Section 9
Capital Improvement Projects

9.1 Introduction

For Watershed Master Plans, the City's Capital Improvement Program has been used for projects that provide substantial benefits to flood reduction, stream stability, and water quality. The results of the hydrologic, hydraulic, and geomorphic evaluations discussed in the previous sections of this report formed the foundation for identifying problem areas in the watershed. Potential improvement projects addressing each problem area were evaluated based on design considerations, economic feasibility, and overall efficiency. The following pages describe the process used to identify problem areas, evaluation approach and formulation of the recommended Capital Improvement Projects (CIP). The CIP Prioritization Worksheets are found in Appendix J, and the cost worksheets for each project are found in Appendix K. Details of other recommended improvements including Bridge & Culvert Improvements, Riparian Corridor Enhancement and Water Quality are found in Appendix L.

9.2 Capital Improvement Projects

9.2.1 Problem Identification

The problem identification was based upon an evaluation of areas along the Little Salt Creek main stem and tributaries which pose a serious public safety concern with respect to drainage infrastructure and stream erosion and/or threaten water quality or natural resources.

The geomorphic evaluation discussed in Section 8 was used to identify stream stability problems in the watershed. The stream processes driving instability identified in Section 8 are systemic channel incision, widening, and plan form adjustment. Incision is the source of much of the erosion and mass wasting observed throughout the Little Salt Creek Watershed and widening and plan form adjustment is the natural progression of instability once the channel has incised to critical bank height. Plan form adjustment is the process of the stream changing its alignment either by meander cut-off or increase in meander amplitude.

Incision is the main stream stability problem in the watershed. In some locations the Little Salt Creek Main stem is expected to incise 12 feet over the next 30 years. The incision stage of channel evolution drives the widespread bank failures, mass wasting, and sediment generation phases that follow. Channel incision threatens bridges and culverts by eroding down to below the structure footing and removing the very soil on which these structures bear. Incision threatens streamside utilities by day-lighting them and exposing the utility to channel shear forces, and also threatens streamside structures by driving bank erosion.

Figure 9-1 illustrates the estimated depth of incision over the next 30 years for the reach of Little Salt Creek Main Stem from upstream of Raymond Road to Bluff Road (from Langendoen, Simon, Alonso, 2000).

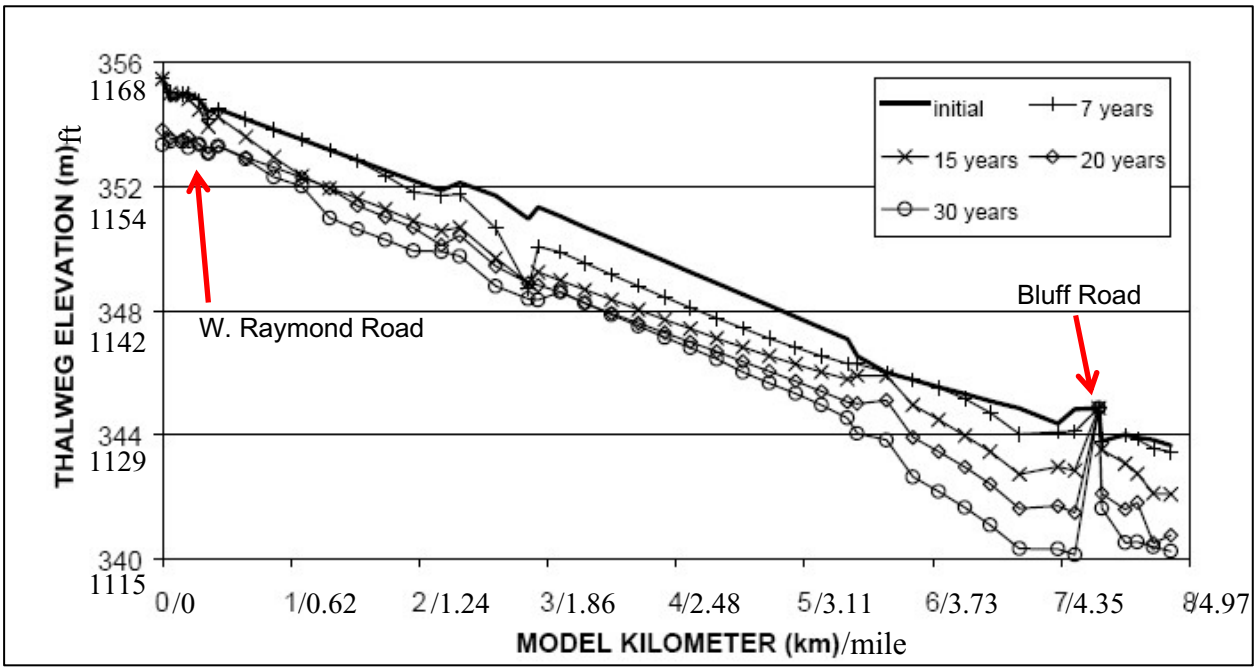


Figure 9-1: Projected incision of Little Salt Creek between Raymond Rd and Bluff Rd

Widening and plan form adjustment are not considered problems because those reaches diagnosed as widening and plan form adjustment can continue to adjust until the stream is in equilibrium without threatening structures or infrastructure.

9.2.2 Evaluation Approach

The recommended projects will not address all the stream stability issues in the watershed. Little Salt Creek is systemically unstable and continuing to degrade watershed-wide. A program to repair all of the problem sites along this stream is cost prohibitive. Instead, the recommended improvements are strategic, focusing on interrupting the cycle of degradation and moving the entire system closer to self-sustaining dynamic equilibrium.

The approach to controlling incision is to place grade controls at bridge crossing locations along the main stem. The grade control holds the channel in place in plan, section and profile. In an incising stream, the effect of a grade control diminishes the farther upstream we move from the grade control. Therefore, placing the grade control immediately downstream of the crossing provides the greatest benefit to the bridge structure and channel immediately upstream of the grade control.

Most of the stream stability addresses systemic channel incision, the source of much of the erosion and mass wasting observed throughout the Little Salt Creek Watershed. Early intervention in this stage of channel evolution minimizes widespread bank failures, mass wasting, and sediment generation. This approach enables construction of stable channel grade and cross section, thereby accelerating channel recovery and reestablishing dynamic equilibrium.

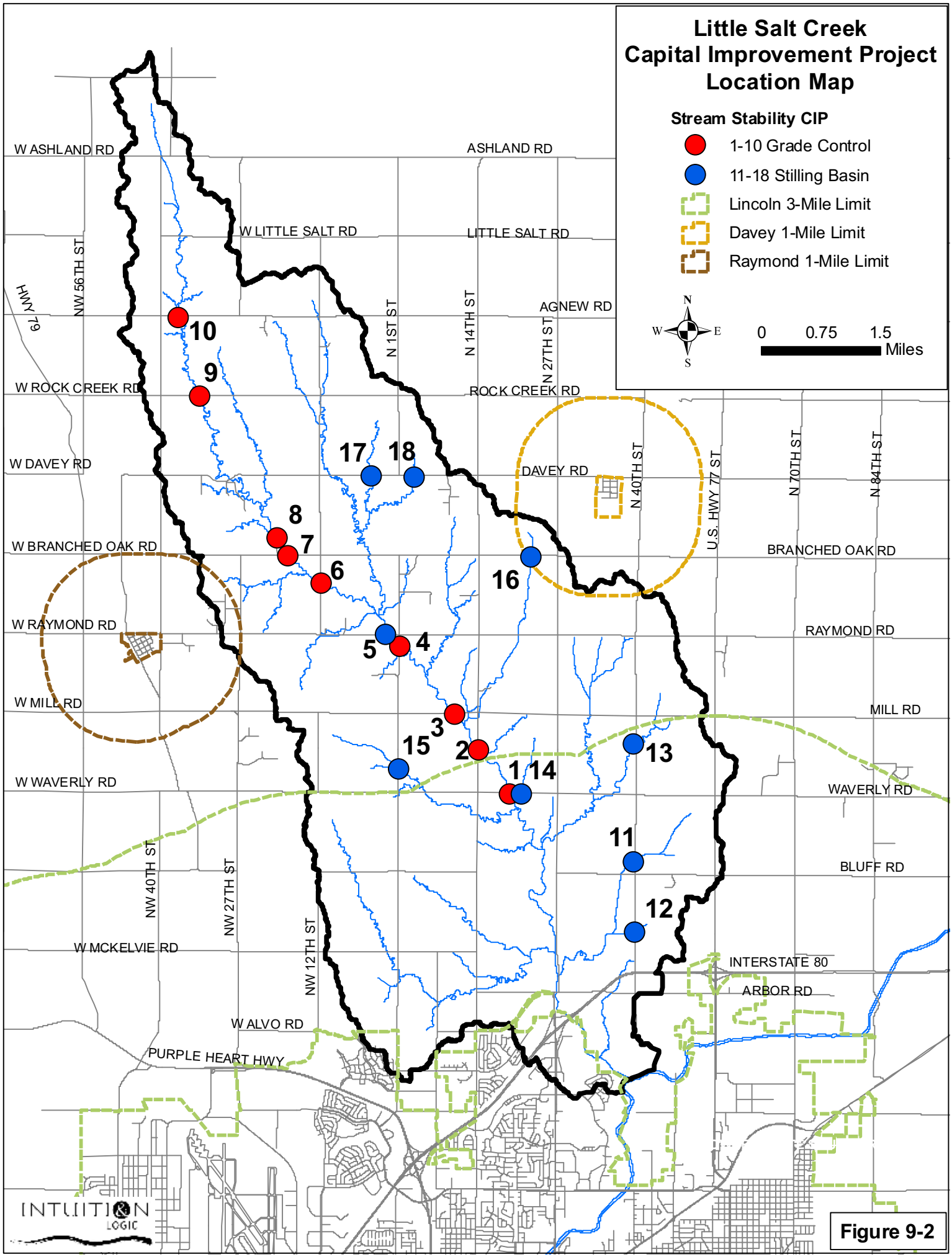
In many locations, incision has advanced to a road crossing culvert, leaving the culvert perched with a one to six foot drop on the downstream end. The approach to protect these

structures from the incision that has already occurred and from future incision is to construct a stilling basin downstream of the culvert to help dissipate the energy from culvert flows and protect the tow wall and foundation of the culvert at the downstream outfall.

Bank failures are commonplace in this watershed and it is reasonable to question why bank stabilization is so rarely the focus of the recommendations. Little Salt Creek is fundamentally unstable. The old truism regarding streambanks is as applicable here as anywhere in this region - *It is impossible to stabilize a streambank on an unstable stream*. Until some measure of equilibrium is regained, extensive bank stabilization efforts are wasteful and probably counterproductive. Critical infrastructure areas, where protection of a bridge or other crossing requires that the stream alignment be fixed, are the exceptions to this rule.

9.2.3 Stream Stability Projects

Conceptual recommended improvements were developed to address each primary problem area. For this study, stream stability problem areas were identified. The types of improvements to address these problems are referred to as Capital Improvement Projects. Figure 9-2 below shows all of the Capital Improvement Projects included in the Capital Improvement Program. A general description of the methodology followed by a detailed description of each capital improvement project is provided below.


Little Salt Creek
Capital Improvement Project
Location Map
Stream Stability CIP
1-10 Grade Control
11-18 Stilling Basin
Lincoln 3-Mile Limit
Davey 1-Mile Limit
Raymond 1-Mile Limit
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0.75
1.5
Miles
W ASHLAND RD
ASHLAND RD
W LITTLE SALT RD
LITTLE SALT RD
HWY 79
NW 56TH ST
N 1ST ST
N 14TH ST
N 27TH ST
AGNEW RD
W ROCK CREEK RD
ROCK CREEK RD
W DAVEY RD
DAVEY RD
N 40TH ST
U.S. HWY 77 ST
N 70TH ST
N 84TH ST
W BRANCHED OAK RD
BRANCHED OAK RD
W RAYMOND RD
RAYMOND RD
W MILL RD
MILL RD
W WAVERLY RD
WAVERLY RD
BLUFF RD
NW 40TH ST
NW 27TH ST
NW 12TH ST
W MCKELVIE RD
INTERSTATE 80
ARBOR RD
W ALVO RD
PURPLE HEART HWY
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INTUITION LOGIC

Figure 9-2

Two categories of projects are recommended to address stream stability along the incising reaches as follows:

1. Grade Control at Bridges - construct grade controls at bridge crossings along the main stem to stop incision at these locations. The grade controls will eliminate incision at each bridge and substantially limit the propagation and depth of incision between the grade controls. There are nine bridge crossings recommended for grade controls. The series of structures will systemically halt incision along the main stem, once the channel profile between the grade controls stabilizes.

   The material for grade controls can be rock, logs or sheet pile, depending on the location and soil conditions at each bridge. Figure 9-3 and 9-4 illustrates the different grade control structures. Piping and erosion of weak soils present significant challenges and should be thoroughly addressed in grade control design. Rock grade controls may be appropriate where the soils are less prone to piping, have higher clay content, and where the rock can be successfully vegetated. Rock should be well graded to fill voids. The designer may consider using graded filters or geosynthetics to limit piping. The designer should prevent concentrated run-off from entering the landward keys of the grade control.

   Alternatively, this approach can be implemented using logs. As is the case with rock structures, piping is a major design consideration and geosynthetics or graded filters should be included.

   Sheetpile grade controls may be more appropriate where the soils are prone to piping or highly erodible, silty with lower clay content and where salinity is higher. Depending on the sheetpile material, sheetpile should have corrosion protection such as a protective coating and cathodic protection. Sheetpile should extend into the banks a sufficient distance to prevent piping around the ends. The design should prevent erosion at the ends of the sheetpile. The designer should consider notching the weir of the grade control for low flow. The designer should consider box or arched planform shapes of the sheet pile to increase weir length or to concentrate or disperse flows.

   Grade control structures made of natural materials and shaped to mimic natural stream structures offer water quality and ecological benefits relative to sheetpile weirs. For those sites where sheetpile structures are preferable, a more sustainable structure can be achieved by integrating a sheetpile cutoff wall through the key of a rock grade control.

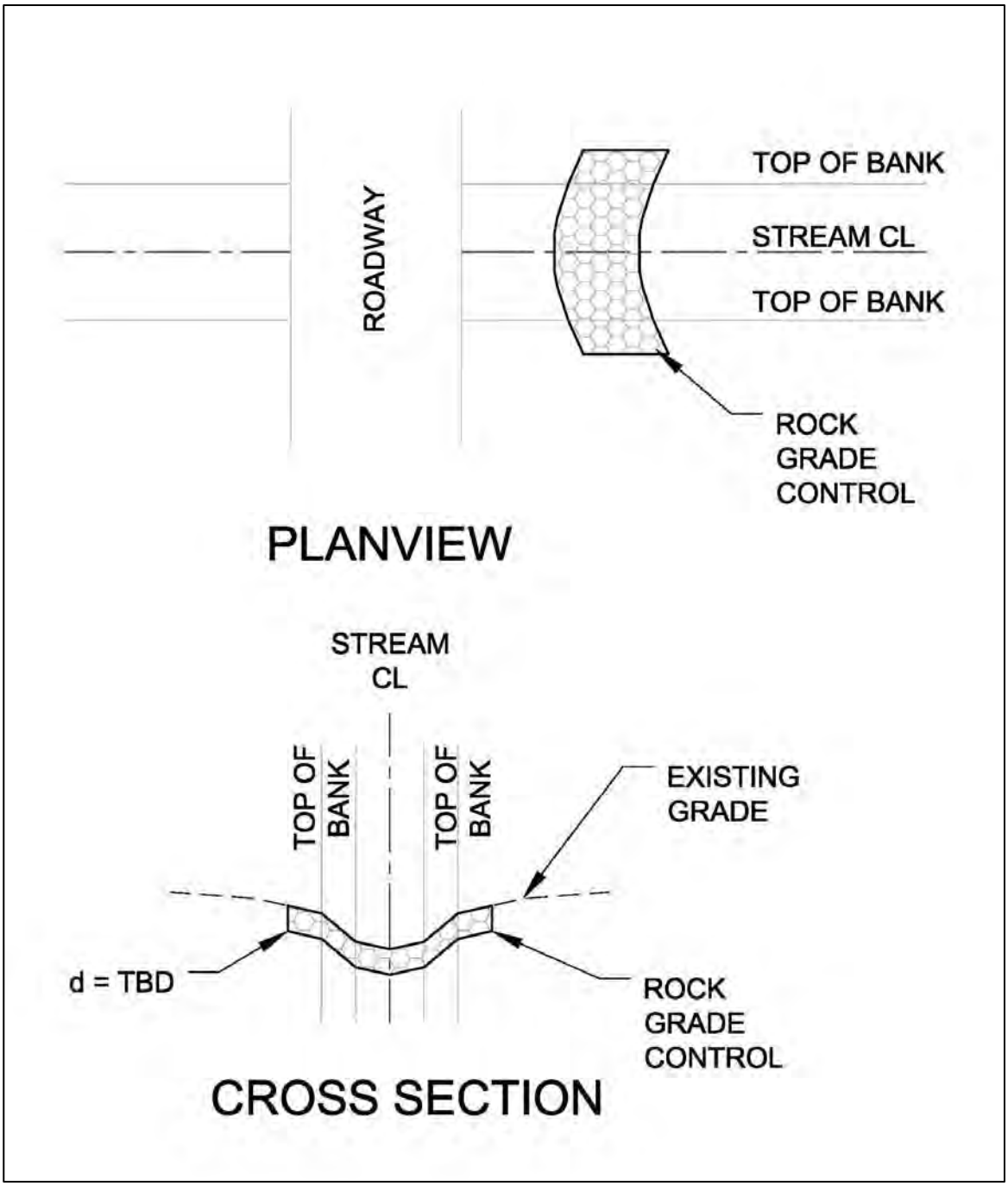


Figure 9-3: Rock Grade Control Structure Detail

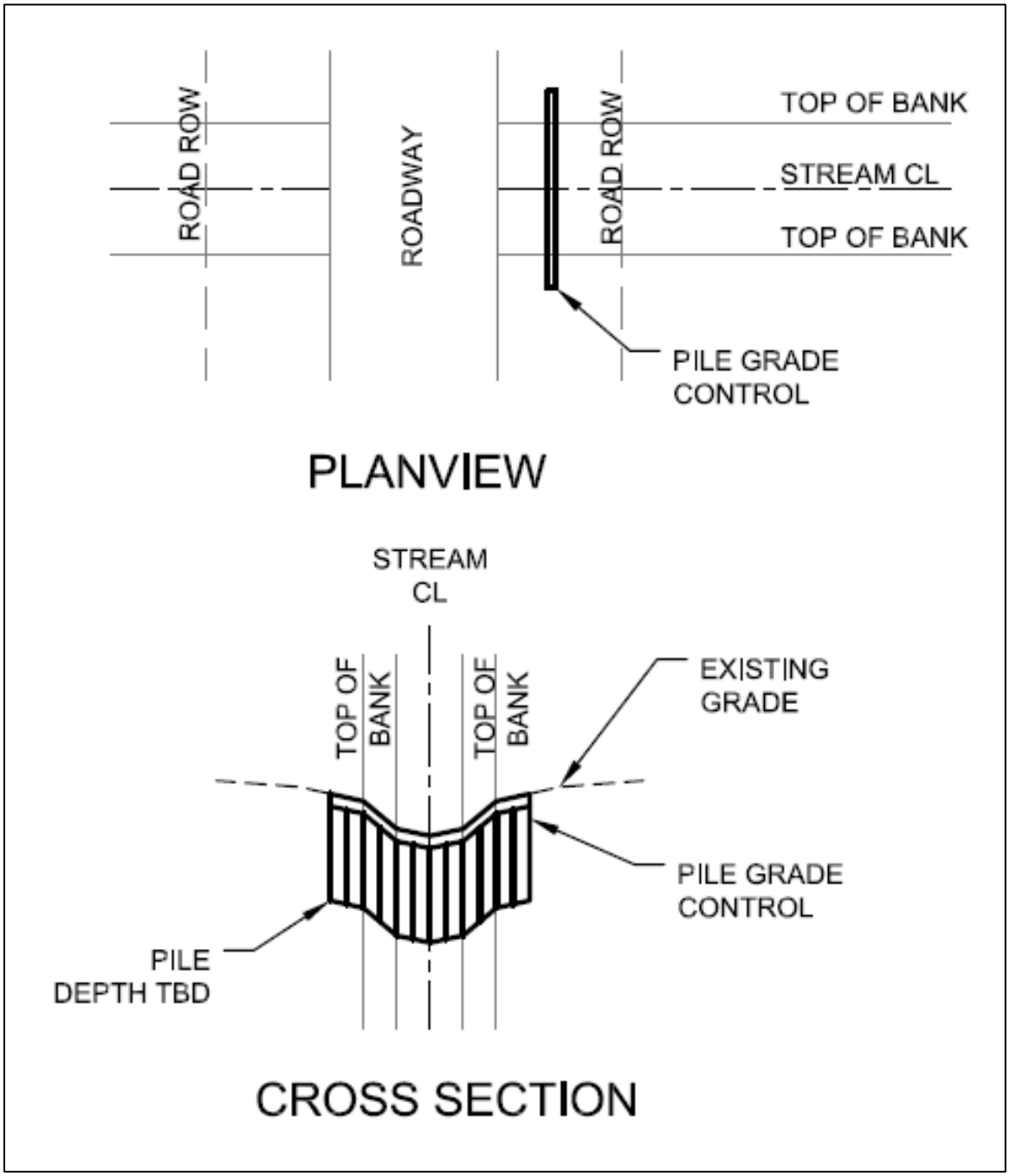


Figure 9-4: Sheet Pile Grade Control Structure Detail

2. Stilling Basins - construct engineered stilling basins at culvert outfalls on the tributaries where channel incision has caused the culvert to be perched. Stilling basins will protect the structure from scour that, if left unchecked, could undermine the outfall. The basins range in size based on the flow, culvert slope, drop height and other parameters and can be constructed of rock and vegetated around the edges. There are eight culvert outfall locations recommended for stilling basins. Since the

stilling basins at culvert outfalls address only the erosion problem at the culvert location, the stilling basin projects are recommended as eight individual projects. Figure 9-5 below show a detail of a stilling basin.

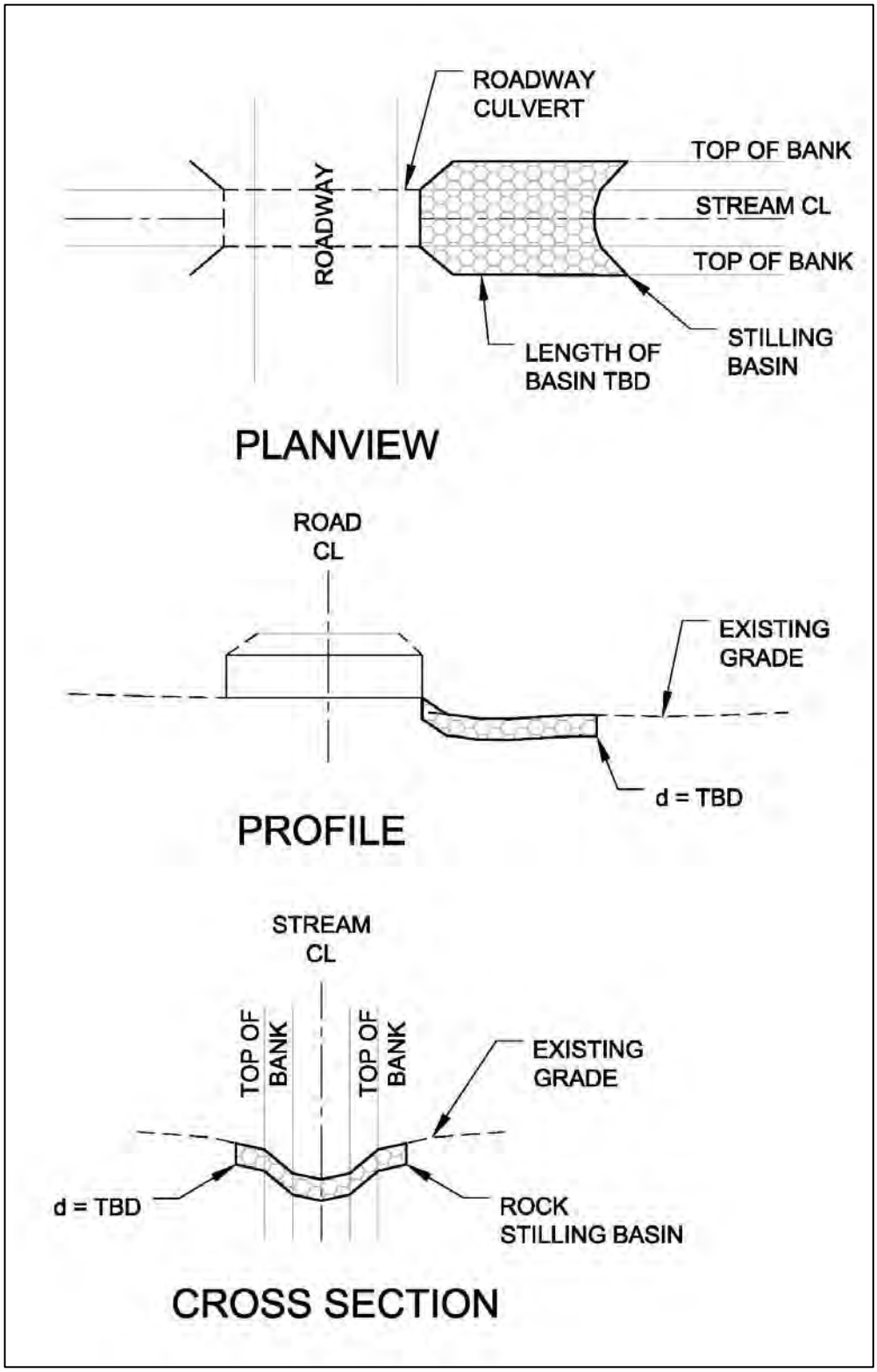


Figure 9-5: Stilling Basin Structure Detail

In determining impacts to Natural Resources and Salt Creek Tiger Beetle habitat, assumptions are made. One of the main and most important assumptions is that there will be good erosion and sediment control measures and maintenance during construction. Good erosion and sediment control measures include multiple layers of protection (silt fence, fabric slopes, sediment traps in the channel with silt dikes). Sediment will not be released into the system, and storing of material will be in such a way that the material will not reach the channel in the event of a spill. It is assumed that the construction will be limited to within the ROW where the land has already been disturbed to construction the road and that Salt Creek Tiger Beetle habitat will not be there. If the project is near a habitat area, it is assumed that construction will not occur during the time of year when the Salt Creek Tiger Beetles are mating or the larvae are hatching. The channel will not be dammed and create bank instability, and any overbank work will not be removing or disturbing habitat.

9.2.3.1 Project 1: Grade Control Main Stem, Waverly Road Bridge

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Figure 9-6: Waverly Road Bridge over Main Stem

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-7 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $95,000

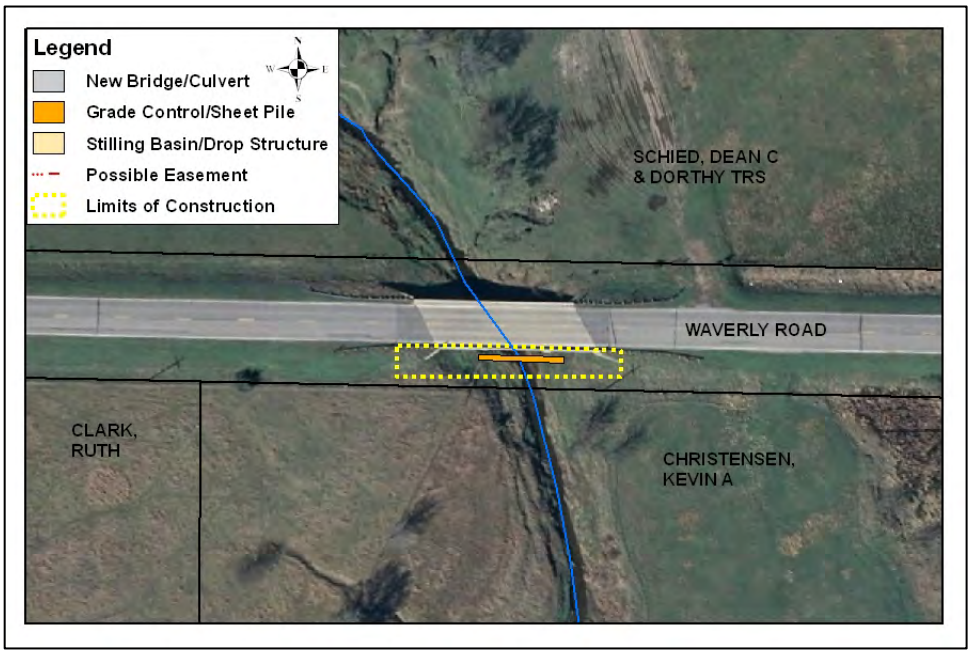


Figure 9-7: Project 1 Proposed Improvements

9.2.3.2 Project 2: Grade Control Main Stem, North 14th Street Bridge

Figure 9-8: North 14th Street Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-9 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $113,000

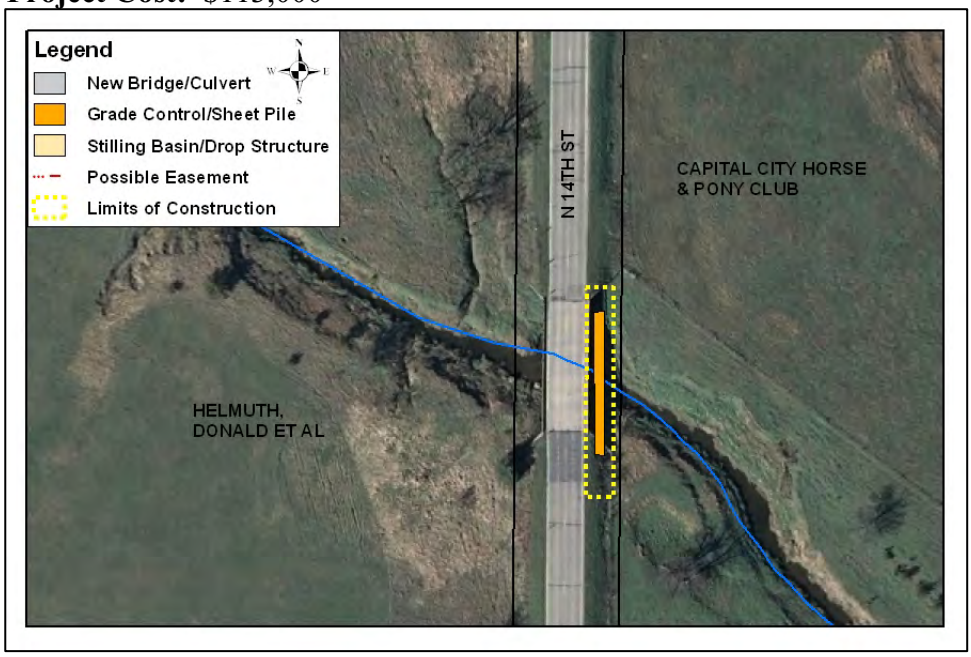


Figure 9-9: Project 2 Proposed Improvements

9.2.3.3 Project 3: Grade Control Main Stem, Mill Road Bridge

Figure 9-10: Mill Road Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-11 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $91,000

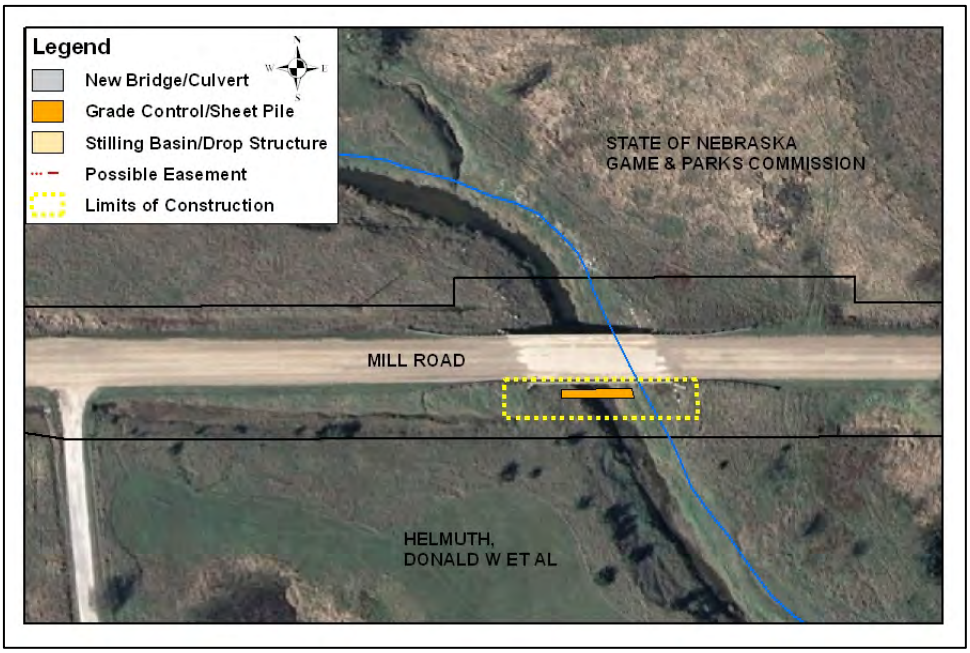


Figure 9-11: Project 3 Proposed Improvements

9.2.3.4 Project 4: Grade Control Main Stem, N 1st Street Bridge

Figure 9-12: North 1st Street Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-13 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $109,000

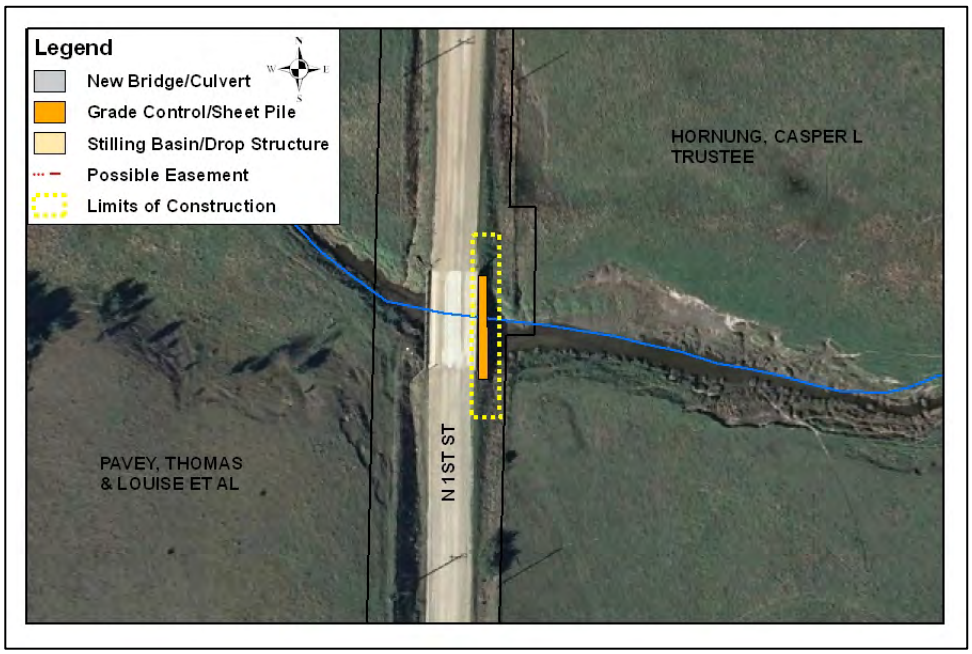


Figure 9-13: Project 4 Proposed Improvements

9.2.3.5 Project 5: Grade Control Main Stem, W Raymond Road Bridge

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel. In addition to the main stem incising, W Raymond Road is one of the paved east/west roads that span the watershed. The existing 48' single span bridge over the Main Stem is topped during the 10-yr storm event.

Figure 9-14: W Raymond Road Bridge over Main Stem

Recommendation: The recommendation includes constructing a grade control immediately downstream of the bridge to maintain the channel grade through bridge, protecting the new bridge and improving local stream stability. Figure 9-15 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed. The recommended improvements also include removing the existing bridge and replacing it with a new bridge configuration capable of passing a 25year storm event without topping the roadway, but this did not impact habitable structures and is not within an urbanized or otherwise artificially altered drainage system and is not included in the cost for Project 5. This structural improvement portion of the project is a road project and would be most appropriately addressed when the bridge/culvert is replaced due to condition issues.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: Saline Wetlands and proposed Salt Creek Tiger Beetle habitat is identified both upstream and downstream of the W Raymond Road Bridge. The Little Salt Fork Marsh Preserve is located immediately north (upstream) of W Raymond Road and the new grade control will help preserve the upstream channel by maintain the channel grade. Halting incision at this location will ultimately reduce slumping in the near upstream reaches, which intern protects the Tiger Beetle habitat at the toe of slope and saline wetlands found within the Little Salt Fork Marsh.

Estimated Project Cost: $115,000

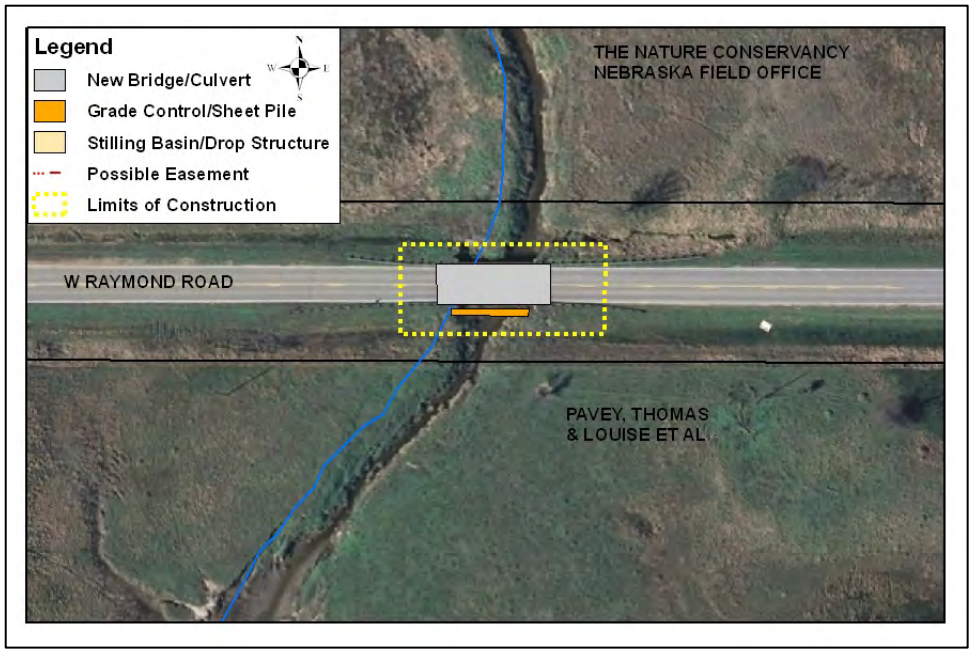


Figure 9-15: Project 5 Proposed Improvements

9.2.3.6 Project 6: Grade Control Main Stem, NW 12th Street Bridge

Figure 9-16: NW 12th Street Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-17 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $91,000

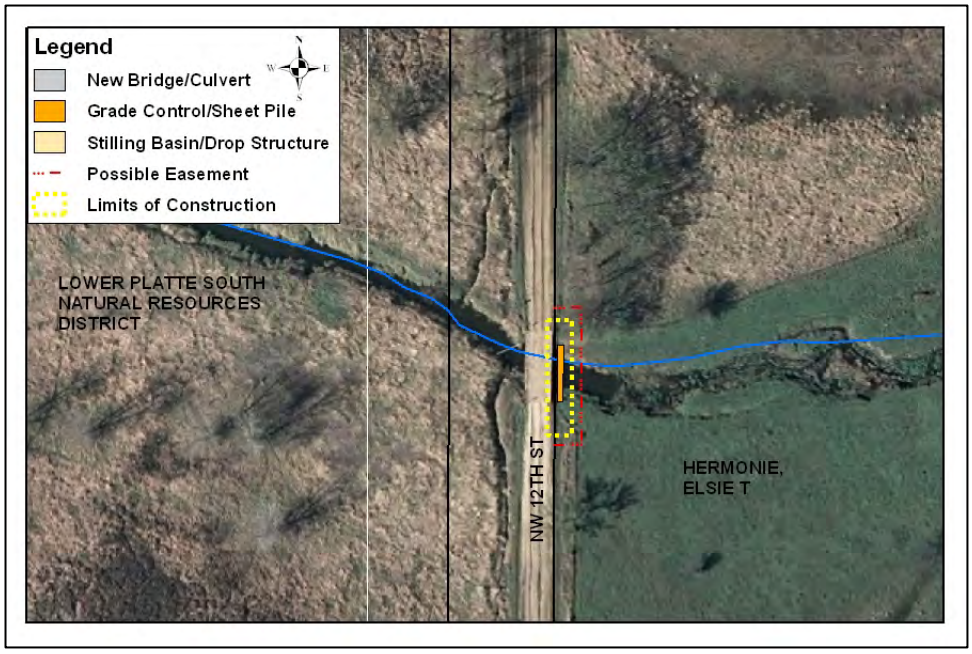


Figure 9-17: Project 6 Proposed Improvements

9.2.3.7 Project 7: Grade Control Main Stem, W Branched Oak Road Bridge

Figure 9-18: W Branched Oak Road Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-19 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $71,000

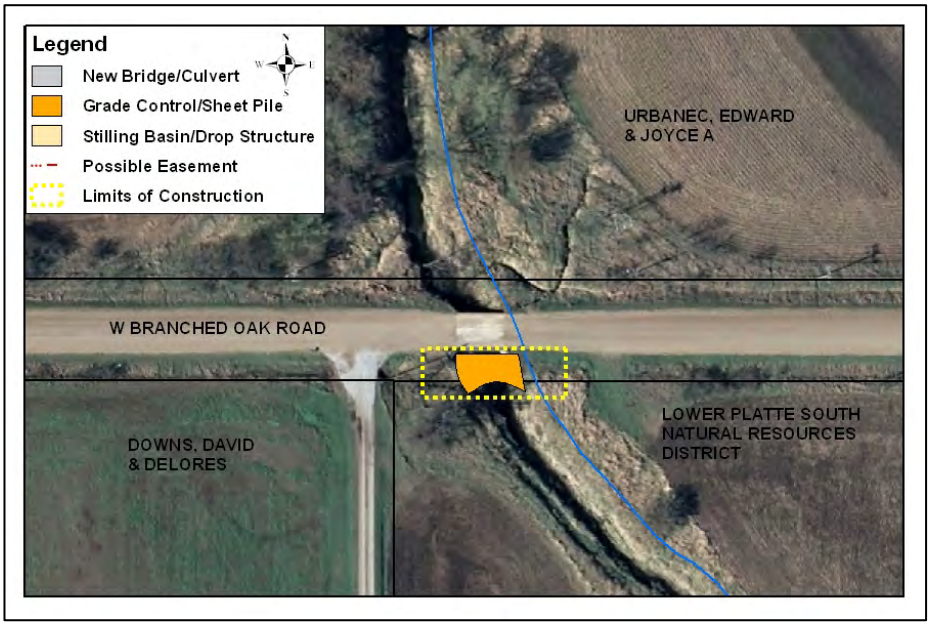


Figure 9-19: Project 7 Proposed Improvements

9.2.3.8 Project 8: Grade Control Main Stem, N 19th Street Bridge

Figure 9-20: North 19th Street Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-21 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $84,000

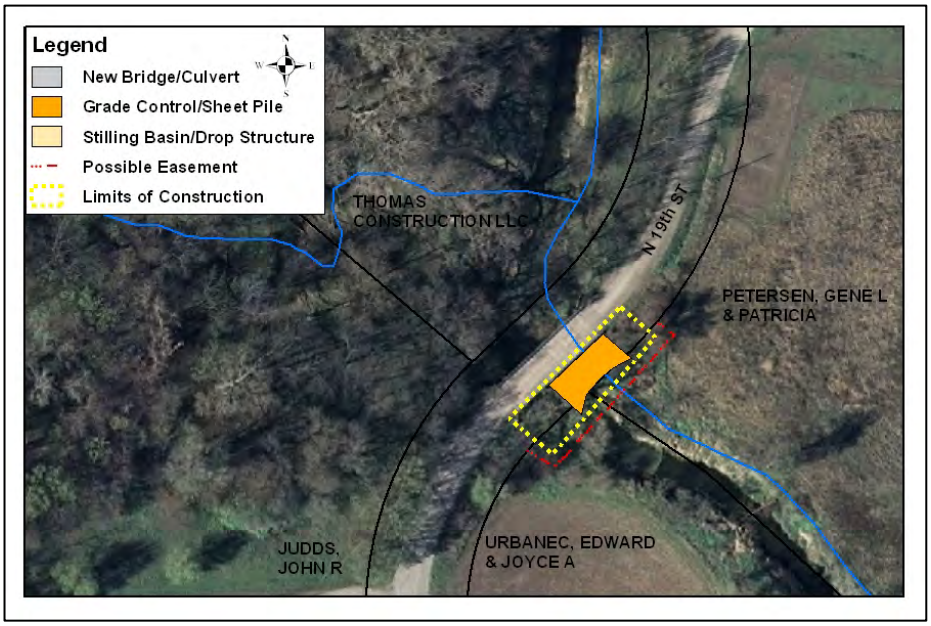


Figure 9-21: Project 8 Proposed Improvements

9.2.3.9 Project 9: Grade Control Main Stem, W Rock Creek Road Bridge

Figure 9-22: W Rock Creek Road Bridge over Main Stem

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-23 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $78,000

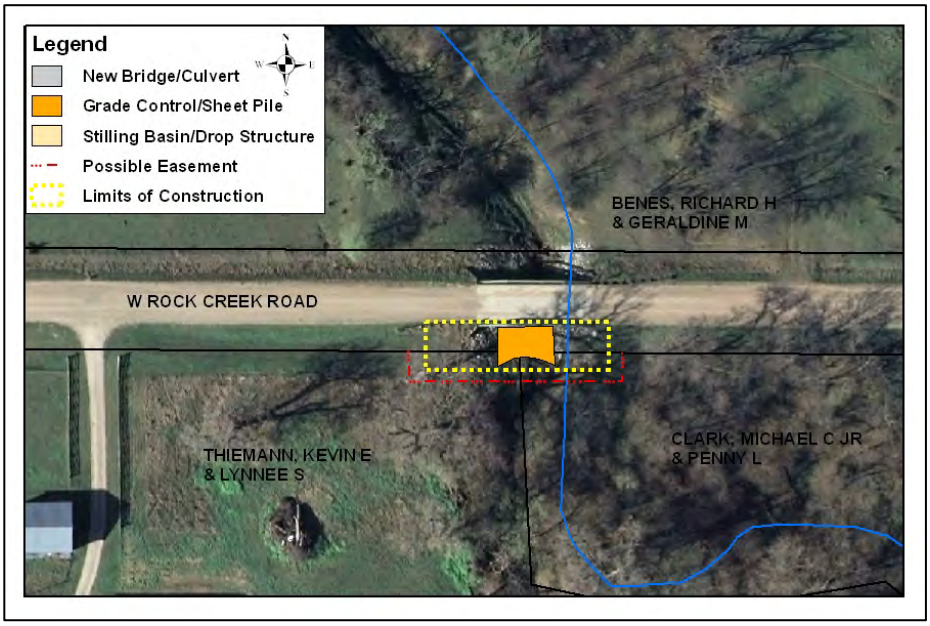


Figure 9-23: Project 9 Proposed Improvements

9.2.3.10 Project 10: Grade Control Main Stem, W Agnew Road Bridge

Problem description: The main stem is incising and projected to continue to incise an additional six to twelve feet over the next 25 years. The incision will cause erosion at the bridge that could compromise bridge footings and stability. Sediment released from incision and subsequent bank failures could threaten natural resources along the channel.

Figure 9-24: W Agnew Road Bridge over Main Stem

Recommendation: The recommended improvement is to construct a grade control immediately downstream of the bridge crossing to hold the profile grade of the channel. Figure 9-25 shows the proposed location of the grade control, possible limits of construction and possible easement needs. The grade control should be placed at grade on the channel bottom and formed in a manner to mimic the elevation and stable slopes of the existing channel banks. The grade control should extend to the top of each bank or the 25 year flow depth, whichever is greater. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. The grade control can be constructed using various materials. For the purposes of this study, a sheet pile grade control system was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
Grade stabilizing the main stem will protect the Tiger Beetle habitat at the toe of slope and within the saline wetlands near the top of banks along the main stem. The grade control is sited within road right of way so there is no direct impact on the possible Salt Creek Tiger Beetle habitat.

Estimated Project Cost: $69,000

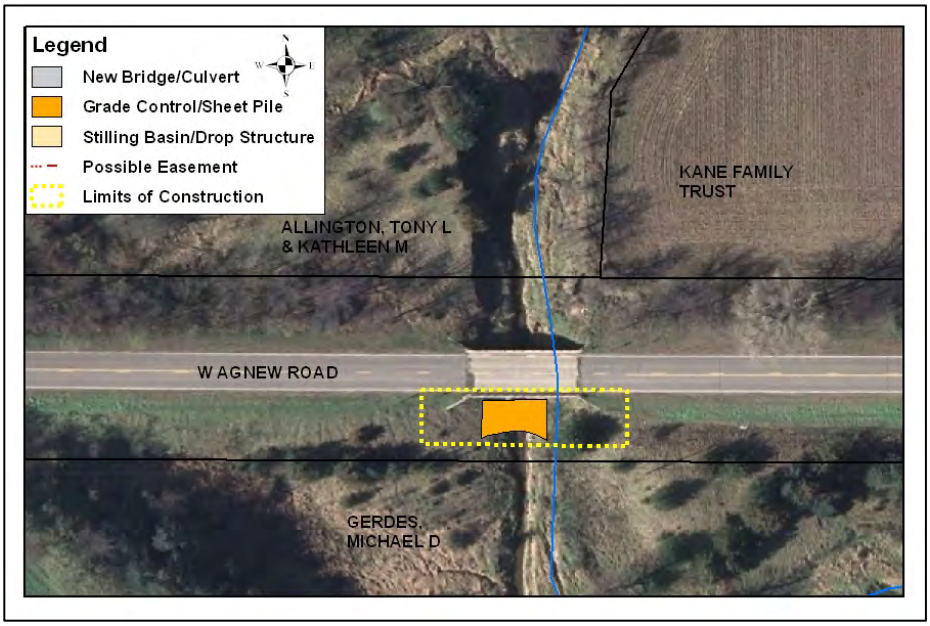


Figure 9-25: Project 10 Proposed Improvements

9.2.3.11 Project 11: Stilling Basin at N 40th Street Culvert Outfall, Tributary 10

Problem description: Channel erosion and incision through Tributary 10 have caused the existing culvert to be perched approximately four feet threatening the stability of the culvert.

Figure 9-26: North 40th Street Culvert on Tributary 10

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-27 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $78,000

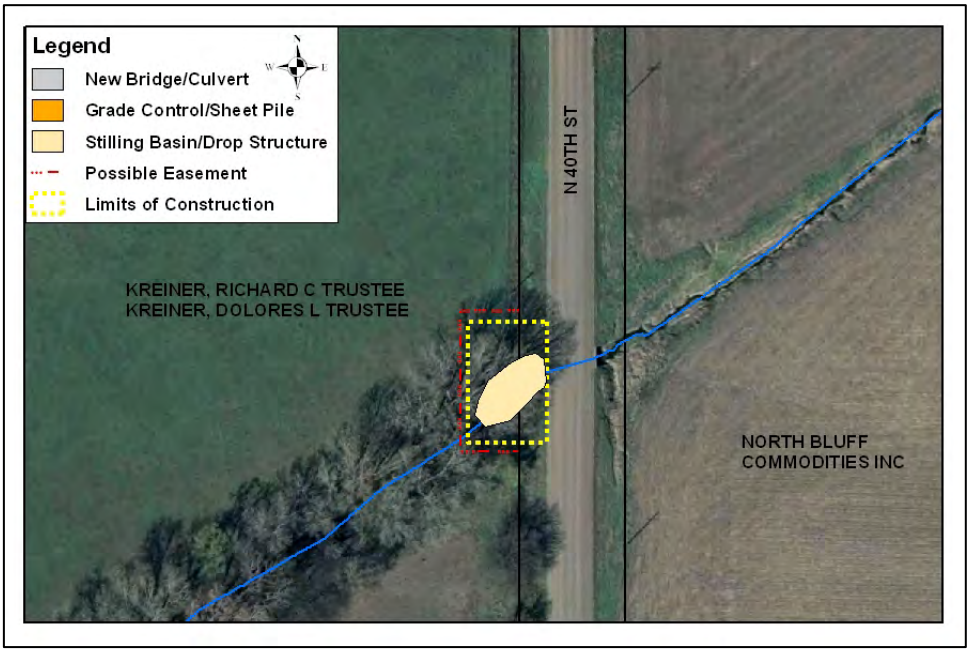


Figure 9-27: Project 11 Proposed Improvements

9.2.3.12 Project 12: Stilling Basin at N 40th Street Culvert Outfall, Tributary 110

Problem description: Tributary 110 is a managed swale between two farm fields. Channel erosion and incision have caused the existing culvert to be perched approximately one to two feet threatening the stability of the culvert.

Figure 9-28: North 40th Street Culvert on Tributary 110

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-29 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $77,000

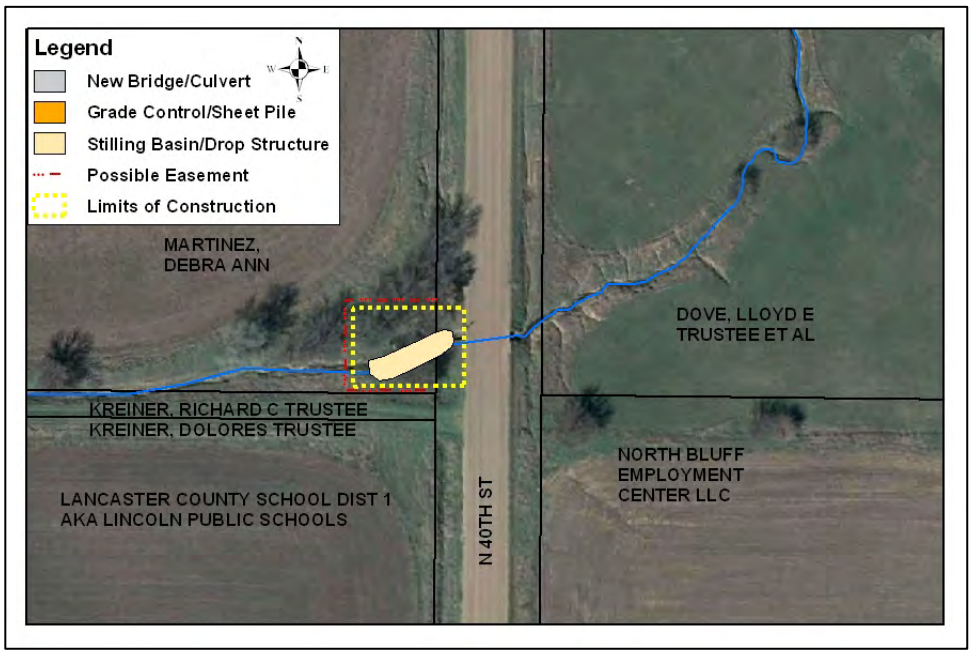


Figure 9-29: Project 12 Proposed Improvements

9.2.3.13 Project 13: Stilling Basin at N 40th Street Culvert Outfall, Tributary 220

Figure 9-30: North 40th Street Culvert on Tributary 220

Problem description: Channel erosion and incision along Tributary 220 have caused the existing culvert to be perched approximately two to three feet threatening the stability of the culvert.

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-31 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $67,000

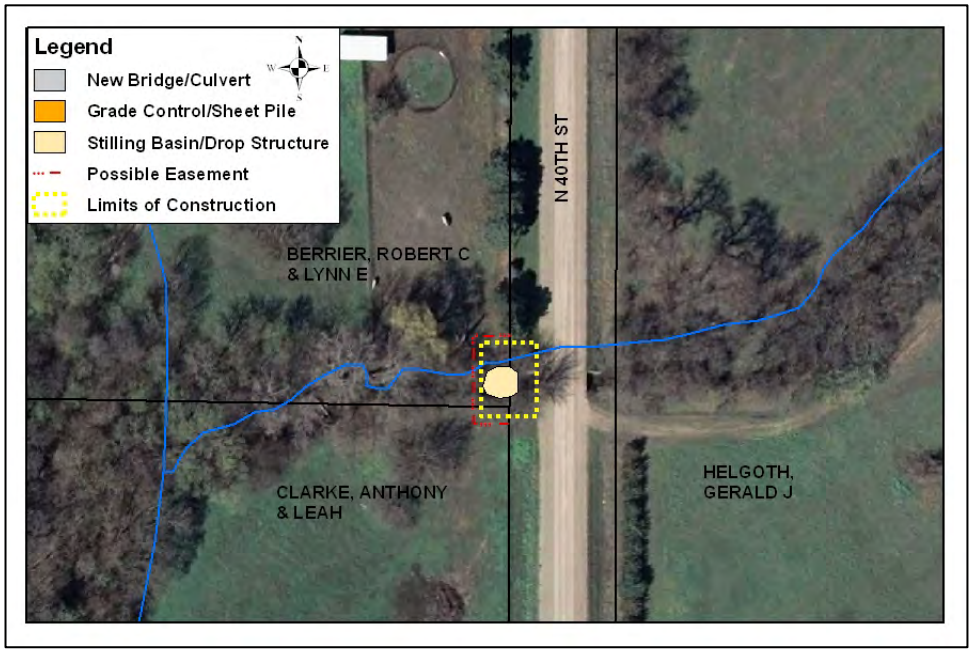


Figure 9-31: Project 13 Proposed Improvements

9.2.3.14 Project 14: Stilling Basin at Waverly Road Culvert Outfall, Tributary 35

Problem description: Channel erosion and past incision at the outfall of the Waverly Road culvert on Tributary 35 have caused the existing culvert to be perched approximately one to two feet threatening the stability of the culvert.

Figure 9-32: Waverly Road Culvert on Tributary 35

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-33 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. Consideration should be given to soil erodability, piping and shear stresses along the grade control and at the edges. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $75,000

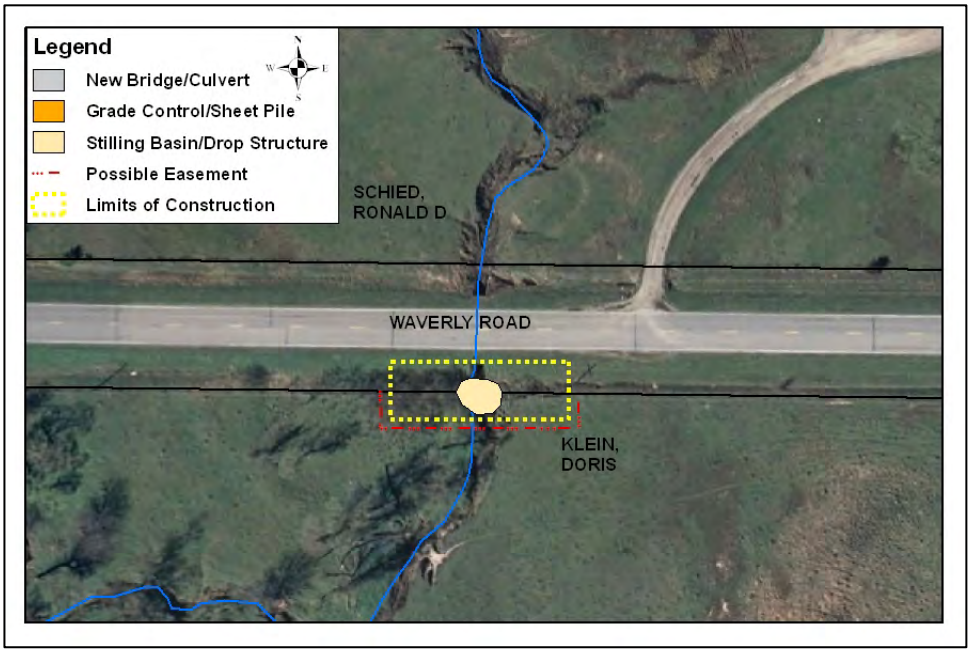


Figure 9-33: Project 14 Proposed Improvements

9.2.3.15 Project 15: Stilling Basin at N 1st Street Culvert Outfall, Tributary 30

Problem description: The existing grouted concreted outfall protection/armor is undermined and fractured immediately downstream of the outfall of the N 1st Street culvert on Tributary 30. The grout is armoring an approximately six-foot drop in bed elevation at the outfall.

Figure 9-34: North 1st Street Culvert on Tributary 30

Recommendation: The recommended improvement is to remove the grouted concrete apron and construct a ramp and stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The ramp and stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-35 shows the proposed location of the ramp and stilling basin, possible limits of construction and possible easement needs. The ramp, stilling basin and associated bank protection can be constructed using various materials. For the purposes of this study, a rock ramp and basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $85,000

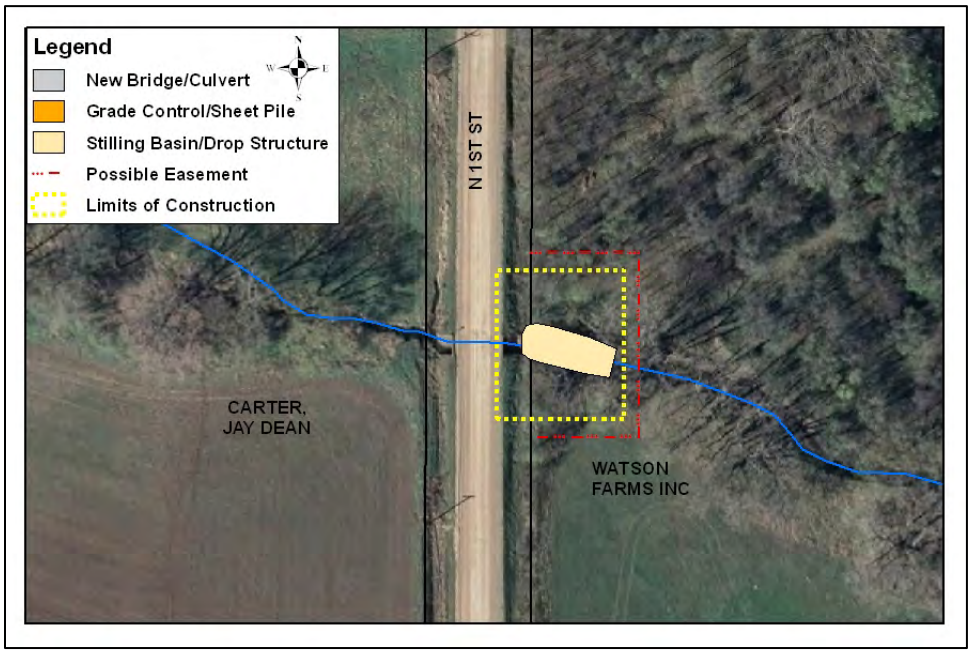


Figure 9-35: Project 15 Proposed Improvements

9.2.3.16 Project 16: Stilling Basin at Branched Oak Road Culvert Outfall, Tributary 45

Figure 9-36: Oak Road Culvert on Tributary 45

Problem description: Channel erosion and incision at the outfall of the Branched Oak Road culvert on Tributary 45 have caused the existing culvert to be perched approximately one to two feet threatening the stability of the culvert.

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-37 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $95,000

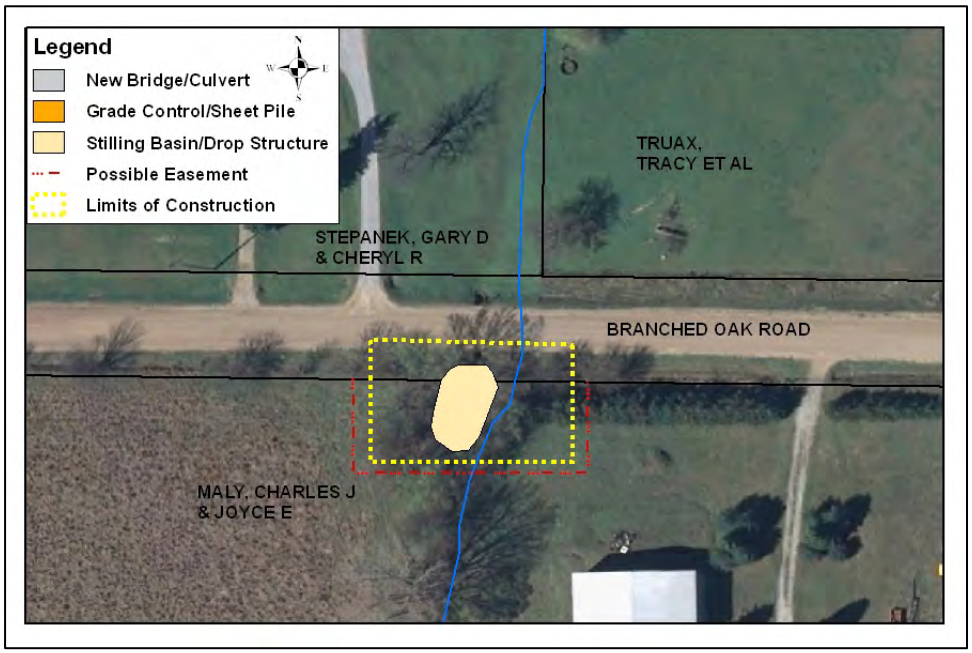


Figure 9-37: Project 16 Proposed Improvements

9.2.3.17 Project 17: Stilling Basin at W Davey Road Culvert Outfall, Tributary 1260

Figure 9-38: W Davey Road Culvert on Tributary 1260

Problem description: Channel erosion and incision at the outfall of the W Davey Road culvert on Tributary 1260 have caused the existing culvert to be perched approximately one to two feet threatening the stability of the culvert.

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-39 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat: This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $113,000

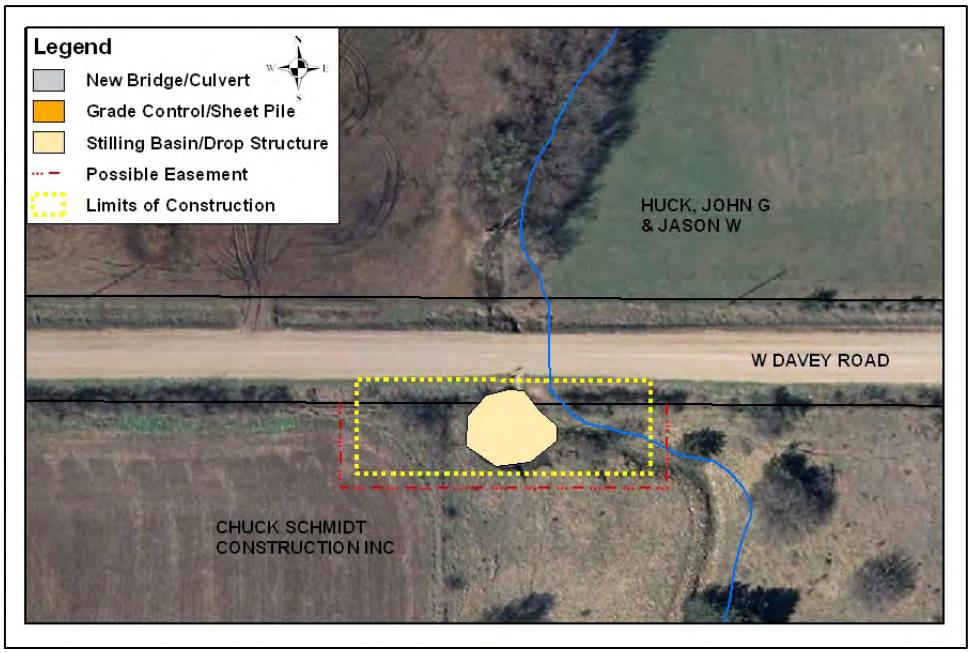


Figure 9-39: Project 17 Proposed Improvements

9.2.3.18 Project 18: Stilling Basin at Davey Road Culvert Outfall, Tributary 260

Figure 9-40: Davey Road Culvert on Tributary 260

Problem description: Channel erosion and incision on Tributary 260 have caused the existing culvert to be perched approximately one to two feet threatening the stability of the culvert.

Recommendation: The recommended improvement is to construct a stilling basin at the downstream end of culvert to dissipate the energy and protect the outfall. The stilling basin should be designed to withstand hydraulic forces during a 25 year storm event. Figure 9-41 shows the proposed location of the stilling basin, possible limits of construction and possible easement needs. The stilling basin and associated bank protection can be constructed using various materials. For the purposes of this study, a rock stilling basin with vegetated banks was assumed.

Impact to Natural Resources and/or Salt Creek Tiger Beetle Habitat:
This project has no impact on the possible Salt Creek Tiger Beetle habitat or natural resources.

Estimated Project Cost: $85,000

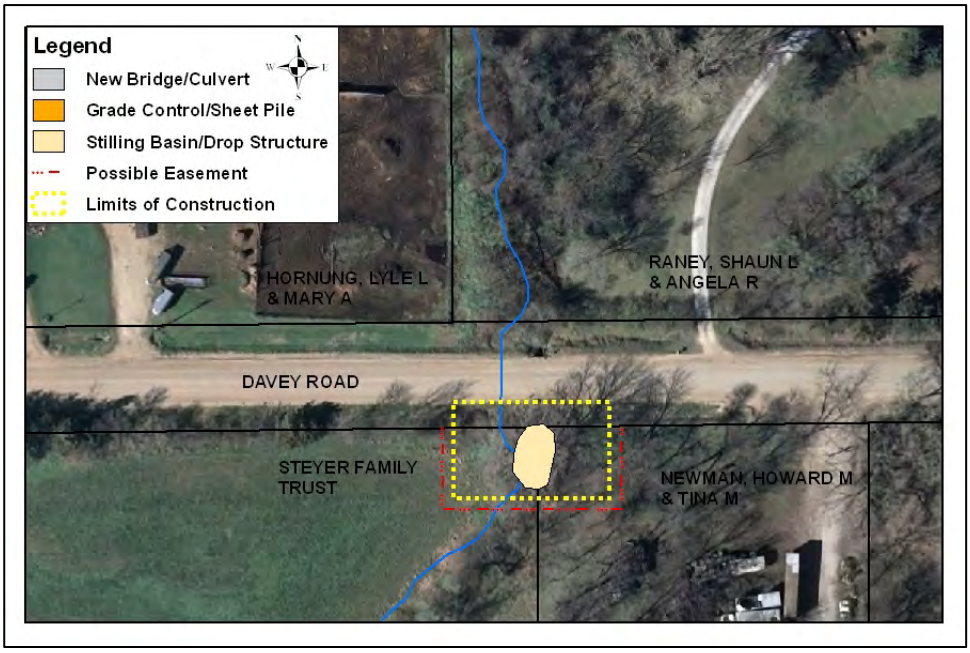


Figure 9-41: Project 18 Proposed Improvements

9.3 Other Improvement Recommendations

Other problems were identified and projects and recommendations developed that have measureable benefits, but do not provide substantial flood reduction, stream stability and water quality benefits and therefore, do not qualify as Capitol Improvement Projects. These projects and recommendations are included in this Master Plan as Other Improvement Recommendations for use with other programs. Details of other recommended improvements including Bridge & Culvert Improvements, Riparian Corridor Enhancement and Water Quality are found in the following pages and in Appendix L.

9.3.1 Problem Identification

9.3.1.1 Bridge and Culvert Problem Identification

The process for identifying bridge and culvert problems was focused on areas along the Little Salt Creek main stem and tributaries. The majority of the watershed is rural with agriculture as the dominant land use.

Hydraulic deficiencies, including undersized bridges and culverts, were identified at roadway stream crossings. There are 81 bridges & culverts in the Little Salt Creek Watershed that have a contributing drainage area greater than 150 acres. 62 of these are Lancaster County Structures, 16 are private and three are for I-80. Figure 9-42 shows the location of these 81 hydraulic structures in the Little Salt Creek Watershed.

Bridge and Culvert topping is characterized as a deficiency if the structure is topped in a storm event more frequent than the 25-year event and the roadway is paved. Six structures were identified as problems based on these criteria. Structures C-91, F-78, F-82, F-86 and F-91 all met the criteria outright, while Structure F-79 was selected because the amount of sediment observed in the structure substantially reduced the conveyance capacity demonstrated by the hydraulic model.

Table 9.1 lists all of the structures draining greater than 150 acres and is sorted by the roadway topping storm event and by the roadway condition (paved or unpaved). Those structures identified as being deficient are highlighted.

Table 9.1 Bridge and Culvert Topping

County Structure Number	Structure Location	Road Topping Event	25-yr Water Depth Over Road (ft)	Roadway Condition (paved, unpaved)	Structure Type	Size	Main Stem or Trib #
	14000 N 14th St	2	2.62	paved	Culvert	8' CMP	Trib 45
	15737 N 14th St	2	1.16	unpaved	Culvert	4.5' CMP	Trib 150
	20200 NW 12th St	2	1.53	unpaved	Culvert	2.5' CMP	Trib 360
C-211A	20900 NW 12th St	2	2.16	unpaved	Culvert	5'w x 3.5'h CMP Ellipse	Trib 360
	870 Raymond Rd	2	2.00	unpaved	Culvert	3.5' CMP	Trib 65
	2801 W Davey Rd	2	2.36	unpaved	Culvert	2' CMP	Trib 85
	1042 W Raymond Rd	2	3.37	unpaved	Culvert	3' CMPs	Trib 65
	966 W Raymond Rd	2	1.73	unpaved	Culvert	Triple 2' CMPs	Trib 65
C-91	W Raymond Rd (just west of 1st St)	10	2.69	paved	Bridge	1-Span, 48'	Main Stem
F-78	8480 N 14th Street	10	1.53	paved	Bridge	1-Span, 25.5'	Trib 15
F-82	9084 N 14th St	10	1.12	paved	Bridge	1-Span, 23'	Trib 115
F-86	11618 N 14th St	10	1.34	paved	Bridge	1-Span, 18.0'	Trib 30
F-91	14000 N 14th Street	10	0.82	paved	Culvert	Triple 9'w x 7'h RCBs	Trib 45
	14123 N 1st St	10	0.79	paved	Culvert	Twin 3' CMPs	Trib 55
F-96	1101 Mill Rd	10	2.87	unpaved	Bridge	3-Span, 88'	Main Stem
F-26	15200 N 1st Street	10	0.82	unpaved	Bridge	1-Span, 59.3'	Main Stem
C-172	NW 12th St (bet. W Branched Oak Rd & W Raymond Rd)	10	1.96	unpaved	Bridge	2-Span, 45'	Main Stem
C-253	East of 1801 W Branched Oak Rd	10	2.04	unpaved	Bridge	1-Span, 32'	Main Stem
C-262	16900 NW 19th St	10	2.69	unpaved	Bridge	1-Span, 68'	Main Stem
C-227	2900 W Davey Rd	10	3.14	unpaved	Culvert	Twin 12.7'w x 12'h RCBs	Main Stem
C-113	3500 W Little Salt Rd	10	1.20	unpaved	Culvert	12'w x 8'h RCB	Main Stem
C-51	4601 W Ashland Rd	10	1.72	unpaved	Culvert	7' CMP	Main Stem
G-144	3636 Bluff Rd	10	0.66	unpaved	Bridge	1-Span, 20'	Trib 10

Table 9.1 Bridge and Culvert Topping

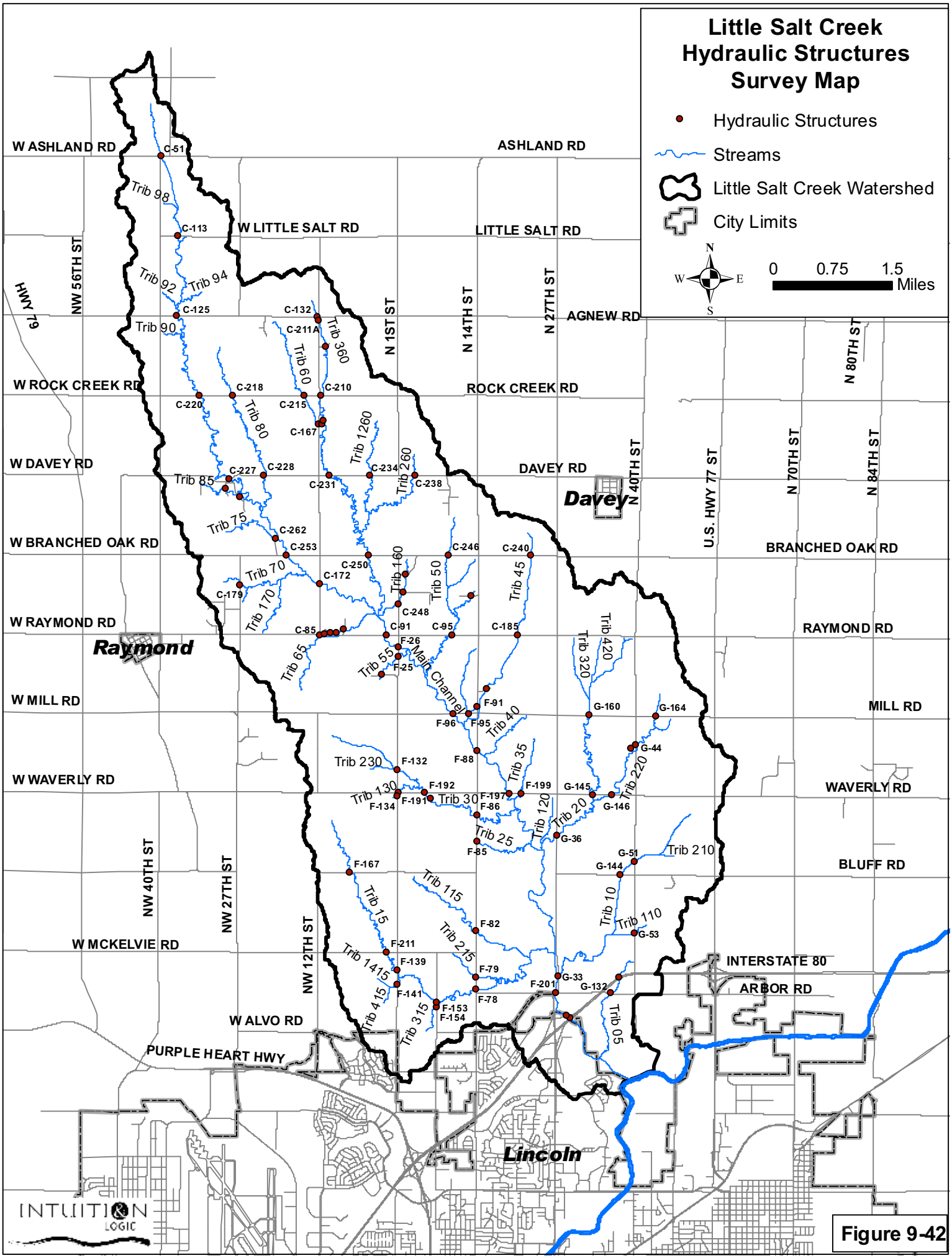
County Structure Number	Structure Location	Road Topping Event	25-yr Water Depth Over Road (ft)	Roadway Condition (paved, unpaved)	Structure Type	Size	Main Stem or Trib #
G-51	11275 N 40th Street	10	0.87	unpaved	Culvert	12.5'w x 6.1'h RCB	Trib 10
F-153	8101 N 7th St	10	0.93	unpaved	Culvert	Twin 8'w x 6.5'h RCBs	Trib 15
F-211	W McKelvie Rd (bet. N 1st St & NW 12th St)	10	1.57	unpaved	Culvert	Twin 8'w x 6'h RCBs	Trib 15
F-167	605 W Bluff Rd	10	1.12	unpaved	Culvert	8'w x 6'h RCB	Trib 15
F-154	8101 N 7th St	10	0.93	unpaved	Culvert	6.75'w x 4.5'h Concrete Ellipse	Trib 315
G-160	3862 Mill Rd	10	2.34	unpaved	Culvert	8'w x 5'h CMPA	Trib 20
F-192	601 Waverly Rd	10	0.90	unpaved	Culvert	11.5'w x 9'h RCB	Trib 30
F-132	N 1st St (bet. Mill Rd. & Waverly Rd)	10	1.25	unpaved	Culvert	12'w x 6'h RCB	Trib 30
F-95	1200 Mill Rd	10	2.15	unpaved	Culvert	10'w x 6'w RCB	Trib 45
C-240	2200 Branched Oak Rd	50	0.80	unpaved	Culvert	6'w x 5.4'h RCB	Trib 45
C-246	1000 Branched Oak Rd	10	1.06	unpaved	Culvert	7'w x7'w RCB	Trib 50
F-25	N 1st St (just south of Raymond Rd)	10	1.68	unpaved	Culvert	10'w x6'w RCB	Trib 55
C-250	400 W Branched Oak Rd	10	2.06	unpaved	Bridge	1-Span, 30.8'	Trib 60
C-231	1000 W Davey Rd	10	1.78	unpaved	Culvert	Twin 10.15'w x 8'h RCBs	Trib 60
C-167	NW 12th St (South of W Rock Creek Rd)	10	1.55	unpaved	Culvert	8.7'w x 6.25'h RCB	Trib 60
C-215	1400 W Rock Creek Rd	10	0.87	unpaved	Culvert	7.5'w x 7'h RCB	Trib 60
C-210	At W Rock Creek Rd & NW 12th St	10	1.16	unpaved	Culvert	8'w x 8'h RCB	Trib 360
C-228	2225 W Davey Rd	10	1.18	unpaved	Culvert	4' CMP	Trib 80
G-53	N 40th St (bet. Bluff Rd & I-80)	10	0.96	unpaved	Culvert	6'w x 6'h RCB	Trib 110
G-33	N 27th St (north of Arbor Rd)	10	1.16	unpaved	Culvert	9.75'w x 10.5'h RCB	Trib 10

Table 9.1 Bridge and Culvert Topping

County Structure Number	Structure Location	Road Topping Event	25-yr Water Depth Over Road (ft)	Roadway Condition (paved, unpaved)	Structure Type	Size	Main Stem or Trib #
	Private – 1000 W Raymond Rd	10	0.83	unpaved	Culvert	Twin 7.15'w x 5.75'h RCBs	Trib 65
	Private – 2801 W Davey Rd	10	1.35	unpaved	Culvert	3.5' CMP	Trib 85
	Private – 12855 N 40th St	10	1.09	unpaved	Bridge	1-Span, 36'	Trib 220
	Private – NW 12th St (bet. W Rock Creek Rd & W Davey Rd)	10	2.01	unpaved	Bridge	1-Span, 29'	Trib 60
	Private – NW 12th St (bet. W Rock Creek Rd & W Davey Rd)	10	1.10	unpaved	Culvert	12' CMP	Trib 360
	Private – 605 Waverly Rd	10	2.68	unpaved	Culvert	4' CMP	Trib 30
F-79	14th St (bet. McKelvie Rd & Arbor Rd)	25	1.53	paved	Culvert	6'w x 3'h RCBs	Trib 215
G-146	3500 Waverly Rd	25	1.43	paved	Culvert	10'w x 8.5'h RCB	Trib 220
C-95	East of 910 Raymond Rd	25	0.11	paved	Culvert	11'w x10'h RCB	Trib 50
C-85	965 W Raymond Rd	25	1.30	paved	Culvert	12'w x 6'h RCB	Trib 65
G-36	N 27th St (bet. Waverly Rd & Bluff Rd	25	0.24	unpaved	Culvert	Twin 14'w x 10'h RCBs	Trib 20
G-44	13051 N 40th St	25	1.16	unpaved	Culvert	12'w x 6.'h RCB	Trib 220
F-191	201 Waverly Rd	25	0.74	unpaved	Culvert	4' CMP	Trib 130
F-134	12200 N 1st Street	10	0.94	unpaved	Culvert	4' CMP	Trib 130
C-185	2240 Raymond Rd	50		unpaved	Culvert	Twin 7.25'w x 6.5'h RCBs	Trib 45
	Private – 333 Branched Oak Rd	50		unpaved	Culvert	4' CMP	Trib 160
C-179	16060 NW 27th St	25	0.29	unpaved	Culvert	5'w x 5'h RCB	Trib 70
C-218	W Rock Creek Rd (bet. NW 12th St & NW 40th St)	100		unpaved	Culvert	6'w x 7'h RCB	Trib 80
G-164	4201 Mill Rd	25	0.31	unpaved	Culvert	5'w x 5'h RCB	Trib 2220
F-201	Arbor Rd & N 27th St	100		paved	Bridge	3-Span, 122'	Main Stem
F-88	13201 N 14th Street	100		paved	Bridge	1-Span, 80'	Main Stem

Table 9.1 Bridge and Culvert Topping

County Structure Number	Structure Location	Road Topping Event	25-yr Water Depth Over Road (ft)	Roadway Condition (paved, unpaved)	Structure Type	Size	Main Stem or Trib #
	I-80 (bet. N 40th St & Arbor Rd)	100		paved	Culvert	10.3'w x 6'h RCB	Trib 05
G-145	Waverly Rd (bet. N 27th St & N 40th St)	100		paved	Culvert	14.5'w x 12'h RCB	Trib 20
C-132	1300 W Agnew Rd	500		paved	Culvert	6'w x 6'h RCB	Trib 360
F-139	8633 N 1st St	100		unpaved	Culvert	Twin 12'w x 8'h RCBs	Trib 15
C-248	15601 N 1st St	100		unpaved	Culvert	4' CMP	Trib 160
	Private – 15800 N 1st St	100		unpaved	Culvert	Twin 3' CMPs	Trib 160
C-238	400 Davey Rd	100		unpaved	Culvert	6'w x 5'h RCB	Trib 260
C-234	East of 638 W Davey Rd	100		unpaved	Culvert	6'w x 6'h RCB	Trib 1260
F-197	1301 Waverly Rd	500		paved	Bridge	3-Span, 98'	Main Stem
F-199	Waverly Rd (bet. N 14th St & N 27th St)	500		paved	Culvert	8'w x 6'h RCB	Trib 35
	I-80 at N 27th St	500+		paved	Bridge	3-Span, 206'	Main Stem
	I-80 off ramp at N 27th St	500+		paved	Bridge	3-Span, 180	Main Stem
C-125	3600 W Agnew Rd	500+		paved	Bridge	3-Span, 70'	Main Stem
F-85	11122 N 14th St	500+		paved	Culvert	5'w x 7'w RCB	Trib 25
C-220	3425 W Rock Creek Rd	500+		unpaved	Bridge	1-Span, 74'	Main Stem
G-132	4001 Arbor Rd	500+		unpaved	Culvert	Twin 8'w x 5'h RCBs	Trib 05
F-141	8101 N 1st St	500+		unpaved	Culvert	Twin 10'w x 6'h RCBs	Trib 415



INTUITION LOGIC

Figure 9-42

9.3.1.2 Natural Resources and Water Quality Problem Identification

The process for identifying natural resources and water quality problems focuses on the protection, preservation and/or enhancement of the saline wetlands and Salt Creek Tiger Beetle Habitat. There are several studies and efforts underway to protect and enhance these vital resources and there is still a lot to learn. In an effort to gain insight into this knowledge base, the Technical Advisory Committee (TAC) was formed and consulted throughout the Little Salt Creek Watershed Master Planning process. The TAC is a panel of stakeholders and experts from the Nebraska Department of Environmental Quality, Nebraska Game and Parks Commission, University of Nebraska at Lincoln School of Natural Resources, University of Nebraska at Lincoln Department of Entomology, Natural Resource Conservation Service, U.S. Fish and Wildlife Services, U.S. Army Corps of Engineers, City of Lincoln Parks & Recreation, Lancaster County Planning, and the Lower Platte South NRD.

The TAC was in general agreement that the continued incising of Little Salt Creek would have a negative effect on near channel groundwater elevations which could, in turn, affect near-channel saline wetlands. It was further generally agreed that continued incision could have a negative effect on Tiger Beetle habitat. For this reason, incision is also considered a natural resource and water quality problem.

Degradation and reduction of saline wetlands and Tiger Beetle habitat was identified as another problem. Several efforts are underway to protect and restore these resources, but funding is limited and many of the areas are left unprotected.

9.3.2 Project Evaluation Approach

9.3.2.1 Bridge and Culvert Evaluation Approach

The bridge and culvert improvement recommendations in this report are based on adding stormwater conveyance capacity in a manner that does not compromise channel geomorphic parameters. The approach to improving the problem of frequent roadway topping on paved roads was to replace or enhance the hydraulic structure to convey a minimum of the 25 year storm event without topping the road. Replacing the bridge or culvert entails removing the existing structure and constructing a new structure. Enhancing the existing structure to add capacity included widening the existing opening or adding flanking culverts. Although these recommendations provide measurable benefits, they are not included as projects in this Watershed Master Plan because they do not impact habitable structures and are not within an urbanized or otherwise artificially altered drainage system. These structural improvement projects are road projects and would be most appropriately addressed when the bridge/culvert is replaced due to condition or capacity issues. Details on these recommendations are found in Appendix L.

9.3.2.2 Natural Resources Evaluation Approach

The natural resources and water quality goals were generated from discussions and coordination with the Technical Advisory Committee. On July 17, 2008, the second Technical Advisory Committee meeting was held with the objective of developing an approach to natural resource and water quality throughout the watershed, among others.

Several issues and approaches were discussed during the meeting and in subsequent conversations throughout the following months. As a result, the goals of improving Salt Creek Tiger Beetle habitat and restoring, enhancing and creating new saline wetlands were established. Currently, the University of Nebraska and other agencies are working with the City to develop the best possible plan to restore and protect the natural resources within the Little Salt Creek watershed. It was determined that more research needs to be done before any specific projects can be developed.

9.3.2.3 Riparian Corridor Enhancement Evaluation Approach

Riparian Corridor Enhancement Program involves re-planting the woody riparian buffer along Little Salt Creek and its tributaries along the reaches where soil and saline content will support a dense, woody riparian corridor with the goal of re-establishing the corridor and reducing erosion and stream downcutting. Over the past decades, the woody riparian corridor has been substantially depleted. This management measures will contribute to a more robust, self-managing stream system and provide abundant opportunity for habitat and improved water quality. There is over 68 miles of corridor that may qualify for this type of restoration. The Riparian Corridor Enhancement is a voluntary program for the landowners and developers and is not considered a Capital Improvement Project because it is cost prohibitive and there are several voluntary tree planting programs already in place. More details on the Riparian Corridor Enhancement Program can be found in Appendix L of this report.

9.3.2.4 Water Quality Evaluation Approach

While the water quality data generated through this study is limited, there is persuasive evidence that nutrient enrichment and high seasonal temperatures are degrading this stream. Sediment generation and transport exacerbate both conditions. Nutrients adhere to sediment particles which, when mobilized and transported, facilitate their distribution throughout the system. Sediment particles also absorb light and contribute to increased water temperatures.

It was determined that more planning needs to be done before any specific projects can be developed to address water quality in the Little Salt Creek Watershed. The water quality management recommendations that follow emphasize sediment management for the purpose of improving water quality.

In most rivers and streams sediment management involves three approaches: 1) reducing the generation of sediment, 2) maintaining transport of entrained sediment and 3) selectively trapping sediment. The primary stream stability approach of grade stabilization at bridges as discussed previously in this section is useful in controlling sediment generation through arresting incision although other incising reaches remain untreated. The second approach, maintaining transport is not applicable in this watershed because the particle size of the sediment in Little Salt Creek is so small that it does not settle out readily and tends to remain entrained. The options available under the third approach, sediment trapping, are limited by the salinity of the watershed. There are no feasible sediment trapping alternatives because the salinity of the soil sharply reduces the effectiveness[1] of the polyacrylamides.

[1] www.nebraskadrybean.com/research23.htm . Yonts, C.D., 1999. Polyacrylamide (PAM) a Method to Control Irrigation Induced Soil Erosion.

As discussed previously in this section, addressing every stream erosion problem is cost prohibitive. Systemic grade controlling to reduce sediment generation falls into this cost prohibitive category. However, as time, money and interests permit, grade controls in addition to the recommended CIP grade controls could be built to advance the goal of reducing sediment generation to enhance water quality. Although these recommendations provide measurable benefits, they are not included as projects in this Watershed Master Plan because the data and research to date is limited. Additional details on these water quality management recommendations are found in Appendix L.

9.4 Prioritization

The recommended capital improvement projects were classified as primary or secondary and categorized using the prioritization categories from the Prioritization Methodology Report for Watershed Master Planning Projects, City of Lincoln, Nebraska, 2006. Primary problem areas are those that pose a public safety concern with respect to road flooding, stream instability or severe maintenance conditions. Secondary problem areas are areas of infrequent flooding or stream degradation or instability that is propagating very slowly and/or is not likely to propagate to other areas of the watershed. The prioritization methodology was developed for the City of Lincoln to set priorities and implement Capital Improvement Programs for watershed master planning each year. The following prioritization categories were used for project ranking:

- Flooding Impacts: This category identifies the impact of floodwater encroachment on structures, public or private property, parking lots, public utilities or other infrastructure. The flooding potential can be identified through hydrologic and hydraulic analysis, study of topographic maps, field investigation and recorded historic problems. This category is further divided according to the frequency of the flooding; flooding that occurs at a more or less frequent rate than the ten-year storm event. Projects primarily intended to address structural or non-structural flooding will usually incorporate a high or low risk safety factor and may, if applicable, incorporate stream stability or water quality benefits.

- For the purposes of the Little Salt Creek Master Plan, roadway flooding was only considered a problem for paved roadways. Gravel and dirt roadways that were topped in ten year storm were not considered a problem.

- Stream Stability: This category identifies the impacts of channel erosion, the transport and undermining of soil by stream flow or overland flow. Channel erosion can threaten structures, public property, parking lots, public utilities or other public infrastructure. Channel erosion can also endanger streams, wetlands, lakes, conservation easements, buffer zones or other natural resources. The stream stability and erosion threat may be identified through visual observation, not strictly fluvial geomorphic assessment. This category is further divided according to the nature of the erosion, aggressive channel downcutting as compared to gradual channel widening. Projects primarily intended for stream stability typically will not incorporate flooding impact benefits; though will incorporate water quality benefits.

- Water Quality: This category identifies the impacts of water quality. A number of geomorphic mechanisms can adversely affect water quality through increased pollutant loading. The water quality benefits broken down in this category reflect the types of projects developed during watershed master planning efforts. This category is further divided according to the perceived scope of the project benefits, with greater emphasis place upon projects with broad-based impacts. Projects primarily intended for water quality typically will not incorporate flooding impact benefits; though may incorporate stream stability benefits.

- Safety Factor: This category identifies benefits to the potential threat to public health and safety. The potential for loss of life or bodily injury may include individuals trapped in structures during flooding or vehicles being swept away by floodwater. A safety factor is generally associated with projects addressing structural or non-structural flooding, though may be associated with stream stability or water quality projects.

- Miscellaneous Factors: This category identifies various other miscellaneous factors and additional considerations that have not been addressed in the previous four categories. Examples of other factors include but are not limited to: project location, development status, adjacent projects, complaints and outside funding opportunities.

This ranking system was specifically developed for Capital Improvement Projects proposed as part of the on-going watershed master planning efforts. Ranking worksheets were used to add points under each category, with the goal of developing an overall score. The projects with the highest point score are considered a higher priority. Appendix J provides a copy of each ranking worksheet.

Table 9.2 lists the classification, priority score, ranking and cost by project for the capital improvement projects within the Little Salt Creek Watershed. For projects with the same overall score, engineering judgment was used to finalize the ranking. The engineering judgment favored projects that provided broader based benefits over those projects that focused benefits to one area. The project costs are based on 2009 material and construction costs.

Table 9.2 Capital Improvement Project Summary Results

Project No.	Project Name	Classification	Priority Score	Project Ranking	Project Cost
1	Grade Control Main Stem, Waverly Road Bridge	Secondary	255	3	$95,000
2	Grade Control Main Stem, North 14th Street Bridge	Secondary	260	1	$113,000
3	Grade Control Main Stem, Mill Road Bridge	Secondary	250	7	$91,000
4	Grade Control Main Stem, North 1st Street Bridge	Secondary	255	4	$110,000
5	Grade Control Main Stem, W Raymond Road Bridge	Secondary	260	2	$115,000
6	Grade Control Main Stem, NW 12th Street Bridge	Secondary	240	8	$91,000
7	Grade Control Main Stem, W Branched Oak Road Bridge	Secondary	255	5	$71,000
8	Grade Control Main Stem, N 19th Street Bridge	Secondary	240	9	$84,000
9	Grade Control Main Stem, W Rock Creek Road Bridge	Secondary	240	10	$78,000
10	Grade Control Main Stem, W Agnew Road Bridge	Secondary	255	6	$69,000
11	Stilling Basin at N 40th Street Culvert Outfall, Tributary 10	Secondary	105	11	$78,000
12	Stilling Basin at N 40th Street Culvert Outfall, Tributary 110	Secondary	95	14	$77,000
13	Stilling Basin at N 40th Street Culvert Outfall, Tributary 220	Secondary	100	13	$67,000
14	Stilling Basin at Waverly Road Culvert Outfall, Tributary 35	Secondary	90	15	$75,000
15	Stilling Basin at N 1st Street Culvert Outfall, Tributary 30	Secondary	100	12	$85,000
16	Stilling Basin at Branched Oak Road Culvert Outfall, Tributary 45	Secondary	85	16	$95,000
17	Stilling Basin at W Davey Road Culvert Outfall, Tributary 1260	Secondary	80	17	$113,000
18	Stilling Basin at Davey Road Culvert Outfall, Tributary 260	Secondary	80	18	$85,000
				Total =	**$1,591,000**

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