions with easy access to a floodplain. The lower third is essentially an alluvial fan with poorly defined channels and evidence of frequent channel migration across the landscape. The channel gradually transitions from a Type B to a Type C and then to an alluvial fan. An alluvial fan is a fan-shaped area of sediment deposition that forms at the downstream end of a stream as the stream transitions from a steep channel slope to flat channel slope. This type of channel transition is expected because there are multiple, major changes to key variables influencing the channel, including floodplain width and influence from backwater from the Minnesota River.

The LMRWD Reach begins at the mouth of the Riley Creek Lower Valley, so the floodplain rapidly expands and flood flows can rapidly expand into the floodplain. As flood flows expand into the floodplain, the velocity in the channel drops and the flow in the channel has a reduced sediment carrying capacity. When this happens, the sediment is deposited in the channel and the channel gradually fills up with sediment.

The Minnesota River is also a major contributor of sediment. The channel within the study reach is located within the 10-year flood elevation for the Minnesota River. The Minnesota River has a high sediment load and deposits a significant amount of sediment on the floodplain during flood events, so sediment deposition from the Minnesota River may also contribute to channel filling in the LMRWD Reach.

Because of the rapid transitions between different channel types, the Rosgen classification dimensions shown in Table 2.2 only show the Rosgen classification values estimated from the 2016 survey data for the upper third of the reach where erosion was evident.

Table 2.2 Summary of Rosgen classification values for LMRWD Reach

Variable	2016 Survey Range
Entrenchment Ratio	1.1-1.3
Width-to-Depth Ratio	5.7-74.4
Sinuosity	1.2
Slope	0.5-1.0%
Bed Material	Sand

2.2 Streambank Erosion

2.2.1 Reach E and Site D3

The initial instability within Reach E was likely caused by the gradual increase in runoff volume and increased peak runoff rates generated by a developing watershed. The bank soils within the Lower Valley are clayey and cohesive, making them somewhat naturally resistant to erosion, particularly if sufficient vegetation is present to provide reinforcement with root masses. Streambanks within this reach are 6 to 10 feet tall, with vertical side slopes that are largely bare of vegetation. A narrow valley concentrates flood flows closer to the channel than in a wide floodplain, thereby generating more erosive pressure on the stream bed and banks, especially during larger storm flows. Due to the channel depth, the creek has limited access to a floodplain. Based on MDNR regional curves (Reference (6)) and USGS regression equations (Reference (7)), Riley Creek should have a mean bankfull depth of 1.5 to 2.5 feet instead of the current 6 to 10 feet. Based on Barr's 2015 PCSWMM model, design flood events up to the 100-yr design storm are largely conveyed within the channel.

At Site D3, the original cause of erosion appears to be concentrated runoff into the ravine from agricultural fields, as shown in Figure 2-3. It appears that the top of the ravine was partially filled and some erosion protection was installed when the current development was built. The adjacent parkland and the back half of seven residential lots along Laforet Drive and Acorn Ridge drain toward the ravine, and the runoff is captured by two berms located near the top of the ravine. A small storm sewer system captures stormwater collected behind the berms and discharges the runoff into the ravine. It is assumed that the current development reduced the drainage area to the ravine and the runoff rates and volume to the ravine have likely been further reduced by the berms installed to intercept runoff at the top of the ravine. However, erosion has continued, as evidenced by undermining of the riprap installed at the storm sewer outlet. The storm sewer outlet is still located high enough within the ravine that the discharge causes erosion of the ravine bed. High velocities from the culvert (12 to 13 feet per second) combined with the steep channel slope of the ravine (11 percent slope) to cause continual erosion downstream of the culvert outfall. The invert of the ravine is actively eroding, creating scarps and adding sediment load to Riley Creek.

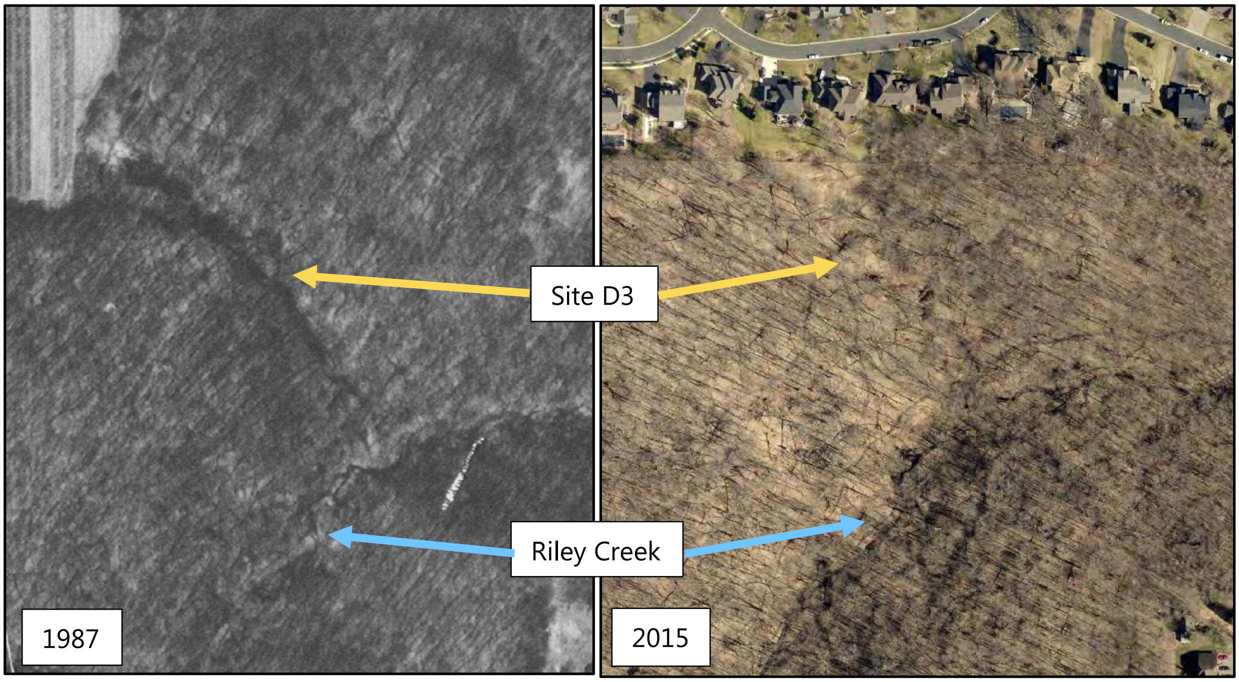

Figure 2-3 Aerial images of Site D3 from 1987 and 2015 (from figures in Appendix F)

2.2.2 LMRWD Reach

At the beginning of this study reach, there is evidence of channel downcutting as the culvert until Flying Cloud Drive is perched by approximately two feet. The downcutting is likely caused by the combination of high velocities entering this reach through concentrated flows through the culvert. The channel banks are nearly 6 to 8 feet tall near Flying Cloud Drive with steep side slopes that are largely bare of vegetation. The channel bank heights slowly decline as Riley Creek approaches Grass Lake. Due to the depth of the channel, the creek has limited access to the floodplain especially near Flying Cloud Drive. Based on MNDNR regional curves and USGS regression equations, Riley Creek should have a mean bankfull depth of approximately 2 to 3 feet in this area instead of the current 6 to 8 feet.

3.0 Additional Assessments and Investigations

3.1 Vegetation Assessment

A vegetation assessment was completed during July 2016 to determine the vegetation composition of the riparian areas along the study reaches.

3.1.1 Reach E and Site D3

The plant community surrounding the creek in Reach E and Site D3 is a densely wooded hardwood forest with a nearly continuous canopy cover (90-100%) dominated by sugar maple (Acer saccharum), northern red oak (*Quercus rubra*), and basswood (*Tilia Americana*) tree species. The hardwood forest is indicative of the local southern mesic maple-basswood forests of this region. Other canopy and subcanopy tree species found commonly throughout the upper reach include ironwood (*Ostrya virginiana*), black cherry (*Prunus serotina*), bitternut hickory (*Carya cordiformis*), and hackberry (*Celtis occidentalis*). The ground-layer cover is interrupted to continuous (30-100%) with large bare patches on heavily eroded slopes closer to the stream bank. Wood nettle (*Laportea canadensis*) is the dominant ground cover species covering 80-100% of the ground-layer along large stretches of the reach. Other native plant species found frequently throughout the reach included wild ginger (*Asarum canadense*), Pennsylvania sedge (*Carex pensylvanica*), bloodroot (*Sanguinaria canadensis*), riverbank rye (*Elymus riparius*), and golden glow (*Rudbeckia laciniata*).

Invasive species as listed by the Minnesota Department of Natural Resources (DNR) can be found throughout Reach E but not in large or dense stands. Mature glossy buckthorn (*Rhamnus cathartica*) is found in the subcanopy layer with plants ranging from 3-8′ in height. Canada thistle (*Cirsium arvense*) is also found in small openings in the canopy layer.

3.1.2 LMRWD Reach

While Reach E was dominated by hardwood forest plant species the LMRWD Reach is dominated by species indicative of southern floodplain forests. Starting south of Flying Cloud Drive the canopy cover is interrupted to continuous (50-100%) with silver maple (*Acer saccharinum*), cottonwood (*Populus deltoids*), and boxelder (*Acer negundo*) trees. In areas densely shaded by buckthorn, boxelder, and riverbank grapes (*Vitis riparia*) exposed soil with little groundcover is present. Along the creek bank in sunnier locations native species including goldenglow, marestail (*Conyza canadensis*), jewelweed (*Impatiens capensis*), stinging nettle (*Urtica dioica*), and White Grass (*leersia viginica*) form dense cover down to the creek's edge (fig 4). Found near the creek's edge are some small (>200 sf) reed canary grass (*Phalaris arundinacea*) patches. Reed canary grass is a highly aggressive plant listed as an invasive species by the DNR. As the creak approaches Grass Lake the topography flattens out into a floodplain with nearly continuous canopy cover (90-100%) dominated by mature silver maple and black willow (*Salix nigra*) trees. There is no subcanopy or shrub layer near Grass Lake. Ground-layer cover is vegetated by flood-tolerant annual and perennial species dominated by wild rye (*Elymus virginicus*), white grass, false nettle (*Boehmeria cylindrical*), Canada thistle, and plantain (*Plantago major*).

3.2 Geotechnical Assessment

A basic geotechnical assessment was completed in June 2016 to get a preliminary assessment of the scarps located in Reach E and to guide the development of stabilization concepts. The assessment was focused on Reach E due to the tall scarps, steep slopes, and challenging construction access, particularly within Sub-reach E2. The geotechnical concepts for Reach E can be applied to Site D3, although due to shorter slopes and scarps and easier site access, construction at Site D3 is less challenging than Reach E. The height of slopes and scarps within the LMRWD reach are more typical of stream bank heights and do not pose a challenging geotechnical stability issue. Therefore, the geotechnical assessment was not completed in the LMRWD reach.

The assessment was limited to visual surveys of the scarps and did not include hand augers, soil borings or geotechnical modeling. The exposed soil of the existing scarps showed a mix of sand and clay within the soil profile. Recent slumps were observed in some locations. The distances from the tops of the scarps to homes and structures were noted and due to the relatively long distances, scarp erosion does not appear to pose a threat to homes or structures in the area in the foreseeable future. Old scarps that had stabilized enough to be partially revegetated were also observed within the reach. It was also noted that other portions of the reach have steep valley slopes that are not currently eroding; however the right conditions in the future may result in a slope failure, even if the channel has been stabilized. Wet periods, heavy storms, or a combination of the two can create saturated slopes that result in failures. An uprooted tree can also change the dynamics of the slope to make it more susceptible to an isolated failure that could then grow over time.

Due to the scarp dimensions and relatively difficult access for heavy equipment, it was assumed that the design and installation of measures that would result in geotechnical stable slope would be extremely expensive for each scarp and unlikely to be a feasible given the lack of a near-term threat to homes or structures. Alternative measures to slow or significantly reduce scarp erosion were discussed, including options for stabilizing the toes of the scarps and grading some portions of the scarps to create slopes less susceptible to erosion, thereby allowing vegetation to become re-established.

3.3 Phase I Environmental Assessment

3.3.1 Reach E and Site D3

A Phase I Environmental Site Assessment (Phase I) was performed in May 2016 to identify recognized environmental conditions (RECs) associated with the Project area. The Phase I consisted of a records review, site reconnaissance, and local interviews. No RECs were identified in connection with the Project area (Reference (6)). The Phase I report is included as Appendix F.

3.3.2 LMRWD Reach

A Phase I was not completed for the LMRWD Reach of Riley Creek. Some debris from what appears to be old household dumping (bicycles, washing machines, etc.) was observed along portions of the streambank. A Phase I environmental assessment is recommended during the early portion of the design phase to identify potential soil contamination that would require treatment or off-site disposal.

3.4 Historic and Cultural Resources

A Phase I archaeological field survey for Reach E, Site D3, and the LMRWD Reach was completed in June 2016 to determine if these reaches might require further investigation for cultural or historical importance. A records/literature search was completed prior to the field survey using the Minnesota State Archaeological Site Files at the Office of the State Archaeologist, the database files of the State Historic Preservation Office, and several historic maps. The field survey included pedestrian visual surface reconnaissance, followed by 10 shovel tests. No cultural materials other than those that can be reliably associated with present-day use of the area were identified in the surveyed areas (Reference (6)).

Based on the negative results of the field survey, it is unlikely that the proposed project would adversely affect any significant intact cultural features or deposits. The cultural resources report, is included as Appendix G.

3.5 Wetlands

The study reaches were evaluated for wetlands and other waters of the U.S. on June 16-17, 2016. The wetland delineation was completed in accordance with the Routine On-Site Determination Method specified in the U.S. Army Corps of Engineers Wetlands Delineation Manual (1987 Edition) (Reference (8)) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Reference (9)). The field delineation is necessary to meet requirements of a USACE Section 404 Permit, MnDNR Public Waters permitting, and the Wetland Conservation Act.

One section of Riley Creek and one wetland were identified within the Reach E and Site D3 project area. The creek reach was delineated as a linear waterway and classified as a R2UBH linear waterway according to the Cowardin system (Reference (10)). Riley Creek is also identified as a public watercourse in the MnDNR's Public Water Inventory (PWI).

One wetland was delineated adjacent to Reach E, near the downstream end of the reach. This wetland is an excavated stormwater pond and was classified as a PUBGx shallow open water basin approximately 0.38 acres in size.

One wetland was delineated adjacent to the LMRWD Reach of Riley Creek. This wetland is floodplain of the Minnesota River and was classified as a PFO1A floodplain forest wetland which extends beyond the surveyed area. The full wetland delineation report, including figures and field data sheets, is included as Appendix H.

4.0 Stabilization Options, Evaluation Criteria and Cost Consideration

4.1 Stabilization Options

When selecting alternatives for detailed design and construction, RPBCWD, LMRWD, and the city of Eden Prairie may select differing approaches at each site (even sites with similar characteristics) to best meet the overall project goals. As a result, there are a large number of possible combinations of alternatives that would provide stabilization benefits throughout the entire project area. Furthermore, detailed design efforts may identify and include stabilization techniques or combinations of techniques that are not specifically included in this engineer's report.

4.1.1 Bioengineering and Hard Armoring Stream Stabilization Techniques

Techniques for stream stabilization generally fall into two categories: bioengineering (also known as soft armoring) and hard armoring. Bioengineering techniques employ biological and ecological concepts to control erosion, using vegetation or a combination of vegetation and construction materials, including logs and boulders. Techniques that do not use vegetative material but are intended to achieve stabilization of natural flow patterns and create in-stream habitat, such as boulder or log vanes, are generally included under the umbrella of bioengineering. Hard armoring techniques include the use of engineered materials such as stone (riprap or boulders), gabions, and concrete to stabilize slopes and prevent erosion.

Bioengineering techniques maintain more of a stream's natural function and provide better habitat and a more natural appearance than hard armoring. If vegetation is well-established this approach can also be self-maintaining. Due to biodegradation of construction materials and variable vegetation establishment success, it is typically assumed that bioengineering installations have a shorter life span and may need more frequent (if less expensive) maintenance, particularly as the vegetation is becoming established. Compared to hard armoring, the success of bioengineering techniques is more dependent on the skill of the designer and installer—sometimes making bioengineering construction more expensive. Hard armoring and bioengineering techniques present different challenges, costs, and benefits for stream stabilization design.

Hard armoring methods are viewed as standard and time-tested and typically have a longer life span due to the permanence of the materials used. Hard armoring is usually effective in preventing erosion where it is installed; however, placement must consider downstream impacts, understanding that the armoring may push the erosive stresses downstream. Hard armoring typically requires little maintenance; however, if the armoring fails, maintenance or replacement can be expensive, particularly if the armoring materials need to be removed from the site.

Technical stakeholders, including the USACE and MDNR, have expressed a preference for bioengineering over hard armoring for stream stabilization where possible. The RPBCWD Rules (Rule F) include specific language requiring that a preference be made for natural materials and bioengineering over hard armor.

4.1.2 Stream Vortex Tubes

Some stream stabilization techniques are neither hard armoring nor bioengineering. Stream Vortex Tubes are an example of a stream stabilization technique that does not fit into either category. The Stream Vortex Tube removes sediment from a stream channel and stores it in an off-channel basin. An open-top pipe is placed in the stream so that flow over the top of the opening is forced into a vortices thereby removing sediment from the water. This sediment is conveyed along the pipe into a pond. The sediment could be used as a commercial product for road base, surfacing, and material processing.

4.1.3 Floodplain Reconnection

In addition to reducing sediment loading through streambank stabilization with bioengineering methods, hard armoring or establishment of vegetation/toe protection, alternatives that improve access to the floodplain by raising the stream bed or excavating the floodplain would further improve the conditions by effectively lowering the depth of water in the channel during storm events. Shear stress on the channel bed and banks correlates with the depth of water in the channel, therefore a lower water depth results in reduced channel erosion.

4.1.4 Stream Stabilization Techniques Evaluated

The following stream stabilization techniques were evaluated for stabilizing Riley Creek within the project area. Example figures and additional descriptions for selected techniques are included in Appendix I.

Bioengineering techniques evaluated

- Active floodplain/vegetated bench—modifications made to the stream cross section to increase floodplain connectivity and decrease erosive stress during flood flows; can involve construction of a soil bench, lowering an existing bench, and/or raising the channel bed
- Boulder or log vane—boulders or large logs buried in the stream bed and extending partially ("vanes") or entirely across the stream ("cross vanes") to achieve one or more of the following goals: re-direct flows away from banks, encourage sediment deposition in selected areas, control stream bed elevations, and create scour pool habitat features
- Constructed riffle—gravel or cobble material installed in the stream bed to create natural flow patterns/varied habitat features and, frequently, to control stream bed elevations
- Vegetated buffer—native vegetation established along a stream bank or overbank area to stabilize bare soils and increase resistance to fluvial erosion
- Vegetated reinforced slope stabilization (VRSS)—soil lifts created with long-lasting, biodegradable fabric and vegetated to stabilize steep slopes and encourage establishment of root systems for further stabilization
- Root wads or toe wood—tree trunks with the root ball attached, installed either singly (root wads) or in conjunction with additional large woody debris and VRSS (toe wood) to achieve one or more of the following goals: increase bank roughness and resistance to erosion, create

undercut/overhanging bank habitat features, re-direct flows away from banks, and provide a bench for establishment of riparian vegetation

- Scarp Toe Stabilization – vertical cedar pilings placed one foot on center along the toe of the actively eroding scarp and extending approximately 2 feet above the channel bed. Salvaged trees are installed longitudinally on the landward side of the cedar pilings. The combined structure would reduce further erosion of the scarp toe and provide a bench for scarp material to deposit, eventually reducing the slope of the scarp and allowing for the scarp revegetation.
- Scarp Stabilization – intended to be constructed in conjunction with Scarp Toe Stabilization, this technique involves grading of the scarp to a stable slope (3:1 or 2:1), installation of erosion control blanket, and establishment of erosion resistant vegetation.

Hard armoring techniques evaluated

- Riprap-lined channel—riprap throughout an entire channel cross section to control stream bed elevations and prevent erosion
- Stone toe protection—riprap or other stones along the lower portion of a stream bank to protect against erosion
- Riprap slope stabilization—riprap along a steep slope to protect against erosion and prevent undercutting and slumping

4.2 Evaluation Criteria

Specific stabilization measures should be selected and designed based on expected velocities and shear stresses within the channel for all sites and reaches. Published threshold values for stabilization measures can be used to make final selection of stabilization criteria. Examples of published threshold criteria are presented in Table 4.1.

Table 4.1 Published threshold values for selected stabilization techniques

Stabilization Technique	Allowable Velocity (fps)	Allowable Shear Stress (lbs/ft^2)
Sandy loam soil[a]	1.75-2.25	0.045-0.05
Stiff clay[a]	3-4	0.26
Riprap (12-in D_{50})[a,b]	10-13	5.1
Riprap (24-in D_{50})[a,c]	14-18	10.1
Rootwads[d]	N/A	N/A

a – from Reference (11)

b – for use in constructed riffles and grade control

c – for use in rock vanes

d – design and installation guidelines in Reference (12)

4.3 Cost Considerations

This section presents the general methodology used to develop an engineer's opinion of probable cost (OPC) of the evaluated alternatives. The OPC estimates have been developed for each alternative evaluated. OPC estimates are considered Class 4 feasibility-level estimates as defined by the American Association of Cost Engineers International (AACI International). The Class 4 level OPC estimates typically have an acceptable range of between -15% to -30% on the low range and +20% to +50% on the high range. Based on the development of concepts and initial vetting of the concepts by the RPBCWD, LMRWD, city of Eden Prairie, and MnDNR, a range for the OPC estimate between -15% and +20% of the estimated construction budget was used for budgeting. The cost estimates for each stabilization measure, including the quantities and unit costs, are included in Appendix J. These costs were combined with respective pollutant load reduction (sediment and TP) estimates to estimate the efficiency of each alternative in terms of dollars per pound of pollutant removed.

- The OPC's incorporate a 15% construction contingency.
- Costs associated with design, permitting, and legal services is assumed to be 20% of the estimated construction costs (excluding contingency).
- Costs associated with construction management are assumed to be 7% of the estimated construction costs (excluding contingency).
- Construction easements may be necessary to construct the project; however, the cost is expected to be negligible.
- Additional work may be required to determine if cultural and/or historical resources are present at any project site.

4.3.1 Off-site Sediment Disposal

Based on the results of the Phase I assessment (Appendix F) for Reach E and Site D3, it is assumed that a Phase II assessment of bank material would not be necessary and that sediment disposed off-site, if necessary, would not require additional testing or special disposal as hazardous or dredged material. As such, these costs are not included in the estimates.

4.3.2 Wetland Mitigation

Stream banks may meet wetland designation criteria; disturbing the banks as part of a restoration project may be considered a temporary wetland impact. However, because the purpose of stream bank repair and restoration is to create a stable bank that can support a riparian ecosystem, the impacts are typically considered to be self-mitigating and do not usually require additional costs for wetland mitigation. As such, these costs are not included in the estimates.

4.3.3 Tree Replacement and Revegetation

It is assumed that the city of Eden Prairie would determine where tree replacements would be desired (based on estimated tree removals and long-term land use plans) during final design. For the cost estimate, tree replacements are assumed to be equal to tree removals. It may be desirable to open the canopy to assist vegetation reestablishment by providing additional sunlight to the understory. As such, tree replacements along the entire project reach may not be desirable. Because many portions of the project reach have significant shade cover, the costs of shade-tolerant species (shrubs and grasses), appropriate site preparation, seeding, and maintenance to establish the vegetation are included in the cost estimate.

4.3.4 Annualized Pollutant Reduction Costs

Estimated annual loading reductions for TSS and TP are based on the assumption that an alternative is successful in reducing bank erosion at each site to a nominal rate of 0.01 feet per year—representative of a well-vegetated stable bank with very low to low near-bank erosive stress. The annualized pollutant-reduction cost for an alternative is the annual load reduction divided by the annualized cost. Annualized pollutant-reduction costs for all alternatives considered in this study are provided in Table 5.3 and Table 5.4.

4.3.5 Easements

4.3.5.1 Reach E and Site D3 Cost Considerations

Most of the project is located on property owned by the city of Eden Prairie or in areas where the City has access easements. The costs associated with easements on city property are typically negligible; no costs for temporary construction easements are included in this estimate.

4.3.5.2 LMRWD Easements

Much of the LMRWD Reach is surrounded by private land. An existing agreement is in place between the landowner and the Met Council for access to the Riley Creek stream gage station; however, the location of this easement is not conducive to construction of the stabilization measures. Stabilization activities would likely require a new easement with the landowner for construction and maintenance activities.

4.3.6 Miscellaneous Costs

Most site costs include miscellaneous items needed during construction (e.g., a rock construction entrance, a filter dike to control in-stream sediment disturbance, and restoration of access paths). Based on previous project experience, the cost estimates include some overage that could be applied to these miscellaneous items.

5.0 Stabilization Alternatives and Additional Considerations

5.1 Stabilization Alternatives

This section described stabilization alternatives developed for each reach or sub-reach of Riley Creek evaluated in this report, including Site D3, Sub-reach E1, Sub-reach E2, Sub-reach E3, and the LMRWD Reach. Table 5.1 provides a summary of the project alternatives for each reach. Additional descriptions follow in the sections below.

Table 5.1 Summary of Project Alternatives for Reach E and Site D3

Reach	Alternative	Description	Total Project OPC[1] and Range[2]
Site D3	A	Additional culvert Outlet structure	$173,000 ($147,000-$208,000)
	B	Ravine Stabilization	$289,000 ($246,000-$347,000)
E1	A1	4 rock riffles, 2 scarp toe stabilizations	$305,000 ($259,000-$366,000)
	A2	4 rock riffles, 2 scarp toe stabilizations, 2 scarp surface stabilizations	$312,000 ($265,000-$374,000)
	B1	4 cross checks, floodplain excavation, channel fill, 2 scarp toe stabilizations	$635,000 ($540,000-$762,000)
	B2	4 cross checks, floodplain excavation, channel fill, 2 scarp toe stabilizations, 2 scarp surface stabilizations	$641,000 ($545,000-$769,000)
E2	A1	3 rock riffles, 7 scarp toe stabilizations	$499,000 ($424,000-$599,000)
	A2	3 rock riffles, 7 scarp toe stabilizations, 7 scarp surface stabilization	$554,000 ($471,000-$665,000)
	B1	3 cross checks, floodplain excavation, channel fill, 7 scarp toe stabilizations	$656,000 ($558,000-$787,000)
	B2	3 cross checks, floodplain excavation, channel fill, 7 scarp toe stabilizations, 7 scarp surface stabilizations	$711,000 ($604,000-$853,000)
E3	A1	3 rock riffles, 2 scarp toe stabilizations	$349,000 ($297,000-$419,000)
	A2	3 rock riffles, 2 scarp toe stabilizations , 2 scarp surface stabilizations	$360,000 ($306,000-$432,000)
	B1	3 cross checks, floodplain excavation, channel fill, 2 scarp toe stabilizations	$772,000 ($656,000-$926,000)
	B2	3 cross checks, floodplain excavation, channel fill, 2 scarp toe stabilizations, 2 scarp surface stabilizations	$781,000 ($664,000-$937,000)

1 – Includes estimated construction costs, a 15% contingency, 7% of construction costs for construction observation, and 20% of construction costs for engineering, design, permitting, and legal.

2 – A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for design, permitting, and legal, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

5.1.1 Site D3 Alternatives

5.1.1.1 Alternative A – Additional Culvert and Outlet Structure

Alternative A would include constructing an additional culvert and outlet structure to convey runoff originating from the upstream residential area directly to the Riley Creek channel (Figure 5-1). The outlet structure would consist of a manhole designed to dissipate the majority of the runoff's energy before it exits the structure. Some riprap would be necessary to stabilize the stream bed and bank in the vicinity of the new outlet. Runoff originating from the ravine's immediate contributing area would still be allowed to flow down the ravine channel, similar to predevelopment conditions. Natural stabilization of the eroded scarps and stream channel is expected as the flow rate and volume would be reduced by the new culvert.

The additional length of culvert associated with Alternative A would allow stormwater to outlet at the Riley Creek channel than the existing outfall structure. This, in turn, would reduce the volume of water currently conveyed through the surface channel of the ravine. The ravine would continue to convey surface runoff from the immediate contributing area as it did naturally prior to development, and the actively eroding areas would be allowed to naturally stabilize. This work would retain the hydraulic capacity of the ravine without raising water levels. However, culvert installation would require considerable excavation and may be challenging due to the current meandering pattern of the ravine.

Though considerable excavation would be required to properly install the pipe, Alternative A is feasible and would provide a natural surface condition for ravine stabilization. The drop structure/energy dissipation structure could be constructed within a manhole, minimizing the impact to Riley Creek.

The OPC of Alternative A ranges from $147,000 to $208,000.

5.1.1.2 Alternative B – Ravine Stabilization

Alternative B would include stabilizing the ravine through the use of riprap, cross checks, scarp toe stabilization and scarp stabilization (Figure 5-2). The existing riprap outfall would be reconstructed. Eight boulder cross vanes would be installed in the lower two-thirds of Site D3 to provide ravine bottom stability and manage velocities through the ravine. Alternative B would also include stabilization of scarps and their toe adjacent to Site D3 and be more natural than Alternative A.

Alternative B provides a less complex, readily feasible solution that design engineers and contractors commonly use in ravine stabilization; however, riprap stabilization of the culvert outfall is not considered a natural solution and may not be aesthetically pleasing within the natural setting of the RCCA. The use of cross vanes could raise the flood stage in the ravine, requiring additional mitigation measures.

The estimated OPC of Alternative B ranges from $246,000 to $347,000.

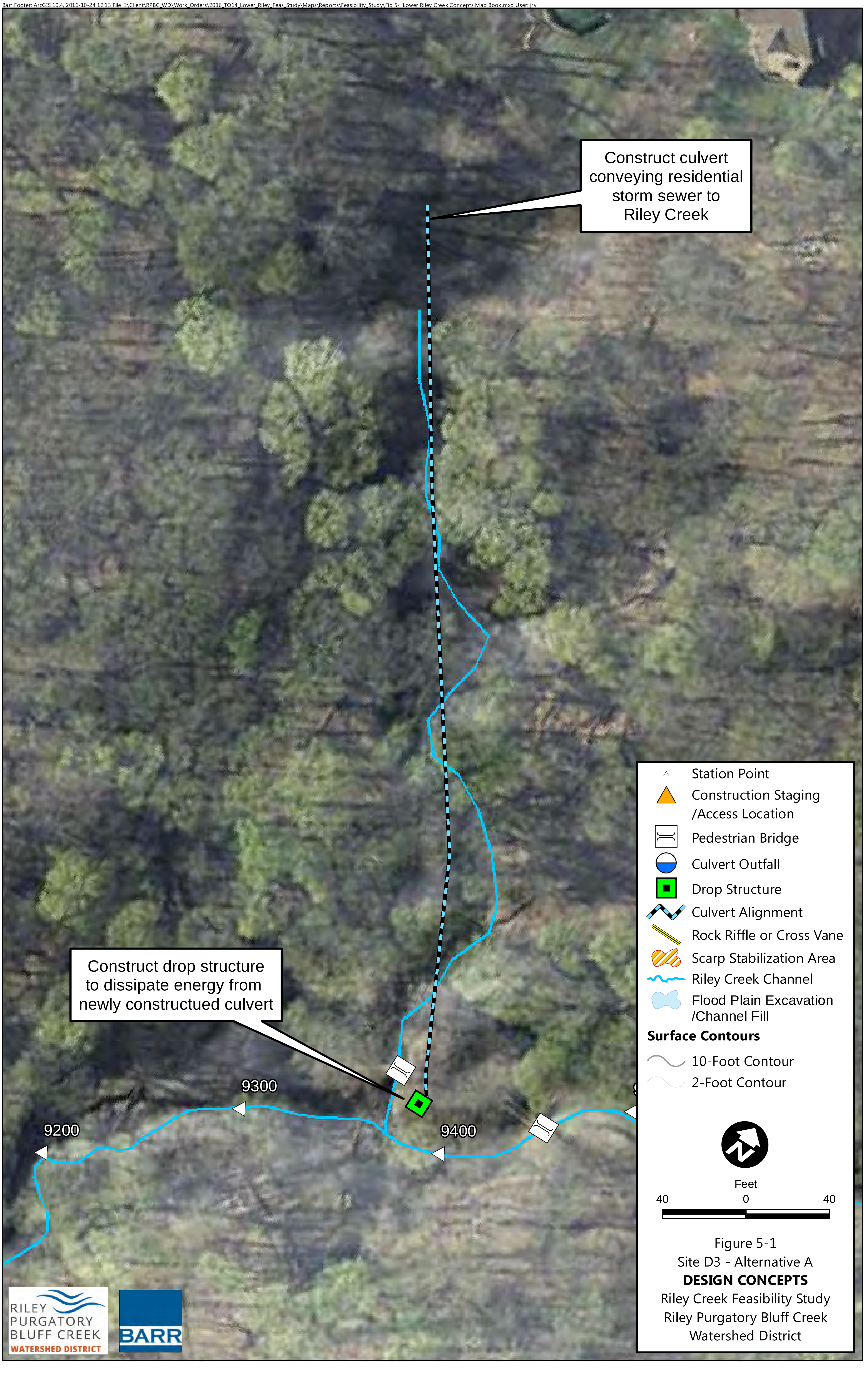

Figure 5-1
Site D3 - Alternative A
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

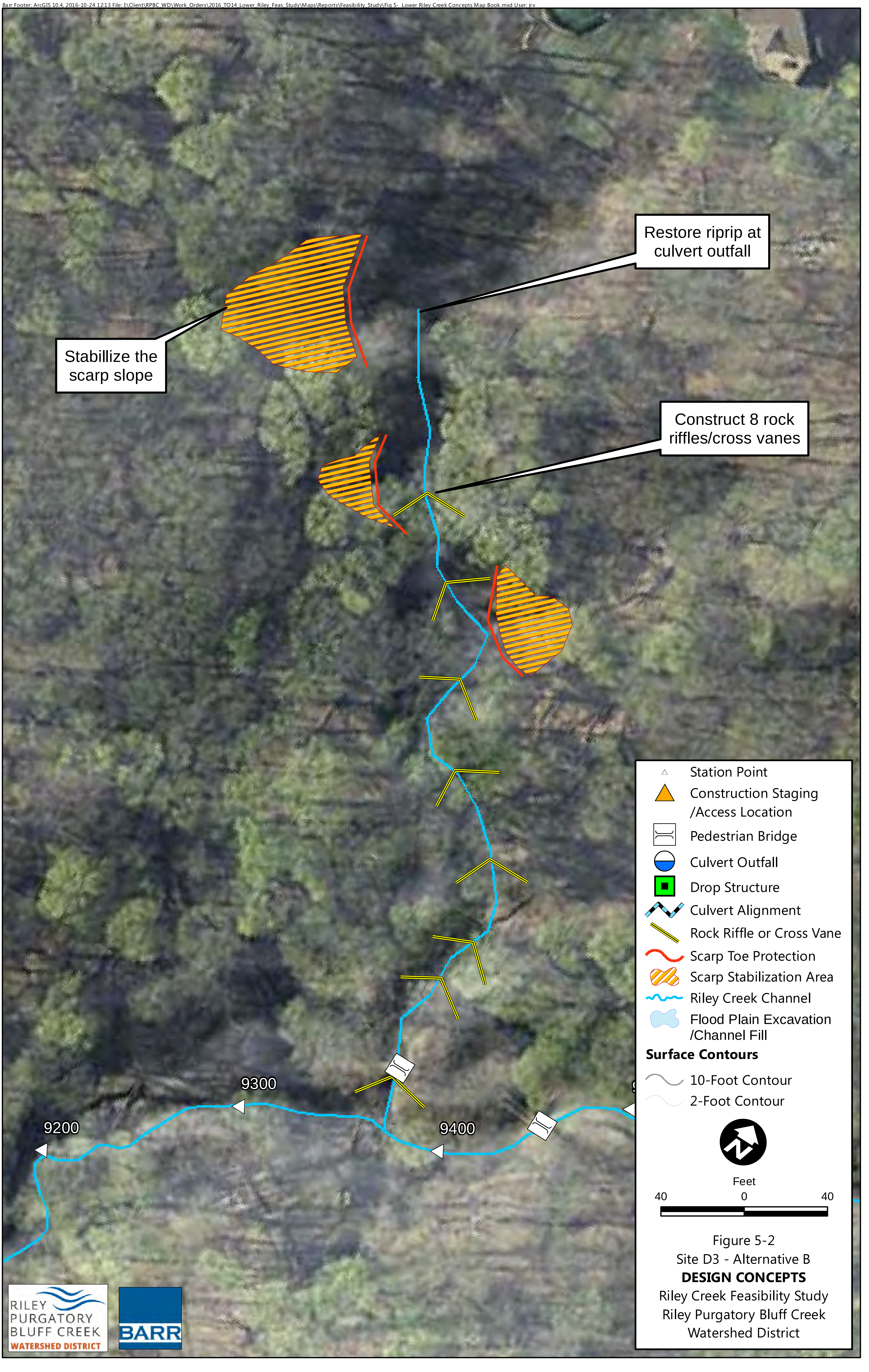

Figure 5-2
Site D3 - Alternative B
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

5.1.2 Sub-reach E1 Alternatives

Two primary alternatives have been developed for Sub-reach E1, each of which contains two variations on the primary stabilization theme.

5.1.2.1 Alternative A1 – Rock Riffles and Scarp Toe Stabilization

Alternative A1 for Sub-reach E1 would include installation of four rock riffles, each approximately three-feet tall. Sedimentation upstream of each rock riffle would naturally raise the channel bed to better match the appropriate bankfull depth and facilitate reconnection of the stream with the floodplain. Alternative A1 would also include stabilizing two active scarp toes to reduce active erosion within the reach (Figure 5-3). Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Sub-reach E1, Alternative A1 would limit the construction footprint and the need for tree removal within the project area. Preliminary hydraulic modeling indicates that raising the bed by three feet would not cause impacts outside of the project reach. Even though design flood impacts are anticipated to be contained within the project reach, raising the design flood level within the project reach could pose permitting challenges. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E1, Alternative A1 ranges from $259,000 to $366,000.

5.1.2.2 Alternative A2 – Rock Riffles, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative A2 for Sub-reach E1 is very similar to Alternative A1 for this reach in that it would include installation of four, three-foot tall rock riffles and would also stabilize two scarp toes. However, Alternative A2 for Sub-reach E1 would also include stabilization of the two scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-3).

Alternative A2 has similar advantages and challenges to those presented with Alternative A1 of Sub-reach E1; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E1, Alternative A2 ranges from $265,000 to $374,000.

Barr Footer: ArcGIS 10.4, 2016-10-24 12:13 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Feasibility_Study\Fig 5- Lower Riley Creek Concepts Map Book.mxd User: jrv

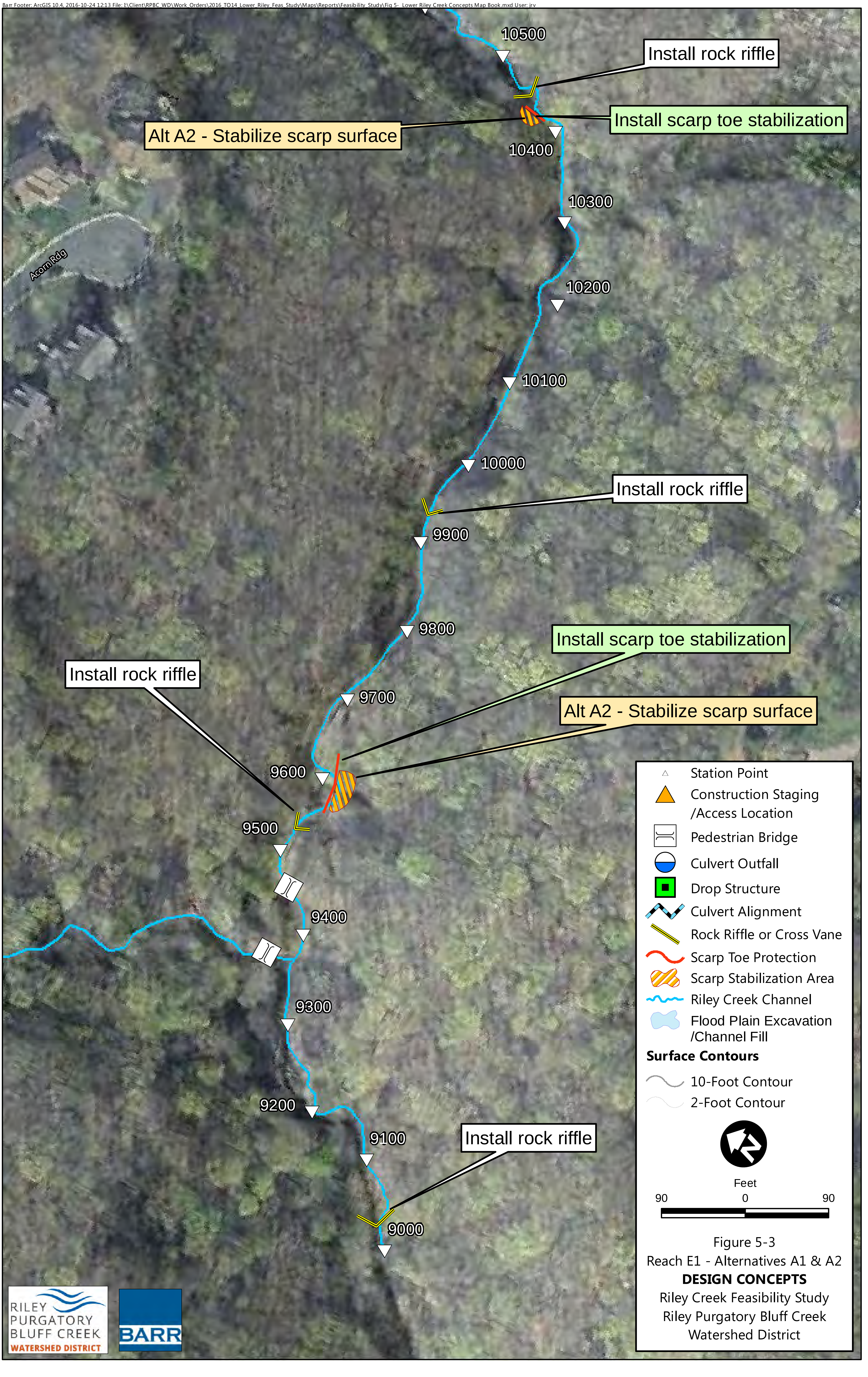

Figure 5-3
Reach E1 - Alternatives A1 & A2
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

5.1.2.3 Alternative B1 – Cross Checks, Floodplain Excavation, Channel Fill, and Scarp Toe Stabilization

Alternative B1 for Sub-reach E1 would include clearing and grubbing the floodplain adjacent to the Riley Creek channel, then excavating approximately two-feet of material from the floodplain. The excavated material would be placed in the existing channel to raise the bed approximately two-feet. Four, one-foot tall cross check structures would be installed in Riley Creek (Figure 5-4). Raising the channel bed would facilitate reconnection of the stream with the floodplain and the cross checks would focus the stream energy away from the banks and minimize potential degradation of the stream bottom. Alternative B1 would also include stabilizing two active scarp toes to reduce active erosion within the reach. Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Alternative B1 would approximately balance floodplain excavation and channel fill, simplifying project permitting and mitigates impacts to the design flood elevation. However, excavating the floodplain would require significant removal and disturbance of trees and vegetation along the channel. Such a disturbance in the floodplain would also create a vulnerability to erosion until vegetation is completely re-established. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E1, Alternative B1 ranges from $540,000 to $762,000.

5.1.2.4 Alternative B2 – Cross Checks, Floodplain Excavation, Channel Fill, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative B2 for Sub-reach E1 is very similar to Alternative B1 for this reach in that it would include clearing, grubbing, and excavating the floodplain, and then placing the excavated material in Riley Creek to raise the bed approximately two-feet. Alternative B2 would also include installation of four, one-foot tall cross check structures in Riley Creek and stabilization of two scarp toes. However, Alternative B2 for Sub-reach E1 would also include stabilization of the two scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-4).

Alternative B2 has similar advantages and challenges to those presented with Alternative B1 of Sub-reach E1; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E1, Alternative B2 ranges from $545,000 to $769,000.

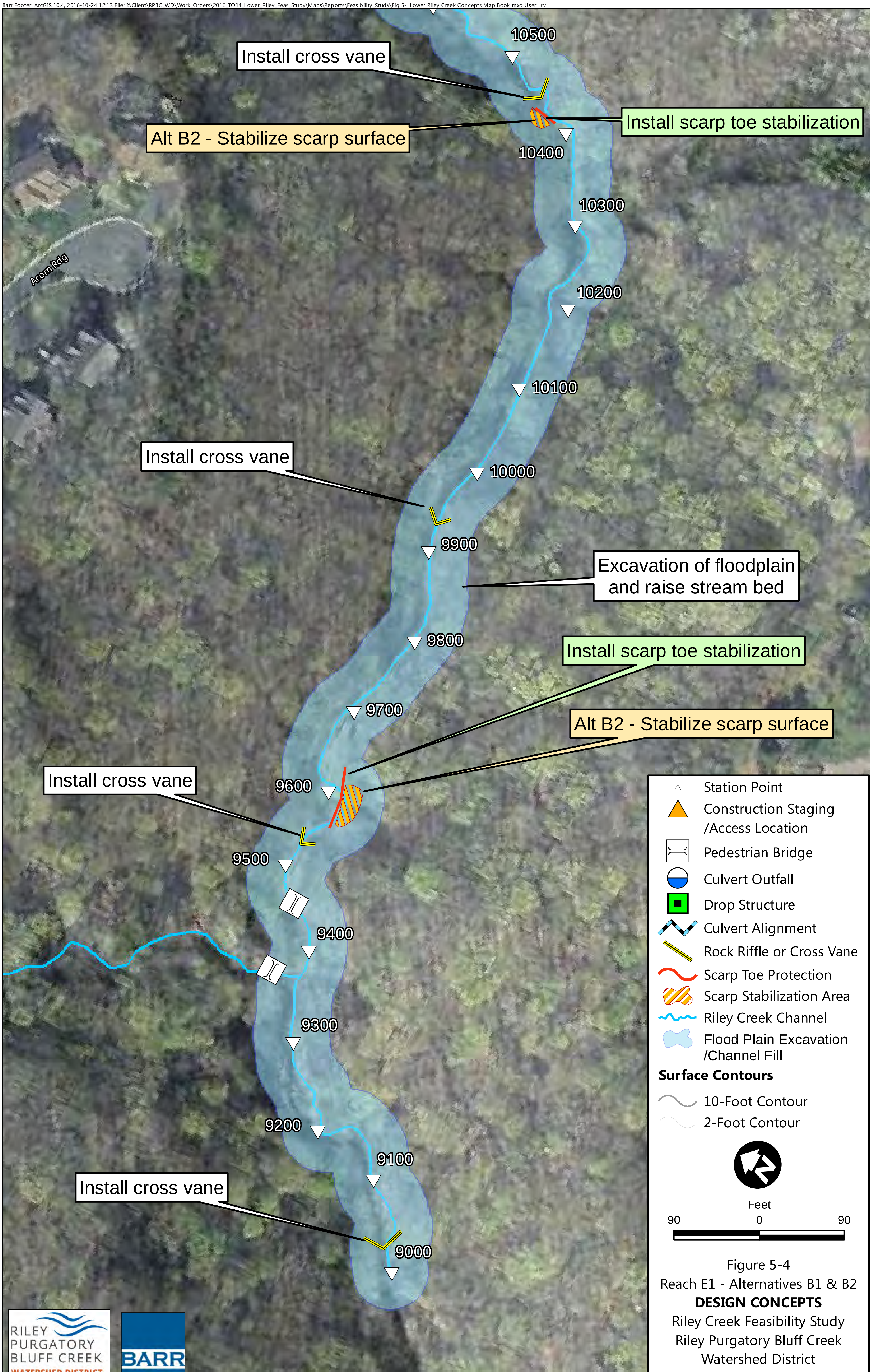

Figure 5-4
Reach E1 - Alternatives B1 & B2
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

5.1.3 Sub-reach E2 Alternatives

Two primary alternatives have been developed for Sub-reach E2, each of which contains two variations on the primary stabilization theme. All sub-reach E2 alternatives would raise the channel bed. As such, the culvert outfall in this sub-reach may need to be raised and re-stabilized. This culvert modification would need to be evaluated regardless of alternative selected.

5.1.3.1 Alternative A1 – Rock Riffles and Scarp Toe Stabilization

Alternative A1 for Sub-reach E2 would include installation of three rock riffles, each approximately three-feet tall. Sedimentation upstream of each rock riffle would naturally raise the channel bed to better match the appropriate bankfull depth and facilitate reconnection of the stream with the floodplain. Alternative A1 would also include stabilizing seven active scarp toes to reduce active erosion within the reach (Figure 5-5). Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Sub-reach E2, Alternative A1 would limit the construction footprint and the need for tree removal within the project area. Preliminary hydraulic modeling indicates that raising the bed by three feet would not cause impacts outside of the project reach. Even though design flood elevation impacts are anticipated to be contained within the project reach, raising the design flood level within the project reach could pose permitting challenges. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E2, Alternative A1 ranges from $424,000 to $599,000.

5.1.3.2 Alternative A2 – Rock Riffles, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative A2 for Sub-reach E2 is very similar to Alternative A1 for this reach in that it would include installation of three, three-foot tall rock riffles and would also stabilize seven scarp toes. However, Alternative A2 for Sub-reach E1 also includes stabilization of the seven scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-5).

Alternative A2 has similar advantages and challenges to those presented with Alternative A1 of Sub-reach E2; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E2, Alternative A2 ranges from $471,000 to $665,000.

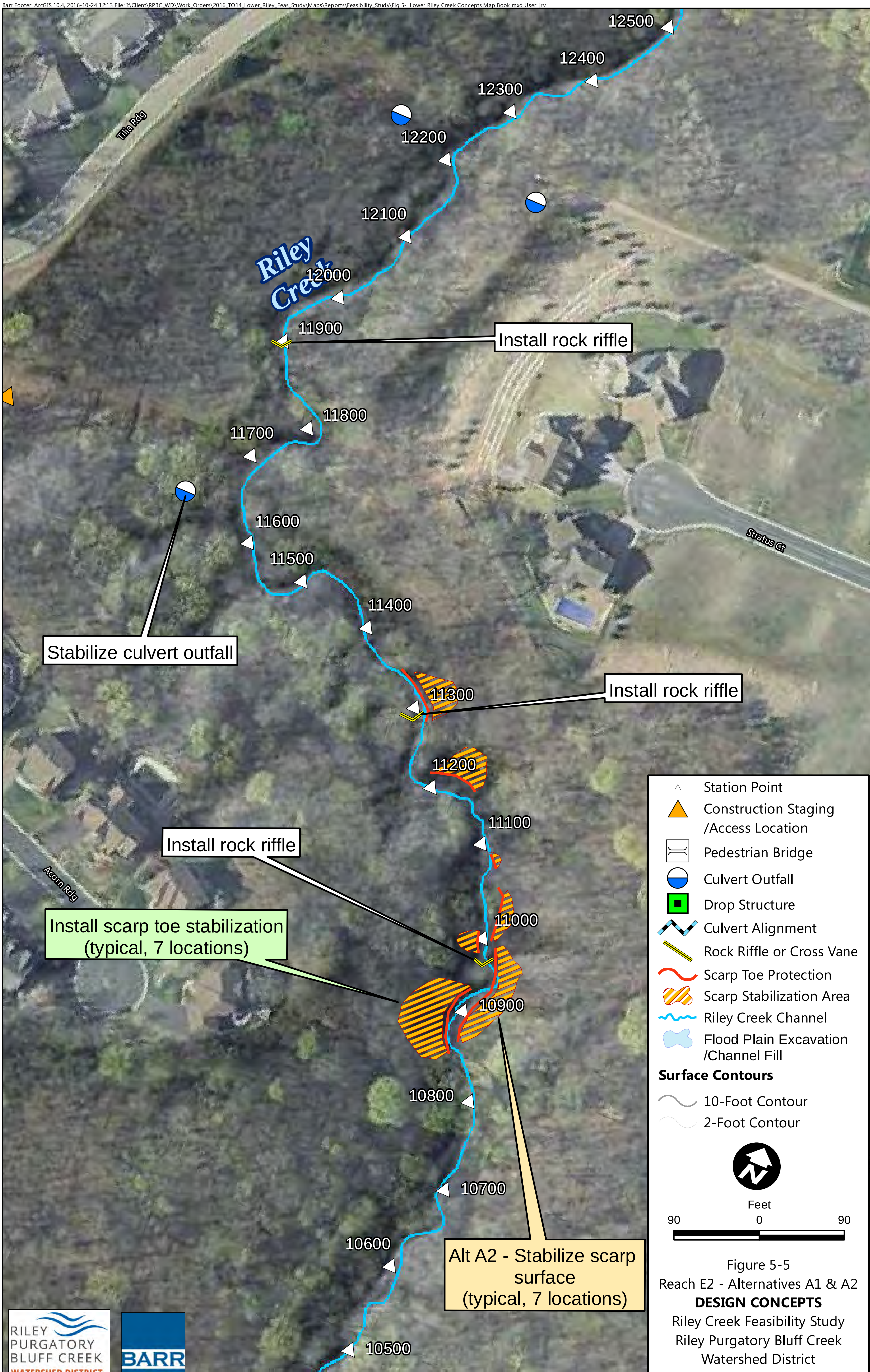

Figure 5-5
Reach E2 - Alternatives A1 & A2
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

5.1.3.3 Alternative B1 – Cross Checks, Floodplain Excavation, Channel Fill, and Scarp Toe Stabilization

Alternative B1 for Sub-reach E2 would include clearing and grubbing the floodplain adjacent to the Riley Creek channel, then excavating approximately two-feet of material from the floodplain. The excavated material would be placed in the existing channel to raise the bed approximately two-feet. Three, one-foot tall cross check structures would be installed in Riley Creek (Figure 5-6). Raising the channel bed would facilitate reconnection of the stream with the floodplain and the cross checks would focus the stream energy away from the banks and minimize potential degradation of the stream bottom. Alternative B1 would also include stabilizing seven scarp toes to reduce active erosion within the reach. Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Alternative B1 would approximately balance floodplain excavation and channel fill, simplifying project permitting and mitigates impacts to the design flood elevations. However, excavating the floodplain would require significant removal and disturbance of trees and vegetation along the channel. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E2, Alternative B1 ranges from $558,000 to $787,000.

5.1.3.4 Alternative B2 – Cross Checks, Floodplain Excavation, Channel Fill, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative B2 for Sub-reach E2 is very similar to Alternative B1 for this reach in that it would include clearing, grubbing, and excavating the floodplain, and then placing the excavated material in Riley Creek to raise the bed approximately two-feet. Alternative B2 would also include installation of three, one-foot tall cross check structures in Riley Creek and stabilization of seven scarp toes. However, Alternative B2 for Sub-reach E2 would also include stabilization of the seven scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-6Figure 5-4).

Alternative B2 has similar advantages and challenges to those presented with Alternative B1 of Sub-reach E2; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E2, Alternative B2 ranges from $604,000 to $853,000.

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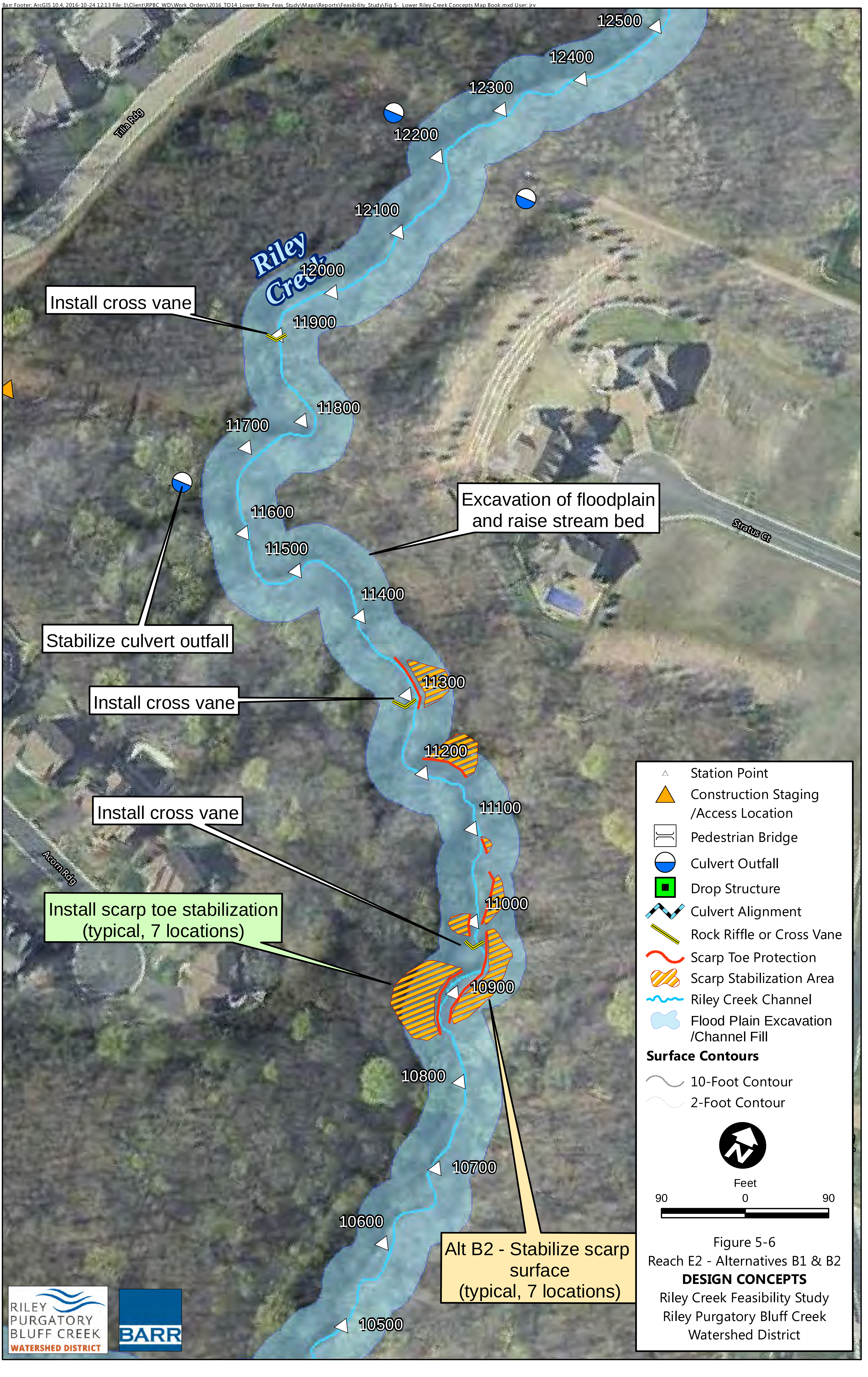


Figure 5-6
Reach E2 - Alternatives B1 & B2
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

5.1.4 Sub-reach E3 Alternatives

Two primary alternatives were developed for Sub-reach E3, each of which contains two variations on the primary stabilization theme. All sub-reach E3 alternatives would raise the channel bed. As such, the three culvert outfalls in this sub-reach may need to be raised and re-stabilized. There is an existing stormwater pond near the downstream end of Sub-reach E3. Similar to the culvert outfalls, the design of this stormwater pond would need to be evaluated during final design to confirm that raising the channel bed would not reduce its storage capacity or function. Culvert and stormwater pond modifications would need to be evaluated regardless of alternative selected.

5.1.4.1 Alternative A1 – Rock Riffles and Scarp Toe Stabilization

Alternative A1 for Sub-reach E3 would include installation of three rock riffles, each approximately three-feet tall. Sedimentation upstream of each rock riffle would naturally raise the channel bed to better match the appropriate bankfull depth and facilitate reconnection of the stream with the floodplain. Alternative A1 would also include stabilizing two active scarp toes to reduce active erosion within the reach (Figure 5-7). Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Sub-reach E3, Alternative A1 would limit the construction footprint and the need for tree removal within the project area. Preliminary hydraulic modeling indicates that raising the bed by three feet would not cause impacts outside of the project reach. Even though design flood elevation impacts are anticipated to be contained within the project reach, raising the design flood level within the project reach could pose permitting challenges. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E3, Alternative A1 ranges from $297,000 to $419,000.

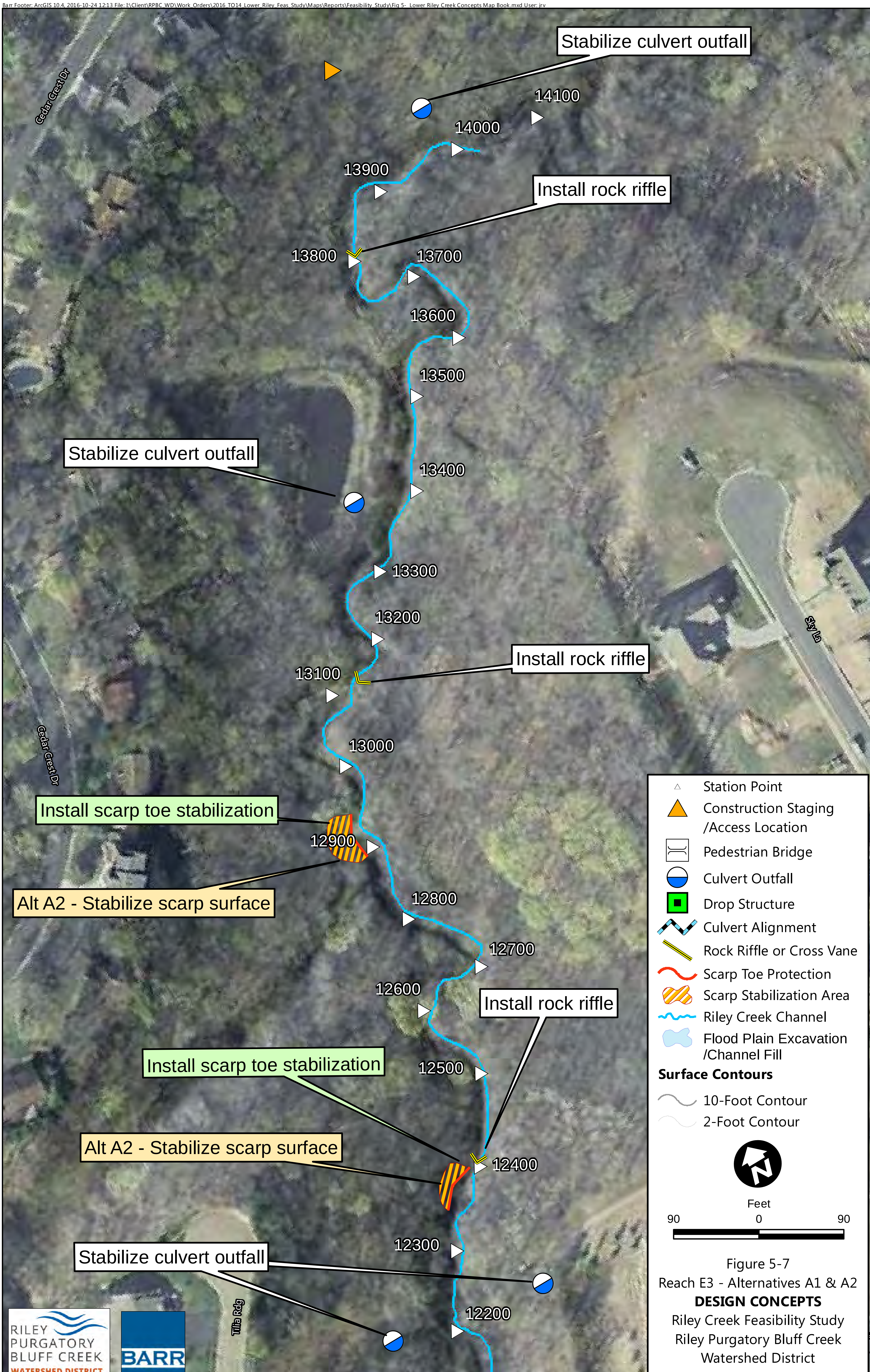
5.1.4.2 Alternative A2 – Rock Riffles, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative A2 for Sub-reach E3 is very similar to Alternative A1 for this reach in that it would include installation of three, three-foot tall rock riffles and would also stabilize two scarp toes. However, Alternative A2 for Sub-reach E3 would also include stabilization of the two scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-7).

Alternative A2 has similar advantages and challenges to those presented with Alternative A1 of Sub-reach E3; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E3, Alternative A2 ranges from $306,000 to $432,000.

Barr Footer: ArcGIS 10.4, 2016-10-24 12:13 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Feasibility_Study\Fig 5- Lower Riley Creek Concepts Map Book.mxd User: jrv



5.1.4.3 Alternative B1 – Cross Checks, Floodplain Excavation, Channel Fill, and Scarp Toe Stabilization

Alternative B1 for Sub-reach E3 would include clearing and grubbing the floodplain adjacent to the Riley Creek channel, then excavating approximately two-feet of material from the floodplain. The excavated material would be placed in the existing channel to raise the bed approximately two-feet. Three, one-foot tall cross check structures would be installed in Riley Creek (Figure 5-8). Raising the channel bed would facilitate reconnection of the stream with the floodplain, and the cross checks would focus the stream energy away from the banks and minimize potential degradation of the stream bottom. Alternative B1 would also include stabilizing two scarp toes to reduce active erosion within the reach. Scarp toes would be stabilized with cedar pilings and appropriately sized logs salvaged from within the project area. Once the toes are stabilized, it is expected that the scarps would naturally revegetate over time.

Alternative B1 would approximately balance floodplain excavation and channel fill, simplifying project permitting and mitigates impacts to the design flood elevations. However, excavating the floodplain would require significant removal and disturbance of trees and vegetation along the channel. Relying on natural process for the scarps to re-establish vegetation could take several years and result in additional erosion until these areas become fully vegetated.

The OPC for Sub-reach E3, Alternative B1 ranges from $656,000 to $926,000.

5.1.4.4 Alternative B2 – Cross Checks, Floodplain Excavation, Channel Fill, Scarp Toe Stabilization, and Scarp Surface Stabilization

Alternative B2 for Sub-reach E3 builds upon Alternative B1 by including stabilization of the two scarp surfaces through grading to a stable, 3:1 to 2:1 slope and revegetating with appropriate vegetation (Figure 5-8).

Alternative B2 has similar advantages and challenges to those presented with Alternative B1 of Sub-reach E3; however, the proposed work on the scarp surfaces allows these areas to become stabilized more quickly than relying on natural processes alone, minimizing the potential for continued erosion across these portions of the reach.

The OPC for Sub-reach E3, Alternative B2 ranges from $664,000 to $937,000.

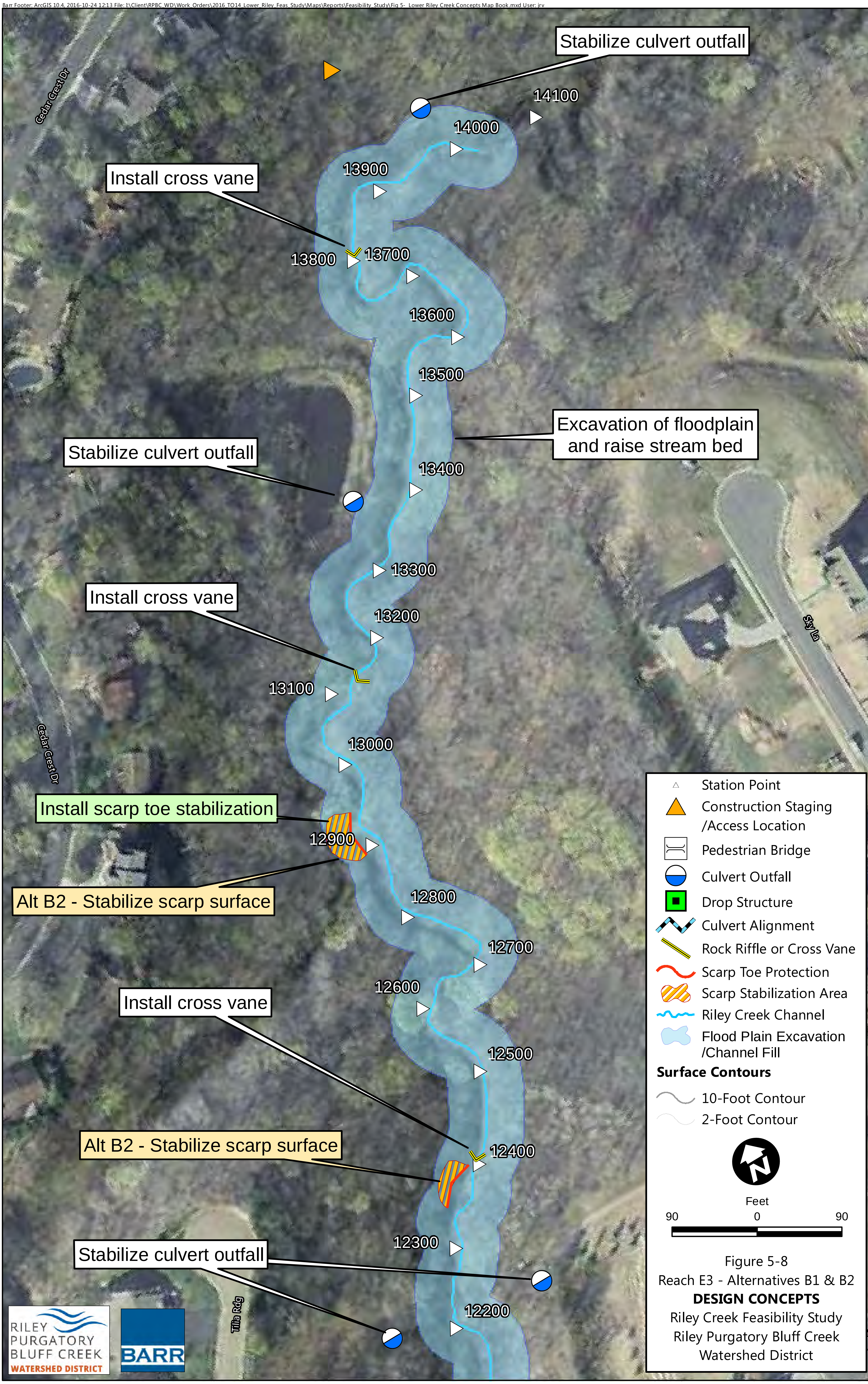


Figure 5-8
Reach E3 - Alternatives B1 & B2
DESIGN CONCEPTS
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

5.1.5 LMRWD Reach Alternatives

Three stabilization alternatives have been developed for the LMRWD reach. Hennepin County is currently planning a roadway reconstruction project on Flying Cloud Drive, immediately adjacent to Riley Creek. It is recommended that a stream stabilization project work in coordination with the Flying Cloud Drive project. Table 5.2 summarizes the project alternatives for this reach, with additional description in the below.

Table 5.2 Summary of Project Alternatives for LMRWD Reach

Reach	Alternative	Description	Total Project OPC[1] and Range[2]
LMRWD Reach	A	3 cross vanes, 3 root wads, bank grading 2 scarp toe stabilizations, 1 scarp surface stabilization	$268,000 ($228,000 – $322,000)
	B	3 cross vanes, 3 root wads, bank grading 2 scarp toe stabilizations, 1 scarp surface stabilization, floodplain excavation	$546,000 ($464,000 – $655,000)
	C	3 cross vanes, 3 root wads, bank grading 2 scarp toe stabilizations, 1 scarp surface stabilization, sediment vortex tube	$512,000 ($435,000 – $614,000)

1 – Includes estimated construction costs, a 15% contingency, 7% of construction costs for construction observation, and 20% of construction costs for engineering, design, permitting, and legal.

2 – A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for design, permitting, and legal, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

5.1.5.1 Alternative A – Cross-Vanes, Root Wads, Bank Grading, Scarp Toe and Surface Stabilization

Alternative A for the LMRWD Reach would include installation of three rock cross-vanes, each approximately three-feet tall (Figure 5-9). Sedimentation upstream of each cross-vane would naturally raise the channel bed to better match the appropriate bankfull depth and facilitate reconnection of the stream with the floodplain. Three root wads would be installed immediately downstream of Flying Cloud Drive to dissipate the stress of flows on the outside bend of Riley Creek in this location. It is anticipated that root wads would be derived from on-site materials. Banks of Riley Creek would be graded back to an approximately 3:1 stable slope. Alternative A would also include stabilizing two active scarp toes to reduce active erosion within the reach. The less severe scarp surface, located near station 15+00, would be allowed to naturally re-vegetate over time. The surface of the more active scarp, located near station 13+00, would be graded to a stable, 3:1 to 2:1 slope and revegetated with appropriate vegetation.

Alternative A would limit the construction footprint and the need to tree removal within the project area. Flood levels for this reach are dictated by the Minnesota River; as such, the bed rise associated with Alternative A would not create flood-related impacts outside of the reach. The biggest challenge associated with Alternative A is that, though bank grading will help stabilize the streambanks, it is not possible to grade back enough of the bank to provide a complete connection of Riley Creek to its floodplain in the uppermost portion of the LMRWD Reach. Though Alternative A would stabilize the LMRWD Reach, it provides no additional considerations for reducing upstream sediment loads.

The OPC for LMRWD Reach, Alternative A ranges from $228,000 to $322,000.

5.1.5.2 Alternative B – Cross-Vanes, Root Wads, Bank Grading, Scarp Toe and Surface Stabilization, and Floodplain Excavation

Alternative B for the LMRWD Reach is very similar to Alternative A in that it would include installation of three, three-foot tall cross vanes, three root wads, bank grading, and stabilization of two scarp toes and one scarp surface. However, Alternative B would also include floodplain excavation on the west bank of Riley Creek, immediately downstream of Flying Cloud Drive (Figure 5-10). The bank in this location is tall, and additional excavation would provide a better connection between Riley Creek and its floodplain.

Alternative B has similar advantages and challenges to those presented with Alternative A of the LMRWD Reach; however, this alternative provides better floodplain connectivity to help address channel down-cutting. Alternative B would require larger construction limits than Alternative A and would, subsequently, require more tree removal. The proposed floodplain excavation area is privately-owned and would require coordination with the affected landowner. Sediment deposited during flooding along the Minnesota River may fill in the floodplain excavation area and require routine maintenance for sediment clean-out. The OPC for LMRWD Reach, Alternative B ranges from $464,000 to $655,000.

5.1.5.3 Alternative C – Cross-Vanes, Root Wads, Bank Grading, Scarp Toe and Surface Stabilization, and Stream Vortex Tube

Alternative C for the LMRWD Reach is also very similar to Alternative A in that it would include installation of three, three-foot tall cross vanes, three root wads, bank grading, and stabilization of two scarp toes and one scarp surface. However, Alternative C would also include installation of a stream vortex tube on the west bank of Riley Creek, immediately downstream of Flying Cloud Drive (Figure 5-11).

A stream vortex tube is essentially a pipe placed in the Riley Creek channel that would connect to an off-channel basin. The vortex created by the pipe, coupled with the off-channel settling basin, would remove sediment from Riley Creek and then return flow to the creek through a small channel. Literature values suggest that a stream vortex tube can reduce sediment loads by one-third to one-half for sediment carrying stream flows (Reference (13)). Though the stream vortex tube would remove sediment, it would primarily remove sediment originating from areas of Riley Creek upstream of the LMRWD Reach.

Alternative C has similar challenges as those presented with Alternative B in that it would require a bigger construction footprint than Alternative A and may be susceptible to Minnesota River sediment deposition, increasing the frequency of routine maintenance for sediment clean-out. The existing design guidelines are vague about the necessary slope needed on the sediment vortex tubes to maximize effectiveness, so it is unclear if they are feasible for this setting. There is too much uncertainty to recommend it as an option; however it could be an option in the future if design guidance is improved. The OPC for LMRWD Reach, Alternative C ranges from $435,000 to $614,000.

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Figure 5-9
ALTERNATIVE A
DESIGN CONCEPTS
Riley Creek Stabilization
Lower Minnesota River Watershed District
Eden Prairie, Minnesota

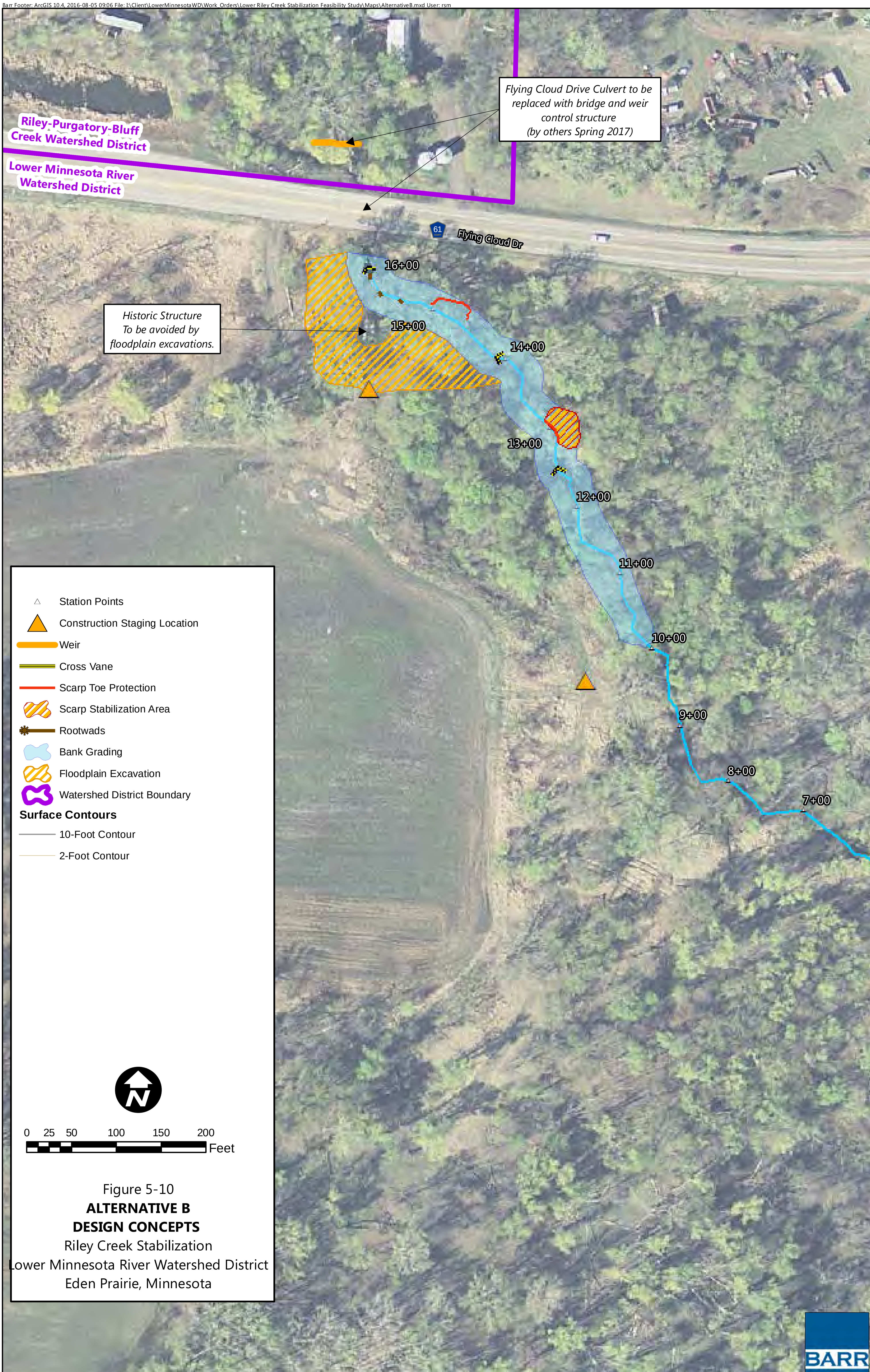


Figure 5-10
ALTERNATIVE B
DESIGN CONCEPTS
Riley Creek Stabilization
Lower Minnesota River Watershed District
Eden Prairie, Minnesota

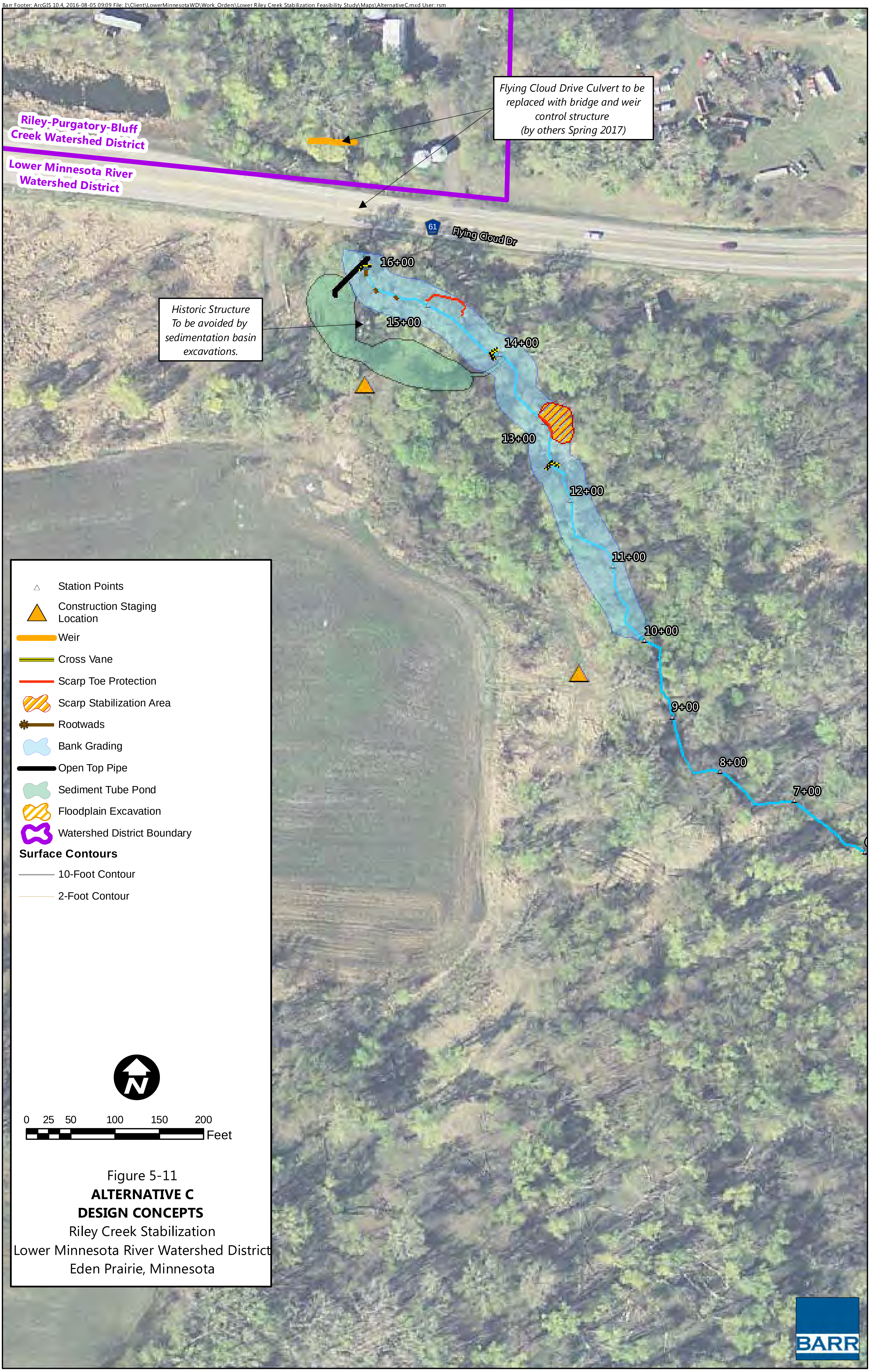


Figure 5-11
ALTERNATIVE C
DESIGN CONCEPTS
Riley Creek Stabilization
Lower Minnesota River Watershed District
Eden Prairie, Minnesota

5.2 Water Quality Benefits

The proposed stabilization measures would result in reduced stream bank erosion and, therefore, reduced sediment and phosphorus loading to Riley Creek and all downstream water bodies, including Grass Lake, the Minnesota River, the Mississippi River, and Lake Pepin. The existing stream bank erosion rate (in units of feet per year) for each stabilization site was estimated based on a field assessment method known as the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS) model (Reference (1)).

The BANCS model uses two erosion-estimation tools to develop risk ratings for the Bank Erosion Hazard Index (BEHI) and the Near-Bank Stress (NBS). The BEHI rating evaluates the susceptibility of a segment of stream bank to erosion as a result of multiple processes: surface erosion, fluvial entrainment, and mass erosion (wasting). The NBS rating characterizes the energy distribution against a segment of stream bank; disproportionate energy distribution in the near-bank region can accelerate bank erosion. The BEHI and NBS estimation tools are applied in a field assessment for each segment of stream bank potentially contributing sediment to the stream channel. BEHI and NBS assessments were completed for Riley Creek during site visits in spring and summer of 2016.

The BEHI and NBS ratings are summarized on a scale of very low to extreme. To convert BEHI and NBS ratings into a stream bank erosion rate estimate, the BANCS model relies on measured bank erosion data to develop relationships applicable to various hydrologic and geologic conditions. No such relationship is currently available for Minnesota; this feasibility study uses relationships developed from data collected in North Carolina (Reference (2)). The estimated total sediment load from bank erosion is calculated using the approximate dimensions of the eroding stream banks at each site.

The pollutant loading and reduction computations for the stream banks were completed using the BANCS model, however this analysis does not quantify erosion from the overbank scarps. Erosion from the scarps includes two processes, 1) erosion from the bare scarp surfaces, and 2) mass wasting from erosion of the scarp toe. Quantification of the combination of these two processes was completed by comparing the 2007 and 2016 survey of the actively eroding scarps. The lateral scarp movement was estimated from the survey data to determine a total sediment loss during the time period and converted to an average annual soil loss for each active scarp.

The portion of scarp erosion associated with the scarp surface was quantified using the RUSLE2 computer model (reference (4)) to predict an average annual loss based on a representative scarp slope. The RUSLE2 model provides this average annual loss estimate as a function of the slope surface area. The scarps within the project reach have similar slopes, lengths, and surface soils, which are the primary inputs for the RUSLE2 model, and allows for the calculated erosion rate to be applied for all of the scarps within the project reach.

The effects of stabilization alternatives on water quality are estimated based on the assumption that each stabilization alternative successfully addresses erosion at the site and brings bank erosion to a low rate, representative of a stable stream in this geologic setting. For this analysis, a stable low erosion rate is assigned a nominal value of 0.02 feet per year for a low NBS and moderate BEHI. Erosion of the scarp due to mass wasting is assumed to be zero if toe protection of the scarp is included in the project. Similarly, if the scarp surface is stabilized, surface erosion is assumed to be zero. The resulting estimated sediment load reduction for stabilization in each reach is calculated and the corresponding reduction of total suspended sediment (TSS) and total phosphorus (TP) load are calculated using an estimation tool developed by BWSR (Reference (3)). The BWSR tool assumes that all eroded sediment becomes TSS, which is conservative because eroded sand and gravel typically is not suspended but is transported as bedload. The BWSR tool also assumes that TP load is equivalent to 1.15 pound TP per pound of eroded sediment.

5.2.1 Reach E and Site D3

The BEHI and NBS ratings for Reach E and Site D3 are summarized in Table 5.3. The portions of Reach E and Site D3 analyzed are generally rated “moderate” or “high” for BEHI due to the high, steep eroding banks. For NBS, the sub-reaches are designated “low” or “high”. The total reduction in pollutant loading as a result of stabilizing the Reach E and Site D3 project reaches is estimated as 2,173,930 pounds per year TSS and 1,250 pounds per year TP. These values are representative of an erosion rate of approximately 0.1 to 0.2 feet per year for the stream banks.

Cross section survey data was collected for the project reach in 2007 and 2016. The 2016 survey collected data from cross sections located close to those collected in 2007 with the intention of estimating erosion rates for these cross sections over the 9 year time period. The scarp extents were also surveyed in both 2007 and 2016 for a select number of actively eroding scarps. Based on the collected data, the average erosion cross sectional area was calculated for each sub-reach of the Riley Creek main channel (Reach E). The change in lateral movement for the scarps was also calculated and used to determine an average scarp erosion rate for each sub-reach. Erosion from the surface of the scarps was estimated using the RUSLE2 model (reference (4)) and used to differentiate the effectiveness of the alternatives. Table 5.3 provides a summary of the estimated erosion rates for the scarps and the main channel. The predicted sediment loading based on the surveyed data is 1,184 tons/yr (2,368,000 lb/yr). The predicted sediment loading based on the BANCS model for Reach E and the surveyed scarps is 2,380,400 lb/yr. The results are comparable and indicate the values calculated by the BANCS model are reflective of the stream condition.

Of the total material eroded from the project segment, approximately 459 ton/yr originates from the scarps. Approximately 27 ton/yr of the scarp eroded material originates from the scarp surface. Since the BANCS model does not provide a means to predict the erosion from scarps, the survey data and scarp erosion calculations were added to the BANCS model erosion rates to determine the total reduction in pollutant loading for Reach E and Site D3.

Table 5.3 Riley Creek feasibility study Reach E and Site D3 existing bank erosion and pollutant loading by sub-reach

Reach	Station	Site Description	Alternative Description	Site Length (1)(2)	Est. Avg. Bank Height (ft)	BEHI rating(1)	NBS rating(1)	Est. Erosion Rate(2) (ft/yr)	Est. Sed. Load(3) (ton/yr)	"Stable" Sed. Load(4) (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction(5) (lb/yr)	TP Reduction(5) (lb/yr)
Ravine D3	NA	Ephemeral ravine with storm sewer outfalls	Stabilize channel with rock riffles or culvert/drop structure, stabilize scarps with toe protection	524	10	Moderate	Low	0.02	178.1	10.1	158.1	316,200	181.82
			Stabilize channel with rock riffles or culvert/drop structure, stabilize scarps with toe protection, stabilize scarp surface with vegetation/grading								168.0	336,000	193.20
Reach E1	90+00 to 108+00	Upstream reach with significant channel degradation and little floodplain connection	Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection, stabilize scarp surface with vegetation/grading	1800	8	Moderate	High	0.12	190.4	27.7	161.3	322,530	185.46
			Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection, stabilize scarp surface with vegetation/grading								162.7	325,330	187.07
Reach E2	108+00 to 120+00	Middle reach with a highly confined channel and significant erosion scarps	Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection	1200	10	High	High	0.2	450.1	23.1	414.1	828,200	476.2
			Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection, stabilize scarp surface with vegetation/grading								427.0	854,000	491.1
Reach E3	120+00 to 141+00	Downstream reach with moderate channel degradation and moderate connection to the floodplain	Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection	2100	8	High	High	0.2	371.6	32.4	336.4	672,800	386.9
			Stabilize channel with rock riffles or cross vanes, stabilize scarps with toe protection, stabilize scarp surface with vegetation/grading								339.2	678,400	390.1
					Totals Without Scarp Vegetation/Grading				1190.2	93.3	1069.9	2,139,730	1230.3
					Totals With Scarp Vegetation/Grading				1190.2	93.3	1096.9	2,193,730	1261.4

(1) BEHI and NBS ratings for Ravine D3 were estimated from photos and aerial imagery, Reaches 1 through 3 utilized field data and collected photos.

(2) Erosion rates derived from North Carolina BEHI/NBS data

(3) Calculated as length (ft) x height (ft) x erosion rate (ft) / 27 (ft3/cy) x 1.3 (ton/cy). Includes scarp erosion rates estimated from 2007 and 2016 survey data.

(4) Estimated from a representative low BEHI, moderate NBS erosion rate of 0.02 ft/yr

(5) Calculated from equations in Reference (3), TSS reduction of 1.0 lb/lb sediment, TP reduction of 1.15 lb/ton sediment.

5.2.2 LMRWD Reach

The BEHI and NBS ratings for LMRWD Reach are summarized in Table 5.4. The portions of LMRWD Reach analyzed are generally rated “moderate” or “high” for BEHI due the high, steep eroding banks in the upstream portion of the reach. For NBS, the study banks were designated “low” or “very high”. The total reduction in pollutant loading as a result of stabilizing the LMRWD reach is estimated as 183,200 pounds per year TSS and 105 pounds per year TP. These values are representative of an erosion rate of approximately 0.02 to 0.28 feet per year for the stream banks.

Table 5.4 Riley Creek feasibility study Lower Minnesota Reach existing bank erosion and pollutant loading by sub-reach

Reach	Station	Site Description	Alternative Description	Site Length (1)(2)	Est. Avg. Bank Height (ft)	BEHI rating(1)	NBS rating(1)	Est. Erosion Rate(2) (ft/yr)	Est. Sed. Load(3) (ton/yr)	"Stable" Sed. Load(4) (ton/yr)	Est. Sed. Load Reduction (ton/yr)	TSS Reduction(5) (lb/yr)	TP Reduction(5) (lb/yr)
Lower Riley	0+00 to 11+00	The bank heights in the lower portion of the reach approach the bank full elevations. The floodplain is flat and water levels are controlled by the Minnesota River.	Alternative A- Grading Banks and stabilize scarps	1100	2	Moderate	Low	0.02	4.2	1.7	2.5	5,080	2.9
			Alternative B- Grading Banks,stabilize scarps, and floodplain excavation								2.5	5,080	2.9
			Alternative C-Grading Banks,stabilize scarps, and sediment vortex tube								111.0	221,930	127.6
Lower Riley	11+00 to 14+00	The bank heights in this reach are higher and the reach is incised although not as significantly incised as further upstream.	Bank Grading	300	6	High	Very High	0.28	48.5	1.4	47.1	94,290	54.2
Lower Riley	14+00 to 16+00	The bank heights in this reach are high and the reach is significantly incised and has large portions of undercutting.	No Construction	200	8	High	Very High	0.28	43.1	1.2	41.9	83,820	48.2
								Total Alt A	95.9	4.3	91.6	183,200	105.3
								Total Alt B	95.9	4.3	91.6	183,200	105.3
								Total Alt C	95.9	4.3	200.0	400,000	230.0

(1) BEHI and NBS ratings were estimated from photos, aerial imagery, field data, and collected photos.
(2) Erosion rates derived from North Carolina BEHI/NBS data
(3) Estimated Sediment Loading for project reach. Calculated as length (ft) x height (ft) x erosion rate (ft) / 27 (ft3/cy) x 1.3 (ton/cy).
(4) Estimated from a representative very low BEHI, very low NBS erosion rate of 0.008 ft/yr
(5) Calculated from equations in Reference (4), TSS reduction of 1.0 lb/lb sediment, TP reduction of 1.15 lb/ton sediment.

5.3 Construction Access

Designating the site access routes is important for determining whether construction access easements are required. In addition, poor access can result in cost increases and project delays. The following sections define the proposed access routes and any additional considerations.

5.3.1 Reach E and Site D3

Reach E and Site D3 are on city of Eden Prairie property that borders public right-of-way and the RPBCWD would need to secure access rights from the city of Eden Prairie prior to initiating construction activities. Within the project area, there are multiple storm sewers from Tilia Ridge and Cedar Crest Drive that discharge into the study reach. The alignment of the storm sewers is generally clear of trees and would likely provide relatively easy access routes. As noted in the vegetation assessment, buckthorn is present in the lower portion of Reach E; therefore, construction traffic should be managed to reduce the spread of buckthorn as much as possible.

The reach between 120+00 and 141+00 consists of dense growth of the invasive species buckthorn. It is recommended that construction traffic be carefully managed to minimize potential spread of buckthorn. For example, construction traffic through an established buckthorn area should not be allowed to proceed into areas where buckthorn is not present. In addition, the RPBCWD Streambank stabilization rule requires that the spread of invasive species be minimized to the extent possible.

Much of the creek is surrounded by steep banks, which can make the movement of construction traffic difficult in some areas. In some cases, construction traffic would be required to use the creek bed to access the proposed project features. This would primarily be true between stations 108+00 to 120+00, where the creek becomes confined between steep, eroding slopes.

5.3.2 LMRWD Reach

Approximately 75 percent of the LMRWD Reach is surrounded by private land. Two stream access locations are proposed, one immediately downstream of Flying Cloud Drive and another near the center of the project reach. Both of these access locations would require construction easements. An existing agreement is in place between the landowner and the Metropolitan Council for access to the Riley Creek stream gage station. Depending on the type of agreement, it may be possible to provide access to the upstream portion of the stream through this existing agreement. The project site is relatively flat and, with the exception of the easement requirement, access to the project features should be relatively simple. A couple locations may require brief longitudinal traverses of the stream due to the presence of steep, eroding banks.

5.4 Construction Easements

All Affected parcel owners will need to agree to a temporary access and construction easements to provide legal access to the property in the interest of completing construction. Permanent easements will also likely be needed to allow for routine maintenance, however the extent of the permanent easements may not be the same as the temporary easements.

5.4.1 Reach E and Site D3

Reach E and Site D3 are surrounded by parkland owned and maintained by the city of Eden Prairie. Access to the project is anticipated to be available through city of Eden Prairie property off of public right-of-way. Therefore, impacts to neighboring properties or the purchase of additional easements are not anticipated. Table 5.5 summarizes which parcels are expected to be impacted by construction of this project.

Table 5.5 Parcels likely to be impacted by construction of Reach E and Site D3

Parcel ID Number	Address	Notes
2911622210051	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622240048	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622210030	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622240019	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622240015	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622310009	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	
2911622320001	City of Eden Prairie, 8080 Mitchell Road, Eden Prairie, MN 55344	

5.4.2 LMRWD Reach

The LMRWD Reach is surrounded by primarily one landowner. The acquisition of temporary construction easements and permanent access and maintenance easements may be necessary for this reach. The surrounding land use is agricultural and impacts to planted fields during the growing season would be avoided to the extent feasible by defining construction easements around planted fields or limiting the construction period to times outside the growing season. Table 5.6 summarizes which parcels are expected to be impacted by construction of this project.

Table 5.6 Parcels likely to be impacted by construction of LMRWD Reach

Parcel ID Number	Address	Notes
3311622220003	15900 Flying Cloud Drive, Eden Prairie, MN 55347	

6.0 Project Impacts

The following sections summarize potential impacts associated with construction of a stabilization project on Site D3, Reach E, and the LMRWD Reach.

6.1 Wetland Impacts

During project design, efforts would be made to avoid wetland impacts to the extent practicable. Unavoidable wetland impacts would be minimized as feasible and may require mitigation.

6.2 Floodplain Impacts

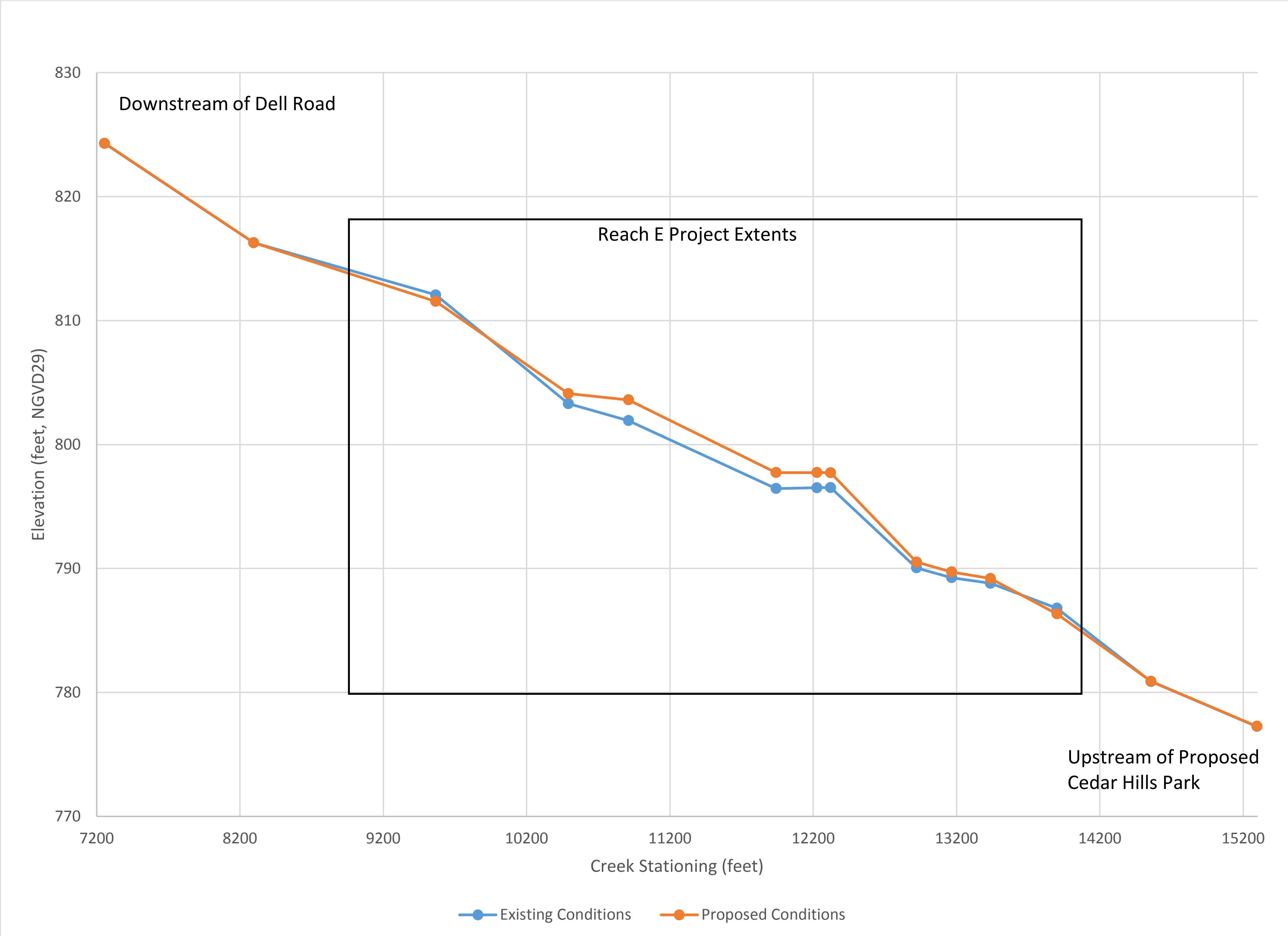
6.2.1 Reach E and Site D3

Site D3 receives intermittent flows from a storm sewer outfall however it has a definable bed and banks, is capable of conveying water. The proposed alternative involving the use of cross checks in the ravine would cause a rise in water surface elevation. The majority of Site D3 is not regulated by FEMA or the DNR with regards to floodplain. Impacts to the water surface elevation are not anticipated to require approval or review by these entities. The adjacent homes and properties are situated high enough above the ravine to maintain adequate freeboard, but should be verified during final design.

The proposed alternatives along Reach E involving the use of cross checks in the ravine would cause a rise in water surface elevation. The project site is located within a FEMA Zone A, which is a limited study area without a defined base flood elevation. Impacts within the project area are permitted up to 0.5 feet based on Minnesota state regulations (FEMA allows up to 1-foot of combined rise within a reach). Any rise above these standards would require permitting through the MnDNR and FEMA. The typical process involves the submittal and approval of a Conditional Letter of Map Revision before construction begins then a Letter of Map Revision post construction through FEMA with additional review by the MnDNR. No rise in water surface elevation would be permitted if it resulted in impacts to adjacent structures. However, RPBCWD requires no net rise in flood elevation.

Figure 6-1 shows the existing and projected water surface elevation for the 100-yr design storm based on the District's Hydrology and Hydraulics (H&H) model. The proposed condition simulates raising the bed of the stream by 3-feet without any additional floodplain mitigation, similar to the rock riffle alternatives proposed. The maximum rise within the reach is 1.7 feet and the proposed profile matches the existing profile near the upstream end of the project reach. Based on this preliminary modeling, the rock riffle alternatives could be permitted through the State and FEMA. RPBCWD Rules B and G require no net rise, maintenance of the hydraulic capacity, and compensatory storage within the floodplain for any fill within the channel.

Figure 6-1 Riley Creek 100-year Existing and Proposed Conditions Water Surface Profile Comparison



The proposed alternatives involving floodplain excavation and channel fill are intended to provide adequate floodplain mitigation to meet the requirements of RPBCWD Rules B and G. In addition, by providing compensatory floodplain storage and maintaining the existing conveyance area, the design is anticipated to produce no rise in the design flood elevation and therefore not require additional consideration from the MDNR or FEMA.

6.2.2 LMRWD Reach

Flood levels for the LMRWD reach are set by the Minnesota River. The proposed alternatives would not alter the flood levels of the Minnesota River.

6.3 Other Project Impacts

6.3.1 Tree Loss

The proposed projects would require some level of tree removal; the final number of significant trees removed would depend on the alternative(s) selected. Trees requiring removal are those located in areas where bank stabilization or site access would be necessary. Per the Eden Prairie City Code, Chapter 11, Section 11.55, Subpart 4 (Tree Replacement Plan Requirements), a tree inventory would be completed during final design to identify significant trees and which of these would be removed or saved. Attempts would be made to target dying/diseased and undercut trees first for removal, followed be less desirable or disease susceptible species such as box elder, cottonwood, or ash. Tree removal would be considered in close coordination with the city of Eden Prairie Forestry Department, and stakeholder input on tree loss would also be considered. A replacement plan for removed trees would be developed in accordance with Eden Prairie City Code.

Many of the trees removed for the projects are proposed to be reused on-site as part of streambank stabilization measures. Trees not used for bank stabilization could be chipped and placed on bare soils on heaver used locations of Riley Creek Conservation Area hiking trails to reduce sediment generation during runoff events.

6.3.2 Protected Species

6.3.2.1 Reach E and Site D3

Based on a review of the MnDNR Natural Resources Heritage System (NHIS), there is one state-listed threatened plant species (kitten tails) located within one-mile of the reach; however, stabilization activities associated with Reach E and Site D3 are not anticipated to affect this species.

There are no federally listed threatened or endangered species and no known bat hibernacula in the vicinity of this reach.

6.3.2.2 LMRWD Reach

Based on a review of the MnDNR NHIS, there is one state-listed threatened plant species (kitten tails), one state-listed threatened fish species (paddlefish), and two state-listed endangered mussels (rock pocketbook and yellow sandshell) located within one-mile of the reach; however, stabilization activities associated with the LMRWD Reach are not anticipated to affect these species.

Two bald eagle nests have previously been documented near the reach. If construction is timed such that it overlaps with the bald eagle nesting season, additional surveys may be required to determine the presence and occupancy status of the nests.

There are no federally listed threatened or endangered species and no known bat hibernacula in the vicinity of this reach.

6.3.3 Utility Conflicts

6.3.3.1 Reach E and Site D3

The project is located within a low lying valley with residential development located on top of the bluffs. Because of the project setting, utilities generally remain on top of the bluffs and would not be a concern for the project features. The primary identified utilities exceptions to this would be the storm sewer outfalls and the Williams Pipeline (liquid petroleum) that runs through the site between station 20+00 and station 21+00. The raising of the channel bed as proposed in all of the alternatives may affect the stormwater outfalls and require them to be raised. Further survey and review of as-built drawings would be necessary during final design to determine the storm sewer impacts and subsequent design considerations.

Final design should include considerations of possible utility crossings of the project area, including sanitary sewer, gas, electric, and communication lines. No additional information regarding these additional utilities is available or has been reviewed for this engineer's report.

6.3.3.2 LMRWD Reach

The project is located within private land that is mostly agricultural and undeveloped floodplain. Because of the project setting, underground utilities generally would not be a concern for the project features. There is an existing electric line that runs along Flying Cloud Drive. Further survey and review of as-built drawings would be necessary during final design to determine the storm sewer impacts and subsequent design considerations.

Final design should include considerations of possible utility crossings of the project area, including sanitary sewer, gas, electric, and communication lines. No additional information regarding these additional utilities is available or has been reviewed for this engineer's report.

6.3.4 Use of Riley Creek Conservation Area

Due to the location of Reach E and Site D3 within the RCCA and adjacent to hiking trails, temporary closures of portions of the trails would be necessary for the safety of recreational users. Recreational features (i.e. trails, pedestrian bridges, etc.) disturbed as a result of construction would be restored to original conditions upon construction completion.

7.0 Permitting

Several permits and approvals would be required prior to construction of the proposed stabilization project, as described in the following sections. To facilitate the permit review process, the USACE and MnDNR were invited on a project site visit in order to discuss preliminary stabilization concept plans and answer initial project questions.

7.1 USACE Letter of Permission

Impacts to waters of the U.S., such as Riley Creek, must be permitted by the USACE. It is expected that Reach E and the LMRWD Reach would each impact less than three acres and would be authorized under a Letter of Permission (LOP-05-MN).

Review of the Letter of Permission request by USACE for similar projects has taken up to six months. As such, the authorization request and wetland delineation report should be submitted at least six months prior to the start of construction and may be submitted prior to finalization of construction documents. Because the proposed activities involve stabilizing existing streambanks and creating better floodplain connectivity, this type of work is generally considered self-mitigating and/or an enhancement to the aquatic system. As such, USACE-required mitigation is not expected.

7.2 MnDNR Work in Public Waters Permit

Since Riley Creek is considered a public water by the MnDNR, a Work in Public Waters Permit from the agency would be required for all stabilization activities on Riley Creek. Work in Public Waters Permits are reviewed by the MnDNR Area Hydrologist and are typically issued in two to four months. The permit application may be submitted prior to finalization of construction documents. Because the proposed activities involve stabilizing existing streambanks and creating better floodplain connectivity, this type of work is generally considered self-mitigating and/or an enhancement to the aquatic system. As such, MnDNR-required mitigation is not expected.

7.3 MPCA Construction Stormwater General Permit

Construction of each proposed project would require a National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater (CSW) General Permit issued by the MPCA. The CSW permit requires preparation of a stormwater pollution prevention plan explaining how stormwater would be controlled within a project area during construction.

Based on the findings of the Phase I (Appendix E) it is not anticipated that contaminated soil and debris would be encountered during stream stabilization activities; therefore it is not anticipated that either project would require additional permits for disposing of contaminated soil. In the unlikely event that environmental contaminants are encountered during the earthwork, contaminated materials would need to be handled and managed appropriately. The response to discovery of contamination typically includes entering the MPCA's voluntary program. In accordance with MPCA guidance, a construction contingency plan could be prepared for these projects. This would include specifying initial procedures for handling potentially impacted materials, collecting analytical samples, and working with the MPCA to determine a method for managing impacted materials.

7.4 Environmental Assessment Worksheet

The Minnesota administrative rules (MN Rules 4410.4300) require the preparation of an Environmental Assessment Worksheet (EAW) for any project that would "change or diminish the course, current, or cross-section of one acre or more of any public water or public waters wetland." Depending on the preferred alternative and associated construction footprint of each project, an EAW may be required. At this time, it is expected that an EAW may be required for the Reach E project, but that the impact footprint of the LMRWD Reach would be smaller than one acre and an EAW is not required.

7.5 City of Eden Prairie Land Alteration Permit

The city of Eden Prairie requires a Land Alteration Permit for grading activities in excess of 100 cubic yards of material. A stormwater management plan is also required as part of this permit.

7.6 City of Eden Prairie Vegetation Alteration Permit

The city of Eden Prairie requires a Vegetation Alteration Permit for vegetation to be cleared as part of project activities. A detailed re-vegetation plan is also required as part of this permit.

7.7 RPBCWD Permit

The RPBCWD has developed district-wide rules for floodplain management and drainage alterations, erosion and sediment control, wetland and creek buffers, dredging and sediment removal, shoreline and streambank stabilization, waterbody crossings and structures, appropriation of public surface waters, appropriation of groundwater, and stormwater management. The RPBCWD requires a District Permit for construction of Reach E and Site D3 to ensure the project is developed in compliance with district rules.

7.8 LMRWD Permit

The LMRWD does not have district-specific rules or permitting processes to govern construction projects. Rather, the LMRWD defers to the city of Eden Prairie for construction project regulation and permitting.

8.0 Stakeholder Input

8.1 Technical Stakeholder Meeting

A technical stakeholder meeting was held on June 22, 2016 at both of the project reaches. Technical stakeholders present included representatives from RPBCWD, LRMWD, MDNR, city of Eden Prairie, and Barr. The USACE was unable to attend; however the project was discussed with USACE at a later date.

The on-site meeting provided an opportunity for the stakeholders to see the reaches and gain a first-hand understanding of the issues present. Stabilization concepts similar to those included in this report were presented to facilitate discussion about the merits of the concepts and potential issues with permitting the project. The technical stakeholders expressed support for the concepts, particularly for raising the bed of the stream to reconnect to the floodplain. The remainder of the discussion focused on permitting as described below.

Preliminary hydrologic and hydraulic modeling indicates that the 100-year flood elevation could be increased in some cases by raising the stream bed to reconnect to the floodplain. Reach E of Riley Creek is a FEMA-designated Zone A with an approximate study to determine the floodplain extents. Raising the flood elevation would not impact any structures; however it would likely still require a variance from both the city of Eden Prairie and RPBCWD.

The technical stakeholders agreed that installing structures within the creek to raise the bed would be considered fill within the floodplain; therefore it may be necessary to create compensatory storage or seek variances from regulations that prohibit floodplain fill.

9.0 Recommendations

This study evaluated a variety of bioengineering and hard-armoring alternatives, as further described in Section 5, for stabilizing Reach E and Site D3, and the LMRWD Reach of Riley Creek. Final projects on each reach would consist of a combination of alternatives discussed in Section 5.1. Where feasible, priority was given to alternatives that were innovative, cost-effective, and used natural materials. The ability of alternatives to improve stream habitat and vegetative surroundings (identified as priorities in stakeholder meetings) was also taken into consideration in choosing the final alternatives. The recommended stabilization measures and range of construction costs for each reach are summarized below.

9.1 Reach E and Site D3 Recommendation

Stabilization of site D3, and along Reach E are identified in the Overall Water Management Plan of the Riley-Purgatory-Bluff Creek Watershed District (as amended) and are a necessary and feasible project to reduce the total phosphorus (TP) and total suspended sediment (TSS) loading reductions while limiting impacts to the surrounding environment.

For Site D3, Alternative B is recommended because it provides a more natural solution and blends into the surroundings than Alternative A. The erosion is likely a remnant from historical drainage patterns and the current drainage area is relatively small. As such, the erosion can be mitigated with grade control and additional scarp stabilization without installing new storm sewer infrastructure. This approach is consistent with RPBCWD stabilization objectives.

Alternative A2 is recommended for all subreaches of Reach E. This option should cause less disturbance than Alternatives B1 and B2. With less direct disturbance to the banks and riparian vegetation, the project will be less vulnerable to erosion immediately after construction. Furthermore, all sub-reaches have limited floodplain available, and raising the bed rather than excavating the floodplain will maximize the available floodplain.

Stabilization and restoration of the stream channel, banks, and eroding scarps within the project areas would improve water quality by 1) repairing actively eroding sites and 2) preventing erosion at other sites by installing preemptive measures to protect existing stream banks. The proposed projects on all reaches would result in reduced stream bank erosion and, therefore, reduced TSS and TP loading to Riley Creek (which is on the MPCA's impaired waters list) and all downstream water bodies, including Grass Lake, the Minnesota River, the Mississippi River, and Lake Pepin. Table 9.1 also summarizes sediment reductions and associated cost benefits. The recommended alternatives are also shown in Figures 9-1 through 9-4.

The recommended alternatives for Reach E (Alternative A2) and Site D3 (Alternative B) have a combined estimated annual maintenance cost of $30,300. Annualized costs for TP removal associated with the full range of alternatives developed range from $76 per pound TP to $134 per pound TP. The high end of the cost range is representative of the alternatives involving overbank excavation which have a similar impact to the sediment reduction with a much higher cost. For the preferred alternative, the estimated total annualized pollutant reduction costs are $84 per pound TP and $0.05 per pound TSS.

9.2 LMRWD Reach Recommendation

Stabilization of the portion of Riley Creek downstream of Flying Cloud Drive has been identified in the Third Generation Watershed Management Plan (as amended) for the Lower Minnesota River Watershed District and is a necessary and feasible project to reduce the total phosphorus (TP) and total suspended sediment (TSS) loading reductions while limiting impacts to the surrounding environment.

For the LMRWD Reach, Alternative A is recommended because it can cost effectively stabilize the eroding banks without added concern about influence from the Minnesota River floodwaters (Alternatives B and C) or the potential effectiveness and uncertain operations and maintenance costs.

Stabilization and restoration of the stream channel, banks, and eroding scarps within the project area would improve water quality by 1) repairing actively eroding sites and 2) preventing erosion at other sites by installing preemptive measures to protect existing stream banks. The proposed projects on all reaches would result in reduced stream bank erosion and, therefore, reduced TSS and TP loading to Riley Creek (which is on the MPCA's impaired waters list) and all downstream water bodies, including Grass Lake, the Minnesota River, the Mississippi River, and Lake Pepin. Table 9.1 also summarizes sediment reductions and associated cost benefits. The recommended alternative is also shown in Figure 9-5.

The recommended alternative (Alternative A) has an annualized maintenance cost of $5,400. Annualized costs for TP removal for the full range of alternatives evaluated range from $75 per pound TP to $363 per pound TP. The low end of the cost range is representative of the off-channel treatment pond, which would only reduce pollutant loading from upstream of the project area. Significant flooding in the Minnesota River could wash away the deposited sediments in this basin, thereby reducing the effectiveness. For the preferred alternative, the estimated total annualized pollutant reduction costs are $178 per pound TP and $0.10 per pound TSS.

Table 9.1 Recommended Stabilization Measures and Estimated Costs

	RPBCWD Reach E and D3	LMRWD Reach

Recommended Stabilization Measures	• Site D3: Alternative B
	  • Stabilize Site D3 by installing cross checks, stabilizing the culvert outfall with riprap, stabilizing the scarp toe, and stabilizing the scarp surfaces with grading and vegetation.
	• Reach E1, E2, and E3: Alternative A2 for all reaches
	  • Construct 10 rock riffles in channel of Riley Creek Reach E to provide grade control, reconnect stream with floodplain, and recreate pool-riffle sequence in channel;
	  • Stabilize toe of 11 major scarps using cedar pilings and trees removed within Reach E;
	  • Install root wads, rock vanes, and log vanes to provide additional toe protection and in-stream habitat;
	  • Stabilize scarp surface through grading and establishing vegetation;
	  • Improve existing culvert outfalls where necessary to match newly raised channel bed.
		• Alternative A
		  • Grade tall, eroding banks immediately downstream of Flying Cloud Drive;
		  • Install rock vanes and root wads to provide toe protection on the graded banks while providing in-stream habitat.

Estimated TSS Reduction (lbs/yr)	2,193,700	183,200
Estimated TP Reduction (lbs/yr)	1,261	105
Cost of Construction (range)[1, 2]	$1,515,000 ($1,288,000 – $1,818,000)	$268,000 ($228,000 – $322,000)
TP cost/benefit ($/lb reduced)[3]	$84	$178
TSS cost/benefit ($/lb reduced) [3]	$0.05	$0.10

[1] Range includes costs for: construction; engineering, design, permitting, and construction observation; legal assistance; construction contingency.
2 Methodology and assumptions used for cost estimates are discussed in Section 4. Detailed cost estimates for all stabilization alternatives considered for this study are provided in Appendix J.
[3] Represents 30-year annualized cost.

Barr Footer: ArcGIS 10.4, 2016-10-24 12:17 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Feasibility_Study\Fig 9- Lower Riley Creek Concepts Map Book.mxd User: jrv

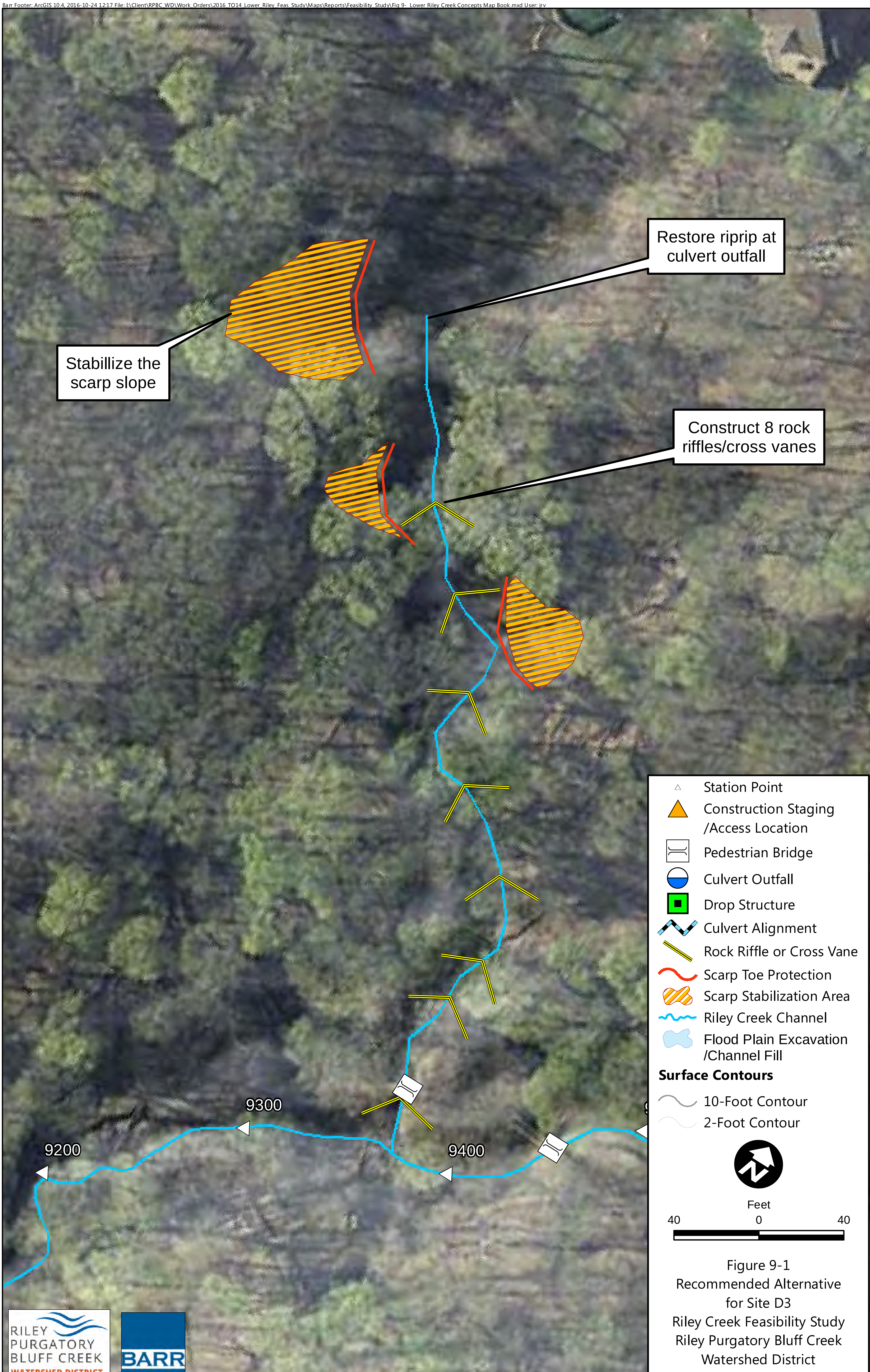


Figure 9-1
Recommended Alternative for Site D3
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

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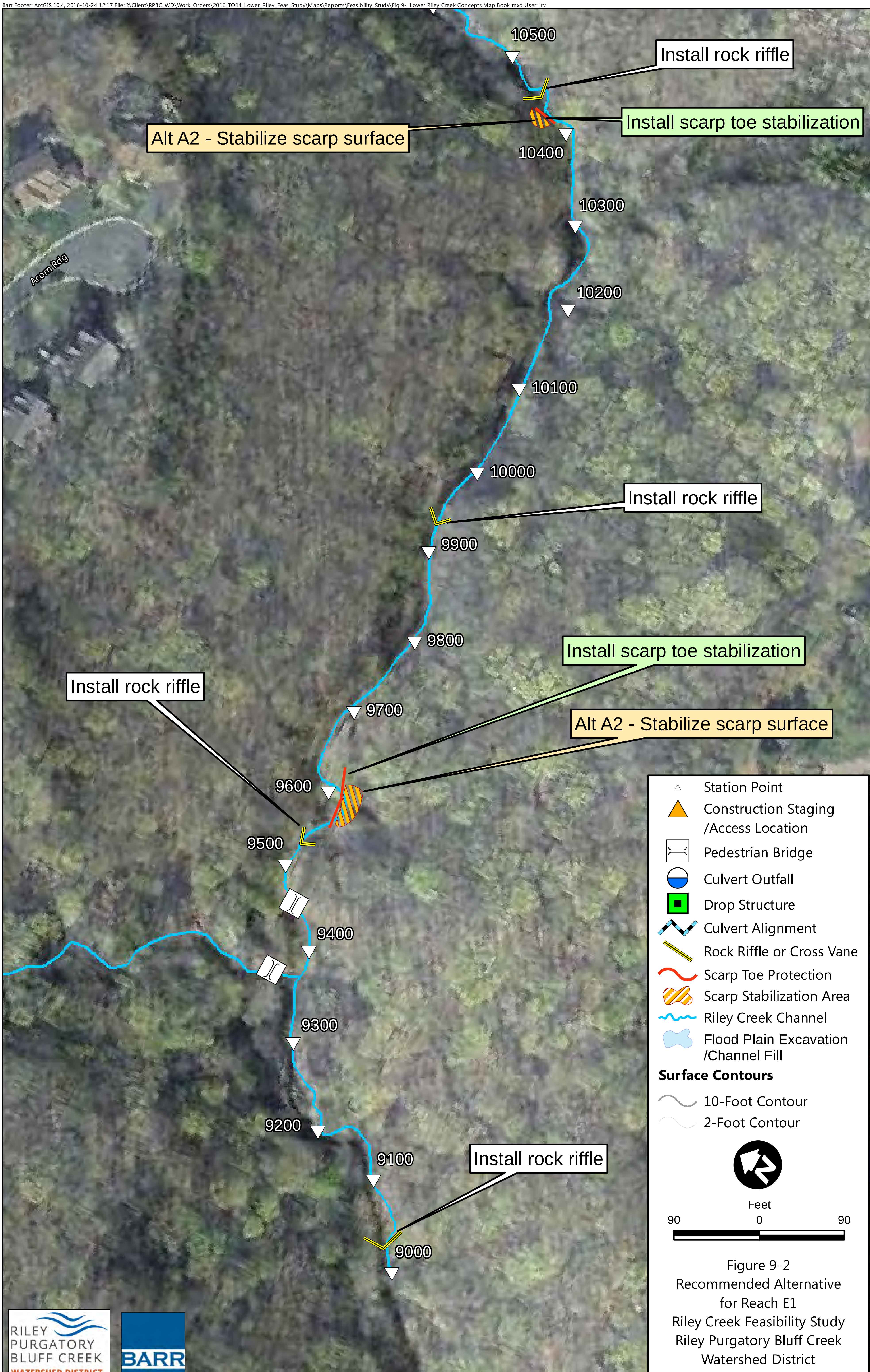

Figure 9-2
Recommended Alternative for Reach E1
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

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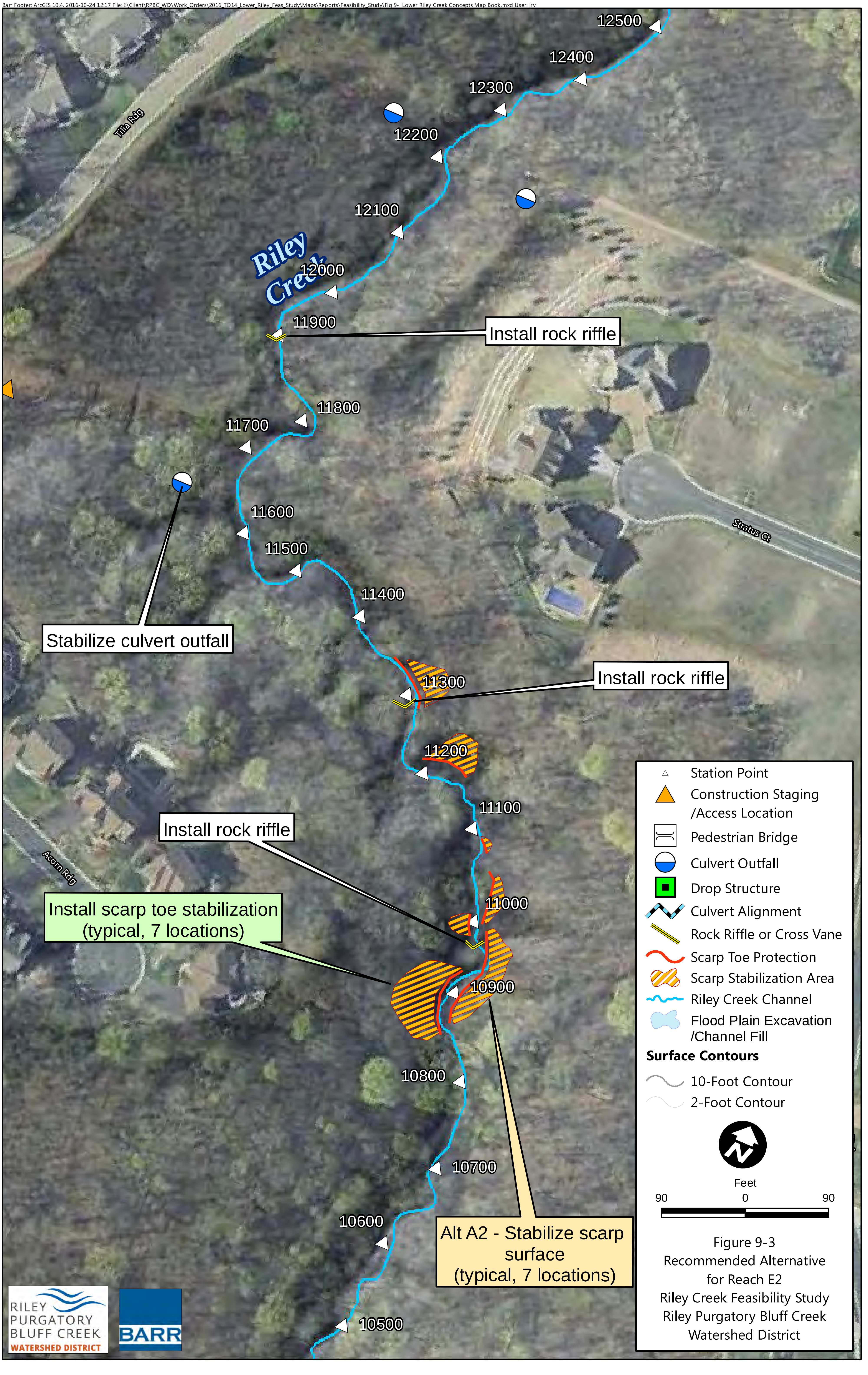

Figure 9-3
Recommended Alternative
for Reach E2
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

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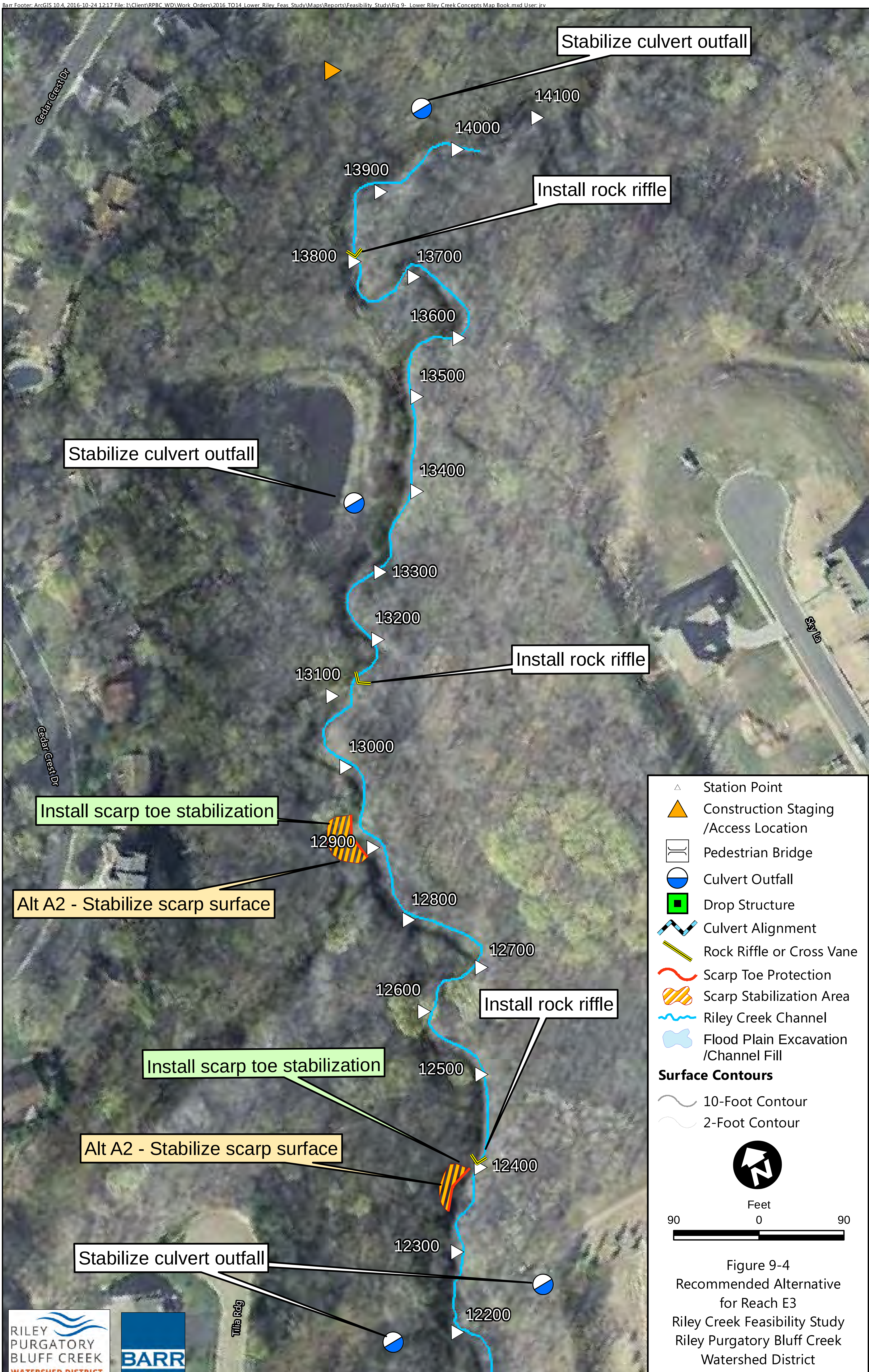

Figure 9-4
Recommended Alternative
for Reach E3
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek
Watershed District

Barr Footer: ArcGIS 10.4, 2016-10-10 10:54 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Feasibility_Study\Figure 9-5 - Recommended Alternative for LMRWD Reach.mxd User: jrv

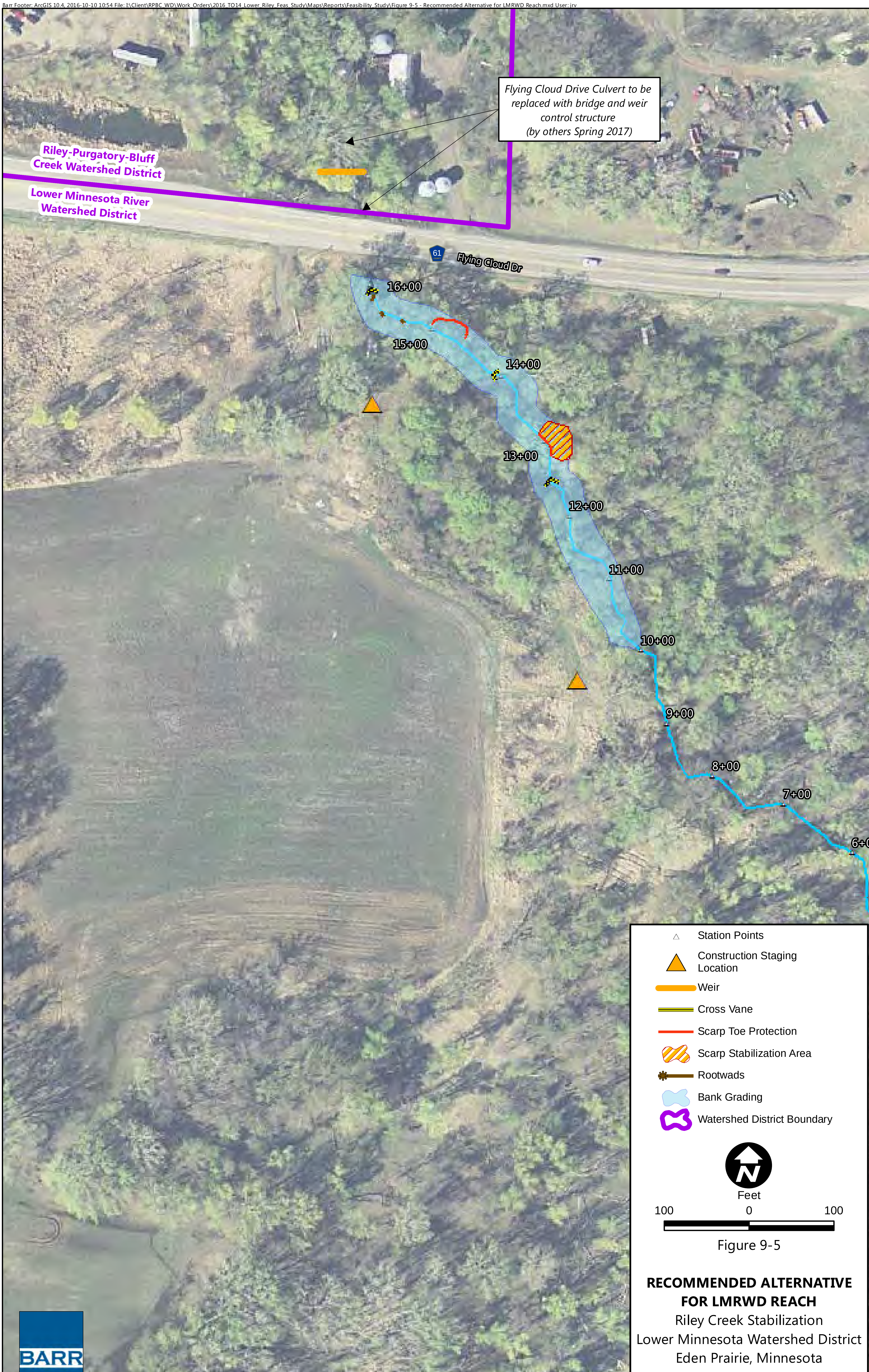

Figure 9-5

RECOMMENDED ALTERNATIVE FOR LMRWD REACH

Riley Creek Stabilization
Lower Minnesota Watershed District
Eden Prairie, Minnesota

10.0 References

1. **Barr Engineering Company.** *Lake Riley Outlet Improvements and Riley Creek Lower Valley Stabilization Feasibility Study.* s.l. : Prepared for Riley Purgatory Bluff Creek Watershed District, March 2007.

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Appendices

Appendix A

2016 Erosion Site Photos

Photo 1. *Site D3.* Ravine, large scarp on right side of photo (photo is looking downstream)

Photo 2. *Site D3.* Failing riprap downstream of storm sewer outfall (photo is looking upstream)


Photo 3. Site D3. Ravine (looking upstream)


Photo 4. *Reach E1.* Debris in channel, outside bend erosion (looking downstream)

Photo 5. *Reach E1.* Channel degradation (looking downstream)

Photo 6. *Reach E1.* Severe bank erosion and smaller scarp downstream (looking downstream)

Photo 7. *Reach E1.* Eroding scarp in left overbank

Photo 8. *Reach E2.* Confined channel with scarp erosion (looking downstream)

Photo 9. *Reach E2.* Severe scarp erosion in left overbank

Photo 10. *Reach E2*. Sever scarp erosion in left overbank

Photo 11. *Reach E2.* Scarp erosion in right overbank

Photo 12. *Reach E2.* Scarp erosion in right overbank


Photo 13. *Reach E2.* Scarp erosion in right overbank


Photo 14. *Reach E3.* Channel degradation and bank erosion (looking downstream)

Photo 15. *Reach E3.* Perched culvert outfall in left overbank

Photo 16. *Reach E3.* Storm sewer easement, possible construction access


Photo 17. *Reach E3.* Perched culvert outfall in right overbank


Photo 18. *Reach E3.* Channel degradation and bank erosion (looking downstream)

Photo 19. *Reach E3.* Recently stabilized storm sewer outfall in right overbank

Photo 20. *Reach E3.* Abandoned pipe in stream channel


Photo 21. *Reach E3.* Channel degradation and bank erosion (looking downstream)


Photo 22. *Reach E3.* Stormwater pond in right overbank

Photo 23. *Reach E3.* Storm sewer easement, possible construction access

Photo 24. *Reach E3.* Channel degradation and bank erosion (looking upstream)

Photo 25. *LMRWD Reach.* Undercutting bank (looking upstream)

Photo 26. *LMRWD Reach.* Channel degradation and bank erosion (looking upstream). A scarp can be seen on the right side of the picture


Photo 27. *LMRWD Reach.* Channel degradation and bank erosion (looking downstream)

Photo 28. *LMRWD Reach.* Channel degradation and bank erosion (looking downstream)

Appendix B

Excerpts from Lake Riley Outlet Improvements and Riley Creek Lower Valley Stabilization Feasibility Study

5.0 Lower Valley Riley Creek Study

A detailed investigation of the Lower Valley of Riley Creek (Lower Valley) was performed in order to quantify the morphologic sensitivity of Riley Creek for different scenarios of hydrology and sediment supply, and to predict the evolution of the longitudinal profile of Riley Creek within the Lower Valley as land use continues to evolve toward a more urbanized setting.

5.1 Watershed Characteristics

The Lower Valley watershed includes the reach between the outlet of Lake Riley and the culvert crossing of US 212 (Map 4). The drainage area of the Lower Valley is 6,600 acres.

Riley Creek flows through loamy till immediately downstream of Lake Riley, and then meanders through relatively steep, glacial outwash deposits of sand and gravel in its course to the Minnesota River floodplain.

5.1.1 Watershed Slopes

Map 5 presents the results of computing area-weighted slopes for each of the sub-watersheds defined in the XP-SWMM model of the Lower Valley watershed. This map indicates that the overall slope of the study watershed is relatively steep, with more than 50 percent of the catchment area having a slope of more than 10 percent. This is an indication that, independent of other factors (such as runoff intensity, soil erodibility, land use, etc.), the potential for soil erosion in the watershed uplands is relatively high. Map 5 also shows that the slope of the watershed uplands increases from the watershed divide to the stream channel, which implies that in addition to the relatively high potential for soil erosion, the conditions are favorable for most of this sediment to reach the main channel rather than depositing before reaching the stream.

Another important finding from Map 5 is the existence of three sub-reaches in which the slope within the stream corridor is steeper than 20 percent: between Stations 35+00 and 70+00, between Stations 95+00 and 130+00, and between Stations 195+00 and 220+00. These sub-reaches are ones in which, independent of other factors, there is not only greater potential for sediment delivery from the watershed uplands to the main channel, but also a greater chance for gully development.

5.1.2 Soil Types

Map 6 shows the surficial geology of the Lower Valley watershed, based on data from the Minnesota Geological Survey (1989) for Hennepin County. The map indicates that the watershed soils consist of loamy tills on the western half, and outwash deposits on the eastern half, with the latter covering the stream corridor downstream of Station 50+00 (i.e., approximately 80 percent of the study reach length). This is consistent with Map 7, which depicts that, according to the Unified Soil Classification System (USCS), there are two soil types covering most of the Lower Valley watershed: low plasticity fine silts dominating the western half, and coarser silty sands dominating the eastern half.

Detailed information about the distribution of soils throughout the watershed is shown in Map 8, which shows that loams cover the western half of the study watershed, whereas coarser sandy loams cover the eastern half of the study watershed (United States Department of Agriculture (USDA) classification). Map 8 shows that beginning approximately at Station 60+00 downstream to the WOMP station, the area within or adjacent to the stream corridor is dominated by loamy sands. Other important soil groups near the stream corridor are sandy loams between Stations 110+00 and 200+00, and coarse sandy loams downstream of Station 200+00.

It is likely that the gradation of sediment delivered from the watershed uplands to the main channel becomes coarser as one progresses down the valley, but a grain size corresponding to medium to coarse sand was assumed to provide a general characterization of the sediment for the entire stream length.

Although a quantification of the volumes of sediment eroded from the watershed uplands and delivered to the main channel was not conducted as part of this study, the relative erosivity of the watershed is presented in Map 9. Using the soil erodibility factor K (as defined by the Universal Soil Loss Equation method), it is evident that, per unit watershed area, the western half of the Lower Valley watershed will contribute more sediment than the eastern half of the watershed for two reasons. First, the soil erodibility factor K is one to two times larger on the western half because the soils are finer (as indicated above). Second, the catchment area is narrower on the western half, therefore sediment delivery rates are anticipated to be higher in this sector.

5.1.3 Imperviousness

The imperviousness of a watershed is a good indicator of the relative volume of runoff that will be generated. Maps 10 and 11 show the percentage of imperviousness for four years from which land use information has been derived: 1945, 1980, 1991, and 2004 (Existing Conditions).

It is evident in Map 11 that, although slight, the percent imperviousness increased between 1945 and 1991, in particular on the northwestern end and the north central sector of the Lower Valley watershed. Map 10 shows that the increase on the northern half of the basin has been significantly greater between 1991 and 2004, and even more dramatic in the eastern corner of the study watershed. Not only runoff volumes but also the magnitude and duration of relatively high flows have likely increased as a result of urbanization. If this is combined with a reduction of the watershed area that is agricultural and subject to soil erosion (as discussed in Section 5.1.4), it can be expected that reaches of the main channel are undergoing channel incision resulting from larger inflows and less sediment supply.

5.1.4 Land Use / Land Cover

Historic aerial photographs from 1945, 1980, 1991, and 2004 (Existing Conditions) in combination with the USDA database for cultivated areas by county were analyzed to estimate changes in land use that have occurred in the past sixty years. The first three periods were selected for the following reasons: Year 1945 represents conditions when field crop agriculture was dominant in the Lower Valley watershed, right before the introduction of row crop agriculture. Year 1980 represents conditions when row crop agriculture was dominant in the watershed, right before the beginning of urbanization. Year 1991 represents conditions of transition from a rural to an urban watershed, yet well before the intense years of urbanization that began in 1998. 2004 represents existing conditions.

Maps 12 and 13 show that areas of the northern and eastern parts of the study watershed have experienced the greatest change in land use. According to the USDA database, the three dominant crops by 1945 were corn, oats and hay, whereas by 1980 soybeans began to displace oats and hay but corn continued being important. The change from field crop to row crop agriculture likely caused an increase in the amount of sediment supply from the watershed uplands to the main channel. This trend likely reversed, however, when land use in the Riley Creek watershed shifted from agricultural to urban beginning in the 1980s. Although, with urbanization, storm events tend to produce larger runoff volumes and flows, the higher percentage of area that is paved or covered with turf grass usually results in less sediment delivered from the watershed uplands to the main channel.

Maps 12 and 13 show that the greatest change in land use occurred between Stations 120+00 and 145+00, which corresponds closely to the reach in which the channel is severely incised (see Section 6.5).

5.1.5 Drainage Patterns and Stormwater Ponds

Map 14 shows that, in general, historic drainage patterns have not been affected in a significant way. However, stormwater ponds continue to be constructed since at least 1997, in order to reduce peak flows and the flashiness of the flood hydrographs contributing to the main channel of Riley Creek.

5.2 Channel Geometry

The channel geometry of most streams is influenced by several factors. Channel slope, streambed material, stream bank material, and riparian vegetation are factors that are directly connected to the stream and have significant influence over channel geometry. Similarly, several hydrologic factors have significant influence as well since they will control how much water enters the stream. These factors include the amount of rainfall, the intensity of rainfall, watershed slopes, storage within the watershed, infiltration capacity within the watershed, impervious area, and land use. All of these factors can change over time or change along the length of the stream, so the stream is constantly trying to achieve equilibrium with these changing influences.

Natural processes of change, such as changing weather patterns or changing vegetation communities, typically happen at a gradual rate, so the stream and the channel geometry has ample time to slowly adjust to these influential factors. Even with these slow processes, it is possible for a stream to undergo significant changes and have large erosion problems. This can be caused either by large catastrophic events or by the stream channel and/or valley reaching a point where a major adjustment is necessary.

Man-made processes of change, such as increased development, altering of storage areas, and altering drainage patterns, tend to happen too quickly for the stream to gradually adjust.

Even though greater measures are being taken to protect streams through the use of detention ponds and other best management practices within the watershed, the streams still require a certain amount of adjustment to once again achieve equilibrium with their watersheds.

Riley Creek, as it flows through the Lower Valley, has varying channel geometries that reflect the influence of some of the factors listed above. Between Lake Riley and Dell Road, the channel has characteristics that are typical of a stream that flows through a wooded area and whose flow is largely controlled by a large body of water. The basic channel geometry changes in typical ways as the stream moves between riffle and pools and over fallen trees. Approximately 3,500 feet downstream of Dell Road, the channel geometry changes dramatically as the stream enters a reach that is experiencing some severe erosion problems. After this reach, the stream returns to a somewhat stable channel geometry. These transitions are explained in more detail in Chapter 6.

5.3 Stream Profile

As with any stream, the slope of Riley Creek varies along its length. Analyzing the changes in channel slope can help identify either current or potential problem areas. The greater the channel slope is, the greater potential there is for erosion because the slope plays a critical role in the flow velocities and the stresses imposed on the stream bed. Given that the streambed in Riley Creek ranges from cohesive clay to gravel and some cobble, a slope less than or equal to 0.5 percent would likely result in a stable creek system. For slopes greater than approximately 0.5 percent, the stream would need larger bed material in order to remain stable for the long term. These reaches, with slopes between approximately 0.5 and 0.75 percent, can be stable and many of them on Riley Creek are stable. However, periodic monitoring of these reaches is recommended to detect early signs of erosion problems. Slopes between 0.75 percent and 1 percent are an additional indicator of potential erosion. If erosion is not already present along these reaches, they should be monitored on an annual basis. Slopes greater than approximately 1 percent are a strong indicator of potential erosion problems. These slopes can generate stream velocities that easily erode streambed or streambank materials.

Appendix A contains plan/profile drawings showing the stream slope over the entire length of Riley Creek as it flows through the Lower Valley.

5.4 Erosion Types

There are four main types of erosion along Riley Creek. They can be categorized as Groundwater Erosion, Stream Bank Erosion, Incision, and Bluff Erosion. These are described in more detail in the following discussion.

5.4.1 Groundwater Induced Erosion

Groundwater erosion is caused by springs and groundwater seepage. Along Riley Creek, this type of erosion occurs most commonly where a bluff meets the floodplain (usually at the toe of the bluff slope). It is characterized by very moist soils or visible springs at the toe of the bluff and results in two subcategories of erosion. The first and most common type of erosion attributed to groundwater flow is a result of the groundwater seepage being a catalyst for additional erosion. The high moisture content in the toe of the bluff significantly reduces cohesion between the soil particles and makes the toe of the bluff highly susceptible to erosion by the creek. During high flows, creek flow easily erodes the soils at the toe of the bluff that are already saturated from the groundwater flow. As the toe of the bluff erodes, the bluff above the toe also recedes. This process also happens in bluffs that do not have groundwater seepage along the toe, but the rate of erosion is often greatly increased by the presence of seepage.

The second form of erosion attributed to groundwater flow results from the groundwater flow itself. The saturated soil has a positive pore water pressure that can cause soil in the area of the spring to be displaced. This causes a slow failure of the bank as small quantities of soil are carried away by the seeping groundwater. This type of erosion generally occurs slowly, but can occur more quickly if groundwater flows are high and soil cohesion is low. It is observed in several areas of the Lower Valley well above the channel level.

Along the Lower Valley of Riley Creek, the majority of erosion caused by groundwater flow is of the first type described above. The presence of the groundwater seepage at the toe of a slope makes the toe more susceptible to stream erosion. This is primarily happening along Reaches G, H and I between Eden Prairie Road and US Highway 212 (US 212). There is a high concentration of this type of erosion in Reach H between the fish barrier on the former Cedar Hills Golf Course and Spring Road.

5.4.2 Stream Bank Erosion

Stream bank erosion is caused by water flowing in the stream channel. The shear stress caused by the flow entrains soil particles into the flow, causing the stream bank to erode away. This is, by far, the most common type of erosion that occurs in streams. Virtually all streams have some amount of this type of erosion occurring as streams naturally change their flow path over time. However, the rate of stream bank erosion can increase when the stream is out of equilibrium with its watershed. Increased flow from a watershed will increase the rate of erosion.

Stream bank erosion is occurring along all reaches on Lower Riley Creek. In most cases, it appears to be a part of the natural process of stream evolution. However, it can lead to high-bank failure where the stream abuts the steep valley walls, and it can exacerbate other forms of erosion.

5.4.3 Channel Incision

Channel incision, or down-cutting, occurs when there is an imbalance between the sediment supply and the sediment carrying capacity of the stream. Erosion occurs when the sediment carrying capacity of a stream exceeds the sediment supply. In streams with cohesive banks, such as Riley Creek, the erosion will occur primarily as streambed incision because that is where the erosive forces are the strongest. Channel incision is more insidious than bank erosion. While sediment that is eroded from bank erosion often redeposits locally (such as on the opposite bank), sediment is often transported a large distance in an incised system. This indicates that the stream is out of balance with the watershed hydrology. As the channel deepens, the banks gradually fail and stream becomes wider. Although the stream will eventually return to equilibrium, the process can take many years and significant amounts of erosion can occur during the process.

Channel incision is occurring along Reach E (Map 15). From station 10,500 to station 14,000, there is evidence that the channel is incising. And, from station 11,800 to station 13,300, there is evidence that the channel is beginning to widen as well.

5.4.4 Bluff Erosion

Bluff erosion occurs on the valley walls of the stream corridor. For the purposes of this analysis, bluff erosion is distinguished as erosion that is above the creek itself and is, therefore, not entirely due to the flow in the creek. It is a naturally occurring phenomenon that can have several different causes, including groundwater seepage, concentrated runoff on the bluff, effects from falling trees, or massive slope failure due to an imbalance of geotechnical forces.

There are some areas of isolated bluff erosion within the Lower Valley, most notably at Site E2 in Reach E. Other areas of bluff erosion within the Lower Valley are more typically a side effect of either groundwater or fluvial bank erosion.

5.5 Suspended Sediments

Total suspended solids (TSS) data has been collected at Riley Creek since 1963. TSS data has been presented and analyzed in the Engineer's Annual Report since 1970. However, the suitability of the TSS data to represent the characteristic climatic and hydrologic variability of the Riley Creek watershed has not been determined. Therefore, the historical data has been revisited in order to identify trends in the amount of sediment produced by the upland areas of the watershed and to relate the amount of sediment conveyed through the main channel with precipitation and flow data. This analysis is discussed in detail in Appendix B.

The study began with analyzing the earliest TSS measurements collected in 1963 by the Minnesota Department of Health, and in 1969 by the MPCA. Grab sample measurements of TSS and turbidity were measured upstream of Lake Riley and downstream of US 212 from 1972 through 1995. Estimating total sediment load from these earlier measurements is difficult because they were conducted randomly, and did not necessarily cover all of the high flow periods, when most of the sediment is transported. TSS values at US 212 were generally greater than measured upstream of Lake Riley, even though much of the suspended sediment from upstream of Lake Riley settles in the lake. This supports the notion that the channel bed and banks of the Lower Valley are contributing a greater amount of total sediment load than the channel upstream of Lake Riley.

The Watershed Outlet Monitoring Program (WOMP) station was installed at US 212 in 1998. Grab and composite sediment samples were obtained on a bi-weekly to monthly basis, with more frequent composite samples during periods of high flows in the creek. The samples were analyzed for TSS concentration and volatile suspended solids (VSS), which is a measure of the organic content of the TSS. In addition, precipitation and flow rates were recorded every 15 minutes. This more detailed data collection, with an emphasis on high flow conditions, provides much more valuable data from which to estimate the total suspended sediment load.

Two different relationships were derived for estimating the total sediment load in the Riley Creek Lower Valley watershed. The first relationship is based on the best fit between the measured concentration of TSS and the corresponding flow rates, accounting for the results of both grab and composite samples. The second relationship is based on the best fit between the measured sediment load and the corresponding runoff volume, accounting for the results of composite samples (collected during high flows) only. The second approach is preferred, and yields an average sediment transport rate of suspended solids of 1675 tons per year, or 704 tons per square mile, as shown in Table 4.

The concentration of VSS from the 1999-2004 WOMP data represents, on average, only 12 percent that of TSS. The measurements in 1963 indicated that the concentration of organic matter represented as much as 40 percent of total solids. A likely explanation is that urbanization of the watershed reduced the amount of agricultural runoff to the stream, which is typically higher in organic matter than runoff from urbanized areas.

Table 4. Estimated Sediment Load (tons/year) in the Riley Creek Lower Valley Watershed

Year	Cumulative from composite samples	Based on relation between TSS and flows	Preferred, Based on relation between Load and volume runoff
1999	61	650	1750
2000	17	65	550
2001	357	4350	2550
2002	38	2150	2050
2003	144	400	1050
2004	82	5000	2100
Average	117	2103	**1675**

5.6 Results of XP-SWMM runs

Four simulations for the Riley Creek Lower Valley watershed were conducted using the event-based calibrated XP-SWMM model previously discussed in Section 3.0:

- Runoff event corresponding to a return period of 2 years, duration of 6 hours, and existing (2006) land use conditions.

- Runoff event corresponding to a return period of 10 years, storm duration of 6 hours, and existing (2006) land use conditions.

- Runoff event corresponding to a return period of 2 years, storm duration of 6 hours, and ultimate (2020) land use conditions.

- Runoff event corresponding to a return period of 10 years, storm duration of 6 hours, and ultimate (2020) land use conditions.

These events were selected for the following reasons. Preliminary XP-SWMM runs showed that the 6-hour storm event produces the largest peak flows in the Lower Valley watershed. In general, the magnitude and duration of relatively high flows in the Lower Valley watershed downstream of Pioneer Trail do not appear to be affected by discharges from Lake Riley, hence the typical duration of the rising limb of the flood hydrograph is relatively short. A flood event with a recurrence interval between 1.5 to 2.5 years is usually considered responsible for determining the geometry of a stream channel in temperate environments. The larger flood event with a recurrence of 10 years was included in this evaluation to investigate the potential for significant changes in the stream profile resulting from larger volumes of sediment being transported. Flood hydrographs at thirteen different locations along the main stem of Riley Creek in the Lower Valley are presented in Figures 17 through 20.

For the reach upstream of Pioneer Trail, as indicated above, flows are primarily controlled by the outlet channel and structure of Lake Riley, with flows increasing at a much slower rate than in the reaches downstream. Between Stations 40+00 and 90+00, the flows substantially increase and the shape of the hydrographs change, and subsequently increase even more progressing further downstream, between Stations 90+00 and 140+00. This increase in large flows is important because it represents flows that are capable of mobilizing significant quantities of bed sediment. The reach between Stations 110+00 and 140+00 has been identified in the field as undergoing severe channel incision (down-cutting), and likely the reach that most critically requires stabilization. Greater increases in peak flows and particularly the duration of relatively high flows is observed in the reaches downstream of Station 140+00, but in this sector the channel has a more developed floodplain area which allows the stream to pass floods without substantial increases in flow velocities that would cause significant erosion of the channel bed or channel banks.

A comparison of Figures 17 and 19 show that peak flow of the 2-year flood event can increase by as much as 50 percent near the lowest reaches of Riley Creek (near US 212). This increase is in part explained by discharges from stormwater ponds located on the eastern end of the catchment area to control runoff volumes, and localized flows and suspended sediments being delivered to the main channel. An increase of this magnitude would definitely have a negative effect on the morphologic stability of the stream. It is worth pointing out, however, that the simulations for ultimate (2020) land use conditions did not consider implementation of additional Best Management Practices (BMPs), so the actual conditions may be less critical than assumed in this evaluationn. Comparison of Figures 18 and 20 does not show a big change for the 10-year flood events under existing (2006) and ultimate (2020) land use conditions.

It is standard practice to determine the morphodynamic stability of a stream based on an indicator of the erosive energy (e.g., stream power or boundary shear stress) that is normally associated with the peak flow magnitude. However, such assessment is incomplete, as the amount of sediment that is transported during the passage of a flood is a function not only of the peak flow but also of the duration of the so-called competent flows (that is, those flows that are able to mobilize bed sediment in significant quantities). For instance, it can be anticipated that a flood event with a peak flow of 100 cfs and a duration of 3 hours above a threshold value of 20 cfs would mobilize significantly less bed sediment than a flood event with the same peak flow of 100 cfs but a duration of 50 hours above the same threshold value of 20 cfs.

XP-SWMM produces an output hydrograph in time increments as fine as 1-minute. This information was tabulated to compute first an indicator of the erosive energy of the flowing water, which was aggregated over the entire flood hydrograph. This indicator was then used in combination with the bulk sediment transport relation by Engelund and Hansen (1976) to compute the total load of sediment transported during the given hydrograph. The results were considered reasonable when compared against the TSS data collected at the WOMP station (see Section 5.5), with total sediment concentrations in the order of 2,000 to 3,000 mg/L for the 2-year flood events, and in the order of 5,000 to 12,000 mg/L for the 10-year flood events.

For the 2-year storm event, the reach-averaged sediment transport rate under ultimate (2020) land use conditions increases by only 8 percent with respect to the case under existing land use conditions, however the lower reaches of Riley Creek could see increases as high as 35 percent. A similar small increase is observed for the 10-year events comparing existing and ultimate land use conditions. However, the sediment transport rates are as much as three times higher for the 10-year event compared to the 2-year event. Therefore, appropriate measures to maintain or even reduce the magnitude of the 10-year and larger flood events could help alleviate significant erosion of the channel bed and banks during these extreme events.

For any of the scenarios, the sediment transport rates increase significantly (one to three times) from Station 94+00 to Station 117+00, and decreases downstream of Station 146+00. This is strong evidence that the reach between Stations 110+00 and 140+00 is currently undergoing severe channel incision, which could be aggravated if the channel bed is not stabilized in this reach.

Figure 17. Modeled Flood Hydrograph, Existing Conditions, 2-Year Event

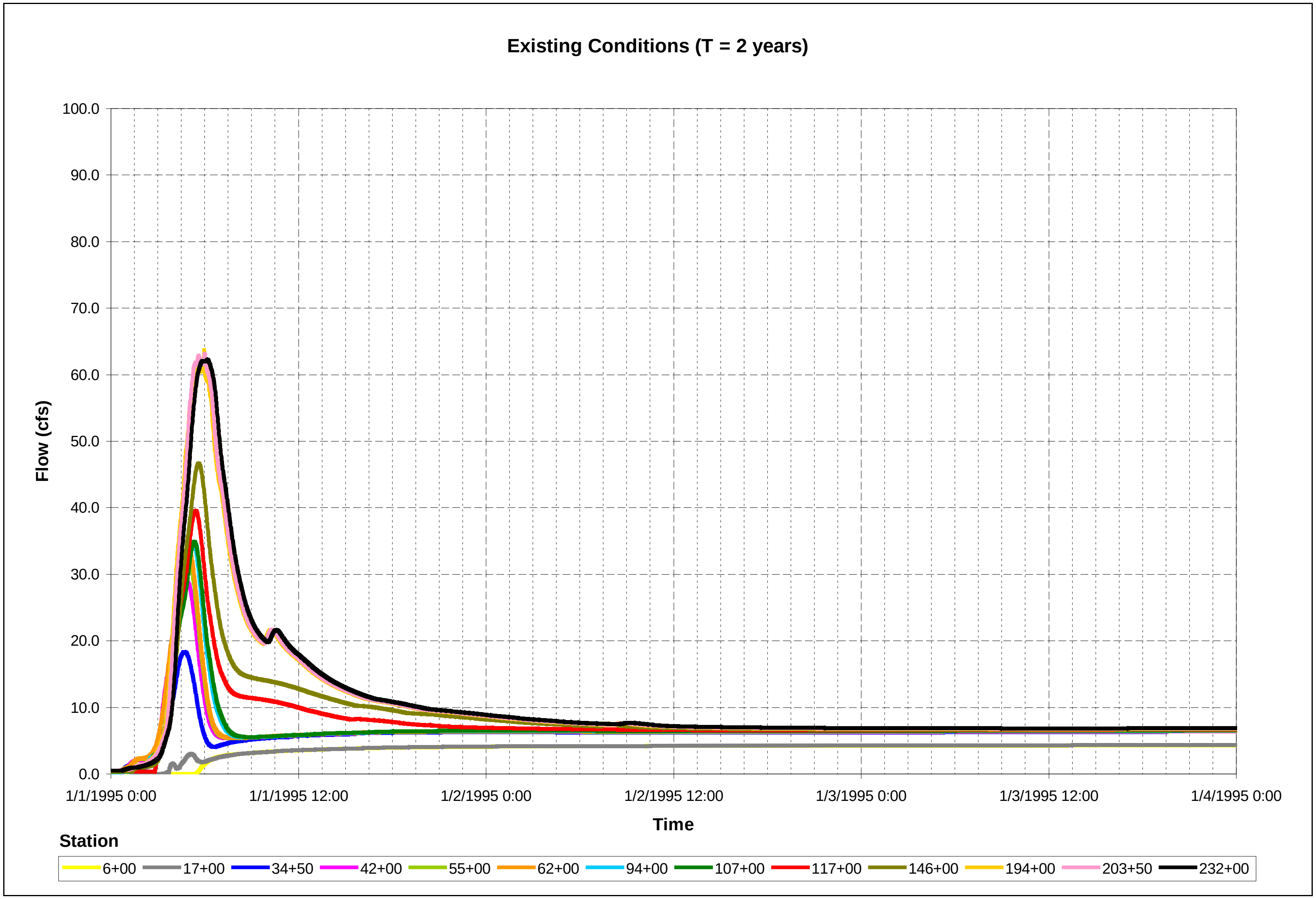


Figure 18. Modeled Flood Hydrograph, Existing Conditions, 10-Year Event

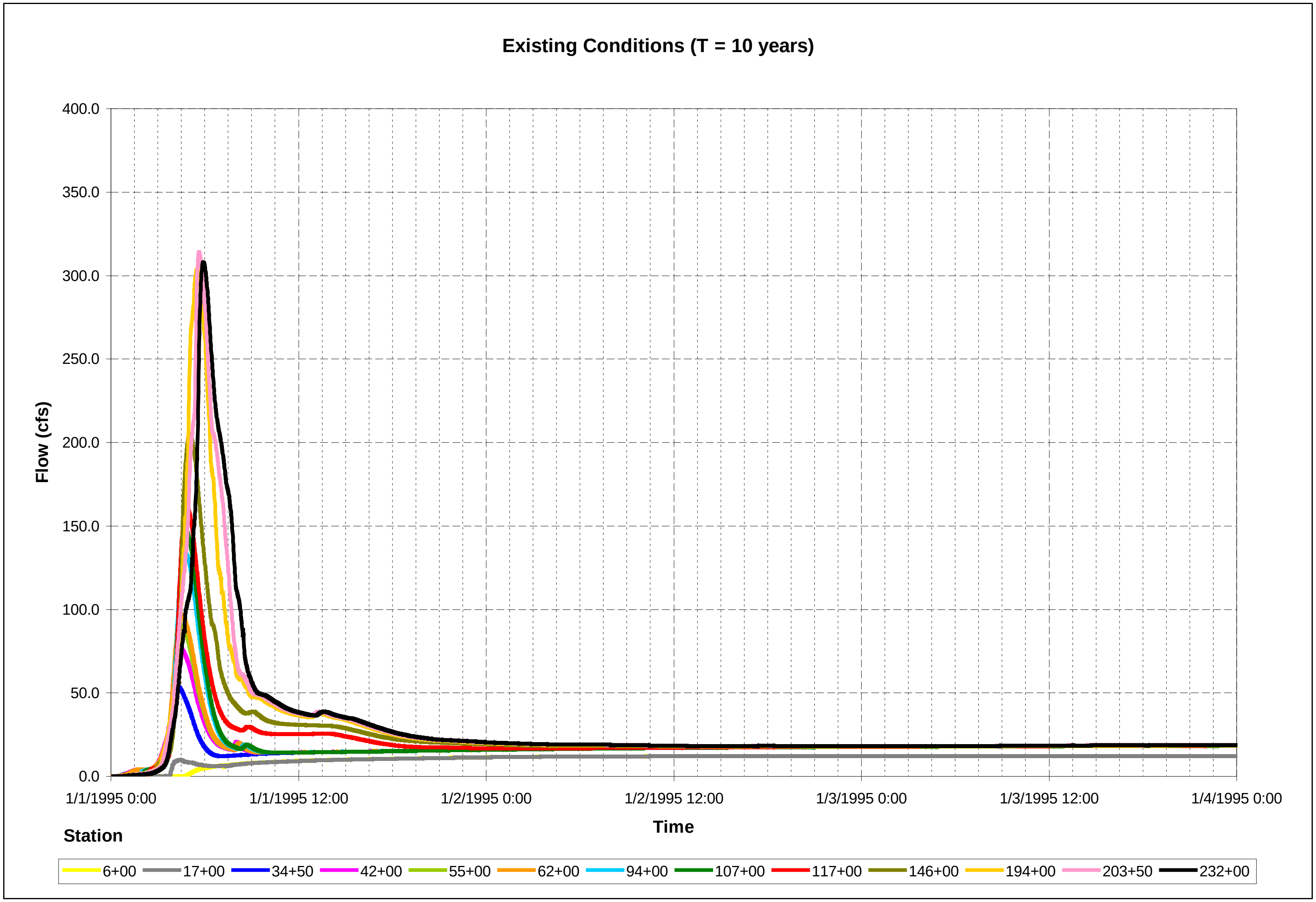


Figure 19. Modeled Flood Hydrograph, Future Conditions, 2-Year Event

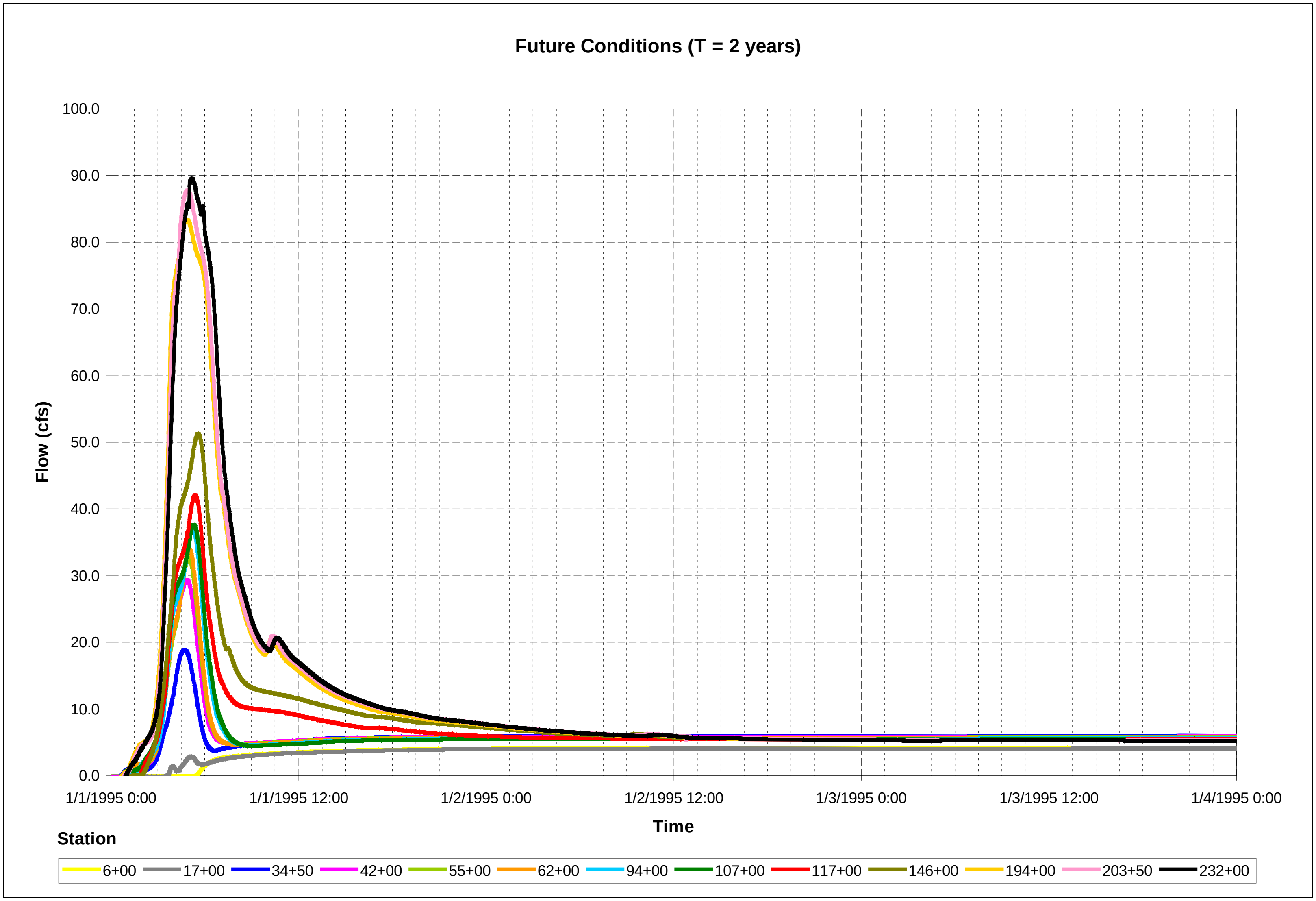
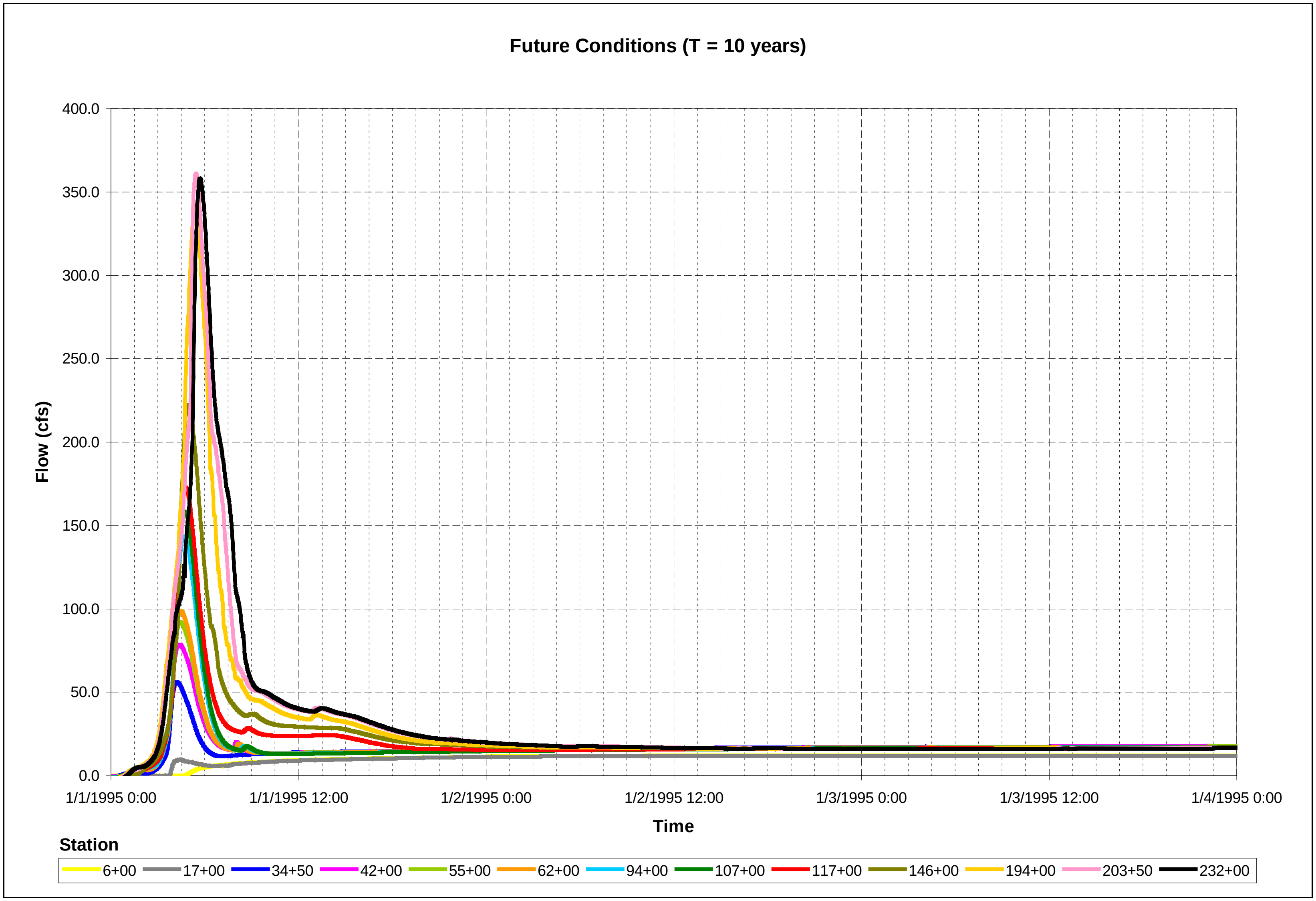


Figure 20. Modeled Flood Hydrograph, Future Conditions, 10-Year Event



6.0 Stream Reach Descriptions

A detailed field survey was completed in the Lower Valley of Riley Creek during 2005-2006. Channel dimensions were measured at representative locations; the channel thalweg (low point) was surveyed; and significant erosion areas were mapped. Worksheets describing the geomorphological characteristics of the stream are contained in Appendix C. Streams can be broken down into reaches that have distinct characteristics from other portions of the stream. Both man-made and natural features can generate boundaries between reaches, as is the case with Riley Creek. The creek is divided into several reaches and characteristics of each reach will be described.

Figures A-1 to A-17 (Appendix A) illustrate portions of the following discussion.

6.1 Reach A – Lake Outlet to Station 30+00

Reach A is a stable reach as it passes from Lake Riley to Pioneer Trail. The valley along this reach is open and the stream has well-established and adequate floodplains available. The channel geometry is typical for a stream such as Riley Creek. The cross sectional area, mean depth, maximum depth, flood flows and flood velocities are all within normal ranges and indicate that the channel is relatively stable.

Riley Creek has a very mild slope of less than 0.25 percent between the Lake Riley outlet and Lakeland Terrace (Figure A-1), resulting in this reach being stable. The slope of the reach between Lakeland Terrace and Pioneer Trail (Figure A-1) ranges between 0.5 percent and 0.75 percent and also appears to be very stable. The same slope range exists between Pioneer Trail and Station 30+00 (Figure A-2). As previously mentioned, these slopes warrant periodic monitoring, but the frequency of culverts along this reach would cause any erosion problems to remain localized. By the time the stream passes under Pioneer Trail, the channel has increased in size by a small but reasonable amount since the contributing watershed area has also grown. The stream still has rather healthy and typical characteristics of a stream with woody riparian vegetation. It goes through typical pool-riffle sequences, which indicate a stable bed and a diversity of habitat for aquatic organisms. The stream has a slightly small width-to-depth ratio, which is the ratio of the bankfull width to the bankfull depth. However, the valley is relatively steep and narrow, which can contribute a lower width-to-depth ratio.

There is relatively little noteworthy erosion in this reach, but the erosion that is present is predominantly fluvial bank erosion, of which most is relatively normal and a low priority for repair.

The primary feature in this reach that requires attention is the culvert under Lakeland Terrace. There is one high priority problem within this reach (Site A1). This is described in detail, along with a proposed remedy, in Appendix D.

6.2 Reach B - Station 30+00 to Private Drive (Station 61+00)

Reach B is similar to Reach A with the primary difference being that the valley and the floodplains are not as wide as in Reach A. The stream channel is slightly larger within this reach, but it is within proportion to the increase in watershed area that contributes flow to this portion of the stream. The cross sectional area, mean depth, maximum depth, flood flows and flood velocities are all within normal ranges. All of these parameters show slight increases when compared to Reach A, but this would be expected due to a slight increase in contributing watershed area.

The channel slope is between 0.25 percent and 0.75 percent for this entire reach (Figures A-3 to A-5). Much like Reach A, it appears to be stable. The width-to-depth ratio for this reach is acceptable, but borderline too low for a stream in a wooded area. The pool-riffle sequences are still present along this reach, so the stream bed appears to be fairly stable. The combination of the stream slope, narrowing valley and borderline-low width-to-depth ratio warrants periodic monitoring of this reach to detect early signs of additional erosion problems.

There is more bank erosion within this reach compared to Reach A, but most of it appears to be part of natural stream processes and are currently low priorities for repair. There are no high priority sites within this reach. There are two other sites of lower priority that will eventually require some attention, and they are described in Appendix D.

6.3 Reach C - Private Drive to Dell Road (Station 61+00 to 70+00)

Reach C is a short, but unique reach on Riley Creek. The changes in channel characteristics are similar to the changes from Reach A to Reach B, with a few exceptions. The valley in this reach is very narrow, so the floodwaters do not have much room to spread out and dissipate energy. This is likely a cause for the channel to continue to grow larger and the width-to-depth ratio to become abnormally low for a stream in a wooded area. Because of the large channel and small floodplain, the flood flows and flood velocities are rather high. The high flood velocities have caused this reach to experience some channel incision, and it currently has some fluvial bank erosion issues. The channel incision that has taken place will possibly lead to some additional bank failures. For nearly 200 feet immediately downstream of the culvert under Private Drive, the stream has a slope of greater than 1 percent. This relatively steep slope is likely a remnant of the channel incision. The remainder of the reach has slopes between 0.5 and 0.75 percent (Figure A-5). The presence of culverts under Dell Road and Private Drive provide a degree of grade control and flow constriction that helps prevent some additional erosion from taking place. There are pool-riffle sequences within this reach, so this reach appears to be fairly stable.

There are no high priority sites within this reach, but it should be monitored to detect any additional problems as they develop. The channel incision will eventually need to be addressed, but it is possible that it can wait until the work can be done in conjunction with any major work that would be done on Dell Road, either replacing the culvert or complete road reconstruction. Details of the work necessary at that time are discussed further in Appendix D.

6.4 Reach D - Dell Road (Station 70+00) to Station 100+00

Reach D is similar to Reach A and B in that the stream appears to be relatively stable. The valley continues to deepen through this reach, but the stream still has sufficient, well developed floodplains in most areas. Erosion is typically limited to bank erosion. The frequency of tall, eroding banks is increasing in this reach, but they would typically remain low priorities for repair.

The cross sectional area continues to slowly grow larger, as do the widths, depths, flows and velocities. The width-to-depth ratio is larger than in Reach C, but it is still small enough to be a concern for long term stability. The channel slopes range from 0.25 percent to more than 1 percent (Figures A-6 and A-7). Another possible future concern for this reach is that the next reach downstream is experiencing some significant changes that could begin to impact this reach. Given the low width-to-depth ratios, the occasionally high channel slope, the increase in bank erosion, and the downstream changes, this reach should be monitored annually.

One site along this reach that is a high priority for repair, but not directly on the stream, is Site D3. A gully that carries runoff from residential neighborhoods is experiencing significant bank erosion that is likely contributing very high sediment loads to the stream. This is discussed in detail in Appendix D.

6.5 Reach E - Station 100+00 to Station 140+00

The stream makes a dramatic change in Reach E. Compared to Reach D, the cross sectional area triples to 150 square feet; the mean depth nearly doubles to 4.5 feet; the maximum depth increases by 50 percent to 7 feet; the flood flows triple to 980 cfs for bankfull flow; and the flood velocities increase by 25 percent to 6.6 feet per second. The channel slope varies much more than in the upper reaches, ranging from less than 0.25 percent to greater than 1 percent (Figures A-8 to A-10). This is the result of this reach experiencing severe channel incision. Channel incision can be caused by both natural and man-made processes, and it is often difficult to pinpoint the exact cause. However, in this case, it is likely that the urbanization of the watershed generated increased runoff volume, which in turn increased the frequency of high velocity flows that can cause channel incision. Also, it is possible there was a natural weakness within the channel system that was exploited by the increased volume in the creek. The stream is currently trying to reach an equilibrium with its watershed. After the initial incision, the stream channel typically erodes its banks and forms a wide, deep channel. From there, it will continue to erode the banks and the channel more slowly as it works to reestablish a floodplain at an appropriate level. This process can take many years to complete and significant amounts of erosion can occur during the process. It is possible to help the stream along during the process by constructing a stable channel that is properly connected to a floodplain.

Stabilizing this reach is a high priority issue. In total, there are ten erosion sites within this reach, including four high priority erosion sites (Sites E1, E2, E3 and E7) within this reach that require immediate attention. This is detailed in Appendix D. This reach needs annual monitoring until the high priority sites are corrected.

6.6 Reach F - Station 140+00 to Eden Prairie Road (Station 168+00)

This portion of the creek is a transition reach. The upper portions of this reach are downstream of Reach E and experience some influence from that reach. The upper half of this reach has woody vegetation along its banks. This reach has some floodplain, but less than required. The lower half of this reach also has woody vegetation on its banks, but the vegetation quickly transitions into grasses further away from the stream. The channel characteristics of cross sectional area, mean depth, maximum depth, flood flows and flood velocities show a gradual increase when compared to Reach D, which provides a better comparison than Reach E since it has not experienced the same amount of erosion. This is a normal progression as more watershed area contributes to the flows.

In this reach, the stream returns to a healthy width-to-depth ratio. Pool-riffle sequences increase in frequency, but at not as prominent as they are in the upper reaches of the stream. Most of this reach has slopes that range between 0.5 percent and 0.75 percent, however there are a few isolated reaches with more severe slopes, including a few of over 1 percent (Figures A-11 to A-12). The primary difference between this reach and any of the reaches further upstream is the amount of floodplain available to the stream. In some places, the stream has an extremely large floodplain, which helps the stream dissipate energy and detain water during high flow conditions.

The dominant erosion on this reach is isolated fluvial bank erosion, primarily on the upper portions of this reach. All in all, this reach is fairly stable, with one significant exception. At station 157+00, a log jam has developed that blocks the stream in high flows and has resulted in a new channel being formed. This is a high priority site, Site F1, that requires immediate attention. Site F2 is not as high priority but would best be done in conjunction with construction on the 2008 Eden Prairie Road improvements. This is explained in detail in Appendix D.

6.7 Reach G - Eden Prairie Road to Fish Dam (Station 168+00 to Station 186+00)

This reach is very stable, with only a few isolated bank erosion sites that appear to be part of normal stream processes. There is an unexpected decrease in many of the characteristic channel parameters within this reach. Between Eden Prairie Road and the fish barrier on the former Cedar Hill Golf Course, the channel cross sectional area actually becomes smaller and is approximately the same size as downstream of Pioneer Trail. The slope through this reach is generally milder than through some of the upper reaches with most of the slopes ranging between 0.25 percent and 0.5 percent with a few steeper reaches (Figure A-13).

There are several possible reasons for the channel to decrease in size within this reach. First, the size of the culvert under Eden Prairie Road reduces the peak flows downstream of the culvert. Second, the large floodplain upstream of Eden Prairie Road detains floodwater thereby reducing peak flows downstream of Eden Prairie Road. Third, the large amount of erosion that is taking place within the critically incised reach has resulted in a considerable amount of sediment to enter the stream system. As the sediment slowly moves downstream, it will settle out and then be resuspended in flood flows. This is possibly resulting in the reach downstream of Eden Prairie Road simply filling with sediment that has been washing downstream, thus making the channel smaller. This would also explain the fact that typical pool-riffle sequences are largely non-existent downstream of Eden Prairie Road and that the width-to-depth ratios are very large for this reach of the creek. Last, the reach just upstream of Eden Prairie Road is the reach farthest upstream that consistently carries baseflow. All reaches upstream of this area periodically run dry. The reaches that consistently carry baseflow are more consistently in equilibrium with the moving water, and therefore the streambed is less susceptible to increased shear stresses during floods.

The fish barrier at the downstream portion of this reach has acted as very effective grade control and helped keep this reach stable. Several springs exist along this reach, maintaining baseflow from this reach on downstream. There are no erosion sites within this reach that are discussed in Appendix D. Periodic monitoring should be sufficient for this reach.

6.8 Reach H - Fish Barrier to Spring Road (Station 186+00 to Station 205+00)

The channel in Reach H shows a gradual increase in characteristic channel parameters that are consistent with an increased watershed area, much like the transitions between reaches on the upper portions of this stream. The channel cross sectional area is still surprisingly small, and the same reasons described in Section 6.7 likely apply here as well. In addition to those potential reasons, the fish barrier likely dampens some peak flows as well. Otherwise, channel width, depth, flood flows and flood velocities look reasonable. The slopes along this reach Range from 0.25 percent to 1 percent (Figures A-14 and A-15).

There appear to be relatively few problems with the stream itself, but this reach is experiencing some significant erosion from tall, eroding banks, most of which are either being caused by or exacerbated by groundwater seepage. Springs are present in abundance along both sides of the valley. The presence of springs along the toes of the bluffs makes the toes more susceptible to erosion during high flows in the stream. When the toe erodes away, the bluff above the toe is undermined and portions of the bluff fall into the stream. Along with Reach E, this is a high priority reach. There are four high priority sites, Sites H1, H2, H3 and H6, that will require immediate attention. These and other lower priority sites are discussed in detail in Appendix D. This reach needs annual monitoring until the high priority sites are fixed.

6.9 Reach I - Spring Road to Hwy 212 (Station 205+00 to Station 234+00)

The last reach within the Lower Valley is fairly stable. Once again, there is a typical increase in characteristic channel parameters. The channel is slightly larger and can carry than in Reach H. The slopes on this reach range from 0.25 percent to some short reaches with greater than 1 percent (Figures A-15 to A-17).

There are a few springs through this reach that contribute to some erosion, but the problems are not nearly as severe as in Reach H. They will likely require some attention in the future, but they are not high priorities. There are two medium to high priority sites, Sites I3 and I4, along this reach that involve erosion of the embankment for Spring Road. These are detailed in Appendix D. This reach needs annual monitoring until the high priority sites are fixed.

7.0 Stabilization Measures

The following is a brief discussion of potential stabilization measures for the Lower Valley of Riley Creek. For additional information on the proposed measures, please refer to the schematics presented in Appendix E.

7.1 Vegetation Management

Vegetation management involves the selection of an optimal species mix to contribute to a healthy and stable stream. Typically an optimal species mix will provide good root structure to help stabilize streambanks and provide good habitat for riparian birds and animals. Obtaining this mix often requires planting new species, removing unwanted or exotic species, and/or thinning existing vegetation to provide enough sunlight to allow new ground vegetation to become established. Vegetation management is recommended for the entire Lower Valley, where mature trees block most of the sunlight from reaching the forest floor during the summer months. It is recommended that invasive species of vegetation and less desirable tree species be removed, leaving the more valuable trees and vegetation in place. Supplemental planting of ground vegetation is also desirable.

7.2 Channel Grade Control

Grade control measures are used where channel downcutting has occurred. This is common on Riley Creek where the channel is confined by the steep valley walls, and where the channel slope is relatively steep. Both of these factors contribute to high flow velocities during flood conditions, thereby increasing the sediment-carrying capacity of the stream. This tends to result in channel downcutting and subsequent widening as the banks become oversteepened and slump into the channel.

The grade control measures should be constructed with boulders and coarse gravel. A V-shaped weir is constructed so that the flow is concentrated toward the center of the channel and away from the banks. Multiple weirs can be constructed to stabilize a longer reach.

7.3 Low Bank Stabilization Measures

Lower bank “toe” protection measures are used at the lower portion of the bank when it is being undercut by channel flow, resulting in bank sloughing and mass wasting. Such erosion is common on Riley Creek, and these measures are recommended at many of the restoration sites.

The recommended bank toe protection measures explained below should be used in conjunction with upper bank stabilization techniques.

7.3.1 Rock Vanes

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 not move during flood flows or by vandalism, with additional smaller rock material to add stability. Rock vanes function in much the same way as rootwads in that they push the stream centerline away from the outside bend. They also promote sedimentation behind the vane, which adds to the toe protection.

7.3.2 Root Wads

Root wads consist of logs with the root ball attached anchored into the bank, so that only the root ball is exposed. Typically placed about half below and half above the normal water line, they are well suited to deeper locations such as outside bends. The trunk portion is placed in the bank by either placing it in a trench or by pushing the trunk into the bank. The root wad absorbs energy and diverts flows away from the bank. Rootwads are generally cost effective and provide excellent fish habitat.

7.3.3 Stone Toe Protection

Stone toe protection employs stones to armor the toe of the bank. It is often used on sites that are too shaded to support good ground vegetation cover, and where vanes or root wads are not necessary. Stones are selected to be large enough so that they would not be moved by flood flows, but small enough to be consistent with the size of other stones found in and near the stream and thus appear natural.

7.4 High Bank Stabilization Measures

High bank stabilization methods are employed on the taller eroded banks to prevent future slumping and bank failure. Bank stabilization will reduce sediment loading to the stream and will reduce the loss of adjacent property.

Stabilizing the high, eroded banks of the Lower Valley will require a combination of methods, depending on the specific site conditions. In particular, many of the erosion sites are exacerbated by groundwater seepage, which when combined with steep banks, sparse vegetation, and fluvial erosion leads to bank failure. Two basic methods of upper bank stabilization are recommended for Riley Creek – bank grading and revegetation, and vegetated reinforced soil slope technique. With either method, stabilization of the lower bank is usually required and is a priority if resources are limited.

Grading and revegetation of the eroded bank is the most common method for stabilization. With this method, the upper bank is graded at a 2:1 (2 foot horizontal to 1 foot vertical) or flatter slope to allow for replanting. The slope is typically seeded with a cover crop and covered with erosion control fabric. Plant plugs and shrubs such as willows or dogwood can then be installed through the erosion control fabric.   The stabilized slope and vegetation work together to prevent erosion from stream flows, wind, and raindrop impact.

Vegetated reinforced soil slope (VRSS) is the second method recommended for upper bank stabilization on Riley Creek. It is typically used on steep slopes where grading the bank to a more stable slope is not an option due to site restrictions. 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, if given enough 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, somewhat expensive.

Appendix C

Excerpts from Creek Restoration Action Strategy

Riley Creek Assessment

Dell Road to Eden Prairie Road

Conducted by: RPBCWD staff [Josh Maxwell; Sean Grogan]
Conducted on: 23 October 2015

Summary

Site/Scope

On the 23rd of October 2015 at 1030, Riley Purgatory Bluff Creek Watershed District (RPBCWD) staff and a University of Minnesota (U of M) student conducted a stream corridor assessment of multiple subreaches within Reach 2 of Riley Creek. Staff started at Dell Road below Lake Riley and walked downstream to the Eden Prairie Road (approximately 1.6 stream miles). Staff walked both sides of the creek to assess overall stream conditions and to discover and prioritize possible restoration locations. Staff conducted a Modified Pfankuch Channel Stability Assessment and a Minnesota Pollution Control Agency (MPCA) Stream Habitat Assessment (MSHA) on the sub reach to better characterize the stream. A GPS, and a GPS-enabled camera were used to mark points and take photos.

- All pictures were taken Facing Downstream unless noted otherwise.
- Right and Left bank are defined by looking downstream.
- Erosion was defined as Slight, Moderate, or Severe.
- Stream bank Erosion was measured from the streambed to the top of the eroding bank.
- Vegetation was defined as Sparse, Patchy, or Dense.
- All measurements were recorded in Meters.
- All major erosion sites were labeled on the GPS by the erosion site number and reach (E#R2).

Weather Conditions

Wind: 10 mph
Temp: 13°C
Cloud Cover: 100%
Rain Total: 0.23 inches

Stream Features

This section of the river passes through deciduous forests and residential areas, ending in a grassy mix near Eden Prairie Road. All subreaches had similar substrates with fine sand and silt being predominant. Slope gradients within the upper reaches were relatively steep averaging 50 to 60%, while subreach R2E was <30%. The stream was fairly sinuous with some long stretches within each subreach being straight. The upper 2 reaches were dry on the day of the walk. There was very little stream development (riffle, run, pool) in all subreaches.

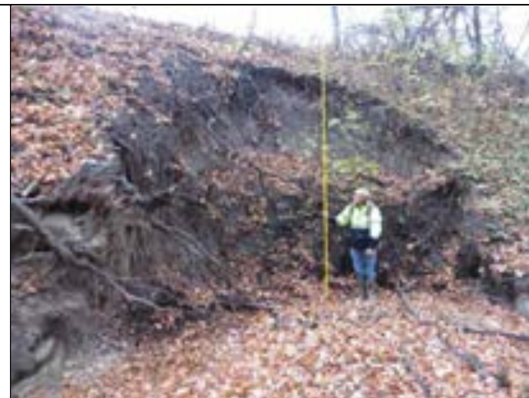
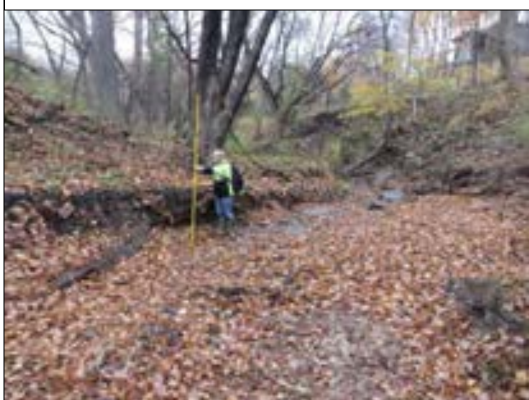
Areas of Concern

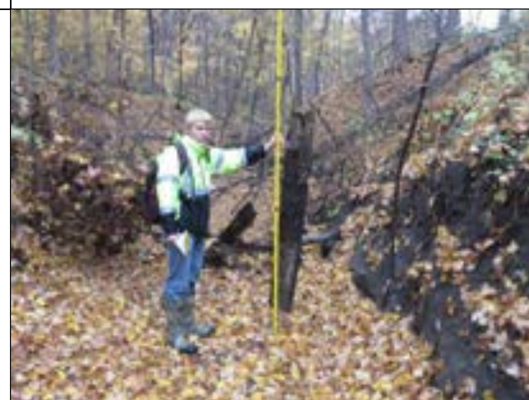
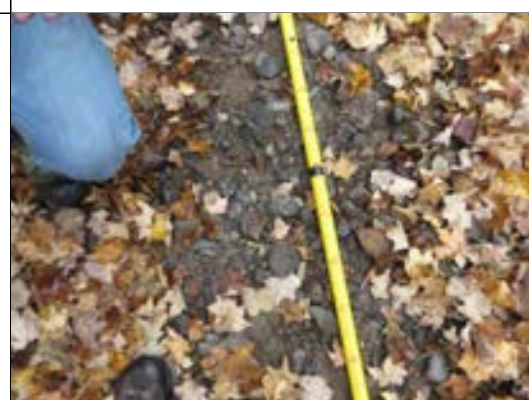
The top two subreaches assessed were severely entrenched and most likely are responsible for contributing sediment yearlong downstream. Both had suspended and/or eroding stormwater culverts riddled throughout. Subreach R2C was incised with raw banks exposed between 1 and 2m in height along the entire stretch. Mass wasting site E1R2 was identified with the subreach measuring 6m by 9m. Several other large erosion sites, mainly around outside bends, were within subreach R2C. Subreach R2D was previously identified within the CRAS as being within the top 10 candidates for restoration project implementation. The entrenchment within this subreach restricted the stream channel, forcing a tight meandering pattern that is causing severe mass wasting and very large erosion sites on almost every bend. Mass wasting site E2R2 measured approximately 13m high by 15m long and had a shear vertically exposed bank. The site also had orange safety fence along the top of the erosion site as a recreational trail runs along the stream. The remainder of the stream was incised on average about 3m. Subreach R2D was incised up to 1m on the upstream half of the section, but was considerably better than the upstream subreaches.

Subreach R2C–Upper Third between Dell Road and Eden Prairie Road **MSHA:** 39 (Fair); **Pfankuch:** 114 (Unstable)

Staff began the creek walk downstream of the culvert under Dell Road below Lake Riley (IMG_5323). The stream subreach is surrounded by a fairly low density deciduous forest with residential development set back about 100m. The culvert under Dell Road was metal and had a diameter of approximately 1.8m. Riprap was placed downstream of the culvert and barbed wire was stretched across culvert (IMG_5323) and along the right bank. Nearly immediately following the culvert, the stream takes a 90 degree turn to the right causing a large washout on the left bank measuring 4.5 x 4.5 m (IMG_5325 and IMG_5327). The creek in this section is continuously incised by approximately 1m with severe incising up to 2m present (IMG_5326). Moving downstream another washout was present as the stream approached Dell Road. The creek swings close to the right bank causing erosion measuring 5m in height, and wraps around a narrow peninsula with erosion measuring 2-3m (IMG_5327). Before the channel swings around the peninsula, the channel was directed into the left bank causing another large erosion site measuring approximately 4m by 6m (IMG_5328). This large erosion has caused a stormwater culvert to be suspended in the air approximately 2.5 m above the stream bed. The substrate within this subreach is dominated by fine silt and gravel with depositional areas being frequent (IMG_ 5329). Boulders are also sparsely present in the channel at the upper portions of the subreach (IMG_5330). Continuing downstream woody debris is littered the channel from the eroding upper banks, including right bank erosion site seen in IMG_5331 measuring 4x4 m. Just downstream of the previously described erosion site, a mass wasting site is located on the right bank measuring 6m x 9 m (IMG_5332). This site was identified as major erosion site E1R1.

Following the mass wasting site a barbed wire fence crosses the stream channel as it straightens. IMG_5334 highlights the stream being incised up to 3m on the right bank and a debris collection point from upstream on the left bank. Staff then noticed a slight change in the substrate which had larger gravel present with silt still abundant (IMG_5335). Moving downstream the right bank was again severely cut on the outside bend measuring 4.5 x 8m. Eden Prairie previously installed bank pins at this location which were exposed approximately 1.3m (IMG_5337). Eventually, staff came across a wooden/steel bridge which had undercutting near the footings (IMG_5338). Downstream of the bridge the right bank had a healing mass wasting site on the right bank measuring 4.5 x 8 m (IMG_ 5339). Just before the 2nd bridge in IMG_5343, a tributary which drains a housing development entered on the left bank and had an additional wood/steel bridge (IMG_5342). The bridge over the main stream has exposed erosion blankets in attempt to stop further undercutting under the bridge (IMG_5343). Following the bridge, the right bank was cut measuring approximately 3x10m with many trees from the upper banks fallen into the channel (IMG_5344). This subreach became more severely entrenched as staff moved downstream (IMG_5340, IMG_5341, and IMG_5345).

	**IMG - 5323** Culvert under Dell Road, photo taken facing upstream		**IMG – 5325** Hillside washout just east of Dell Road
	**IMG – 5326** Stream continuous incised (1m)		**IMG – 5327** Hillside washout just east of Dell Road
	**IMG – 5328** Suspended stormwater culvert		**IMG – 5329** Substrate was fine silt and gravel

	**IMG – 5330** General stream photo, note the stream is incised 2m		**IMG – 5331** Woody debris and continuous incised 1.5m
	**IMG – 5332** Severe mass wasting site on right bank, E1R2		**IMG – 5333** Barbed wire across stream channel
	**IMG – 5334** Woody debris and large cut on outside bend of right bank		**IMG – 5335** Substrate in run is sand/gravel
	**IMG – 5336** Very large erosion cut on outside bend of the right bank		**IMG – 5337** Bank pin exposed 1.3m

	**IMG – 5338** Bridge		**IMG – 5339** Healing mass wasting site
	**IMG – 5340** General stream, note the stream is incised up to 2m		**IMG – 5341** General stream photo
	**IMG -5342** Bridge over tributary that enters stream on the left bank		**IMG – 5343** Bridge
	**IMG – 5344** Woody debris and erosion		**IMG – 5345** Entrenched stream 2-3m

Subreach R2D–Middle Third between Dell Road and Eden Prairie Road **MSHA:** 26.5 (Fair); **Pfankuch:** 126 (Unstable)

Image 5346 begins subreach R2D. This subreach was identified by the steepening slopes, the severe entrenchment of the channel, and by the severe erosion present. Substrate in this subreach is dominated by silt, but gravel and sand were also present. The residential housing in this subreach is set back aproximatley 80 m from the stream banks. Just downstream of the beginning of the subreach, a mass wasting site measuring 4 x 8m is located on the left bank and has upper bank trees downed within the channel (IMG_5346). Moving donstream the 2nd major erosion site was identified as E2R2. The site was located on the left bank and measured approximately 13m high by 15m long on with shear vertically exposed banks (IMG_5348, IMG_5349, and IMG_5350). The site also had orange safety fence along the top of the site because a recreational trail runs along the stream. The entrenchment within this subreach restricts the stream channel, forcing a tight meandering pattern that is causing severe mass wasting and very large erosion sites on almost every bend (IMG_5351, IMG_5352, IMG_5357 and IMG_5358). These sites are contributing sediment yearlong and have significant woody debris present in the channel due to the upper bank migration of sediment (IMG_5353, IMG_5354, and IMG_5355). IMG_5356 and IMG_5359 displays the incised stream reaching 3m in height with raw and exposed banks. Moving downstream 2 stormwater culverts enter on both banks starting on the left bank (IMG_5360 and IMG_5361). Both culverts have erosion fabric exposed with moderate erosion occurring. Another cement stormwater culvert was located downstream on the left bank and was broken at the first connection (IMG_5363). Downstream from the culvert, a very large metal pipe was present in the stream channel (IMG_5364) with considerable erosion occurring on the left and right banks near it (IMG_5365 and IMG_5366). Continuing downstream the channel turns right (IMG_5368 and IMG_5369) and then left (IMG_5370) exposing both outside bends and significant erosion.

	**IMG - 5346** Beginning of subreach R2D		**IMG – 5347** Mass wasting site on left bank measuring 4x8 m

	**IMG – 5348** Extreme mass wasting site E2R2 near recreational trail		**IMG - 5349** Extreme mass wasting site E2R2 near recreational trail
	**IMG - 5350** View downstream of extreme mass wasting site E2R2		**IMG – 5351** Severe mass wasting on right bank
	**IMG – 5352** Severe mass wasting on left bank		**IMG – 5353** Severe mass wasting on right bank
	**IMG – 5354** Severe mass wasting on right bank with fallen trees		**IMG - 5355** Severe mass wasting on right bank with fallen trees

	**IMG - 5356** Stream incised up to 3m		**IMG – 5357** Severe mass wasting on the right bank
	**IMG – 5358** Severe mass wasting on the right bank		**IMG – 5359** General stream photo, note stream incised up to 3m
	**IMG – 5360** Stormwater culvert on left bank, note exposed erosion tarp		**IMG – 5361** Stormwater culvert on right bank, note exposed erosion tarp

	**IMG – 5362** Stormwater culvert on right bank, note exposed erosion tarp		**IMG – 5363** Broken concrete stormwater culvert on left bank
	**IMG - 5364** Large metal pipe in stream channel		**IMG – 5365** Right bank erosion
	**IMG – 5366** Left bank erosion, partially healed		**IMG – 5367** General stream photo
	**IMG – 5368** Large erosion site on outside bend of left bank		**IMG – 5369** Large erosion site on outside bend of left bank, note large fallen tree

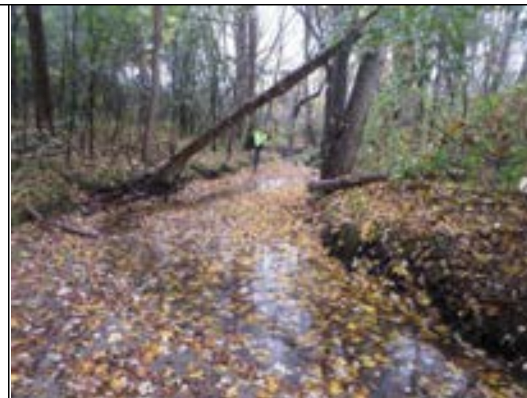
	**IMG – 5370** Large cut on the outside bend of the right bank		**IMG – 5371** Large downed tree within the stream channel

Subreach R2E–Lower Third between Dell Road and Eden Prairie Road **MSHA:** 38 (Fair); **Pfankuch:** 100 (Moderately Unstable)

Subreach R2E had a reduction in the slope gradient (<30%), a change in substrate to almost entirely sand, and a reduction in the overall erosion (IMG_5375). The stream also has a more diverse and dense upland vegetation community (IMG_5376) comprised of deciduous trees and shrubs with more grasses present near Eden Prairie Road (IMG_5383). In IMG_5372 the stream is incised approximately 1m. Around the left bend as seen in IMG_5372, a metal stormwater culvert is suspended in the air about 0.75 m from the streambed and about 2m out from the edge of the bank (IMG_5373). Another culvert was located directly downstream from the previous culvert, however it was sealed with concrete (IMG_5374). Continuing downstream an additional stormwater culvert located on the left bank has broken off at the first segment and is causing considerable erosion downstream (IMG_5377).

The stream became less incised as staff moved downstream (IMG-5379 and IMG_5381) and with the increase in surrounding vegetation, woody debris was building up at stream bends (IMG_5380 and IMG_5386). Continuing downstream, staff came across a private wooden bridge stretching across the stream channel (IMG_5382). Near Eden Prairie Road a past restoration/bank stabilization project was still in place, with bio-logs bordering outside stream bends and unstable banks (IMG_5387, IMG_5389, IMG_5390, and IMG_5391). The stabilization project was functioning correctly and was allowing vegetation to solidify both banks. Eventually the stream flows under Eden Prairie Road which has new riprap placed above and below as part of the culvert that was replaced in 2014 (IMG_5392).

	**IMG – 5372** Stream incised 1m		**IMG – 5373** Suspended metal stromwater culvert on left bank
	**IMG - 5374** Stormwater culvert sealed with concrete		**IMG - 5375** Sustrate was fine sands
	**IMG – 5376** General stream photo, note increase in diversity and density of vegetation		**IMG – 5377** Busted cement stormwater culvert with erosion
	**IMG – 5378** Drainage from housing located near the left bank		**IMG_ 5379** General stream photo

	**IMG - 5380** Large instream woody debris pile		**IMG - 5381** General stream photo
	**IMG – 5382** Wooden bridge		**IMG – 5383** General stream photo, note increase in grasses
	**IMG – 5384** General stream photo		**IMG_5385** Riprap below stormwater culvert on left bank
	**IMG – 5386** Woody debris built up around stream bends		**IMG – 5387** Bank stabilization bio-logs

	**IMG – 5388** Rock riffle with bank stabilization		**IMG – 5389** Bio-logs along stream banks
	**IMG – 5390** Bio-logs along stream banks		**IMG – 5391** Bio-logs along stream banks
	**IMG – 5392** Upstream view, 2014 culvert reconstruc-tion under Eden Prairie Road		

Appendix D

Excerpts from Strategic Resources Evaluation

STRATEGIC RESOURCES EVALUATION OF THE LOWER MINNESOTA RIVER WATERSHED

LOWER MINNESOTA RIVER
WATERSHED DISTRICT

Managing and protecting the Minnesota River, lakes, streams, wetlands, and groundwater, and assisting and facilitating in providing river navigation

January 2014

Prepared for the

Lower Minnesota River
Watershed Management District

By

HDR, Engineering Inc.

Appendix E – CATEGORY 2 STREAM FEASIBILITY STUDY

Contents

Feasibility Study for Category 2 Streams

Four streams in the Lower Minnesota River Watershed District (District) are on the 2012 303(d) as being impaired for turbidity (Bluff Creek, Riley Creek, Carver Creek, and East Chaska Creek; see **Error! Reference source not found.**,
Figure 2,

Figure 3. East Chaska Creek Priority Sites and Reaches
, below. These streams were selected for a feasibility study to determine potential best management practices (BMPs) to mitigate sources of erosion, thereby reducing turbidity in the streams in areas within the District. This feasibility study also provides costs for the BMPs.

An initial desktop analysis of the streams consisted of examining aerial photos, geographic information system (GIS), and the District gully inventory (Appendix H in the District's Third Generation Plan). Adequate visual detail for BMP recommendation was not possible using only a desktop analysis, so a field reconnaissance trip to these streams took place August 28th, 2012, to examine erosion areas in greater detail. The following sections describe each of the four stream visits, present suggested BMPs to address erosion problem areas, and provide costs associated with implementation.

Bluff Creek

Bluff Creek (
Figure 2) is in Chanhassen near the intersection of County Road 61 (Flying Cloud Drive) and County Road 101 (Great Plains Boulevard). The District section of the creek begins at the southern edge of Bluff Creek Park, emerging from a tunnel underneath a gravel bike trail. A Watershed Outlet Monitoring Program (WOMP) monitoring station, operated by the Metropolitan Council Environmental Services (MCES), is on Bluff Creek at North Highway 101 (Flying Cloud Drive). Streambank erosion was observed below the tunnel exit (Photo 1). Active erosion was observed at the bridge abutments approximately 100 feet downstream at the North Hwy 101 crossing. Active erosion was observed on outer stream bends, where near vertical banks exist. However, the overall channel seemed stable. In sum, excessive active erosion was not observed in Bluff Creek.

Suggested actions for Bluff Creek include providing an energy dissipation structure at the tunnel exit, bank stabilization measures along outside creek bends, re-directing runoff coming off of the North Hwy 101 Bridge, and stabilizing the areas around the bridge abutments.

Riley Creek

Riley Creek (
Figure 2) is in Eden Prairie near the intersection of County Road 61 (Flying Cloud Drive and County Road 4 (Spring Road). The District section of the creek begins at Flying Cloud Drive near the Riley Creek WOMP monitoring station. The creek travels 1.3 miles from there to the Minnesota River, passing through Grass Lake. This study examined the reach immediately below the WOMP station.

Streambank erosion was observed at the concrete apron near the WOMP station (
Photo 2. Riley Creek WOMP station downstream of Flying Cloud Drive (Eden Prairie)

). Erosion was particularly evident at outside bends where undercut banks and exposed tree roots were observed. The right bank wingwall was also noticed to be broken from the apron structure. In sum, excessive active erosion was not observed in Riley Creek near the WOMP station.
Suggested actions for Riley Creek include providing energy dissipation structures below County Road 61 and/or redirecting flows away from outside creek meanders to prevent future erosion during runoff events.

Carver Creek

Carver Creek (
Figure 2) is in Carver south of County Road 40 (Main Street W) near downtown Carver. The District section of the creek begins near a trail crossing approximately 1,000 feet above the confluence with the Minnesota River.
The meandering creek had near vertical banks at outer creek bends showing active erosion (bank sloughing). However, the channel banks seem to be held in place by debris jams and not mobilizing downstream (**Error! Reference source not found.**). Approximately 150 feet upstream of the trail crossing there was active gully erosion depositing sediment into the channel (**Error! Reference source not found.**). Further upstream there was similar outer creek bend erosion but debris jams were absent (**Error! Reference source not found.**). In sum, active erosion was observed in Riley Creek at several locations.
Suggested actions for Carver Creek include stabilizing outer bends with toe protection and grading banks to a more stable slope, and stabilizing the gully to prevent future sediment from being transported downstream.

East Chaska Creek

East Chaska Creek (

Figure 3. East Chaska Creek Priority Sites and Reaches

) is in downtown Chaska. The District section of the creek begins below County Road 10 (Engler Boulevard) and continues downstream to the confluence with the Minnesota River. For assessment, the creek was divided into five reaches, A through E, starting from the upstream most point within the District. Recommendations for the different reaches are presented in the text .

Reach A: Engler Boulevard to Crosstown Boulevard

Reach A was heavily vegetated, had some coarse sediment in the channel bed, and as generally stable. There was some localized erosion caused by debris jams in the channel (
*). The culvert outfall at Engler Boulevard was relatively stable, with energy dissipation provided by riprap (**Error! Reference source not found.**). Suggestions for Reach A include removal of channel debris and dead trees.*

Reach B – Crosstown Boulevard to County Road 61

In this stream section, the entire reach was downcut approximately two feet, which was especially evident at the downstream apron at the Crosstown Blvd bridge. There was little to no coarse sediment in channel, consisting mainly of silty sands. The left bank (approximately six feet high, vertical) was problematic, with the majority of the reach having actively eroding banks. The worst area was approximately 720 feet long, beginning at 902 Yellow Brick Road.

*Bridge left bank erosion persists (**Error! Reference source not found.**). The right abutment has been grouted and has been downcut. Power lines cross the channel and are threatened by continued erosion of both banks. The outfall is buried by vegetation and sediment on the right bank upstream of the bridge.*

Suggestions for Reach D include removal of debris and dead trees in the channel, and addressing localized problems at outfalls and crossings. Specific suggestions include:

- *Near Beech Street Bridge – apply grade control throughout the reach, along with toe protection and left bank stabilization.*
- *Upstream of E.Sixthth Street Bridge – repair the left bank abutment (currently presents a safety hazard).*

Reach E – Beech Street to Courthouse Lake Trail

*In Reach E the channel was much wider and deeper than the other reaches (**Error! Reference source not found.**). Near vertical banks existed at outside channel bends and localized erosion of banks was occurring because of debris jams in the channel. In all other aspects Reach E is similar to other reaches. Suggestions for Reach E include removal of debris and dead trees in the channel and addressing localized problems at outfalls.*

East Chaska Creek Summary

With the exception of Reach A, the creek needs attention to prevent further erosion. The majority of Reach B is actively eroding, especially along the left bank (with respect to the downstream direction) and at blockages in the channel. The reach appears to be actively downcutting and is stabilized by two bridges. A systemic approach to the reach is suggested. That would include looking at channel slope and stability and using grade control structures throughout the reach. An alternate suggestion, which would apply from Reach B to Reach E, would be to focus on localized solutions and include stabilizing the worst of the left bank erosion, pruning canopy, removing debris and log jams, and focusing on outfalls and bridge crossings.

Conclusions

The suggested actions to address erosion in each of the four creeks examined in this study are summarized in the following table.

Table 1. Lower Minnesota River Watershed District: Category 2 Stream Resources - Suggested Actions

Resources	Suggested Action
Bluff Creek	1. Provide an energy dissipation structure at the tunnel exit. 2. Apply bank stabilization measures along outside creek bends. 3. Re-direct runoff coming off of the North Hwy 101 Bridge. 4. Stabilize the areas around the bridge abutments.
Riley Creek	1. Provide an energy dissipation structure below CR 61. 2. Redirect flows away from outside creek meanders to prevent future erosion during runoff events.
Carver Creek	1. Stabilize outer bends with toe protection. 2. Grade banks to a more stable slope.

Resources	Suggested Action
	3. Stabilize the gully to prevent future sediment from being transported downstream.
East Chaska Creek Overall Suggestions	1. Remove debris and dead trees from the channel. 2. Address localized problems at outfalls and crossings.
East Chaska Creek Reach A and Reach B	*General: remove debris and dead trees from the channel, address localized problems at outfalls and crossings.* *Specific suggestions:* 1. *Outfall A – remove log jam, stabilize right bank at outfall, revegetate bank, remove sediment deposit.* 2. *Outfall B – stabilize outfall with rock, step down the outfall, toe protection 10-ft upstream & 40-ft downstream.* 3. *Outfall C – stabilize outfall with rock, step down the outfall, toe protection 10-ft upstream & 40-ft downstream.* 4. *Pedestrian Bridge – re-direct runoff from bridge to channel bed, stabilize abutments 5-ft upstream and 15-ft downstream.* 5. *Crosstown Blvd. Bridge – grade control/energy dissipation structures to step the channel down and dissipate energy away from the bridge and vulnerable banks; re-direct runoff from bridge.*
East Chaska Creek Reach C	1. *Remove debris and* dead *trees in the channel where possible.* 2. *Insert grade control structures.*
East Chaska Creek Reach D	*General: remove debris and dead trees in the channel, and address localized problems at outfalls and crossings. Specific suggestions include:* 1. *Near Beech Street Bridge – apply grade control throughout the reach, along with toe protection and left bank stabilization.* 2. *Upstream of E. Sixth Street Bridge – repair the left bank abutment (currently presents a safety hazard).*
East Chaska Creek Reach E	1. *Selective clearing, excavation, toe protection, erosion control (jute mesh), topsiol replacement and grading for approximately 2,000 feet*

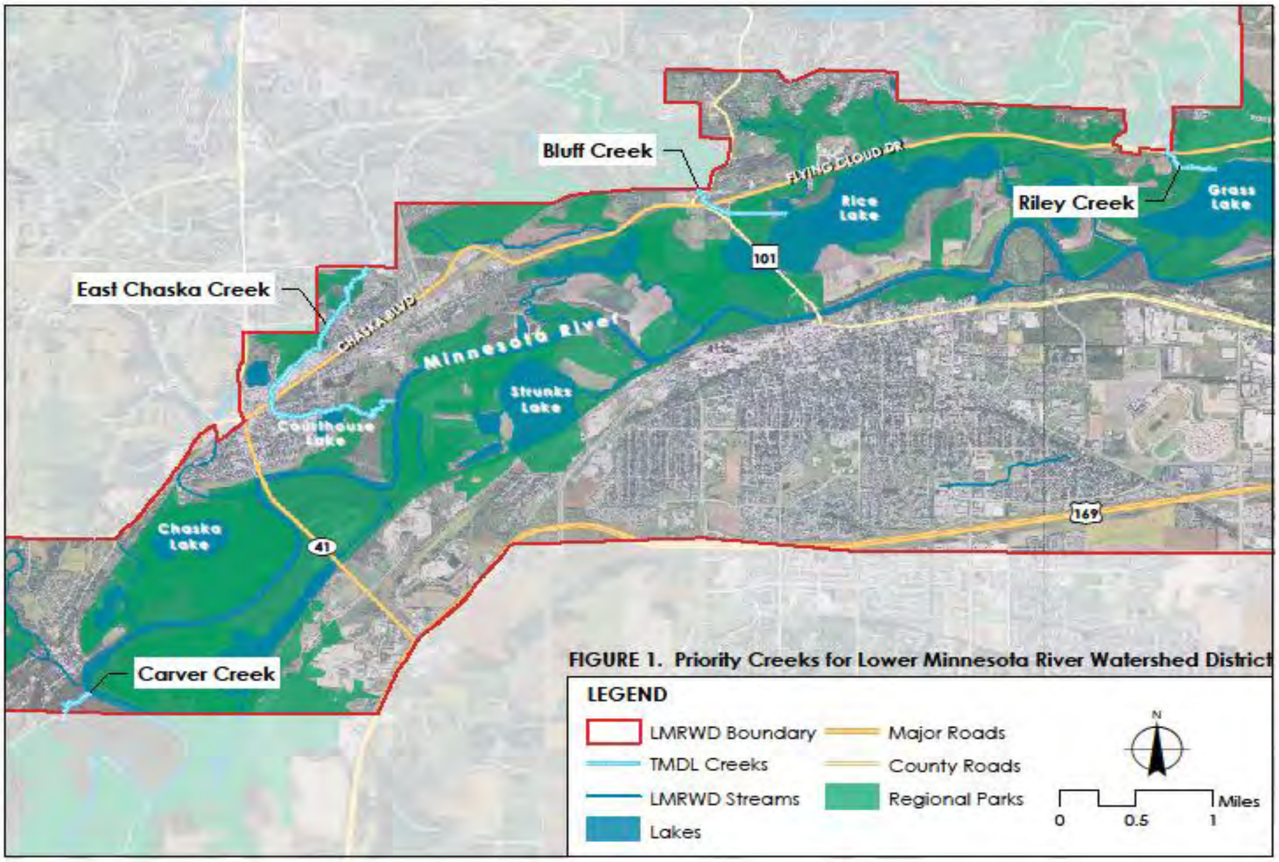


Figure 1. Priority Creeks for Lower Minnesota River Watershed District

Photo 1. Bluff Creek below Flying Cloud Drive (Eden Prairie) and downstream erosion

Photo 2. Riley Creek WOMP station downstream of Flying Cloud Drive (Eden Prairie)

Appendix E

Survey Comparison

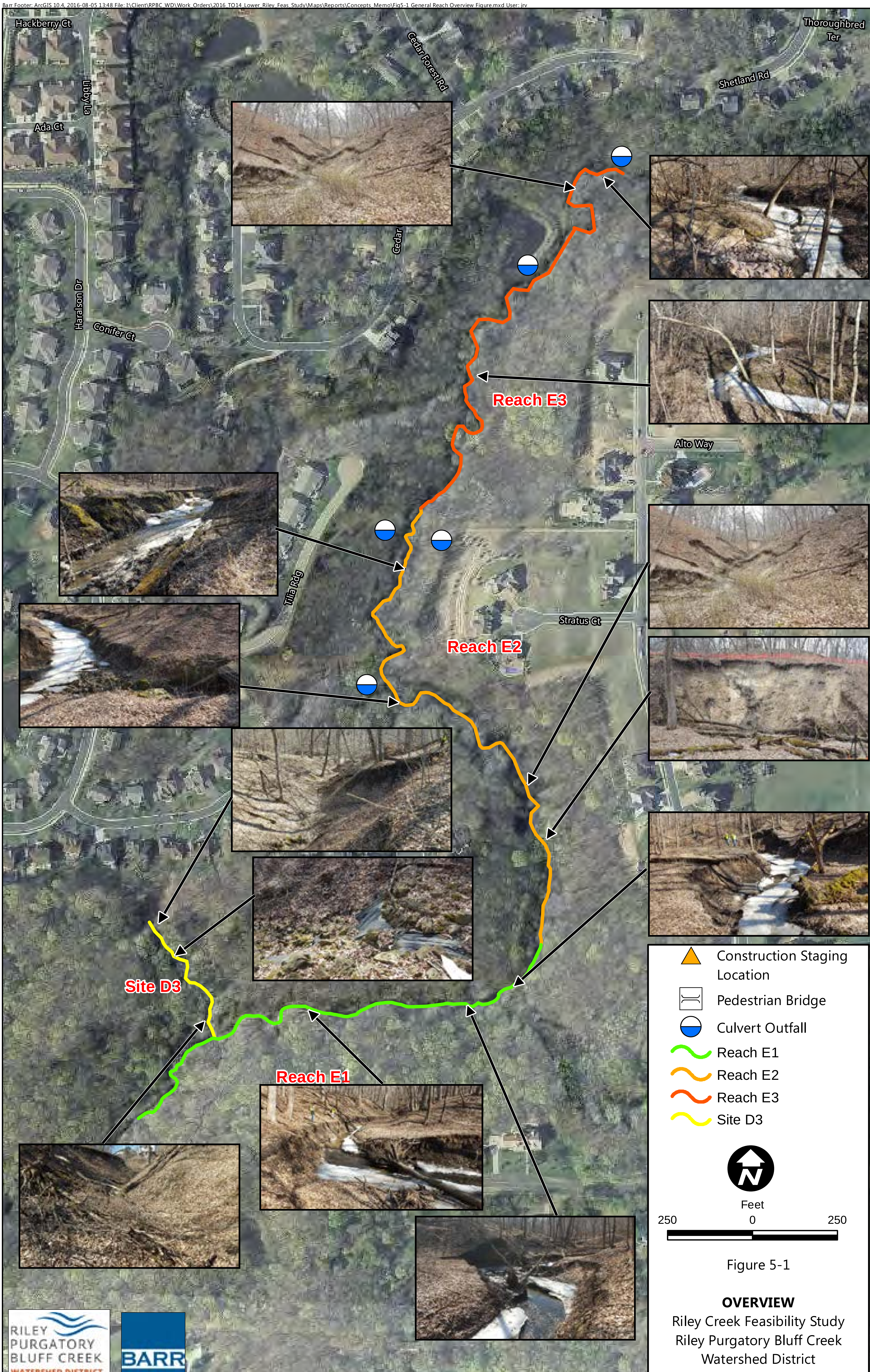
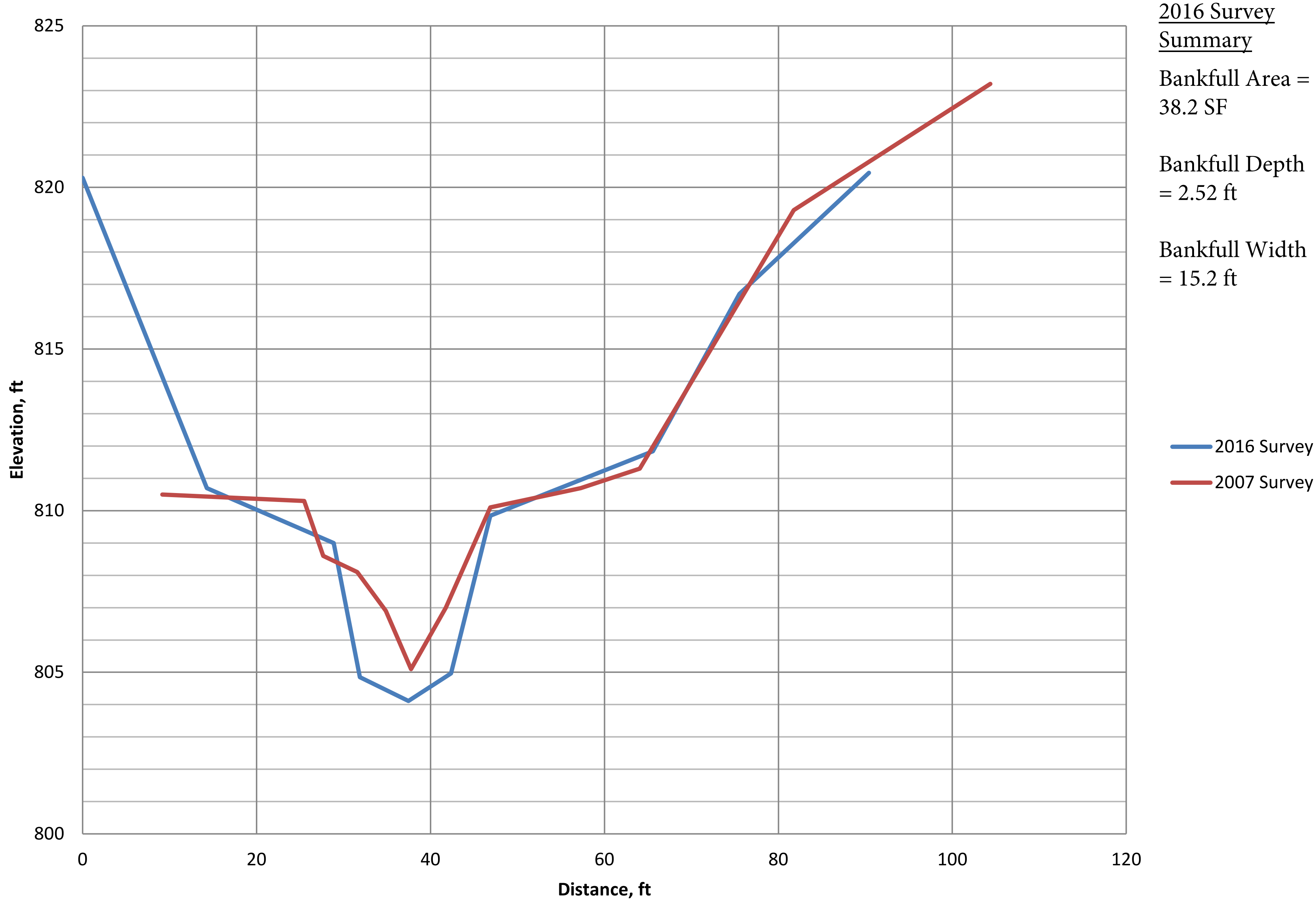


Figure 5-1

OVERVIEW
Riley Creek Feasibility Study
Riley Purgatory Bluff Creek Watershed District

Project Station 93+00

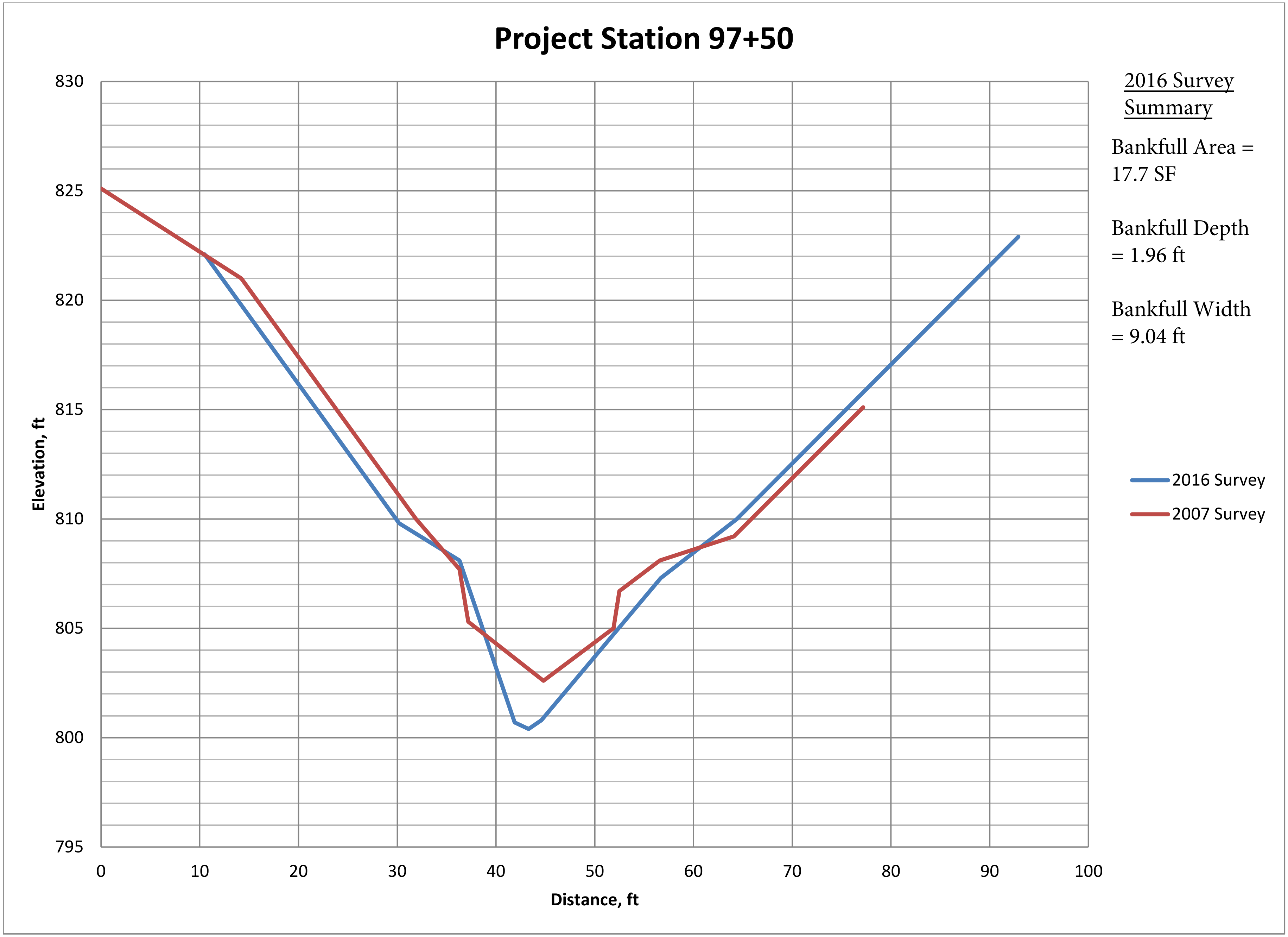


2016 Survey Summary

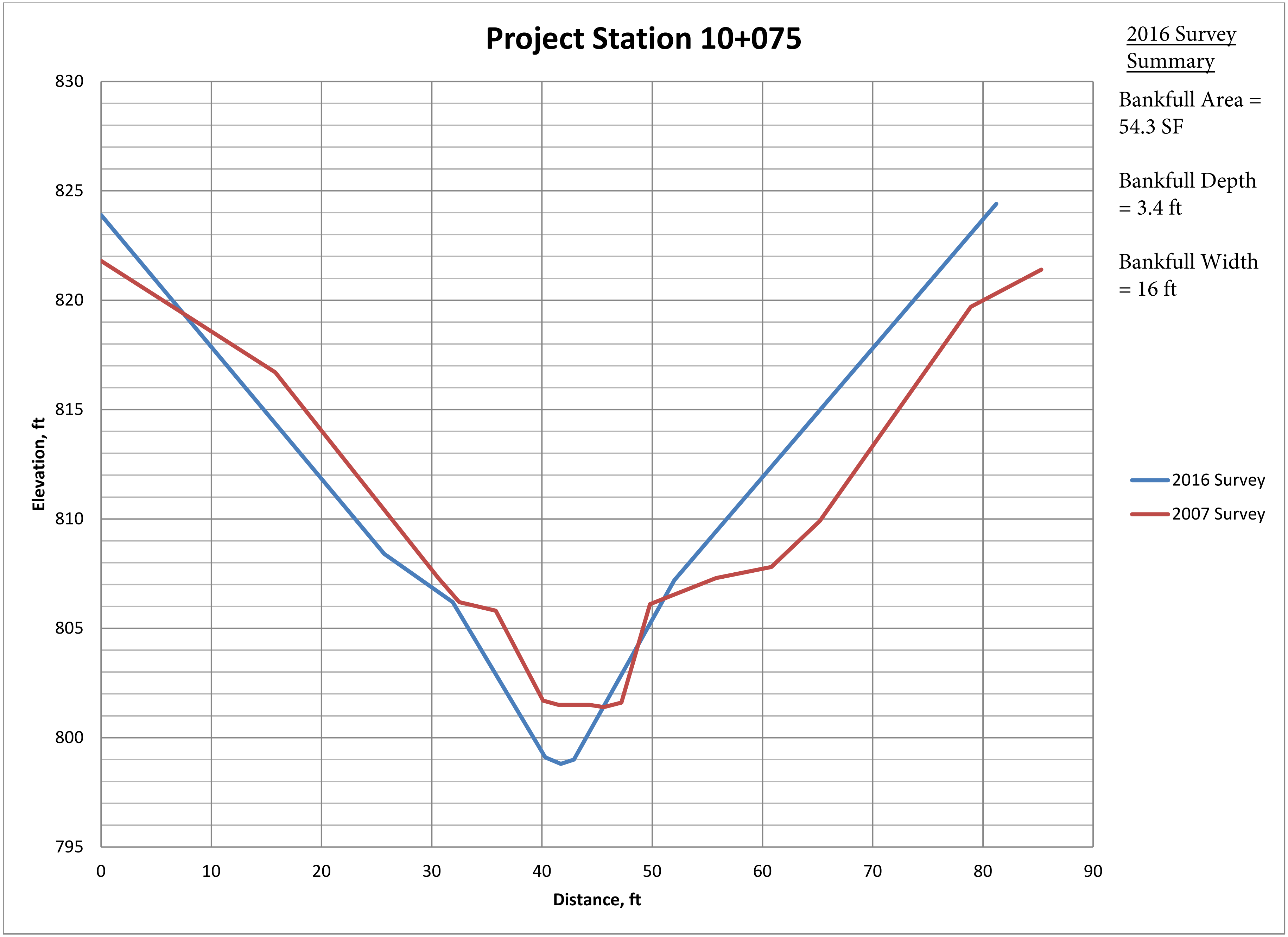
Bankfull Area = 38.2 SF

Bankfull Depth = 2.52 ft

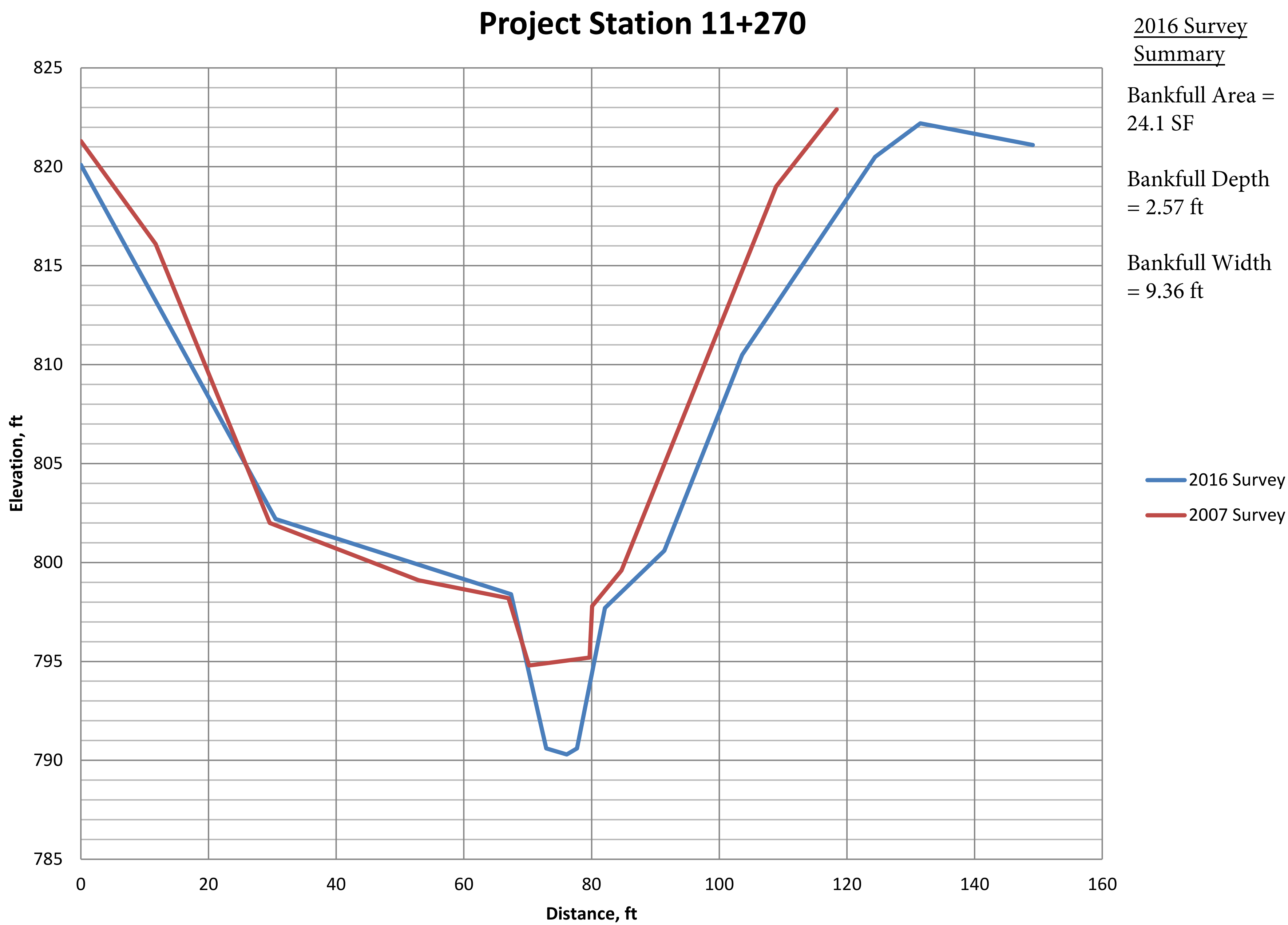
Bankfull Width = 15.2 ft



Project Station 97+50
830
825
820
815
810
805
800
795
Elevation, ft
0
10
20
30
40
50
60
70
80
90
100
Distance, ft
2016 Survey Summary
Bankfull Area = 17.7 SF
Bankfull Depth = 1.96 ft
Bankfull Width = 9.04 ft
2016 Survey
2007 Survey



Project Station 10+075
2016 Survey Summary
Bankfull Area = 54.3 SF
Bankfull Depth = 3.4 ft
Bankfull Width = 16 ft
830
825
820
815
810
805
800
795
Elevation, ft
0
10
20
30
40
50
60
70
80
90
Distance, ft
2016 Survey
2007 Survey

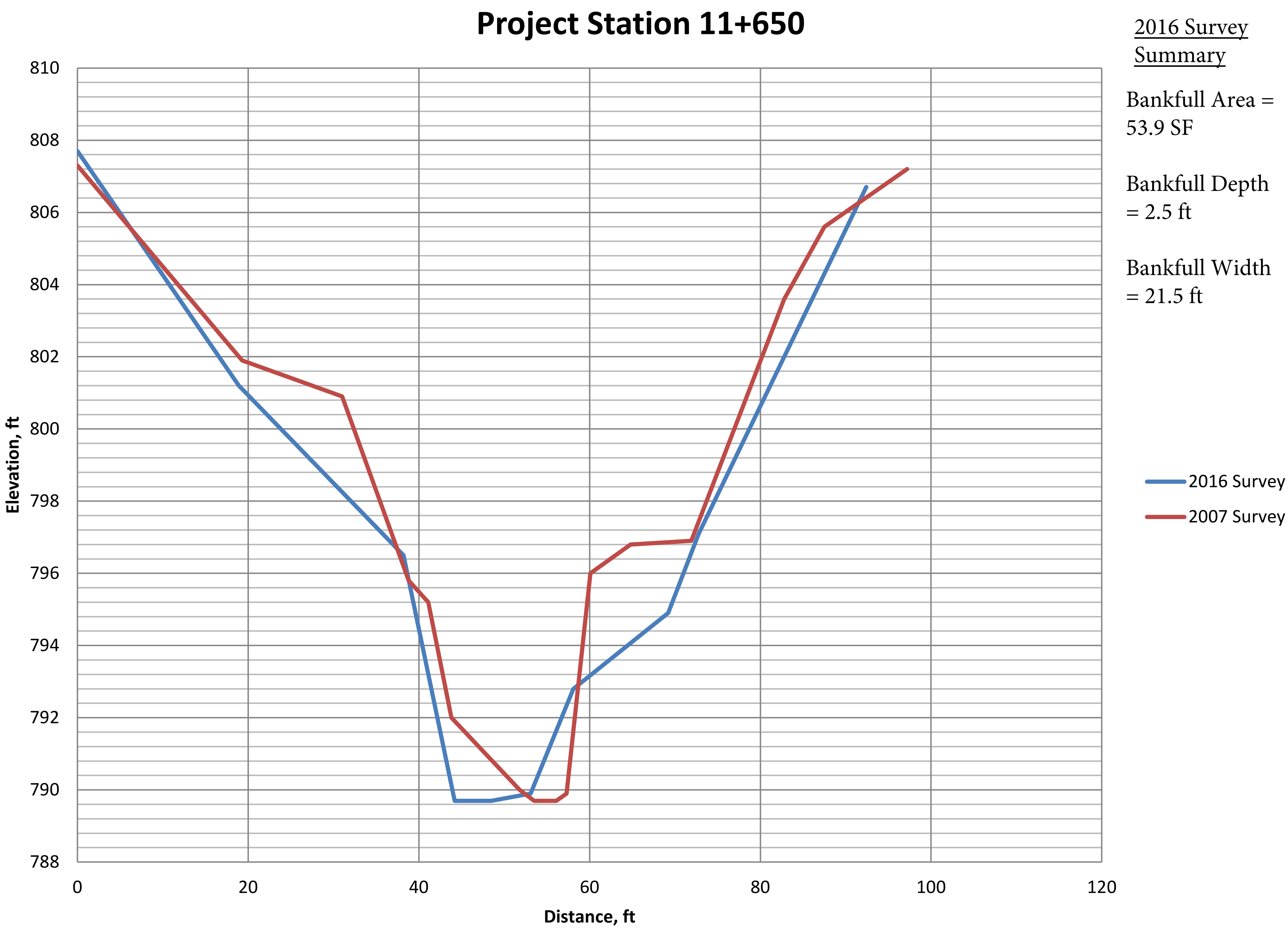


2016 Survey Summary

Bankfull Area = 24.1 SF

Bankfull Depth = 2.57 ft

Bankfull Width = 9.36 ft

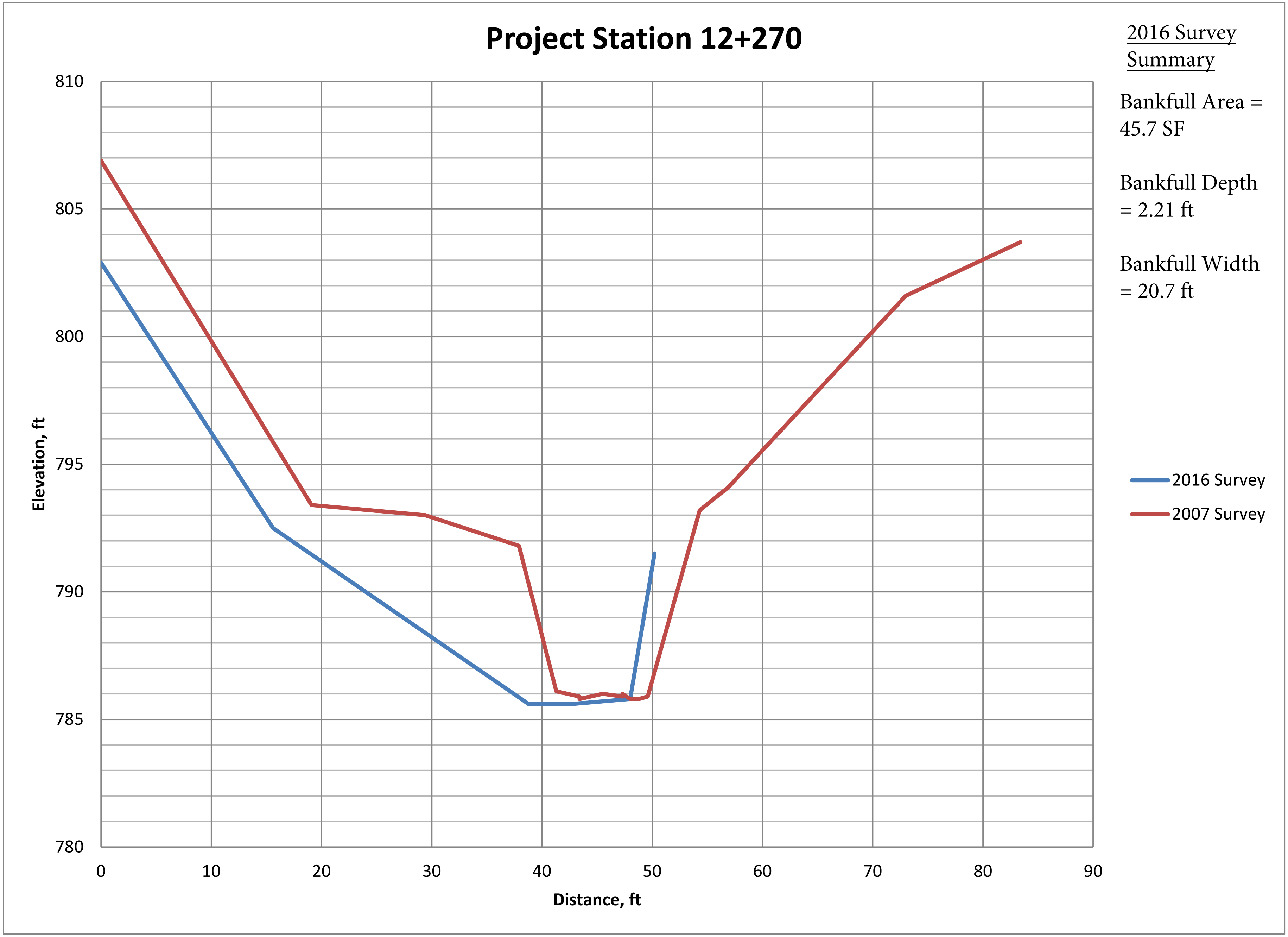


2016 Survey Summary

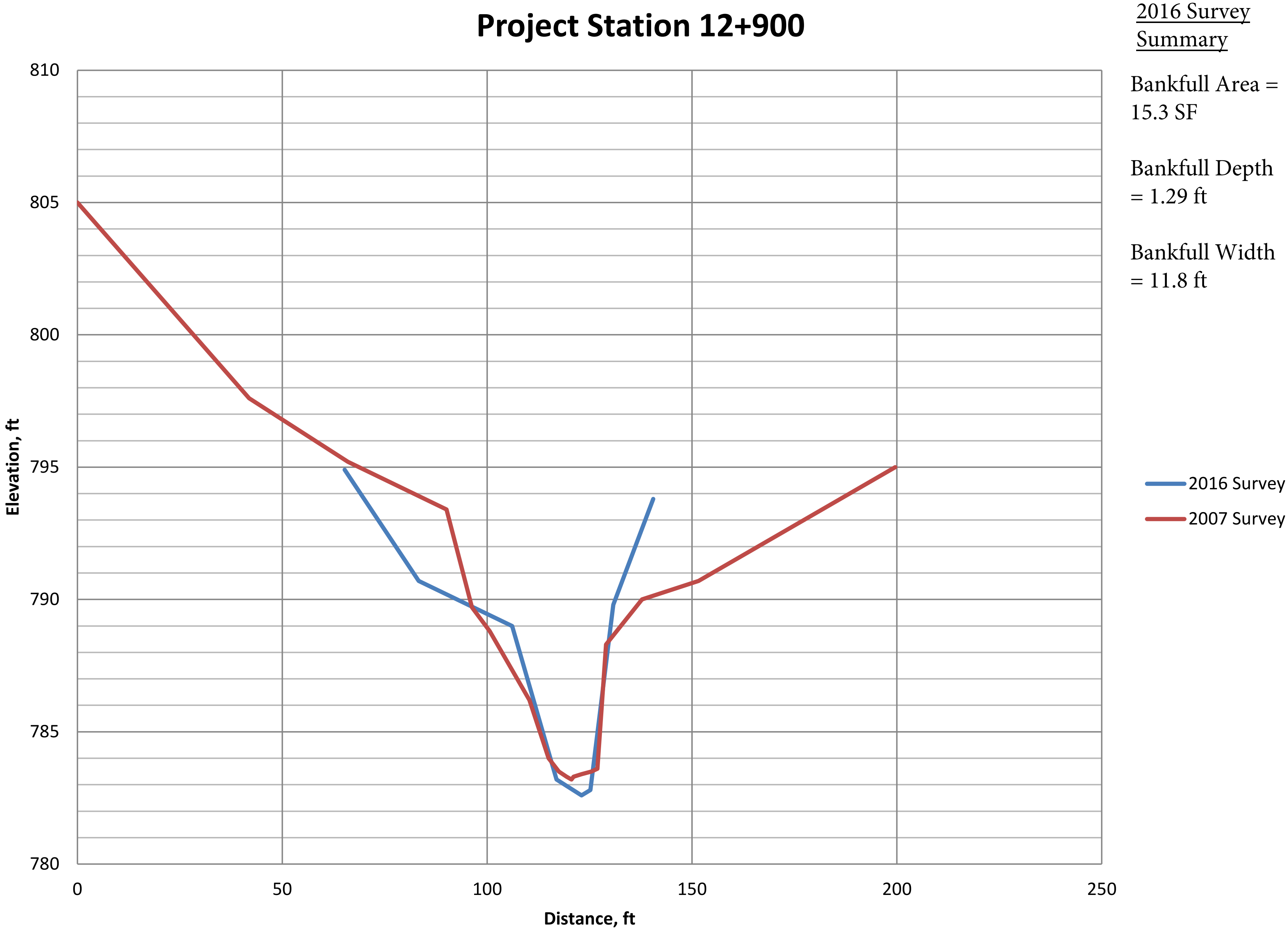
Bankfull Area = 53.9 SF

Bankfull Depth = 2.5 ft

Bankfull Width = 21.5 ft



Project Station 12+270
2016 Survey Summary
Bankfull Area = 45.7 SF
Bankfull Depth = 2.21 ft
Bankfull Width = 20.7 ft
2016 Survey
2007 Survey
Elevation, ft
Distance, ft
810
805
800
795
790
785
780
0
10
20
30
40
50
60
70
80
90

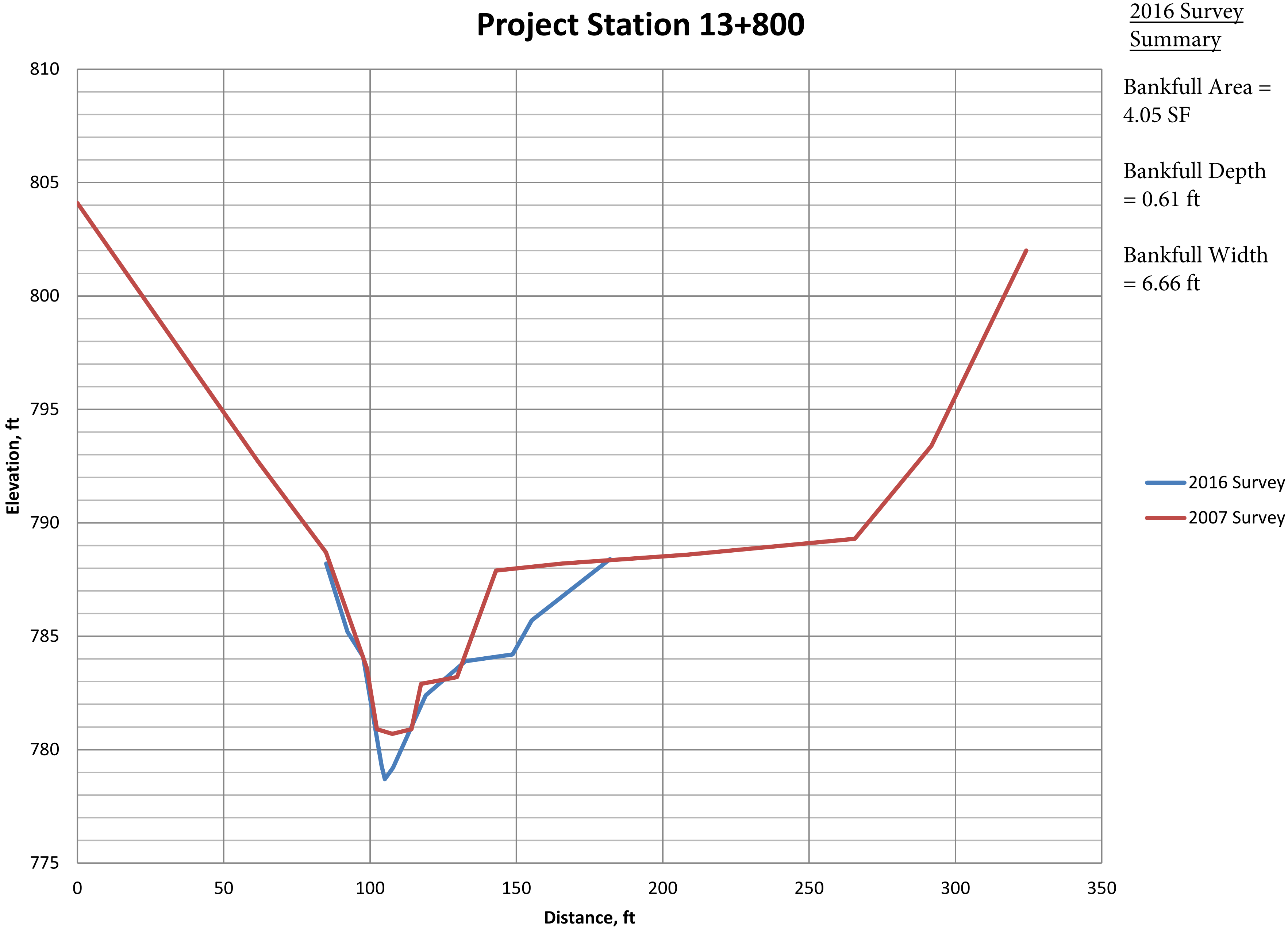


<u>2016 Survey Summary</u>

Bankfull Area = 15.3 SF

Bankfull Depth = 1.29 ft

Bankfull Width = 11.8 ft

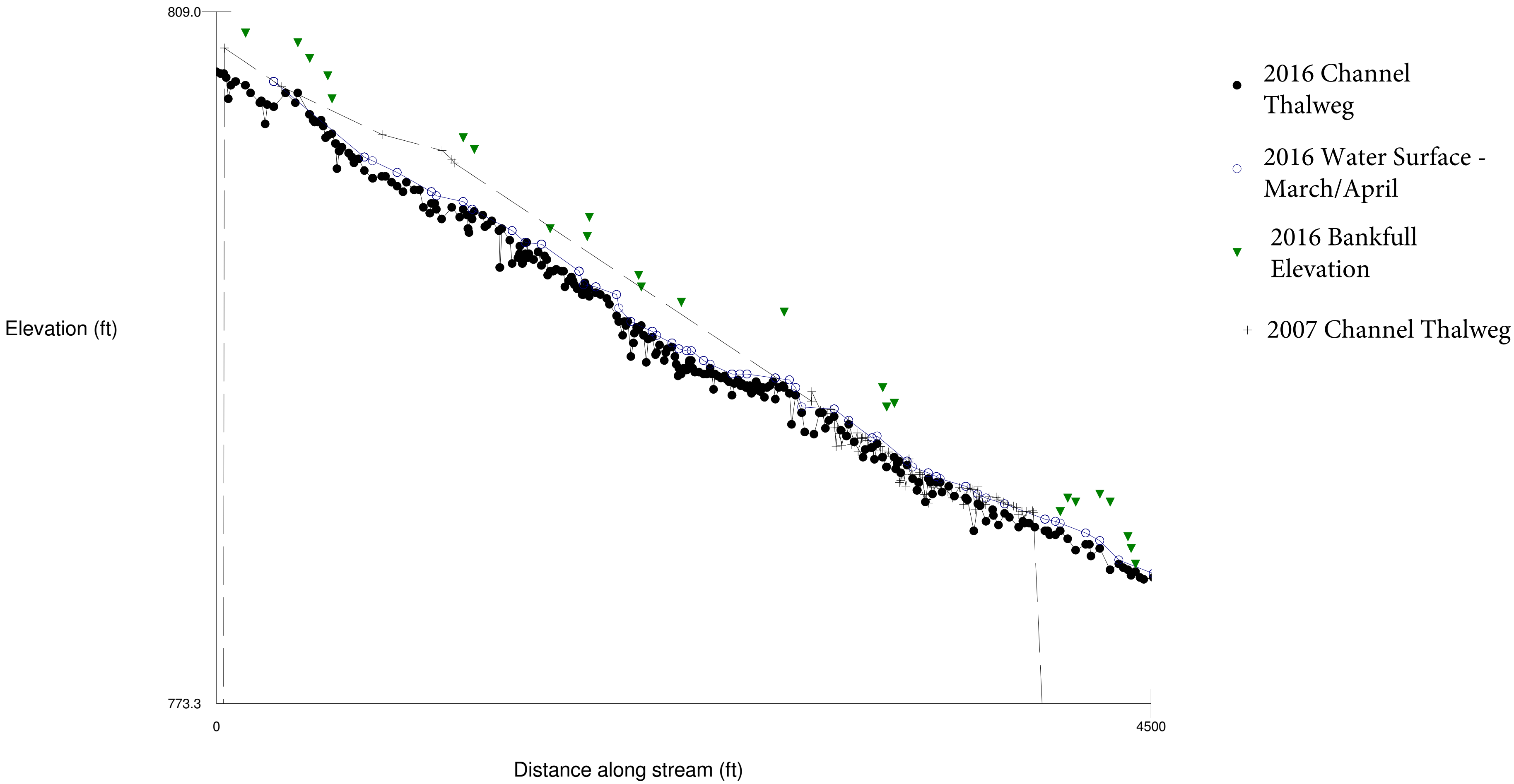


2016 Survey Summary

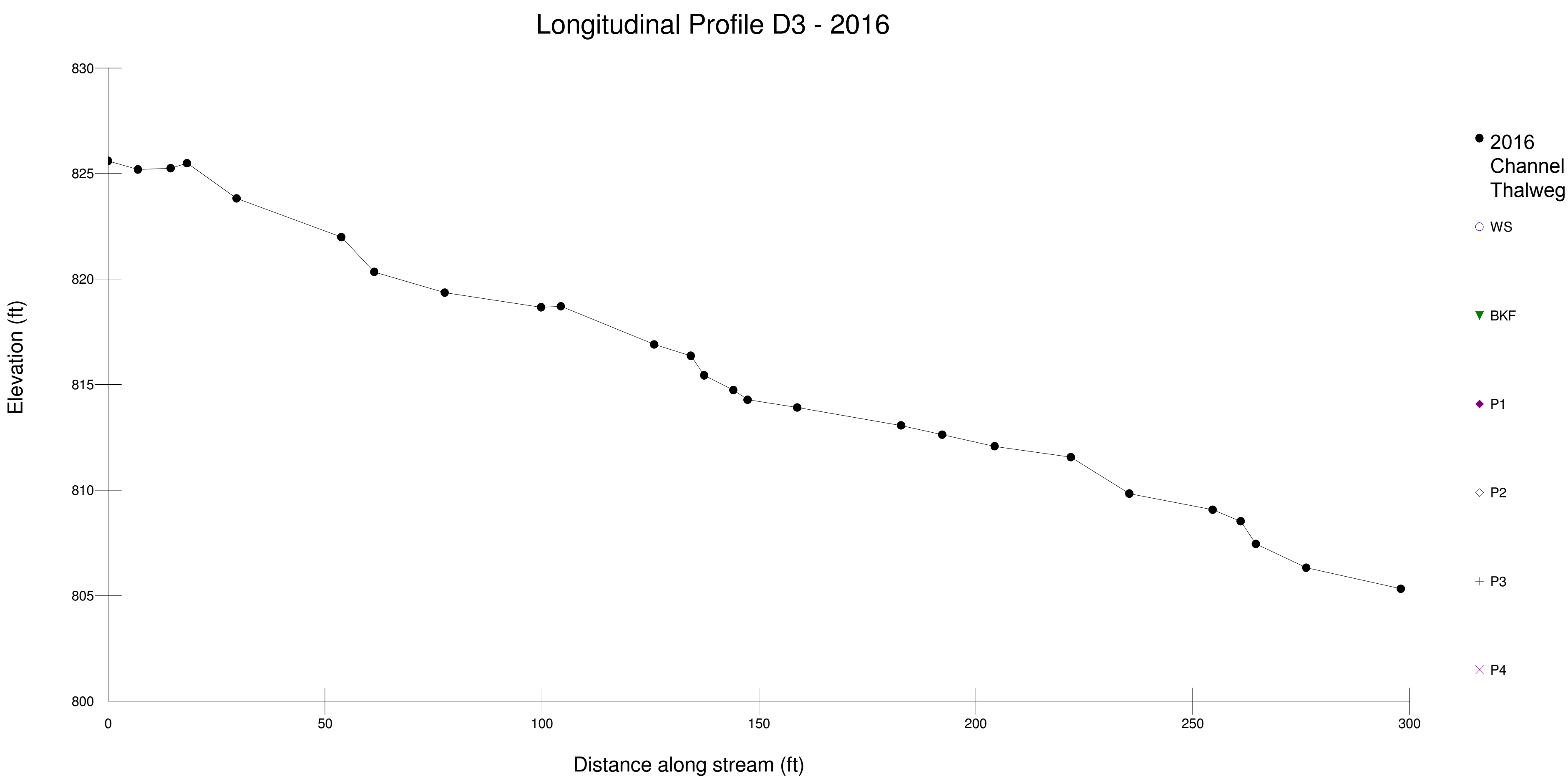
Bankfull Area = 4.05 SF

Bankfull Depth = 0.61 ft

Bankfull Width = 6.66 ft



809.0
773.3
0
4500
Elevation (ft)
Distance along stream (ft)
2016 Channel Thalweg
2016 Water Surface - March/April
2016 Bankfull Elevation
2007 Channel Thalweg


Longitudinal Profile D3 - 2016
Elevation (ft)
830
825
820
815
810
805
800
0
50
100
150
200
250
300
Distance along stream (ft)
2016 Channel Thalweg
WS
BKF
P1
P2
P3
P4

Appendix F

Phase I Environmental Site Assessment

Phase I Environmental Site Assessment

Riley Creek, Reach E and Site D3
Eden Prairie, Minnesota
May 2016

Prepared for
Riley Purgatory Bluff Creek Watershed District

Barr Engineering Co.

Phase I Environmental Site Assessment

Riley Creek, Reach E and Site D3
Eden Prairie, Minnesota
May 2016

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1.0 Introduction

Barr Engineering Co. (Barr) was retained by the Riley Purgatory Bluff Creek Watershed District to complete a Phase I Environmental Site Assessment (Assessment) of a property owned by the City of Eden Prairie and used for Riley Creek Conservation Area and walking trails. The property is located in the west half of Section 29 and the east half of Section 30, Township 116 north, Range 22 west within the City limits of Eden Prairie, Hennepin County, Minnesota (Property). The Property location is shown on Figure 1.

This report summarizes the findings, opinions, and conclusions of the Assessment. Detailed descriptions of the Property setting, utility information, land-use history, regulatory history, and current Property conditions and features are presented in the Phase I documentation in Appendix A. Informational resources are described in Section 5 of this report and are assigned unique reference numbers, which are used throughout the report and Appendix A.

Barr has performed this Assessment in conformance with ASTM, International (ASTM) Practice E 1527-13 (Practice). No intentional deviations from the Practice were made in performing this Assessment except as described in Section 1.4. In following the Practice, this Assessment also complies with the U.S. Environmental Protection Agency 40 CFR Part 312 Standards and Practices for All Appropriate Inquiries; Final Rule.

1.1 Purpose

The purpose of the Assessment is to identify recognized environmental conditions (RECs) in connection with the Property as defined by the Practice and discussed in the findings and opinions section of the report in support of a planned creek stabilization project (Ref. 4c).

1.2 Scope of Services

The Assessment involved completion of the following five components described in Section 7 of the Practice: records review, site reconnaissance, interviews, reporting, and file reviews. The following tasks were completed during the Assessment. The details of each task are described below and in Appendix A.

<u>Records Review</u>

- A Regulatory Database Report was obtained and federal, state, and readily available tribal records databases were reviewed.
- USGS topographic maps were reviewed and used to determine physical setting information.
- Discretionary physical setting sources including published geological reports were reviewed and used to determine physical setting information.
- Historical aerial photographs; historical maps; and reverse city directories were reviewed for the Property and surrounding land.
- A fire insurance map search was conducted and no fire insurance maps were available for the Property and maps were reviewed.

Site Reconnaissance

- A visual inspection was conducted of the exterior features on the Property. Current conditions with respect to land use; chemical and waste storage, use, and disposal; facility operations and equipment; utilities; and evidence of potential releases of petroleum products or hazardous substances were documented, if observed. Evidence of historical uses or conditions, if encountered, was also documented. Current land-use and occupants of neighboring properties were documented during the site visit.

Interviews

- Interviews were conducted with a Property representative and the City of Eden Prairie public works department.

Evaluation and Report Preparation

- This report was prepared to document the resources used during completion of the Assessment and to describe the findings, opinions, and conclusions of the Assessment.

File Review

- The Property and adjoining properties were not identified on any of the standard environmental record sources, so a file review was not conducted

1.3 Significant Assumptions

The following significant assumptions were made to complete the Assessment:

- The detailed history of ownership and land-use to satisfy the requirements and purpose of the Assessment was determined from the activities listed in Section 1.2, Scope of Work, and a title review was not needed. Lack of a title review and detailed history of ownership is not a significant data gap.

1.4 Limitations, Exceptions, and Data Gaps

The following limitations and exceptions are associated with this Assessment:

- Gaps of greater than five years in historical documentation are present, and are summarized in the following table.

Date Range	Property Changes
Prior to 1896	Historical documentation was not readily ascertainable; therefore, changes in general Property land-uses are unknown.
1907 – 1937 1940 – 1947 1947 – 1954 1960 – 1967 1972 – 1978 1987 – 1993 1994 – 2000	Gaps greater than five years in historical documentation are present; however, general Property land-uses did not change during the time periods.

1.5 Special Terms and Conditions

The scope of the Assessment did not involve the collection and analysis of any type of sample. The Assessment did not involve completion of any surveys or the offering of any opinions or advice with respect to structural engineering matters, asbestos-containing materials, radon, lead-based paint, lead in drinking water, wetlands, compliance with environmental regulations, cultural and historic resources, industrial hygiene, health and safety, ecological resources, endangered species, indoor air quality , biological agents, mold, or other conditions that are beyond the scope of the Practice.

Barr has performed its work in a manner consistent with the care and skill ordinarily exercised by members of the environmental profession under similar budget and time constraints. Within this context, Barr assumes responsibility for its own observations, along with its interpretation of the information gathered. No other warranty is made or intended.

Because Barr was not retained to verify information, Barr assumes no responsibility for the accuracy of information that it obtained from other sources including, without limitation, regulatory and government agencies, persons interviewed about the Property, and vendors of public data. Performance of the Practice is intended to reduce, but will not eliminate uncertainty regarding the presence of recognized environmental conditions on the Property. To the extent that Barr does not identify recognized environmental conditions on the Property, Barr's opinions in the report are not representations that the Property is free of such conditions. Under no circumstances can Barr represent or warrant that releases of hazardous substances or petroleum products do not exist on the Property.

1.6 User Reliance

The Assessment has been prepared for the exclusive use of Riley Purgatory Bluff Creek Watershed District, herein referred to as the "User." No others may rely on the Assessment without obtaining a formal authorization in the form of a reliance letter from Barr. Barr will provide reliance letters for additional parties only if authorized by the User.

2.0 Site Description

2.1 Location and Legal Description

The Property is located in the west half of Section 29 and the east half of Section 30, Township 116 north, Range 22 west within the City limits of Eden Prairie, Hennepin County, Minnesota. The Property is a 200-foot corridor that follows a portion of Riley Creek. The Property boundaries are shown on Figure 2.

2.2 Property Setting and Land Use

Topography of the Property is variable, and deeply incised on both sides of Riley Creek (Ref. 1e). Shallow groundwater flow direction at the Property is considered to be to the south, based on the Hennepin County Geologic Atlas (Ref. 2c).

The Property is currently the Riley Creek Conservation area with walking trails, and is zoned public, residential, and rural (Ref. 5d). No buildings are located on the Property (Refs. 1a, 4a, 5b). Neither water nor sanitary services are present on the Property (Ref. 4a). Historically, the Property has been maintained as a creek (Ref. 1a).

The current use of adjoining properties includes residential and woodland. The past use of adjoining properties includes farmland, residential, and woodland (Refs. 1a, 4a, 5a).

Additional descriptions of the Property setting and land-use are presented in Appendix A.

2.3 User-Provided Information

As detailed in Section 6 of the Practice, the User has responsibilities associated with identifying possible recognized environmental conditions in connection with the Property. Barr provided a User Questionnaire to facilitate gathering information required by the Practice. The completed User Questionnaire is included in Appendix F.

The User indicated that there is not a significantly lower purchase price for the Property. The User has no knowledge of environmental cleanup liens or activity use limitations against the Property. The User did not report conditions indicative of releases or threatened releases, any obvious indicators that point to the presence or likely presence of contamination at the Property, or specialized knowledge about the Property related to the items listed in Section 6 of the Practice (Ref. 4c, Appendix F).

3.0 Findings and Opinions

This section summarizes observations regarding the presence of hazardous substances or petroleum products on the Property (findings) and discusses the basis for concluding if a finding is or is not a recognized environmental condition.

3.1 Definitions

Finding – For the purpose of this Assessment, a finding is an observation regarding the presence of hazardous substances or petroleum products on the Property which may be considered a recognized environmental condition, a historical recognized environmental condition, or de minimis condition.

Recognized environmental condition (REC) - A REC is defined by the Practice as "the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment. De minims conditions are not recognized environmental conditions."

Historical recognized environmental condition (HREC) - An HREC is defined by the Practice as "a past release of any hazardous substances or petroleum products that has occurred in connection with the property and has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted use criteria established by a regulatory authority, without subjecting the property to any required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). Before calling the past release a historical recognized environmental condition, the environmental professional must determine whether the past release is a recognized environmental condition at the time the Phase I Environmental Site Assessment is conducted (for example, if there has been a change in the regulatory criteria). If the EP considers the past release to be a recognized environmental condition at the time the Phase I ESA is conducted, the condition shall be included in the conclusions section of the report as a recognized environmental condition."

Controlled recognized environmental condition (CREC) – A CREC is defined by the Practice as "a recognized environmental condition resulting from a past release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority (for example, as evidenced by the issuance of a no further action letter or equivalent, or meeting risk-based criteria established by regulatory authority), with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls (for example, property use restrictions, activity and use limitations, institutional controls, or engineering controls). A condition considered by the environmental professional to be a controlled recognized environmental condition shall be listed in the findings section of the Phase I Environmental Site Assessment report, and as a recognized environmental condition in the conclusions section of the Phase I Environmental Site Assessment report."

De minimis conditions – As defined by the Practice, conditions determined to be "de minimis" generally do not present a threat to human health or the environment and generally would not be subject of an enforcement action if brought to the attention of appropriate governmental agencies. De minimis conditions are not considered RECs.

3.2 Findings and Opinions

Barr has identified the following finding and developed the following opinion regarding this finding:

- A discrete length of metal pipe, approximately 10 feet long and 2 feet in diameter, was observed within Riley Creek (see Figure 2). No staining or sheen were observed on or around the pipe. Based on the inert nature of the pipe, this finding is not a REC.

4.0 Conclusions

We have performed a Phase I Environmental Site Assessment in conformance with the scope and limitations of ASTM Practice E 1527-13 of Lower Riley Creek, Reaches D and E, the Property. Any exceptions to, or deletions from, this Practice are described in Section 1.4 of this report. This assessment has revealed no evidence of recognized environmental conditions in connection with the Property.

4.1 Deviations

There were no deletions, deviations from, or additions to the Practice associated with the Assessment other than the limitations and exceptions listed in Section 1.4.

5.0 References

The following resources are numbered for use as references.

Ref #	Resource	Years Covered or Item Date
Standard Historical Resources		
1a	Aerial Photographs	2015, 2012, 2009, 2004, 2000,1994, 1987, 1984,1978, 1971, 1967, 1960, 1956, 1947, 1940, 1937
1b	Fire Insurance Maps	Not available
1c	Property Tax Files	Not reviewed
1d	Recorded Land Title Records	Not reviewed
1e	USGS Topographic Maps	2013, 1993, 1980, 1972, 1967, 1958, 1954, 1907, 1905, 1901, 1896
1f	Local Street Directories	2012, 2007, 2002
1g	Building/Department Records	Not reviewed
1h	Zoning/Land Use Records	Not reviewed
1i	Other Historical Sources	Not reviewed
1j	Prior Assessments	Not available
Discretionary and Non-Standard Physical Setting Sources		
2a	Published Geologic Report – Depth to Bedrock and Bedrock Topography. Bloomgren, Bruce A., Jane M Cleland, and Bruce M. Olsen, 1989. Geologic Atlas Hennepin County, Minnesota. University of Minnesota.	1989
2b	Published Geologic Report – Surficial Geology. Meyer, Gary N., and Howard C. Hobbs, 1989. Geologic Atlas Hennepin County, Minnesota. University of Minnesota.	1989
2c	Published Geologic Report – Quaternary Hydrogeology. Kanivetsky, Roman, 1989. Geologic Atlas Hennepin County, Minnesota. University of Minnesota.	1989
2d	Published Geologic Report – Bedrock Geology. Olsen, Bruce M., and Bruce A. Bloomgren, 1989. Geologic Atlas Hennepin County, Minnesota. University of Minnesota.	1989
2e	Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/	Accessed May 25, 2016
Standard Environmental Record Sources		
3a	Historical Information Gatherers, Inc. Report (Appendix D)	May 5, 2016
Interviews		
4a	User Representative: Claire Bleser, Riley Purgatory Bluff Creek Watershed District, 952-607-6512	May 17, 2016

4b	Public Works/City Engineering: Denise Christensen, City of Eden Prairie Public Works Department, 952- 949-8318	May 26, 2016
4c	User Questionnaire – Claire Bleser, Riley Purgatory Bluff Creek Watershed District, 952-607-6512	May 31, 2016
Supplemental Resources		
5a	Site Visit Amanda Bohnenblust, Barr Engineering, 952-842-3533	April 28, 2016
5b	Mapping Data From GIS	Accessed May 24, 2016
5c	Eden Prairie City Map. Available online at https://gis01.edenprairie.org/PublicCityMap/viewer/index.html	Accessed May 25, 2016
5d	Eden Prairie Water Facts. Available online at http://www.edenprairie.org/community/living-green/groundwater-and-drinking-water/eden-prairie-water-facts	Accessed May 25, 2016

6.0 Signature and Qualifications of Environmental Professional

I declare that, to the best of my professional knowledge and belief, I meet the definition of *Environmental Professional* as defined in §312.10 of 40 CFR 312. I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

Barr performed this Assessment in conformance with the ASTM, International (ASTM) Practice E 1527-13. Special terms, conditions, limitations, and exceptions that apply to the Assessment are described throughout this Report and in the Appendices.

Mary K. Sands (signature) — 26 October 2016

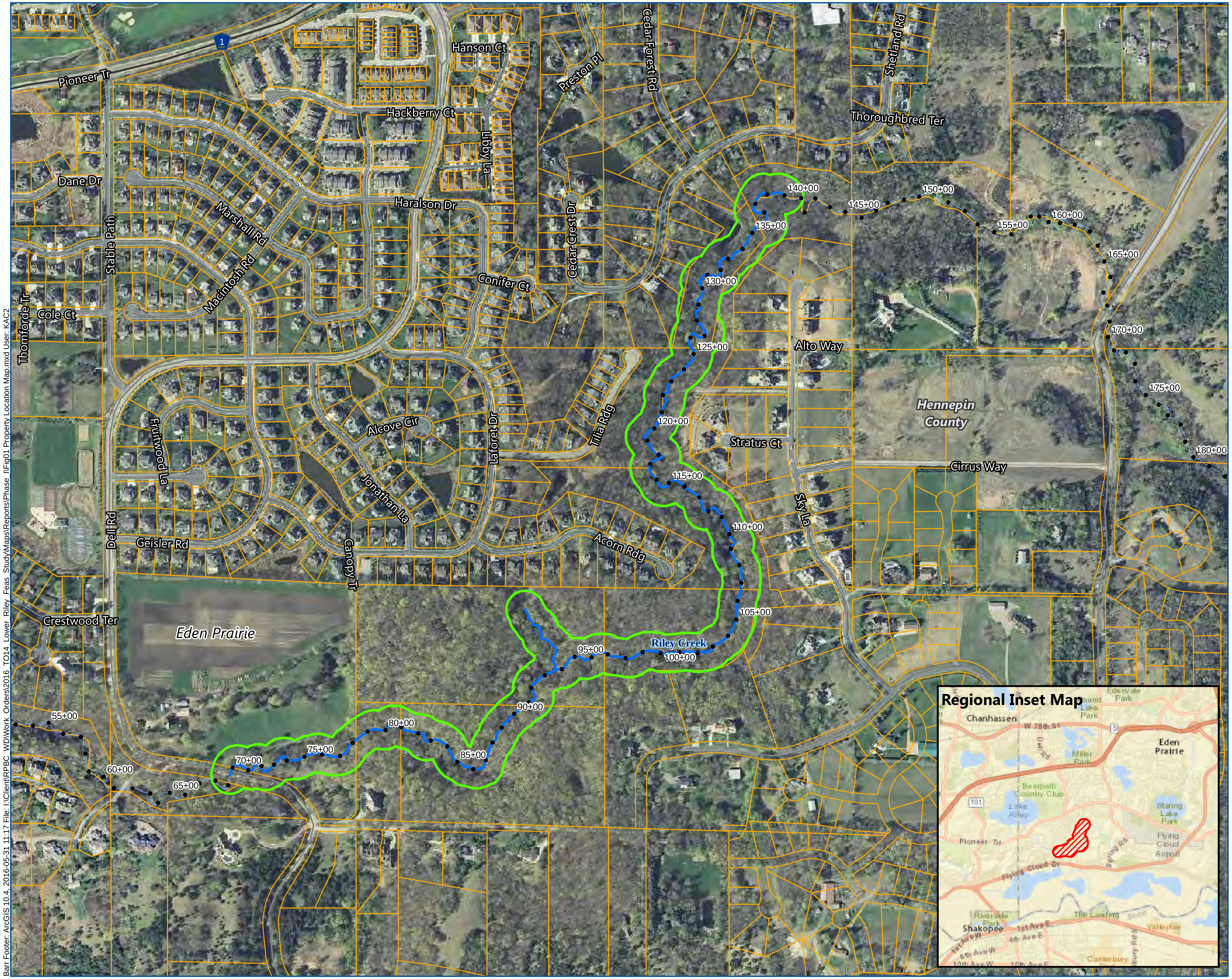
Mary Sands, Environmental Professional (Date)

Elizabeth Maher (signature) — 10/26/16

Elizabeth Maher, Environmental Support Staff (Date)

Qualifications of the Environmental Professional are summarized in Appendix G.

Figures



Riley Creek
Stationing Points (100 ft)
Property Boundary
Parcel Boundary

Feet
500 0 500

Figure 1

PROPERTY LOCATION MAP
Lower Riley Creek
Eden Prairie, Minnesota

Figure 2

PROPERTY LAYOUT MAP
Lower Riley Creek
Eden Prairie, Minnesota

Appendices

Appendix A

Phase I Documentation

Appendix A

Phase I Environmental Site Assessment Documentation
Lower Riley Creek, Reaches D and E
Eden Prairie, Minnesota
May 2016

I. General Property Information

Property location map is shown on Figure 1. Property layout with existing features is shown on Figure 2.

Property name: Lower Riley Creek, Reaches D and E

County: Hennepin

Township: 116N **Range:** 22W **Section:** 29 and 30

Property size: Approximately 32.5 acres (Ref. 5b).

Current Property owner and year of purchase: The Property is owned by the City of Eden Prairie. It is unknown when the Property was purchased by the City, but it has been maintained as a creek since the earliest available documentation in 1986 (Refs. 1a, 1e, 4a).

Current Occupant: There are no occupants of the Property (Refs. 4a).

Current Property use: The Property is located in the Riley Creek Conservation Area (Ref. 5a). Nature walking trails pass through the Property (Ref. 5a).

II. Physical Setting

Surface elevation: Approximately 850 feet above mean sea level (MSL; Ref. 1e).

Topographic conditions of Property: Topography of the Property varies widely and is deeply incised near Riley Creek (Ref. 5a).

Stratigraphy (soils and upper bedrock units): Soils on the Property are made up of Suckercreek fine sandy loam, Hawick loamy sand, and Lester-Malardi complex (Ref. 2e). Bedrock in the area is Prairie du Chien and is between 150 and 200 feet below ground surface (Refs. 2a, 2d).

Nearest surface water body (name and distance): Riley Creek is located in the center of the Property; various small creeks that drain into Riley Creek intersect the Property (Ref. 1a, 1e, 5a). One stormwater pond was located on the northern portion of the Property (Ref. 5a).

Anticipated groundwater depth/flow direction: Based on the Hennepin County Geologic Atlas, regional groundwater flow is to the south (Ref. 2c). Groundwater intercepts the land surface at the creek at an elevation of approximately 850 feet MSL (Ref. 1e). It is anticipated that the water table elevation is approximately equivalent to the elevation of the creek during low flow events.

III. Municipal Information & Utility Service to Property

Water Supply

Municipal water supply and intake location(s): The City of Eden Prairie gets its water from 15 wells drilled into the Jordan Aquifer (Ref. 5d).

Property potable/process water supply: The Property is not connected to potable/process water supply (Refs. 4a, 4b).

Have other potable water supplies serviced the Property? If yes, describe: No (Ref. 4a).

Sanitary Service

Type of sanitary service for the Property: The Property is not connected to sanitary service (Refs. 4a, 4b).

Have other methods of sanitary service been used at the Property? No (Ref. 4a).

Evidence of current onsite septic systems or drain fields: No (Ref. 5a).

Stormwater Management

Is the Property serviced by stormwater drains, storm sewers, ponds or drainage ditches? One stormwater pond was located on the northern portion of the Property (see Figure 2; Ref. 5a).

Do any neighboring properties discharge to the Property? Smaller, unnamed creeks discharge to Riley Creek; however, no debris or sheen were observed (Ref. 5a).

Property Zoning

Lower Riley Creek intersects three different zoning areas. The northern stretch of the Property is zoned public, the middle stretch is zoned one-family residential, and the southern stretch is zoned rural (Ref. 5c).

IV. Current Property Use

Current Property Waste Management

Waste is not generated at the Property (Refs. 4a, 5a).

V. Property, Adjoining, and Surrounding Area Regulatory Status

Regulatory database summary and supporting information is in the Historical Information Gatherers, Inc. Report located in Appendix D. Only information generated through searches of databases required by ASTM 1527-13 and within the appropriate minimum search distances were reviewed.

Property and Adjoining Property Regulatory Status – Not listed

File review results are summarized in Section VI. Justification for not completing a file review, if applicable, is provided below.

Surrounding Area Regulatory Status

The following table provides a summary of those database listing that the environmental professional has identified as potentially upgradient. Downgradient and/or side gradient listing are also included if the environmental professional has determined that the nature of the listing (e.g. Superfund site, chlorinated solvent release, landfill, etc.) should be evaluated for their potential to impact the Property.

Table 2

ASTM Listing	Address	Listing Status	Potential or Documented Release to Environment	Was a Regulatory File Review Completed?
PBF	9950 Eden Prairie Rd.	Inactive	Unknown	No. Site is inactive and is located 0.35 mile downgradient of Property.

ASTM List Definitions:
PBF – Petroleum Brownfields Program Sites

Tribal Sites

As part of the Historical Information Gatherers, Inc. Report, locations of Native American reservations equal to or greater than 640 acres in size within the search area are reported. No reservations meeting this size criterion were identified within 1 mile of the Property (Ref. 3a). The local government contact was not aware of Native American reservations or administered lands within 1 mile of the Property (Ref. 4b).

Orphan Site Summary – None

VI. Report and File Review Summary

Previous Environmental Investigations/Remedial Actions of the Property – None

Property File Review Summary

The Property and adjoining sites were not identified in a standard database; no file review was completed.

Property Historical Releases

No chemical or petroleum releases were reported for the Property. No remedial actions or environmental violations have occurred on the Property (Ref. 4c).

Environmental Liens

No environmental liens were identified for the Property (Ref. 4c).

Activity Use Limitations

No institutional or engineering controls were identified for the Property (Ref. 4c).

Proceedings Involving the Property

No pending, threatened, or past litigation. Administrative proceedings, or government notices relevant to hazardous substances or petroleum products were identified (Ref 4c).

Adjoining Property File Review Summary

No adjoining sites were identified in a standard database; no file review was completed.

VII. Property and Nearby Property Land-Use History

Property Land-use History

Original Property development (year/use): The Property has not been developed but has been maintained as a creek. Aerial photographs show farmland was present in the surrounding area since at least 1937 (Ref. 1a).

Chronology of Past Property use/ownership:

The Property is currently owned by the City of Eden Prairie and it is unknown when it was originally purchased. The Property has been maintained as creek since the earliest available topographic maps in 1986 (Refs. 1a, 1e, 4a).

Historical Property Structures

There were no historic structures that were demolished on the Property (Refs. 1a, 4a).

Demolition Debris: Not applicable.

Current Property Structures, Renovations, and Additions – None

Renovation Debris: Not applicable.

Building Additions: Not applicable.

Nearby Property Land-Use History

North	**Historical Use:**	Woods, farmland
	Current Use:	Residential
South	**Historical Use:**	Woods, farmland
	Current Use:	Woods, residential
East	**Historical Use:**	Woods, farmland
	Current Use:	Residential
West	**Historical Use:**	Woods, farmland
	Current Use:	Woods, residential, farm

General type of current or past uses in the surrounding areas: The area surrounding the Property was developed as farmland since at least the earliest available aerial photographs in 1937 (Ref. 1a). The area remained largely woods and farmland until residences were developed in the late 1990s and early 2000s (Ref. 1a).

Historical releases associated with adjacent properties or communities: None identified (Refs. 3a, 4a).

VIII. Site Reconnaissance

The objective of the site reconnaissance is to obtain information indicating the likelihood of identifying recognized environmental conditions in connection with the property (ASTM 1527-13 Sec 9.1). Existing Property features are shown in the Property layout on Figure 2. Photographs obtained during the Property inspection are in Appendix B.

Date of inspection: April 28, 2016

Name of individual conducting site visit: Mandy Bohnenblust, Barr Engineering

Weather information: Rainy, 40 degrees Fahrenheit

Exterior Observations

Methodology used to observe the Property: On foot, starting at the parking lot to the Riley Creek Conservation Area and walking the trails along Riley Creek.

Access to the Property (vehicular access and restrictions to public access): Access to the Property is available from the Riley Creek Conservation area and a paved path west from Sky Lane.

Periphery of the Property (roads, streets and parking facilities, etc.): The Property is surrounded by woods and residences.

Ground surface cover (paved, gravel, grass): The ground surface is covered with trees and natural vegetation. No vegetative stress was observed.

Visible evidence of filling, excavation, or burned areas: None observed.

Visible evidence of vegetative stress: None observed.

Pits, ponds, lagoons, and standing surface water: One stormwater pond was located on the northern portion of the Property (see Figure 2).

Stained soil or pavement: None observed.

Wastewater, stormwater, and other visible liquid discharge points into a pipe, pond, ditch, stream adjoining property or the Property: None observed; however, various small creeks drain into Riley Creek. No sheen or debris was observed.

Indications of past uses of the Property likely to involve the use, treatment, storage, disposal or generation of hazardous substances or petroleum products: None observed.

Nonpotable/process wells: None observed.

Pipelines across or into Property: A pipe approximately 10 feet by 2 feet was observed in Riley Creek, (see Figure 2). The pipe appeared to be in good condition with no signs of staining or prior use.

Rail lines: None observed.

Transformers: None observed.

Outdoor Chemical Storage Areas/Drums: None observed.

Underground Utility Locations: None observed.
Odors: None encountered.

Other: Wooden foot bridges were present throughout the Property to allow trail users to cross creeks or other low spots. They appeared to be in good condition with no staining.

Erosion control structures include bio logs, fiber mats, and rocks were observed throughout the Property.

VIII. Interior and Exterior USTs and ASTs

Not present.

IX. Interviews

The objective of interviews is to obtain information indicating recognized environmental condition in connection with the property (ASTM 1527-13 Sec 10.1). Interview questionnaires are in Appendix F. Especially relevant information from the interviews is included and documented throughout the Assessment report and Appendix A.

Appendix B

Property Inspection Photographs

Appendix B
Property Inspection Photographs

Riley Creek
Eden Prairie, Minnesota
April 28, 2016

Photo #	Comments
1	Entrance to Riley Creek Conservation Area
2	Typical View of Riley Creek
3	Typical Footbridge Observed Throughout the Property
4	Typical View of Walking Trail
5	Typical View of Riley Creek
6	Typical View of Erosion Control Devices
7	Pipe Observed Within Riley Creek
8	Stormwater Pond

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Appendix C

Historical Documentation

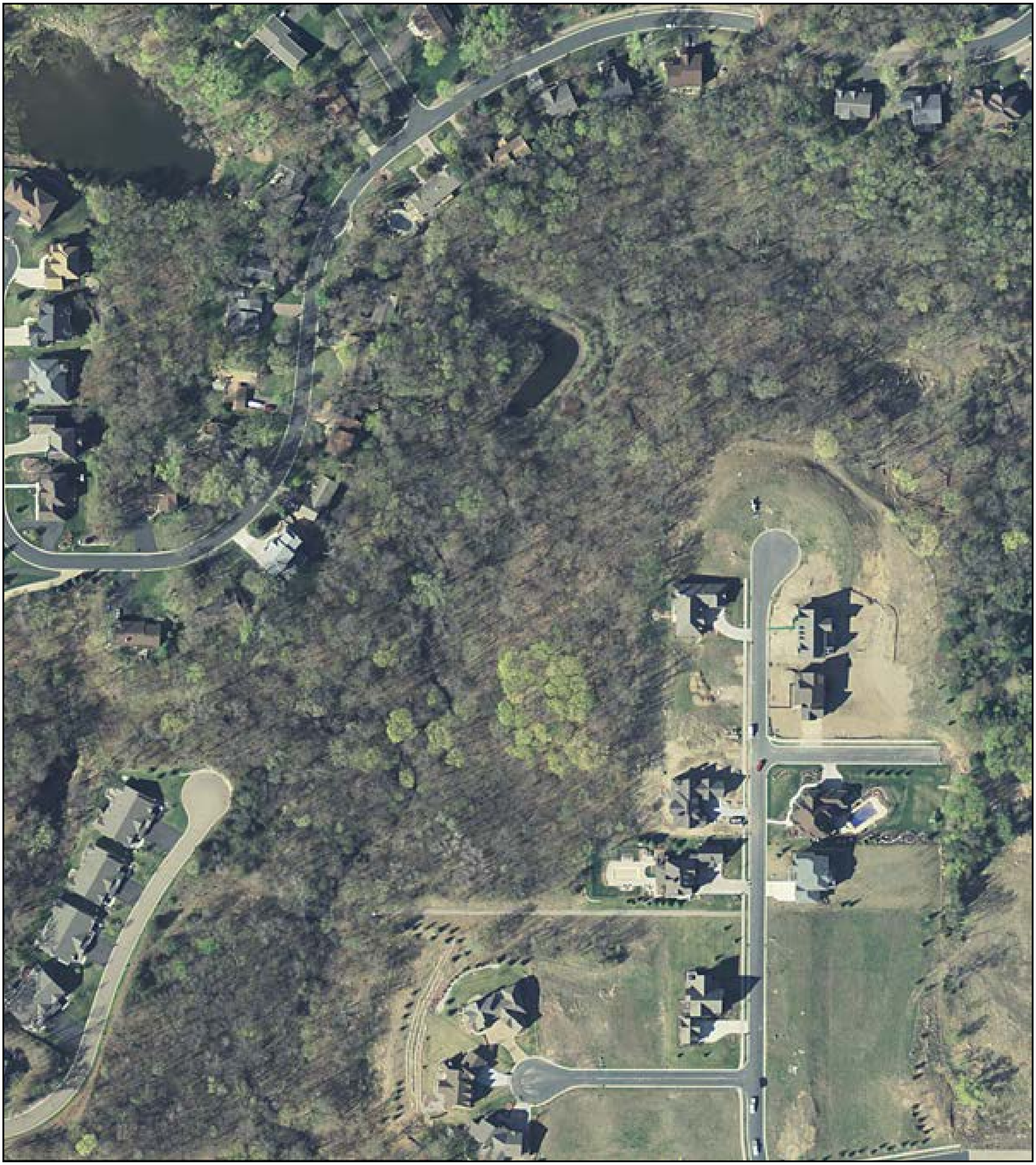
Aerial Photographs

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2015

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2012

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2009

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**2004** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com	HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2000

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1994

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

1987

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1984

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1978

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1971

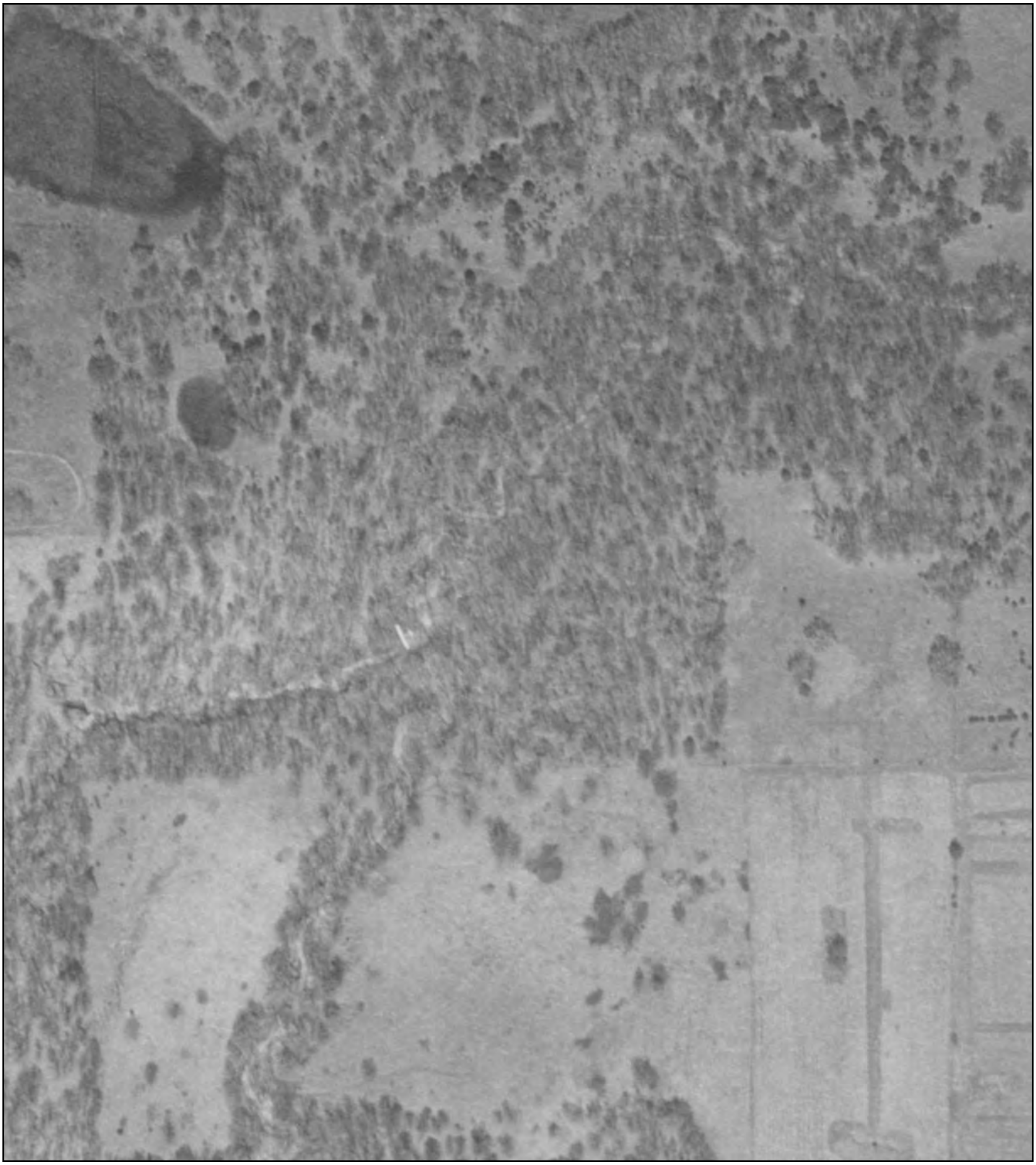
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1967

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1960

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1956

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

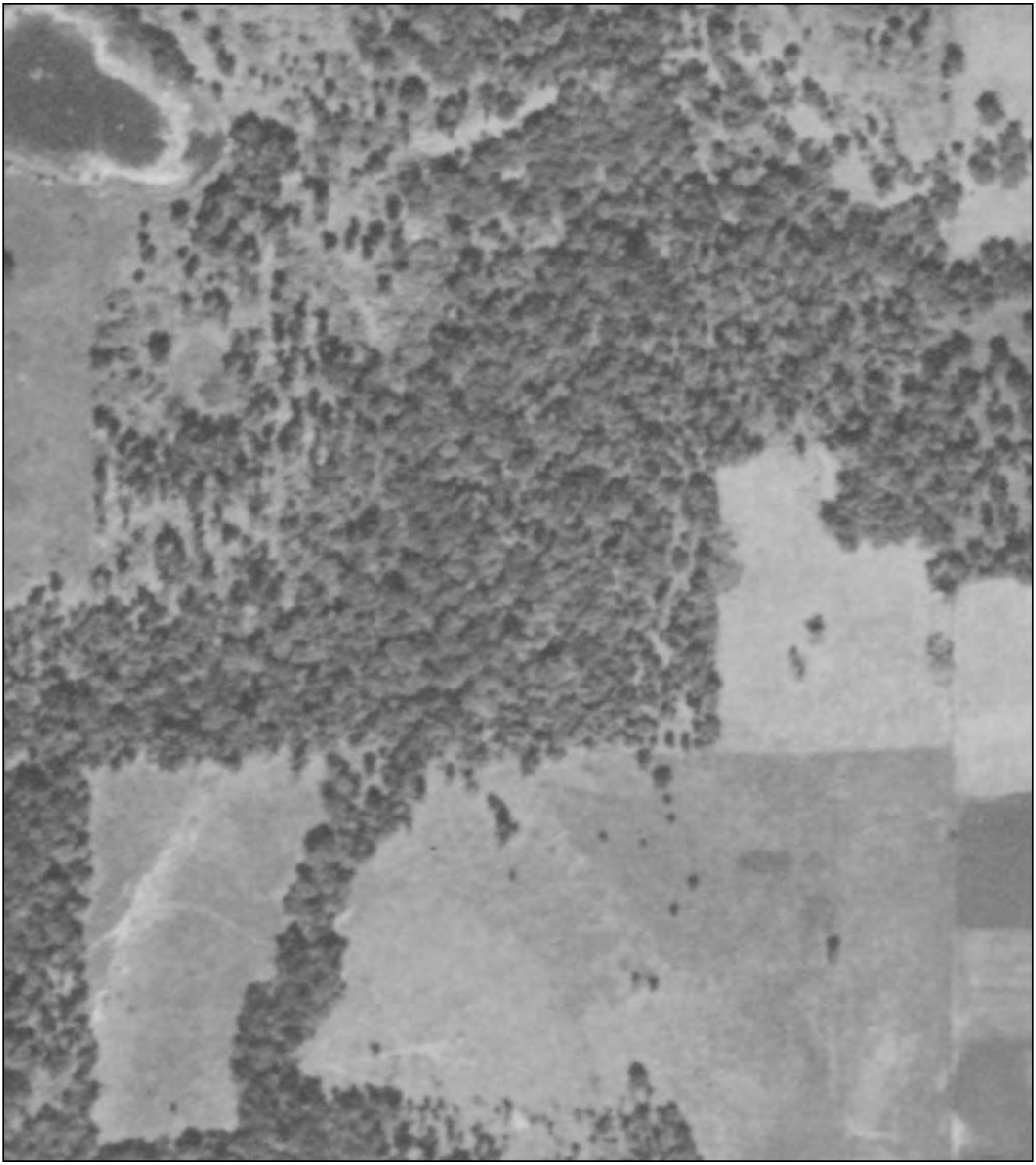
HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

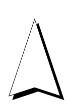
N

1947

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN



1940

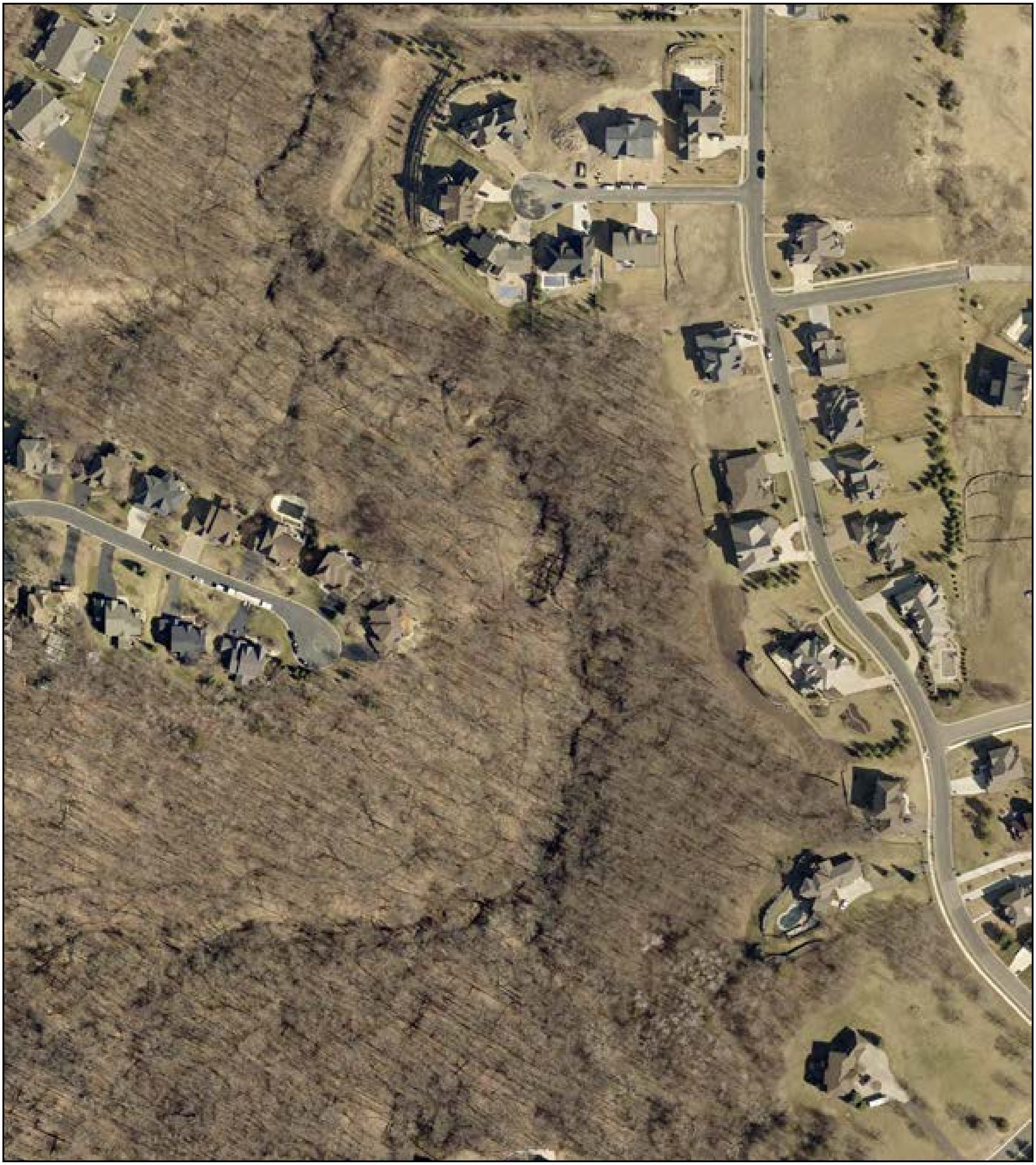
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1937

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

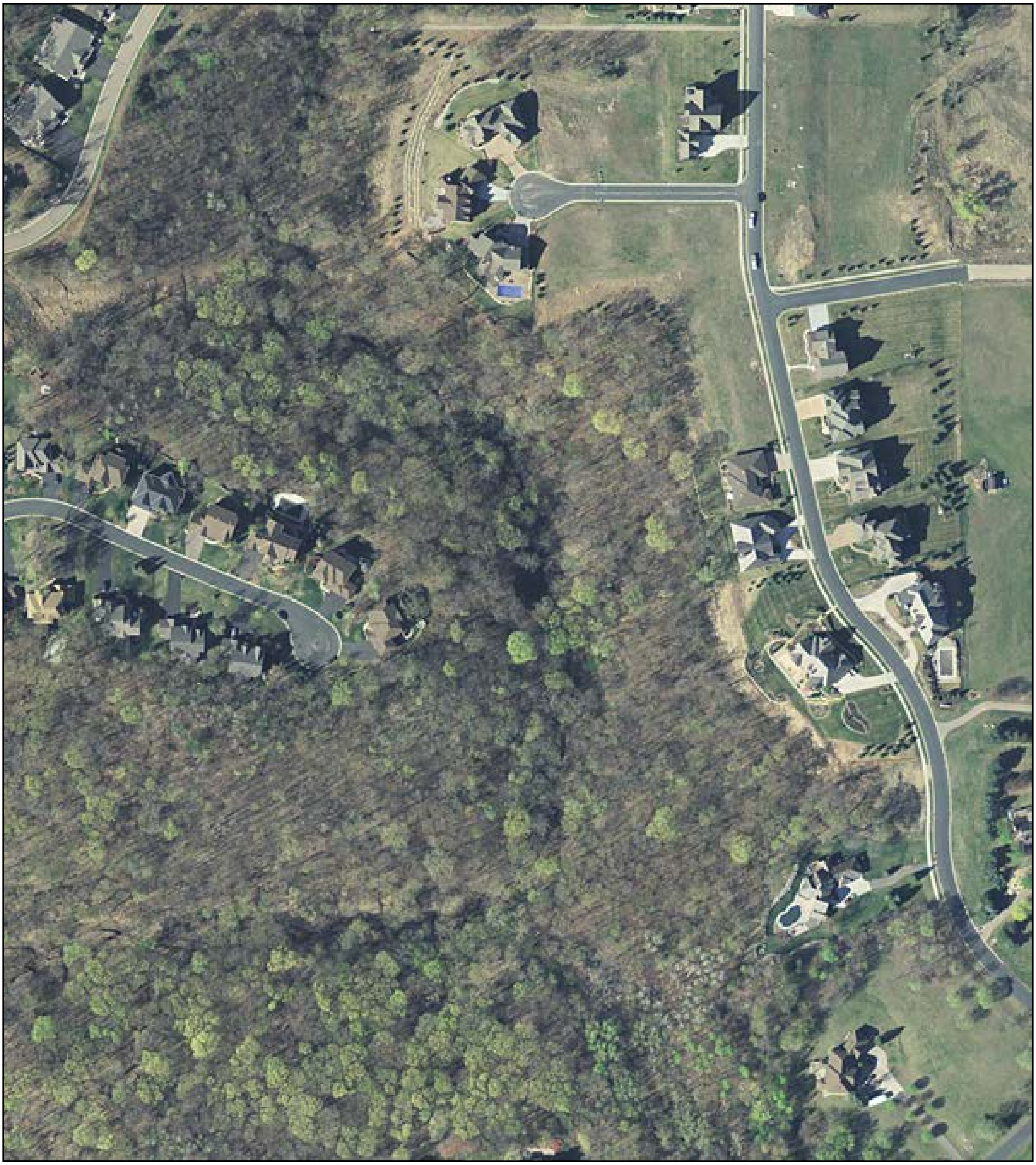


Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2015

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

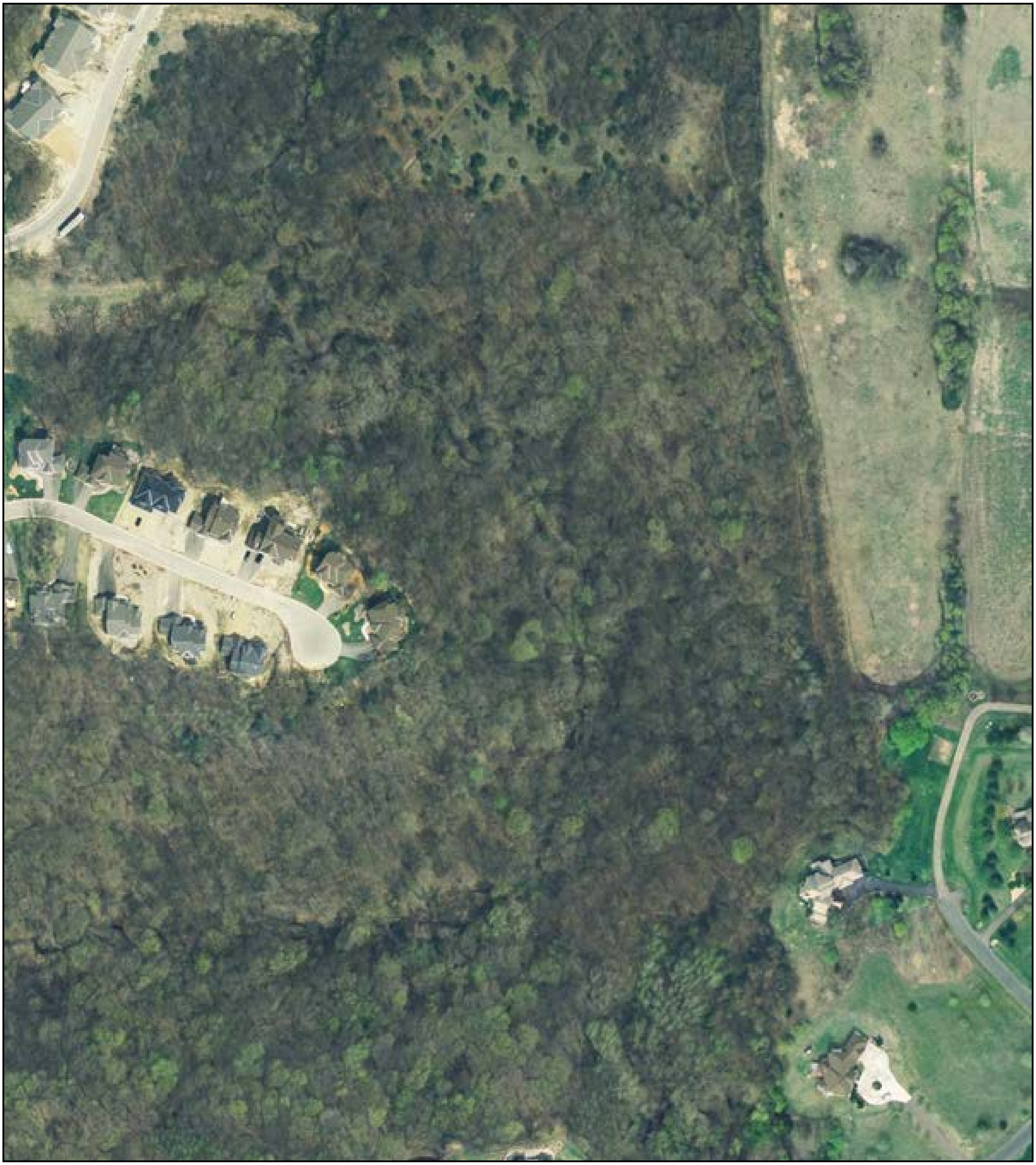
N

2012

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

HIG

Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**2009** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com	HIG



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2004

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2000

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1994

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1987

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1984

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1978

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1971

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

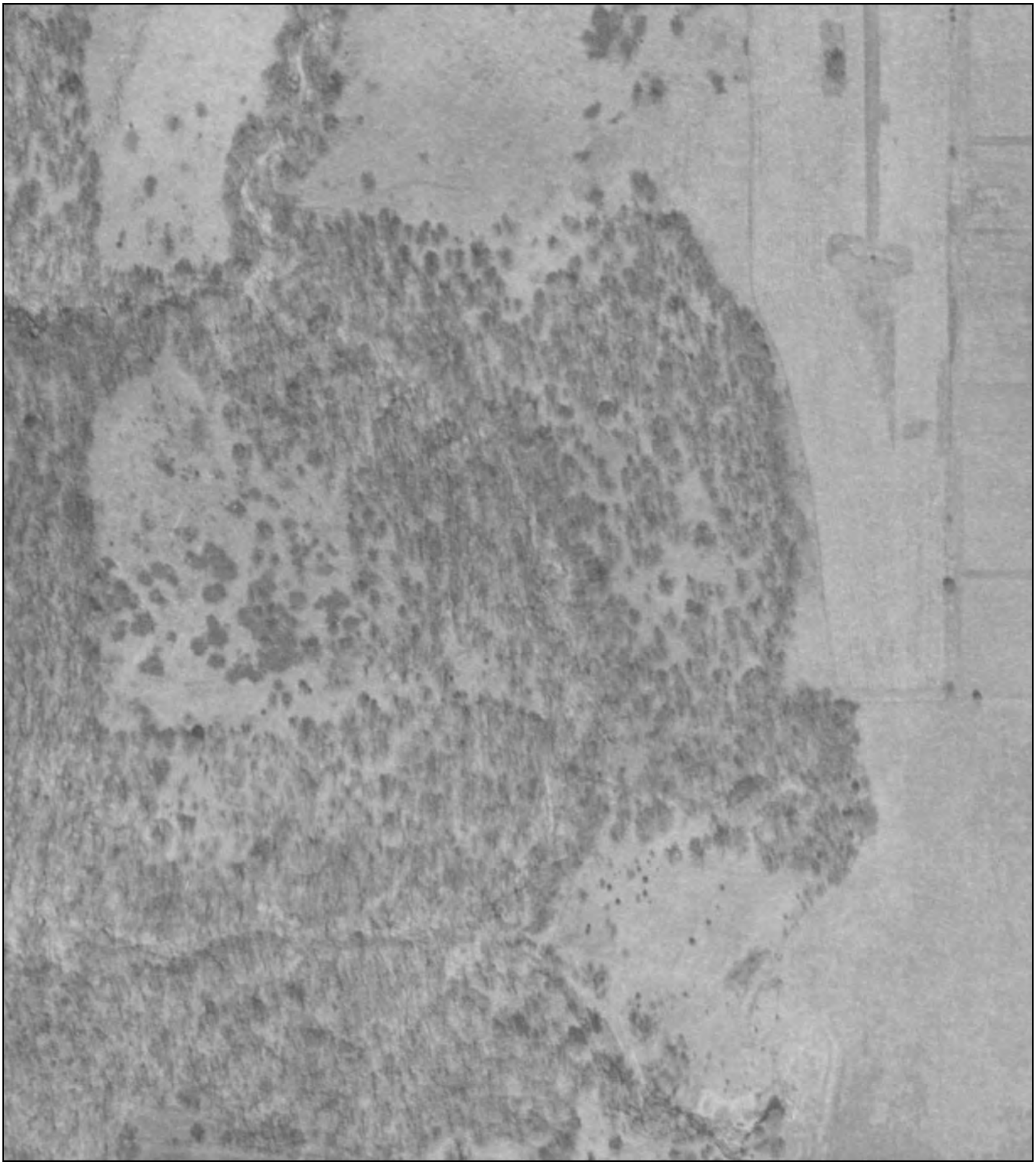
HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1967

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1960

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1956

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1947

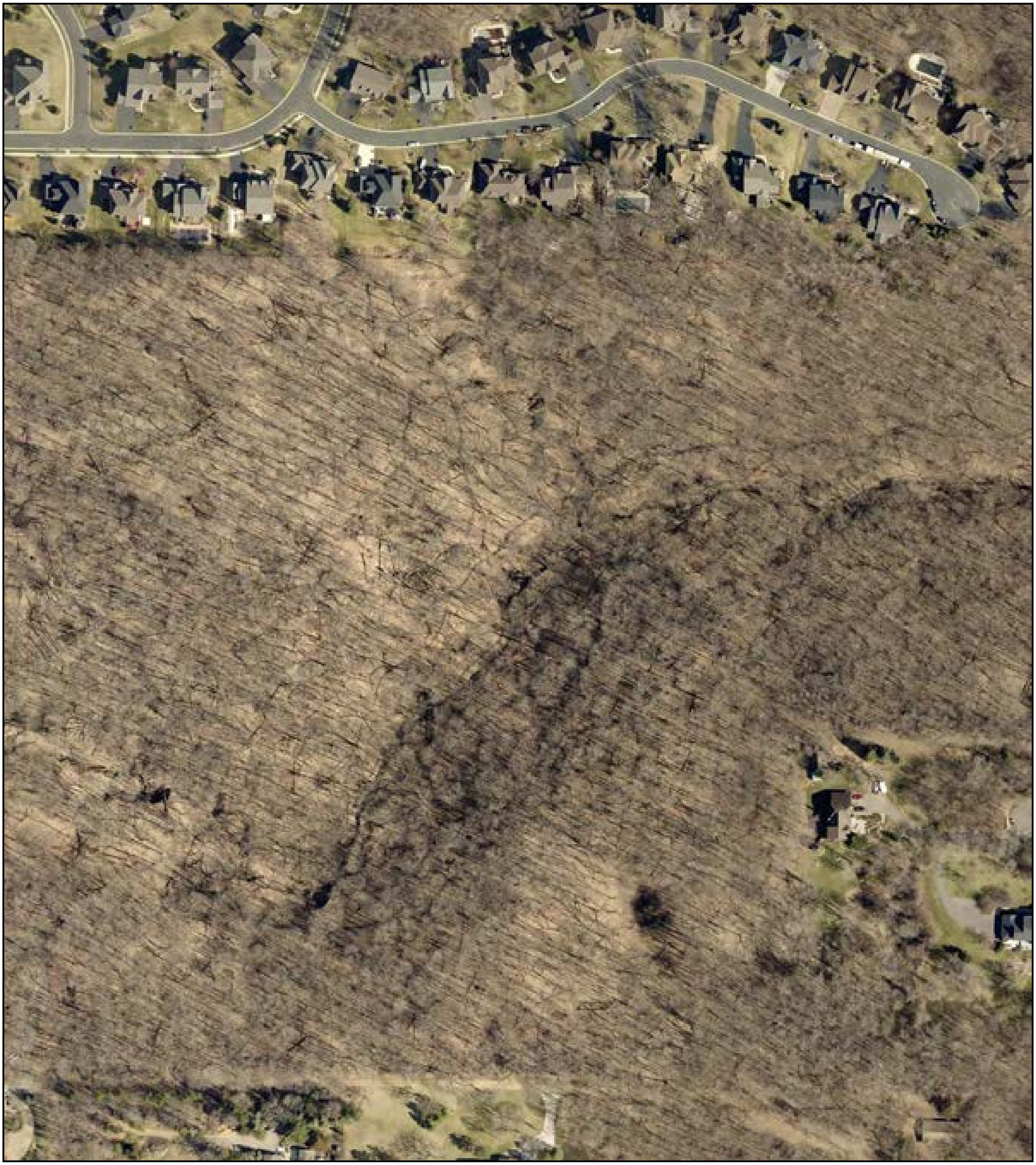
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1937

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

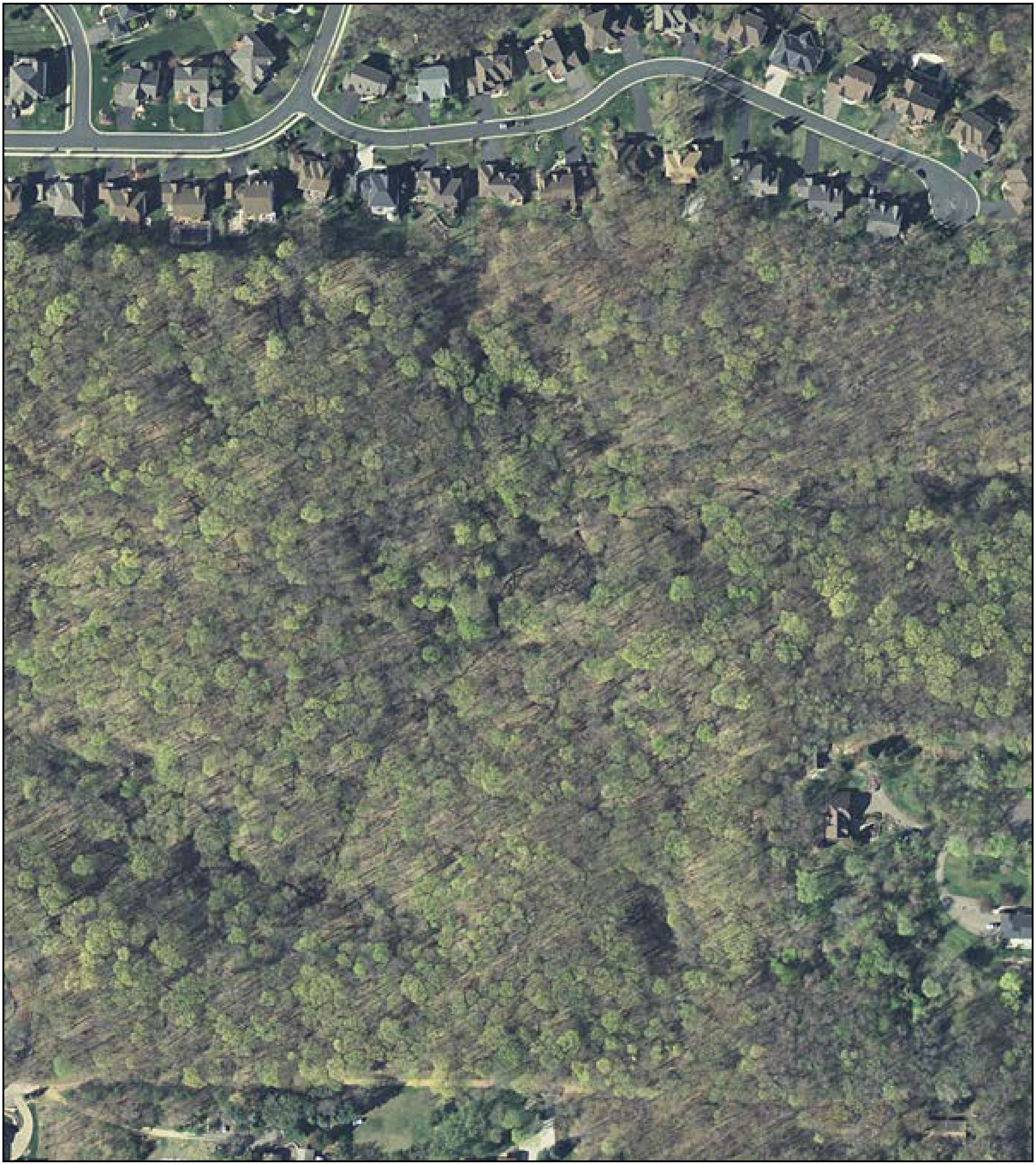


Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2015

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2012

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

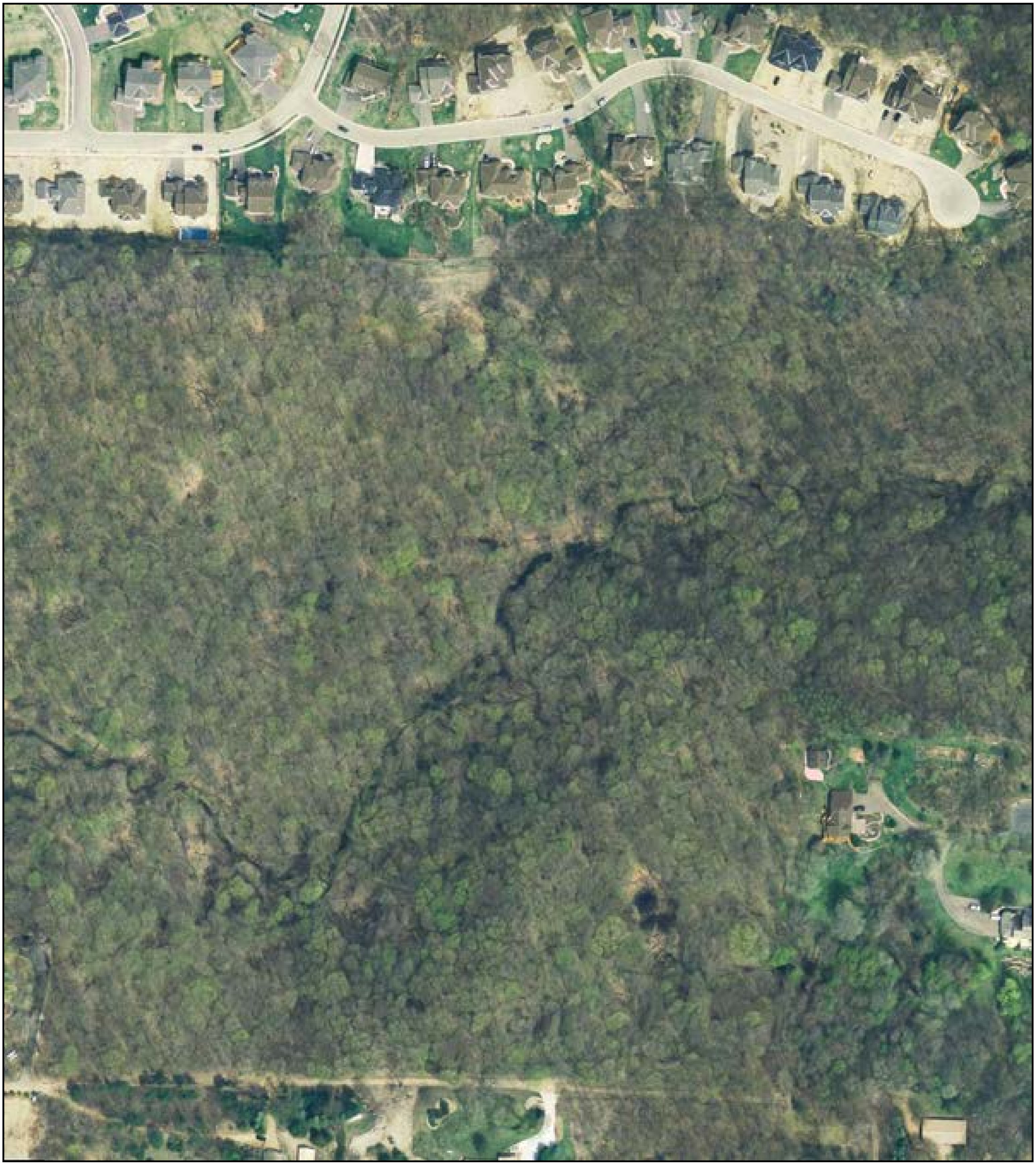
HIG

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2009

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2004

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

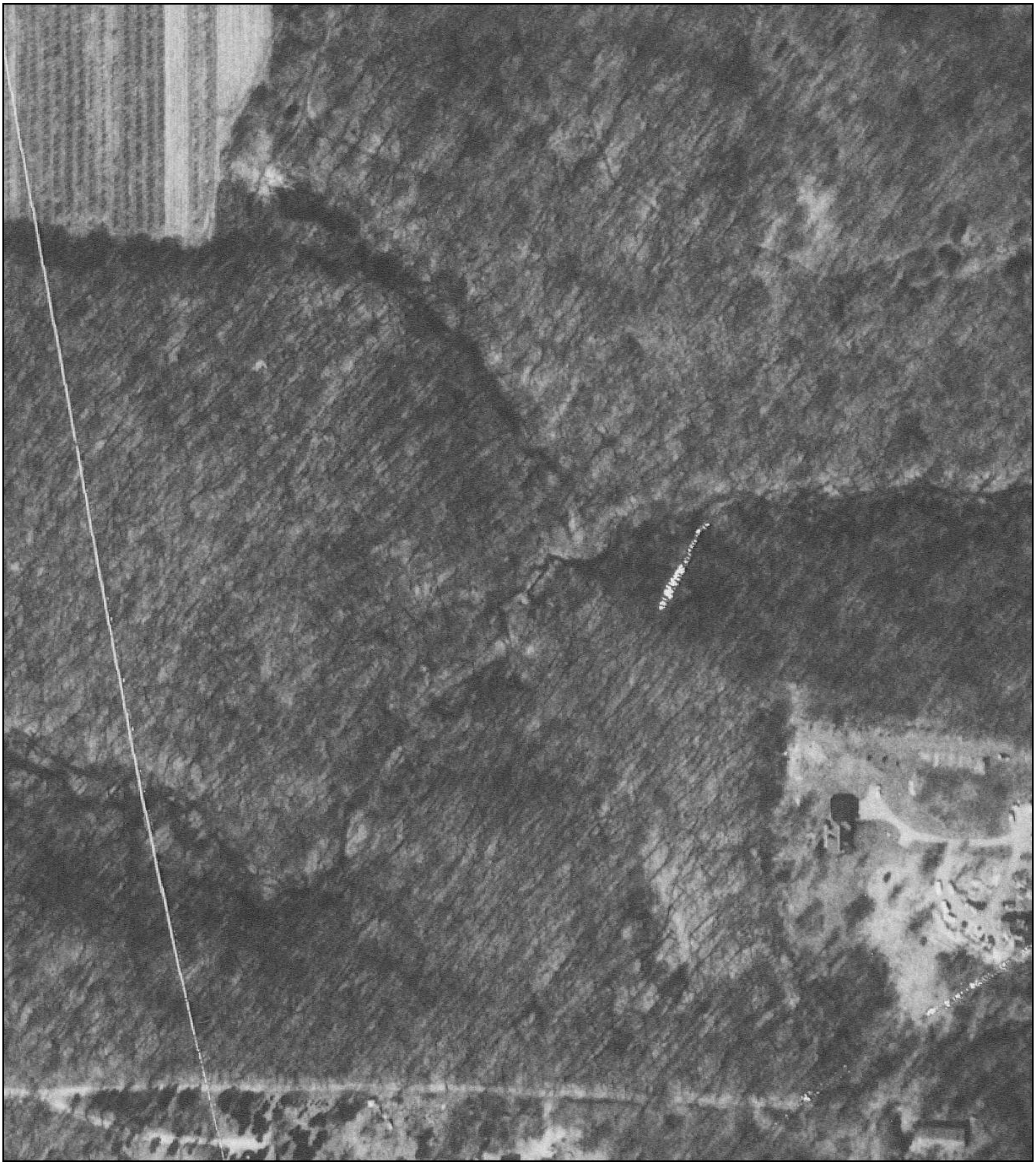
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2000

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**1994** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com	HIG



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1987

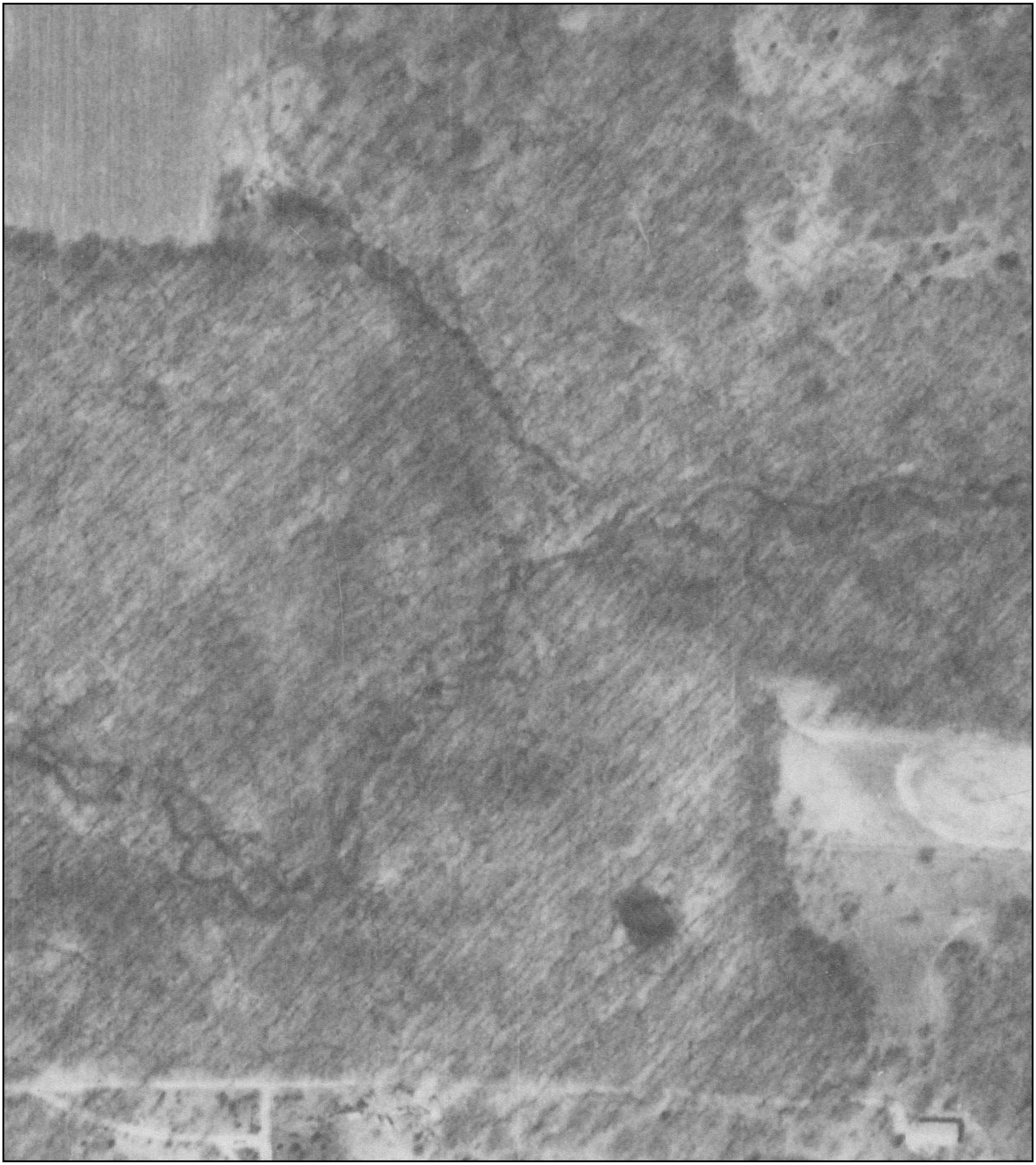
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1984

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1978

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1971

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

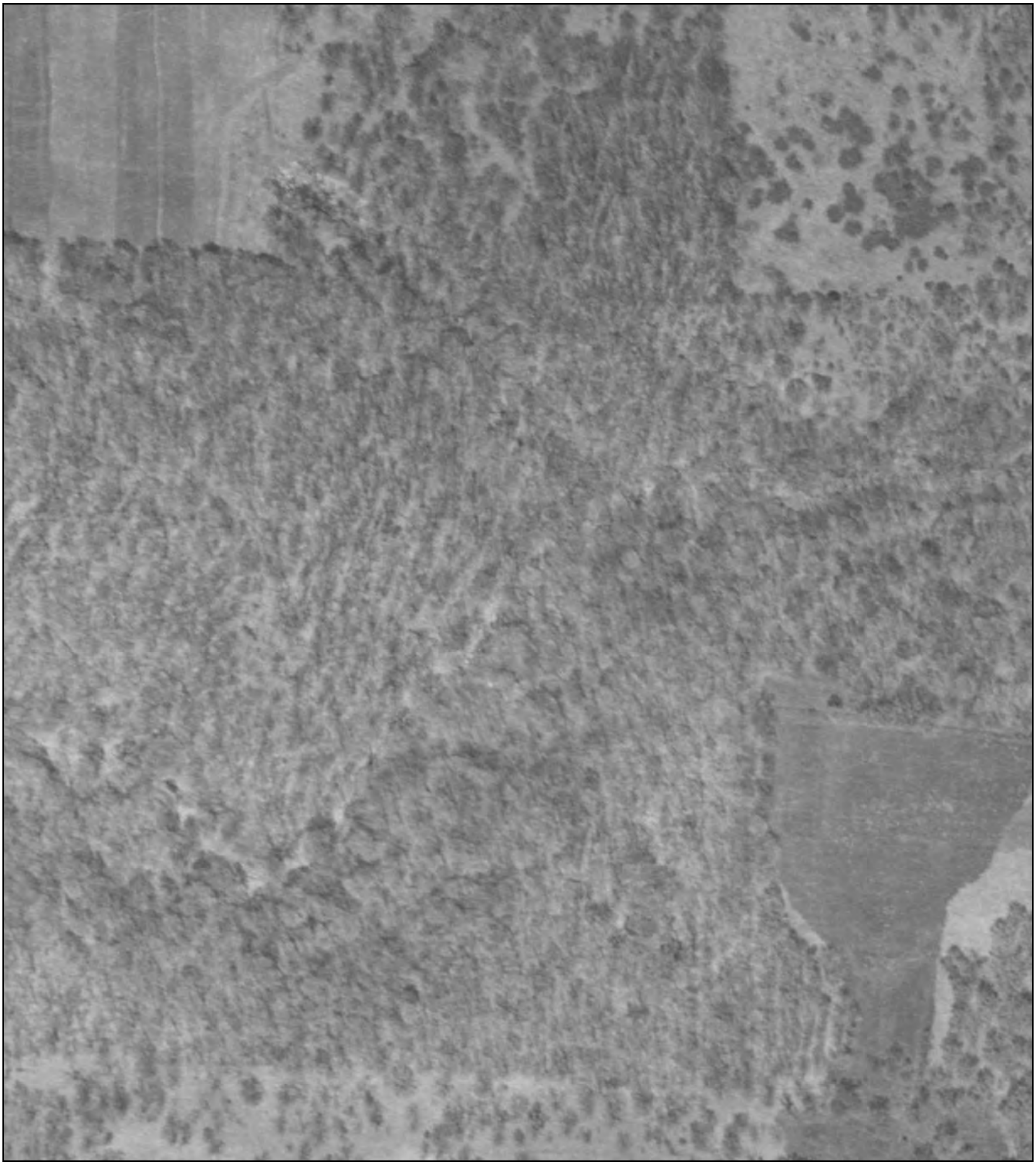
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1967

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

HIG



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1960

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1956

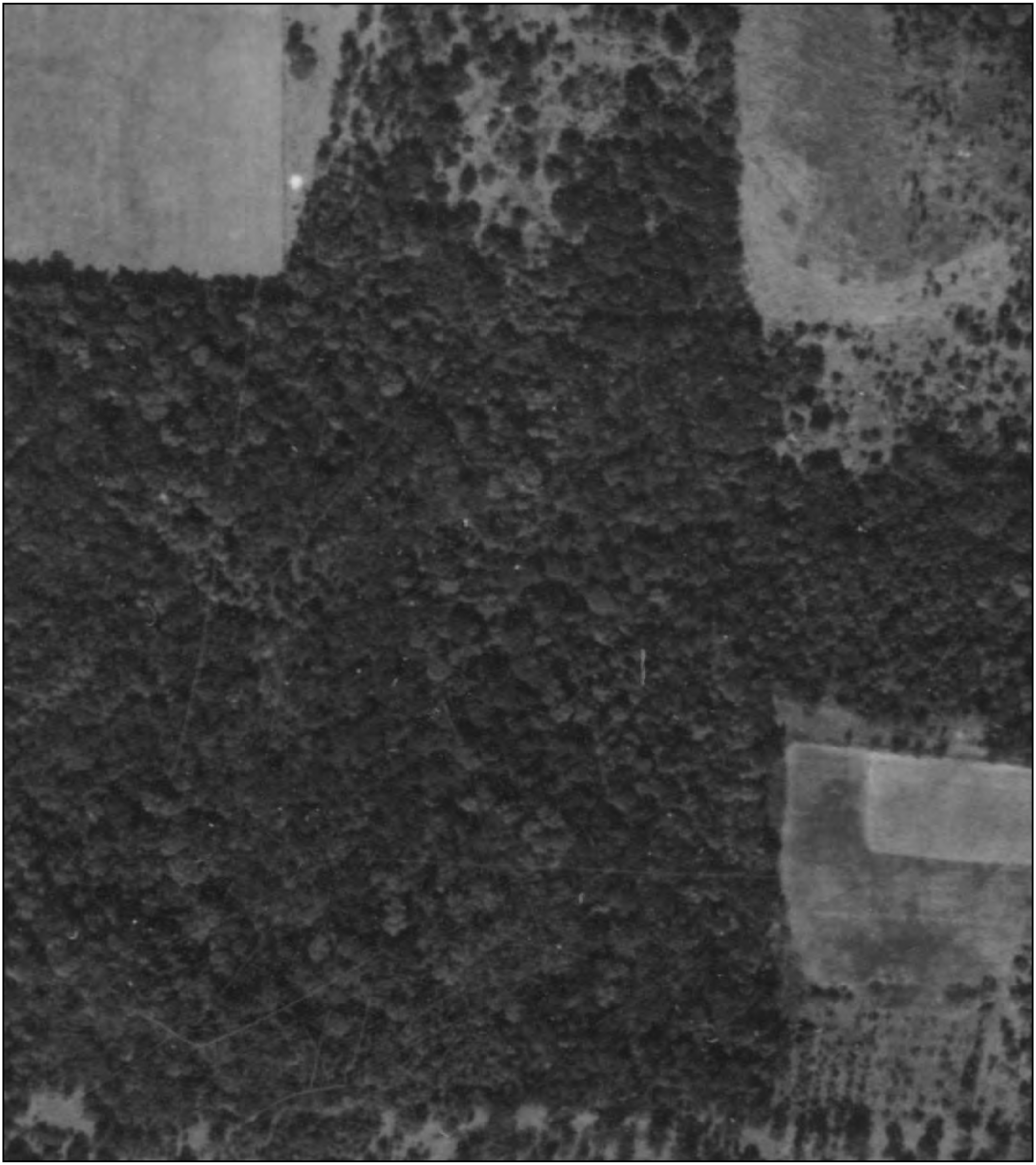
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

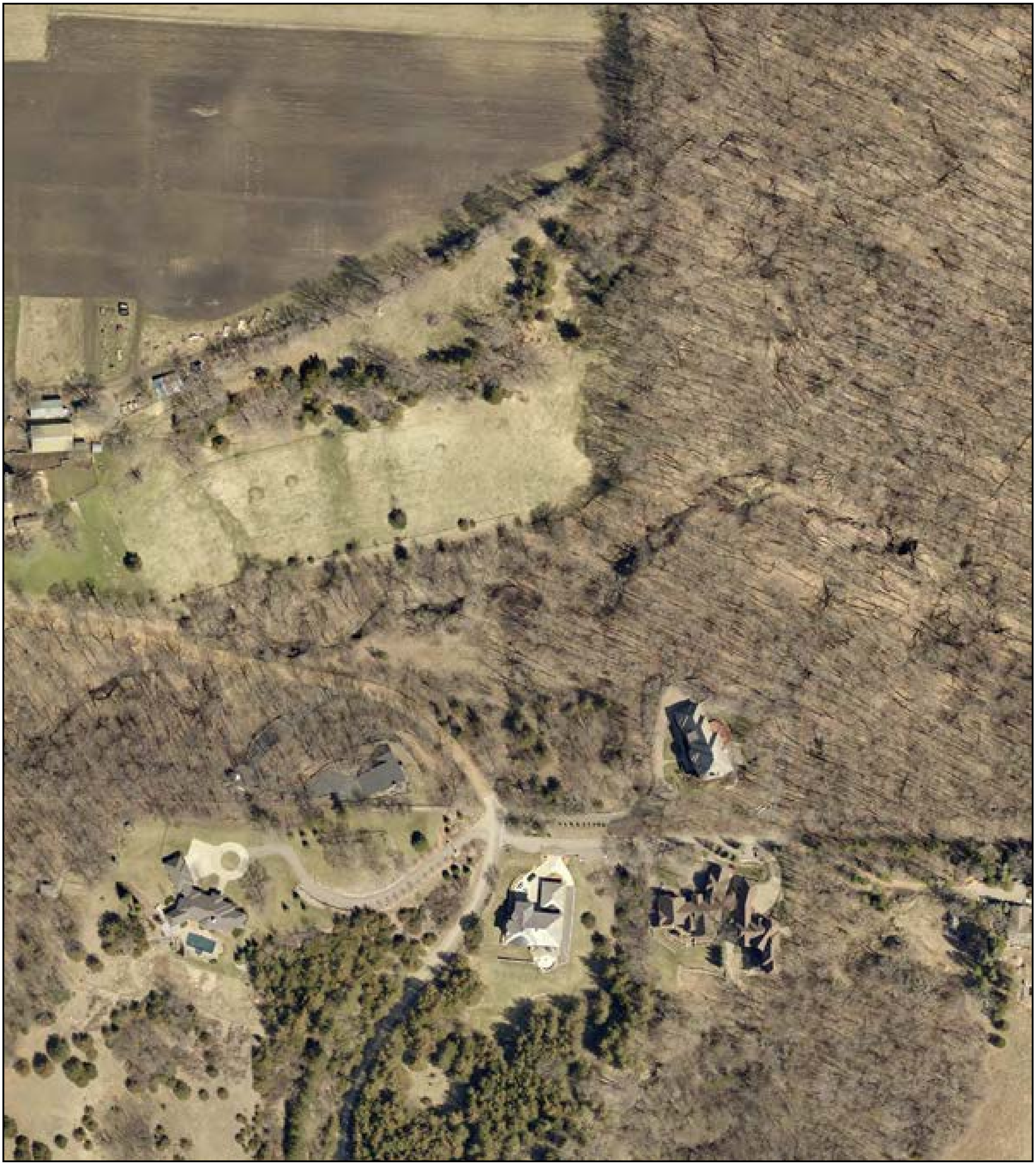
N

1947

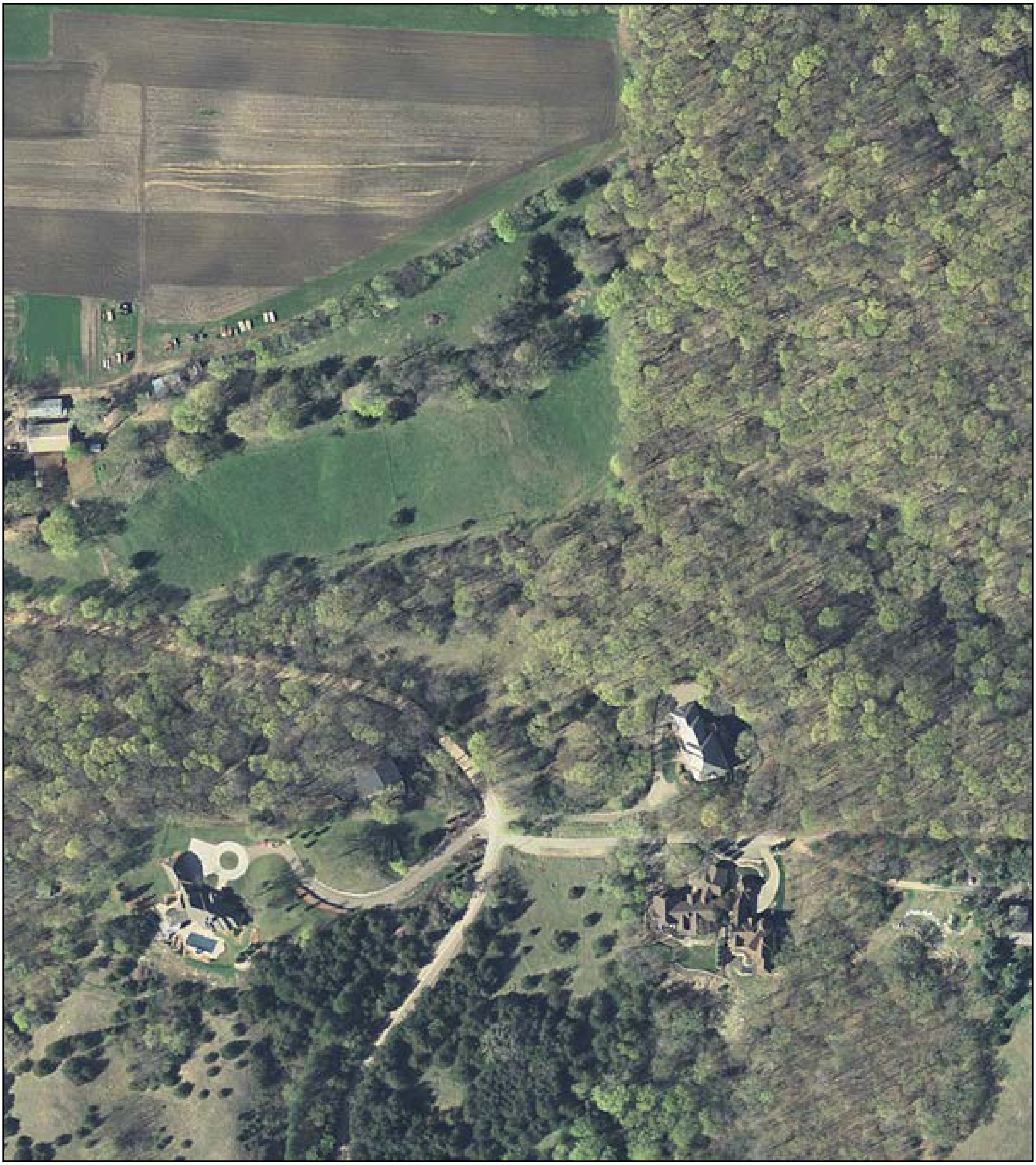
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**1937** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com



Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**2015** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com



Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2012

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2009

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2004

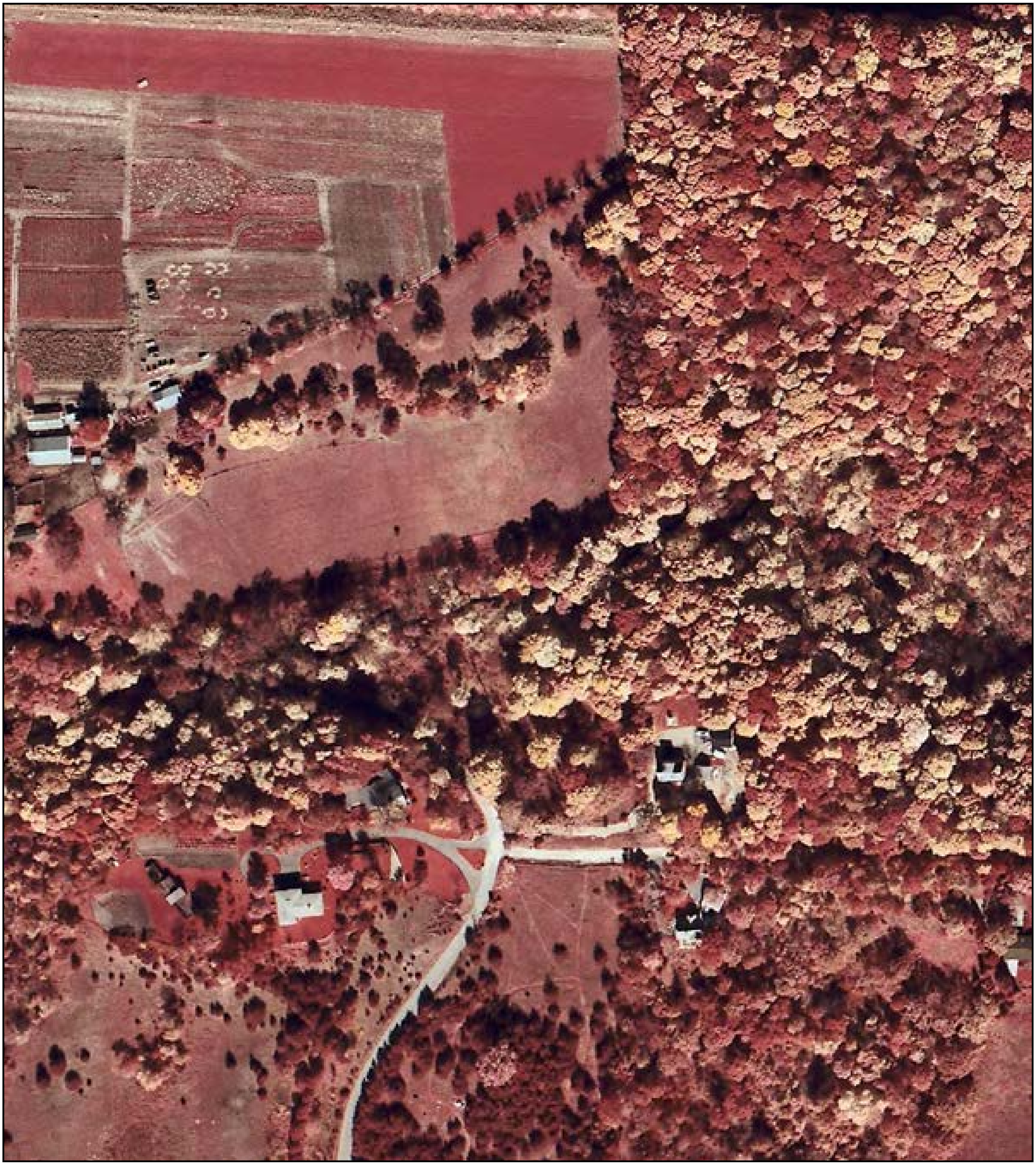
HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

2000

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com



Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**1994** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1987

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1984

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1978

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1971

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1967

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1960

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor Eden Prairie Eden Prairie, MN	N	**1956** HIG Project # 1632102 Client Project # Approximate Scale 1: 2,400 (1"=200') www.historicalinfo.com	

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1947

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

Riley Creek corridor
Eden Prairie
Eden Prairie, MN

N

1937

HIG Project # 1632102
Client Project #
Approximate Scale 1: 2,400 (1"=200')
www.historicalinfo.com

City Directories

33419 Dr Brian Richard Anderson (1/00) 02● NP
Dr Lisa Kay Anderson (11/00) 02● NP
33446 Carl Beaupre (9/02) 02●763 689 1726
Suzanne Kay Lind (9/02) 02●763 689 1726
33480 David Fowler (1/07) 07● NP
James Seymour Fowler (1/07) 07● NP
33485 Katrina Leaf (12/10) 09● NP
33527 Gary T Yeager 06 NP
20 RESIDENCE

●SKY LN

Eden Prairie
CT 260.17 9500 - 9845 SA
9500 - 9845 55347

9500 9507,9510,9527 NP
9530 Jeanne Diane Oakley (10/07) 04● NP
Stephen Roy Oakley (10/07) 04● NP
9547 9550,9567,9570 NP
9587 Lorene Michelle Freehill (1/07) 05● NP
Michael Quinn Freehill (1/07) 05● NP
9607 NP
9610 Bob James Blue (8/08) 06●952 934 1165
James David Blue (8/08) 06●952 934 1165
9627 9647,9667,9687 NP
9707 Anthony J Colistra Jr (6/11) +●952 322 7272
Melissa Ann Colistra (6/11) +●952 322 7272
9710 NP
9727 Kay Johnson (7/08) 06● NP
Eric S Mills (7/08) 06● NP
9730 Edward Nick Hanson (3/10) 07●952 378 1150
9747 Marissa N Brachfeld (9/06) 06●952 426 0396
Dr Susan Ann Marcinelli (6/06) 06●952 426 0396
9750 NP
9767◇ Nancy A Isbell (10/06) 05● NP
9770 NP
9787 Brock Neilson (5/07) 04●952 303 3789
Chris Vance Neilson (5/07) 04●952 303 3789
9790 Diana N Hanline (9/07) 05●952 949 0081
Michael James Hanline (9/07) 05●952 949 0081
9805 Diane Lucille Driver (11/07) 97● NP
Ray Eugene Driver (11/97) 97● NP
9810 NP
9820 Shyan Leah Fitzgerald 07●952 590 9195
9845 Karen Lynn Rempfer 89●952 937 8971
Vernon B Rempfer 89●952 937 8971
–BEVERLY DR INTS
40 RESIDENCE

●SKY HIGH DR

Saint Paul
CT 411.07 1820 - 1993 SC
1820 - 1993 55112

1820 Jeffrey D Lange (9/07) 82●651 639 0213
Sherrie Lee Lange (9/93) 82●651 639 0213
1823 Kathryn D Vetter (6/11) 07●651 493 4352
Scott G Vetter (6/11) 07●651 493 4352
1831 Rita Schaving Simmer (6/05) 80●651 636 4003
Robert Francis Simmer (6/05) 80●651 636 1033
1875 Douglas B Bengson 62●651 633 5189
Marion M Bengson 62●651 633 5189
1900 David Paul Onken 77●651 636 7579
Jennifer Marie Onken 77●651 636 7579
1901★BHL Services Inc........ + 651.636.4292
Maria Elizabeth Lloyd 88● NP
William Hans Lloyd 88● NP
1932 Thuong Vinh Nguyen (9/03) 03● NP
1943 Kelly Ann Foltmer (8/93) 89●651 639 8484
Dave Ray Ross (8/90) 89●651 639 8484
1964 Jacqueline Vardmin Godfrey 75●651 633 7497
1973 NP
1993 Violet Ann Dorumsgaard 86●651 631 8629
18 RESIDENCE 1 BUSINESS

●SKY VIEW CT

Saint Paul
CT 607.34 4830 - 4859 SB
4830 - 4859 55122

–GALAXIE AVE W INTS
4830 Bonnie Mathsen Holland 86●651 683 1970
Richard Bentley Holland 86●651 683 1970
4835 Kim Anne Krueger 85●651 454 1647
Ronald Allen Krueger 85●651 454 1647
4836 Duane A Hauser 86●651 456 0279
Margaret Anne Hauser 86●651 456 0279
4841 Jim Brooke Galloway 86● NP
4842 Eva Yichiou Hang (8/07) 86●651 688 0351
Starsky S Hang (8/07) 86●651 688 0351
4847 James Michael Nee (11/98) 99● NP
Jody Travous Nee (11/98) 99● NP
4848 James Ray Kennedy (5/99) 89●651 452 5969
Marcella Ann Kennedy (5/99) 89●651 452 5969
4853 NP
4854 Anita Jagdeo (6/05) 05● NP
Uranwattee Biddgeanand Jagdeo (6/05) 05● NP
4859 Reshma Janakiram Rao (1/09) 94● NP
Shashi S Rao (1/98) 94● NP
18 RESIDENCE

●SKYBLUE CT

Saint Paul
CT 403.02 2500 - 2517 SC
2500 - 2517 55110

2500◇ Jim McMeans 05●651 407 7186
◇ Kermit M McMeans Jr 05●651 407 7186
2501 NP
2504 Margaret M Cords (5/05) 05●651 426 2912
Nicholas J Cords (5/05) 05●651 426 2912
2505 Harvey Arthur Bartz (7/07) 06●651 330 2333
Janet Gail Bartz (7/07) 06●651 330 2333
2508 NP
2509◇ Joan C Gerrs 05●651 777 2333
◇ Gregory Charles Simpson 05●651 777 2333
2512 Gerald Clarence Brown (1/04) 03●651 770 1556
Nanc Ellen Brown (1/04) 03●651 770 1556
2513 2517 NP
14 RESIDENCE

●SKYCROFT CIR

Minneapolis
CT 201.01 3304 - 3437 SC
3304 - 3437 55418

3304 Stanley Luverne Gordon 70●612 781 1679
3305 NP
3308 Carole Mae Toman 95●612 789 6170
Steven Henry Toman 95●612 789 6170
3309 James Dominic Molinaro (10/97) 94●612 781 2955
Mary Beth Molinaro (10/97) 94●612 781 7966
3312 Julie Marie Gebhardt (10/93) 93●612 789 2373
Rick Emil Gebhardt Jr (10/93) 93●612 789 2373
3313 Eugene William Hunstad 69●612 789 5537
Sherry Lynn Hunstad 69●612 789 5537
3316 Michael C Jacobs II (12/02) 99● NP
Michelle Ann Jacobs (12/02) 99● NP
3317 James Albert Bueltel 01●612 788 9907
Malgorzata Izabella Bueltel 01●612 788 9907
3320 Holly Ann Stene (8/99) 92●612 706 3235
Jeffrey Curtis Stene (8/99) 92●612 706 3235
3324 Jeff Steven Jensen (7/05) 05●612 789 2877
Roseann Susan Jensen (7/05) 05●612 789 2877
★St Croix Hardwood Flooring 05 612.781.3635
3325 Richard L Ernst 72●612 788 4550
3328◇ Jean Ann Heberle (5/87) 87●612 789 9020
◇ Robert A Heberle Jr (5/87) 87●612 789 9020
3329 Nancy Jean Anderson (2/99) 02● NP
3333★Automotive Recyclers Of Minnesota
05 612.781.5555
3337 Erik G Thoreson (4/10) 06● NP
Jessica L Thoreson (4/10) 06● NP
3341 NP
3400 Gail Marie Anttila (8/86) 86●612 789 7843
Roger L Anttila (8/86) 86●612 789 7843
3401 Gregory John Seward 93●612 789 3399
Laura Kruger Seward 93●612 789 3399
3404 Gordon Earl Lavalley 67●612 781 4609
Ruth Margaret Lavalley 67●612 781 4609
3405 Joel Lynn Whitmore (6/87) 87●612 789 1070
Terri Ann Whitmore (6/87) 87●612 782 0510
3408 Catherine Ann Jaray (12/01) 01●612 788 4488
Jeff M Jaray (12/01) 01●612 788 4488
3409 NP
3412 Brian William Rude Atty (12/89) 89●612 782 0574
Cathy Ane Rude (12/89) 89●612 789 6953
★Rude Brian W 10 612.789.6953
3413 Carla W Foley (9/92) 92●612 782 9893
John Fitzgerald Foley (9/92) 92●612 782 9893
3416 Cameron M Winter (12/10) 09●612 545 5564
Michelle K Winter (12/10) 09●612 545 5564
3417 Werner Hans Kuhnert (5/90) 89●612 789 8115
Zolia H Kuhnert (5/90) 89●612 789 8115
3420 Clyde C Gates 76●612 789 8767
Mary Louise Gates 76●612 789 8767
3421 Holly N Saenz (6/93) 93● NP
Holly Noelle Schaefer (6/93) 93● NP
3425 Gordon Michael Januszewski (10/97) 97● NP
Stephanie Ann Januszewski (10/97) 97● NP
3429 Janice Yvonne Stroom 77●612 789 3421
Paul D Stroom 77●612 789 3421
3433 Gerald Ray Sorsoleil (5/85) 85●612 788 0271
Gloria Jean Sorsoleil (5/85) 85●612 788 0271
3437 NP
55 RESIDENCE 3 BUSINESS

●SKYCROFT DR

Minneapolis
CT 201.01 3200 - 3534 SC
3200 - 3534 55418

3200 David Timothy Wiggins (7/00) 96● NP
Lisa Kay Wiggins (7/00) 96● NP
3201 3204 NP
3205 Kathleen Elizabeth Jurkovich (2/02) 96●612 781 0351
Mark William Jurkovich DDS (2/02) 96●612 781 0351
3208 J Kelly 00●612 781 6275
3209◇ Michele Sue Bentz (6/07) 07●612 208 1431
◇ Scott Arnold Bentz (6/07) 07●612 208 1431
3212 Debora Jean Martinez (8/08) 06●612 781 3439
Robert J Martinez (8/08) 06●612 781 3439
3213◇ Mary Ellen Gabel 75●612 789 7832
3216 Cynthia L Petersen (4/85) 88●612 781 0916
Douglas A Petersen (4/85) 88●612 788 6950
3217 NP
3220◇ Diana Sletten (5/82) 82●612 789 9238
◇ Tom Brian Sletten (5/82) 82●612 789 9238
3221 David Edgar Gordhamer (7/94) 94●612 782 6929
Mary Beth Gordhamer (7/94) 94●612 782 6929
3224 Howard E Leppla 62●612 781 7115
Mary A Leppla 62●612 781 2008
3225 Pam Carlson 09 NP
Donald Levin 09 NP
★Wingspan 10 612.788.1181
3300 Deborah Ann Enrooth 65●612 789 0362
Douglas V Enrooth 65●612 789 0362
3304 Erica Joanne Mendesh 93● NP
Joey Mendesh 93● NP
3308 Timothy Thomas Johnson (12/97) 97●612 782 9347
Terese Marie Lynch (12/97) 97●612 782 9347
3312 Lori Jean Lafleur (6/91) 91●612 789 3622
Robert Allen Lafleur (6/91) 91●612 789 3622
3315 Anne M Lindskog 77●612 789 7763
Eric Carl Lindskog 77●612 789 7763
3316 Glen Warren Johnson 69●612 781 8386
Marlys Marie Johnson 69●612 781 8386
3319★1 Always A Locksmith ... 09 612.412.9130
Harriette Ann Watten 94●612 781 9184
Sandra L Watten 94●612 781 9184
3320 Stephanie Lynn Russell 07 NP
Wade Wade Russell 07 NP
3323 Patrick Harris Niccum (8/98) 98●612 788 7511
Patty Niccum (8/98) 98●612 788 7511
3324 NP
3327 Carsa Sibbet (3/75) 97●612 789 9004
Steve Ralph Sibbet (3/75) 97●612 789 9004
3328 Ben N Wahi (4/84) 84●612 788 3795
Nicholas Francis Wahi (4/84) 84●612 788 3795
3331 Barry Melvin Kinsey (6/03) 84●612 789 1493
Bernice Kuure Kuure (6/03) 84●612 789 5470
3335 NP
3339 Brad Duane Rice (6/90) 89●612 781 1734
Georgia Jane Rice (6/90) 89●612 781 1734
3400 Jodi M Bradt (2/88) 88●612 789 9030
Stuart Frank Bradt (2/88) 88●612 789 9030
3404 Diane L Bakun (2/76) 76●612 781 7726
John Frank Bakun (2/76) 76●612 781 7726
3408 Douglas E Koehntop (9/77) 77●612 789 1891
Edla M Koehntop (9/77) 77●612 789 1891
3411 Jade Preier 09 NP
3412 Melinda W Johnson (4/99) 98●612 782 8608
Terry Lin Johnson (4/99) 98●612 782 8608
3416 David Mark Ferguson (8/08) 07● NP
Karen Louise Ferguson (8/08) 07● NP
3420 Stanley Andrew Partyka (8/86) 86●612 781 1182
Suzanne Elaine Partyka (8/86) 86●612 781 1182
3421 Lillian Louise Kaye (8/84) 84●612 781 5186
3424 Joel Andrew Setterholm (3/76) 76●612 788 5803
Lois Evelyn Setterholm (3/76) 76●612 788 5803
★Setterholm Paul W Rev.... 09 612.788.5803
3427 Henry Benny Czupryna 67●612 781 3979
Jean Lucille Czupryna 67●612 781 3979
3428 Dr Henry Joseph Osekowsky MD 68●612 781 6193
Iris Mary Osekowsky 68●612 781 6193
★Osekowsky Henry J Dr.... 09 612.781.6193
3500 Derek Evan Stendahl (8/08) 08●612 788 1721
Kirsten Carol Stendahl (8/08) 08●612 788 1721
3501 Cathy Lynn Krause (8/04) 04●612 782 9409
Jeffrey David Krause II (8/04) 04●612 782 9409
3502 Brian James Vnak 76●612 788 5186
Kathleen Lea Vnak 76●612 788 5186
3504 Sandra Ann Maxwell (5/80) 80●612 782 2240
Tom Lawrence Maxwell (5/80) 80●612 788 1891
3505 Cynthia McBeay McBeay Seitz (2/92) 92● NP
Jerry Kent Seitz (2/92) 92● NP
3506 Kimberly P Bloom (1/87) 87●612 788 1008
Rod Kent Bloom (1/87) 87●612 788 1008
3507 Jarrod Paul Arnan 09●612 788 4968
Kathryn Elizabeth Arnan 09●612 788 4968
3508 NP
3509 Lisa Diane Eckman (8/89) 75● NP
Scott Eric Eckman (8/89) 75● NP
3510 Jeffrey P Johnson 65●612 789 5912
Sandra Jean Johnson 65●612 789 5912
★Johnson Kenneth H Dr.... 09 612.789.5912
3511 Michelle Mary Pechman (10/06) 06●612 788 8512
Thomas William Pechman (10/06) 06●612 788 8512
3512 Jerry Ferkinhoff (8/92) 98●612 789 3989
Theresa Marie Ferkinhoff (8/92) 98●612 789 3989
3513 Curtis Lee Nordahl (1/83) 83● NP
Shirley Viola Nordahl (1/83) 83● NP
3514 Denise Christa Dunn (10/00) 00●612 788 0030
Robert Coleman Dunn Jr (10/00) 00●612 788 0030
3515 Rebecca S Sharkey (9/10) 08●612 781 5897
Todd Allen Sharkey (9/10) 08●612 781 5897
3516 Amy Ruth Galyon (11/05) 05●612 788 1162
Heath Lawrence Gaylon (11/05) 05●612 788 1162
3517 Tamara Wilowo 05 NP
3518 Gladys Virginia Mikkola 67●612 789 2186
Wayne Anton Mikkola 67●612 789 2186
3519 Mary Ruth Madison (10/91) 91●612 781 8368
William Michael Madison (10/91) 91●612 781 8368
3520 Anna Karin Mandell (4/81) 81●612 789 7711
Jacob Petter Mandell (4/81) 81●612 789 7711
3521 Sharon Kotinek Marsh (5/98) 98●612 781 8046
Thomas Cosgrove Marsh (5/98) 98●612 781 8046
3522 Jerome Richard Wenker (5/80) 80●612 789 5897
Leigh S Wenker (5/80) 80●612 789 5897
3523 Linnea J Crovender 65●612 781 4693
Maris D Maris 65●612 781 4693
3524 Marilyn Carol Eberlein 62●612 789 8395
3525 Nima Salehi (7/03) 03●612 788 6520
Omid Salehi (7/03) 03●612 788 6520
3526 Hudson R Nichols (6/85) 85●612 788 2597
Mary Ellen Nichols (6/85) 85●612 788 2597
3527 Louise Susan Louiselle (4/93) 94●612 781 9445
Paul P Louiselle (4/93) 94●612 781 9445
3528 Rachel Ann Mann (10/90) 87● NP
Roberta Joyce Mann (10/90) 87● NP
3529 John Weeks Macleod (4/93) 93● NP
Megan Anne Macleod (4/93) 93● NP
3530 Mallary Jane Moats + NP
3531 Doug Allan Henry (11/92) 92●612 789 8097
Julie Beth Henry (11/92) 92●612 789 8097
3532 Michael B Callaghan 70●612 789 0198
Rachel Christine Callaghan 70●218 753 5822
3534 Gilbert Bruce Olson (9/86) 86● NP
Per Greibrok Olson (9/86) 86● NP
133 RESIDENCE 5 BUSINESS

●SKYLARK CT S

Cottage Grove
CT 712.06 6850 - 6931 SC
6850 - 6931 55016

6850 Michelle Ann Boeser (4/02) 02●651 459 8000
Todd Michael Boeser (4/02) 02●651 459 8000
6851 Gail Dorothy Ivesdale (11/01) 01● NP
Jon T Ivesdale (11/01) 01● NP
6862 Joan Marie Anderson (9/01) 01●651 797 2938
Paul Martin Anderson (9/01) 01●651 797 2938
6865 Neng Xiong (9/09) 09● NP
6874 Michelle Renee Freemyer (1/02) 00● NP
Scott Allen Freemyer (1/02) 00● NP
6877 Brian Kendall Klinga (8/01) 01● NP
Tracy Lynn Klinga (8/01) 01● NP
6886 NP
6889 Stuart Todd Holweger (8/01) 01●651 458 0270
Toni Rae Holweger (8/01) 01●651 458 0270
6898 David Joseph Norlander IV (2/02) 02●651 459 3901
Terri Jean Norlander (2/02) 02●651 459 3901
6903 Barbara Jean Skinner (6/01) 99●651 769 8905
William R Skinner (6/01) 99●651 769 8905
6910 Angela Carol Whitcomb (1/02) 01●651 768 0050
Mark Bradley Whitcomb (1/02) 01●651 768 0050
6921 Frank Anthony Andreotti (8/01) 00●651 769 8924
Renee A Andreotti (8/01) 00●651 769 8924
6922 Mary Ann Benck (8/01) 01● NP
Todd Arthur Benck (8/01) 01● NP
6931 Adetunji Ayinla Oshodi (9/01) 01●651 224 3761
Taofikat Nike Oshodi (9/01) 01●651 769 0269
26 RESIDENCE

●SKYLARK DR NE

Bethel
CT 501.09 24005 - 24282 SD
24005 - 24282 55005

24005 Dorene Nelson 10 763 434 9176
24100 Dennis Charles Priem 82●763 434 9740
Gloria Marie Priem 82●763 434 9740
24108 Amy Maren Green (11/89) 89●763 434 0071
John Carl Green (11/89) 89●763 434 0071
24124 Rodney Theodore Eng (2/04) 04●763 434 1567
24125 Kathleen Marion Bulow 82●763 434 6881
William F Bulow 82●763 434 6881
24140 Wanda Colleen Reid 86●763 434 8104
William Edward Reid 86●763 434 8104
24148 Tim W Hughes 83●763 434 3142
Vicky Lynn Hughes 83●763 434 3142
24149 Jennifer Jopp (11/05) 05●763 434 4511
Randy P Jopp (11/05) 05●763 434 4511
24152 MIA Kimberly Thornton (12/07) 99●763 413 3413
Shane Gregory Thornton (12/07) 99●763 413 3413
24205 Linda Marie Engler 84● NP
Reed Robert Engler 84● NP
24220 Julie Lynne Lux (3/99) 96●763 434 0895
Peter Thomas Lux (3/99) 96●763 434 0895
24282 Shu H Chan-Johnson (7/00) 93●763 434 8754
Dale Arnold Johnson (7/00) 93●763 434 8754
22 RESIDENCE

●SKYLARK LN

Saint Paul
CT 607.35 E 4100 - 4118 SC
E 4100 - 4118 55122

–MEADOWLARK RD INTS
4100 Vanessa A Carter (12/06) 94●651 687 0378
4102 4104 NP
4106 Antonia Edowan Simmons (10/01) 01● NP
Dawn E Simmons (10/01) 01● NP
4108 James George Scott (5/98) 87●651 454 6873
Sharon Scott (5/98) 87●651 454 6873
4110 Iryna Shambalava (3/11) +● NP
4112 Aaron Ostler (4/10) 10● NP
Stephanie Smith (4/10) 10● NP
4114 Christopher Francis Peterka (8/99) 99●651 452 2355
4116 Joe A Rice + NP
4118 NP
13 RESIDENCE

●SKYLINE AVE NW

Prior Lake
CT 809.03 15531 - 15791 SA
CT 809.04 15545 - 15674 SB
15531 - 15791 55372

–MARSH ST NW INTS
15531 Kathy Mary Torkelson 03 NP
Michael Allen Torkelson 03 NP
15532 Jeff Wayne Rivard 83●952 447 4507
Marie Rene Rivard 83●952 447 4507
15545♣ Michael Dupont (3/04) 04● NP
15550 NP
15568 Diane M Weisgurt (8/07) 07●952 855 4253
Mark Robert Weisgurt (8/07) 07●952 855 4253
15571 David Bruce Westveer 83●952 447 8471
Zinaida Westveer 83●952 447 8471
15582 Richard A Rustad 79●952 447 4613
15595 Kathryn Mahlkuch 06 NP
15596 David Allen Retzlaff 81●952 447 4298
Mary Kay Retzlaff 81●952 447 4298
15606 Gail Ann Boe 94● NP
Robert William Boe 94● NP
15609 Janet Lynn Bear-Rivard 91● NP
Dale Wayne Rivard 91● NP
15616 Charles Henry Furlong (7/04) 03●952 447 8219
Sandra Lea Furlong (7/04) 03●952 447 8219
15621 Diane Ellen Dols 85●952 447 1939
Joseph Paul Dols 85●952 447 1939
15630 15631 NP
15637 Jonathan David Olsen (1/96) 94● NP
Sandra Lea Olsen (1/96) 94● NP
15649 Pamela Lee Boltz 10 NP
Jennifer Kraska 10 NP
15650 Gary Wayne Anderson + NP
Sheri L Anderson + NP
15665 Daniel James Kasid 08 952 440 1771
15674♣ John Kelly 02 NP
15687 Cressenda Louise Enger (3/00) 91● NP
Randy Perry Enger (3/00) 91● NP
–HIGHLAND AVE NW INTS
15711 Matthew Richard Crego (7/03) 03● NP
Shawn B Crego (7/03) 03● NP
15724 Robert H Huenecke (7/10) 10● NP
15733 Kurtis John Wagner (6/99) 94●952 440 3103
Renee Lynn Wagner (6/99) 94●952 440 3103
15777 Claude John Beumer 88●952 440 5695
Jean Ann Beumer 88●952 440 5695
15780 Mary Frances Strand 83● NP
Merlin Arthur Strand Jr 83● NP
15787 Michael A Kranz 78 952 447 5161
15788 Gary William Gaddis (2/98) 95●952 447 6916
Jane Marie Gaddis (2/98) 95●952 440 5127
15790 Wade Alan Kotula (12/07) 02● NP
15791 Cari Michelle Grayson + NP
48 RESIDENCE

●SKYLINE CIR

Elko New Market
CT 811.00 25825 - 25895 SA
25825 - 25895 55020

–259TH ST E INTS
25825 Mary Kathryn Staszak (3/91) 92●952 461 3061
Timothy S Staszak (3/91) 92●952 461 3061
25826 David Michael Frame 81●952 461 2909
Karen Rae Frame 81●952 461 2909
25851★Lyle Wolfs Home Repairs . 10 952.461.2284
Jan Anne Wolf 90● NP
Lyle Kenneth Wolf 90● NP

A D D R E S S

● SKOGMAN LAKE RD

Cambridge
CT 1101.00 43425 - 44154
◆ RR1 43425 - 44154 55008

43425 ★ Norman Reinhart........ 96 763.689.2369
Norman Lee Reinhart ..... 82 ● 763.689.2369
Roger E Reinhart ..... 82 ● 763.689.2369
43671 Brian Warren Davis ..... 92 ● 763.689.5256
Joan Kay Davis ..... 92 ● 763.689.5256
43685 ▲ Anthony Mickelson ..... 04 NP
43723 ◇ Brian James Mickelson ..... 93 ● 763.689.4201
◇ Maria Ann Mickelson ..... 93 ● 763.689.4201
43815 Moriah Shawnell Stuempges 96 ● 763.689.0013
Shawn H Stuempges ..... 96 ● 763.689.0013
43945 43991.44095 ..... NP
44154 Jerry Felton ..... 01 ● 763.689.0183
Ona Lea Felton ..... 01 ● 763.689.0183
14 RESIDENCE 1 BUSINESS

● SKOGMAN LAKE RD NE

Cambridge
CT 1304.00 32516 - 32620 $D
CT 1303.00 32970 - 33485 $E
CT 1101.00 0 33527 - 33527
◆ RR1 32516 - 33527 55008

32516 ..... NP
32570 Gary Ray Christofferson ..... 78 ● 763.689.4610
32613 ★ Darrell Vosika 02 763.689.4214
Bethelda Karen Vosika ..... 76 ● 763.689.4214
Darrell Davis Vosika ..... 76 ● 763.689.4214
32620 Paul Victor Swenson 97 763.689.3272
32970 Joseph A Simons ..... 89 ● 763.689.4317
33160 Arthel Eugene Bromwich 82 763.691.8269
Jeff E Bromwich 82 763.689.4216
33225 ..... NP
33328 Clyde E Bloyer 03 763.552.0379
Jolson Bloyer 03 763.552.0379
33362 Rhonda Kay Dondlinger 03 763.552.0476
33419 Dr Brian Richard Anderson 02 763.689.5447
Dr Lisa Kay Anderson 02 763.689.5447
33446 Janet Mae Lind 02 763.689.1726
Suzanne Kay Lind 02 763.689.1726
33480 Amy Jean Kerns ..... 95 ● 763.689.9132
James Robert Kerns ..... 95 ● 763.689.9132
★ Reliant Builders Inc...... 00 ..
33485 ..... NP
33527 ★ Garys Drywall Taping Service + ..
◇ Rebecca Marie Mitchell ..... 88 ● 763.689.2581
◇ Richard Robert Mitchell ..... 88 ● 763.689.2581
21 RESIDENCE 3 BUSINESS

● SKY LN

Eden Prairie
CT 260.17 9587 - 9845 $A
◆ RR1 9587 - 9845 55347

9587 9590.9607.9610.9627.9647 ..... NP
9667 9687.9707.9710.9730.9747 ..... NP
9750 ..... NP
9767 ◇ Douglas Morris Isbell ..... + ● NP
◇ Nancy A Isbell ..... + ● NP
9770 9787.9790 ..... NP
9805 Diane Lucille Dover ..... 97 ● 952.949.8933
Ray Eugene Dover ..... 97 ● 952.949.8933
★ Toms Custom Cut & Lndscping Inc + 952.949.8933
9810 ..... NP
9820 ★ Epic Development VIII Llc . 03 952.906.3577
◇ Nora Lee Ragatz ..... 05 ● 952.906.3577
◇ Richard William Ragatz Jr ..... 05 ● 952.906.3577
9845 Karen Lynn Rempfer ..... 89 ● 952.937.8971
Vernon B Rempfer ..... 89 ● 952.937.8971
25 RESIDENCE 2 BUSINESS

● SKY HIGH DR

Saint Paul
CT 411.07 1820 - 1993 $D
◆ 1820 - 1993 55112

1820 Dennis A Lange ..... 82 ● 651.639.0213
Sherrie Lee Lange ..... 82 ● 651.639.0213
1823 Pauline A Westlund ..... 81 ● 651.633.5661
Roger W Westlund ..... 81 ● 651.633.5661
1831 Rita Schiavino Simmer ..... 80 ● 651.636.1033
Robert Francis Simmer ..... 80 ● 651.636.1033
1875 ◇ Carole L Bengson ..... 62 ● 651.633.5189
◇ Douglas B Bengson ..... 62 ● 651.633.5189
-20TH AVE SW INTS
1900 David Paul Onken ..... 77 ● 651.636.7579
Jennifer Marie Onken ..... 77 ● 651.636.7579
1901 Maria Elizabeth Lloyd ..... 88 ● 651.631.1146
William Hans Lloyd ..... 88 ● 651.631.1146
1932 Thuong Vinh Nguyen ..... 03 ● NP
1943 Kelly Ann Foltmer ..... 89 ● 651.639.8484
Dave Ray Ross ..... 89 ● 651.639.8484
1964 Jacqueline Vardmn Godfrey ..... 75 ● 651.633.7497
1973 Adaline Helena Boe ..... 72 ● 651.633.9392
Philip Warren Boe ..... 72 ● 651.633.9392
1993 Violet A Dorumsgaard ..... 86 ● 651.631.8629
19 RESIDENCE

● SKY VIEW CT

Saint Paul
CT 607.34 4830 - 4859 $B
◆ 4830 - 4859 55122

-GALAXIE AVE INTS
4830 Bonnie M Hetland ..... 86 ● 651.683.1970
Richard B Hetland ..... 86 ● 651.683.1970
4835 ◇ Kim A Krueger ..... 85 ● 651.454.1647
◇ Ronald Allen Krueger ..... 85 ● 651.454.1647
4836 ◇ Duane A Hauser ..... 86 ● 651.456.0279
◇ Peggi Hauser ..... 86 ● 651.456.0279
4841 Jim Brooke Galloway ..... 86 ● NP
4842 ◇ Eva Yichiou Hang ..... 86 ● 651.688.0351
◇ Starsky S Hang ..... 86 ● 651.688.0351
4847 James Michael Nee ..... 99 ● 651.905.1796
Jody Travous Nee ..... 99 ● 651.905.1796
4848 ◇ James Ray Kennedy ..... 89 ● 651.452.5969
◇ Marcella Ann Kennedy ..... 89 ● 651.452.5969
4853 4854 ..... NP
4859 ★ Perfect Pizza Inc........ 04 651.442.8286
◇ Reshma Janakiram Rao ..... 94 ● 651.994.1432
◇ Shashi K Rao ..... 94 ● 651.994.1432
17 RESIDENCE 1 BUSINESS

● SKYBLUE CT

Saint Paul
CT 404.01 2500 - 2517 $D
◆ 2500 - 2517 55110

2500 ◇ Jim McMeans 05 651.407.7186
◇ Kermit M McMeans Jr 05 651.407.7186
2504 Margaret H Cords ..... 05 ● NP
Nicholas J Cords ..... 05 ● NP
2505 ◇ Harvey A Bartz ..... + NP
◇ Janet G Bartz ..... + NP
2508 Kathleen M Dybdal ..... 04 ● 651.330.0800
Robert Kenneth Dybdal ..... 04 ● 651.330.0800
2509 ◇ Gregory Charles Simpson ..... 05 ● 651.777.2333
◇ Joan C Simpson ..... 05 ● 651.777.2333
2512 Gerald Clarence Brown ..... 03 ● 651.748.0993
Nanc Ellen Brown ..... 03 ● 651.770.1556
2513 Joan Ronnelle Rippe ..... 03 ● 651.777.3046
John R Rippe ..... 03 ● 651.777.3046
2517 Apartment
15 Margaret Eloise Frederick 04 651.429.9688
15 Oliver Ernest Frederick Jr 04 651.429.9688
16 RESIDENCE

● SKYCROFT CIR

Minneapolis
CT 201.01 3301 - 3437 $C
◆ 3301 - 3437 55418

-SKYCROFT DR INTS
3301 ..... NP
3304 ◇ Stanley L Gordon ..... 70 ● 612.781.1679
3305 ..... NP
3308 Cynthia M Toman ..... 95 ● 612.789.6170
Paul W Toman ..... 95 ● 612.789.6170
3309 James Dominic Molinaro ..... 94 ● 612.781.2955
Mary Beth Molinaro ..... 94 ● 612.781.2955
3312 Julie M Gebhardt ..... 93 ● 612.789.2373
Rick E Gebhardt Jr ..... 93 ● 612.789.2373
3313 ◇ Eugene William Hunstad ..... 69 ● 612.789.5537
◇ Sherry Lynn Hunstad ..... 69 ● 612.789.5537
3316 Michael C Jacobs ..... 99 ● 612.781.4309
Michelle C Jacobs ..... 99 ● 612.781.4309
3317 ◇ Malgorzata Izabella Bueltel ..... 01 ● 612.788.9907
3320 ◇ Holly Ann Stene ..... 92 ● 612.706.3235
◇ Jeffrey Curtis Stene ..... 92 ● 612.706.3235
3321 A Anderson ..... 62 ● 612.789.1338
Helen Rosalie Anderson ..... 62 ● 612.789.1338
3324 ★ Brookville 25 Investment . + ..
Jeff Steven Jensen ..... 05 ● 612.789.2877
Roseann Susan Jensen ..... 05 ● 612.789.2877
★ St Croix Hardwood Flooring 98 ..
3325 Richard L Ernst ..... 72 ● 612.788.4550
3329 Jeanne Clare Louis 98 612.789.9276
3333 ★ Automotive Recyclers Of Minnesota
94 612.290.6262
Kelly A Salseg ..... 96 ● 612.782.8786
Samuel Richard Salseg ..... 96 ● 612.782.8786
3337 Elaine Hugill ..... 63 ● 612.789.3327
Maurice L Hugill ..... 63 ● 218.768.3991
3341 Joal J Moses ..... 05 ● NP
Tony Moses ..... 05 ● NP
3400 Gail Marie Anttila ..... 86 ● 612.788.3398
Roger L Anttila ..... 86 ● 612.788.3398
3401 Gregory J Seward ..... 93 ● 612.789.3389
Laura Kruger Seward ..... 93 ● 612.789.3389
3404 Claudia E Lavalley ..... 67 ● 612.781.4609
Patrick John Lavalley ..... 67 ● 612.781.4609
3405 ★ Skills In The Sills .... + 612.789.1070
Joel Linn Whitmore ..... 87 ● 612.789.1070
Terri Ann Whitmore ..... 87 ● 612.789.1070
3408 C Janay ..... 01 ● 612.788.4488
Jeff C Janay ..... 01 ● 612.788.4488
3409 Matthew G Schmitz ..... NP
3412 ★ Brian W Rude Attorney At Law 91 612.789.6953
Brian W Rude Atty ..... 89 ● 612.782.0574
Cathy Ann Rude ..... 89 ● 612.782.0574
3413 Carla W Foley ..... 92 ● 612.782.9893
John Fitzgerald Foley ..... 92 ● 612.782.9893
3416 ★ Larsen Consulting Group Inc 99 612.789.4921
3417 Werner Hans Kuhnert ..... 89 ● 612.789.8115
Zofia Kuhnert ..... 89 ● 612.789.8115
3420 ◇ Clyde C Gates ..... 76 ● 612.789.8767
◇ Mary Louise Gates ..... 76 ● 612.789.8767
3421 Holly N Saenz ..... 93 ● 612.789.4221
Holly Noelle Schaefer ..... 93 ● 612.789.4221
3425 ◇ Gordon Michael Januszewski 97 ● NP
◇ Stephanie Ann Januszewski ..... 97 ● NP
3429 ◇ Janice Yvonne Stroom ..... 77 ● 612.789.3421
◇ Paul D Stroom ..... 77 ● 612.789.3421
3433 Gerald R Sorsoleil ..... 85 ● 612.788.0271
Gloria R Sorsoleil ..... 85 ● 612.788.3307
3437 ..... NP
56 RESIDENCE 6 BUSINESS

● SKYCROFT DR

Minneapolis
CT 201.01 3200 - 3534 $C
◆ 3200 - 3534 55418

-32ND AVE NE INTS
3200 David Timothy Wiggins ..... 96 ● 612.706.4164
Lisa Kay Wiggins ..... 96 ● 612.706.4164
3201 Loren R Massie ..... 91 ● 612.781.7877
Michael Joseph Massie ..... 91 ● 612.788.2457
3204 3205 ..... NP
3209 ▲ Sarah Ann Elbert ..... + 612.208.1006
3212 Brian P Durand ..... 04 ● 612.706.6080
3213 Blaine Lee Totman ..... 94 ● 612.781.9987
3216 ★ Blackman Petersen Institute Inc
04 ..
★ DA Petersen Associates Inc 92 612.781.3713
Cynthia L Petersen ..... 88 ● 612.781.3713
Doug A Petersen ..... 88 ● 612.788.6950
3217 ..... NP
3220 ◇ Anita Davis Sletten ..... 82 ● 612.789.9238
◇ Tom B Sletten ..... 82 ● 612.789.9238
3221 ★ Cornerstone Construction Mgmt 98 612.781.4696
◇ David Edgar Gordhamer ..... 94 ● 612.782.6929
◇ Mary Beth Gordhamer ..... 94 ● 612.782.6929
3224 Howard E Leppla ..... 62 ● 612.781.7115
Mary A Leppla ..... 62 ● 612.781.2008
★ Leppla & Associates 05 612.781.2008
3225 Harland Clifford Walbon II ..... 77 ● 612.781.1511
★ Walbon Construction & Excavating Co
98 612.781.1511
-SKYCROFT CIR INTS
3300 ★ EBS 02 612.781.0425
3304 Adriann Gayle Mendesh ..... 93 ● 612.788.9384
Erica Mendesh ..... 93 ● 612.788.9384
3308 Timothy J Johnson ..... 97 ● 612.782.9347
Terese M Lynch ..... 97 ● 612.782.9347
3312 ◇ Lori Jean Lafleur ..... 91 ● 612.789.3622
◇ Robert Allen Lafleur ..... 91 ● 612.789.3622
3315 Barbara Susan Lindskog ..... 77 ● 612.789.7763
Thomas J Lindskog ..... 77 ● 612.789.7763
3316 Glen Warren Johnson ..... 69 ● 612.781.8386
Marlys Marie Johnson ..... 69 ● 612.781.8386
3319 Harriet A Watten ..... 94 ● 612.781.9184
3320 ◇ Lorin L Coolidge ..... 67 ● 612.789.2126
◇ Timothy David Coolidge ..... 67 ● 612.789.2126
3323 Patrick Harris Niccum ..... 98 ● 612.788.7511
Patty H Niccum ..... 98 ● 612.788.7511
3324 Kathy Anne Backer ..... 92 ● 612.788.9716
Leighton L Backer ..... 92 ● 612.788.9716
★ Metro Chair Massage Llc . + ..
3327 Carisa Diane Sibbet ..... 97 ● 612.789.9004
Steve Ralph Sibbet ..... 97 ● 612.789.9004
3328 Nicholas Francis Wahl ..... 84 ● 612.788.3796
3331 Barry Melvin Kinsey ..... 84 ● 612.789.1493
Bernice Kiuure Kinsey ..... 84 ● 612.789.5470
3335 Richard Jon Feist ..... 85 ● 612.781.1133
Susan Marie Feist ..... 85 ● 612.781.1133
3339 ..... NP
-DOWNERS DR NE INTS
3400 Jodi M Bradt ..... 88 ● 612.789.9030
Stuart F Bradt ..... 88 ● 612.789.9030
3404 Diane L Bakun ..... 76 ● 612.781.7726
John Frank Bakun ..... 76 ● 612.781.7726
3408 ◇ Douglas E Koehntop ..... 77 ● 612.789.1891
◇ Edia M Koehntop ..... 77 ● 612.789.1891
3411 Burnett Clayton Denker ..... 62 ● 612.781.3504
Marcella Marie Denker ..... 62 ● 612.781.3504
3412 Elier A Johnson ..... 95 ● 612.782.8608
Marilyn L Johnson ..... 93 ● 612.782.8608
3416 Kathryn Marie Dorr ..... 91 ● 612.781.5234
Aleyna S Dorr ..... 91 ● 612.781.5234
3420 Stas Partyka ..... 80 ● 612.781.1182
Suzanne E Partyka ..... 80 ● 612.781.1182
3421 ◇ Lillian L Kaye ..... 84 ● 612.781.5186
3424 Joel Andrew Setterholm ..... 76 ● 612.788.5803
Lois E Setterholm ..... 76 ● 612.788.5803
3427 Henry Benny Czupryna ..... 67 ● 612.781.3979
Jean Lucille Czupryna ..... 67 ● 612.781.3979
3428 ◇ Dr Henry J Osekowsky MD ..... 68 ● 612.781.6193
◇ Iris Mary Osekowsky ..... 68 ● 612.781.6193
-MAPLEWOOD DR INTS
3501 Cathy Lynn Krause ..... 04 ● 612.782.9409
3502 Diane Rose Diane ..... 76 ● 612.788.5186
Brian James Vnak ..... 76 ● 612.788.5186
-36TH AVE NE INTS
3504 Sandra A Maxwell ..... 60 ● 612.782.2240
Thomas Lawrence Maxwell ..... 80 ● 612.788.1891
3505 ..... NP
3506 Kimberly P Bloom ..... 87 ● 612.788.1008
Rod K Bloom ..... 87 ● 612.788.1008
3507 Denny M Luke ..... 99 ● 612.781.1529
3508 ◇ Allen A Otte ..... 79 ● 612.788.8389
◇ Annette Ehntt Otte ..... 79 ● 612.788.8389
3509 Lisa Diane Eckman ..... 75 ● 612.789.8288
Scott Eric Eckman ..... 75 ● 612.789.8288
3510 Jean Arlene Johnson ..... 65 ● 612.789.5912
Dr Kenneth H Johnson ..... 65 ● 612.789.5912
3511 Michael Edwards ..... 05 NP
3512 Jerry Ferkinhoff ..... 98 ● 612.789.3989
Theresa M Ferkinhoff ..... 98 ● 612.789.3989
3513 Curtis Lee Nordahl ..... 83 ● 612.788.6482
Shirley Viola Nordahl ..... 83 ● 612.788.6482
3514 Denise Christu Dunn ..... 00 ● 612.781.6017
Robert C Dunn Jr ..... 00 ● 612.789.4576
3515 Richard Norrish ..... + 612.208.1904
3516 Amy Ruth Galyon ..... 05 ● NP
Heath Lawrence Gaylon ..... 05 ● NP
3517 Budidarma Santoso ..... 05 ● 612.788.1477
3518 Gladys Virginia Mikkola ..... 67 ● 612.789.2186
Wayne Anton Mikkola ..... 67 ● 612.789.2186
3519 Mary Ruth Madison ..... 91 ● 612.781.8368
William Michael Madison ..... 91 ● 612.781.8368
3520 Monica Borghammar Mandell 81 ● 612.789.7711
Richard M Mandell ..... 81 ● 612.789.7711
3521 Sharon Lynn Marsh ..... 98 ● 612.781.8046
Thomas C Marsh ..... 98 ● 612.781.8046
3522 Jerome Richard Wenker ..... 80 ● 612.789.5897
3523 ◇ Linnea J Grovender ..... 65 ● 612.781.4693
◇ Mans D Grovender ..... 65 ● 612.781.4693
3524 Marilyn Carol Eberlein ..... 62 ● 612.789.8395
3525 ◇ Nima Salehi ..... 03 ● 612.788.6520
◇ Omid Salehi ..... 03 ● 612.788.6520
3526 ★ Hudson R Nichols Cpa ... 02 612.788.2597
Hudson R Nichols ..... 85 ● 612.788.2597
Mary Ellen Nichols ..... 85 ● 612.788.2597
3527 Louise S Louiselle ..... 94 ● 612.781.9445
Paul P Louiselle ..... 94 ● 612.781.9445
3528 Rachel Ann Mann ..... 87 ● 612.788.0756
Roberta Joyce Mann ..... 87 ● 612.788.0756
3529 John Weeks Macleod ..... 93 ● 612.789.1217
Megan Anne Macleod ..... 93 ● 612.789.1217
3530 ★ Pet Pros Center.......... 95 612.788.6665
Betty Jean Simmons ..... 78 ● 612.788.6665
3531 ◇ Doug A Henry ..... 92 ● 612.789.8097
◇ Julie Beth Henry ..... 92 ● 612.789.8097
3532 ..... NP
3534 Beth M Olson ..... 86 ● 612.788.0507
Gilbert B Olson ..... 86 ● 612.788.0507
119 RESIDENCE 9 BUSINESS

● SKYLARK CT S

Cottage Grove
CT 712.06 6850 - 6931 $C
◆ RR5 6850 - 6931.... 55016

6850 Michelle A Boeser ..... 02 ● 651.459.8000
Todd M Boeser ..... 02 ● 651.459.8000
6851 Gail Ivesdale ..... 01 ● NP
Jon T Ivesdale ..... 01 ● NP
6862 Joan Marie Anderson ..... 01 ● 651.459.6737
Paul M Anderson ..... 01 ● 651.459.6737
6865 Melissa Eleanor Theissen ..... 01 ● NP
Timothy Michael Theissen ..... 01 ● NP
6874 Michelle Renee Freemyer ..... 00 ● NP
Scott Allen Freemyer ..... 00 ● NP
6877 Brian Kendall Klinga ..... 01 ● 651.493.4693
Tracy Lynn Klinga ..... 01 ● 651.493.4693
6886 Mary Susan Kipke ..... 01 ● 651.493.6557
Christopher Paul Kipke ..... 01 ● 651.493.6557
6889 Patty Holweger ..... 01 ● 651.458.0270
Stuart Todd Holweger ..... 01 ● 651.458.0270
6898 David Joseph Nortander IV ..... 02 ● 651.459.3901
Terri Jean Nortander ..... 02 ● 651.459.3901
6903 Barb Jean Skinger ..... 99 ● NP
William R Skinger ..... 99 ● NP
6910 Angela Whitcomb ..... 01 ● 651.768.0050
Mark B Whitcomb ..... 01 ● 651.768.0050
6921 Frank Anthony Andreotti ..... 00 ● 651.769.8924
Renee A Andreotti ..... 00 ● 651.769.8924
6922 Mary Ann Benck ..... 01 ● 651.458.8119
Todd Arthur Benck ..... 01 ● 651.458.8119
6931 ★ Angel Caring Inc........ 04 651.224.3761
Adetunji Ayinla Oshodi ..... 01 ● 651.224.3761
Taofikat Nike Oshodi ..... 01 ● 651.769.0269
28 RESIDENCE 1 BUSINESS

● SKYLARK DR NE

Bethel
CT 501.09 24005 - 24282 $D
◆ RR3 24005 - 24282..... 55005

24005 ..... NP
24100 Dennis Charles Priem ..... 82 ● 763.434.9740
Gloria M Priem ..... 82 ● 763.434.9740
★ Priem Distributing Inc ... 93 763.434.9740
24108 Amy Maren Green ..... 89 ● 763.434.0071
John Carl Green ..... 89 ● 763.434.0071
24116 Kimberly Paige Briggs ..... 98 ● NP
Lee Thomas Briggs ..... 98 ● NP
★ Metro Electronic Lifestyle 99 ..
24124 Rodney Theodore Eng ..... 04 ● 763.434.1567
24125 Kathleen Marion Bulow ..... 82 ● 763.434.6881
William Bulow ..... 82 ● 763.434.6881
24140 Wanda Colleen Reid ..... 86 ● 763.434.8104
William Edward Reid ..... 86 ● 763.434.8104
24148 Tim W Hughes ..... 83 ● 763.434.3142
Vicky L Hughes ..... 83 ● 763.434.3142
24149 Randy P Jopp ..... 05 ● 763.434.4511
24152 MIA Thompton ..... 99 ● 763.413.3413
Shane Gregory Thornton ..... 99 ● 763.413.3413
24205 Linda Marie Engler ..... 84 ● 763.434.5212
Reed Robert Engler ..... 84 ● 763.434.5212
★ JRL Investments 99 763.434.5212
24220 Julie Lynne Lux ..... 96 ● 763.434.0895
Peter Thomas Lux ..... 96 ● 763.434.0895
★ Ppg Communications..... 05 763.434.0895
24282 Dale Arnold Johnson ..... 93 ● NP
S C Johnson ..... 93 ● NP
★ Northpoint Electronics ... 99 763.434.8754
23 RESIDENCE 5 BUSINESS

● SKYLARK LN

Saint Paul
CT 607.35 E 4100 - 4118 $C
◆ E 4100 - 4118 55122

-MEADOWLARK RD INTS
4100 ◇ Vanessa S Carter ..... 94 ● 651.687.0378
4102 Tiffany Peterson ..... 84 ● 651.994.7117
William Reid Peterson ..... 84 ● 651.688.0766
4104 Apartment
142 Jack Okumu ..... 04 ● NP
142 Shamyka Okumu ..... 04 ● NP
4106 Antonia Eddwan Simmons ..... 01 ● 651.688.7251
Dawn Simmons ..... 01 ● 651.688.7251
4108 James George Scott ..... 87 ● 651.454.6873
Sharon Scott ..... 87 ● 651.454.6873
4110 Brenda Marie Peralta 05 651.994.2021
4112 Deidre Olson ..... 01 ● 651.293.1626
Jonathan L Olson ..... 01 ● 651.293.1626
4114 Chris F Peterka ..... 99 ● 651.452.2355
4118 ..... NP
14 RESIDENCE

● SKYLINE AVE NW

Prior Lake
CT 809.03 15531 - 15791 $A
◆ RR21 15531 - 15791..... 55372

-HIGHLAND AVE NW INTS
15531 Heidi Lee Phillips ..... 03 ● 952.447.4544
15532 Jeff Wayne Rivard ..... 83 ● 952.447.4507
Marie Rene Rivard ..... 83 ● 952.447.4507
15545 ▲ Michael Dupont ..... 04 ● NP
15550 Felicia M Landavazo ..... + NP
15568 Craig Anthony Kasch ..... 93 ● 952.447.8823
Nancy R Kasch ..... 93 ● 952.447.8823
15571 David Bruce Westveer ..... 83 ● 952.447.8471
Zirrada Westveer ..... 83 ● 952.447.8471
15582 Richard A Rustad ..... 79 ● 952.447.4613
15595 Bernard John Dupont ..... 01 ● 952.447.2235
Donna Mae Dupont ..... 01 ● 952.447.2235
15596 David Allen Retzlaff ..... 81 ● 952.447.4298
Mary Kay Retzlaff ..... 81 ● 952.447.4298
15606 Gail A Boe ..... 94 ● NP
Robert W Boe ..... 94 ● NP
★ RW Boe Consulting Inc ... + ..
15609 Dale Wayne Rivard ..... 91 ● 952.440.5331
Janet Rivard ..... 91 ● 952.440.5331
15616 ..... NP
15621 Diane Ellen Dols ..... 85 ● 952.447.1939
Joseph Paul Dols ..... 85 ● 952.447.1939
15630 Bradley R Olson ..... 02 ● NP
15631 Patrick James Green ..... 91 ● 952.440.8759
Paula Kay Green ..... 91 ● 952.440.8759
★ Professional Wireless Commun + 952.440.8759
15637 Jonathan David Olsen ..... 94 ● NP
Sandra Lea Olsen ..... 94 ● NP
15649 ★ Fr8 Dawg Llc 05 952.440.3249
K Drenstein ..... 02 ● 952.440.3249
Kurt M Orenstein ..... 02 ● 952.440.3249
15650 ..... NP
15665 Larry Lee Herrmann ..... 05 ● 952.440.1371
15674 ▲ John Kelly ..... 02 NP
15687 Apartment
952 Cressenda Louise Enger ..... 91 ● 952.440.4545
952 Randy Perry Enger ..... 91 ● 952.440.4545
◇ Jacquie A Ostrool ..... 04 ● NP
-MARSH ST NW INTS
15711 Matthew R Chego ..... 03 ● 952.447.6304
Shawn B Chego ..... 03 ● 952.447.6304
15724 Debbie Ann Rude ..... 88 ● 952.440.2914
Mark Allan Rude ..... 88 ● 952.440.2914
15733 Kurtis John Wagner ..... 94 ● 952.440.3103
Renee Lynn Wagner ..... 94 ● 952.440.3103
15777 ..... NP
15780 ★ Pearle Vision.......... 97 ..
Mary F Strand ..... 83 ● 952.440.6882
Merlin Arthur Strand Jr ..... 83 ● 952.447.6881
15787 Michael A Kranz 78 952.447.5161
Shaeen M Kranz 78 952.447.5161
15788 ★ Bridge Data 03 952.447.8010
Gary William Gaddis ..... 95 ● 952.447.6916
Jane Marie Gaddis ..... 95 ● 952.440.5127
15790 Susan Marie Berglund ..... 02 NP
15791 ◇ Cori Swartz ..... + ● 952.440.4996
◇ Todd G Swartz ..... + ● 952.440.4996
50 RESIDENCE 5 BUSINESS

55418
3216 Cynthia L Petersen 85 • NP
3217 Joyce S Lafontaine 77 • 612-789-1827
N L Lafontaine .77 • 612-789-1827
3220 Anita D Sletten .82 • 612-789-9238
Thomas B Sletten .82 • 612-789-9238
3221 David E Gordhamer 94 • 612-782-6929
Mary B Gordhamer 94 • 612-782-6929
3224 Howard E Leppla .52 • 612-781-7115
Mary A Leppla .62 • 612-781-2008
3225 Harland C Walbon 77 • 612-781-1511
- 33RD AVE NE INTS
3300 Barbara J Enrooth 65 • 612-789-0362
Richard A Enrooth 65 • 612-789-0362
★ EBS 612-781-0425
★ Enrooth Richard 612-781-0425
3304 Adriana G Mendesh 93 • 612-788-9145
James M Mendesh 93 • 612-788-9384
3308 Timothy J Johnson 97 • 612-782-9347
3312 NP
3315 Barbara S Lindskog 77 • 612-789-7763
Thomas J Lindskog 77 • 612-789-7763
3316 Glen W Johnson .69 • 612-781-8386
Marlys M Johnson 69 • 612-781-8386
3319 Alvin J Watten .94 • 612-781-9184
3320 Lorin L Coolidge .67 • 612-789-2126
Timothy D Coolidge 67 • 612-789-2126
3323 Patrick H Niccum .98 • 612-788-7511
Patty H Niccum .98 • 612-788-7511
3324 Kathy A Backer .92 • 612-788-9716
Leigton L Backer .92 • 612-788-9716
3327 Byron Simonson .75 • 612-788-4994
Marilyn D Simonson 75 • 612-788-4994
3328 Nicholas F Wehl .84 • 612-788-3795
3331 Barry M Kinsey .84 • 612-789-1493
Bernice K Kinsey .84 • 612-789-1493
3335 Richard J Feist .85 • 612-781-1133
Susan M Feist .85 • 612-781-1133
3339 Brad D Rice .89 • 612-781-1734
Georgia J Rice .89 • 612-781-1734
- DOWNERS DR NE INTS
3400 Jodi M Bradt .88 • 612-789-9030
Stuart F Bradt .88 • 612-789-9030
3404 Diane L Bakun .76 • 612-781-7726
John F Bakun .76 • 612-781-7726
3408 Douglas E Koehntop 77 • 612-789-1891
Edla M Koehntop .77 • 612-789-1891
3411 Burnett C Denker .62 • 612-781-3504
Marcella M Denker .62 • 612-781-3504
3412 Terry L Johnson .98 • 612-782-8608
3416 Kathryn M Dorr .91 • 612-781-5234
3420 Stanley E Partyka .86 • 612-781-1182
3421 Lillian L Kaye .84 • 612-781-5186
3424 Joel A Setterholm 76 • 612-788-5803
Lois E Setterholm .76 • 612-788-5803
★ Setterholm P W Rev 612-788-5803
3427 Henry B Czupryna .67 • 612-781-3979
Jean L Czupryna .67 • 612-781-3979
3428 Henry V Osekowsky 68 • 612-781-6193
Iris M Osekowsky .68 • 612-781-6193
★ Osekowsky H J Dr 612-781-6193
- MAPLEWOOD DR INTS
3500 B J Cappelletti .76 • 612-789-0653
3501 Dorothy V Wethe .77 • 612-781-7573
Earle D Wethe .77 • 612-781-7573
3502 Apartments
104 Diane R Vnak .76 • 612-788-5186
104 James S Vnak .76 • 612-788-5186
- 36TH AVE NE INTS
3504 Sandra A Maxwell 80 • 612-782-2240
Thomas L Maxwell 80 • 612-788-1891
3505 Cyndi M Seitz .92 • NP
3506 Kimberly P Bloom .87 • 612-208-0629
Rod K Bloom .87 • 612-788-1008
3507 D R Luke .99 • 612-781-1529
Denny M Luke .99 • 612-781-1529
3508 Allen A Otte .79 • 612-788-8389
Annetta E Otte .79 • 612-788-8389
3509 Lisa D Eckman .75 • 612-789-8288
Scott E Eckman .75 • 612-789-8288
3510 Jean A Johnson .65 • 612-789-5912
Kenneth H Johnson 65 • 612-789-5912
3511 Roger G Williams .63 • 612-789-9608
3512 J E Ferkinhoff .98 • 612-789-3989
3513 Curtis L Nordahl .83 • 612-788-6482
Shirley V Nordahl .83 • 612-788-6482
3514 Patrick W Dunn .00 • 612-788-0030
Robert C Dunn .00 • 612-788-0030
3515 Marilyn A Asp .76 • 612-781-4470
3516 Linda R Gonier .70 • 612-788-3010
3517 Gloria J Brandt + • NP
Michelle Brandt + NP
3518 Inge K Weeks + • NP ♣
3519 Mary R Madison .91 • 612-781-8368
William M Madison 91 • 612-781-8368
3520 Monica M Mandell 81 • 612-789-7711
Richard F Mandell 81 • 612-789-7711
3521 Sharon L Marsh .98 • 612-781-8046
Thomas C Marsh .98 • 612-781-8046
3522 Jerome R Wenker .80 • 612-789-5897
Leigh S Wenker .80 • 612-789-5897
3523 Linnea J Grovender 65 • 612-781-4693
Maris D Grovender 65 • 612-781-4693
3524 Marilyn C Eberlein 62 • 612-789-8395
3525 Lorene A Buscher .91 • 612-781-4147
Ralph F Buscher .91 • 612-781-4147
3526 Hudson R Nichols 85 • 612-788-2597
Mary E Nichols .85 • 612-788-2597
3527 Paul P Louiselle .94 • 612-781-9445
3528 Michelle A Mann .87 • 612-788-0756
Roberta J Mann .87 • 612-788-0756
3529 John W MacLeod .93 • 612-789-1217
Megan A MacLeod 93 • 612-789-1217
3530 Betty J Simmons .78 • 612-788-6665
3531 Doug A Henry .92 • 612-789-8097
Julie B Henry .92 • 612-789-8097
3532 Michl D Callaghan 70 • 612-789-0198
Steph P Callaghan 70 • 612-789-0198
3534 Beth M Olson .86 • 612-788-0507
Gilbert B Olson .86 • 612-788-0507
120 RESIDENCE 4 BUSINESS

SKY HIGH DR 55112
Saint Paul
1800- 1999 CT 411.07 $B..
- HAINES ST INTS
1820 Apartments
DR Dennis A Lange .82 • 651-639-0213
DR Steven J Lange .82 • 651-639-0213
1823 Roger W Westlund 81 • 651-633-5661
1831 Rita S Simmer .80 • 651-636-1033
Robert F Simmer .80 • 651-636-1033
1875 Carole L Bengson .62 • 651-633-5189
Douglas B Bengson 62 • 651-633-5189

- 20TH AVE SW INTS
1900 Arlyss A Onken .77 • 651-636-7579
Paul V Onken .77 • 651-636-7579
1901 William H Lloyd .88 • 651-631-1146
1932 Howard A Rey .97 • 651-634-0307
Kellye F Rey .97 • 651-634-0307
1943 Kelly A Foltmer .89 • 651-639-8484
Dave R Ross .89 • 651-639-8484
1964 J V Godfrey .75 • 651-633-7497
1973 Adeline H Boe .72 • 651-633-9392
Philip W Boe .72 • 651-633-9392
1993 V A Dorumsgaard .86 • 651-631-8629
16 RESIDENCE

SKY LN
Eden Prairie
9800- 9899 CT 260.12 $A..
RR 1 55347
9805 Diane L Driver .97 • 952-949-8933
Raymond E Driver .97 • 952-949-8933
9820 Brian B Tilby .91 • 952-937-9658
Charlene M Tilby .91 952-937-9658
9845 Karen R Rempfer .89 • 952-937-8971
Vernon B Rempfer 89 • 952-937-8971
6 RESIDENCE

SKYLARK DR NE
Bethel
24000-24299 CT 501.05 $D..
RR 3 55005
24005 Alvin E Blum .82 • 763-434-6035
Patricia H Blum .82 • 763-434-6035
24100 Dennis C Priem .82 • 763-434-9740
Gloria M Priem .82 • 763-434-9740
24108 Amy M Green .89 • 763-434-0071
John C Green .89 • 763-434-0071
24116 Lee T Briggs .98 • 763-413-0918
24124 Craig E Coleman .96 • 763-413-0068
Jane K Coleman .96 • 763-413-0068
24125 William K Bulow .82 • 763-434-6881
24140 Wanda C Reid .86 • 763-434-8104
William E Reid .86 • 763-434-8104
24148 Tim W Hughes .83 • 763-434-3142
24149 Jason G Aiken .00 • 763-434-2602
24152 Edward G Anderson 84 • 763-434-4576
Merna M Anderson 84 • 763-434-4576
24205 Linda M Engler .84 • 763-434-5212
Reed R Engler .84 • 763-434-5212
24220 Julie L Lux .96 • 763-434-0895
Peter T Lux .96 • 763-434-0895
24282 Dale A Johnson .93 • 763-434-8754
Shu H Johnson .93 • 763-434-8754
★ Nrthest Elctrncs 763-434-8754
22 RESIDENCE 1 BUSINESS

SKYLARK LN 55122
Saint Paul
4100- 4199 CT 607.23 $C..
- MEADOWLARK RD INTS
4100 Vanessa C Thompson 94 • NP
4102 William Peterson .84 • 651-688-0755
4104 Susan D Rutschke 92 • 651-452-6498
4106 Antonia E Simmons + • 651-686-7251
Dawn Simmons + • 651-686-7251
4108 James G Scott .87 • 651-454-6873
4110 Doris E Olson .81 • 651-454-4686
4112 Penny L Harbarts .00 • NP
4114 Chris F Peterka .99 • 651-452-2355
4116 Noel Johnson + • 651-994-9129
Noel D Johnson + • 651-994-9129
4118 Robert McGinley .02 • 651-686-0457
12 RESIDENCE

SKYLINE AVE NW
Prior Lake
15500-15799 CT 809.01 $B..
RR 8 55372
15531 NP
15532 Marie R Pedersen .96 NP
15550 NP
15568 Craig A Kasch .93 • 952-447-8923
Nancy R Kasch .93 • 952-447-8923
15571 David B Westveer .83 • 952-447-8471
Zinaida Westveer .83 • 952-447-8471
15582 Richard A Rustad .79 • 952-447-4613
15595 Bernard J Dupont + • NP
15596 David A Retzlaff .81 • 952-447-4298
Mary K Retzlaff .81 • 952-447-4298
- HIGHLAND AVE NW INTS
15606 Gail A Boe .94 • NP
15609 Janet L Beamvard 91 952-440-5331
Dale W Rivard .91 952-440-5331
15616 Todd M Johnson .97 • 952-440-9358
15621 Diane E Dols .85 • 952-447-1939
Joseph P Dols .85 • 952-447-1939
15630 Micheal E Frazer .83 952-447-6953
Micheal J Frazer .83 952-447-6953
15631 Patrick J Green .97 952-440-8759
Paula K Green .97 952-440-8759
★ Prfseal Wireless 952-447-9909
15637 Jonathan D Olsen .94 • NP
15649 NP
15650 Carrie L Benz .96 NP
15665 Jason J Hombach 94 952-447-0189
15687 Randy P Enger .91 • 952-440-4545
15711 NP
15724 Debbie A Rude .88 952-440-2914
Mark A Rude .88 952-440-2914
15733 Kurtis J Wagner .94 • 952-440-3103
Renee L Wagner .94 • 952-440-3103
15777 Claude J Beumer .88 • 952-440-5695
Jean A Beumer .88 • 952-226-5695
15780 Mary F Strand .83 952-440-6882
Merlin A Strand .83 952-447-6881
15787 Michael A Kranz .78 952-447-5161
15788 Gary W Gaddis .95 • 952-447-6916
Jane M Gaddis .95 • 952-440-5127
15790 Gary L Baker .92 • 952-440-5962
15791 NP
40 RESIDENCE 1 BUSINESS

SKYLINE CIR
Elko
25800-25899 CT 811 $B..
RR 2 55020
- E 259TH ST INTS
25825 NP
25826 David M Frame .81 • 952-461-2909
Karen R Frame .81 • 952-461-2909
25851 Angela R Wolf .90 952-461-2284
Lyle K Wolf .90 952-461-2284
★ Wolf Lyle K 952-461-2284
25870 L L Needham .83 • 952-461-2818
25873 Kevin M Jackson .83 • 952-461-2451
Renee T Jackson .83 • 952-461-2451
25894 NP
25895 Alan M Bangen .87 952-461-3268
Carol J Bangen .87 952-461-3268
11 RESIDENCE 1 BUSINESS

SKYLINE CIR
Shakopee
13300-13599 CT 803 $B..
13600-13799 CT 808 $D..
RR 3 55379
13433 Nancy L Fogelberg 99 • 952-445-7477
13470 Chad A Soupir .00 • 952-496-2871
Shelly J Soupir .00 • 952-496-2871
13525 Darren F Dierbeck 99 • NP
13551 Penny A Ranan .00 NP
Pp P Ranan .00 NP
13580 NP
13595 M D Oeltjenbruns .98 952-403-0817
S M Oeltjenbruns .98 952-403-0817
- PEREGRINE CIR INTS
13610 Glenn Schmitt .94 • 952-496-0900
Glenn J Schmitt .94 • 952-496-0900
13631 ★ Paul Bnyn Tr Svc 952-445-1812
13700 NP
13750 Dann Saccoman + • NP
Dawn M Saccoman + NP
13756 Nancy L Garlock .96 952-445-4576
Rick D Garlock .96 952-445-4576
16 RESIDENCE 1 BUSINESS

SKYLINE CT 55121
Saint Paul
1400- 1599 CT 607.15 $B..
- SKYLINE DR INTS
1534 Bart D Laihinen .94 • 651-688-2759
Hilery A Laihinen .94 • 651-688-2759
1537 David L Smith .91 • 651-688-0154
Linda C Smith .91 • 651-688-7428
1545 Merri B Schreiber .96 • 651-454-6343
Paul J Schreiber .96 • 651-454-4992
1550 Michl D Mallinger .92 • 651-686-6540
1553 Frank D Bolstorff .98 • 651-454-4280
Lynn Bolstorff .98 • 651-454-4280
1558 Don I Prettyman .93 • 651-454-3195
K M Prettyman .93 • 651-454-3195
1561 Judd O Gold .95 • NP
12 RESIDENCE

SKYLINE CURV 55411
Minneapolis
1800- 1999 CT 23 $E..
1800 Tom E Ericksen .98 • 612-522-3218
1802 Jesse K Thomas + • NP
1804 Josh Curlee + 612-529-5359
R J Schusterman + • 612-588-0228
1806 Scott Schmidt + • 612-529-8372
1808 Merle P Worley .88 • 612-529-3609
Patrick M Worley .88 • 612-529-3609
1810 Stephen W Gow .91 • NP
1814 Elaine F Eiland .93 • NP
1816 Charise R Rhodes .95 • 612-521-2310
1818 Mark Slobodnik .99 • 612-522-1682
1820 Lois J Turen .87 • 612-521-3501
1822 Brian D Grondin + • NP ♣
13 RESIDENCE

SKYLINE DR 55337
Burnsville
12400-12599 CT 607.12 $B..
12400 NP
12401 Brad P Nelson .97 • 952-882-0462
Lisa J Nelson .97 • 952-882-8462
12404 NP
12405 Lori Barnett .90 • 952-736-0811
12408 David T Moen .73 • 952-894-1561
Teresa R Moen .73 • 952-894-1561
12409 David F Powers .67 • 952-890-3278
Shirley A Powers .67 • 952-890-3278
12412 C E Springer .84 • 952-894-3664
Justin E Springer .84 • 952-894-3664
12413 Heinz F Lambrecht 73 • 952-890-3475
Irene D Lambrecht 73 • 952-890-3475
12416 George H Miner .73 • 952-890-7368
Marlene G Miner .73 • 952-890-7368
12417 Faith M Johnson .71 • 952-890-1328
Gunerd A Johnson 71 • 952-890-1328
12500 Louise K Becker .88 • 952-894-9086
12501 Ruben N Gonzalez + • 952-736-8148
12504 Roy E Powell .92 • 952-707-9057
12505 Jes Peterson .00 • 952-808-0305
Sherry A Peterson .00 952-808-0305
12508 David J Oja .73 • 952-890-7473
Karen F Oja .73 • 952-890-7473
12512 Elizabeth A Cole .95 • 952-895-0589
Robert V Cole .95 • 952-895-0589
26 RESIDENCE

SKYLINE DR 55422
Minneapolis
1300- 1599 CT 217 $B..
2300- 2499 CT 251 $B..
5000- 5199 CT 235.02 $A..
1350 George G Walker .99 • 763-588-6836
Susan Walker .99 • 763-588-6836
1360 Terryl K White .99 • 763-529-1561
1365 James Dangelo .94 • NP
1370 Timothy T Thompson 98 • 763-529-9396
Wendy S Thompson 98 • 763-529-9396
1375 Maria J Kelley .00 NP ♣
Maria J Kinney .00 NP ♣
1400 Julie N Mele .95 • 763-588-7848
Mark L Mele .95 • 763-588-7848
1405 NP
1410 Edward E Engle .94 • 763-529-7402
Ilene J Engle .94 • 763-529-7402
1415 NP
1420 Bruce G Nimmer .99 • NP
1425 Manly D Rubin .99 763-522-1133
Sybil E Rubin .99 763-522-1133
1430 Mark F Alexander .99 • 763-521-5155
Nancy E Alexander 99 763-521-5155
1435 Jaime J Gmach .00 • 763-302-9000
Rebecca L Olson .00 • 763-302-9000
1440 Debra A Loeckle + • NP
1445 James E Studeny .99 • 763-587-0251
Lynn A Studeny .99 763-587-0251
1450 James K Pfau .99 • NP
1455 NP
1460 Karen Spangler .99 • 763-521-0745
Mark T Spangler .99 • 763-521-0745
1461 Julie E Fricke .94 • 763-521-3098
Walter L Fricke .94 • 763-521-3098
1470 Greg A McGrane .00 • 763-302-4584
1475 James P Quinn .99 • 763-522-9227
1480 Camille A Boomer 00 • NP
Harvey Boomer .00 NP
1485 Michael L Kremer .00 763-521-6396
1490 Barbara A Smith .94 • 763-588-7393
Lynn R Smith .94 • 763-588-7393
1495 Robert D Frink .94 • 763-287-9298

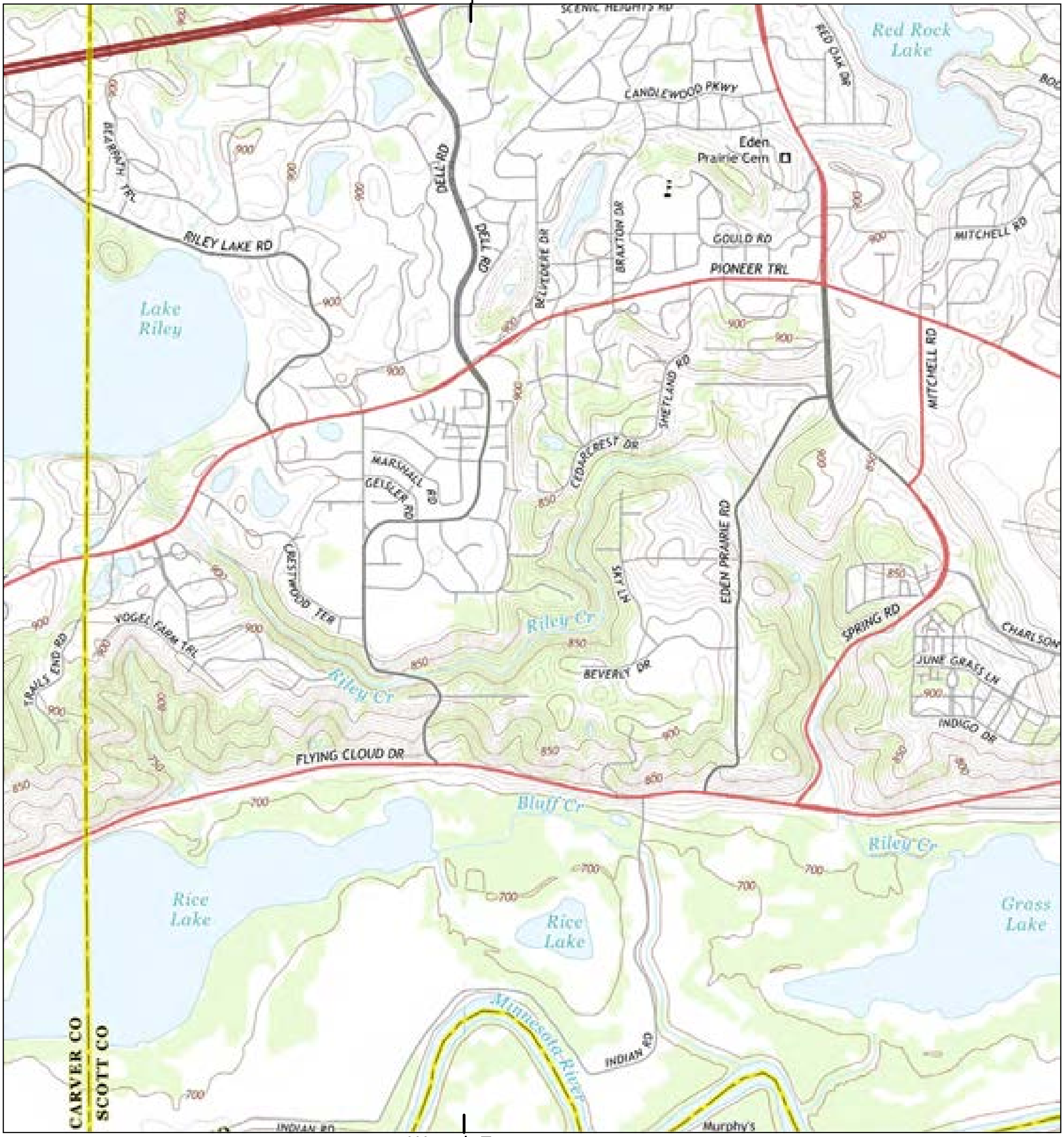
55425
2300 Julie A Kroeger .85 • 952-854-8106
Steve W Kroeger .85 • 952-854-8106
2301 NP
2308 Barbara S Kaminski 79 • 952-854-1997
David G Kaminski .79 • 952-854-1997
2309 Edward P Varevice 00 • 952-854-5829
Phyllis M Varevice 00 • 952-854-5829
2316 NP
2317 Annamarie B Boe + • 952-854-4587
David J Boe + • 952-854-4587
2324 Betty S Clements 64 • 952-854-2971
Floyd A Clements .64 • 952-854-2971
2325 Gary M OBrien .80 • 952-854-4606
Lois E OBrien .80 • 952-854-4606
2332 Harvey W Culver .82 • 952-854-8455
Sharon N Culver .82 • 952-854-8455
2340 Daniel A Enright .97 • 952-854-4803
Debra A Enright .97 • 952-854-4803
2341 Richard K Nelson .64 • 952-854-2832
- RIVER RIDGE RD INTS
2401 Dale R Swanson .94 • 952-853-0946
Lorraine S Swanson 94 • 952-853-0946
2403 George J Karnas .94 • 952-854-6516
Lois M Karnas .94 • 952-854-6516
2405 Mary L Wesner + • 952-854-1014
2407 Frank H Googins .94 • 952-883-0324
Patricia J Googins 94 • 952-883-0536
2409 Carl G Marxen .95 • 952-854-9085
Flossie Marxen .95 • 952-854-9085
2411 Karen J Campion .95 • 952-854-3065
Richard M Campion 95 • 952-854-3065
2413 Wade D Keller .94 • NP
2415 Mary S Naughton .95 • 952-854-7999
2417 Jas W Bissonnette 97 • 952-876-0741
Lois E Bissonnette 97 • 952-876-0741
2419 Richard L Brachman 93 • 952-854-0084
2421 Apartments
417 Amy L Korinke + • 952-854-4987
417 Richard E Korinke + • 952-854-4987
2423 J T Traub .95 • 952-854-3915
Sharon L Traub .95 • 952-854-3915
2425 Chris M Brennom .91 • 952-858-9574
James L Brennom 91 • 952-858-9574
2427 NP
2429 Charles T Kaluza .95 • 952-883-0703
Michael C Kaluza 95 • 952-883-0703
2431 Mary L Arland .94 • 952-883-0935
Raymond J Arland 94 • 952-883-0935
2433 Erin P McKenney 96 • NP
2435 Colleen E Getten 96 • 952-883-0309
Robert Getten .96 • 952-883-0309
2437 Delores E Doyle .96 • NP
2439 Dale A Paulson .90 • 952-854-1731
2440 Berit C Roberts .98 • 952-854-2247
Thomas A Roberts 98 • 952-854-2247
2441 Lorraine G Peter .95 • 952-854-1103
2443 Louise J Regetz + • 952-854-6382
2444 Gregory R Sears .96 • 952-854-6963
2445 Joanne C Kateley .94 • 952-854-5089
2447 Dennis M Sansone 96 • 952-854-5066
Nancy E Sansone .96 • 952-854-5066
2449 Michael B Lebaron 95 • 952-858-8598
2450 Joanna McIntosh .96 • 952-851-9288
Robert J McIntosh 96 • 952-851-9288
2451 Barbara J Prigge .96 • 952-854-3158
Roger L Prigge .96 952-854-3158
2453 Geraldine J Krohn + • 952-854-8881
2454 Paul S Williamson .95 • 952-854-7484
2455 Melinda I Cress .94 • NP
2460 Jeanne K Freeman 95 • 952-883-0253
Neil D Freeman .95 • 952-883-0253
2464 NP
2470 Anthony L Kiorpes + • NP ♣
2474 Jean M Fox .92 • 952-876-0944

55436
- BLOSSOM CT INTS
5004 Gloria Y Wong .60 • 952-929-0773
Leng B Wong .60 • 952-929-0773
5005 Steven B Johansen 91 • NP
5008 Nancy L Brand .97 • 952-926-6517
5016 Lester A Brunker .92 • 952-925-2685
Theresa C Brunker 92 • 952-925-2685
5017 Ellen B Kaiser .99 • NP
5100 Marian K Reid .79 • 952-929-5846
Richard C Reid .79 • 952-929-5846
5101 Cath A Brunkow .78 • 952-920-0937
Gary L Brunkow .78 • 952-920-0937
5104 Guy R Wikman .94 • 952-929-5993
Janice R Wikman .94 • 952-929-5993
5105 Brad P Timmons .55 • 952-929-6081
Grace K Timmons .55 • 952-929-6081
5108 Joan P Gerrish .55 • 952-929-9274
John K Gerrish .55 • 952-929-9274
5109 Tim R Campion .00 • 952-925-0927
5112 Nancy C Kleiber .90 • 952-920-7607
Robert F Kleiber .90 • 952-920-7607
5116 Ann Persons .82 • 952-927-5802
Joy A Persons .82 • 952-927-5802
5117 NP
5120 Eliz L Helland .55 • 952-929-8113
5121 Chris W Neu .88 • 952-925-3827
Jessica Neu .88 • 952-925-3827
5124 Jerrold F Bergfalk 94 • 952-920-3257
Judith N Bergfalk .94 • 952-920-3257
5125 Loa D Kline .94 • 952-922-2339
Patrick J Kline .94 • 952-922-2339
5127 Carolyn C Rozman 93 • 952-920-4842
Thomas J Rozman 93 • 952-920-4842
5128 Kevin T McTigue .88 • NP
143 RESIDENCE

+ — New Listing 95,96,Etc. — Year First Listed 1995,96,Etc. • — Verified Homeowner ♣ — Postal Delivery Questionable

Topographic Maps

93°30'W
West | East

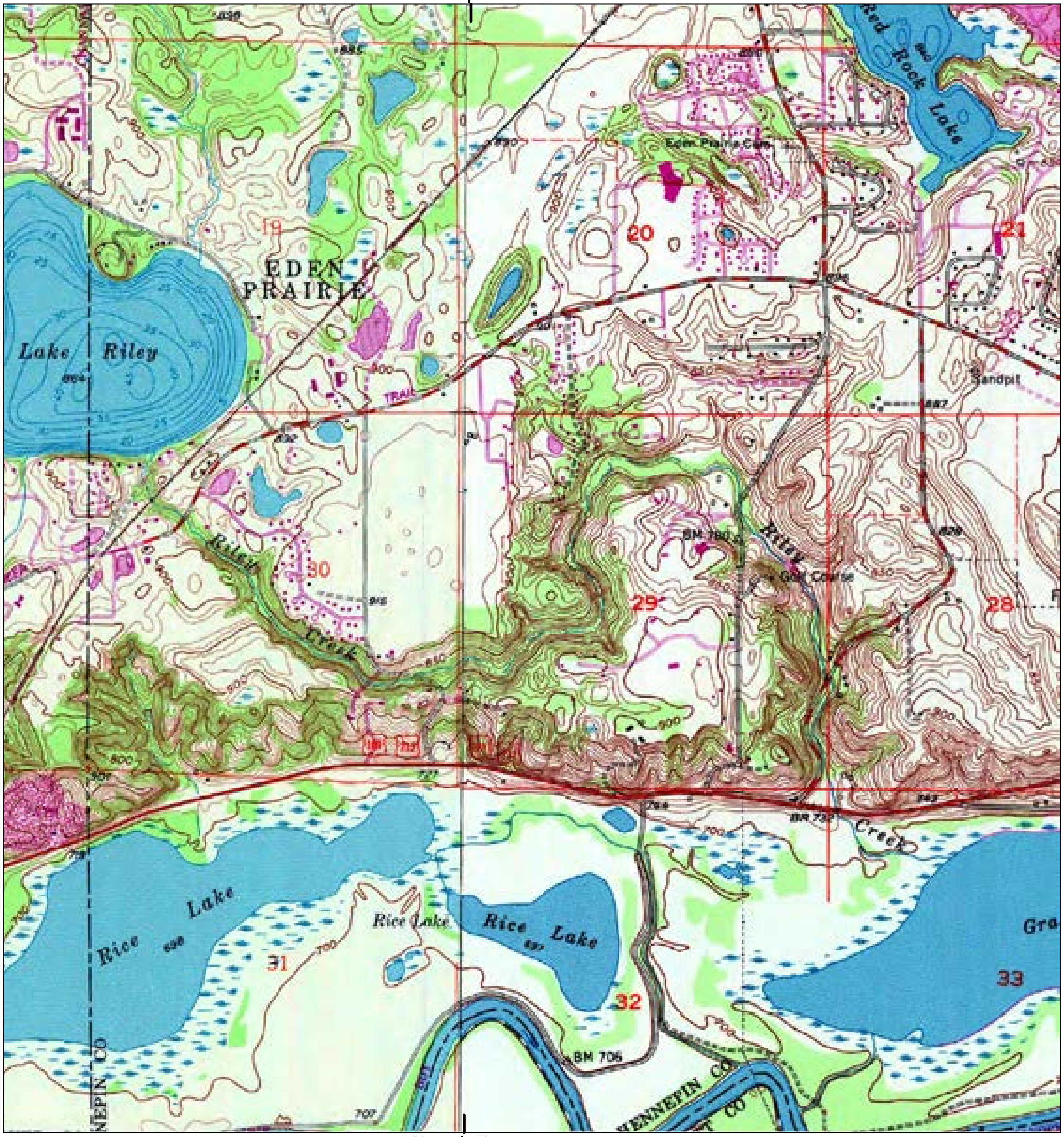


West | East
93°30'W

2013	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN	HIG
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.		Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates Photo Year	Inspected	Revised
East	Eden Prairie, MN	USGS	7½' x 7½'	2013	--	--	--
West	Shakopee, MN	USGS	7½' x 7½'	2013	--	--	--

93°30'W
West | East



West | East
93°30'W

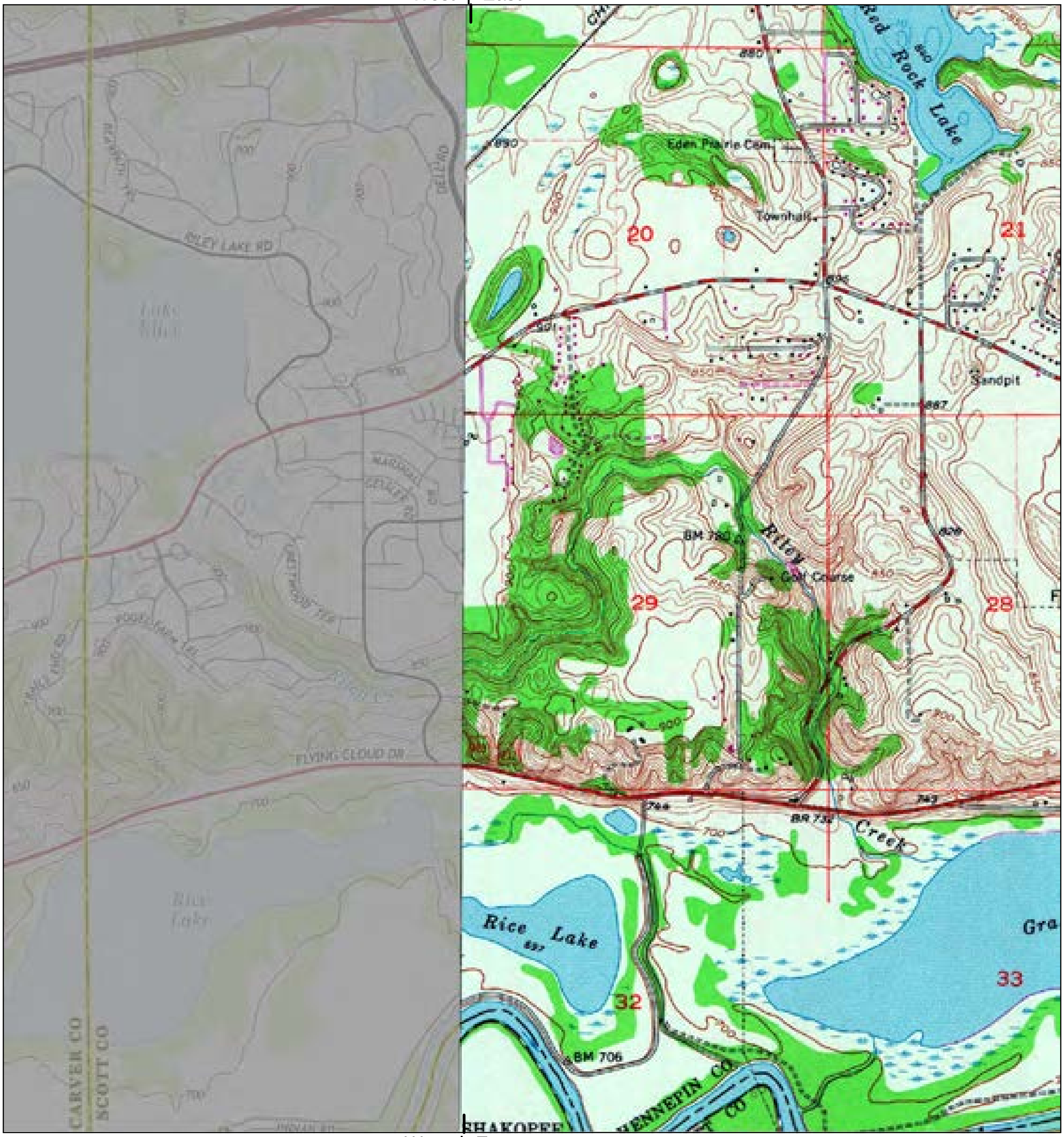
1993	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Photo Year	Inspected	Revised
					Aerial Photo	Topo Updates	
East	Eden Prairie, MN	USGS	7½' x 7½'	1967	1992	--	1993
West	Shakopee, MN	USGS	7½' x 7½'	1958	1991	--	1993

93°30'W
West | East



West | East
93°30'W

1980

0 Distance in Miles 1

1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N

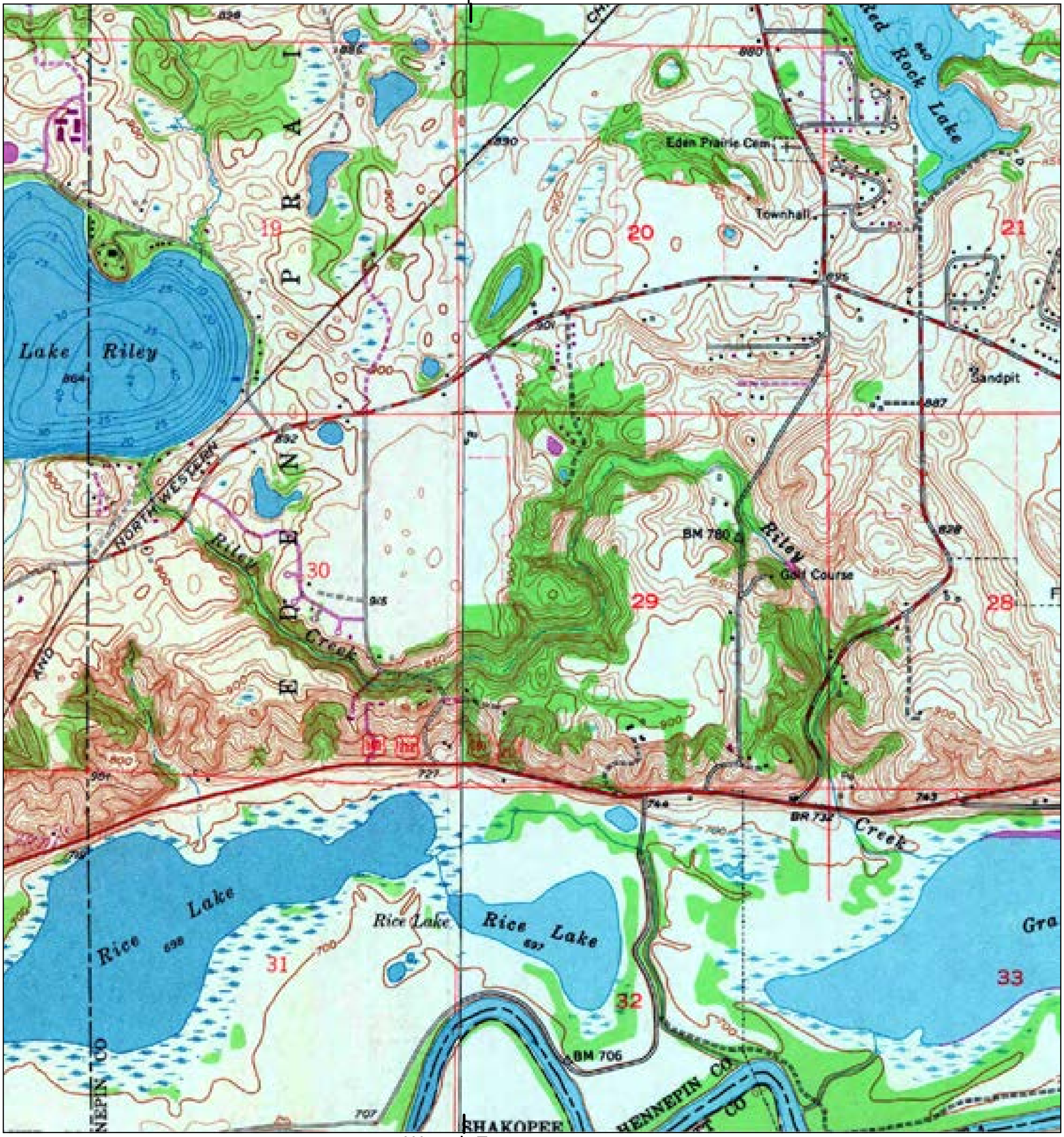
Site information:
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates Photo Year	Inspected	Revised
East	Eden Prairie, MN	USGS	7½' x 7½'	1967	1977	--	1980

93°30'W
West | East



West | East
93°30'W

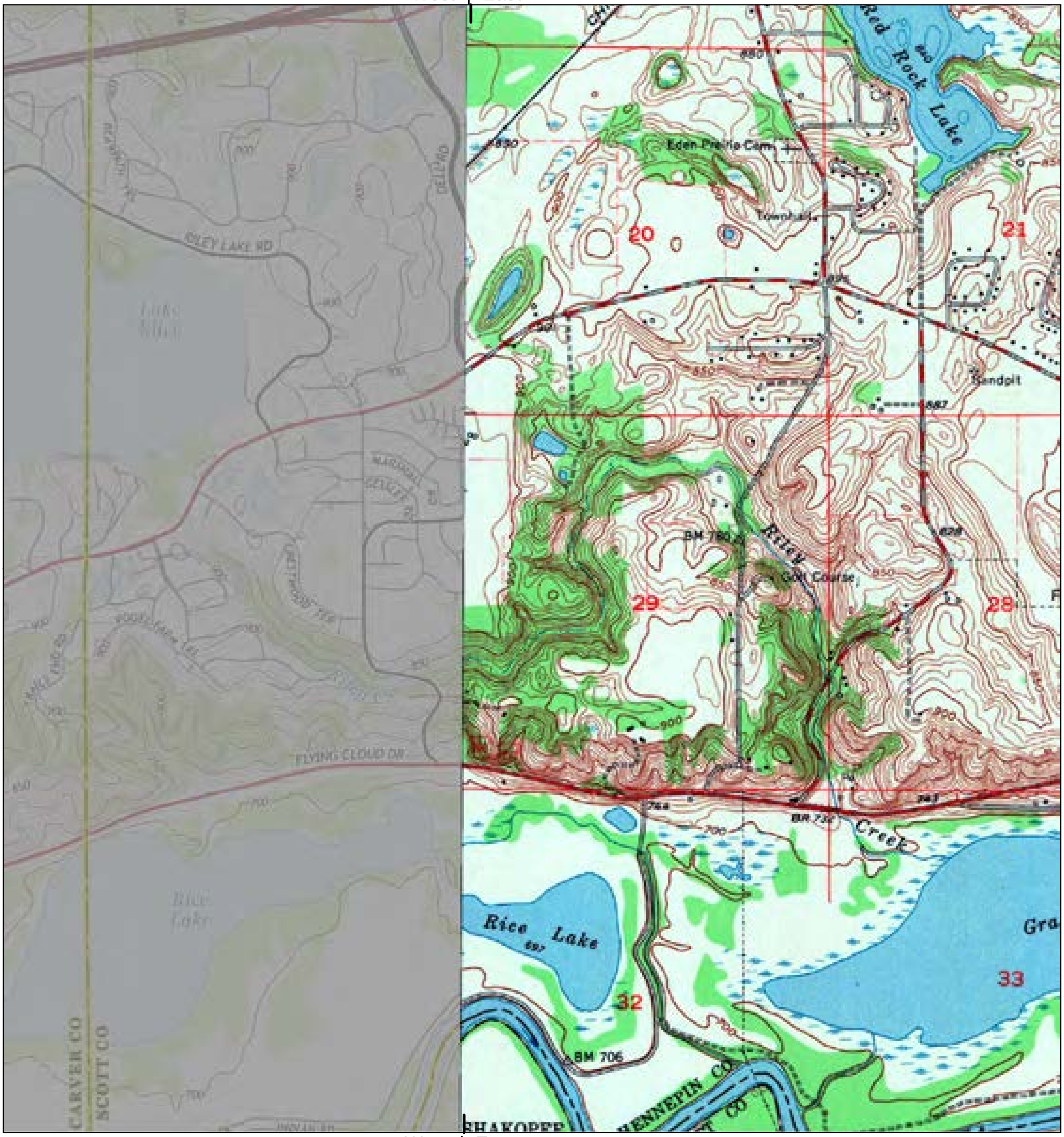
1972	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Eden Prairie, MN	USGS	7½' x 7½'	1967	1972	--	1972
West	Shakopee, MN	USGS	7½' x 7½'	1958	1972	--	1972

93°30'W
West | East

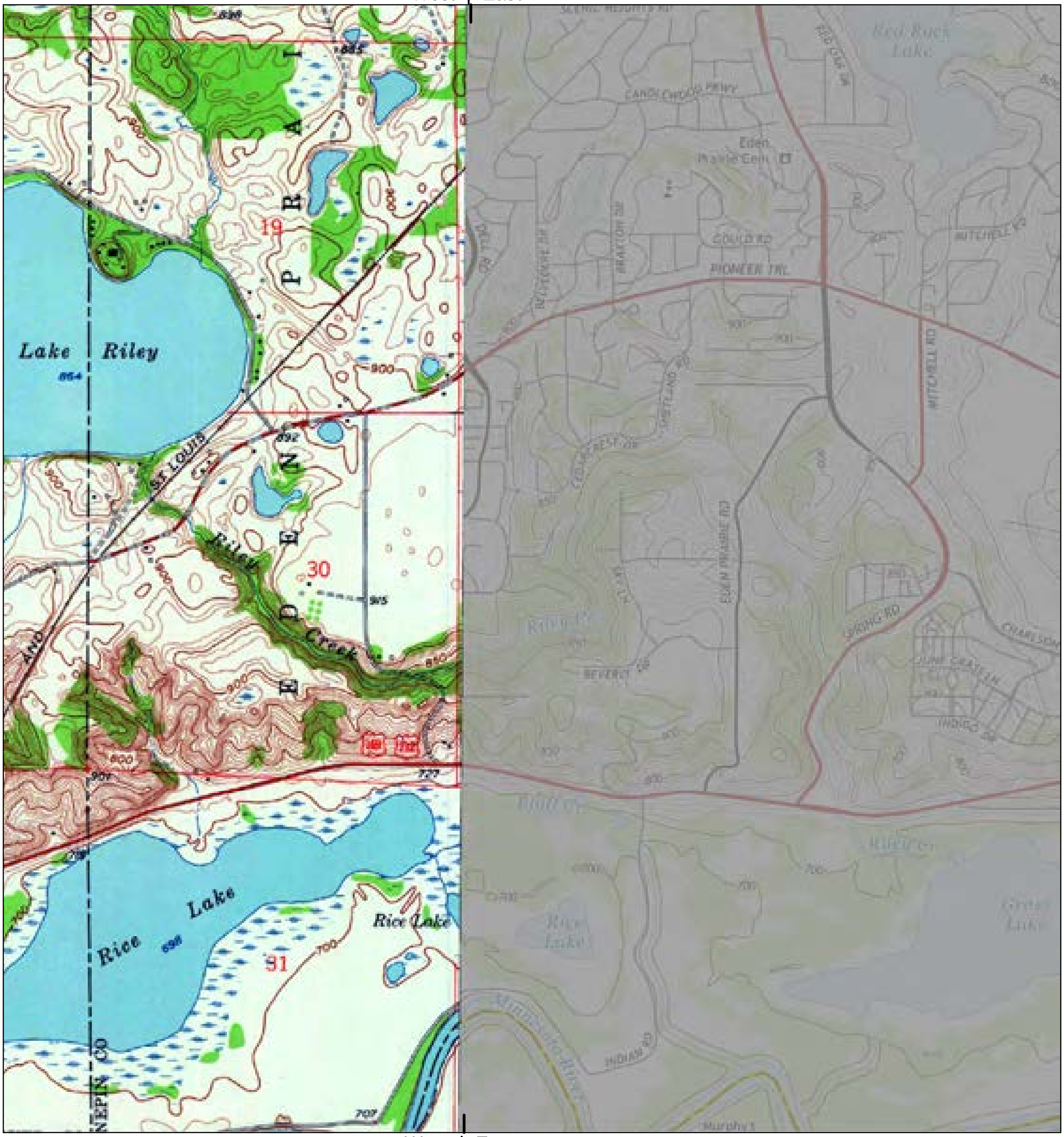


West | East
93°30'W

1967	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.	Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Eden Prairie, MN	USGS	7½' x 7½'	1967	1947	--	--

93°30'W
West | East



West | East
93°30'W

1958

0 Distance in Miles 1

1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N

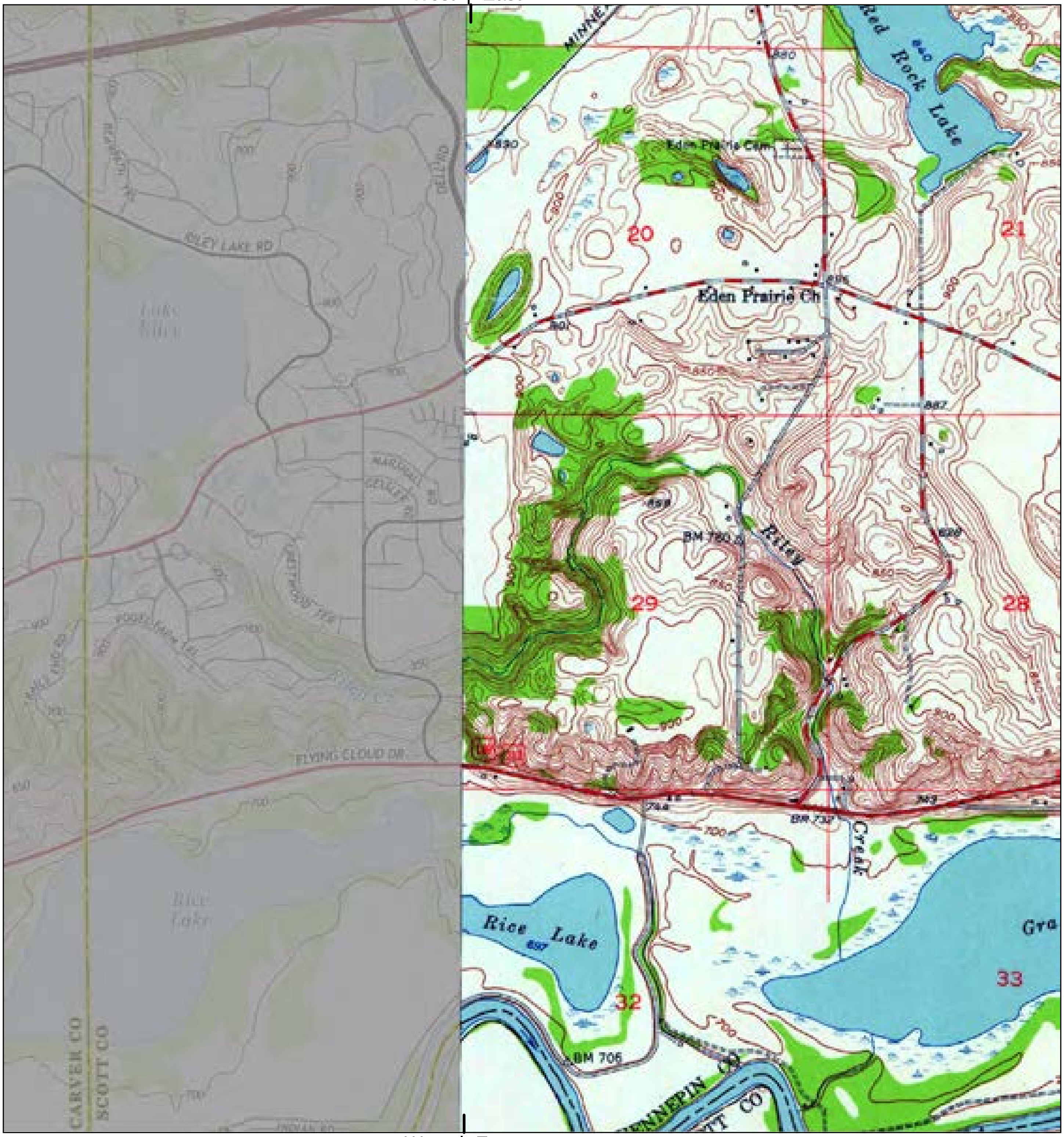
Site information:
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
West	Shakopee, MN	USGS	7½' x 7½'	1958	1953	--	--

93°30'W
West | East



West | East
93°30'W

1954

0 Distance in Miles 1

1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N

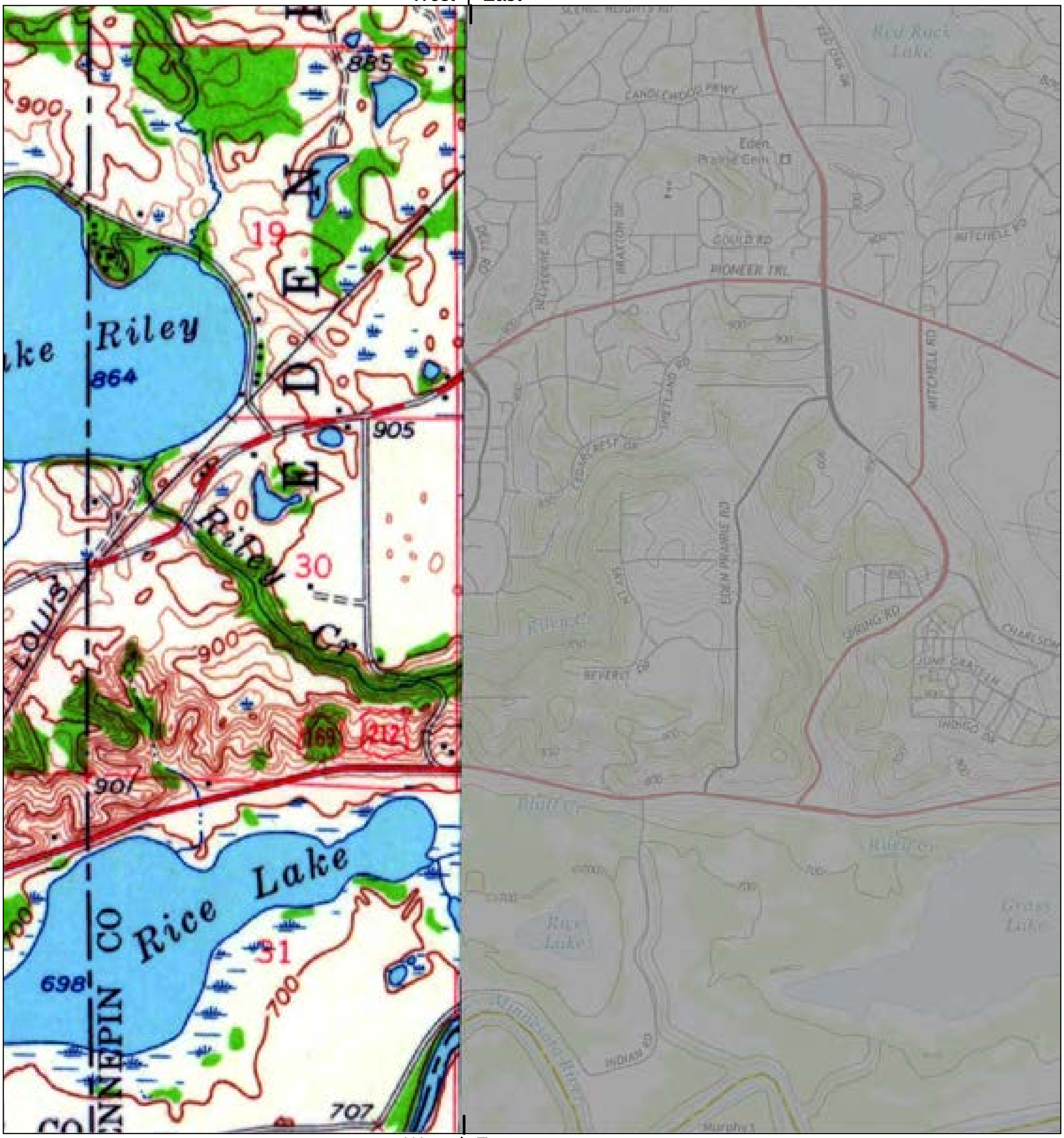
Site information:
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Eden Prairie, MN	USGS	7½' x 7½'	1954	1947	--	--

93°30'W
West | East



West | East
93°30'W

1958

0 — Distance in Miles — 1

1: 24,000 (1"=2,000')   NAD 1983 UTM Zone 15N

Site information:
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

HIG

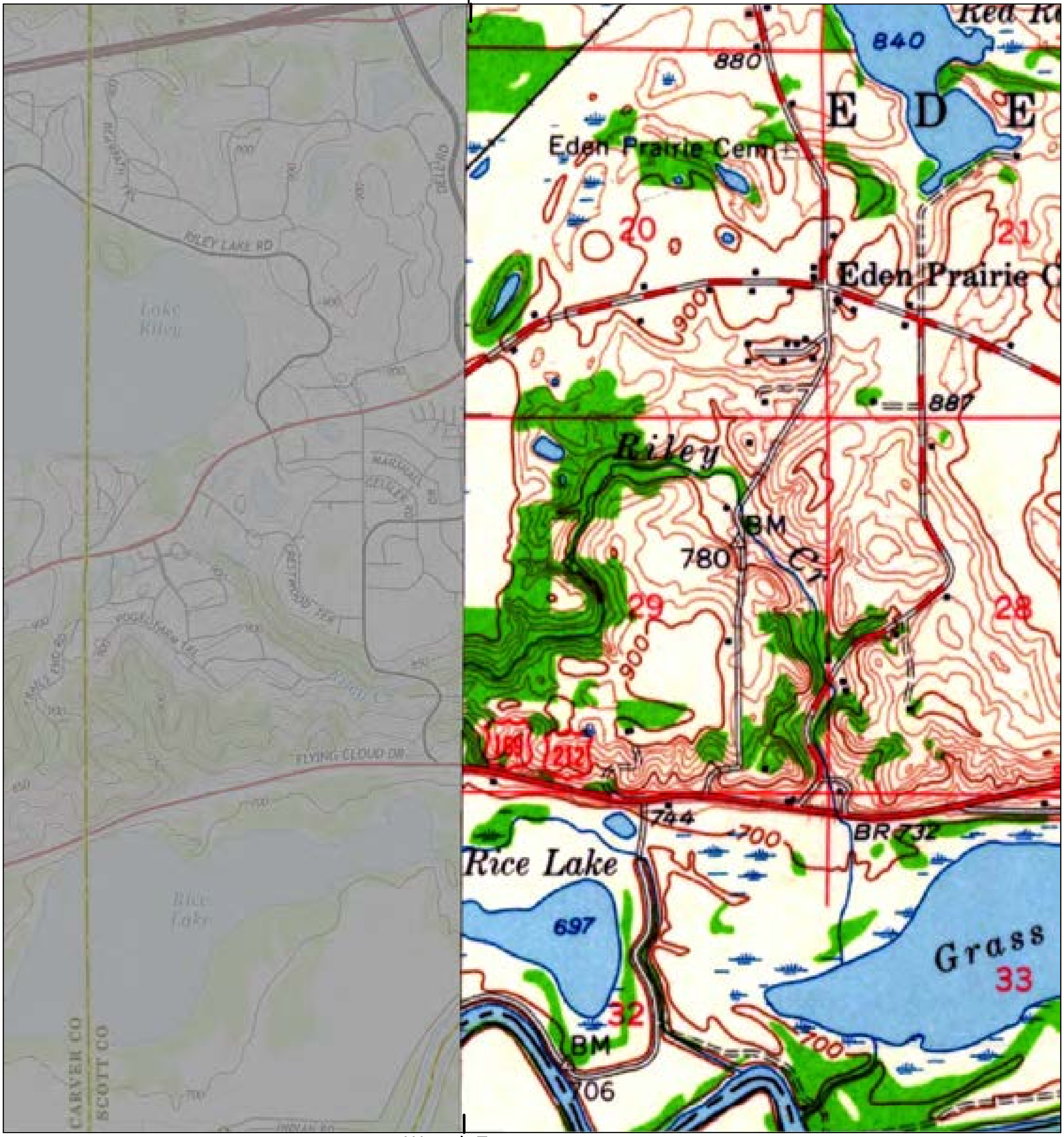
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Photo Year	Inspected	Revised
West	Lake Minnetonka, MN	USGS	15' x 15'	1958	1953	--	--

(Aerial Photo Topo Updates: Photo Year | Inspected | Revised)

93°30'W
West | East



West | East
93°30'W

1954	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.	Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Minneapolis, MN	USGS	15' x 15'	1954	1951	--	--

93°30'W
West | East

West | East
93°30'W

1907	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.	Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
West	Minnetonka, MN	USGS	15' x 15'	1907	--	--	--

93°30'W
West | East

West | East
93°30'W

1905	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.	Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates Photo Year	Inspected	Revised
West	Minnetonka, MN	USGS	15' x 15'	1905	--	--	--

93°30'W
West | East

West | East
93°30'W

1901

Distance in Miles: 0 – 1

1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N

Site information:
Riley Creek corridor
Eden Prairie
Eden Prairie, MN

Unified maps show subdued modern topo features where corresponding maps of the same year were not published.

Barr
HIG #1632102 completed: 04/28/2016

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Minneapolis, MN	USGS	15' x 15'	1901	--	--	--

93°30'W
West | East

West | East
93°30'W

1896	0 Distance in Miles 1 1: 24,000 (1"=2,000') NAD 1983 UTM Zone 15N	Site information: Riley Creek corridor Eden Prairie Eden Prairie, MN
Unified maps show subdued modern topo features where corresponding maps of the same year were not published.	Barr HIG #1632102 completed: 04/28/2016	

Zone	Topographic Map Name	Publisher	Map Size	Base Map	Aerial Photo Topo Updates: Photo Year	Inspected	Revised
East	Minneapolis, MN	USGS	15' x 15'	1896	--	--	--

Appendix D

Regulatory Records Documentation

GeoSearch

On time. On target. In touch.™

Radius Report

Satellite view

Target Property:

Eden Prairie corridor

Eden Prairie, Hennepin County, Minnesota 55347

Prepared For:

Historical Information Gatherers

Order #: 66572

Job #: 144604

Project #: 1632102

Date: 05/05/2016

Table of Contents

Disclaimer

This report was designed by GeoSearch to meet or exceed the records search requirements of the All Appropriate Inquiries Rule (40 CFR §312.26) and the current version of the ASTM International E1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process or, if applicable, the custom requirements requested by the entity that ordered this report. The records and databases of records used to compile this report were collected from various federal,state and local governmental entities. It is the goal of GeoSearch to meet or exceed the 40 CFR §312.26 and E1527 requirements for updating records by using the best available technology. GeoSearch contacts the appropriate governmental entities on a recurring basis. Depending on the frequency with which a record source or database of records is updated by the governmental entity, the data used to prepare this report may be updated monthly, quarterly, semi-annually, or annually.

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Target Property Summary

Target Property Information

Eden Prairie corridor
Eden Prairie, Minnesota 55347

Coordinates
Area centroid (-93.495150, 44.8260331)
892 feet above sea level

USGS Quadrangle
Shakopee, MN
Eden Prairie, MN

Geographic Coverage Information

County/Parish: Hennepin (MN) , Scott (MN) , Carver (MN)
ZipCode(s):
Chanhassen MN: 55317
Eden Prairie MN: 55347
Shakopee MN: 55379

Radon
* Target property is located in Radon Zone 1.
Zone 1 areas have a predicted average indoor radon screening level greater than 4 pCi/L (picocuries per liter).

FEDERAL LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
EMERGENCY RESPONSE NOTIFICATION SYSTEM	ERNSMN	0	0	TP/AP
FEDERAL ENGINEERING INSTITUTIONAL CONTROL SITES	EC	0	0	TP/AP
LAND USE CONTROL INFORMATION SYSTEM	LUCIS	0	0	TP/AP
RCRA SITES WITH CONTROLS	RCRASC	0	0	TP/AP
NO LONGER REGULATED RCRA GENERATOR FACILITIES	NLRRCRAG	0	0	0.1250
RESOURCE CONSERVATION & RECOVERY ACT - GENERATOR FACILITIES	RCRAGR05	0	0	0.1250
RESOURCE CONSERVATION & RECOVERY ACT - NON-GENERATOR FACILITIES	RCRANGR05	0	0	0.1250
BROWNFIELDS MANAGEMENT SYSTEM	BF	0	0	0.5000
DELISTED NATIONAL PRIORITIES LIST	DNPL	0	0	0.5000
NO LONGER REGULATED RCRA NON-CORRACTS TSD FACILITIES	NLRRCRAT	0	0	0.5000
RESOURCE CONSERVATION & RECOVERY ACT - NON-CORRACTS TREATMENT, STORAGE & DISPOSAL FACILITIES	RCRAT	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM	SEMS	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM ARCHIVED SITE INVENTORY	SEMSARCH	0	0	0.5000
NATIONAL PRIORITIES LIST	NPL	0	0	1.0000
NO LONGER REGULATED RCRA CORRECTIVE ACTION FACILITIES	NLRRCRAC	0	0	1.0000
PROPOSED NATIONAL PRIORITIES LIST	PNPL	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - CORRECTIVE ACTION FACILITIES	RCRAC	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - SUBJECT TO CORRECTIVE ACTION FACILITIES	RCRASUBC	0	0	1.0000

SUB-TOTAL		0	0	

Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
AEROMETRIC INFORMATION RETRIEVAL SYSTEM / AIR FACILITY SUBSYSTEM	AIRSAFS	0	0	TP/AP
BIENNIAL REPORTING SYSTEM	BRS	0	0	TP/AP
CERCLIS LIENS	SFLIENS	0	0	TP/AP
CLANDESTINE DRUG LABORATORY LOCATIONS	CDL	0	0	TP/AP
EPA DOCKET DATA	DOCKETS	0	0	TP/AP
FACILITY REGISTRY SYSTEM	FRSMN	0	0	TP/AP

Database Summary

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
HAZARDOUS MATERIALS INCIDENT REPORTING SYSTEM	HMIRSR05	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM (FORMERLY DOCKETS)	ICIS	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	ICISNPDES	0	0	TP/AP
MATERIAL LICENSING TRACKING SYSTEM	MLTS	0	0	TP/AP
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	NPDESR05	0	0	TP/AP
PCB ACTIVITY DATABASE SYSTEM	PADS	0	0	TP/AP
PERMIT COMPLIANCE SYSTEM	PCSR05	0	0	TP/AP
SECTION SEVEN TRACKING SYSTEM	SSTS	0	0	TP/AP
TOXIC SUBSTANCE CONTROL ACT INVENTORY	TSCA	0	0	TP/AP
TOXICS RELEASE INVENTORY	TRI	0	0	TP/AP
HISTORICAL GAS STATIONS	HISTPST	0	0	0.2500
OPEN DUMP INVENTORY	ODI	0	0	0.5000
DEPARTMENT OF DEFENSE SITES	DOD	0	0	1.0000
FORMERLY USED DEFENSE SITES	FUDS	0	0	1.0000
RECORD OF DECISION SYSTEM	RODS	0	0	1.0000

SUB-TOTAL		0	0	

Database Summary

STATE (MN) LISTING

Standard Environmental Records

Database	***Acronym***	***Locatable***	***Unlocatable***	***Search Radius (miles)***
SITES WITH INSTITUTIONAL CONTROLS	*IC*	*0*	*0*	*TP/AP*
HAZARDOUS WASTE GENERATOR SITES	*HWGS*	*0*	*0*	*0.1250*
WATER DISCHARGE PERMITS	*WDP*	*1*	*0*	*0.1250*
REGISTERED STORAGE TANKS	*UAST*	*0*	*0*	*0.2500*
CERCLIS SITES	*CERCLIS*	*0*	*0*	*0.5000*
CLOSED LANDFILLS	*CLF*	*0*	*0*	*0.5000*
HAZARDOUS WASTE TREATMENT STORAGE DISPOSAL SITES	*HWSTSD*	*0*	*0*	*0.5000*
OPEN SOLID WASTE FACILITIES	*SWF*	*0*	*0*	*0.5000*
PERMITTED BY RULE LANDFILLS	*PBRLF*	*0*	*0*	*0.5000*
PETROLEUM BROWNFIELDS PROGRAM SITES	*PBF*	*1*	*0*	*0.5000*
POTENTIAL VOLUNTARY INVESTIGATION AND CLEANUP PROGRAM SITES	*PVICP*	*0*	*0*	*0.5000*
REGISTERED LEAKING STORAGE TANKS	*LUAST*	*0*	*0*	*0.5000*
SITE RESPONSE SECTION DATABASE	*SRS*	*0*	*0*	*0.5000*
UNPERMITTED DUMP SITES	*UNPERMDUMPS*	*0*	*0*	*0.5000*
VOLUNTARY INVESTIGATION AND CLEANUP PROGRAM SITES	*VICP*	*0*	*0*	*0.5000*
HAZARDOUS WASTE CLEANUP SITES	*HWCS*	*0*	*0*	*1.0000*
STATE ASSESSMENT SITES	*SAS*	*0*	*0*	*1.0000*
SUPERFUND SITE INFORMATION LISTING	*SF*	*0*	*0*	*1.0000*

SUB-TOTAL		*2*	*0*	

Additional Environmental Records

Database	***Acronym***	***Locatable***	***Unlocatable***	***Search Radius (miles)***
CLANDESTINE DRUG LABORATORY LOCATIONS	*CDL*	*0*	*0*	*TP/AP*
PERMITTED AIR FACILITIES	*AIRS*	*0*	*0*	*TP/AP*
SOLID WASTE UTILIZATION PROJECTS	*SWUP*	*0*	*0*	*TP/AP*
SPILLS LISTING	*PCASPILLS*	*0*	*0*	*TP/AP*
TIER TWO FACILITY LISTING	*TIERII*	*0*	*0*	*TP/AP*
FEEDLOTS	*FEEDLOT*	*0*	*0*	*0.1250*
BULK STORAGE PERMITS	*BULKSTORAGE*	*0*	*0*	*0.2500*
REGISTERED DRYCLEANING FACILITIES	*CLEANERS*	*0*	*0*	*0.2500*
AGRICULTURAL CONTINGENCY SITES	*CONTINGENCIES*	*0*	*0*	*0.5000*
AGRICULTURAL SPILLS LISTING	*AGSPILLS*	*0*	*0*	*0.5000*

Database Summary

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
CONCENTRATED ANIMAL FEEDING OPERATIONS	CAFO	0	0	0.5000
RECYCLING MARKETS DIRECTORY	RECYCLERS	0	0	0.5000
CONTAMINATED SOIL TREATMENT FACILITIES	CSTF	0	0	1.0000
SUB-TOTAL		0	0	

Database Summary

TRIBAL LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	USTR05	0	0	0.2500
LEAKING UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	LUSTR05	0	0	0.5000
OPEN DUMP INVENTORY ON TRIBAL LANDS	ODINDIAN	0	0	0.5000
SUB-TOTAL		0	0	

Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
INDIAN RESERVATIONS	INDIANRES	0	0	1.0000
SUB-TOTAL		0	0	

TOTAL		2	0	

Database Radius Summary

FEDERAL LISTING

*Standard environmental records are displayed in **bold**.*

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
AIRSAFS	0.0200	0	NS	NS	NS	NS	NS	0
BRS	0.0200	0	NS	NS	NS	NS	NS	0
CDL	0.0200	0	NS	NS	NS	NS	NS	0
DOCKETS	0.0200	0	NS	NS	NS	NS	NS	0
EC	**0.0200**	**0**	**NS**	**NS**	**NS**	**NS**	**NS**	**0**
ERNSMN	**0.0200**	**0**	**NS**	**NS**	**NS**	**NS**	**NS**	**0**
FRSMN	0.0200	0	NS	NS	NS	NS	NS	0
HMIRSR05	0.0200	0	NS	NS	NS	NS	NS	0
ICIS	0.0200	0	NS	NS	NS	NS	NS	0
ICISNPDES	0.0200	0	NS	NS	NS	NS	NS	0
LUCIS	**0.0200**	**0**	**NS**	**NS**	**NS**	**NS**	**NS**	**0**
MLTS	0.0200	0	NS	NS	NS	NS	NS	0
NPDESR05	0.0200	0	NS	NS	NS	NS	NS	0
PADS	0.0200	0	NS	NS	NS	NS	NS	0
PCSR05	0.0200	0	NS	NS	NS	NS	NS	0
RCRASC	**0.0200**	**0**	**NS**	**NS**	**NS**	**NS**	**NS**	**0**
SFLIENS	0.0200	0	NS	NS	NS	NS	NS	0
SSTS	0.0200	0	NS	NS	NS	NS	NS	0
TRI	0.0200	0	NS	NS	NS	NS	NS	0
TSCA	0.0200	0	NS	NS	NS	NS	NS	0
NLRRCRAG	**0.1250**	**0**	**0**	**NS**	**NS**	**NS**	**NS**	**0**
RCRAGR05	**0.1250**	**0**	**0**	**NS**	**NS**	**NS**	**NS**	**0**
RCRANGR05	**0.1250**	**0**	**0**	**NS**	**NS**	**NS**	**NS**	**0**
HISTPST	0.2500	0	0	0	NS	NS	NS	0
BF	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
DNPL	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
NLRRCRAT	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
ODI	0.5000	0	0	0	0	NS	NS	0
RCRAT	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
SEMS	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
SEMSARCH	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
DOD	1.0000	0	0	0	0	0	NS	0
FUDS	1.0000	0	0	0	0	0	NS	0
NLRRCRAC	**1.0000**	**0**	**0**	**0**	**0**	**0**	**NS**	**0**
NPL	**1.0000**	**0**	**0**	**0**	**0**	**0**	**NS**	**0**

Database Radius Summary

Acronym	*Search Radius (miles)*	*TP/AP (0 - 0.02)*	*1/8 Mile (> TP/AP)*	*1/4 Mile (> 1/8)*	*1/2 Mile (> 1/4)*	*1 Mile (> 1/2)*	*> 1 Mile*	*Total*
PNPL	***1.0000***	***0***	***0***	***0***	***0***	***0***	***NS***	***0***
RCRAC	***1.0000***	***0***	***0***	***0***	***0***	***0***	***NS***	***0***
RCRASUBC	***1.0000***	***0***	***0***	***0***	***0***	***0***	***NS***	***0***
RODS	*1.0000*	*0*	*0*	*0*	*0*	*0*	*NS*	*0*

SUB-TOTAL		*0*	*0*	*0*	*0*	*0*	*0*	*0*

Database Radius Summary

STATE (MN) LISTING

*Standard environmental records are displayed in **bold**.*

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
AIRS	0.0200	0	NS	NS	NS	NS	NS	0
CDL	0.0200	0	NS	NS	NS	NS	NS	0
IC	**0.0200**	**0**	**NS**	**NS**	**NS**	**NS**	**NS**	**0**
PCASPILLS	0.0200	0	NS	NS	NS	NS	NS	0
SWUP	0.0200	0	NS	NS	NS	NS	NS	0
TIERII	0.0200	0	NS	NS	NS	NS	NS	0
FEEDLOT	0.1250	0	0	NS	NS	NS	NS	0
HWGS	**0.1250**	**0**	**0**	**NS**	**NS**	**NS**	**NS**	**0**
WDP	**0.1250**	**0**	**1**	**NS**	**NS**	**NS**	**NS**	**1**
BULKSTORAGE	0.2500	0	0	0	NS	NS	NS	0
CLEANERS	0.2500	0	0	0	NS	NS	NS	0
UAST	**0.2500**	**0**	**0**	**0**	**NS**	**NS**	**NS**	**0**
AGSPILLS	0.5000	0	0	0	0	NS	NS	0
CAFO	0.5000	0	0	0	0	NS	NS	0
CERCLIS	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
CLF	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
CONTINGENCIES	0.5000	0	0	0	0	NS	NS	0
HWSTSD	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
LUAST	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
PBF	**0.5000**	**0**	**0**	**0**	**1**	**NS**	**NS**	**1**
PBRLF	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
PVICP	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
RECYCLERS	0.5000	0	0	0	0	NS	NS	0
SRS	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
SWF	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
UNPERMDUMPS	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
VICP	**0.5000**	**0**	**0**	**0**	**0**	**NS**	**NS**	**0**
CSTF	1.0000	0	0	0	0	0	NS	0
HWCS	**1.0000**	**0**	**0**	**0**	**0**	**0**	**NS**	**0**
SAS	**1.0000**	**0**	**0**	**0**	**0**	**0**	**NS**	**0**
SF	**1.0000**	**0**	**0**	**0**	**0**	**0**	**NS**	**0**
SUB-TOTAL		0	1	0	1	0	0	2

Database Radius Summary

TRIBAL LISTING

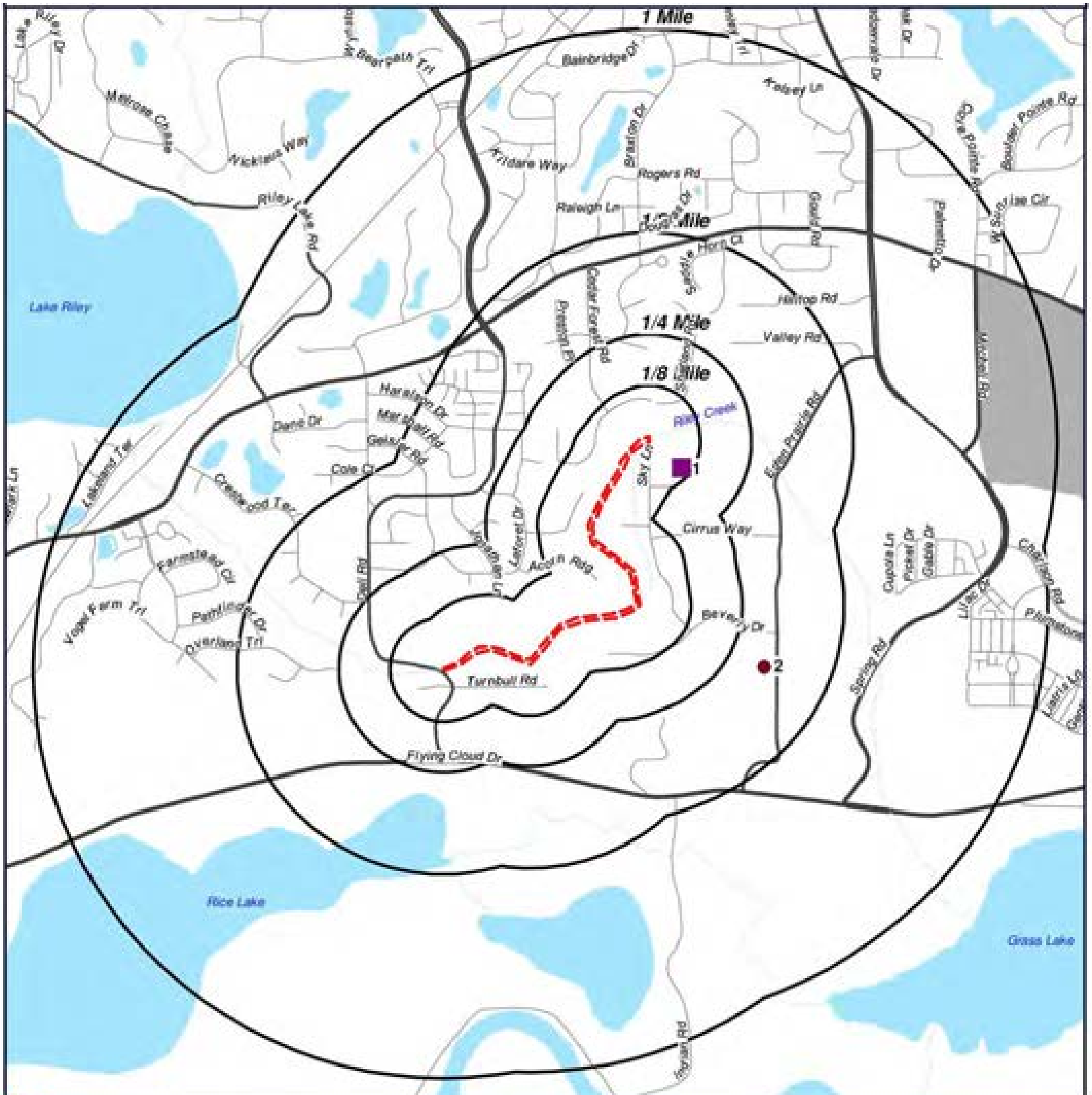
*Standard environmental records are displayed in **bold**.*

Acronym	***Search Radius (miles)***	***TP/AP (0 - 0.02)***	***1/8 Mile (> TP/AP)***	***1/4 Mile (> 1/8)***	***1/2 Mile (> 1/4)***	***1 Mile (> 1/2)***	***> 1 Mile***	***Total***
USTR05	***0.2500***	***0***	***0***	***0***	***NS***	***NS***	***NS***	***0***
LUSTR05	***0.5000***	***0***	***0***	***0***	***0***	***NS***	***NS***	***0***
ODINDIAN	***0.5000***	***0***	***0***	***0***	***0***	***NS***	***NS***	***0***
INDIANRES	*1.0000*	*0*	*0*	*0*	*0*	*0*	*NS*	*0*
SUB-TOTAL		*0*	*0*	*0*	*0*	*0*	*0*	*0*

TOTAL		*0*	*1*	*0*	*1*	*0*	*0*	*2*

NOTES:
NS = NOT SEARCHED
TP/AP = TARGET PROPERTY/ADJACENT PROPERTY

Radius Map 1



- Target Property (TP)
- WDP
- PBF

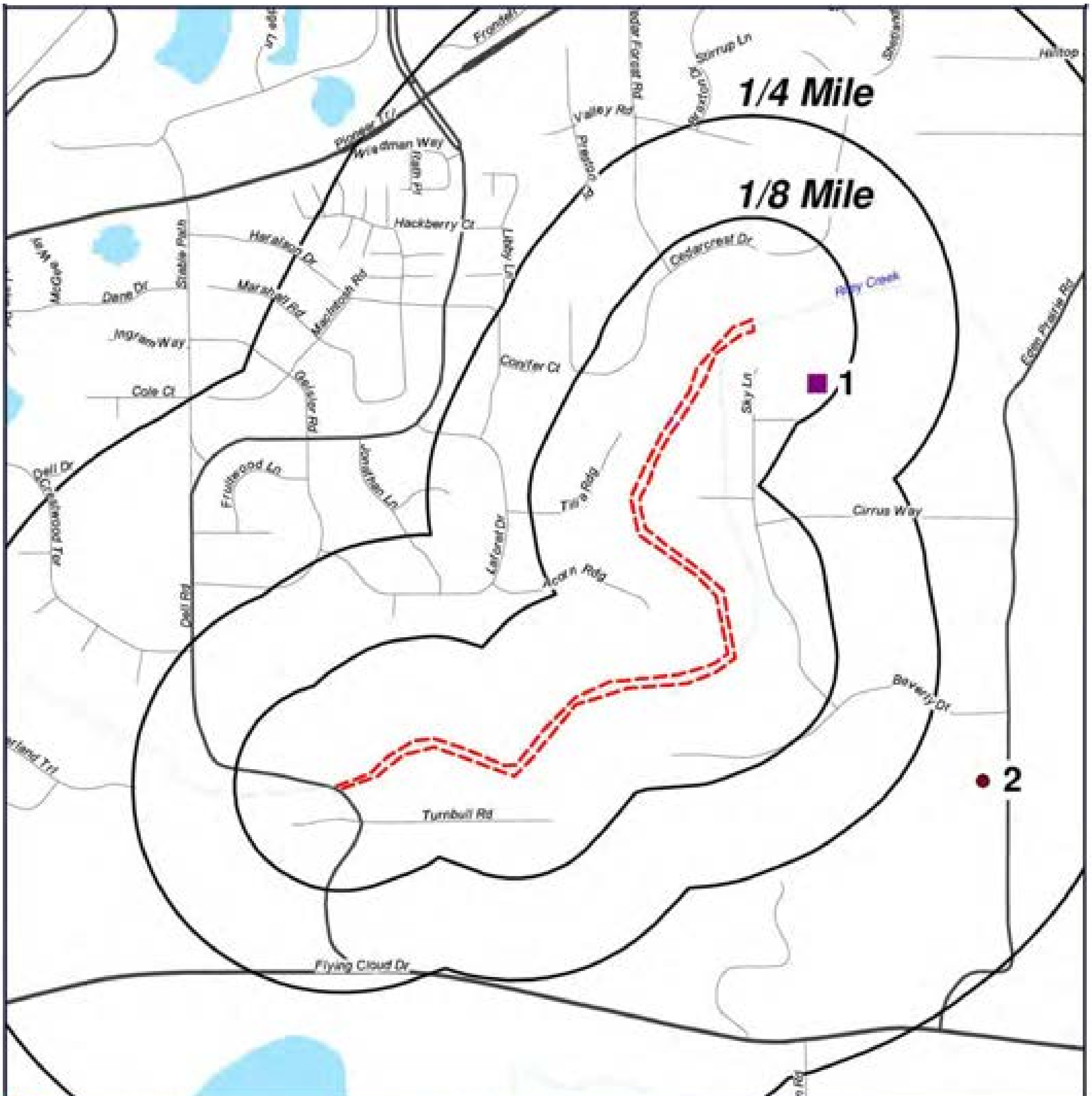
Eden Prairie corridor
Eden Prairie, Minnesota
55347

N W E S

0' 1000' 2000' 3000'
SCALE: 1" = 2000'

[Click here to access Satellite view]

Radius Map 2



Target Property (TP)
WDP
PBF

Eden Prairie corridor
Eden Prairie, Minnesota
_55347_

N W E S

0' 500' 1000' 1500'
SCALE: 1" = 1000'

[Click here to access Satellite view]

Ortho Map

Target Property (TP)
WDP
PBF

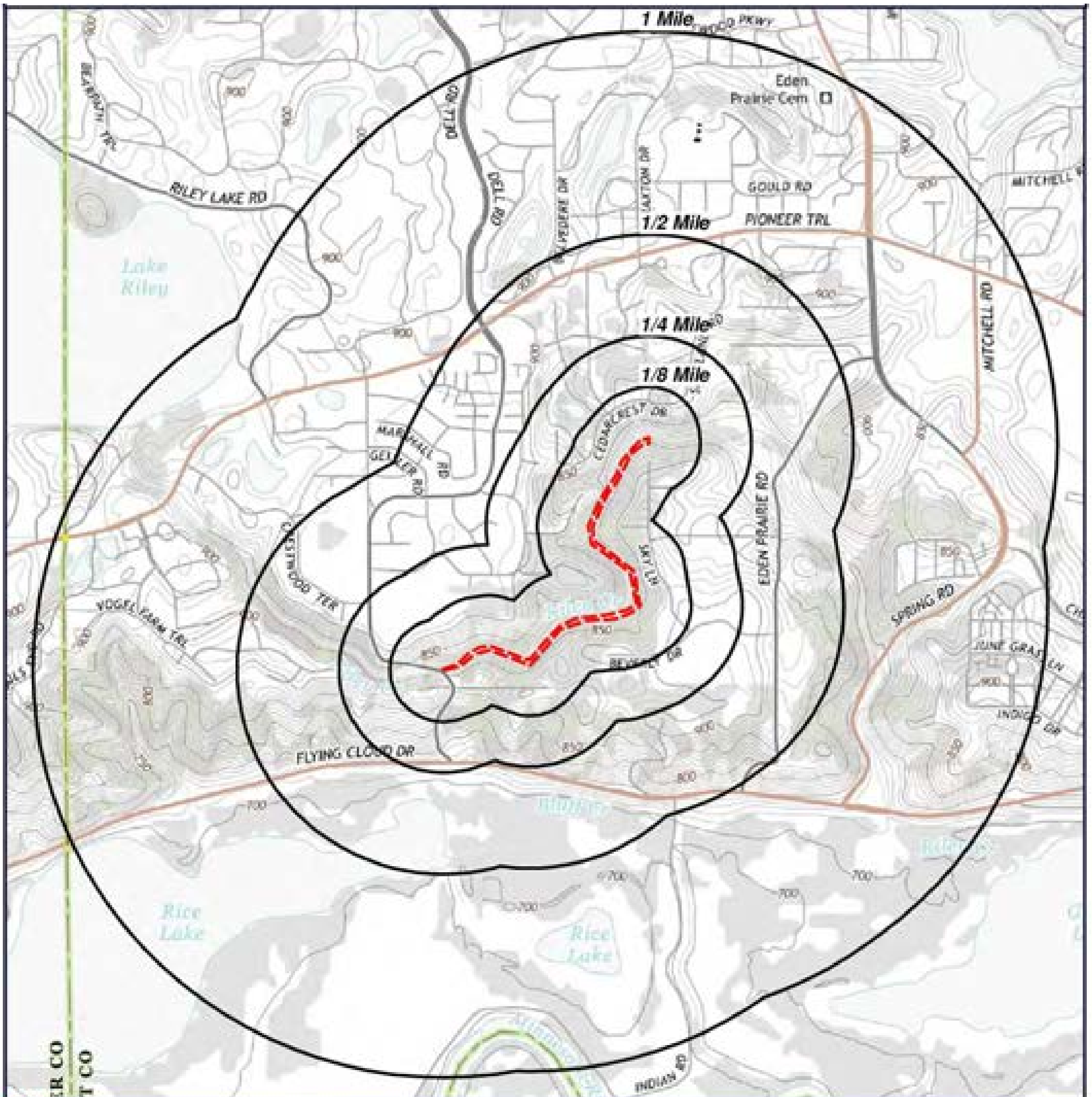
Quadrangle(s): Shakopee, Eden Prairie
Eden Prairie corridor
Eden Prairie, Minnesota
55347

N W E S

0' 500' 1000' 1500'
SCALE: 1" = 1000'

Click here to access Satellite view

Topographic Map



Target Property (TP)

Quadrangle(s): Shakopee, Eden Prairie
Source: USGS, 08/20/2013
Eden Prairie corridor
Eden Prairie, Minnesota
55347

N W E S

0' 1000' 2000' 3000'
SCALE: 1" = 2000'

[Click here to access Satellite view]

Located Sites Summary

*NOTE: Standard environmental records are displayed in **bold**.*

Map ID#	Database Name	Site ID#	Relative Elevation	Distance From Site	Site Name	Address	PAGE #
1	***WDP***	***62674109***	***Lower (868 ft.)***	***0.11 mi. SE (581 ft.)***	***HIGHPOINT AT RILEY CREEK***	***ADDRESS UNKNOWN, EDEN PRAIRIE, MN 55346***	***17***
2	***PBF***	***67925606PBF***	***Lower (891 ft.)***	***0.35 mi. SE (1848 ft.)***	***WUTTTKE PROPERTY***	***9950 EDEN PRAIRIE RD, EDEN PRAIRIE, MN 55347***	***18***

Elevation Summary

Elevations are collected from the USGS 3D Elevation Program 1/3 arc-second (approximately 10 meters) layer hosted at the NGTOC. .

Target Property Elevation: 892 ft.

*NOTE: Standard environmental records are displayed in **bold**.*

EQUAL/HIGHER ELEVATION

Map ID#	Database Name	Elevation	Site Name	Address	Page #
2	***PBF***	***891 ft.***	***WUTTTKE PROPERTY***	***9950 EDEN PRAIRIE RD, EDEN PRAIRIE, MN 55347***	***18***

LOWER ELEVATION

Map ID#	Database Name	Elevation	Site Name	Address	Page #
1	***WDP***	***868 ft.***	***HIGHPOINT AT RILEY CREEK***	***ADDRESS UNKNOWN, EDEN PRAIRIE, MN 55346***	***17***

Water Discharge Permits (WDP)

MAP ID# 1

Distance from Property: 0.11 mi. (581 ft.) SE
Elevation: 868 ft. (Lower than TP)

FACILITY INFORMATION

SITE ID: **62674109**

SITE NAME: **HIGHPOINT AT RILEY CREEK**

ADDRESS: **ADDRESS UNKNOWN**
EDEN PRAIRIE, MN 55346 HENNEPIN

PDF URL: **http://cf.pca.state.mn.us/wimn/siteInfo_print.cfm?siteid=62674109**

FACILITY DETAILS

ID: **C00033821**

TYPE: **CONSTRUCTION STORMWATER PERMIT**

WATERSHED: **LOWER MINNESOTA RIVER**

CURRENTLY ACTIVE: **YES**

INDUSTRY CLASSIFICATION: **NOT REPORTED**

Back to Report Summary

Petroleum Brownfields Program Sites (PBF)

MAP ID# 2 | **Distance from Property: 0.35 mi. (1,848 ft.) SE**
Elevation: 891 ft. (Lower than TP)

FACILITY INFORMATION

GEOSEARCH ID: **67925606PBF**
NAME: **WUTTTKE PROPERTY**
ADDRESS: **9950 EDEN PRAIRIE RD**
EDEN PRAIRIE, MN 55347
COUNTY: **HENNEPIN**
OWNER: **PULTE HOMES OF MINNESOTA LLC**
WATERSHED: **LOWER MINNESOTA RIVER**
LATITUDE: **44.822990800**
LONGITUDE: **-93.485311010**
COORDINATE COLLECTION METHOD: **ADDRESS MATCHING HOUSE NUMBER**

FACILITY DETAILS

ID: **4489**
ACTIVITY NAME: **WUTTTKE PROPERTY**
ACTIVE?: **NO**
SITE SIZE: **NOT REPORTED**
LEAK SOURCE: **NOT REPORTED**

Back to Report Summary

Unlocated Sites Summary

This list contains sites that could not be mapped due to limited or incomplete address information.

No Records Found

AIRSAFS Aerometric Information Retrieval System / Air Facility Subsystem

VERSION DATE: 10/20/14

The United States Environmental Protection Agency (EPA) modified the Aerometric Information Retrieval System (AIRS) to a database that exclusively tracks the compliance of stationary sources of air pollution with EPA regulations: the Air Facility Subsystem (AFS). Since this change in 2001, the management of the AIRS/AFS database was assigned to EPA's Office of Enforcement and Compliance Assurance.

BRS Biennial Reporting System

VERSION DATE: 12/31/11

The United States Environmental Protection Agency (EPA), in cooperation with the States, biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended. The Biennial Report captures detailed data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage and disposal facilities. Currently, the EPA states that data collected between 1991 and 1997 was originally a part of the defunct Biennial Reporting System and is now incorporated into the RCRAInfo data system.

CDL Clandestine Drug Laboratory Locations

VERSION DATE: 01/20/16

The U.S. Department of Justice ("the Department") provides this information as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments. The Department does not establish, implement, enforce, or certify compliance with clean-up or remediation standards for contaminated sites; the public should contact a state or local health department or environmental protection agency for that information.

DOCKETS EPA Docket Data

VERSION DATE: 12/22/05

The United States Environmental Protection Agency Docket data lists Civil Case Defendants, filing dates as far back as 1971, laws broken including section, violations that occurred, pollutants involved, penalties assessed and superfund awards by facility and location. Please refer to ICIS database as source of current data.

EC Federal Engineering Institutional Control Sites

VERSION DATE: 08/03/15

This database includes site locations where Engineering and/or Institutional Controls have been identified as part of a selected remedy for the site as defined by United States Environmental Protection Agency official remedy decision documents. A site listing does not indicate that the institutional and engineering controls are currently in place nor will be in place once the remedy is complete; it only indicates that the decision to include either of them in the remedy is documented as of the completed date of the document. Institutional controls are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Engineering controls include caps, barriers, or other device engineering to prevent access, exposure, or continued migration of contamination.

ERNSMN Emergency Response Notification System

VERSION DATE: 02/21/16

This National Response Center database contains data on reported releases of oil, chemical, radiological, biological, and/or etiological discharges into the environment anywhere in the United States and its territories. The data comes from spill reports made to the U.S. Environmental Protection Agency, U.S. Coast Guard, the National Response Center and/or the U.S. Department of Transportation.

FRSMN Facility Registry System

VERSION DATE: 02/03/16

The United States Environmental Protection Agency's Office of Environmental Information (OEI) developed the Facility Registry System (FRS) as the centrally managed database that identifies facilities, sites or places subject to environmental regulations or of environmental interest. The Facility Registry System replaced the Facility Index System or FINDS database.

HMIRSR05 Hazardous Materials Incident Reporting System

VERSION DATE: 11/08/15

The HMIRS database contains unintentional hazardous materials release information reported to the U.S. Department of Transportation located in EPA Region 5. Region 5 includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

ICIS Integrated Compliance Information System (formerly DOCKETS)

VERSION DATE: 12/06/15

ICIS is a case activity tracking and management system for civil, judicial, and administrative federal Environmental Protection Agency enforcement cases. ICIS contains information on federal administrative and federal judicial cases under the following environmental statutes: the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Emergency Planning and Community Right-to-Know Act - Section 313, the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Safe Drinking Water Act, and the Marine Protection, Research, and Sanctuaries Act.

ICISNPDES Integrated Compliance Information System National Pollutant Discharge Elimination System

VERSION DATE: 12/20/15

In 2006, the Integrated Compliance Information System (ICIS) - National Pollutant Discharge Elimination System (NPDES) became the NPDES national system of record for select states, tribes and territories. ICIS-NPDES is an information management system maintained by the United States Environmental Protection Agency's Office of Compliance to track permit compliance and enforcement status of facilities regulated by the NPDES under the Clean Water Act. ICIS-NPDES is designed to support the NPDES program at the state, regional, and national levels.

LUCIS Land Use Control Information System

VERSION DATE: 09/01/06

The LUCIS database is maintained by the U.S. Navy and contains information for former Base Realignment and Closure (BRAC) properties across the United States.

MLTS Material Licensing Tracking System

VERSION DATE: 02/12/16

MLTS is a list of approximately 8,100 sites which have or use radioactive materials subject to the United States Nuclear Regulatory Commission (NRC) licensing requirements.

NPDESR05 National Pollutant Discharge Elimination System

VERSION DATE: 04/01/07

Information in this database is extracted from the Water Permit Compliance System (PCS) database which is used by United States Environmental Protection Agency to track surface water permits issued under the Clean Water Act. This database includes permitted facilities located in EPA Region 5. This region includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The NPDES database was collected from December 2002 until April 2007. Refer to the PCS and/or ICIS-NPDES database as source of current data.

PADS PCB Activity Database System

VERSION DATE: 07/01/14

The PCB Activity Database System (PADS) is used by the United States Environmental Protection Agency to monitor the activities of polychlorinated biphenyls (PCB) handlers.

PCSR05 Permit Compliance System

VERSION DATE: 08/01/12

The Permit Compliance System is used in tracking enforcement status and permit compliance of facilities controlled by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act and is maintained by the United States Environmental Protection Agency's Office of Compliance. PCS is designed to support the NPDES program at the state, regional, and national levels. This database includes permitted facilities located in EPA Region 5. This region includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. PCS has been modernized, and no longer exists. National Pollutant Discharge Elimination System (ICIS-NPDES) data can now be found in Integrated Compliance Information System (ICIS).

RCRASC RCRA Sites with Controls

VERSION DATE: 02/23/16

This list of Resource Conservation and Recovery Act sites with institutional controls in place is provided by the U.S. Environmental Protection Agency.

SFLIENS CERCLIS Liens

VERSION DATE: 06/08/12

A Federal CERCLA ("Superfund") lien can exist by operation of law at any site or property at which United States Environmental Protection Agency has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties. This database contains those CERCLIS sites where the Lien on Property action is complete.

SSTS Section Seven Tracking System

VERSION DATE: 12/08/14

The United States Environmental Protection Agency tracks information on pesticide establishments through the Section Seven Tracking System (SSTS). SSTS records the registration of new establishments and records pesticide production at each establishment. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requires that production of pesticides or devices be conducted in a registered pesticide-producing or device-producing establishment. ("Production" includes formulation, packaging, repackaging, and relabeling.)

TRI Toxics Release Inventory

VERSION DATE: 12/31/14

The Toxics Release Inventory, provided by the United States Environmental Protection Agency, includes data on toxic chemical releases and waste management activities from certain industries as well as federal and tribal facilities. This inventory contains information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

TSCA Toxic Substance Control Act Inventory

VERSION DATE: 12/31/06

The Toxic Substances Control Act (TSCA) was enacted in 1976 to ensure that chemicals manufactured, imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment. TSCA section 8(b) provides the United States Environmental Protection Agency authority to "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States." This TSCA Chemical Substance Inventory contains non-confidential information on the production amount of toxic chemicals from each manufacturer and importer site.

NLRRCRAG No Longer Regulated RCRA Generator Facilities

VERSION DATE: 02/09/16

This database includes RCRA Generator facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly generated hazardous waste.
Large Quantity Generators: Generate 1,000 kg or more of hazardous waste during any calendar month; or Generate more than 1 kg of acutely hazardous waste during any calendar month; or Generate more than 100 kg of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month; or Generate 1 kg or less of acutely hazardous waste during any calendar month, and accumulate more than 1kg of acutely hazardous waste at any time; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulated more than 100 kg of that material at any time.
Small Quantity Generators: Generate more than 100 and less than 1000 kilograms of hazardous waste during any calendar month and accumulate less than 6000 kg of hazardous waste at any time; or Generate 100 kg or less of hazardous waste during any calendar month, and accumulate more than 1000 kg of hazardous waste at any time.
Conditionally Exempt Small Quantity Generators: Generate 100 kilograms or less of hazardous waste per calendar month, and accumulate 1000 kg or less of hazardous waste at any time; or Generate one kilogram or less of acutely hazardous waste per calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste.

RCRAGR05 Resource Conservation & Recovery Act - Generator Facilities

VERSION DATE: 02/09/16

This database includes sites listed as generators of hazardous waste (large, small, and exempt) in the RCRAInfo system. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS). This database includes sites located in EPA Region 5. This region includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

Large Quantity Generators: Generate 1,000 kg or more of hazardous waste during any calendar month; or Generate more than 1 kg of acutely hazardous waste during any calendar month; or Generate more than 100 kg of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month; or Generate 1 kg or less of acutely hazardous waste during any calendar month, and accumulate more than 1kg of acutely hazardous waste at any time; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulated more than 100 kg of that material at any time.

Small Quantity Generators: Generate more than 100 and less than 1000 kilograms of hazardous waste during any calendar month and accumulate less than 6000 kg of hazardous waste at any time; or Generate 100 kg or less of hazardous waste during any calendar month, and accumulate more than 1000 kg of hazardous waste at any time.

Conditionally Exempt Small Quantity Generators: Generate 100 kilograms or less of hazardous waste per calendar month, and accumulate 1000 kg or less of hazardous waste at any time; or Generate one kilogram or less of acutely hazardous waste per calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste; or Generate 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, or acutely hazardous waste during any calendar month, and accumulate at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste.

RCRANGR05 Resource Conservation & Recovery Act - Non-Generator Facilities

VERSION DATE: 02/09/16

This database identifies RCRAInfo system sites that only handle hazardous waste, such as transporters, without generating any amount hazardous waste. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS). This database includes sites located in EPA Region 5. This region includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

HISTPST Historical Gas Stations

VERSION DATE: NR

This historic directory of service stations is provided by the Cities Service Company. The directory includes

Cities Service filling stations that were located throughout the United States in 1930.

BF Brownfields Management System

VERSION DATE: 01/28/16

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. The United States Environmental Protection Agency maintains this database to track activities in the various brown field grant programs including grantee assessment, site cleanup and site redevelopment. This database included tribal brownfield sites.

DNPL Delisted National Priorities List

VERSION DATE: 07/22/15

This database includes sites from the United States Environmental Protection Agency's Final National Priorities List (NPL) where remedies have proven to be satisfactory or sites where the original analyses were inaccurate, and the site is no longer appropriate for inclusion on the NPL, and final publication in the Federal Register has occurred.

NLRRCRAT No Longer Regulated RCRA Non-CORRACTS TSD Facilities

VERSION DATE: 02/09/16

This database includes RCRA Non-Corrective Action TSD facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly treated, stored or disposed of hazardous waste.

ODI Open Dump Inventory

VERSION DATE: 06/01/85

The open dump inventory was published by the United States Environmental Protection Agency. An "open dump" is defined as a facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944) and which is not a facility for disposal of hazardous waste. This inventory has not been updated since June 1985.

RCRAT Resource Conservation & Recovery Act - Non-CORRACTS Treatment, Storage & Disposal Facilities

VERSION DATE: 02/09/16

This database includes Non-Corrective Action sites listed as treatment, storage and/or disposal facilities of hazardous waste in the RCRAInfo system. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of

1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

SEMS Superfund Enterprise Management System

VERSION DATE: 03/07/16

The U.S. Environmental Protections Agency's (EPA) Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation (OSRTI), has implemented The Superfund Enterprise Management System (SEMS), formerly known as CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) to track and report on clean-up and enforcement activities taking place at Superfund sites. SEMS represents a joint development and ongoing collaboration between Superfund's Remedial, Removal, Federal Facilities, Enforcement and Emergency Response programs.

SEMSARCH Superfund Enterprise Management System Archived Site Inventory

VERSION DATE: 03/16/16

The Superfund Enterprise Management System Archive listing (SEMS-ARCHIVE) has replaced the CERCLIS NFRAP reporting system in 2015. This listing reflect sites that have been assessed and no further remediation is planned and is of no further interest under the Superfund program.

DOD Department of Defense Sites

VERSION DATE: 06/21/10

This information originates from the National Atlas of the United States Federal Lands data, which includes lands owned or administered by the Federal government. Army DOD, Army Corps of Engineers DOD, Air Force DOD, Navy DOD and Marine DOD areas of 640 acres or more are included.

FUDS Formerly Used Defense Sites

VERSION DATE: 06/01/15

The Formerly Used Defense Sites (FUDS) inventory includes properties previously owned by or leased to the United States and under Secretary of Defense Jurisdiction, as well as Munitions Response Areas (MRAs). The remediation of these properties is the responsibility of the Department of Defense. This data is provided by the U.S. Army Corps of Engineers (USACE), the boundaries/polygon data are based on preliminary findings and not all properties currently have polygon data available. DISCLAIMER: This data represents the results of data collection/processing for a specific USACE activity and is in no way to be considered comprehensive or to be used in any legal or official capacity as presented on this site. While the USACE has made a reasonable effort to insure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either expressed or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. For additional information on Formerly Used Defense Sites please contact the USACE Public Affairs Office at (202) 528-4285.

NLRRCRAC No Longer Regulated RCRA Corrective Action Facilities

VERSION DATE: 02/09/16

This database includes RCRA Corrective Action facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements.

NPL National Priorities List

VERSION DATE: 12/15/15

This database includes United States Environmental Protection Agency (EPA) National Priorities List sites that fall under the EPA's Superfund program, established to fund the cleanup of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action.

PNPL Proposed National Priorities List

VERSION DATE: 07/22/15

This database contains sites proposed to be included on the National Priorities List (NPL) in the Federal Register. The United States Environmental Protection Agency investigates these sites to determine if they may present long-term threats to public health or the environment.

RCRAC Resource Conservation & Recovery Act - Corrective Action Facilities

VERSION DATE: 02/09/16

This database includes all hazardous waste sites with ongoing corrective action activity and where corrective action is statutorily required to be address but have not had corrective action imposed in the RCRAInfo system. The Corrective Action Program requires owners or operators of RCRA facilities (or treatment, storage, and disposal facilities) to investigate and cleanup contamination in order to protect human health and the environment. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

RCRASUBC Resource Conservation & Recovery Act - Subject to Corrective Action Facilities

VERSION DATE: 02/09/16

This database includes hazardous waste sites which are potentially subject to corrective action regardless of whether they have correction action underway, plus any sites showing a corrective action event of RFI or beyond in the RCRAInfo system. Sites conducting corrective action under analogous state authorities are also included. The United States Environmental Protection Agency defines RCRAInfo as the comprehensive information system which provides access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS) and the Biennial Reporting System (BRS).

RODS Record of Decision System

VERSION DATE: 07/01/13

These decision documents maintained by the United States Environmental Protection Agency describe the chosen remedy for NPL (Superfund) site remediation. They also include site history, site description, site characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, and scope and role of response action.

AIRS Permitted Air Facilities

VERSION DATE: 03/31/16

This database contains facilities with air permits issued by the by the Minnesota Pollution Control Agency. These permits identify the units at each facility that generate air pollutants and, where applicable, the limits on those emissions. In some cases a permit may also authorize construction or modification of a facility.

CDL Clandestine Drug Laboratory Locations

VERSION DATE: 03/30/16

This listing of clandestine methamphetamine laboratories is provided by the Minnesota Department of Health. Each meth lab, spill or dump is a potential hazardous waste site, requiring assessment and remediation by experienced and qualified personnel. Former meth lab sites are being cleaned (or remediated) in many Minnesota communities. In these communities, the cleanups are being guided by city and county ordinances, local housing laws, and Minnesota Statute 145A, the Public Health Nuisance Statute.

IC Sites with Institutional Controls

VERSION DATE: 02/18/16

Institutional controls are defined by Minnesota Statute, Section 115B.02, subdivision 9a, as legally enforceable restrictions, conditions, or controls on the use of real property, ground water, or surface water located at or adjacent to a facility where response actions are taken that are reasonably required to assure that the response actions are protective of public health or welfare or the environment. Institutional controls include restrictions, conditions, or controls enforceable by contract, easement, restrictive covenant, statute, ordinance, or rule, including official controls such as zoning, building codes, and official maps. An affidavit required under section 115B.16, subdivision 2, or similar notice of a release recorded with real property records is also an institutional control.

PCASPILLS Spills Listing

VERSION DATE: 03/01/16

The Minnesota Pollution Control Agency's Emergency Response Team maintains this listing of reported petroleum product, hazardous substance, and/or other spills.

SWUP Solid Waste Utilization Projects

VERSION DATE: 03/31/16

According to the Minnesota Pollution Control Agency, a solid waste utilization project uses certain wastes in a new way to recycle the material instead of putting it into a landfill. An example is using tires to create furniture. The beneficial use of waste products saves landfill capacity for materials that do not have alternative uses. By using solid waste, individuals and organizations can reduce disposal costs, or even generate profit through the sale of materials that have a beneficial use.

TIERII Tier Two Facility Listing

VERSION DATE: 09/02/15

The Minnesota Department of Public Safety's Emergency Planning and Community Right-to-Know Act Program (EPCRA) maintains this listing of Tier Two facilities which store hazardous chemicals on-site. These facilities subject to EPCRA reporting submit Tier II forms which provide information such as the Material Safety Data Sheet (MSDS) chemical or common name, emergency contact information, approximate amount of chemical stored, along with the location of the chemical at the facility.

FEEDLOT Feedlots

VERSION DATE: 04/01/16

Feedlots may be small farms or large-scale commercial livestock operations. They are places where animals are confined for feeding, breeding or holding. The Minnesota Pollution Control Agency (MPCA) and its county partners place requirements on how manure is managed at feedlots, so that it does not contaminate nearby surface water and groundwater.

HWGS Hazardous Waste Generator Sites

VERSION DATE: 09/24/15

The Minnesota Pollution Control Agency (MPCA) provides this list of active and inactive Hazardous Waste Generator Sites, including large quantity and small to minimal quantity generators. A large quantity generator (LQG) is a facility that generates at least 1,000 kilograms (2,200 pounds) of hazardous waste or 1 kilogram (2.2 pounds) of acutely hazardous waste per calendar month. An MPCA permit is not required for a large quantity generator, but the facility must have a current hazardous waste license. A small to minimal quantity generator is a facility that generates less than 1,000 kilograms (2,200 pounds) of hazardous waste or 1 kilogram (2.2 pounds) of acutely hazardous waste per calendar month. These facilities have less stringent rules than large quantity generators. This group includes Small Quantity Generators (SQGs), which produce 100 - 1000 kg of hazardous waste per month; Very Small Quantity Generators (VSQGs), which produce less than 100 kg of hazardous waste per month; and Conditionally Exempt Generators, which produce less than 100 kg or 10 gallons of hazardous waste per year. Like large quantity generators, SQGs and VSQGs must have current hazardous waste licenses.

WDP Water Discharge Permits

VERSION DATE: 04/01/16

This Minnesota Pollution Control Agency (MPCA) database includes the following types of water permits: Construction Stormwater Permits, Construction Stormwater Site Subdivisions, Industrial Stormwater Permits, MS4 Projects, and Wastewater Dischargers. A construction stormwater permit is designed to limit pollution during and after construction by controlling the erosion associated with construction activities. A construction stormwater site subdivision is a site where a construction project with an existing stormwater permit has been sub-divided into smaller parcels. Industrial stormwater permits are designed to limit the amount of harmful contaminants that reach surface water and groundwater, by requiring good practices for storing and handling materials. A Municipal Separate Storm Sewer System (MS4) is a system of conveyances - such as gutters, ditches, city streets and storm drains - which is used as a path for stormwater. Regulated MS4s cover large areas, and are owned or operated by a public entity such as a city, county, township, watershed district or university. A wastewater discharger is a facility that generates or treats wastewater for discharge onto land or into water.

BULKSTORAGE Bulk Storage Permits

VERSION DATE: 03/24/16

The Minnesota Department of Agriculture's Licensing Information System (LIS) lists individuals or companies who hold licenses, certificates and/or permits required by state law and regulated by the Department. This database only contains those LIS licenses related to anhydrous ammonia storage facilities and bulk pesticide/ fertilizer storage facilities. Please note the data is real time and therefore constantly changing.

CLEANERS Registered Drycleaning Facilities

VERSION DATE: 10/05/10

The Minnesota Pollution Control Agency maintains this listing of registered dry cleaning facilities.

UAST Registered Storage Tanks

VERSION DATE: 03/01/16

The Registered Storage Tanks Database provides information on aboveground and underground storage tanks registered with the Minnesota Pollution Control Agency. Owners of USTs and ASTs with a capacity of 500 gallons or more which contain petroleum or hazardous substances must notify the MPCA of the existence of these tanks. Tanks not subject to notification include farm and residential motor fuel tanks less than 1,100 gallons; heating oil tanks less than 1,100 gallons; flow-through process tanks; septic tanks; and agricultural chemical tanks.

AGSPILLS Agricultural Spills Listing

VERSION DATE: 03/30/16

This list of reported spill incidents is provided by the Minnesota Department of Agriculture (MDA). The MDA is the lead agency for response to, and cleanup of, agricultural chemical contamination (pesticides and fertilizers) in Minnesota. The MDA has grouped these spills into three categories: Old Emergencies, Small Spills and Investigations, and Investigations Boundaries. Old Emergencies represent emergencies which were closed prior to March 1, 2004. These files and the locations plotted have not been reviewed for accuracy and completeness. Smalls Spills and Investigations represent the location of small spills and investigations, which were closed after March 1, 2004. Investigation Boundaries represent the approximate extent of large spills and other types of facility investigations. Facility Investigations are further subdivided into the following program areas: Awaiting Prioritization Investigation files of known or potential agricultural chemical contamination that are waiting to be prioritized; Prioritized Investigation files of known or potential agricultural chemical contamination that have been prioritized and are awaiting activation; Comprehensive Facility Investigation / MERLA Investigation files of known or potential agricultural chemical contamination that have been activated in MDA's Comprehensive Facility Investigation Program or are active Superfund sites under MDA's oversite; AgVIC Investigation files of known or potential agricultural chemical contamination that have enrolled in the MDA's Agricultural Voluntary Investigation and Cleanup (AgVIC) Program; and Agricultural Chemical Emergency Response Investigation files that were reported as emergency spills of agricultural chemicals and are large enough in size to be represented by a polygon.

CAFO Concentrated Animal Feeding Operations

VERSION DATE: 11/19/15

A Concentrated Animal Feeding Operation (CAFO) is any feeding operation with a capacity of 1,000 or more animal units according to federal animal unit calculations. The Minnesota Pollution Control Agency can also define a facility with less than 1,000 animal units as a CAFO on a case-by-case basis, depending on site conditions, and if manure or process wastewater is directly discharged to waters of the state. Facilities that are CAFOs must comply with both federal regulations and state rules. Two or more feedlots under common ownership are considered a single facility if they adjoin each other or use the same manure storage or disposal system.

CERCLIS CERCLIS Sites

VERSION DATE: 03/31/16

CERCLIS sites are places that are listed in the federal Comprehensive Environmental Response, Compensation and Liability Information System. This means that they are or were suspected of being contaminated. The CERCLIS database contains information on preliminary assessments, site inspections, and cleanup activities for these sites. After CERCLIS sites are investigated, they may be elevated to state or federal Superfund lists, or it may be determined that no action is necessary. This database is provided by the Minnesota Pollution Control Agency.

CLF Closed Landfills

VERSION DATE: 03/25/16

The Minnesota Pollution Control Agency Closed Landfill Program (CLP) is a voluntary program established by the legislature in 1994 to properly close, monitor, and maintain Minnesota's closed municipal sanitary landfills. Any MPCA-permitted mixed-municipal solid waste landfill that stopped accepting mixed municipal solid waste (MMSW) by April 9, 1994, and demolition debris before May 1, 1995, can qualify for application to this program.

CONTINGENCIES Agricultural Contingency Sites

VERSION DATE: 03/30/16

The Minnesota Department of Agriculture (MDA) Incident Response Unit (IRU) is the state lead agency for the investigation and remediation of incidents involving agricultural chemicals (pesticides and fertilizer). This MDA IRU database includes sites with a soil or ground water contingency, deed restriction, local ordinance, restrictive covenant or deed affidavit in place. The accuracy of these sites can be variable. In most cases, the site boundaries should be considered as only representing the vicinity of the soil or ground water contingency area or plume.

HWSTSD Hazardous Waste Treatment Storage Disposal Sites

VERSION DATE: 09/24/15

A hazardous waste Treatment Storage and /or Disposal facility (TSD) is any business designed to treat, store and / or dispose of hazardous waste. These facilities typically collect hazardous wastes for other businesses and treat it or dispose of it properly. TSD facilities must have valid operating permits issued by the Minnesota Pollution Control Agency (MPCA). This means that they are required to develop detailed plans to train and protect their workers and the environment. This database contains active and inactive TSD facilities.

LUAST Registered Leaking Storage Tanks

VERSION DATE: 03/01/16

The Minnesota Pollution Control Agency maintains this listing of leaking aboveground and underground storage tanks. Tank owners are required to immediately report a leak or spill of more than five gallons of petroleum, or any amount of a hazardous substance, from any tank or piping. All leaks and spills from USTs and ASTs and associated piping must be cleaned up to protect the environment and public health.

PBF Petroleum Brownfields Program Sites

VERSION DATE: 03/30/16

This listing of Petroleum Brownfield sites, including those with Development Response Action Plans dated between 2008 and 2012, is provided by the Minnesota Pollution Control Agency (MPCA). The Petroleum Brownfields Program (formerly VPIC) provides the technical assistance and liability assurance needed to facilitate and expedite the development, transfer, investigation and/or cleanup of property that is contaminated with petroleum. Even after cleanup or MPCA file closure most properties will have contamination remaining. State law requires that persons properly manage contaminated soil and water they uncover or disturb - even if they are not the party responsible for the contamination. Property owners, purchasers or developers of property where contaminated soil or water might be encountered may include provisions - called "response actions" - in development plans describing how petroleum contaminated soil and water will be managed if encountered. For some properties, special construction might be needed to prevent the further spreading of the contamination and/or to prevent petroleum vapors from entering buildings or utility access shafts.

PBRLF Permitted By Rule Landfills

VERSION DATE: 03/30/16

According to the Minnesota Pollution Control Agency, a landfill that is permitted by rule is not required to obtain an individual solid waste permit if it meets certain eligibility criteria. However, it must comply with waste management rules and regulations. Landfills may be permitted by rule if they have a small capacity and/or operate for a short period of time.

PVICP Potential Voluntary Investigation and Cleanup Program Sites

VERSION DATE: 02/18/16

This listing of Potential Voluntary Investigation and Cleanup Program sites is provided by the Minnesota Pollution Control Agency. These potential sites have not yet entered into the VIC Program until an application has been received at the MPCA.

RECYCLERS Recycling Markets Directory

VERSION DATE: 02/14/13

The Recycling Markets Directory is provided by the Minnesota Pollution Control Agency. The markets in this database accept large (commercial) quantities of materials.

SRS Site Response Section Database

VERSION DATE: 02/18/16

The Minnesota Pollution Control Agency (MPCA) is involved in remediation activities through various programs. Remediation is the process of cleaning up pollution in the soil, water or air. The pollution can result from an accidental spill or from activities that occur over a long time. This MPCA database includes remediation sites from the Superfund, Voluntary Investigation and Cleanup, Brownfields, Resource Conservation and Recovery Act, Tanks, Landfills, and Emergency Response Programs.

SWF Open Solid Waste Facilities

VERSION DATE: 03/25/16

Open landfills are regulated by Minnesota Rules 7001 and 7035. They actively accept, under the terms and conditions of a Minnesota Pollution Control Agency permit, certain types of wastes for disposal. They are part of a larger and integrated collection of open solid waste management facilities that process, transfer and receive waste for disposal in Minnesota. Open landfills fall into several categories, which include: demolition, industrial, mixed municipal and municipal waste combustor ash.

UNPERMDUMPS Unpermitted Dump Sites

VERSION DATE: 03/31/16

Unpermitted dump sites are landfills that never held a valid permit from the Minnesota Pollution Control Agency (MPCA). Generally, these dumps existed prior to the permitting program established with the creation of the MPCA in 1967. These dumps are not restricted to any type of waste, but were often old farm or municipal disposal sites that accepted household waste. State assessment staff have investigated many of these dump sites.

VICP Voluntary Investigation and Cleanup Program Sites

VERSION DATE: 02/18/16

The Voluntary Investigation and Cleanup (VIC) Program site listing is provided by the Minnesota Pollution Control Agency. This program encourages timely property transactions by reducing potential health or environmental risks from contamination and promoting the redevelopment of these properties.

CSTF Contaminated Soil Treatment Facilities

VERSION DATE: 03/31/16

Contaminated soil treatment facilities are places that the Minnesota Pollution Control Agency (MPCA) has approved or permitted to take petroleum-contaminated soils from leak sites and provide treatment through a number of different processes. The processes include thermal treatment (usually by roasting soils at high temperatures), composting, or thin-spreading soils and allowing natural microorganisms to biodegrade the petroleum.

HWCS Hazardous Waste Cleanup Sites

VERSION DATE: 02/18/16

Soil and or groundwater cleanup under RCRA Corrective Action is conducted by the Site Remediation Division of the Minnesota Pollution Control Agency. The Hazardous Waste Treatment, Storage, or Disposal Facilities enter the RCRA corrective action program through the permitting process. Interim Status Facilities enter the RCRA Correction Action Program through a negotiated process initiated by the MPCA (these facilities at one time applied for a RCRA treatment, storage and or disposal permit, but did not complete the permitting process). Hazardous Waste Generators usually enter the RCRA remediation program through evidence of suspected releases to soil and or ground water from improper management of hazardous wastes or hazardous constituents uncovered during hazardous waste inspections conducted by state, county or city inspectors.

SAS State Assessment Sites

VERSION DATE: 04/06/16

State Assessment sites are places that Minnesota Pollution Control Agency (MPCA) Site Assessment staff have investigated because of suspected contamination. The sites investigated include abandoned industrial properties, small commercial businesses and publicly-owned land. (Note that petroleum-contaminated sites are investigated by MPCA Tanks and Leaks staff.) These sites may be referred to the Site Assessment program by the Voluntary Investigation and Cleanup (VIC) program, the Petroleum Remediation program, Minnesota Duty Officer reports or citizen complaints. Site Assessment staff do an initial assessment, and then determine if further action is needed. If a site poses a threat to human health or the environment, it is referred to CERCLIS, Superfund, RCRA Cleanup or VIC.

SF Superfund Site Information Listing

VERSION DATE: 02/18/16

The Minnesota Pollution Control Agency's Superfund Program identifies, investigates and determines appropriate cleanup plans for abandoned or uncontrolled hazardous waste sites where a release or potential release of a hazardous substance poses a risk to human health or the environment. Superfund does not deal with Resource Conservation and Recovery Act (RCRA) sites or petroleum storage tank releases.

USTR05 Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/15

This database, provided by the United States Environmental Protection Agency (EPA), contains underground storage tanks on Tribal lands located in EPA Region 5. Region 5 includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

LUSTR05 Leaking Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/15

This database, provided by the United States Environmental Protection Agency (EPA), contains leaking underground storage tanks on Tribal lands located in EPA Region 5. Region 5 includes the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

ODINDIAN Open Dump Inventory on Tribal Lands

VERSION DATE: 11/08/06

This Indian Health Service database contains information about facilities and sites on tribal lands where solid waste is disposed of, which are not sanitary landfills or hazardous waste disposal facilities, and which meet the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944).

INDIANRES Indian Reservations

VERSION DATE: 01/01/00

The Department of Interior and Bureau of Indian Affairs maintains this database that includes American Indian Reservations, off-reservation trust lands, public domain allotments, Alaska Native Regional Corporations and Recognized State Reservations.

Appendix E

Previous Investigations of Property (None Available)

Appendix F

Interview Documentation

PHASE I ENVIRONMENTAL SITE ASSESSMENT
USER QUESTIONNAIRE FORM

Property : Riley Creek – between Dell Rd and Eden Prairie Road **Interviewer:** N/A

Project No.: 23270053.14 014 005 **Date:** May 31, 2016

User Information:

Name: Claire Bleser Tel. No.: 952-294-5976

Position Title & Co. RPBCWD Administrator Connection to Property: ______

Introduction

In order to qualify for one of the Landowner Liability Protections (LLPs) offered by the Small Business Liability Relief and Brownfields Revitalization Act of 2001 (the "Brownfields Amendments"), the user must provide the following information (if available) to the environmental professional that will conduct the Environmental Site Assessment (ESA). Failure to provide this information could result in a determination that "all appropriate inquiry" is not complete. If your goals include protections afforded by the Act, you should consult with legal counsel as to your responses.

1. Why is the Phase I required and who will rely on the Phase I report (please list lending institutions if they wish to rely on the Phase I ESA)?

To evaluate potential environmental conditions in support of planned creek stabilization project.

2. Are you aware of any environmental cleanup liens against the Property that are filed or recorded under federal, tribal, state, or local law? If, yes, please describe.

No

3. Are you aware of any activity and use limitations*, such as engineering controls, land use restrictions or institutional controls that are in place at the Property or have been filed or recorded in a registry under federal, tribal, state or local law? If yes, please describe.

No

4. As the user of this ESA, do you have any knowledge or experience related to the Property or nearby properties? For example, are you involved in the same line of business as the current or former occupants of the Property or

*activity and use limitations —legal or physical restrictions or limitations on the use of, or access to, a property: (1) to reduce or eliminate potential exposure to hazardous substances or petroleum products in the soil or ground water on the property, or (2) to prevent activities that could interfere with the effectiveness of a response action, in order to ensure maintenance of a condition of no significant risk to public health or the environment. These legal or physical restrictions, which may include institutional and/or engineering controls, are intended to prevent adverse impacts to individuals or populations that may be exposed to hazardous substances and petroleum products in the soil or ground water on the property.

an adjoining property so that you would have knowledge of the chemicals and processes used by this type of business? If yes, please describe.

No

5. Does the purchase price being paid for this Property reasonably reflect the fair market value of an uncontaminated property? If you conclude that there is a difference, have you considered whether the lower purchase price is because contamination is known or believed to be present at the Property?

NA

6. Are you aware of information about the Property that would help the environmental professional to identify conditions indicative of releases or threatened releases or hazardous substances or petroleum products? For example, as user:

a. Do you know the past uses of the Property? If yes, please explain.

No

b. Do you know of specific chemicals that are present or once were present at the Property? If yes, please explain.

No

c. Do you know of spills or other chemical releases that have taken place the Property? If yes, please explain.

No

d. Do you know of any environmental cleanups that have taken place at the Property? If yes, please explain.

No

7. As the user of this ESA, based on your knowledge and experience related to the Property, are there any indicators that point to the presence or likely presence of contamination at the Property?

No

8. Do any of the following documents exist for the Property? If so, please provide a copy to Barr either prior to, or at the time of, the site reconnaissance.

Document type	*Exists – yes or no*	*Comments*
Environmental site assessment reports	*N*	

Document type	*Exists – yes or no*	*Comments*
Environmental compliance audit reports	N	
Environmental permits (for example, solid waste disposal permits, hazardous waste disposal permits, wastewater permits, NPDES permits, underground injection permits)	N	
Registrations for underground and above-ground storage tanks	N	
Registrations for underground injection systems	N	
Material safety data sheets for chemicals used onsite	N	
Community right-to-know plan	N	
Safety plans; preparedness and prevention plans; spill prevention, countermeasure, and control plans; etc.	N	
Reports regarding hydrogeologic conditions on the Property or surrounding area	N	
Notices or other correspondence from any government agency relating to past or current violations of environmental laws with respect to the Property or relating to environmental liens encumbering the Property	N	
Hazardous waste generator notices or reports	N	
Geotechnical studies for building foundations, etc.	N	
Risk assessments	N	
Title search	N	
Boundary survey of the Property	N	

9. Do you know of:

i. Any pending, threatened, or past litigation relevant to hazardous substances or petroleum products in, on, or from the Property? If yes, please explain.

No

ii. Any pending, threatened, or past administrative proceedings relevant to hazardous substances or petroleum products in, on or from the Property? If yes, please explain.

No

iii. Any notices from any governmental entity regarding any possible violation of environmental laws or possible liability relating to hazardous substances or petroleum products associated with the Property? If yes, please explain.

No

Appendix G

Qualifications

Appendix G
Qualifications

Company Information

Barr provides a wide range of engineering and scientific consulting services. Barr traces its origins to the early 1900s, and was incorporated as an employee-owned firm in 1966. Our company, which is based in Minneapolis, has gained the confidence of clients throughout the upper Midwest and the nation, including industries, utilities, law firms, and all levels of government.

Barr has branch offices in Duluth and Hibbing, Minnesota; Jefferson City, Missouri; Ann Arbor, Michigan, and Bismarck, North Dakota. Drawing upon skills in more than two dozen technical areas, our staff is able to form multidisciplinary teams to meet those needs in the areas of:

- Solid and hazardous waste management and site remediation
- Water resources management
- Environmental management
- Air quality
- Process and materials handling
- Facilities and infrastructure engineering
- Information technology

Barr employs approximately 750 engineers, scientists, and support staff in the following disciplines:

Engineering/Design	Science	Support Services
Agricultural	Atmospheric Science	Accounting
Architectural	Biology	Computer Science
Chemical	Biochemistry	Drafting/Graphics
Civil	Chemistry	Field Operations
Electrical	Data QA/QC	Laboratory Operations
Environmental	Epidemiology	Library Science
Geologic	Forestry	Information Management
Geotechnical	Geochemistry	Public Relations
Hydraulic	Geology	Surveying
Hydrologic	Geophysics	Technical Writing
Mechanical	Hydrogeology	Word Processing
Structural	Industrial Hygiene	
Water Resources	Public Health	
	Soil Science	
	Toxicology	

Barr uses a project team approach that matches our expertise with the unique requirements of each project. Overall responsibility for each project is maintained by an officer of the company. Barr uses computer and data processing systems to manage and monitor budgets, staff workloads, and billings for all projects.

Quality control on each project is the responsibility of every member of the project team. Reports, designs, and specifications are prepared to meet the client's requirements. Barr's quality assurance program includes:

- Obtaining clear and complete understanding of the client's needs
- Communication among team members and with the client as work progresses
- Peer review as the work progresses
- Evaluation of completed documents for technical accuracy and cost-effectiveness

Qualifications and Experience – Environmental Site Assessments

Barr conducts environmental site assessments for a wide variety of clients involved in property and business transactions. Clients include cities, attorneys, developers, and private and public parties interested in selling, purchasing, or redeveloping property.

Barr has specialized in the investigation and design of remedial actions for contaminated sites since the early 1970s. Our company has completed hundreds of site investigations, feasibility studies, and remedial action designs. This experience includes work on most of the larger contaminated sites in Minnesota as well as numerous smaller sites. Barr has been a primary consultant on about two-thirds of the EPA National Priority List sites in Minnesota and has been involved in either a primary or secondary role on about half of the sites listed by the state of Minnesota. Barr's work on virtually all of these sites has been on behalf of potentially responsible parties. We have worked on contaminated sites in many other states as well.

Many projects are initiated by clients who are buying or selling property or who are required to conduct an environmental site assessment for financing purposes. Other projects are initiated by clients who suspect that contamination may be present on a site. Still other projects are in response to orders from regulatory agencies. Many of these projects involve a state voluntary cleanup program. Barr works for clients in both the public and private sectors, and clients range from major industries to state and federal agencies.

Barr has worked on a variety of properties, including:

- Steel and coke manufacturing
- Wood treating
- Petroleum refining
- Manufacturing (paint waste/spent solvents)
- Coal gasification
- Mining and mineral processing
- Petroleum product storage (above and below ground)
- Metal plating
- Scrapyards
- Landfills
- Fly and bottom ash
- Permitted and nonpermitted waste disposal facilities

Barr staff is familiar with a wide range of industrial practices and we provide environmental and waste management consulting to many industries. The resumes of the specific Barr staff who worked on this Assessment are included in the following pages.

MARY SANDS
Vice President, Senior Chemical Engineer

BARR

Experience

Mary Sands has 31 years of experience as an environmental consultant. Mary's experience includes brownfields investigation and remediation, all phases of environmental due diligence, multi-media compliance audits, and cost engineering for environmental liability assessment. Her clients have included attorneys, developers, corporate real-estate managers, Native American tribes, universities, and others associated with property development. Mary has managed the investigation of numerous sites with hazardous-substance, petroleum, and agricultural contamination in the soil and groundwater. Prior to joining Barr, Mary served as a principal for another firm. Her work there included:

- Serving on environmental due-diligence teams made up of attorneys, lenders, and corporate officials on commercial and industrial merger and acquisition projects. These involved compliance audits, projects file reviews, Phase I and Phase II environmental site assessments (ESAs), and preparation of detailed capital and operation and maintenance (O&M) cost estimates to address future environmental liabilities associated with wastewater treatment, air-pollution control, solid and hazardous waste treatment and disposal, and soil and groundwater remediation.
- Directing numerous Phase I ESAs, transaction screen questionnaires, and Phase II subsurface investigations in accordance with ASTM guidelines to identify potential environmental liabilities prior to property transfer, foreclosure, or refinancing at industrial, commercial, residential, and underdeveloped land across the country. Phase I activities consisted of historical research of past uses and activities, regulatory file searches, site visits, and reports. Phase II activities typically included soil or groundwater sampling to confirm the presence or absence of contamination.
- Managing a brownfield redevelopment project for the City of Roseville, Minnesota, which received two brownfield-assessment demonstration pilot grants from the U.S. Environmental Protection Agency (USEPA). The initial grant project involved a comprehensive environmental assessment, Phase II soil and groundwater investigation, and remedial action plan for a trucking-terminal corridor. The supplemental grant project involved performing an area-wide groundwater evaluation.
- Serving as program coordinator for assisting Native American tribes in Michigan, Minnesota, and Wisconsin in implementing their brownfield programs. This has included preparing quality assurance project plans (QAPPs) and sampling and analysis plans (SAPs) and implementing these plans to investigate perchlorates associated with former fireworks handling, general maintenance activities, lumberyard operations, and dump sites.

Education

MBA, Business Administration, University of Minnesota, 1994

BS, Chemical Engineering, University of Minnesota, 1984

Certification

40-hour HAZWOPER training (1987) with annual 8-hour refresher training

ELIZABETH MAHER
Project Assistant

BARR

Experience

Liz Maher has more than four years of experience with projects related to investigation and remediation of contaminated sites. Relevant examples of her work at Barr include:

- Performing primary components (site reconnaissance, historic and regulatory review, and report writing) of multiple Phase I environmental site assessments and file reviews for a variety of industrial, commercial, and residential sites in Minnesota, Wisconsin, Missouri, and Kansas in accordance with the ASTM E-1527-13 standard. These sites have ranged from a city parcel in downtown Minneapolis to an 80-acre farm field in rural Wisconsin.
- Conducting a complex Phase I environmental site assessment of a 1.5-mile creek corridor in Minneapolis for the Bassett Creek Watershed Management Commission. This assessment was part of a feasibility study for a creek bank stabilization project. Using a web-based mapping tool, seven known areas of concern were identified within the corridor.
- Providing assistance in the completion of 20 Phase I environmental site assessments within one month for a confidential client in Missouri.
- Assisting with an area-wide groundwater study in the approximately 230-acre Bassett Creek Valley redevelopment area of Minneapolis for Hennepin County. Responsibilities included developing the summary format and compiling information for more than 200 sites.
- Assisting with a complex vapor intrusion investigation and mitigation project in Minnesota for a confidential client. Responsibilities included maintaining a property-owner database for large-scale residential sampling and mitigation; preparing and reviewing property owner communications and regulatory status updates; and managing access agreements for more than 300 properties.
- Providing assistance on an engineering and permitting project for a confidential industrial sand client in Wisconsin. Responsibilities included scheduling residential well inspections, serving as contact for property owners for a proposed industrial sand mine, and maintaining a property-owner database.
- Reviewing investigation work plans, field sampling plans, quality assurance plans, and other reports and deliverables for completeness, consistency, and clarity.
- Coordinating communications, meetings, and events between project team members and clients.
- Creating graphics and geological cross sections using Adobe InDesign and Illustrator.

Education

BA, Journalism (Spanish Studies minor), University of Minnesota-Twin Cities, 2011

Training

Phase I Environmental Site Assessment Practices for Commercial Real Estate: Phase I Site Assessment and Transaction Screen (ASTM Training), 2014

Appendix G

Phase I Archaeological Survey for Riley Creek Bank Stabilization Feasibility Study

Phase I Archaeological Survey for Riley Creek Bank Stabilization Feasibility Study, Hennepin County, Minnesota

[DRAFT]

By
Timothy A. Tumberg, PhD, RPA
Principal Investigator
10,000 Lakes Archaeology, Inc.
South St. Paul, Minnesota

Prepared for
Barr Engineering Co.
4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
Contract No. W912ES-07-T-0202

July 18, 2016

Management Summary

In June 2016 Barr Engineering contracted 10,000 Lakes Archaeology Inc. to conduct a Phase I archaeological survey as part of a feasibility study for stabilizing the creek and stream banks on three distinct portions of Riley Creek in Eden Prairie, MN. The survey included a literature search to identify previously documented archaeological sites in the project area vicinity and a field investigation to identify any previously undocumented sites in the project area. Results of the investigation revealed that the project area is in an archaeologically sensitive region but it is unlikely that the proposed project will adversely affect any significant cultural resources and the project should be allowed to proceed as planned.

Introduction

In June 2016 Barr Engineering Co. contracted 10,000 Lakes Archaeology Inc. to conduct a Phase I archaeological survey as part of a feasibility study for stabilizing the creek and stream banks on three distinct portions of Riley Creek in the City of Eden Prairie in the westernmost part of Hennepin County, MN. This report presents the survey results and includes the results of a background literature search conducted to identify previously documented archaeological sites in the project area vicinity as well as a description of the field methods employed and the results of the field investigation.

The Riley Creek project area is located in the W½ of Section 29 and the NW¼ of Section 33, T116N, R22W. The three areas subject to survey include an approximately 4,000-foot section identified as the E-segments Reach, a ravine identified as Point D3 that extends northwesterly off the main channel, and an approximately 2,000-foot Lower Reach section that extends generally southeasterly from the south side of Flying Cloud Drive to Grass Lake (Figure 1). Principal Investigator Timothy A. Tumberg and field technician Ryan P. Grohnke conducted pedestrian visual surface reconnaissance of the entire project area and identified the highest potential shovel test locations June 9, shovel tested the E-segments reach June 22 and shovel tested the Lower Reach segment June 28, 2016.

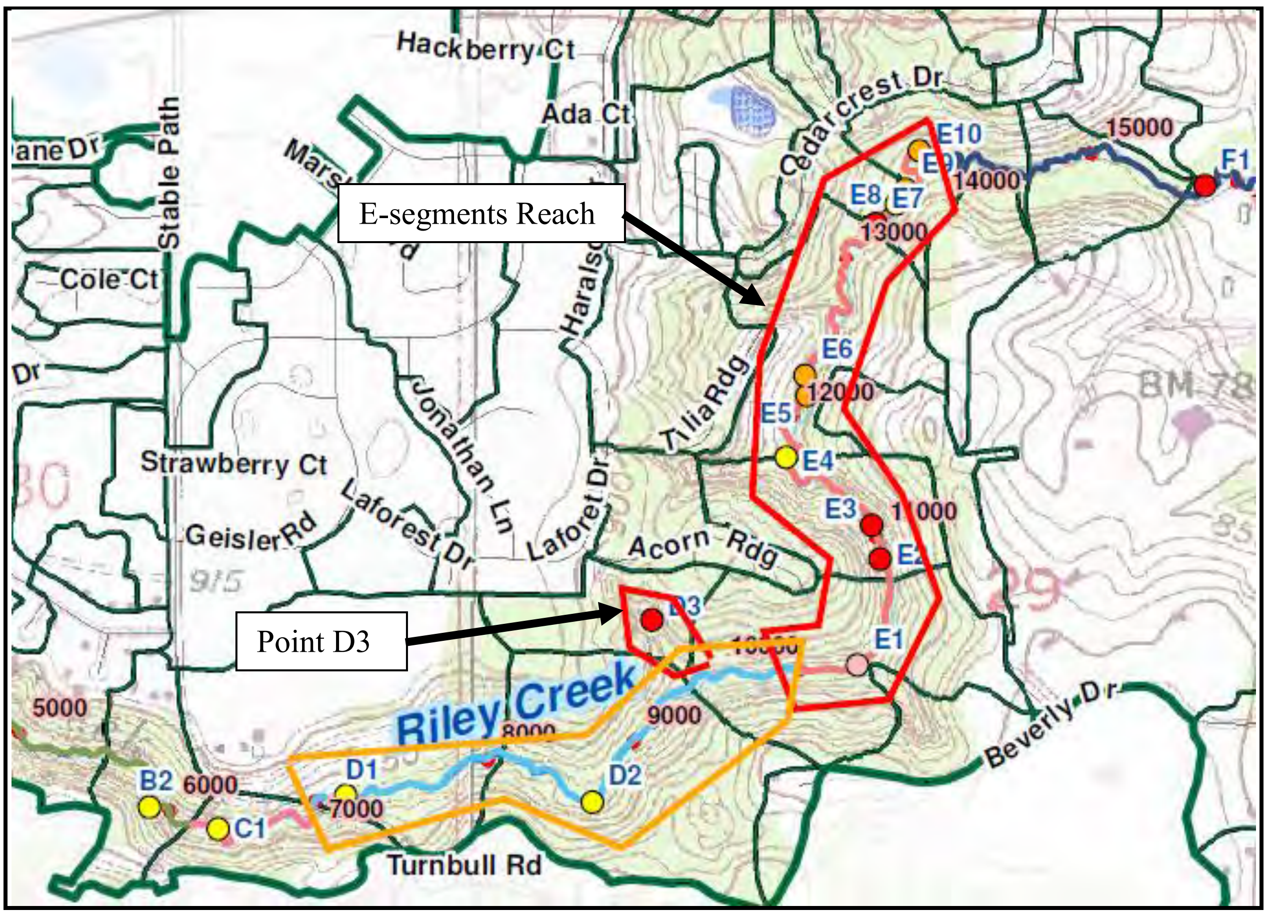


Figure 1: Location of the Riley Creek E-segments Reach and Point D3.

Background Research/Literature Review

The background research and literature review for this project consisted of examining the Minnesota State Archaeological Site Files at the Office of the State Archaeologist (OSA), the database files of the State Historic Preservation Office (SHPO), the A.T. Andreas *Illustrated Historical Atlas of the State of Minnesota*, and the J.W. Trygg *Composite Map of United States Land Surveyors Original Plats and Field Notes [Minnesota Series]*. This review revealed that there are 33 previously documented sites within one mile of the proposed project area (Figure 2).

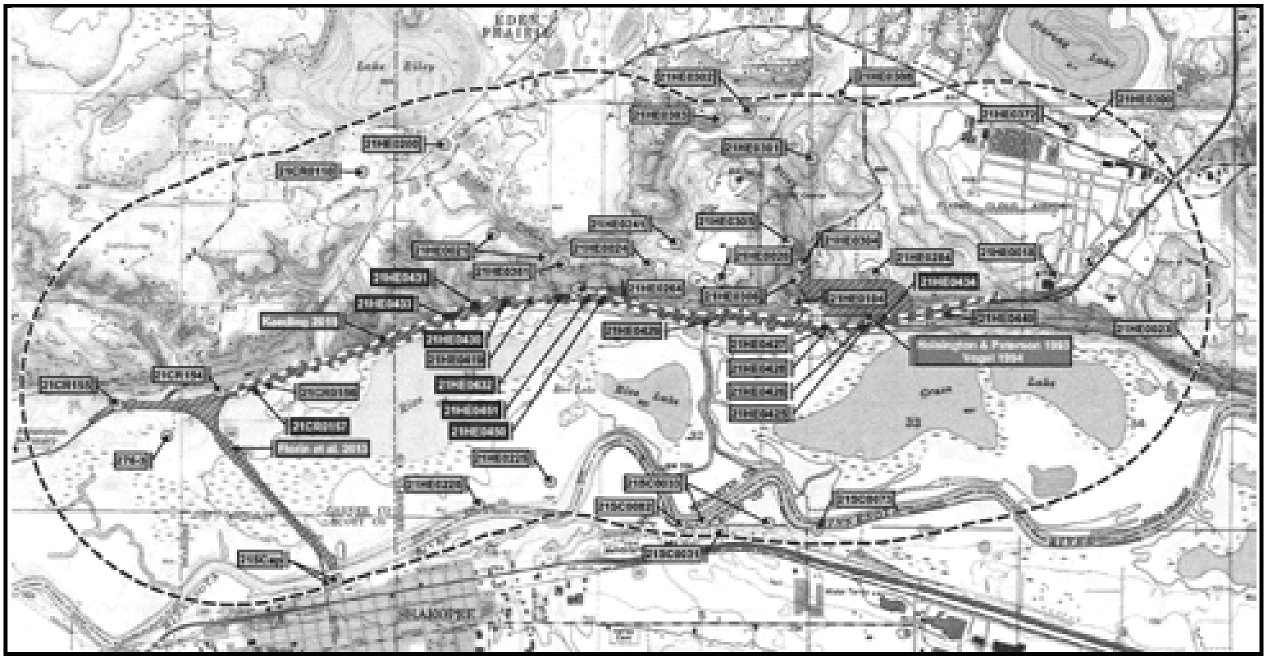


Figure 2: Previously documented sites within one mile of the Riley Creek project area (adapted from Kaeding 2015).

Field Review of the E-segments Reach

The E-segments Reach is covered by with mixed hardwoods and conifers and includes a generally sparse understory that provides moderate to good ground surface visibility even in the woods (Figures 3 and 4). In addition to the ground surface visibility, frequent exposed cut-banks alongside Riley Creek provide plentiful additional opportunities to conduct a visual pedestrian surface examination for cultural materials (Figures 5 and 6).

Topography throughout the E-segments Reach is dominated by steeply sloping ravines and valley walls that extend down from ridge-tops that parallel each side of Riley Creek down to the creek banks. The valleys are interspersed with a number of intermittent primary and secondary terraces situated some 10 feet to 25 feet above the water level respectively. The prevalence of steep-sided ravines combined with the high percentage of surface visibility obviated the need for a standard 50-foot shovel test grid but in order to define soil profiles, five shovel tests were excavated on either side of Riley Creek at selectively identified terrace locations that appeared to retain the highest potential for containing intact subsurface cultural features or deposits (Figure 7). Shovel tests measured 40cm in diameter and soil was screened through ¼" hardware cloth. No cultural materials other than those that can be reliably associated with present-day use of the area were identified in the E-segments Reach.

Figure 3: Exposed ground surface in the Riley Creek E-segments Reach on the east side of the creek. Photo by author, view to the north.

Figure 4: Exposed ground surface in the Riley Creek E-segments Reach on the west side of the creek. Photo by author, view to the northeast.

Figure 5: Exposed cut-bank in the Riley Creek E-segments Reach on the east side of the creek. Photo by author, view to the southwest.

Figure 6: Exposed cut-bank in the Riley Creek E-segments Reach on the west side of the creek. Photo by author, view to the east.

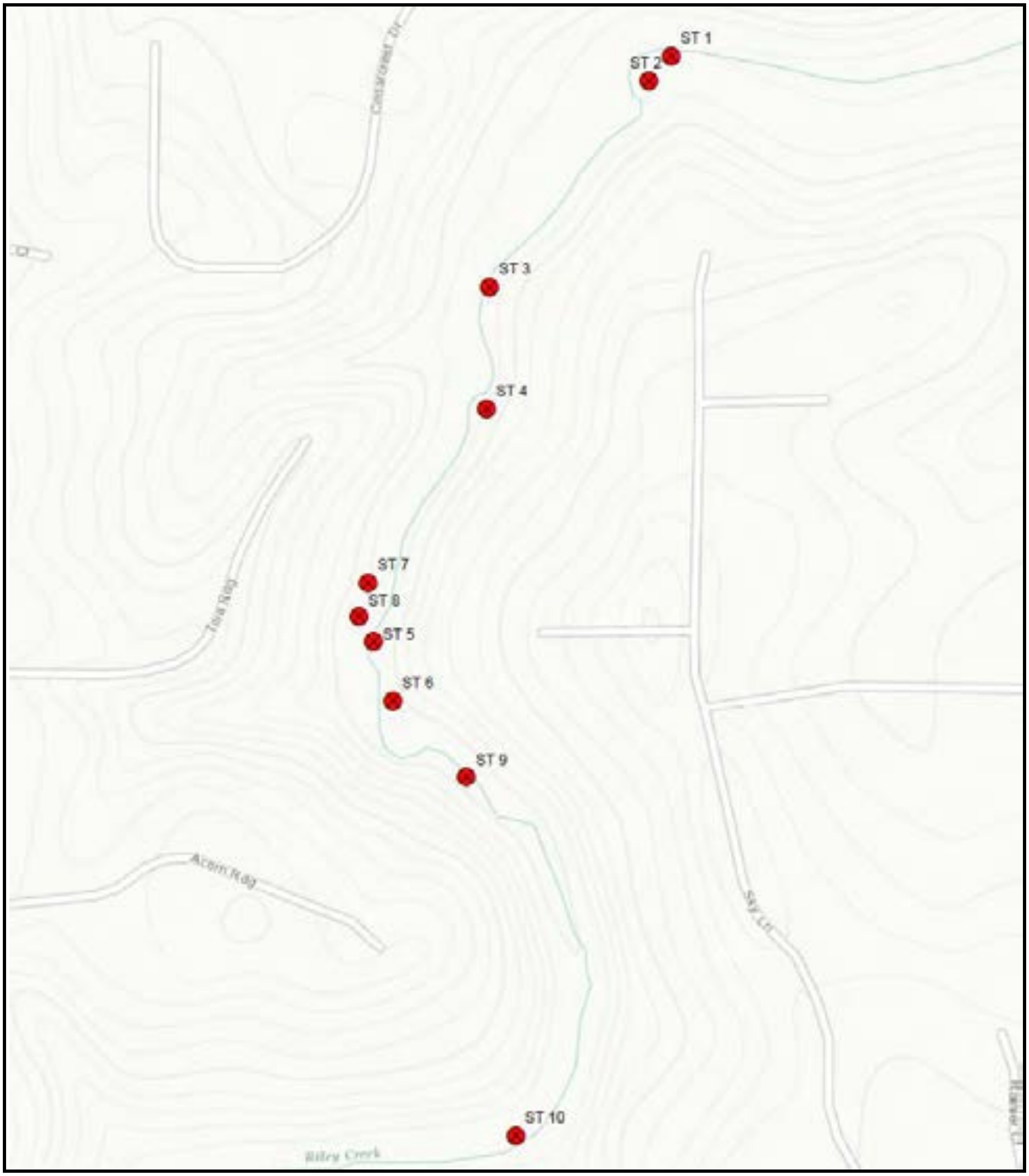


Figure 7: Locations of shovel tests excavated in the Riley Creek E-segments Reach.

Field Review of Point D3

The Point D3 project area comprises an irregularly shaped pentagon that measures up to a maximum of approximately 600 feet from northwest to southeast and up to 300 feet from southwest to northeast (Figure 1). Pedestrian visual reconnaissance revealed that the D3 section is encompassed by steeply sloped and minimally vegetated sidewalls (Figures 8 and 9). The degree of slope and the high percentage of exposed surface combined to negate the need for subsurface testing in the Point D3 area. No cultural materials were identified during the surface reconnaissance.

Figure 8: Riley Creek Point D3. Photo by author, view to northwest.

Figure 9: Riley Creek Point D3. Photo by author, view to northwest.

Field Review of the Lower Reach

The Lower Reach consists of a 2000-foot stretch of Riley Creek that extends generally southeasterly from Flying Cloud Drive to Grass Lake (Figure 10). The northernmost portion consists of mostly level fluvial terraces approximately 3-5 feet above water on both sides of the creek. The terraces are largely wooded but contain sparse understory and surface visibility is good to excellent along creek bank tops as well as along the exposed cut-banks on either side of the creek (Figure 11). Approximately 800 feet south of Flying Cloud Drive the generally southeasterly direction of Riley Creek curves to head virtually due east. At the directional change the terraces sink into a lower lying spongy mass of transitional wetland (Figure 12) and the southeastern-most portion of the Lower Reach eventually transitions fully to marsh and wetland before it enters Grass Lake.

Figure 10: Riley Creek Lower Reach (adapted from image courtesy of Barr Engineering Co.).

Despite good surface visibility, due to the proximity of previously documented sites and to define soil profiles, five shovel tests were excavated on either side of Riley Creek at locations that appeared to retain the highest potential for containing intact subsurface cultural features or deposits. Because the north portion of the Lower Reach was recently tested during a previous cultural resource survey (Figure 13) and because the south portion was comprised of marsh and wetland, the 10 shovel tests excavated in the Lower Reach clustered within a 500-foot span (Figure 14). Shovel tests measured 40cm in diameter and soil was screened through ¼” hardware cloth. No cultural materials other than those that can be reliably associated with present-day use of the area were identified in the Lower Reach.

Figure 11: Terrace edge and cut-bank on the east side of the Riley Creek Lower Reach segment. Photo by author, view to east-southeast.

Figure 12: Transitional wetland zone in the Riley Creek Lower Reach segment. Photo by author, view to northeast.

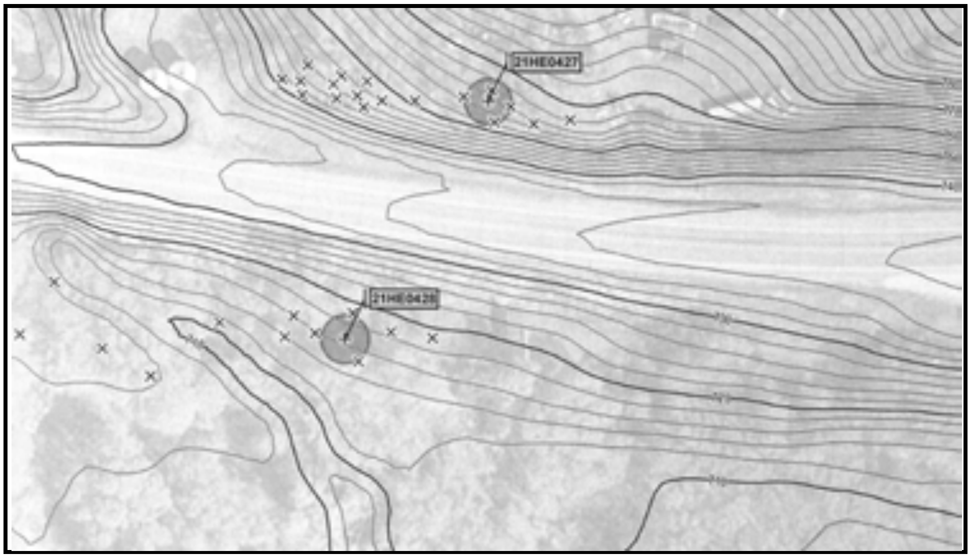


Figure 13: Shovel tests excavated in 2014 in the northern portion of the Riley Creek Lower Reach segment as part of an archaeological survey conducted in advance of the CSAH 61 reconstruction project (adapted from Kaeding 2015).

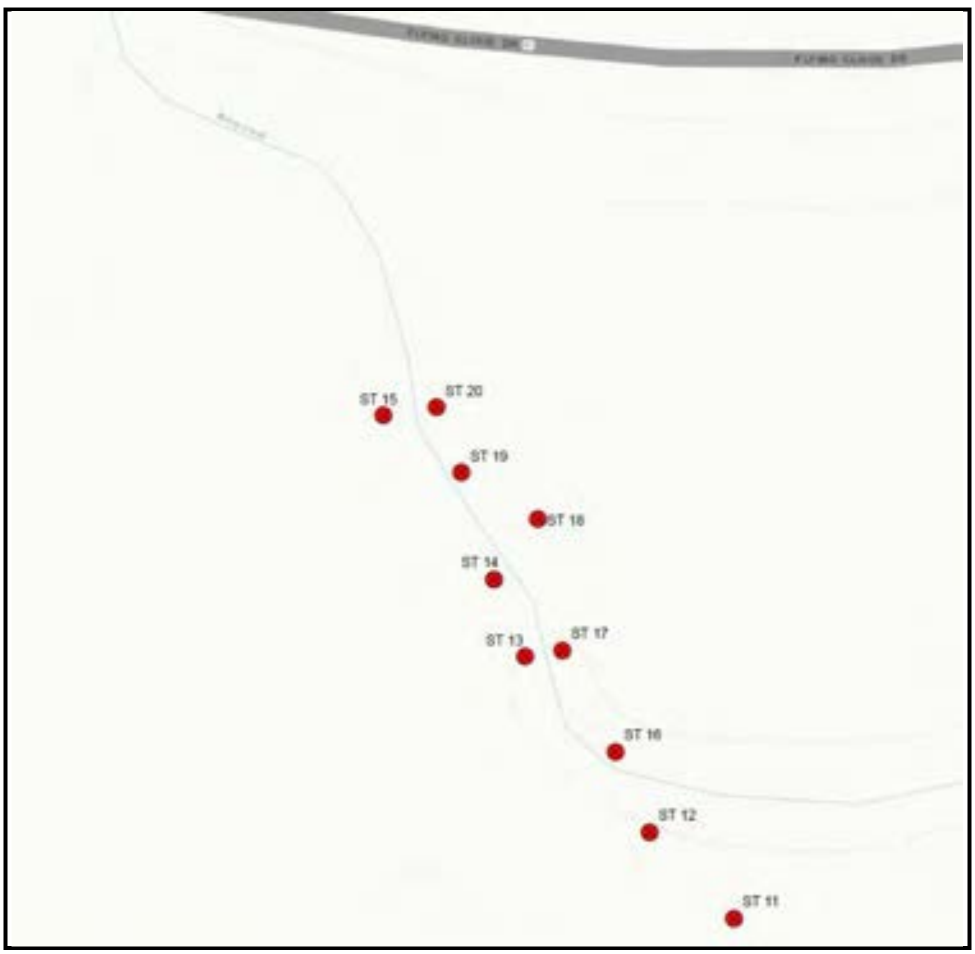


Figure 14: Locations of shovel tests excavated in the Riley Creek Lower Reach segment.

Field Review Results
The Phase I Riley Creek archaeological field survey included pedestrian visual surface reconnaissance of the E-segments Reach, Point D3, and the Lower Reach followed by the excavation of 20 shovel tests (10 in the E-segments Reach and 10 in the Lower Reach). No cultural materials other than those that can be reliably associated with present-day use of the area were identified in any of the three distinct project areas.

Recommendation
Based on the negative results of the field survey and the relatively limited scope of development, it is considered unlikely that the proposed project will adversely affect any significant intact cultural features or deposits. It is recommended that the project proceed as planned and no further investigation should be necessary unless the project area boundaries are changed.

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Appendix H

Riley Creek 2016 Wetland Delineation Report

Wetland Delineation Report

Lower Riley Creek Wetland & Waterbody Delineations

Prepared for
Riley Purgatory Bluff Creek Watershed District and
Lower Minnesota River Watershed District

October 2016

Wetland Delineation Report

Lower Riley Creek Wetland & Waterbody Delineations

Prepared for
Riley Purgatory Bluff Creek Watershed District and
Lower Minnesota River Watershed District

October 2016

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Wetland Delineation Report

October 2016

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1.0 Introduction

Riley Purgatory Bluff Creek Watershed District (RPBCWD) is submitting a Wetland Delineation Report as part of a study that examines the feasibility of stabilizing two stream reaches damaged by erosion or affected by sedimentation. Reach E is located in the middle of Lower Riley Creek Valley and the Lower Minnesota Reach is located from Flying Cloud Drive and downstream toward Grass Lake. Both reaches are located in Eden Prairie, Hennepin County, Minnesota, Sections 29 and 33 of Township 116 North, Range 22 West (**Figure 1**).

This Wetland Delineation Report has been prepared in accordance with the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual ("1987 Manual", USACE, 1987), the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (USACE, 2010) and the requirements of the Minnesota Wetland Conservation Act (WCA) of 1991. Barr delineated the creek edges and wetland boundaries and determined wetland types within the project area on June 16 and 17, 2016.

This report includes a project overview (Section 2.0), general environmental information (Section 3.0), descriptions of the delineated wetlands and waterbodies (Section 4.0), and a discussion of regulations and the administering authorities (Section 5.0). The **Tables** section includes the precipitation data. The **Figures** section includes the Project Location Map, Topography Maps, National Wetland Inventory (NWI) Maps, Public Waters Inventory (PWI), Soil Survey Maps and the Wetland and Waterbody Delineation Maps. **Appendix A** includes Wetland Data Forms, and site photographs are included in **Appendix B**.

2.0 Project Description

This Wetland Delineation Report is part of a larger study to examine erosion issues and potential stabilization measures on two reaches of Lower Riley Creek in Eden Prairie, Minnesota. The upstream reach, Reach E, is located in the middle of the Riley Creek Lower Valley and is within the Riley Purgatory Bluff Creek Watershed District (RPBCWD) jurisdictional boundary. The downstream reach, Lower Minnesota River Watershed District (LMRWD) Reach, is located just downstream of Flying Cloud Drive (County Road 61) and is within the LMRWD boundary. The overall purpose of the project report is to assess streambank stabilization and restoration measures to begin addressing the Minnesota Pollution Control Agency's (MPCA's) identified turbidity impairment along the portion of Riley Creek between Dell Road and Grass Lake by reducing erosion and improving water quality. The goals and objectives of this study, across both reaches, are to:

1. Examine the reach and determine the causes of erosion;
2. Review the feasibility of implementing streambank stabilization measures along these segments of Riley Creek to reduce erosion and improve water quality;
3. Complete assessments for the potential impact to wetlands and determine the impacts to permitting;
4. Complete a Phase I Environmental Assessment to determine the likelihood of contamination and the potential need to avoid or treat contaminated sites during construction activities;
5. Complete a Phase I Cultural and Historical assessment to determine the likelihood of the presence of cultural or historical sites within the project area and the potential to need to avoid such sites or complete additional investigations prior to the start of construction activities;
6. Develop conceptual designs for stabilizing the eroding areas;
7. Provide an opinion of costs for conceptual design options to stabilize the streambanks, minimizing erosion.

3.0 General Environmental Setting

3.1 Project Site Descriptions

The proposed project area is made up of two separate reaches within Lower Riley Creek located within City of Eden Prairie property. Reach E is located within Riley Creek Woods – Canopy Trail between Pioneer Trail and Flying Cloud Drive. Lower Minnesota Reach is located south of Flying Cloud Drive and ends at Grass Lake. Land use in the vicinity of Reach E is forested Public Park and medium density residential area. Land use in the vicinity of the Lower Minnesota Reach is mostly farmlands to the west with wetlands and forest area surrounding it (**Figure 1**).

3.2 Topography

Most of the Reach E project area has steep and abrupt slopes leading into Riley Creek with occasional mud flats at the bases of slopes along the creek. Above the creek channel, topography moderately ungulates throughout the forested park area but maintains a consistent downward slope toward the creek (**Figure 2A, 2B & 2C**). Topography along the Lower Minnesota Reach of Riley Creek also has steep and abrupt slopes starting at the upstream culvert location, but gradually flattens out as the creek extends downstream. Area beyond the creek outlet to the south is flat floodplain forest with a dendritic network of smaller and narrower channelization's leading to Grass Lake. Areas surrounding the creek are generally flat with minor undulations (**Figure 3**).

3.3 Precipitation

Recent precipitation data were compared to historic data for evaluating annual and monthly deviations from normal conditions. Simulated precipitation data were obtained from the Minnesota Climatology Working Group, Wetland Delineation Precipitation Data Retrieval from a Gridded Database (http://climate.umn.edu/gridded_data/precip/wetland/wetland.asp) for wetlands in Hennepin County, Township 116 North, Range 22 West, Sections 29 & 33.

In 2016, antecedent moisture conditions were within the dry range based on precipitation for the three months prior to the June 16 and 17 site visits. These data were obtained from NRCS climate station 215443, NWS: Flying Cloud Drive AP (**Table 1**). The water year has varied between normal and wet for the past six years from 2010 through 2015 (**Table 2**).

3.4 National Wetland Inventory

The National Wetland Inventory (NWI) Map has identified one wetland at the northwest side of Reach E as Type 5, PUBGx, shallow open water wetland (**Figure 4**). The NWI has identified areas within and surrounding the Lower Minnesota Reach as Type 1, PFO1A, freshwater forested/shrub wetland (**Figure 5**). Both Reach E and the Lower Minnesota Reach along Riley Creek were not mapped on the NWI as riverine wetland. No other NWI wetlands were mapped within the Riley Creek project areas.

3.5 Water Resources

The Minnesota Department of Natural Resources (MnDNR) Public Waters Inventory (PWI) has identified Riley Creek as a public water inventory watercourse and Grass Lake as a Public Water Basin (**Figure 6**). Riley Creek is identified by the Minnesota Pollution Control Agency (MPCA) as an impaired water because of turbidity, with aquatic life as their affected use. Aquatic consumption and aquatic recreation have not been assessed. Grass Lake is not identified as an impaired basin.

3.6 Soil Resources

Soil information for the wetland and waterbody delineation was obtained from the Natural Resources Conservation Service SSURGO Database. Three soil map units were identified within areas along Reach E: Hawick loamy sand, 18 to 40 percent slopes (L32F), Suckercreek fine sandy loam, 0 to 2 percent slopes occasionally flooded (L28A), and Lester-Ridgeton complex, 25 to 45 percent slopes (L110F) (**Figure 7**). One soil map unit was identified along the Lower Minnesota Reach: Minneiska fine sandy loam, 0 to 2 percent slopes, occasionally flooded (L39A) (**Figure 8**). Suckercreek fine sandy loam, Lester-Ridgeton complex, and Minneiska fine sandy loam are classified as hydric soils.

4.0 Wetland Delineation

4.1 Wetland Delineation and Classification Methods

Wetlands within the project area were delineated and classified during site visits on June 16 and 17, 2016. The wetland delineation was established according to the Routine On-Site Determination Method specified in the U.S. Army Corps of Engineers Wetlands Delineation Manual (1987 Edition) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (USACE, 2010).

The delineated wetland boundaries, sample points, and creek edges were surveyed using a Global Positioning System (GPS) with sub-meter accuracy (**Figures 9 and 10**).

Wetlands were classified using the U.S. Fish and Wildlife Service (USFWS) Cowardin System (Cowardin et al., 1979), the USFWS Circular 39 system (Shaw and Fredine, 1956), and the Eggers and Reed Wetland Classification System (Eggers and Reed, 1977).

Soil borings were placed in and around the delineated wetlands and other sample areas, to a depth of at least 24 inches below the ground surface where possible. Representative soil samples from each boring were examined for the presence of hydric soil indicators using the Natural Resources Conservation Service (NRCS) hydric soil indicators (Version 7.0). Soil colors (e.g., 7.5YR 4/2, etc.) were determined using a Munsell® soil color chart and noted on the Wetland Data Forms **Appendix A**.

Hydrologic conditions were evaluated at each soil boring, and this information was also noted on the Wetland Data Forms. The dominant plant species were identified, and the corresponding wetland indicator status of each plant species was determined and noted on the Wetland Data Forms (**Appendix A**). Photographs taken at the time of the site visit are provided in **Appendix B**.

4.2 Wetland Descriptions

Creek channel was delineated along two separate reaches of Riley Creek. Two wetland boundaries were also established; one stormwater pond along the northwest edge of Reach E, and the other at the downstream outlet of the Lower Minnesota Reach which is floodplain forest fringe of Grass Lake at the delineated boundary. Descriptions and assessments of these delineated areas are provided below, with representative photographs in **Appendix B**.

4.2.1 Reach E – Creek Channel

Reach E of Riley Creek is located in the middle of Lower Riley Creek Valley and is deeply channelized with severe bank erosion throughout the project area. There is some meandering along the channel but it is not significant. The creek is confined to a channel with banks between 2 feet and nearly 20 feet high with virtually no floodplain.

Water flow within the creek channel had a medium velocity and substrate was sandy and rocky in most of the shallow areas and more silty in deeper areas. No emergent, or aquatic plants were observed within the creek channel. Mixed hardwood trees and shrubs were dominant at higher elevations adjacent to the creek.

Within the project area, the entire creek channel along Reach E was delineated as a linear waterway and classified using the USFWS Cowardin System. The creek channel within the project area was classified by Barr as an R2UBH linear waterway (**Figure 9**). There is no NWI classification for Reach E (**Figure 4**).

4.2.2 Reach E – Wetland 1

Wetland 1 was delineated as a Type 5, PUBGx, shallow open water basin that is 0.38 acres (16,497ft^2) in size and located at the northwest end of Reach E (**Figure 9**). Wetland 1 is an excavated storm water pond with a storm sewer connection to residential area at its west end. Topography leading into Wetland 1 descends abruptly into open water.

The only dominant plant at Sample Point 1-1 Wetland (SP 1-1 WET) was common duckweed (*Lemna minor*). There was no emergent vegetation present within the wetland boundary.

Primary indicators of hydrology observed at SP 1-1 WET was surface water (A1), high water table (A2), saturation (A3), true aquatic plants (B14), and hydrogen sulfide odor (C1). Secondary indicators of hydrology observed were geomorphic position (D2), and a positive FAC-neutral test (D5).

Soils mapped at SP 1-1 WET were identified as Suckercreek fine sandy loam, 0 to 2 percent slopes, occasionally flooded. Sampled soils were black sandy muck down to 10 inches. Soils were not sampled below 10 inches given that the sample area was inundated and the borehole collapses into itself after each attempt at augering the hole deeper. There was no need to go deeper than 10 inches at this location because soils have obvious hydric characteristics at the surface. The hydric soil indicator at SP 1-1 WET is sandy mucky mineral (S1).

The transition to upland was defined by the lack of hydrology and hydric soil indicators. Dominant vegetation in upland areas consisted European buckthorn (*Rhamnus cathartica*) and garlic mustard (*Alliaria petiolata*), which passed the dominance test and the prevalence index.

4.2.3 Reach E – Non-Wetland Sample Points (NWSP)

NWSP-1

NWSP-1 was sampled within an upland swale leading into Riley Creek from residential area (**Figure 9**). The swale is located west of Riley Creek at the north-central portion of the channel. Dominant vegetation at NWSP-1 and throughout the swale was Eastern red-cedar (*Juniperus virginiana*), Eastern cottonwood, Canadian goldenrod (*Solidago canadensis*), and Pennsylvania sedge (*Carex pensylvanica*). Soils were dark brown (10YR 3/3) sandy loams down to 15 inches and transitioned to a very dark brown (10YR 3/2) matrix with the same textures as the surface soils. There were no hydrology indicators at NWSP-1, nor were any observed in other areas within the swale. Wetland vegetation, hydric soil, and wetland hydrology were not observed within this swale at NWSP-1. This swale was not identified by Barr as wetland.

NWSP-2

NWSP-2 was sampled within an upland swale located approximately 500 feet south of NWSP-1 on the west side of Riley Creek (**Figure 9**). The swale leads into Riley Creek from residential area to the west. Dominant vegetation was reed canary grass. Soils were identified as a hydric with a redox dark surface (F6) hydric soil indicator. A positive FAC-neutral test was the only secondary indicator of hydrology, and no primary indicators of hydrology were present at NWSP-2. Wetland vegetation and hydric soil wetland criteria were met in this area, but wetland hydrology was not met. This swale was not identified by Barr as wetland.

NWSP-3

NWSP-3 was sampled within a narrow rocky and sandy ravine with steep side slopes along its edges. NWSP-3 is located approximately 1500 feet southwest of NWSP-2 (**Figure 9**). There is a storm sewer outlet located at higher elevations within the ravine closer to residential area. The ravine surface was sandy and underlain by a rocky impenetrable substrate or was rocky at the surface. Dominant vegetation was wood nettle (*Laportea canadensis*), but most areas within the ravine were not vegetated. There were no wetland hydrology indicators observed within the ravine. Sampled soils were sandy and had a restrictive layer of rocky substrate at 5 inches below the surface. Hydric soil and hydrology wetland criteria were not met in this ravine, but wetland vegetation criteria was met. This ravine was not identified by Barr as wetland.

4.2.4 Lower Minnesota Reach – Creek Channel

The Lower Minnesota Reach located downstream of Flying Cloud Drive is a transition reach between Riley Creek's lower valley and the Minnesota River floodplain. Immediately downstream of Flying Cloud Drive, the channel is incised with tall, eroding banks. The stream rapidly transitions to a more fluid system characterized by a channel in transition with evidence of new channels being formed and old channels becoming filled. Channel migration in this area is likely due to two sources of sediment deposition: backwater from Minnesota River depositing sediment as floodwaters recede, and sediment from upstream reaches of Riley Creek depositing in this flatter portion of the creek.

Water flow within the Lower Minnesota Reach channel had a slow to medium velocity and substrate was sandy in most of the shallow areas and siltier in deeper areas. No emergent, or aquatic plants were observed within the creek channel. Mixed hardwood trees and shrubs were dominant at higher elevations adjacent to the creek.

The creek channel along the Lower Minnesota Reach was delineated as a linear waterway and classified using the USFWS Cowardin System. It was classified by Barr as an R2UBG linear waterway (**Figure 10**). There is no NWI classification for the Lower Minnesota Reach (**Figure 5**).

4.2.5 Lower Minnesota Reach – Wetland 2

Wetland 2 is a Type 1L (PFO1A), floodplain forest wetland (**Figure 10**). Slopes leading into Wetland 2 are gradual with a less naturally defined wetland boundary. Flood waters likely encroach Wetland 2 occasionally during the growing season. At the time of the site visit there was surface saturation throughout most of the floodplain forest community of Wetland 2 and inundation within the channelized areas to approximately 6 inches. Wetland 2 floodplain forest community is fringe wetland community to Grass Lake.

Dominant plants at SP 2-1 WET were American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), ash-leaf maple (*Acer negundo*), and spotted touch-me-nots (*Impatiens capensis*).

Primary indicators of hydrology observed at SP 2-1 WET were high water table (A2), and saturation (A3). Secondary indicators present were geomorphic position (D2) and a positive FAC-neutral test.

Soils mapped at SP 2-1 WET and throughout Wetland 1 were identified as Minneiska fine sandy loam, 0 to 2% slopes. Sampled soils were very dark gray (10YR 3/1) at the surface down to 6 inches with silty clay loam textures. Soils from 6 to 8 inches were grayish brown with sandy textures and transitioned to sandy muck with very dark gray (10YR 3/1) matrix to 26 inches. The hydric soil indicator at SP 2-1 WET is sandy mucky mineral (S1).

The transition to upland at SP 2-1 UPL was defined by the lack of hydrology indicators. Dominant vegetation in upland areas consisted of ash-leaf maple, green ash (*Fraxinus pennsylvanica*), and garlic mustard. The hydric soil indicator at SP 2-1 UPL is redox dark surface (F6).

Dominant plants at SP 2-2 WET were green ash, pussy willow (*Salix discolor*), reed canary grass, and spotted touch-me-nots.

Primary indicators of hydrology observed at SP 2-2 WET were high water table (A2), and saturation (A3). Secondary indicators present were geomorphic position (D2) and a positive FAC-neutral test.

Soils mapped at SP 2-2 WET and throughout Wetland 1 were identified as Minneiska fine sandy loam, 0 to 2% slopes. Sampled soils were very dark gray (10YR 3/1) at the surface down to 7 inches with dark brown (10YR 3/3) redox concentrations and sandy loam textures. Soils from 7 to 18 inches were black (10YR 2/1) with dark brown (10YR 3/3) redox concentrations and sandy clay textures. Soils transitioned to sandy muck with a black (10YR 2/1) matrix to 27 inches. The hydric soil indicator at SP 2-2 WET is redox dark surface (F6).

The transition to upland at SP 2-2 UPL was defined by the lack of hydrology indicators. Dominant vegetation in upland areas consisted of ash-leaf maple, sandbar willow (*Salix interior*), reed canary grass, and Canadian thistle (*Cirsium arvense*). The hydric soil indicator at SP 2-2 UPL is redox dark surface (F6).

5.0 Regulatory Overview

The USACE regulates the placement of dredge or fill materials into navigable waterbodies or wetlands that are located adjacent to or are hydrologically connected to interstate or navigable waters under the authority of Section 404 of the Clean Water Act. If the USACE has jurisdiction over any portion of a project, they may also review impacts to wetlands under the authority of the National Environmental Policy Act.

Filling, excavating, and draining wetlands are also regulated by the Minnesota Wetland Conservation Act (WCA), and the Minnesota Public Waters Inventory Program, which are administered by the City of Eden Prairie and the Minnesota Department of Natural Resources (DNR) respectively. The City of Eden Prairie and the DNR should be contacted before altering any wetlands within the project area. In addition, delineated wetland boundaries may be reviewed by a Technical Evaluation Panel (TEP) consisting of representatives from the Minnesota Board of Water and Soil Resources, and Hennepin County, along with the City of Eden Prairie.

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Tables

Table 1
Antecedent Moisture Conditions Prior to June 17, 2016 Site Visit
Lower Riley Creek Wetland and Waterbody Delineations
Eden Prairie, MN

Precipitation Worksheet Using Gridded Database

Precipitation data for target wetland location:

County: Hennepin
Township Name: Eden Prairie
Nearest Community: Eden Prairie
Township Number: 116N
Range Number: 22W
Section Number: 29 & 33

Aerial photograph or site visit date:
Friday, June 17, 2016

Score using 1981-2010 normal period

(value are in inches)	first prior month: **May 2016**	second prior month: **April 2016**	third prior month: **March 2016**
estimated precipitation total for this location:	2.13	**2.73**	**1.63**
there is a 30% chance this location will have less than:	2.70	2.02	2.23
there is a 30% chance this location will have more than:	4.60	2.92	2.12
type of month: **dry** **normal** **wet**	**dry**	**normal**	**normal**
monthly score	**3 * 1 = 3**	**2 * 2 = 4**	**1 * 2 = 2**
multi-month score: 6 to 9 (**dry**) 10 to 14 (**normal**) 15 to 18 (**wet**)	9 (**dry**)		

* Data for Man & June 2016 was obtained from NWS Flying Cloud AP (Station 215443).

Table 2
Precipitation in Comparison to WETS Data
Lower Riley Creek Wetland and Waterbody Delineations
Eden Prairie, MN

Precipitation data for target wetland location:

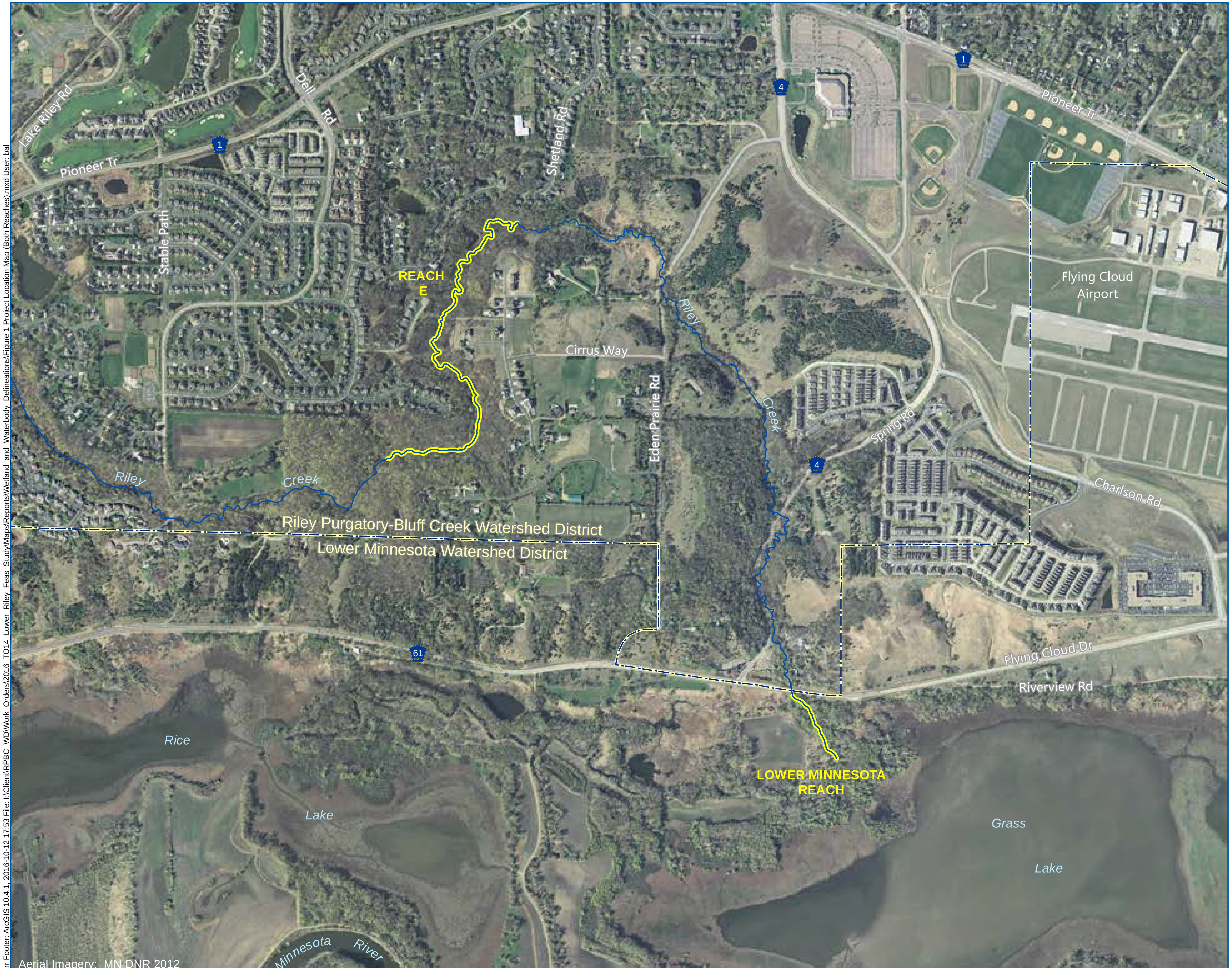
County: Hennepin | **Township Number**: 116N
Township Name: Eden Prairie | **Range Number**: 22W
Nearest Community: Eden Prairie | **Section Number**: 29 & 30

Precipitation Totals are in Inches	
Color Key	**Multi-month Totals**:
total is in lowest 30th percentile of the period-of-record distribution	**WARM** = warm season (May thru September)
total is => 30th and <= 70th percentile	**ANN** = calendar year (January thru December)
total is in highest 30th percentile of the period-of-record distribution	**WAT** = water year (Oct. previous year thru Sep. present year)

Period-of-Record Summary Statistics															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.51	0.49	1.10	1.40	2.51	3.24	2.30	2.70	1.79	1.08	0.65	0.53	16.40	25.87	26.03
70%	0.97	1.10	1.96	2.86	4.54	5.49	4.48	4.70	3.92	2.60	1.78	1.18	21.17	32.13	31.45
mean	0.84	0.86	1.57	2.34	3.70	4.47	3.76	3.71	3.02	2.15	1.47	0.96	18.66	28.84	28.86
1981-2010 Summary Statistics															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
30%	0.55	0.37	1.23	2.02	2.70	3.32	2.83	3.23	2.36	1.30	1.09	0.64	17.58	29.10	27.89
70%	0.98	1.04	2.12	2.92	4.60	5.22	4.41	5.38	4.23	3.42	1.91	1.36	22.93	33.96	34.52
mean	0.86	0.75	1.73	2.64	3.65	4.26	4.06	4.49	3.48	2.47	1.76	1.10	19.93	31.24	31.06
Year-to-Year Data															
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	WARM	ANN	WAT
2016	0.23	0.78	1.63	2.73	2.13	4.32	-	-	-	-	-	-	-	-	-
2015	0.30	0.28	0.79	2.35	4.54	4.44	7.67	3.52	3.11	2.61	4.15	1.71	23.28	35.47	29.94
2014	1.24	1.38	0.65	6.32	4.52	12.89	3.08	3.33	1.77	1.29	0.73	0.92	25.59	38.12	40.75
2013	0.81	1.23	1.96	4.74	6.19	6.14	5.74	1.70	1.58	3.58	0.58	1.41	21.35	35.66	33.73
2012	0.61	2.16	1.41	2.96	10.18	5.25	3.34	2.10	0.52	1.35	0.83	1.46	21.39	32.17	30.30
2011	0.91	1.32	1.78	3.06	5.00	4.40	4.57	3.02	0.35	0.81	0.20	0.76	17.34	26.18	31.33
2010	0.62	0.95	1.08	2.79	2.79	5.07	3.73	6.79	5.42	1.95	2.09	2.88	23.80	36.16	37.73
2009	0.57	1.13	1.75	1.61	0.60	2.95	1.49	8.93	0.82	5.88	0.51	2.10	14.79	28.34	24.22
2008	0.13	0.45	2.15	3.74	2.81	3.32	3.49	2.96	2.36	1.50	1.50	1.37	14.94	25.78	27.89
2007	0.91	1.13	3.33	2.10	1.88	1.01	1.34	8.12	4.68	4.54	0.15	1.79	17.03	30.98	28.34
2006	0.85	0.43	1.51	3.50	2.02	4.37	0.86	5.45	3.93	0.64	1.11	2.09	16.63	26.76	31.01
2005	0.99	1.12	1.19	2.35	4.40	5.94	2.27	4.17	9.69	5.07	1.71	1.31	26.47	40.21	35.96
2004	0.57	1.31	2.23	2.61	7.44	5.34	4.16	1.90	4.79	2.27	1.04	0.53	23.63	34.19	33.48
2003	0.29	0.94	1.61	2.51	5.61	4.19	3.46	0.80	2.36	0.84	1.26	1.03	16.42	24.90	26.36
2002	0.46	0.56	1.87	2.94	3.08	8.53	4.91	8.02	4.61	4.15	0.11	0.33	29.15	39.57	39.39
2001	1.34	1.42	0.91	6.84	5.23	5.17	1.49	2.90	3.77	0.83	3.05	0.53	18.56	33.48	34.88
2000	0.97	1.11	1.20	1.14	4.56	3.40	4.03	3.52	0.88	1.05	3.40	1.36	16.39	26.62	22.86
1999	2.08	0.36	1.54	3.48	6.38	5.33	3.85	4.40	2.84	0.80	1.03	0.22	22.80	32.31	34.37
1998	1.40	0.73	3.11	1.73	4.84	4.93	3.07	5.55	1.17	2.48	1.22	0.41	19.56	30.64	29.35
1997	1.58	0.20	1.38	1.00	1.44	2.76	9.74	5.83	4.06	1.90	0.65	0.27	23.83	30.81	38.38

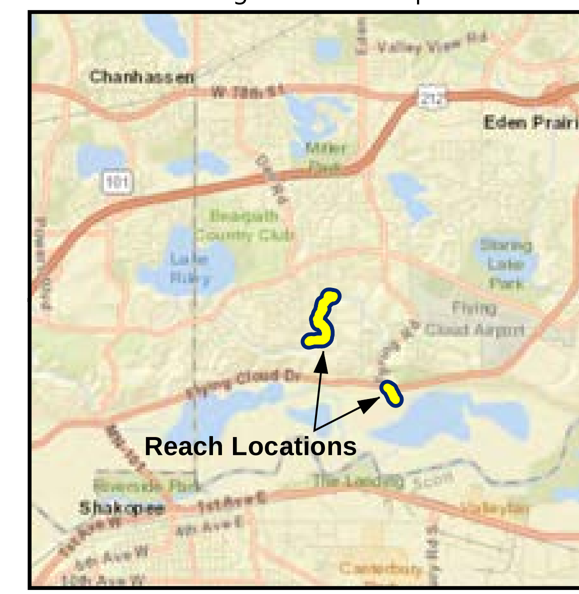
* Data for Man & June 2016 was obtained from NWS Flying Cloud AP (Station 215443).

Figures



Riley Creek
Feasibility Study Reach

Regional Inset Map



Feet
500 0 500 1,000 1,500

Figure 1

PROJECT LOCATION MAP
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

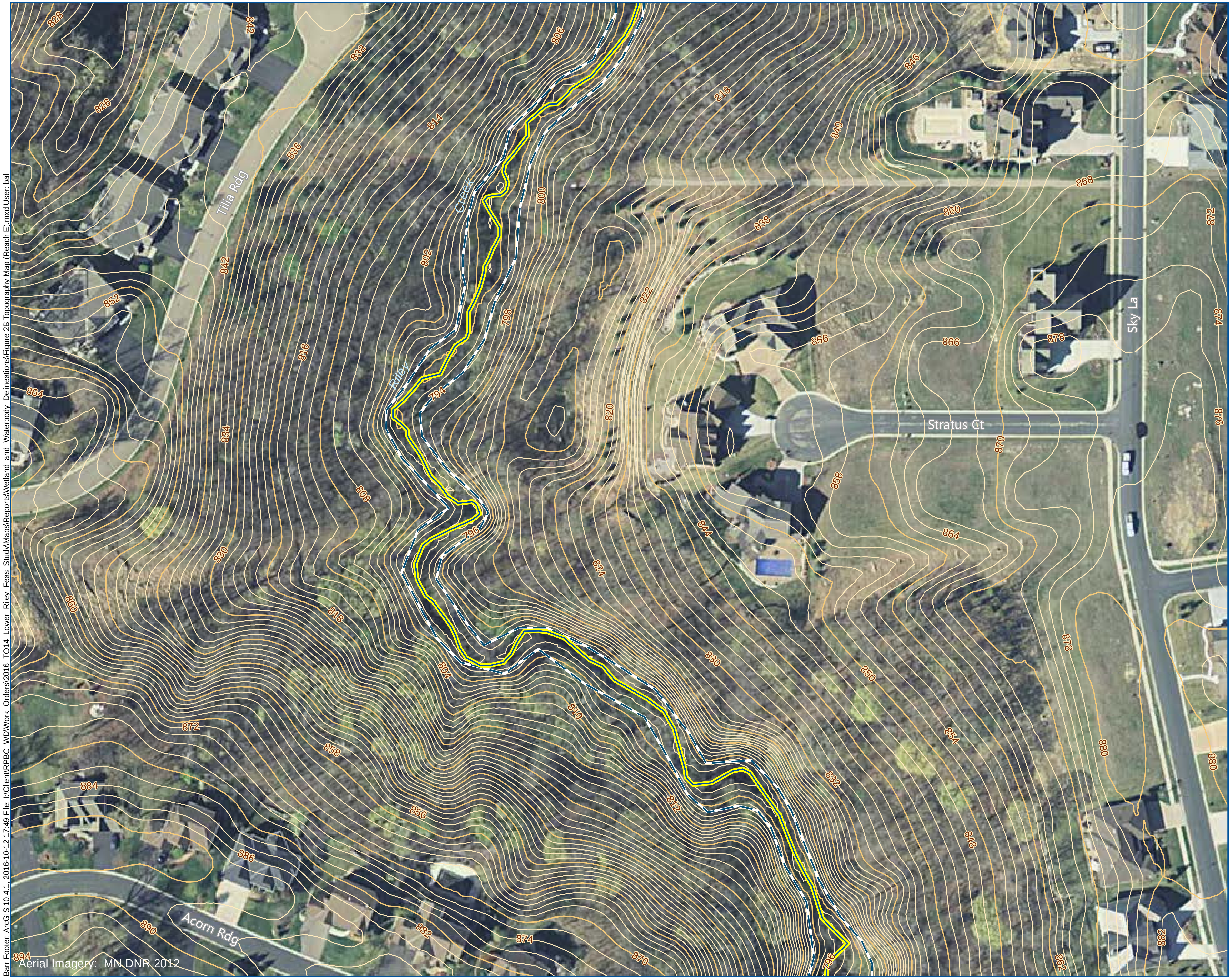
Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary
10-Foot Interval Contour
2-Foot Interval Contour

Elevation Contours: LiDAR derived from the MN DNR 2011.

Feet
50 0 50 100 150 200

Figure 2A

TOPOGRAPHY MAP (REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota



Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary
10-Foot Interval Contour
2-Foot Interval Contour

Elevation Contours: LiDAR derived from the MN DNR 2011.

Feet
50 0 50 100 150 200

Figure 2B

TOPOGRAPHY MAP (REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary
10-Foot Interval Contour
2-Foot Interval Contour

Elevation Contours: LiDAR derived from the MN DNR 2011.

Feet

50 0 50 100 150 200

Figure 2C

TOPOGRAPHY MAP (REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary
10-Foot Interval Contour
2-Foot Interval Contour

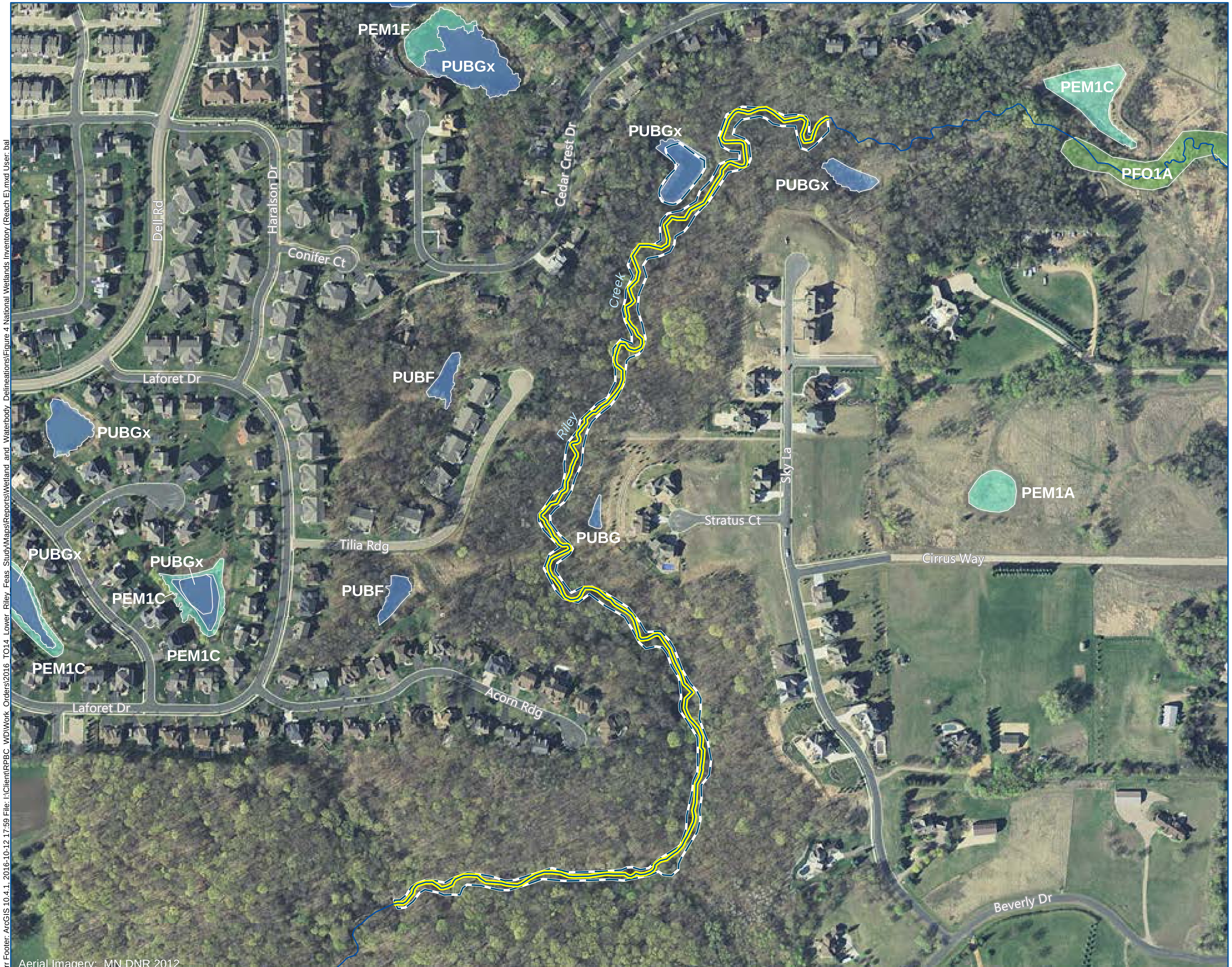
Elevation Contours: LiDAR derived from the MN DNR 2011.

Feet

50 0 50 100 150 200

Figure 3

TOPOGRAPHY MAP
(LOWER MINNESOTA REACH)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota



Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary
Wetlands (MN DNR NWI East Central Update)
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond

N

Feet
150 0 150 300 450

Figure 4

NATIONAL WETLANDS INVENTORY
(REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

- Riley Creek
- Feasibility Study Reach
- Wetland Delineation Boundary

Wetlands (MN DNR NWI East Central Update)

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

Feet

50 0 50 100 150 200

Figure 5

NATIONAL WETLANDS INVENTORY
(LOWER MINNESOTA REACH)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

Barr Footer: ArcGIS 10.4.1, 2016-10-12 17:57 File: I:\Client\RPBC_WD\Work_Orders\2016_TO14_Lower_Riley_Feas_Study\Maps\Reports\Wetland_and_Waterbody_Delineations\Figure 5 National Wetlands Inventory (Lower Minnesota Reach).mxd User: bal

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Feasibility Study Reach

Public Water Inventory Watercourse

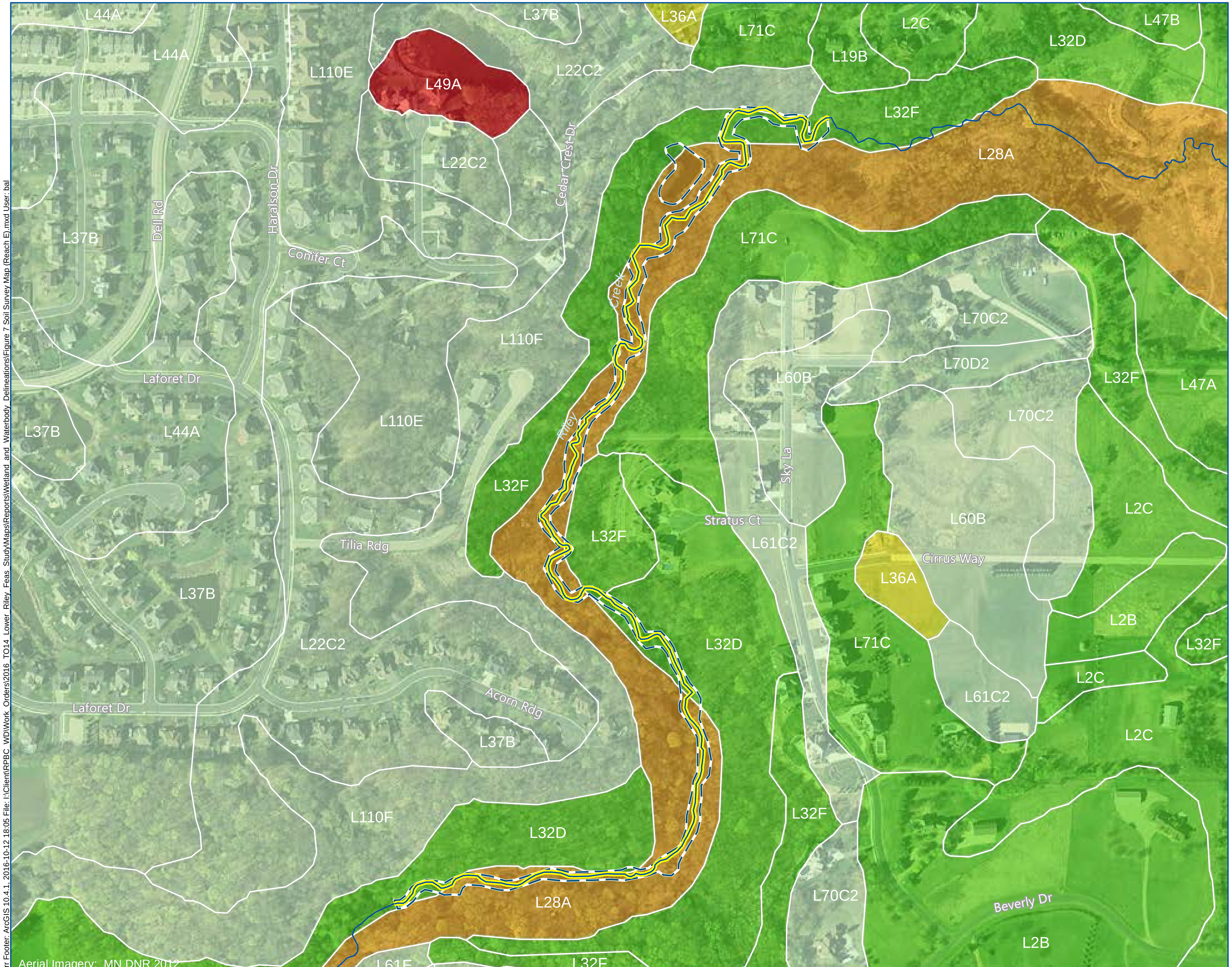
Public Water Inventory Basin

Feet

500 0 500 1,000 1,500

Figure 6

PUBLIC WATERS INVENTORY
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota



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- Riley Creek
- Feasibility Study Reach
- Wetland Delineation Boundary

SSURGO Hydric Soil Rating

- Not Hydric (0%)
- Hydric (1 to 32%)
- Hydric (33 to 65%)
- Hydric (66 to 99%)
- Hydric (100%)

L110E	Lester-Ridgeton complex, 18 to 25 percent slopes
L110F	Lester-Ridgeton complex, 25 to 45 percent slopes
L17B	Angus-Malardi complex, 2 to 6 percent slopes
L19B	Moon loamy fine sand, 2 to 5 percent slopes
L22C2	Lester loam, 6 to 10 percent slopes, moderately eroded
L28A	Suckercreek fine sandy loam, 0 to 2 percent slopes, occasionally flooded
L2B	Malardi-Hawick complex, 1 to 6 percent slopes
L2C	Malardi-Hawick complex, 6 to 12 percent slopes
L32D	Hawick loamy sand, 12 to 18 percent slopes
L32F	Hawick loamy sand, 18 to 40 percent slopes
L36A	Hamel, overwash-Hamel complex, 0 to 3 percent slopes
L37B	Angus loam, 2 to 6 percent slopes
L44A	Nessel loam, 1 to 3 percent slopes
L46A	Tomall loam, 0 to 2 percent slopes
L47A	Eden Prairie sandy loam, 0 to 2 percent slopes
L47B	Eden Prairie sandy loam, 2 to 6 percent slopes
L49A	Klossner soils, depressional, 0 to 1 percent slopes
L60B	Angus-Moon complex, 2 to 5 percent slopes
L61C2	Lester-Metea complex, 6 to 12 percent slopes, eroded
L61E	Lester-Metea complex, 18 to 25 percent slopes
L70C2	Lester-Malardi complex, 6 to 12 percent slopes, eroded
L70D2	Lester-Malardi complex, 12 to 18 percent slopes, eroded
L71C	Metea loamy fine sand, 6 to 12 percent slopes

Feet

150 0 150 300 450

Figure 7

SOIL SURVEY (REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

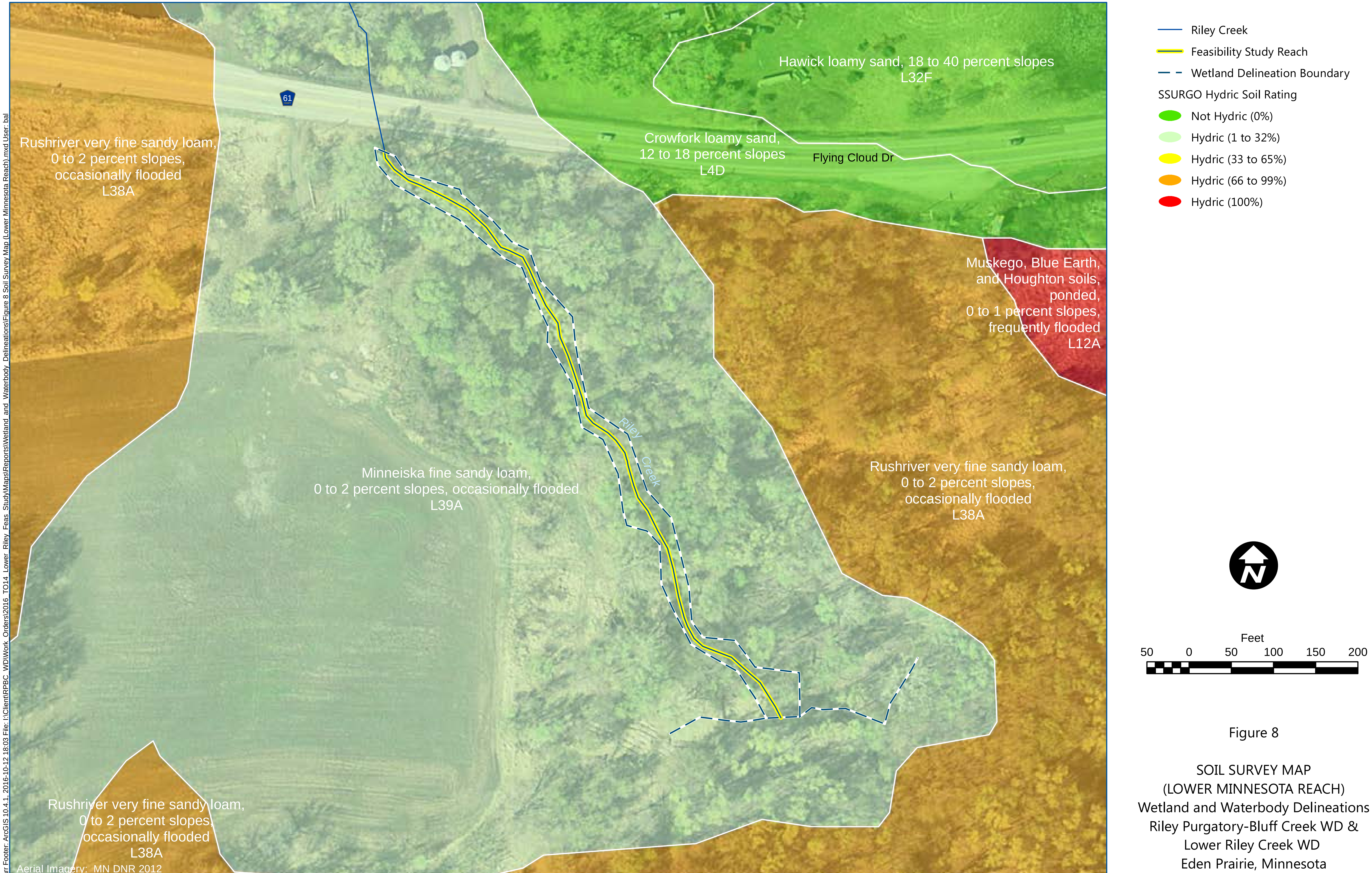
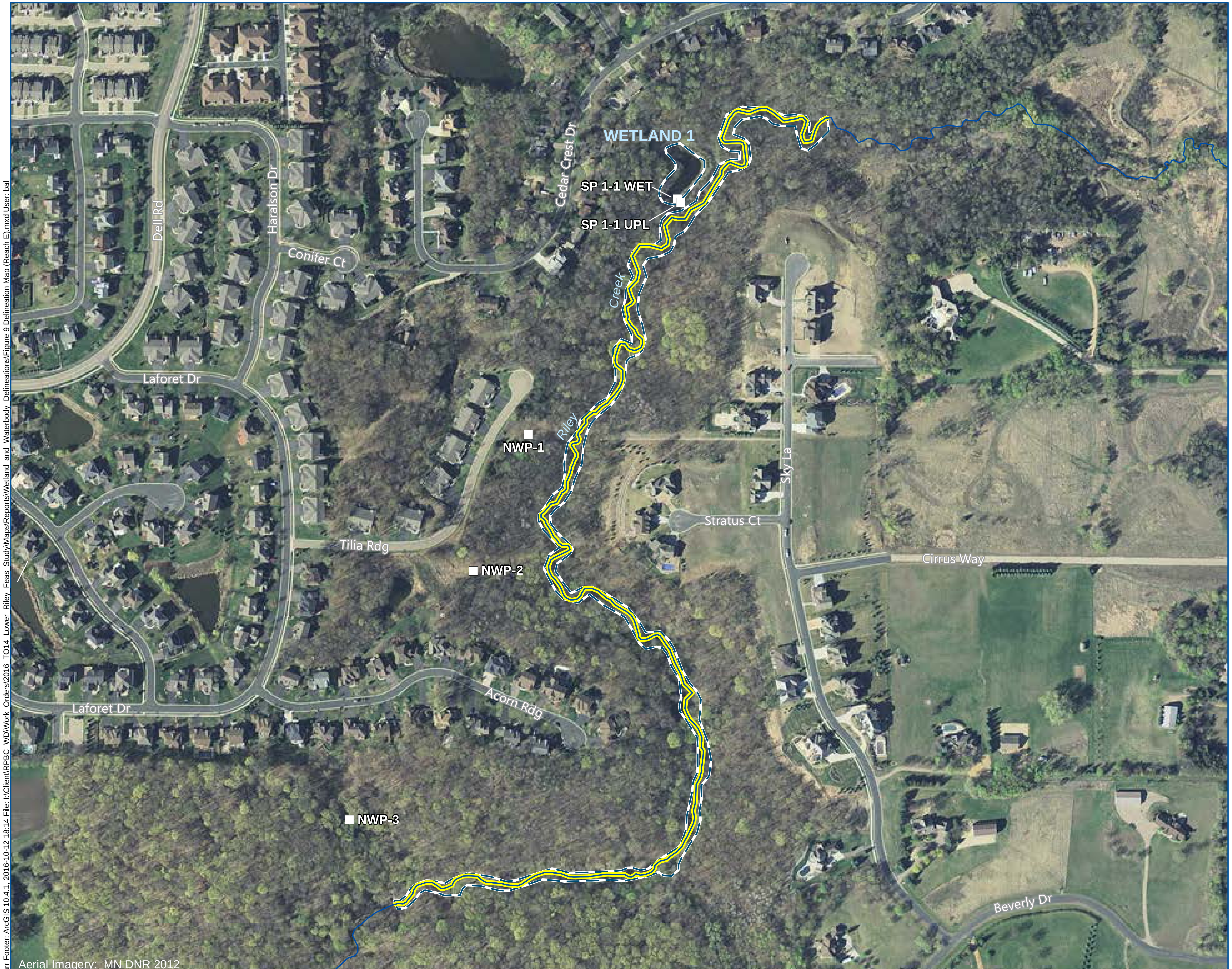


Figure 8

SOIL SURVEY MAP
(LOWER MINNESOTA REACH)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota



Sample Point Location
Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary

Feet
150 0 150 300 450

Figure 9

DELINEATION MAP (REACH E)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

Sample Point Location
Riley Creek
Feasibility Study Reach
Wetland Delineation Boundary

Feet
50 0 50 100 150 200

Figure 10

DELINEATION MAP
(LOWER MINNESOTA REACH)
Wetland and Waterbody Delineations
Riley Purgatory-Bluff Creek WD &
Lower Riley Creek WD
Eden Prairie, Minnesota

Appendix A

Wetland Data Forms

WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Lower Riley Creek Feasiblity Study - Reach E
Applicant/Owner: Riley Purgatory Bluff Creek WD
City/County: Eden Prairie/ Hennepin
State: MN
Sampling Date: 06/17/16
Investigator(s): BKB
Section: 29
Township: 116
Range: 22
Sampling Point: 1-1 UPL
Land Form: Hillslope
Local Relief: Concave
Slope %: 3
Soil Map Unit Name: Suckercreek fine sandy loam, 0-2% slopes
Subregion (LRR): M
Latitude: 4964267 mN
Longitude: 461035 mE
Datum: UTM83 Meters
Cowardin Classification: Upland
Circular 39 Classification: Upland
Mapped NWI Classification: Upland
Are climatic/hydrologic conditions on the site typical for this time of year? No (If no, explain in remarks)
Eggers & Reed (primary): Upland
Are vegetation No Soil No Hydrology No significantly disturbed?
Are "normal circumstances" present? Yes
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Are vegetation No Soil No Hydrology No naturally problematic?
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
Indicators of wetland hydrology present? No
Is the sampled area within a wetland? No
If yes, optional Wetland Site ID: Upland

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

VEGETATION

Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
Total Cover:	0		
Sapling/Shrub Stratum (Plot Size: 15 ft)			
1. Rhamnus cathartica	10	Yes	FAC
2.	0		
3.	0		
4.	0		
5.	0		
Total Cover:	10		
Herb Stratum (Plot Size: 5 ft)			
1. Alliaria petiolata	65	Yes	FAC
2. Laportea canadensis	20	No	FACW
3. Geranium maculatum	10	No	FACU
4. Urtica dioica	5	No	FACW
5. Arisaema triphyllum	1	No	FACW
6. Galium triflorum	2	No	FACU
7.	0		
8.	0		
Total Cover:	103		
Woody Vine Stratum (Plot Size: 30 ft)			
1.	0		
2.	0		
Total Cover:	0		

% Bare Ground in Herb Stratum:
% Sphagnum Moss Cover:

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

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	2	5
Herb Stratum	20.6	51.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **2** (A)
Total Number of Dominant Species Across All Strata: **2** (B)
Percent of Dominant Species That Are OBL, FACW or FAC: **100.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	26	X 2	52
FAC Species	75	X 3	225
FACU Species	12	X 4	48
UPL Species	0	X 5	0
Column Totals:	**113**	(A)	**325** (B)

Prevalence Index = B/A = **2.88**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 1-1 UPL

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 %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 12	10YR 2/1						Sandy Loam	
2.	12 - 16	10YR 3/1						Loamy Sand	
3.	16 - 28	10YR 3/2						Sandy Clay Loam	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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): ______

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

10/13/2016 3:08:33 PM

WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site:	Lower Riley Creek Feasiblity Study - Reach E	Applicant/Owner:	Riley Purgatory Bluff Creek WD	City/County:	Eden Prairie/ Hennepin	State:	MN	Sampling Date:	06/17/16
Investigator(s):	BKB	Section:	29	Township:	116	Range:	22	Sampling Point:	1-1 WET
Land Form:	Depression	Local Relief:	Concave	Slope %:	2	Soil Map Unit Name:	Suckercreek fine sandy loam, 0-2% slopes		
Subregion (LRR):	M	Latitude:	4964270 mN	Longitude:	461031 mE	Datum:	UTM 83 Meters, Zone 15		
Cowardin Classification:	PUBGx	Circular 39 Classification:	Type 5			Mapped NWI Classification:	PUBGx		

Are climatic/hydrologic conditions on the site typical for this time of year? No (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): Shallow, Open Water

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?	Yes
Indicators of wetland hydrology present?	Yes
Is the sampled area within a wetland?	Yes

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

If yes, optional Wetland Site ID: Wetland 1

VEGETATION

Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
Total Cover:	0		
Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.	0		
2.	0		
3.	0		
4.	0		
5.	0		
Total Cover:	0		
Herb Stratum (Plot Size: 5 ft)			
1. Lemna minor	95	Yes	OBL
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
7.	0		
8.	0		
Total Cover:	95		
Woody Vine Stratum (Plot Size: 30 ft)			
1.	0		
2.	0		
Total Cover:	0		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	19	47.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	**1**	(A)
Total Number of Dominant Species Across All Strata:	**1**	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	**100.00%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	95	X 1	95
FACW Species	0	X 2	0
FAC Species	0	X 3	0
FACU Species	0	X 4	0
UPL Species	0	X 5	0
Column Totals:	**95** (A)		**95** (B)

Prevalence Index = B/A = **1.00**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 1-1 WET

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 - 10	N 2.5/0						Sandy Muck	
2.	-								
3.	-								
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- [x] 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)
- [ ] Dark Surface (S7)
- [ ] Iron-Manganese Masses (F12)
- [ ] Very Shallow Dark Surface (TF12)
- [ ] 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

Soil Remarks: Soils were inundated and mucky mineral at the surface.

HYDROLOGY

Wetland Hydrology Indicators:

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

- [x] Surface Water (A1)
- [x] 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)
- [x] True Aquatic Plants (B14)
- [x] 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):	2
Water table present?	☑	Water Table Depth (inches):	0
Saturation present? (includes capillary fringe)	☑	Saturation Depth (inches):	0

Indicators of wetland hydrology present? Yes

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Lower Riley Creek Feasiblity Study - Reach E | Applicant/Owner: Riley Purgatory Bluff Creek WD | City/County: Eden Prairie/ Hennepin | State: MN | Sampling Date: 06/17/16

Investigator(s): BKB | Section: 29 | Township: 116 | Range: 22 | Sampling Point: NWSP-1

Land Form: Hillslope | Local Relief: Concave | Slope %: 8 | Soil Map Unit Name: Hawick loamy sand, 18-40% slopes

Subregion (LRR): M | Latitude: 4964040 mN | Longitude: 460886 mE | Datum: UTM 83 Meters, Zone 15

Cowardin Classification: Upland | Circular 39 Classification: Upland | Mapped NWI Classification: Upland

Are climatic/hydrologic conditions on the site typical for this time of year? No (If no, explain in remarks) | Eggers & Reed (primary): Upland

Are vegetation No Soil No Hydrology No significantly disturbed? | Are "normal circumstances" present? Yes | Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Are vegetation No Soil No Hydrology No naturally problematic? | 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
Indicators of wetland hydrology present?	No
Is the sampled area within a wetland?	No

General Remarks (explain any answers if needed):
-Conditions are dryer than normal within the three months prior to the site visit.
-Sample in dry vegetated swale upslope from Riley Creek. Surface flow presumably disappears into sandy soils. No evidence of surface flow in swale at this location.

If yes, optional Wetland Site ID: Upland

VEGETATION

Tree Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
	Total Cover:	0		

Sapling/Shrub Stratum (Plot Size: 15 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Juniperus virginiana	5	Yes	FACU
2.	Populus deltoides	5	Yes	FAC
3.		0		
4.		0		
5.		0		
	Total Cover:	10		

Herb Stratum (Plot Size: 5 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Solidago canadensis	30	Yes	FACU
2.	Carex pensylvanica	30	Yes	UPL
3.	Euphorbia esula	10	No	UPL
4.	Parthenocissus quinquefolia	10	No	FACU
5.	Rubus sp.	10	No	
6.	Bromus inermis	5	No	FACU
7.		0		
8.		0		
	Total Cover:	95		

Woody Vine Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Vitis riparia	5	Yes	FACW
2.		0		
	Total Cover:	5		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	2	5
Herb Stratum	19	47.5
Woody Vine Stratum	1	2.5

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **2** (A)

Total Number of Dominant Species Across All Strata: **5** (B)

Percent of Dominant Species That Are OBL, FACW or FAC: **40.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	5	X 2	10
FAC Species	5	X 3	15
FACU Species	50	X 4	200
UPL Species	40	X 5	200
Column Totals:	**100**	(A)	**425** (B)

Prevalence Index = B/A = **4.25**

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- 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

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: NWSP-1

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 %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 15	10YR 3/3						Sandy Loam	
2.	15 - 25	10YR 3/2						Sandy Loam	
3.	-								
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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): ______

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site:	Lower Riley Creek Feasiblity Study - Reach E	Applicant/Owner:	Riley Purgatory Bluff Creek WD	City/County:	Eden Prairie/ Hennepin	State: MN	Sampling Date: 06/17/16
Investigator(s):	BKB	Section:	29	Township:	116	Range: 22	Sampling Point: NWSP-2
Land Form:	Hillslope	Local Relief:	Concave	Slope %:	5	Soil Map Unit Name:	Lester-Ridgeton complex, 25-45% slopes
Subregion (LRR):	M	Latitude:	4963907 mN	Longitude:	460832 mE	Datum:	UTM 83 Meters, Zone 15

Cowardin Classification: Upland Circular 39 Classification: Upland Mapped NWI Classification: Upland

Are climatic/hydrologic conditions on the site typical for this time of year? No (If no, explain in remarks) Eggers & Reed (primary): Upland

Are vegetation No Soil No Hydrology No significantly disturbed? Are "normal circumstances" present? Yes Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Are vegetation No Soil No Hydrology No naturally problematic? Eggers & Reed (quaternary):

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

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

General Remarks (explain any answers if needed):
-Conditions are dryer than normal within the three months prior to the site visit.
-Sample in dry vegetated swale upslope from Riley Creek. Surface flow presumably disappears into well drained soils. No evidence of surface flow in swale at this location.

If yes, optional Wetland Site ID: Upland

VEGETATION

Tree Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
	Total Cover:	0		

Sapling/Shrub Stratum (Plot Size: 15 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	0		

Herb Stratum (Plot Size: 5 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Phalaris arundinacea	80	Yes	FACW
2.	Cirsium arvense	10	No	FACU
3.	Bromus inermis	10	No	FACU
4.	Equisetum arvense	10	No	FAC
5.	Solidago canadensis	5	No	FACU
6.		0		
7.		0		
8.		0		
	Total Cover:	115		

Woody Vine Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	23	57.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	100.00%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	0	X 1	0	
FACW Species	80	X 2	160	
FAC Species	10	X 3	30	
FACU Species	25	X 4	100	
UPL Species	0	X 5	0	
Column Totals:	115	(A)	290	(B)

Prevalence Index = B/A = 2.52

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: NWSP-2

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 - 10	10YR 3/2	98	2.5Y 4/4	2			Clay	
2.	10 - 35	2.5Y 3/2	100					Clay	
3.	-								
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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): ______

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Lower Riley Creek Feasiblity Study - Reach E Applicant/Owner: Riley Purgatory Bluff Creek WD City/County: Eden Prairie/ Hennepin State: MN Sampling Date: 06/17/16

Investigator(s): BKB Section: 29 Township: 116 Range: 22 Sampling Point: NWSP-3

Land Form: Hillslope Local Relief: Concave Slope %: 5 Soil Map Unit Name: Lester-Ridgeton complex, 25-45% slopes

Subregion (LRR): M Latitude: 4963665 mN Longitude: 460711 mE Datum: UTM 83 Meters, Zone 15

Cowardin Classification: Upland Circular 39 Classification: Upland Mapped NWI Classification: Upland

Are climatic/hydrologic conditions on the site typical for this time of year? No (If no, explain in remarks) Eggers & Reed (primary): Upland

Are vegetation No Soil No Hydrology No significantly disturbed? Are "normal circumstances" present? Yes Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Are vegetation No Soil No Hydrology No naturally problematic? 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
Indicators of wetland hydrology present?	No
Is the sampled area within a wetland?	No

General Remarks (explain any answers if needed):
-Conditions are dryer than normal within the three months prior to the site visit.
-Sample in dry rocky and sandy swale upslope from Riley Creek at the time of the site visit. Surface water flows intermittently from a culvert located at the top of the slope during rain events.

If yes, optional Wetland Site ID: Upland

VEGETATION

Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
Total Cover:	0		
Sapling/Shrub Stratum (Plot Size: 15 ft)			
1.	0		
2.	0		
3.	0		
4.	0		
5.	0		
Total Cover:	0		
Herb Stratum (Plot Size: 5 ft)			
1. Laportea canadensis	15	Yes	FACW
2.	0		
3.	0		
4.	0		
5.	0		
6.	0		
7.	0		
8.	0		
Total Cover:	15		
Woody Vine Stratum (Plot Size: 30 ft)			
1.	0		
2.	0		
Total Cover:	0		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	3	7.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	**1**	(A)
Total Number of Dominant Species Across All Strata:	**1**	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	**100.00%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	15	X 2	30
FAC Species	0	X 3	0
FACU Species	0	X 4	0
UPL Species	0	X 5	0
Column Totals:	**15**	(A)	**30** (B)

Prevalence Index = B/A = **2.00**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: NWSP-3

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 - 5	10YR 5/3						Sand	
2.	-								
3.	-								
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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:** Rocky **Depth (inches):** 0 -5

Hydric soil present? No

Soil Remarks: Rocky and sandy ravine.

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):

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site:	Lower Riley Creek Feasiblity Study - Lwr MN Reach	Applicant/Owner:	Riley Purgatory Bluff Creek WD	City/County:	Eden Prairie/ Hennepin	State: MN	Sampling Date: 06/16/16
Investigator(s):	BKB	Section:	33	Township:	116	Range: 22	Sampling Point: 2-1 UPL
Land Form:	Summit	Local Relief:	None	Slope %:	2	Soil Map Unit Name:	Minneiska fine sandy loam, 0 to 2% slope
Subregion (LRR):	M	Latitude:	4962628 mN	Longitude:	462262 mE	Datum:	UTM 83 Meters, Zone 15
Cowardin Classification:	Upland	Circular 39 Classification:	Upland			Mapped NWI Classification:	PFO1A

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

Eggers & Reed (primary): Upland

Are vegetation No Soil No Hydrology No significantly disturbed?

Are "normal circumstances" present? Yes

Eggers & Reed (secondary):

Eggers & Reed (tertiary):

Are vegetation No Soil No Hydrology No naturally problematic?

Eggers & Reed (quaternary):

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

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

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

If yes, optional Wetland Site ID: Upland

VEGETATION

Tree Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Fraxinus pennsylvanica	20	Yes	FACW
2. Acer negundo	20	Yes	FAC
3.	0		
4.	0		
Total Cover:	40		

Sapling/Shrub Stratum (Plot Size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
3.	0		
4.	0		
5.	0		
Total Cover:	0		

Herb Stratum (Plot Size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Alliaria petiolata	60	Yes	FAC
2. Urtica dioica	15	No	FACW
3. Phalaris arundinacea	15	No	FACW
4. Rubus sp.	5	No	
5. Impatiens capensis	2	No	FACW
6.	0		
7.	0		
8.	0		
Total Cover:	97		

Woody Vine Stratum (Plot Size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1.	0		
2.	0		
Total Cover:	0		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:	20%	50%
Tree Stratum	8	20
Sapling/Shrub Stratum	0	0
Herb Stratum	19.4	48.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	**3**	(A)
Total Number of Dominant Species Across All Strata:	**3**	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	**100.00%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	52	X 2	104
FAC Species	80	X 3	240
FACU Species	0	X 4	0
UPL Species	0	X 5	0
Column Totals:	**132**	(A)	**344** (B)

Prevalence Index = B/A = **2.61**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 2-1 UPL

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 - 10	10YR 3/1	95	10YR 3/3	5	C	M	Silty Clay Loam	
2.	10 - 17	10YR 3/2	98	10YR 3/3	2	C	M	Fine Sandy Loam	
3.	17 - 25	5Y 4/1	95	10YR 3/4	5	C	M	Loamy Fine Sand	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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):	14
Saturation present? (includes capillary fringe)	☑	Saturation Depth (inches):	16

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Lower Riley Creek Feasiblity Study - Lwr MN Reach | Applicant/Owner: Riley Purgatory Bluff Creek WD | City/County: Eden Prairie/ Hennepin | State: MN | Sampling Date: 06/16/16

Investigator(s): BKB | Section: 33 | Township: 116 | Range: 22 | Sampling Point: 2-1 WET

Land Form: Toeslope | Local Relief: None | Slope %: 1 | Soil Map Unit Name: Minneiska fine sandy loam, 0 to 2% slope

Subregion (LRR): M | Latitude: 4962619 mN | Longitude: 462268 mE | Datum: UTM 83 Meters, Zone 15

Cowardin Classification: PFO1A | Circular 39 Classification: Type 1L | Mapped NWI Classification: PFO1A

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

Eggers & Reed (primary): Floodplain Forest
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

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
Indicators of wetland hydrology present?	Yes
Is the sampled area within a wetland?	Yes

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

If yes, optional Wetland Site ID: Wetland 2

VEGETATION

Tree Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Ulmus americana	15	Yes	FACW
2.	Populus deltoides	15	Yes	FAC
3.	Acer negundo	15	Yes	FAC
4.		0		
	Total Cover:	45		

Sapling/Shrub Stratum (Plot Size: 15 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	0		

Herb Stratum (Plot Size: 5 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Impatiens capensis	70	Yes	FACW
2.	Phalaris arundinacea	10	No	FACW
3.	Urtica dioica	5	No	FACW
4.	Laportea canadensis	5	No	FACW
5.	Alliaria petiolata	5	No	FAC
6.		0		
7.		0		
8.		0		
	Total Cover:	95		

Woody Vine Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: ______ % Sphagnum Moss Cover: ______

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

50/20 Thresholds:	20%	50%
Tree Stratum	9	22.5
Sapling/Shrub Stratum	0	0
Herb Stratum	19	47.5
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW or FAC:	100.00%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:		
OBL Species	0	X 1	0	
FACW Species	105	X 2	210	
FAC Species	35	X 3	105	
FACU Species	0	X 4	0	
UPL Species	0	X 5	0	
Column Totals:	**140**	(A)	**315**	(B)

Prevalence Index = B/A = **2.25**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 2-1 WET

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 %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 6	10YR 3/1						Silty Clay Loam	
2.	6 - 8	10YR 5/2						Sand	
3.	8 - 26	10Y 3/1						Sandy Muck	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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): 8
- Saturation present? (includes capillary fringe) ☑ Saturation Depth (inches): 6

Indicators of wetland hydrology present? Yes

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site: Lower Riley Creek Feasiblity Study - Lwr MN Reach
Applicant/Owner: Riley Purgatory Bluff Creek WD
City/County: Eden Prairie/ Hennepin
State: MN
Sampling Date: 06/16/16

Investigator(s): BKB
Section: 33
Township: 116
Range: 22
Sampling Point: 2-2 UPL

Land Form: Summit
Local Relief: Convex
Slope %: 1
Soil Map Unit Name: Minneiska fine sandy loam, 0 to 2% slope

Subregion (LRR): M
Latitude: 4962611 mN
Longitude: 462207 mE
Datum: UTM 83 Meters, Zone 15

Cowardin Classification: Upland
Circular 39 Classification: Upland
Mapped NWI Classification: PFO1A

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

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

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
Indicators of wetland hydrology present? No
Is the sampled area within a wetland? No

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

If yes, optional Wetland Site ID: Upland

VEGETATION

Tree Stratum (Plot Size: 30 ft)

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Acer negundo	15	Yes	FAC
2.		0		
3.		0		
4.		0		
	Total Cover:	15		

Sapling/Shrub Stratum (Plot Size: 15 ft)

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Salix interior	10	Yes	FACW
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	10		

Herb Stratum (Plot Size: 5 ft)

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Phalaris arundinacea	60	Yes	FACW
2.	Cirsium arvense	20	Yes	FACU
3.	Urtica dioica	10	No	FACW
4.	Impatiens capensis	2	No	FACW
5.	Solidago canadensis	2	No	FACU
6.		0		
7.		0		
8.		0		
	Total Cover:	94		

Woody Vine Stratum (Plot Size: 30 ft)

#	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum:
% Sphagnum Moss Cover:

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

50/20 Thresholds:

	20%	50%
Tree Stratum	3	7.5
Sapling/Shrub Stratum	2	5
Herb Stratum	18.8	47
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **3** (A)
Total Number of Dominant Species Across All Strata: **4** (B)
Percent of Dominant Species That Are OBL, FACW or FAC: **75.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	82	X 2	164
FAC Species	15	X 3	45
FACU Species	22	X 4	88
UPL Species	0	X 5	0
Column Totals:	**119**	(A)	**297** (B)

Prevalence Index = B/A = **2.50**

Hydrophytic Vegetation Indicators:

- No — Rapid Test for Hydrophytic Vegetation
- Yes — Dominance Test is >50%
- Yes — 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? Yes

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 2-2 UPL

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 - 10	10YR 2/1	98	10YR 3/3	2	C	M	Sandy Loam	
2.	10 - 18	10YR 3/2						Loamy Sand	
3.	18 - 28	10YR 4/2						Sand	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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):	17
Saturation present? (includes capillary fringe)	☑	Saturation Depth (inches):	14

Indicators of wetland hydrology present? No

Describe Recorded Data:

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

Hydrology Remarks:

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WETLAND DETERMINATION DATA FORM - Midwest Region

Project/Site:	Lower Riley Creek Feasiblity Study - Lwr MN Reach	Applicant/Owner:	Riley Purgatory Bluff Creek WD	City/County:	Eden Prairie/ Hennepin	State:	MN	Sampling Date:	06/16/16
Investigator(s):	BKB	Section:	33	Township:	116	Range:	22	Sampling Point:	2-2 WET
Land Form:	Toeslope	Local Relief:	None	Slope %:	0	Soil Map Unit Name:	Minneiska fine sandy loam, 0 to 2% slope		
Subregion (LRR):	M	Latitude:	4962599 mN	Longitude:	462212 mE	Datum:	UTM 83 Meters, Zone 15		
Cowardin Classification:	PFO1A	Circular 39 Classification:	Type 1L	Mapped NWI Classification:	PFO1A				

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

Eggers & Reed (primary): Floodplain Forest
Eggers & Reed (secondary):
Eggers & Reed (tertiary):
Eggers & Reed (quaternary):

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
Indicators of wetland hydrology present?	Yes
Is the sampled area within a wetland?	Yes

General Remarks (explain any answers if needed): Conditions are dryer than normal within the three months prior to the site visit.

If yes, optional Wetland Site ID: Wetland 2

VEGETATION

Tree Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Fraxinus pennsylvanica	15	Yes	FACW
2.	Salix discolor	15	Yes	FACW
3.		0		
4.		0		
	Total Cover:	30		

Sapling/Shrub Stratum (Plot Size: 15 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
3.		0		
4.		0		
5.		0		
	Total Cover:	0		

Herb Stratum (Plot Size: 5 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.	Phalaris arundinacea	50	Yes	FACW
2.	Impatiens capensis	30	Yes	FACW
3.	Mentha arvensis	2	No	FACW
4.	Urtica dioica	10	No	FACW
5.		0		
6.		0		
7.		0		
8.		0		
	Total Cover:	92		

Woody Vine Stratum (Plot Size: 30 ft)

	Species	Absolute % Cover	Dominant Species?	Indicator Status
1.		0		
2.		0		
	Total Cover:	0		

% Bare Ground in Herb Stratum: ____ % Sphagnum Moss Cover: ____

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

50/20 Thresholds:

	20%	50%
Tree Stratum	6	15
Sapling/Shrub Stratum	0	0
Herb Stratum	18.4	46
Woody Vine Stratum	0	0

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW or FAC: **4** (A)

Total Number of Dominant Species Across All Strata: **4** (B)

Percent of Dominant Species That Are OBL, FACW or FAC: **100.00%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:	
OBL Species	0	X 1	0
FACW Species	122	X 2	244
FAC Species	0	X 3	0
FACU Species	0	X 4	0
UPL Species	0	X 5	0
Column Totals:	**122**	(A)	**244** (B)

Prevalence Index = B/A = **2.00**

Hydrophytic Vegetation Indicators:

No	Rapid Test for Hydrophytic Vegetation
Yes	Dominance Test is >50%
Yes	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? Yes

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WETLAND DETERMINATION DATA FORM - Midwest Region

SOIL

Sampling Point: 2-2 WET

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 %	Type [1]	Loc [2]	Texture	Remarks
1.	0 - 7	10YR 3/1	98	10YR 3/3	2	C	M	Sandy Loam	
2.	7 - 18	10YR 2/1	95	10YR 3/3	5	C	M	Sandy Clay	
3.	18 - 27	10YR 2/1						Sandy Muck	
4.	-								
5.	-								
6.	-								

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked 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)
- ☐ Dark Surface (S7)
- ☐ Iron-Manganese Masses (F12)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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

Soil 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)
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- ☐ Hydrogen Sulfide Odor (C1)
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- ☐ 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):	11
Saturation present? (includes capillary fringe)	☑	Saturation Depth (inches):	8

Indicators of wetland hydrology present? Yes

Describe Recorded Data:

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

Hydrology Remarks:

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Appendix B

Site Photographs

Appendix B – Lower Riley Creek Wetland and Waterbody Delineations
Site Photos

Photo 1 – June 17, 2016

Wetland 1 (Reach E)

Wetland 1 is a shallow open water wetland dominated by lesser duckweed.

Photo 2 – June 17, 2016

NWP – 1 (Reach E)

Area within NWP-1 was dominated by upland plant species. No hydrology or hydric soils were observed.

Photo 3 – June 17, 2016

NWP – 2 (Reach E)

Area within NWP-2 was dominated by wetland vegetation and hydrc soils. Wetland hydrology was not present.

Appendix B – Lower Riley Creek Wetland and Waterbody Delineations
Site Photos

Photo 4 – June 17, 2016 **NWP – 3 (Reach E)** NWP-3 is a narrow rocky and sandy swale with steep side slopes along its edges dominated by wood nettle. Bottom of the swale was pure sand underlain by a rocky impenetrable substrate or rocky at the surface. No hydrology was observed.	
Photo 5 – June 17, 2016 **Riley Creek (Reach E)** Typical view of Riley Creek facing downstream looking north. Much of the creek edges are steep and eroding.	
Photo 6 – June 16, 2016 **Riley Creek (Lower Minnesota Reach)** Facing NW at culvert that extends beneath Hwy 61. This is the start point of the Lower Minnesota Reach, which extends toward Grass last to the south of this point.	

Appendix B – Lower Riley Creek Wetland and Waterbody Delineations
Site Photos

Photo 7 – June 16, 2016

Riley Creek
(Lower Minnesota Reach)

Typical view of Riley Creek facing downstream to the south. Side slopes along this reach are not as tall and steep as Reach E

Photo 8 – June 16, 2016

Riley Creek
(Lower Minnesota Reach)

View of Riley Creek looking upstream to the north near the edge of Wetland 2. Stream bank elevations decline as Riley Creek extends closer to Wetland 2.

Photo 9 – June 16, 2016

Riley Creek
(Lower Minnesota Reach)

Facing downstream to the south at the floodplain forest community wetland boundary.

Appendix I

Stream Stabilization Examples

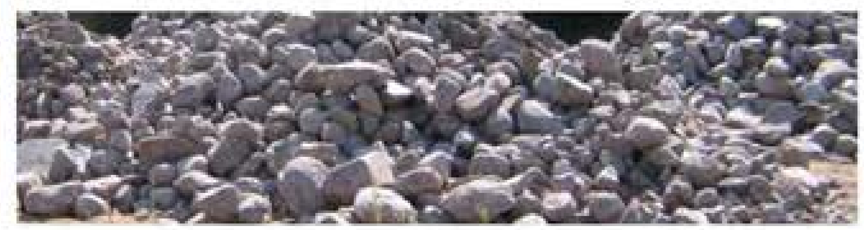
Stream Stabilization Plan

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.

MATERIALS

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



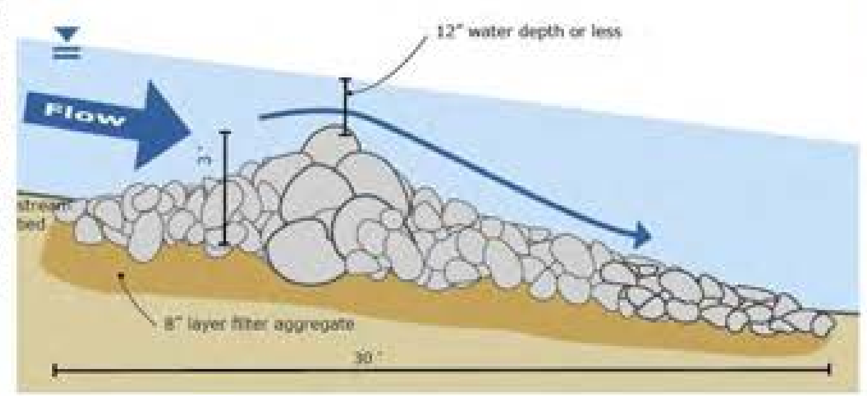
SIMILAR PROJECTS

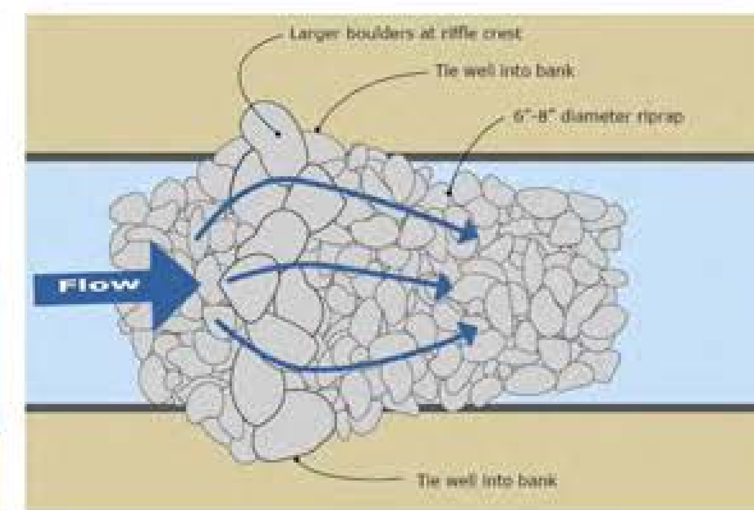
Following the 1987 "super storm," a rapids was constructed on Nine Mile Creek downstream of the 106th Street Bridge. The rapids was one of several grade-control structures that were installed on a three-mile stretch of creek in the lower valley. The proposal allowed the stream to continue its course 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.

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

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.

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).

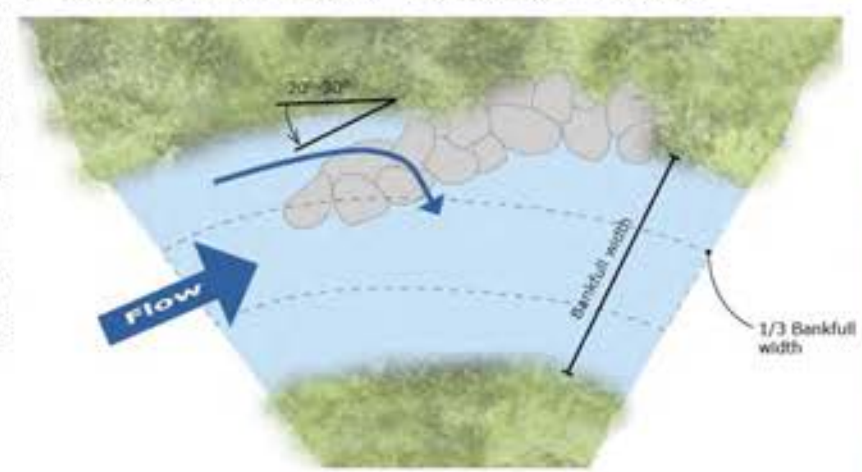
MATERIALS

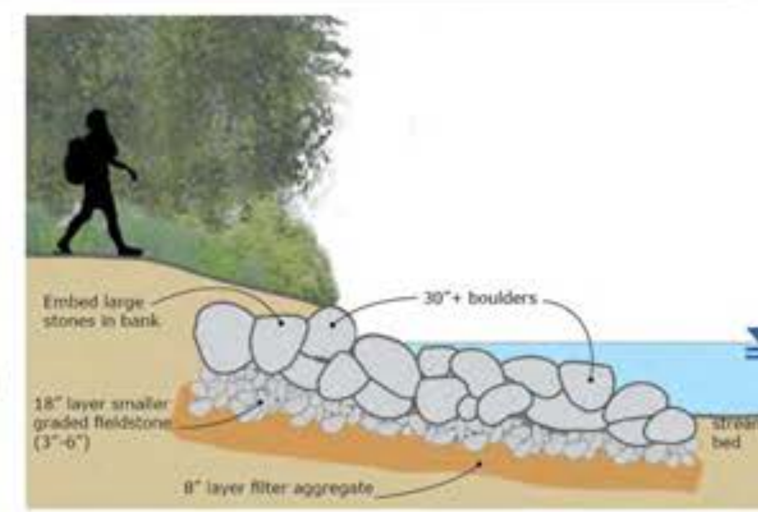
Materials will consist of various gradations of rock, ranging from large, 3-foot boulders to coarse gravel.

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

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.

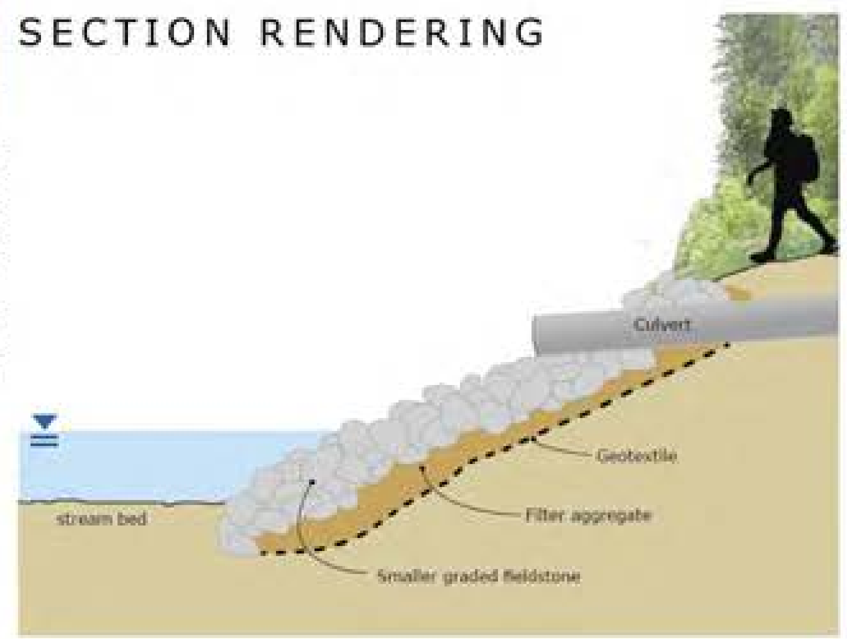
SIMILAR PROJECTS

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



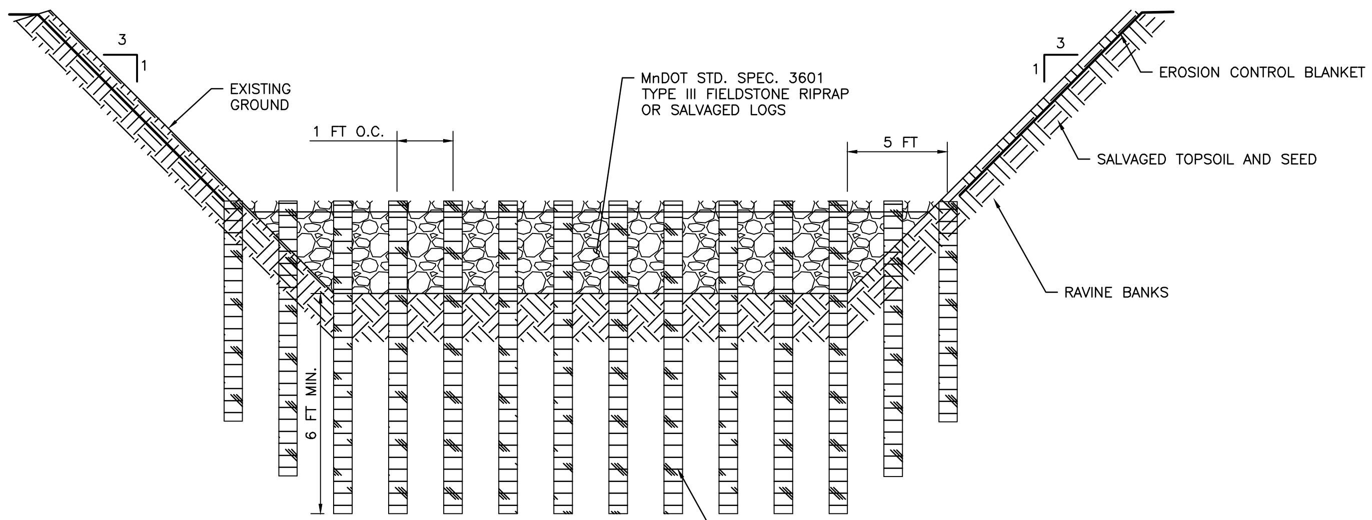
MATERIALS

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

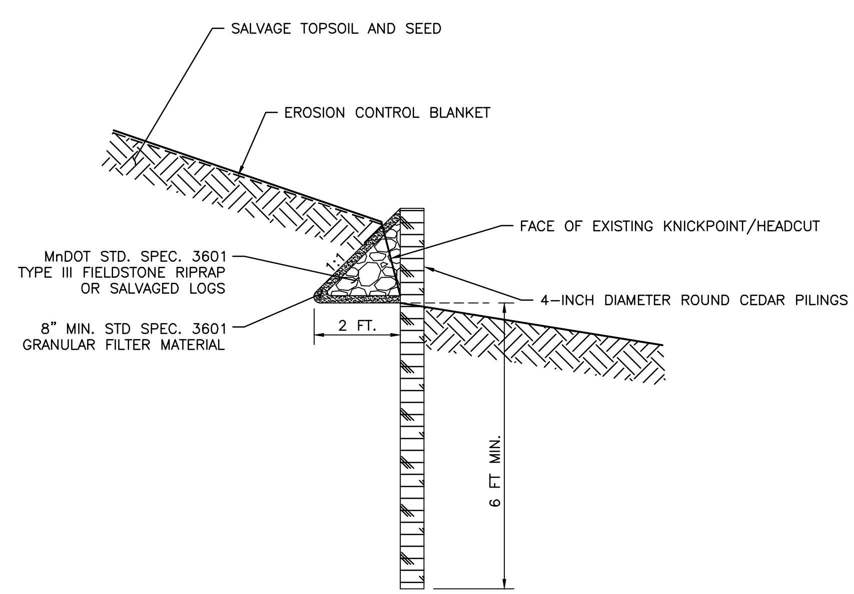
BARR



1 DETAIL: CEDAR PILINGS
NOT TO SCALE

CEDAR PILINGS SPECIFICATIONS:

1. CEDAR PILING MATERIAL: 4-INCH DIAMETER ROUND NORTHERN WHITE CEDAR; CUT FROM LIVE, GROWING TREES; MANUFACTURED IN ACCORDANCE WITH Mn/DOT STD. SPEC. 3413C
2. DRIVE POSTS AT THE SPACING AND TO THE PENETRATION DEPTHS SHOWN ON THE DRAWINGS
3. TOP OF POSTS APPROXIMATELY 0.5-FT. ABOVE CHANNEL BOTTOM.
4. IN THE EVENT THAT POSTS CANNOT BE DRIVEN, EXCAVATE A NARROW TRENCH, BACKFILL WITH GRANULAR FILL AT LEAST 4 FEET IN DEPTH, AND THEN DRIVE POSTS TO THE ELEVATIONS SHOWN ON THE DRAWINGS. BACKFILL TO EXISTING GRADE WITH GRANULAR FILL.
5. EXCAVATE 2 FEET BEHIND PILINGS AND BACKFILL WITH 8" MnDOT STD. SPEC 3601 GRANULAR FILTER MATERIAL AND TYPE III FIELDSTONE RIPRAP AS SHOWN ON DRAWING.
6. BACKFILL WITH EXISTING MATERIAL TO EXISTING GRADE.
7. ON ALL DISTURBED BANKS AND AREAS REPLACE SALAVAGED TOPSOIL, RE-VEGETATE AND STABILIZE WITH EROSION CONTROL BLANKET AS SPECIFIED IN THE CONTRACT DOCUMENTS.



2 SECTION: CEDAR PILINGS
NOT TO SCALE

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

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.

PRINTED NAME ______

SIGNATURE ______

DATE ______ LICENSE # ______

RELEASED TO/FOR	A	B	C	0	1	2	3
CLIENT							
BID							
CONSTRUCTION							
PERMITTING							

DATE RELEASED

BARR
Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

Scale	AS SHOWN
Date	6/15/16
Drawn	JPP
Checked	LAD
Designed	JPP
Approved	LAD

CEDAR PILES AND RIPRAP APRON DETAILS

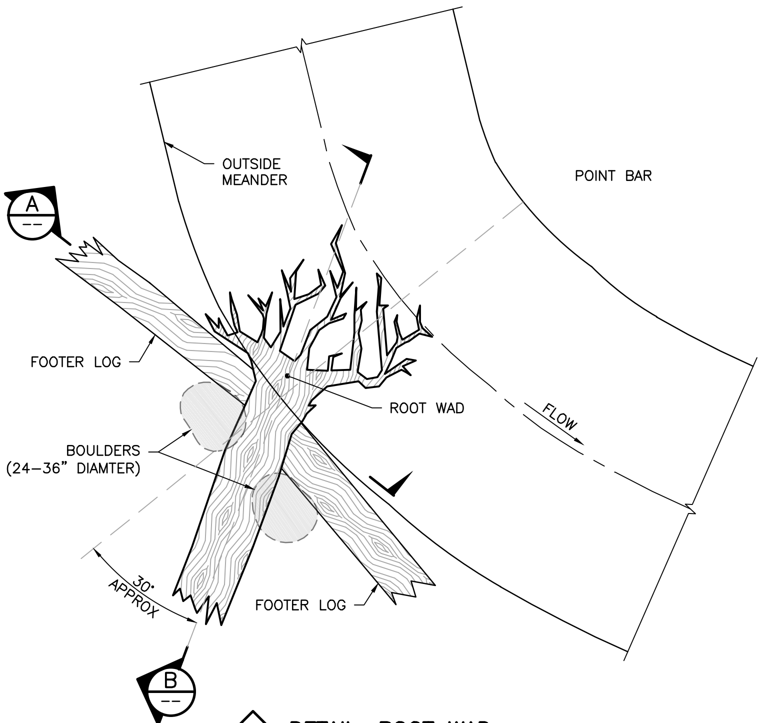
BARR PROJECT No.

CLIENT PROJECT No.

DWG. No.

REV. No. 0

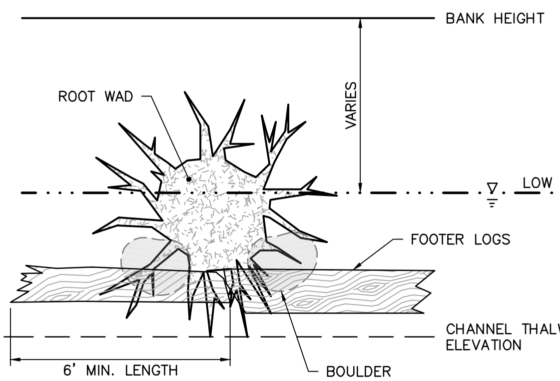
CADD USER: ADAM K. HOWARD FILE: P:\MPLS\23 MN\27\2327053\WORKFILES\TASK ORDERS_TO_14_LOWER_RILEY_FEASIBILITY_STUDY\FEASIBILITY STUDY\FEASIBILITY STUDY REPORT\APPENDICES\APPENDIX I - STABILIZATION EXAMPLES\CEDARPILINGS.DWG PLOT SCALE: 1:2 PLOT DATE: 10/9/2016 3:25 PM



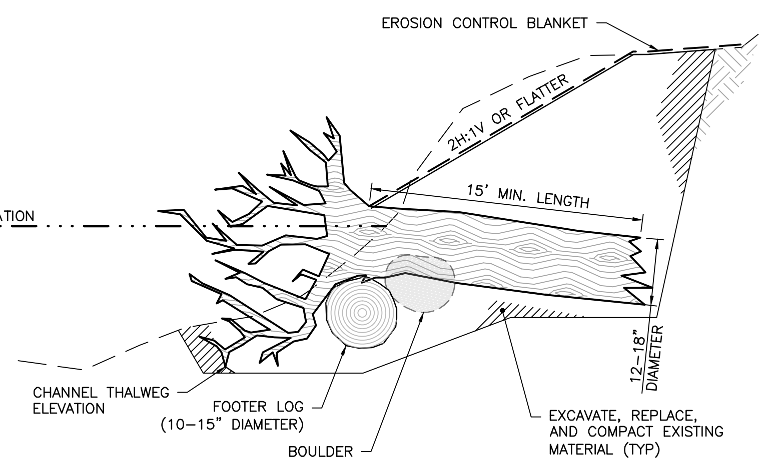
DETAIL: ROOT WAD
NOT TO SCALE

GENERAL NOTES:

1. THE ENGINEER MUST BE NOTIFIED AT LEAST 3 DAYS PRIOR TO ROOT WAD INSTALLATION AND MUST BE ON SITE DURING INSTALLATION.
2. TO THE EXTENT POSSIBLE, ROOT WADS SHOULD BE CREATED FROM TREES THAT WILL BE REMOVED FROM THE SITES WITHIN THE PROJECT AREA.
3. CONSTRUCTION SHOULD PROCEED FROM DOWNSTREAM TO UPSTREAM IN AREAS WHERE MORE THAN ONE ROOT WAD WILL BE INSTALLED AS SHOWN ON THE DRAWINGS.
4. EXCAVATE A TRENCH ALONG THE STREAMBANK TOE FOR THE FOOTER LOGS.
5. PLACE THE FOOTER LOGS INTO THE TRENCH, WITH THE TOPS OF THE LOGS AT SPECIFIED ELEVATIONS FOR EACH SITE.
6. EXCAVATE A TRENCH IN WHICH TO PLACE THE ROOT WAD. IN SOFT SOILS IT MAY BE POSSIBLE TO DRIVE THE ROOT WAD INTO THE BANK WITH EQUIPMENT AFTER SHARPENING THE END TO A POINT. CARE SHALL BE TAKEN NOT TO DAMAGE THE ROOT WAD.
7. THE ROOT WAD MUST BE PLACED IN THE BANK SO THAT THE BACK OF THE ROOT FAN RESTS AGAINST THE FRONT OF THE FOOTER LOG.
8. THE ROOT FAN MUST BE PLACED SUCH THAT THE FAN IS ANGLED UPSTREAM AS SHOWN AND AS DIRECTED BY THE ENGINEEER.
9. MOVING UPSTREAM, THE PROCESS IS REPEATED FOR EACH ADDITIONAL ROOT WAD AS SHOWN ON THE DRAWINGS.
10. LARGE BOULDERS ARE PLACED ON EITHER SIDE OF THE TRUNK OF EACH ROOTWAD.
11. PLACE BACK FILL OVER THE BOULDERS AS NECESSARY WITH A COARSE FILTER AGGREGATE (MN/DOT STANDARD SPECIFICATION 3142.2H) AND MATCH EXISTING GRADE WITH 6" OF TOPSOIL.
12. REVEGETATE AND STABILIZE WITH EROSION CONTROL BLANKET AS SPECIFIED FOR EACH SITE AS SHOWN IN THE DRAWINGS AND DIRECTED BY THE ENGINEER.
13. TRIM THE ROOTS THAT EXTEND ABOVE THE STREAM BANK TO A HEIGHT SLIGHTLY BELOW BANK HEIGHT AS DIRECTED BY THE ENGINEER.



A SECTION: ROOT WAD
NOT TO SCALE



B SECTION: ROOT WAD
NOT TO SCALE

CADD USER: ADAM K. HOWARD FILE: M:\DESIGN\23821067.00\SR_BANK PROTECTION – ROOT WAD.DWG PLOT SCALE: 1:1 PLOT DATE: 10/9/2016 3:34 PM

BARR

CREATED BY: PEB
LAST EDITED BY: PEB, 10/9/16
KNOWLEDGEABLE PERSONS:
JTL2, TEM, PJH2, JDW

STREAM RESTORATION DETAILS
BANK PROTECTION
ROOT WAD

Appendix J

Detailed Cost Estimates

Cost Estimate

Engineer's opinions of probable costs for design, permitting, and construction were developed for each conceptual design. These opinions of costs, project reserves, contingency, documentation and discussion are intended to provide background information for feasibility alternatives assessment, analysis purposes and budget authorization by the RPBCWD. The cost of time escalation is not included in the opinions of probable cost. All costs are presented in 2016 US dollars. Quantities were estimated with calculations based on available information presented in the Engineer's Report.

Unit costs are based on recent bid prices, published construction cost index resources, and similar stormwater BMP projects. Unit process were developed and compared to similar project prices. Costs associated with Base Planning Engineering and Design (PED) are based on percentages of estimated construction cost and are within a range similar to those used in past projects designed by Barr. Costs associated with Construction Management (CM) are based on estimated costs to manage the construction process, based on Barr's experience with similar projects, but may change depending on the services that are provided during construction. The estimates also include Permitting and Regulatory Approvals, which is intended to account for additional planning, coordination, and mitigation costs that are likely to be incurred as the project is permitted with environmental agencies.

The opinions of cost include tasks and items related to engineering and design, permitting, constructing each conceptual design, and vegetation monitoring. The opinions of cost do not include other tasks following construction of each alternative presented such as operations and maintenance, or other forms of monitoring.

Contingency used in these opinions of probable cost are intended to help identify an estimated construction cost amount for the minor items included in the current Project scope, but have not yet been quantified or estimated directly during the feasibility evaluation. Stated another way, contingency is the resultant of the pluses and minuses that cannot be estimated at the level of project definition that exists. The contingency includes the cost of ancillary items not currently itemized in the quantity summaries but commonly identified in more detailed design and required for completeness of the work. A 25% contingency is applied to the estimated construction cost to account for the costs of these items.

Industry resources for cost estimating (*AACE International Recommended Practice No. 18R-97, and ASTM E2516-06 Standard Classification for Cost Estimate Classification System*) provide guidance on cost uncertainty, depending on the level of project design developed. The opinion of probable cost for the alternatives evaluated generally corresponds to a Class 3 estimate characterized by completion of limited engineering and use of deterministic estimating methods. As the level of design detail increases, the level of uncertainty is reduced. Figure J-1 provides a graphic representation of how uncertainty (or accuracy) of cost estimates can be expected to improve as more detailed design is developed.

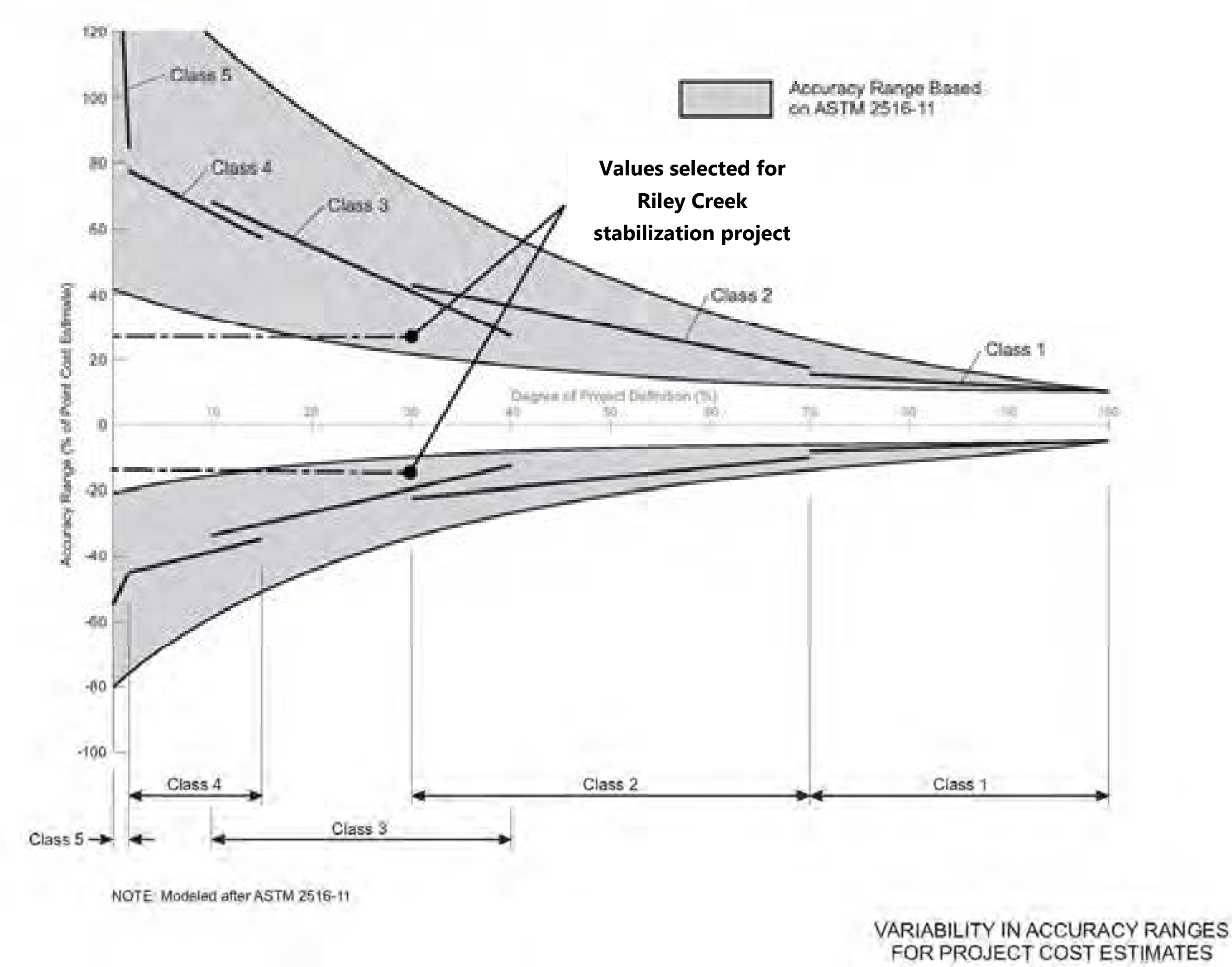


Figure J-1 Relationship between Cost Accuracy and Degree of Project Definition

At this early stage of design, the range of uncertainty of total project cost is high. Due to the early stage of design, it is standard practice to place a broad accuracy range around the point cost estimate.

The accuracy range is based on professional judgment considering the level of design completed, the complexity of the project, and the uncertainties in the project scope; the accuracy range does not include costs for future scope changes that are not part of the project as currently defined or risk contingency. The estimated accuracy range for this point estimate is -15% to +25%.

The opinion of probable cost provided in this engineer's report is made on the basis of Barr Engineering's experience and qualifications and represents our best judgment as experienced and qualified professionals familiar with the project. It is acknowledged that additional investigations and additional site specific information that becomes available in the next stage of design may result in changes to the proposed configuration, cost and functioning of project features. This opinion is based on project-related information available to Barr Engineering at this time and includes a conceptual-level feasibility design of the project. The opinion of cost may change as more information becomes available and further design is completed. In addition, because we have no control over the eventual cost of labor, materials, equipment or services furnished by others, or over the contractor's methods of determining prices, or over competitive bidding or market conditions, Barr Engineering cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinion of probable cost presented in this memorandum. If the RPBCWD wishes greater assurance as to the probable project cost, the RPBCWD should authorize further investigation and design of a selected alternative.

References

American Society for Testing and Materials. 2006. ASTM E2516-06 Standard Classification for Cost Estimate Classification System. ASTM International, West Conshohocken, PA, DOI: 10.1520/E2516-06

Association for the Advancement of Cost Estimating. 2005. *AACE International Recommended Practice NO. 18R-97*, February 2, 2005.

Riley Purgatory Bluff Creek Watershed District

Reach E and Site D3 Cost Estimates

Appendix I Riley Creek Reach E3 and Site D3 recommended alternatives cost summary

Reach	Station	Alternative	Alternative Description	Construction Cost Estimate[1]	Annualized Cost [2]	TP Loading		TSS Loading	
						Load Reduction (lb/yr)	Cost/lb Reduced[3]	Load Reduction (lb/yr)	Cost/lb Reduced[3]
Ravine D3	NA	Alternative B	Stabilize culvert outfall with riprap, raise existing berms by 1-ft, stabilize bottom 2/3 with eight cross checks and grade/stabilize scarp surface	$289,000	$ 20,250	$ 193	$ 105	$ 336,000	$ 0.06
Reach E1	90+00 to 108+00	Alternative A2	Four rock riffles, two scarp toe stabilizations, two scarp stabilizations	$312,000	$ 21,800	$ 187	$ 117	$ 325,330	$ 0.07
Reach E2	108+00 to 120+00	Alternative A2	Three rock riffles, seven scarp toe stabilizations, seven scarp stabilizations, stabilize culvert outfall	$554,000	$ 38,800	$ 491	$ 79	$ 854,000	$ 0.05
Reach E3	120+00 to 141+00	Alternative A2	Three rock riffles, two scarp toe stabilizations, two scarp stabilizations, three stabilize culvert oufalls	$360,000	$ 25,200	$ 390	$ 65	$ 678,400	$ 0.04
			Project Totals*	**$ 1,515,000**	**$ 106,050**	**1261**	**$ 84**	**2,193,730**	**$ 0.05**

* Costs may not sum due to rounding.

(1) A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for planning, engineering, and design, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed

(2) Assumed to be 2% of the total project cost for annual maintenance plus the initial project cost distributed evenly over a 20 year project lifespan.

(3) Annualized cost divided by estimated annual pollution load reduction.

Appendix I Riley Creek feasibility study Reach E and Site D3 cost estimate

Reach	Station	Alternative	Project Cost Estimate (1)	Annualized Maintenance Cost (2)
Ravine D3	NA	Alternative A	$173,000 ($147,000-$208,000)	$3,500 ($2,900-$4,200)
Ravine D3	NA	Alternative B	$289,000 ($246,000-$347,000)	$5,800 ($4,900-$6,900)
Reach E1	90+00 to 108+00	Alternative A1	$305,000 ($259,000-$366,000)	$6,100 ($5,200-$7,300)
Reach E1	90+00 to 108+00	Alternative A2	$312,000 ($265,000-$374,000)	$6,200 ($5,300-$7,500)
Reach E1	90+00 to 108+00	Alternative B1	$635,000 ($540,000-$762,000)	$12,700 ($10,800-$15,200)
Reach E1	90+00 to 108+00	Alternative B2	$641,000 ($545,000-$769,000)	$12,800 ($10,900-$15,400)
Reach E2	108+00 to 120+00	Alternative A1	$499,000 ($424,000-$599,000)	$10,000 ($8,500-$12,000)
Reach E2	108+00 to 120+00	Alternative A2	$554,000 ($471,000-$665,000)	$11,100 ($9,400-$13,300)
Reach E2	108+00 to 120+00	Alternative B1	$656,000 ($558,000-$787,000)	$13,100 ($11,200-$15,700)
Reach E2	108+00 to 120+00	Alternative B2	$711,000 ($604,000-$853,000)	$14,200 ($12,100-$17,100)
Reach E3	120+00 to 141+00	Alternative A1	$349,000 ($297,000-$419,000)	$7,000 ($5,900-$8,400)
Reach E3	120+00 to 141+00	Alternative A2	$360,000 ($306,000-$432,000)	$7,200 ($6,100-$8,600)
Reach E3	120+00 to 141+00	Alternative B1	$772,000 ($656,000-$926,000)	$15,400 ($13,100-$18,500)
Reach E3	120+00 to 141+00	Alternative B2	$781,000 ($664,000-$937,000)	$15,600 ($13,300-$18,700)
Combination 1 (Ravine D3 Alt A, Reach 1 Alt A1, Reach 2 Alt A1, Reach 3 Alt A1)*			$1,326,000 ($1,127,000-$1,592,000)	$26,600 ($22,500-$31,900)
Combination 2 (Ravine D3 Alt A, Reach 1 Alt A2, Reach 2 Alt A2, Reach 3 Alt A2)*			$1,399,000 ($1,189,000-$1,679,000)	$28,000 ($23,700-$33,600)
Combination 3 (Ravine D3 Alt B, Reach 1 Alt A2, Reach 2 Alt A2, Reach 3 Alt A2)*			$1,515,000 ($1,288,000-$1,818,000)	$30,300 ($25,700-$36,300)
Combination 4 (Ravine D3 Alt A, Reach 1 Alt B1, Reach 2 Alt B1, Reach 3 Alt B1)*			$2,236,000 ($1,901,000-$2,683,000)	$44,700 ($38,000-$53,600)
Combination 5 (Ravine D3 Alt B, Reach 1 Alt B2, Reach 2 Alt B2, Reach 3 Alt B2)*			$2,422,000 ($2,059,000-$2,906,000)	$48,400 ($41,200-$58,100)

* Costs may not sum due to rounding.

(1) A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for planning, engineering, and design, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

(2) Assumed to be 2% of the total project cost

Preliminary Cost Estimate for Ravine D3, Alt A RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$10,792	$10,790
Control of Water	LS	1	$2,017	$2,020
Erosion Control	LS	1	$3,026	$3,030
Clearing and Grubbing	ACRE	0.8	$7,000	$5,740
Select Tree Removal (>4")	EACH	10	$400	$4,000
Excavate/Salvage Soil	CY	1941	$12	$23,290
Grading	SY	1747	$6	$10,480
36" RCP Culvert	LF	524	$76	$39,820
36" Flared End Section	EACH	1	$1,245	$1,250
Connections to Existing Manholes	EACH	1	$500	$500
48" Manhole	EACH	1	$3,000	$3,000
Furnish and Install Fieldstone Ripra	TON	16	$100	$1,560
Seeding and Mulch	ACRE	0.8	$8,000	$6,560
Plant Trees	Each	10.0	$250	$2,500
Erosion Control Blanket	SY	715	$3	$2,150
One-Year Establishment Maintenance Period	LS	1	$2,017	$2,020
			Construction Total	**$ 118,710**
			Construction Total w/ Contingency (15%)	$ 136,517
			Planning, Engineering & Design (20%)	$ 27,303
			Construction Management (7%)	$ 9,556
			Project Total	**$ 173,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 147,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 208,000**
			Annual Maintenance Cost (2%)	**$ 3,460**
			Annual Maintenance Cost Lower Bound (2%)	**$ 2,940**
			Annual Maintenance Cost Upper Bound (2%)	**$ 4,160**

Preliminary Cost Estimate for Ravine D3, Alt B RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$17,965	$17,970
Control of Water	LS	1	$3,358	$3,360
Erosion Control	LS	1	$5,037	$5,040
Clearing and Grubbing	ACRE	0.8	$7,000	$5,740
Select Tree Removal (>4")	EACH	10	$400	$4,000
Excavate/Salvage Soil	CY	356	$12	$4,270
Grading	SY	1747	$6	$10,480
Scarp Toe Stabilization	LF	202	$300	$60,600
Scarp Stabilization	SY	744	$30	$22,330
Furnish and Install Fieldstone Ripra	TON	20	$100	$2,000
Rock Riffles	EACH	8	$5,000	$40,000
Seeding and Mulch	ACRE	0.8	$8,000	$6,560
Erosion Control Blanket	SY	3969	$3	$11,910
One-Year Establishment Maintenance Period	LS	1	$3,358	$3,360
			Construction Total	**$ 197,620**
			Construction Total w/ Contingency (15%)	$ 227,263
			Planning, Engineering & Design (20%)	$ 45,453
			Construction Management (7%)	$ 15,908
			Project Total	**$ 289,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 246,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 347,000**
			Annual Maintenance Cost (2%)	**$ 5,780**
			Annual Maintenance Cost Lower Bound (2%)	**$ 4,920**
			Annual Maintenance Cost Upper Bound (2%)	**$ 6,940**

Preliminary Cost Estimate for Reach 1, Station 90+00 - 108+00 Alternative A1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$19,006	$19,010
Control of Water	LS	1	$3,553	$3,550
Erosion Control	LS	1	$5,329	$5,330
Clearing and Grubbing	ACRE	0.6	$7,000	$3,860
Select Tree Removal (>4")	EACH	60	$400	$24,000
Grading	SY	2667	$6	$16,000
Scarp Toe Stabilization	LF	90	$300	$27,000
Rock Riffles	EACH	4	$10,000	$40,000
Topsoil Import	CY	444	$33	$14,670
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	60	$250	$15,000
Seeding and Mulch	ACRE	0.6	$8,000	$4,410
Erosion Control Blanket	SY	480	$3	$1,440
One-Year Establishment Maintenance Period	LS	1	$3,553	$3,550
			Construction Total	**$ 209,070**
			Construction Total w/ Contingency (15%)	$ 240,431
			Planning, Engineering & Design (20%)	$ 48,086
			Construction Management (7%)	$ 16,830
			Project Total	**$ 305,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 259,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 366,000**
			Annual Maintenance Cost (2%)	**$ 6,100**
			Annual Maintenance Cost Lower Bound (2%)	**$ 5,180**
			Annual Maintenance Cost Upper Bound (2%)	**$ 7,320**

Preliminary Cost Estimate for Reach 1, Station 90+00 - 108+00 Alternative A2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$19,433	$19,430
Control of Water	LS	1	$3,605	$3,610
Erosion Control	LS	1	$5,408	$5,410
Clearing and Grubbing	ACRE	0.6	$7,000	$3,860
Select Tree Removal (>4")	EACH	60	$400	$24,000
Grading	SY	2667	$6	$16,000
Scarp Toe Stabilization	LF	90	$300	$27,000
Scarp Stabilization	SY	136	$30	$4,070
Rock Riffles	EACH	4	$10,000	$40,000
Plant Trees	EACH	60	$250	$15,000
Topsoil Import	CY	444	$33	$14,670
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Seeding and Mulch	ACRE	0.6	$8,000	$4,410
Erosion Control Blanket	SY	480	$3	$1,440
One-Year Establishment Maintenance Period	LS	1	$3,605	$3,610
Construction Total				**$ 213,760**
Construction Total w/ Contingency (15%)				$ 245,824
Planning, Engineering & Design (20%)				$ 49,165
Construction Management (7%)				$ 17,208
Project Total				**$ 312,000**
Total w/ Construction Lower Bound (-15%), Legal, and Engineering				**$ 265,000**
Total w/ Construction Upper Bound (+20%), Legal, and Engineering				**$ 374,000**
Annual Maintenance Cost (2%)				**$ 6,240**
Annual Maintenance Cost Lower Bound (2%)				**$ 5,300**
Annual Maintenance Cost Upper Bound (2%)				**$ 7,480**

Preliminary Cost Estimate for Reach 1, Station 90+00 - 108+00 Alternative B1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$39,527	$39,530
Control of Water	LS	1	$7,307	$7,310
Erosion Control	LS	1	$10,961	$10,960
Clearing and Grubbing	ACRE	1.7	$7,000	$11,570
Select Tree Removal (>4")	EACH	100	$400	$40,000
Floodplain Excavation	CY	5333	$25	$133,330
Grading	SY	4000	$6	$24,000
Scarp Toe Stabilization	LF	90	$300	$27,000
Cross Vanes	EACH	4	$4,000	$16,000
Topsoil Import	CY	1333	$33	$44,000
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	100	$250	$25,000
Seeding and Mulch	ACRE	1.7	$8,000	$13,220
Erosion Control Blanket	SY	1441	$3	$4,320
One-Year Establishment Maintenance Period	LS	1	$7,307	$7,310
			Construction Total	**$ 434,800**
			Construction Total w/ Contingency (15%)	$ 500,020
			Planning, Engineering & Design (20%)	$ 100,004
			Construction Management (7%)	$ 35,001
			Project Total	**$ 635,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 540,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 762,000**
			Annual Maintenance Cost (2%)	**$ 12,700**
			Annual Maintenance Cost Lower Bound (2%)	**$ 10,800**
			Annual Maintenance Cost Upper Bound (2%)	**$ 15,240**

Preliminary Cost Estimate for Reach 1, Station 90+00 - 108+00 Alternative B2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$39,869	$39,870
Control of Water	LS	1	$7,124	$7,120
Erosion Control	LS	1	$10,687	$10,690
Clearing and Grubbing	ACRE	1.7	$7,000	$11,570
Select Tree Removal (>4")	EACH	100	$400	$40,000
Floodplain Excavation	CY	5333	$25	$133,330
Grading	SY	4000	$6	$24,000
Scarp Toe Stabilization	LF	90	$300	$27,000
Scarp Stabilization	SY	136	$30	$4,070
Cross Vanes	EACH	4	$4,000	$16,000
Topsoil Import	CY	1333	$33	$44,000
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	100	$250	$25,000
Seeding and Mulch	ACRE	1.7	$8,000	$13,220
Erosion Control Blanket	SY	1441	$3	$4,320
One-Year Establishment Maintenance Period	LS	1	$7,124	$7,120
			Construction Total	**$ 438,560**
			Construction Total w/ Contingency (15%)	$ 504,344
			Planning, Engineering & Design (20%)	$ 100,869
			Construction Management (7%)	$ 35,304
			Project Total	**$ 641,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 545,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 769,000**
			Annual Maintenance Cost (2%)	**$ 12,820**
			Annual Maintenance Cost Lower Bound (2%)	**$ 10,900**
			Annual Maintenance Cost Upper Bound (2%)	**$ 15,380**

Preliminary Cost Estimate for Reach 2, Station 108+00 - 120+00 Alternative A1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$31,036	$31,040
Control of Water	LS	1	$5,664	$5,660
Erosion Control	LS	1	$8,496	$8,500
Clearing and Grubbing	ACRE	0.7	$7,000	$4,840
Select Tree Removal (>4")	EACH	75	$400	$30,000
Grading	SY	3344	$6	$20,070
Scarp Toe Stabilization	LF	427	$300	$128,100
Rock Riffles	EACH	3	$10,000	$30,000
Furnish and Install Fieldstone Ripr	TON	10	$100	$1,040
36" RCP Culvert	LF	10	$76	$760
Topsoil Import	CY	557	$33	$18,390
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	75	$250	$18,750
Seeding and Mulch	ACRE	0.7	$8,000	$5,530
Erosion Control Blanket	SY	603	$3	$1,810
One-Year Establishment Maintenance Period	LS	1	$5,664	$5,660
			Construction Total	**$ 341,400**
			Construction Total w/ Contingency (15%)	$ 392,610
			Planning, Engineering & Design (20%)	$ 78,522
			Construction Management (7%)	$ 27,483
			Project Total	**$ 499,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 424,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 599,000**
			Annual Maintenance Cost (2%)	**$ 9,980**
			Annual Maintenance Cost Lower Bound (2%)	**$ 8,480**
			Annual Maintenance Cost Upper Bound (2%)	**$ 11,980**

Preliminary Cost Estimate for Reach 2, Station 108+00 - 120+00 Alternative A2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$34,471	$34,470
Control of Water	LS	1	$5,955	$5,960
Erosion Control	LS	1	$8,933	$8,930
Clearing and Grubbing	ACRE	0.7	$7,000	$4,840
Select Tree Removal (>4")	EACH	75	$400	$30,000
Grading	SY	3344	$6	$20,070
Scarp Toe Stabilization	LF	427	$300	$128,100
Scarp Stabilization	SY	1111	$30	$33,320
Rock Riffles	EACH	3	$10,000	$30,000
Furnish and Install Fieldstone Ripr	TON	10	$100	$1,040
36" RCP Culvert	LF	10	$76	$760
Topsoil Import	CY	557	$33	$18,390
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	75	$250	$18,750
Seeding and Mulch	ACRE	0.7	$8,000	$5,530
Erosion Control Blanket	SY	603	$3	$1,810
One-Year Establishment Maintenance Period	LS	1	$5,955	$5,960
			Construction Total	**$ 379,180**
			Construction Total w/ Contingency (15%)	$ 436,057
			Planning, Engineering & Design (20%)	$ 87,211
			Construction Management (7%)	$ 30,524
			Project Total	**$ 554,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 471,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 665,000**
			Annual Maintenance Cost (2%)	**$ 11,080**
			Annual Maintenance Cost Lower Bound (2%)	**$ 9,420**
			Annual Maintenance Cost Upper Bound (2%)	**$ 13,300**

Preliminary Cost Estimate for Reach 2, Station 108+00 - 120+00 Alternative B1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$40,825	$40,830
Control of Water	LS	1	$7,025	$7,030
Erosion Control	LS	1	$10,538	$10,540
Clearing and Grubbing	ACRE	1.3	$7,000	$9,000
Select Tree Removal (>4")	EACH	75	$400	$30,000
Floodplain Excavation	CY	3556	$25	$88,890
Grading	SY	2667	$6	$16,000
Scarp Toe Stabilization	LF	427	$300	$128,100
Cross Vanes	EACH	3	$4,000	$12,000
Furnish and Install Fieldstone Ripr	TON	10	$100	$1,040
36" RCP Culvert	LF	10	$76	$760
Topsoil Import	CY	1037	$33	$34,220
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	75	$250	$18,750
Seeding and Mulch	ACRE	1.3	$8,000	$10,280
Erosion Control Blanket	SY	1121	$3	$3,360
One-Year Establishment Maintenance Period	LS	1	$7,025	$7,030
			Construction Total	**$ 449,080**
			Construction Total w/ Contingency (15%)	$ 516,442
			Planning, Engineering & Design (20%)	$ 103,288
			Construction Management (7%)	$ 36,151
			Project Total	**$ 656,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 558,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 787,000**
			Annual Maintenance Cost (2%)	**$ 13,120**
			Annual Maintenance Cost Lower Bound (2%)	**$ 11,160**
			Annual Maintenance Cost Upper Bound (2%)	**$ 15,740**

Preliminary Cost Estimate for Reach 2, Station 108+00 - 120+00 Alternative B2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$44,249	$44,250
Control of Water	LS	1	$7,292	$7,290
Erosion Control	LS	1	$10,937	$10,940
Clearing and Grubbing	ACRE	1.3	$7,000	$9,000
Select Tree Removal (>4")	EACH	75	$400	$30,000
Floodplain Excavation	CY	3556	$25	$88,890
Grading	SY	2667	$6	$16,000
Scarp Toe Stabilization	LF	427	$300	$128,100
Scarp Stabilization	SY	1111	$30	$33,320
Cross Vanes	EACH	3	$4,000	$12,000
Furnish and Install Fieldstone Ripr	TON	10	$100	$1,040
36" RCP Culvert	LF	10	$76	$760
Topsoil Import	CY	1037	$33	$34,220
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	75	$250	$18,750
Seeding and Mulch	ACRE	1.3	$8,000	$10,280
Erosion Control Blanket	SY	1121	$3	$3,360
One-Year Establishment Maintenance Period	LS	1	$7,292	$7,290
			Construction Total	**$ 486,740**
			Construction Total w/ Contingency (15%)	$ 559,751
			Planning, Engineering & Design (20%)	$ 111,950
			Construction Management (7%)	$ 39,183
			Project Total	$ 711,000
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 604,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 853,000**
			Annual Maintenance Cost (2%)	**$ 14,220**
			Annual Maintenance Cost Lower Bound (2%)	**$ 12,080**
			Annual Maintenance Cost Upper Bound (2%)	**$ 17,060**

Preliminary Cost Estimate for Reach 3, Station 120+00 - 141+00 Alternative A1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$21,770	$21,770
Control of Water	LS	1	$3,863	$3,860
Erosion Control	LS	1	$5,795	$5,790
Clearing and Grubbing	ACRE	1.0	$7,000	$7,280
Select Tree Removal (>4")	EACH	45	$400	$18,000
Grading	SY	5033	$6	$30,200
Scarp Toe Stabilization	LF	107	$300	$32,100
Rock Riffles	EACH	3	$10,000	$30,000
Furnish and Install Fieldstone Ripr	TON	31	$100	$3,110
36" RCP Culvert	LF	30	$76	$2,280
Topsoil Import	CY	839	$33	$27,680
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	45	$250	$11,250
Seeding and Mulch	ACRE	1.0	$8,000	$8,320
Erosion Control Blanket	SY	907	$3	$2,720
One-Year Establishment Maintenance Period	LS	1	$3,863	$3,860
Construction Total				**$ 239,000**
Construction Total w/ Contingency (15%)				$ 274,850
Planning, Engineering & Design (20%)				$ 54,970
Construction Management (7%)				$ 19,240
Project Total				**$ 349,000**
Total w/ Construction Lower Bound (-15%), Legal, and Engineering				**$ 297,000**
Total w/ Construction Upper Bound (+20%), Legal, and Engineering				**$ 419,000**
Annual Maintenance Cost (2%)				**$ 6,980**
Annual Maintenance Cost Lower Bound (2%)				**$ 5,940**
Annual Maintenance Cost Upper Bound (2%)				**$ 8,380**

Preliminary Cost Estimate for Reach 3, Station 120+00 - 141+00 Alternative A2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$22,387	$22,390
Control of Water	LS	1	$3,768	$3,770
Erosion Control	LS	1	$5,652	$5,650
Clearing and Grubbing	ACRE	1.0	$7,000	$7,280
Select Tree Removal (>4")	EACH	45	$400	$18,000
Grading	SY	5033	$6	$30,200
Scarp Toe Stabilization	LF	107	$300	$32,100
Scarp Stabilization	SY	216	$30	$6,490
Rock Riffles	EACH	3	$10,000	$30,000
Furnish and Install Fieldstone Ripr	TON	31	$100	$3,110
36" RCP Culvert	LF	30	$76	$2,280
Topsoil Import	CY	839	$33	$27,680
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	45	$250	$11,250
Seeding and Mulch	ACRE	1.0	$8,000	$8,320
Erosion Control Blanket	SY	907	$3	$2,720
One-Year Establishment Maintenance Period	LS	1	$3,768	$3,770
			Construction Total	**$ 246,260**
			Construction Total w/ Contingency (15%)	$ 283,199
			Planning, Engineering & Design (20%)	$ 56,640
			Construction Management (7%)	$ 19,824
			Project Total	**$ 360,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 306,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 432,000**
			Annual Maintenance Cost (2%)	**$ 7,200**
			Annual Maintenance Cost Lower Bound (2%)	**$ 6,120**
			Annual Maintenance Cost Upper Bound (2%)	**$ 8,640**

Preliminary Cost Estimate for Reach 3, Station 120+00 - 141+00 Alternative B1, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$48,041	$48,040
Control of Water	LS	1	$8,045	$8,050
Erosion Control	LS	1	$12,068	$12,070
Clearing and Grubbing	ACRE	1.9	$7,000	$13,180
Select Tree Removal (>4")	EACH	120	$400	$48,000
Floodplain Excavation	CY	6222	$25	$155,560
Grading	SY	9111	$6	$54,670
Scarp Toe Stabilization	LF	107	$300	$32,100
Cross Vanes	EACH	3	$4,000	$12,000
Furnish and Install Fieldstone Ripr	TON	31	$100	$3,110
36" RCP Culvert	LF	30	$76	$2,280
Topsoil Import	CY	1519	$33	$50,110
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	120	$250	$30,000
Seeding and Mulch	ACRE	1.9	$8,000	$15,060
Erosion Control Blanket	SY	1642	$3	$4,920
One-Year Establishment Maintenance Period	LS	1	$8,045	$8,050
			Construction Total	**$ 528,450**
			Construction Total w/ Contingency (15%)	$ 607,718
			Planning, Engineering & Design (20%)	$ 121,544
			Construction Management (7%)	$ 42,540
			Project Total	**$ 772,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 656,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 926,000**
			Annual Maintenance Cost (2%)	**$ 15,440**
			Annual Maintenance Cost Lower Bound (2%)	**$ 13,120**
			Annual Maintenance Cost Upper Bound (2%)	**$ 18,520**

Preliminary Cost Estimate for Reach 3, Station 120+00 - 141+00 Alternative B2, RPBCWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$48,595	$48,600
Control of Water	LS	1	$7,775	$7,780
Erosion Control	LS	1	$11,663	$11,660
Clearing and Grubbing	ACRE	1.9	$7,000	$13,180
Select Tree Removal (>4")	EACH	120	$400	$48,000
Floodplain Excavation	CY	6222	$25	$155,560
Grading	SY	9111	$6	$54,670
Scarp Toe Stabilization	LF	107	$300	$32,100
Scarp Stabilization	SY	216	$30	$6,490
Cross Vanes	EACH	3	$4,000	$12,000
Furnish and Install Fieldstone Ripr	TON	31	$100	$3,110
36" RCP Culvert	LF	30	$76	$2,280
Topsoil Import	CY	1519	$33	$50,110
Root wads	EACH	15	$750	$11,250
Rock Boulder Vane	EACH	10	$2,000	$20,000
Plant Trees	EACH	120	$250	$30,000
Seeding and Mulch	ACRE	1.9	$8,000	$15,060
Erosion Control Blanket	SY	1642	$3	$4,920
One-Year Establishment Maintenance Period	LS	1	$7,775	$7,780
			Construction Total	**$ 534,550**
			Construction Total w/ Contingency (15%)	$ 614,733
			Planning, Engineering & Design (20%)	$ 122,947
			Construction Management (7%)	$ 43,031
			Project Total	**$ 781,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 664,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 937,000**
			Annual Maintenance Cost (2%)	**$ 15,620**
			Annual Maintenance Cost Lower Bound (2%)	**$ 13,280**
			Annual Maintenance Cost Upper Bound (2%)	**$ 18,740**

Appendix I **Riley Creek feasibility study Reach E and Site D3 TP and TSS loading reduction cost summary**

Reach	Station	Alternative	Alternative Description	Project Cost Estimate[1]	Annualized Cost[2]	TP Loading: Load Reduction (lb/yr)	TP Loading: Cost/lb Reduced[3]	TSS Loading: Load Reduction (lb/yr)	TSS Loading: Cost/lb Reduced[3]
Ravine D3	NA	Alternative A	Construct culvert and drop structure connecting existing outfall to the creek	$173,000	$12,150	182	$67	316,200	$0.04
Ravine D3	NA	Alternative B	Stabilize culvert outfall with riprap, raise existing berms by 1-ft, stabilize bottom 2/3 with eight cross checks and grade/stabilize scarp surface	$289,000	$20,250	193	$105	336,000	$0.06
Reach E1	90+00 to 108+00	Alternative A1	Four rock riffles, two scarp toe stabilizations	$305,000	$21,350	185	$115	322,530	$0.07
Reach E1	90+00 to 108+00	Alternative A2	Four rock riffles, two scarp toe stabilizations, two scarp stabilizations	$312,000	$21,800	187	$117	325,330	$0.07
Reach E1	90+00 to 108+00	Alternative B1	Four cross vanes, fill channel, floodplain excavation, two scarp toe stabilizations	$635,000	$44,450	185	$240	322,530	$0.14
Reach E1	90+00 to 108+00	Alternative B2	Four cross vanes, fill channel, floodplain excavation, two scarp toe stabilizations, two scarp stabilizations	$641,000	$44,850	187	$240	325,330	$0.14
Reach E2	108+00 to 120+00	Alternative A1	Three rock riffles, seven scarp toe stabilizations, stabilize culvert outfall	$499,000	$34,950	476	$73	828,200	$0.04
Reach E2	108+00 to 120+00	Alternative A2	Three rock riffles, seven scarp toe stabilizations, seven scarp stabilizations, stabilize culvert outfall	$554,000	$38,800	491	$79	854,000	$0.05
Reach E2	108+00 to 120+00	Alternative B1	Three cross vanes, fill channel, floodplain excavation, seven scarp toe stabilizations, stabilize culvert outfall	$656,000	$45,900	476	$96	828,200	$0.06
Reach E2	108+00 to 120+00	Alternative B2	Three cross vanes, fill channel, floodplain excavation, seven scarp toe stabilizations, seven scarp stabilizations, stabilize culvert outfall	$711,000	$49,750	491	$101	854,000	$0.06
Reach E3	120+00 to 141+00	Alternative A1	Three rock riffles, two scarp toe stabilizations, three stabilize culvert oufalls	$349,000	$24,450	387	$63	672,800	$0.04
Reach E3	120+00 to 141+00	Alternative A2	Three rock riffles, two scarp toe stabilizations, two scarp stabilizations, three stabilize culvert oufalls	$360,000	$25,200	390	$65	678,400	$0.04
Reach E3	120+00 to 141+00	Alternative B1	Three cross vanes, fill channel, floodplain excavation, two scarp toe stabilizations, three stabilize culvert oufalls	$772,000	$54,000	387	$140	672,800	$0.08
Reach E3	120+00 to 141+00	Alternative B2	Three cross vanes, fill channel, floodplain excavation, two scarp toe stabilizations, two scarp stabilizations, three stabilize culvert oufalls	$781,000	$54,650	390	$140	678,400	$0.08
	Combination 1 (Ravine D3 Alt A, Reach 1 Alt A1, Reach 2 Alt A1, Reach 3 Alt A1)*			**$1,326,000**	**$92,900**	**1230**	**$76**	**2,139,730**	**$0.04**
	Combination 2 (Ravine D3 Alt A, Reach 1 Alt A2, Reach 2 Alt A2, Reach 3 Alt A2)*			**$1,399,000**	**$97,950**	**1250**	**$78**	**2,173,930**	**$0.05**
	Combination 3 (Ravine D3 Alt B, Reach 1 Alt A2, Reach 2 Alt A2, Reach 3 Alt A2)*			**$1,515,000**	**$106,050**	**1261**	**$84**	**2,193,730**	**$0.05**
	Combination 4 (Ravine D3 Alt A, Reach 1 Alt B1, Reach 2 Alt B1, Reach 3 Alt B1)*			**$2,236,000**	**$156,500**	**1230**	**$127**	**2,139,730**	**$0.07**
	Combination 5 (Ravine D3 Alt B, Reach 1 Alt B2, Reach 2 Alt B2, Reach 3 Alt B2)*			**$2,422,000**	**$169,500**	**1261**	**$134**	**2,193,730**	**$0.08**

* Costs may not sum due to rounding.

(1) A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for planning, engineering, and design, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

(2) Assumed to be 2% of the total project cost for annual maintenance plus the initial project cost distributed evenly over a 20 year project lifespan.

(3) Annualized cost divided by estimated annual pollution load reduction.

Lower Minnesota River Watershed District

Cost Estimates

Appendix J Riley Creek Lower Minnesota Reach recommended alternatives cost summary

Reach	Station	Alternative	Alternative Description	Construction Cost Estimate(1)	Annualized Cost (Upper Bound)(2)	TP Loading		TSS Loading	
						Load Reduction (lb/yr)	Cost/lb Reduced(3)	Load Reduction (lb/yr)	Cost/lb Reduced(3)
Lower Riley	11+00 to 16+00	Alternative A	Grade out overbanks of upper portion of creek (between station 11+00 and 16+00).Provide three rock cross vanes, three rootwads, and provide stabilization of adjacent scarp (grading and toe protection)	$338,000	$23,700	105	$225	183,190	$ 0.13
Lower Riley	11+00 to 16+00	Alternative B	Grade out overbanks of upper portion of creek (between station 11+00 and 16+00).Provide three rock cross vanes, three rootwads, and provide stabilization of adjacent scarp (grading and toe protection). This alternative expands on Alternative A by creating floodplain excavations.	$546,000	$38,200	105	$363	183,190	$ 0.21
Lower Riley	11+00 to 16+00	Alternative C	Grade out overbanks of upper portion of creek (between station 11+00 and 16+00).Provide three rock cross vanes, three rootwads, and provide stabilization of adjacent scarp (grading and toe protection). This alternative replaces the Alternative B floodplain excavations with a Sediment Vortex Tube.	$512,000	$35,800	479	$75	400,040	$ 0.09

(1) A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for planning, engineering, and design, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

(2) Assumed to be 2% of the total project cost for annual maintenance plus the initial project cost distributed evenly over a 20 year project lifespan.

(3) Annualized cost divided by estimated annual pollution load reduction.

Riley Creek feasibility study Lower Minnesota Reach cost estimate

Reach	Station	Alternative	Project Cost Estimate (1)	Annualized Maintenance Cost (2)
Lower Riley	0+00 to 16+00	Alternative A	$338,000 ($287,000-$406,000)	$6,800 ($5,700-$8,100)
Lower Riley	0+00 to 16+00	Alternative B	$546,000 ($464,000-$655,000)	$10,900 ($9,300-$13,100)
Lower Riley	0+00 to 16+00	Alternative C	$512,000 ($435,000-$614,000)	$10,200 ($8,700-$12,300)

* Costs may not sum due to rounding.

(1) A Class 4 screening-level opinion of probable cost, as defined by the American Association of Cost Engineers International (AACI International), has been prepared for these alternatives. The opinion of probable construction cost provided in this table is based on 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. Includes 15% project contingency, 20% for planning, engineering, and design, and 7% for construction administration. Lower bound assumed at -15% and upper bound assumed at +20%.

(2) Assumed to be 2% of the total project cost

Preliminary Cost Estimate for Alternative A LMRWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 7,326	$ 7,330
Control of Water	LS	1	$ 7,326	$ 7,330
Erosion Control	LS	1	$ 10,990	$ 10,990
Clearing and Grubbing	ACRE	0.19	$ 7,000	$ 1,310
Select Tree Removal (>4")	EACH	100	$ 400	$ 40,000
Excavate/Salvage Soil	CY	1049	$ 25	$ 26,220
Grading	SY	909	$ 12	$ 10,900
Topsoil Import	CY	151	$ 33	$ 5,000
Root Wads	EACH	3	$ 750	$ 2,250
Rock Boulder Cross-vane	EACH	3	$ 4,000	$ 12,000
Plant Shrubs	EACH	75	$ 50	$ 3,750
Plant Trees	EACH	100	$ 250	$ 25,000
Scarp Toe Stabilization	LF	150	$ 350	$ 52,500
Seeding and Mulch	ACRE	0.19	$ 8,000	$ 1,500
Erosion Control Blanket	SY	909	$ 3	$ 2,730
One-Year Establishment Maintenance Period	LS	1	$ 7,326	$ 7,330
			Construction Total	**$ 216,000**
			Construction Total w/ Contingency (15%)	$ 248,400
			Planning, Engineering, & Design (20%)	$ 64,800
			Construction Management (7%)	$ 24,840
			Project Total	**$ 338,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 287,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 406,000**
			Annual Maintenance Cost	**$ 6,800**
			Annual Maintenance Cost Lower Bound (+2%)	**$ 5,700**
			Annual Maintenance Cost Upper Bound (+2%)	**$ 8,100**

Preliminary Cost Estimate for Alternative B LMRWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 11,838	$ 11,840
Control of Water	LS	1	$ 11,838	$ 11,840
Erosion Control	LS	1	$ 17,756	$ 17,760
Clearing and Grubbing	ACRE	0.49	$ 7,000	$ 3,410
Select Tree Removal (>4")	EACH	130	$ 400	$ 52,000
Excavate/Salvage Soil	CY	3410	$ 25	$ 85,240
Grading	SY	2361	$ 12	$ 28,330
Topsoil Import	CY	393	$ 33	$ 12,980
Root Wads	EACH	3	$ 750	$ 2,250
Rock Boulder Cross-vane	EACH	3	$ 4,000	$ 12,000
Plant Shrubs	EACH	75	$ 50	$ 3,750
Plant Trees	EACH	130	$ 250	$ 32,500
Scarp Toe Stabilization	LF	150	$ 350	$ 52,500
Seeding and Mulch	ACRE	0.49	$ 8,000	$ 3,900
Erosion Control Blanket	SY	2361	$ 3	$ 7,080
One-Year Establishment Maintenance Period	LS	1	$ 11,838	$ 11,840
Construction Total				**$ 349,000**
Construction Total w/ Contingency (15%)				$ 401,350
Planning, Engineering, & Design (20%)				$ 104,700
Construction Management (7%)				$ 40,135
Project Total				**$ 546,000**
Total w/ Construction Lower Bound (-15%), Legal, and Engineering				**$ 464,000**
Total w/ Construction Upper Bound (+20%), Legal, and Engineering				**$ 655,000**
Annual Maintenance Cost				**$ 10,900**
Annual Maintenance Cost Lower Bound (+2%)				**$ 9,300**
Annual Maintenance Cost Upper Bound (+2%)				**$ 13,100**

Preliminary Cost Estimate for Alternative C LMRWD Reach

Item Description	Unit	Estimated Quantity	Unit Price	Extension
Mobilization	LS	1	$ 11,019	$ 11,020
Control of Water	LS	1	$ 11,019	$ 11,020
Erosion Control	LS	1	$ 16,528	$ 16,530
Clearing and Grubbing	ACRE	0.39	$ 7,000	$ 2,710
Select Tree Removal (>4")	EACH	120	$ 400	$ 48,000
Excavate/Salvage Soil	CY	3308	$ 25	$ 82,690
Grading	SY	1877	$ 12	$ 22,520
Topsoil Import	CY	313	$ 33	$ 10,320
Root Wads	EACH	3	$ 750	$ 2,250
Rock Boulder Cross-vane	EACH	3	$ 4,000	$ 12,000
Plant Shrubs	EACH	75	$ 50	$ 3,750
Plant Trees	EACH	120	$ 250	$ 30,000
Scarp Toe Stabilization	LF	150	$ 350	$ 52,500
Seeding and Mulch	ACRE	0.39	$ 8,000	$ 3,100
Erosion Control Blanket	SY	1877	$ 3	$ 5,630
36" RCP Culvert		20	$ 76	$ 1,520
One-Year Establishment Maintenance Period	LS	1	$ 11,019	$ 11,020
			Construction Total	**$ 327,000**
			Construction Total w/ Contingency (15%)	$ 376,050
			Planning, Engineering, & Design (20%)	$ 98,100
			Construction Management (7%)	$ 37,605
			Project Total	**$ 512,000**
			Total w/ Construction Lower Bound (-15%), Legal, and Engineering	**$ 435,000**
			Total w/ Construction Upper Bound (+20%), Legal, and Engineering	**$ 614,000**
			Annual Maintenance Cost	**$ 10,200**
			Annual Maintenance Cost Lower Bound (+2%)	**$ 8,700**
			Annual Maintenance Cost Upper Bound (+2%)	**$ 12,300**