Section 7
Capital Improvement Projects

7.1 Introduction

The results of the hydrologic, geomorphic, water quality and special areas evaluations discussed in the previous sections of this report formed the foundation for identifying problem areas in the Middle Creek Watershed Study Area. The Potential Capital Improvement Projects (CIP) addressing each problem area were evaluated based on design, economic feasibility, and overall efficiency of addressing systemic problems within the study area. Each CIP was then prioritized according to the City's Priority Ranking for Watershed Master Plan Projects.

The CIP identification and development process is detailed in the following subsections. The CIP Prioritization Worksheets are found in Appendix H, and the cost estimate worksheets for each project are found in Appendix I.

7.2 Problem Identification

The problem identification was based upon an evaluation of the Middle Creek main stem and tributaries to identify areas 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 5 was used to identify stream stability problems in the watershed. The stream processes driving instability identified in Section 5 are incision, widening, and plan form adjustment. Widening and plan form adjustment represent the main source of much of the erosion and mass wasting observed throughout the Middle Creek main stem. Incision has already occurred on the main stem and the observed widening and plan form adjustment are the natural progression of instability once the channel has incised to critical bank height. Incision is taking place on the tributaries as they down-cut to match the main stem flow line elevation.

Incision, widening and plan form adjustment all drive the widespread bank failures, mass wasting, and sediment generation identified in Section 5. Channel incision threatens bridges and culverts by eroding below the structure footing and removing the very soil on which these structures bear. Incision also threatens streamside utilities by day-lighting them and exposing the utility to channel shear forces. Bank failures and mass wasting resulting from incision, widening and plan form adjustment threaten streamside infrastructure and structures.

The water quality evaluation discussed in Section 4 identified elevated levels of E. coli, total suspended solids, phosphorus, total organic carbon and sodium. All of these conditions stem from systemic watershed characteristics, land use and watershed management practices rather than specific localized water quality problems or contamination sources. As a result, no water quality CIPs were developed. Instead, the identified water quality problems led to watershed best management practice recommendations which are discussed in the Implementation section of this report.

7.3 Evaluation Approach

7.3.1 Stream Erosion Evaluation

The major drivers of instability in the Middle Creek Watershed Study Area are widening and plan form adjustment along the main stem and incision on the tributaries. Many of the Middle Creek tributaries are managed channels at the tributary confluence with the main stem which has prevented the propagation of incision up these tributaries. For those tributaries that are not managed, incision has substantially moved up the tributary creating deeply incised channels and leaving crossing roadway culverts perched. In many cases, roadway culverts have stopped the progression of tributary incision at the road crossing.

There are no structures threatened by widening and plan form adjustment on the main stem. Instead, the main stem projects are grade control projects to stabilize knickpoints in the channel created by beaver dams. The grade controls will help stabilize this reach by preventing future incision caused by beaver dam breaches.

Several of the CIP projects address perched culverts and storm pipe outfalls due to past incision on the main stem and active incision on the tributaries. Stilling basins and outlet scour protection is recommended to protect the channel, banks and culvert outfalls from erosion due to perched pipes and culverts.

Bank stabilization is also included in the CIPs to address bank erosion and mass wasting in areas where infrastructure is threatened. The old truism regarding streambanks – *It is impossible to stabilize a streambank on an unstable stream* – is as applicable here as anywhere in the region. Therefore, grade controls are included in the bank stabilization CIPs to prevent future incision at the bank stabilization location. These grade controls are not included at sites where an existing nearby downstream grade control exists.

Nine recommended CIP's are developed for the Middle Creek Watershed Study Area. These recommended projects are strategic in nature, focusing on protecting existing infrastructure and interrupting the cycle of degradation by arresting channel incision prior to its propagation into stable reaches. The CIP's do not address all of the stream erosion issues in the watershed study area, as a program to repair all of the problem sites would be cost prohibitive. However, many of the recommended improvements are designed to address both the local stability problem identified in addition to helping the entire stream system move closer to self-sustaining dynamic equilibrium.

7.3.2 Water Quality Considerations

Water quality impacts are included in the evaluation of potential CIP's. Project evaluation and development took into account the potential water quality impacts which may occur as a result of project construction. Consideration was also given to the benefit that grade-control and bank stabilization projects would provide in terms of reducing channel erosion and protecting stable reaches, therefore reducing sediment loading. For example, grade controls and bank

stabilization projects designed to address stream erosion also assist in reducing sediment pollutants.

7.3.3 Special Areas Considerations

The process of evaluating the potential CIP's also included a consideration of the potential impacts each project may have on the Special Areas. Consideration was given to both avoiding potential negative impacts during project construction as well as the benefits each project provides in terms of protecting the local Special Areas from unmanaged system instability.

7.3.4 Capital Improvement Project Types

The recommended projects generally fall into one of three categories of projects:

1. **Grade Control Projects** - construct grade controls along the main stem and tributaries at select locations to stop incision at these locations. The grade controls will stop incision at the site and limit the propagation and depth of incision upstream of each grade control project. Grade control projects also include any localized bank stabilization necessary to construct a stable grade control. The bank stabilization should incorporate the use of native riparian vegetation. 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. Where stabilizing a knickpoint, a ramp slope of 20H: 1V maximum should be used. 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.

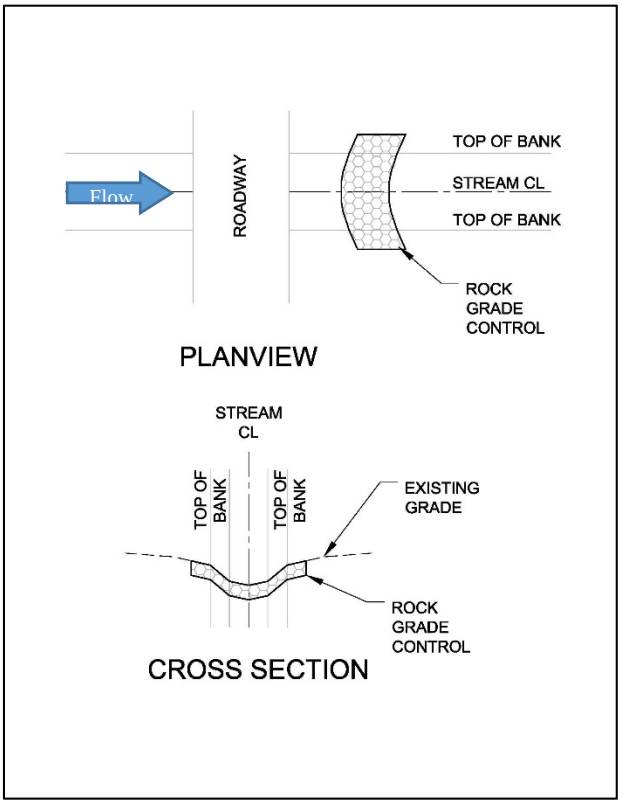

Figure 7-1: Rock Grade Control Structure Detail

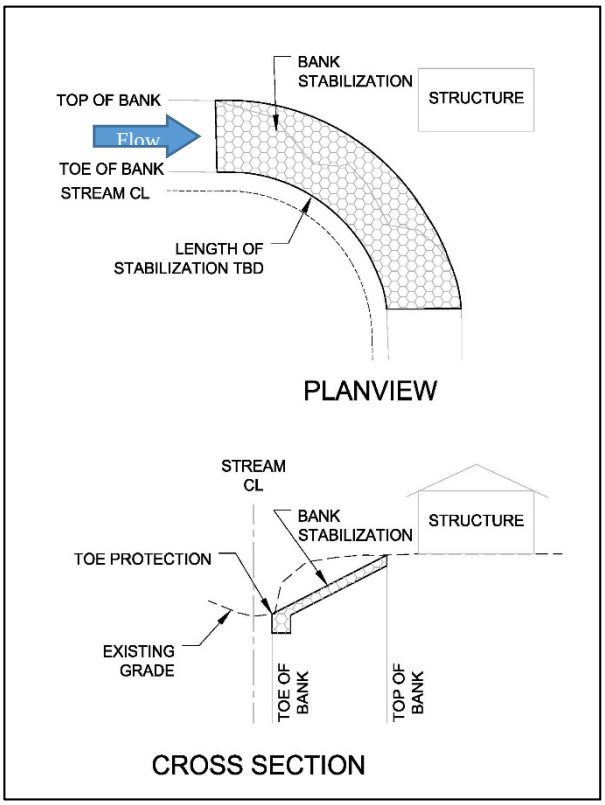

Figure 7-2: Bank Stabilization Structure Detail

2. **Bank Stabilization Projects** - construct engineered bank stabilization to protect identified infrastructure or structures from continuing bank erosion threatening the structure. The bank stabilization measures vary in size based on flow parameters, bank height, bank slope, site-conditions and other parameters. Bank stabilization should extend through the entire bend, beginning and ending at a riffle. To the greatest extent practical, bank stabilization shall be bio-engineered, incorporating the use of native riparian vegetation. Each bank stabilization project includes grade controls at the project limits to protect the stabilized bank from potential future incision and add to the systemic stability of the watershed study area.

3. **Outlet Stilling Basin and Scour Protection** – construct a stilling basin or scour protection at the pipe or culvert outfall to protect the pipe from erosion and undermining due to outfall scour. The limits of protection 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 through the scour protection and at the edges. When using a stilling basin, consideration should be given to the depth of scour anticipated in the plunge pool for a variety of flow events. Due to tailwater influences, the greatest potential for scour may not occur at the largest flowrate.

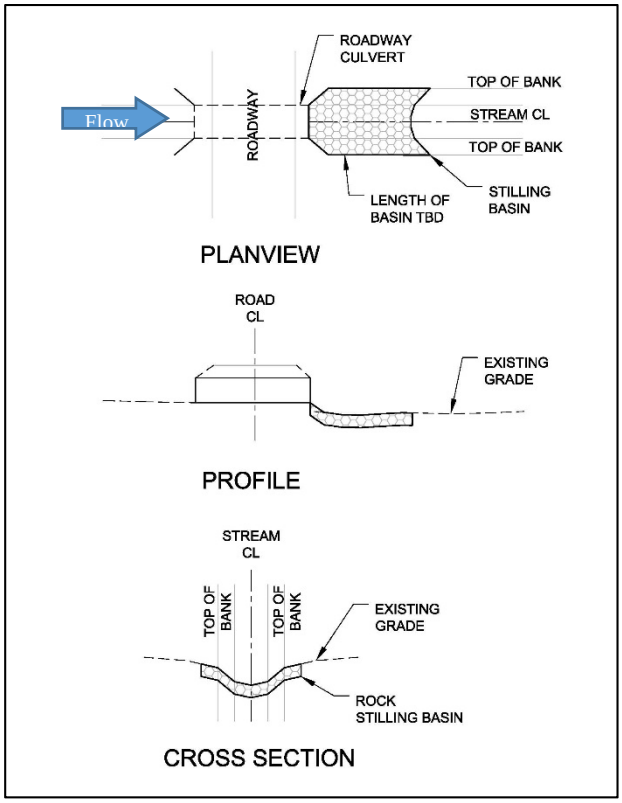

Figure 7-3: Stilling Basin Structure Detail

7.4 Capital Improvement Projects

The potential CIP's are discussed in the following pages and their locations illustrated in Figure 7-4.

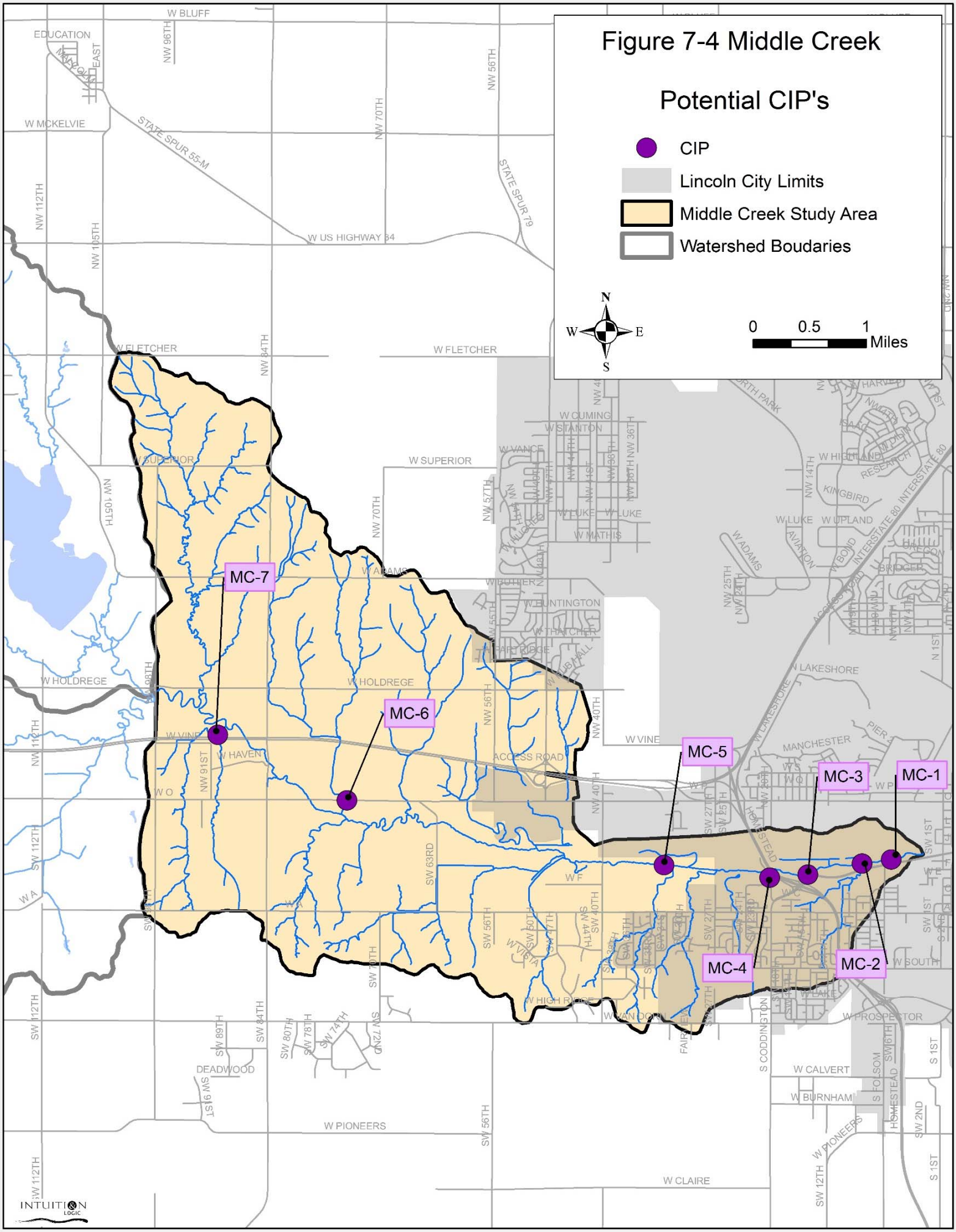
Figure 7-4 Middle Creek
Potential CIP's
CIP
Lincoln City Limits
Middle Creek Study Area
Watershed Boudaries
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0.5
1
Miles
MC-7
MC-6
MC-5
MC-4
MC-3
MC-2
MC-1
W BLUFF
EDUCATION
W MCKELVIE
STATE SPUR 55-M
W US HIGHWAY 34
STATE SPUR 79
W FLETCHER
W SUPERIOR
W HOLDREGE
W VINE
W HAVEN
ACCESS ROAD
W LAKESHORE
MANCHESTER
W CUMING
W STANTON
W VANCE
W LUKE
W MATHIS
W ADAMS
W BUTLER
W HUNTINGTON
W THATCHER
W HIGHLAND
W UPLAND
KINGBIRD
INTERSTATE 80
RESEARCH
AVIATION
W BOND
BRIDGER
W SOUTH
W PROSPECTOR
W CALVERT
W BURNHAM
W PIONEERS
W CLAIRE
DEADWOOD
HOMESTEAD
NW 96TH
NW 70TH
NW 56TH
NW 112TH
NW 105TH
NW 84TH
NW 57TH
NW 40TH
NW 91ST
SW 63RD
SW 56TH
SW 112TH
SW 89TH
SW 84TH
SW 80TH
SW 78TH
SW 74TH
SW 72ND
SW 91ST
SW 27TH
SW 25TH
SW 1ST
S 1ST
INTUITION & LOGIC

7.4.1 Project MC-1: Grade Control Main Stem MCR005 Near S Folsom St and Rosa Parks Way

Figure 7-5: Existing knickpoint

Problem description: An existing knickpoint in the main stem channel MCR005 approximately 600 feet northeast of the S Folsom St and Rosa Parks Way intersection.

Recommendation: Recommend constructing an engineered grade control at or immediately upstream of the existing knickpoint to protect the public and private parcels contiguous to the channel at this locations. The grade control will prevent the knickpoint from propagating upstream. This project will be a joint City, NRD and State (NDOR) project and will need participation of all entities.

Impact to Special Areas and Water Quality: Proposed access runs through Seacrest West Park and the project is located in or near potential wetlands. Consideration during design and construction should be provided to minimize disturbance to special areas and reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $146,000

Figure 7-6: Conceptual Layout of MC-1

7.4.2 Project MC-2: Grade Control Tributary MC005R005 North of Rosa Parks Way and S Folsom St

Figure 7-7: Failing grade control

Problem description: The existing tributary MC005R005 grade control and bank armor along the reach immediately upstream of the confluence is failing. The rock appears to be undersized and is placed on top of geo-textile fabric. The rock is washing away and the fabric is becoming exposed. The project site is located 1,000 feet northwest of the S Folsom St and Rosa Parks Way intersection and is partially located within the existing State right-of-way. Potentially affected parcels are public property including Seacrest Park.

Recommendation: Recommend removing the existing grade control and fabric and replacing with an engineered rock grade control to prevent further erosion. This project will be a joint City, NRD and State (NDOR) project and will need participation of all entities.

Impact to Special Areas and Water Quality: Proposed access runs through Seacrest West Park and the project is located in or near potential wetlands. Consideration during design and construction should be provided to minimize disturbance to special areas and reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $87,000

Figure 7-8: Conceptual Layout of MC-2

7.4.3 Project MC-3: Pipe Outfall Restoration and Erosion Protection Main Stem MCR010 along Rosa Parks Way

Figure 7-9: Pipe outfall erosion

Problem description: Two pipe outfalls located high on the slope, away from the main stem channel MCR010 along the Rosa Parks Way ROW fence, is causing erosion on the right descending bank. The project sites are located directly northeast of the Rosa Parks Way and Homestead Parkway interchange and is partially located within the existing State right-of-way. At the east location, a large area of scour and erosion is present at the outfall, and the fence has been undermined. At the west location, the invert of a CMP culvert has rusted out and the outfall beneath the CMP is eroding. The erosion from these outfalls potentially affects parcels which are public property.

Recommendation: Recommend replacing the CMP culvert outfalls and constructing scour protection at each location to stop the erosion. In addition, reshape and rock line the erosion from the pipe outfall to the channel and repair the fence. This project will be a joint City, NRD and State (NDOR) project and will need participation of all entities.

Impact to Special Areas and Water Quality: No special area impacts are anticipated. Consideration during design and construction should be provided to reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $129,000

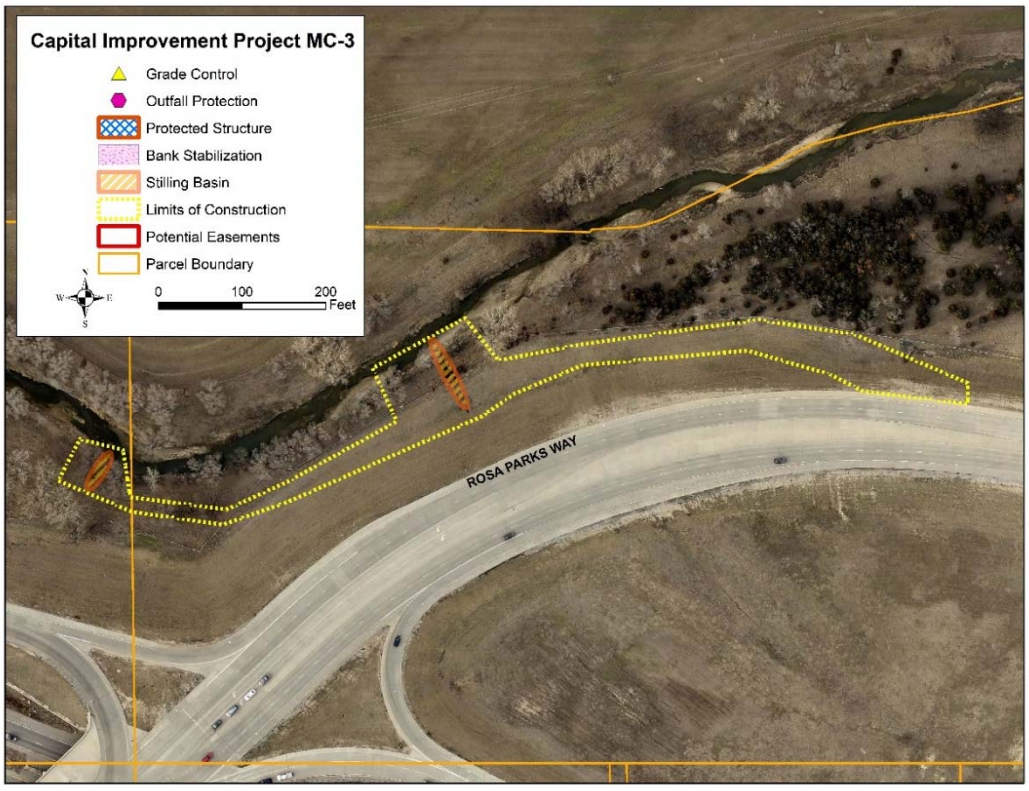

Figure 7-10: Conceptual Layout of MC-3

7.4.4 Project MC-4: Bank Stabilization and Grade Control Erosion along Tributary MC015R005

Figure 7-11: Bank cutting along tributary/ditch parallel to S Coddington Ave.

Problem description: Bank erosion and channel incision along tributary MC015R005 is threatening S Coddington Ave just north of the S Coddington Ave and W Millstone Rd intersection and is partially located within the existing State right-of-way. At one location, the bank erosion is within 10 feet the edge of S Coddington Ave pavement. In addition, the invert of the existing CMP culvert outfall for this tributary has rusted out and the slope under the CMP is eroding. The CMP is located on the right descending bank at the confluence with the main stem.

Recommendation: Recommend constructing bank stabilization with associated channel modification to stop erosion along the tributary. In addition, replace the rusted CMP outfall and reshape and rock line the erosion from the pipe outfall to the channel. This project will be a joint City, NRD and State (NDOR) project and will need participation of all entities.

Impact to Special Areas and Water Quality: No special area impacts are anticipated. Consideration during design and construction should be provided to reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $175,000

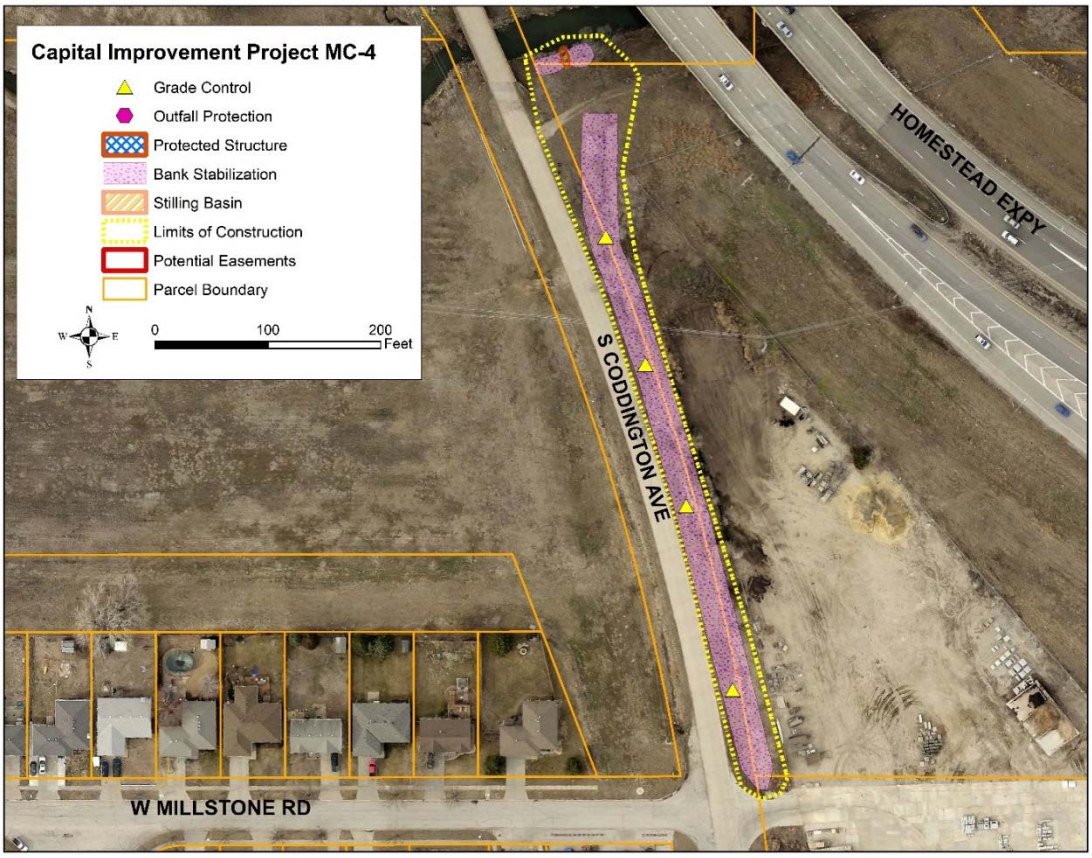

Figure 7-12: Conceptual Layout of MC-4

7.4.5 Project MC-5: Grade Control Main Stem MCR020 East of SW 40th St

Figure 7-13: Project Reach

Problem description: The main stem MCR020 along this reach has incised and transitioned into widening. Center bars and active slumps are still present throughout this reach, however this reach also exhibits signs of transition from widening to a stable sediment transport, as indicated by the presence of riffles. The stability appears tenuous based on the presence of multiple knickpoints along the reach. Securing the knickpoints with engineered grade controls will help stabilize this reach by preventing future incision caused by the knickpoints propagating upstream. The reach extends 5,400 feet east of SW 40th St. The access is approximately 0.25 miles north of SW 40th St and West F St. Potentially affected parcels are both publicly and privately owned property. The profile grade is at 1,145 feet at the upstream limits of the project reach and 1,139 feet at the downstream limits. 4 to 6 grade controls appear sufficient to accommodate this 5 feet of grade change.

Recommendation: Recommend installing 4 to 6 engineered grade controls along 5,400 feet of channel along the main stem to halt future incision along this reach. An additional rock grade control is recommended at the tributary on the left descending bank to provide a stabilized construction access. This project will be a joint City, Country, NRD and Burlington Northern Santa Fe Railroad project and will need participation of all parcel owners.

Impact to Special Areas and Water Quality: No special area impacts are anticipated. Consideration during design and construction should be provided to reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $590,000

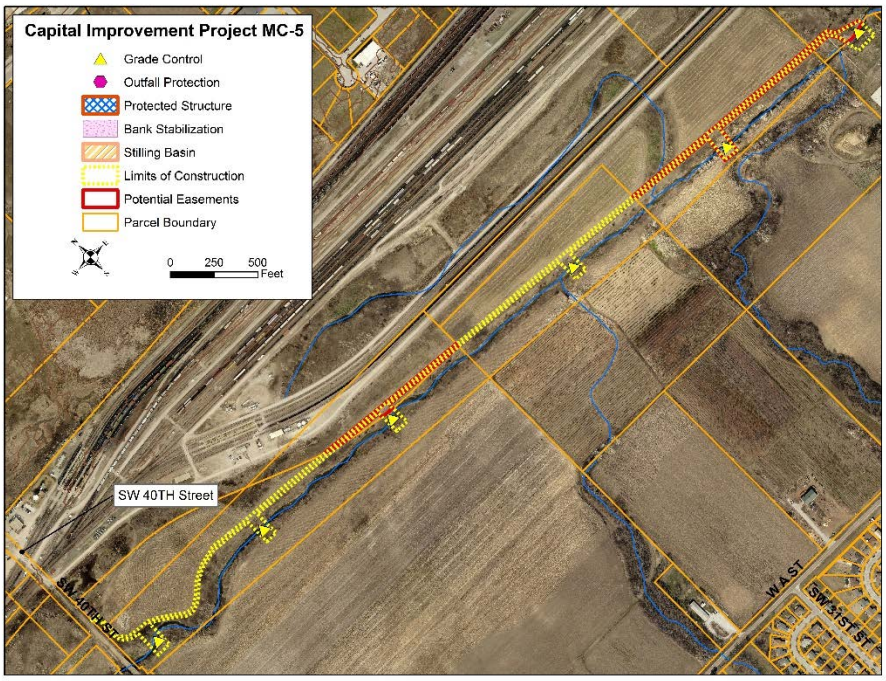

Figure 7-14: Conceptual Layout of MC-5

7.4.6 Project MC-6: Stilling Basin at Perched W O St Culvert on Tributary MC60R015

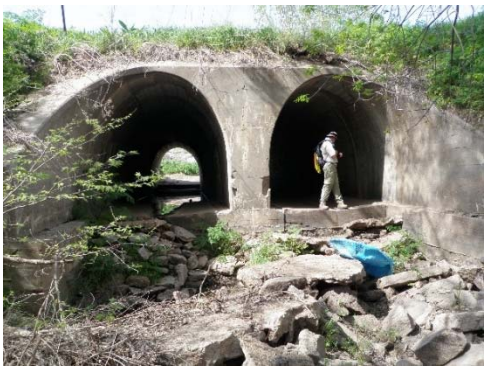

Figure 7-15: Perched W O St culvert

Problem description: The tributary MC60R015 culvert on the 7400 block of W O St is perched, and the culvert footings have been exposed. The project is located 3,800 feet east of the NW 84th St and W O St intersection and is partially located within the existing State right-of-way. Potentially affected parcels are both publicly and privately owned.

Recommendation: Recommend removing the existing dumped rubble and constructing an engineered stilling basin and rock grade control structure to protect the culvert outfall. This project will be a joint City, NRD and State (NDOR) project and will need participation of all parcel owners

Impact to Special Areas and Water Quality: No special area impacts are anticipated. Consideration during design and construction should be provided to reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $287,000

Figure 7-16: Conceptual Layout of MC-6

7.4.7 Project MC-7: Grade Control Knickpoint and Stilling Basin at 1-80 Culvert Outfall on Tributary MC070R005

Problem description: A 3 foot knickpoint is located in tributary MC070R005 approximately 2,170 feet west of NW 84th St and 130 feet north of I-80 and is partially located within the existing State right-of-way. In addition, the I-80 culvert outfall at this location is perched from past incision.

Figure 7-17: 3 foot knickpoint

Recommendation: Recommend installing grade control structures to stop incision and installing a stilling basin and grade control structure to protect the culvert outfall. This project will be a joint City, NRD and State (NDOR) project and will need participation of all entities.

Figure 7-18: I-80 culvert outfall

Impact to Special Areas and Water Quality: Project is located within the Beltway Corridor Protection Area and a woodland corridor. Consideration during design and construction should be provided to minimize disturbance to special areas and reduce impacts to water quality to the greatest extent practical.

Estimated Project Cost: $297,000

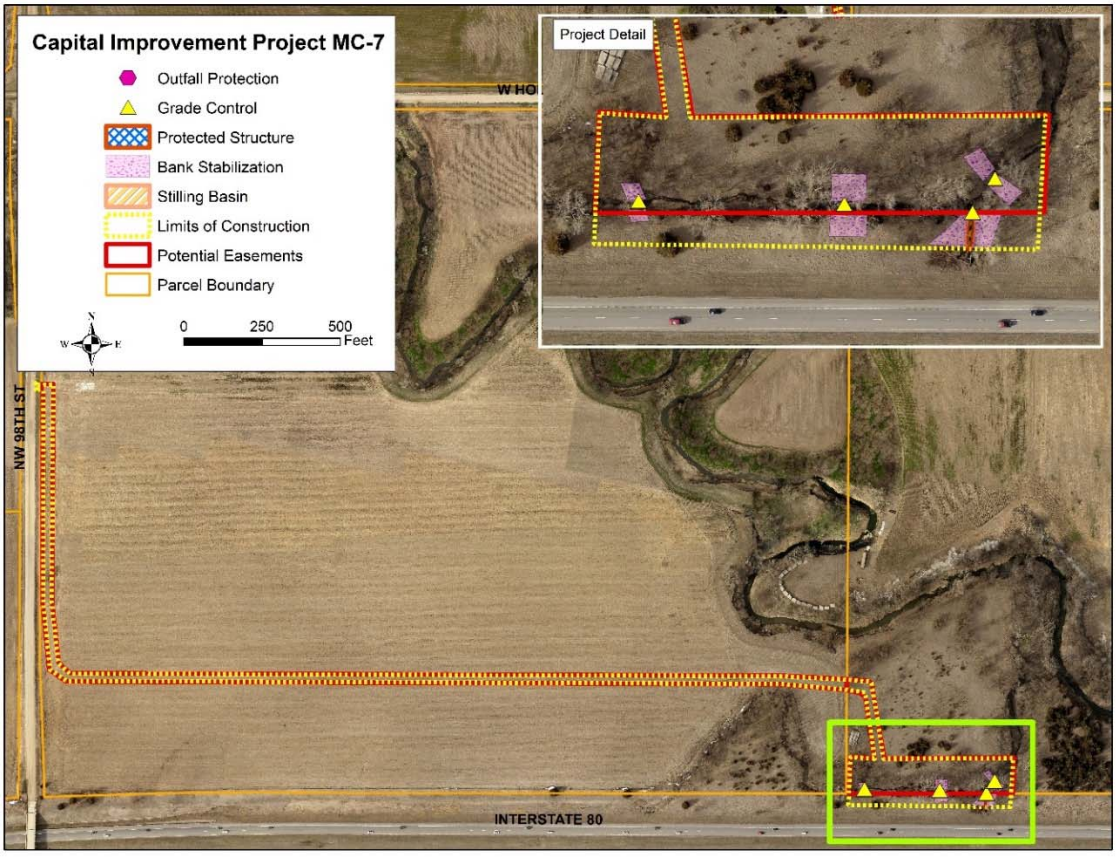

Figure 7-19: Conceptual Layout of MC-7

7.5 Prioritization

The recommended CIP's were classified using the prioritization categories from the Prioritization Methodology Report for Watershed Master Planning Projects, City of Lincoln, Nebraska, 2006. The prioritization methodology was developed for the City of Lincoln to set priorities and implement Capital Improvement Programs for watershed master planning each year. A Flood Impacts Analysis was not included in this Watershed Master Plan, therefore, Flood Impact projects are not included in the CIP. 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.
- 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 placed 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 H provides a copy of each ranking worksheet.

Table 7.1 lists the priority score, ranking and cost by project for the capital improvement projects within the Middle Creek Watershed Study Area. 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 2014 material and construction costs.

Table 7.1 Project Priority, Rank and Cost

Project Name	Project Description	Priority Score	Project Ranking	Project Cost
MC 1	Grade Control Main Stem MCR005 Near S Folsom St and Rosa Parks Way	220	2	$ 146,000
MC 2	Grade Control Tributary MC005R005 North of Rosa Parks Way and S Folsom St	195	7	$ 87,000
MC 3	Pipe Outfall Restoration and Erosion Protection Main Stem MCR010 along Rosa Parks Way	220	4	$ 129,000
MC 4	Bank Stabilization and Grade Control Erosion along Tributary MC015R005	220	3	$ 175,000
MC 5	Grade Control Main Stem MCR020 East of SW 40th St	210	5	$ 590,000
MC 6	Stilling Basin at Perched W O St Culvert on Tributary MC60R015	200	6	$ 287,000
MC 7	Grade Control Knickpoint and Stilling Basin at 1-80 Culvert Outfall on Tributary MC070R005	240	1	$ 297,000
			Total	$ 1,711,000

7.6 Other Improvement Recommendations

While the process for identifying problem areas in the Middle Creek Watershed Study Area was primarily focused on identifying and evaluating potential CIP's, it inevitably identified other projects which are not eligible for consideration as a CIP given the detailed criteria used in this evaluation.

Generally these problem areas were classified into one of two potential categories.

1. Other Projects – generally consisted of projects addressing problems identified to have measureable benefits, but do not qualify as Capital Improvement Projects or projects recommending monitoring of potential problem areas during future CIP planning. These projects and recommendations are included in this Master Plan as Other Improvement Recommendations for use with other programs.
2. Private Projects – generally consisted of problems identified in relation to privately owned structures and/or privately owned and operated utility pipelines and infrastructure either exposed in the channel bed or otherwise threatened by channel

erosion. Private projects have little to no measureable benefits to the public, while also not providing substantial flood reduction, stream stability, and water quality benefits. These project locations were provided to the City of Lincoln officials for their use in notifying the private utility of the threatened infrastructure. Some of the pipelines appear abandoned or are no longer in service, so this should be evaluated further prior to proceeding with the project.

The projects categorized as Other and Private are discussed in the following pages.

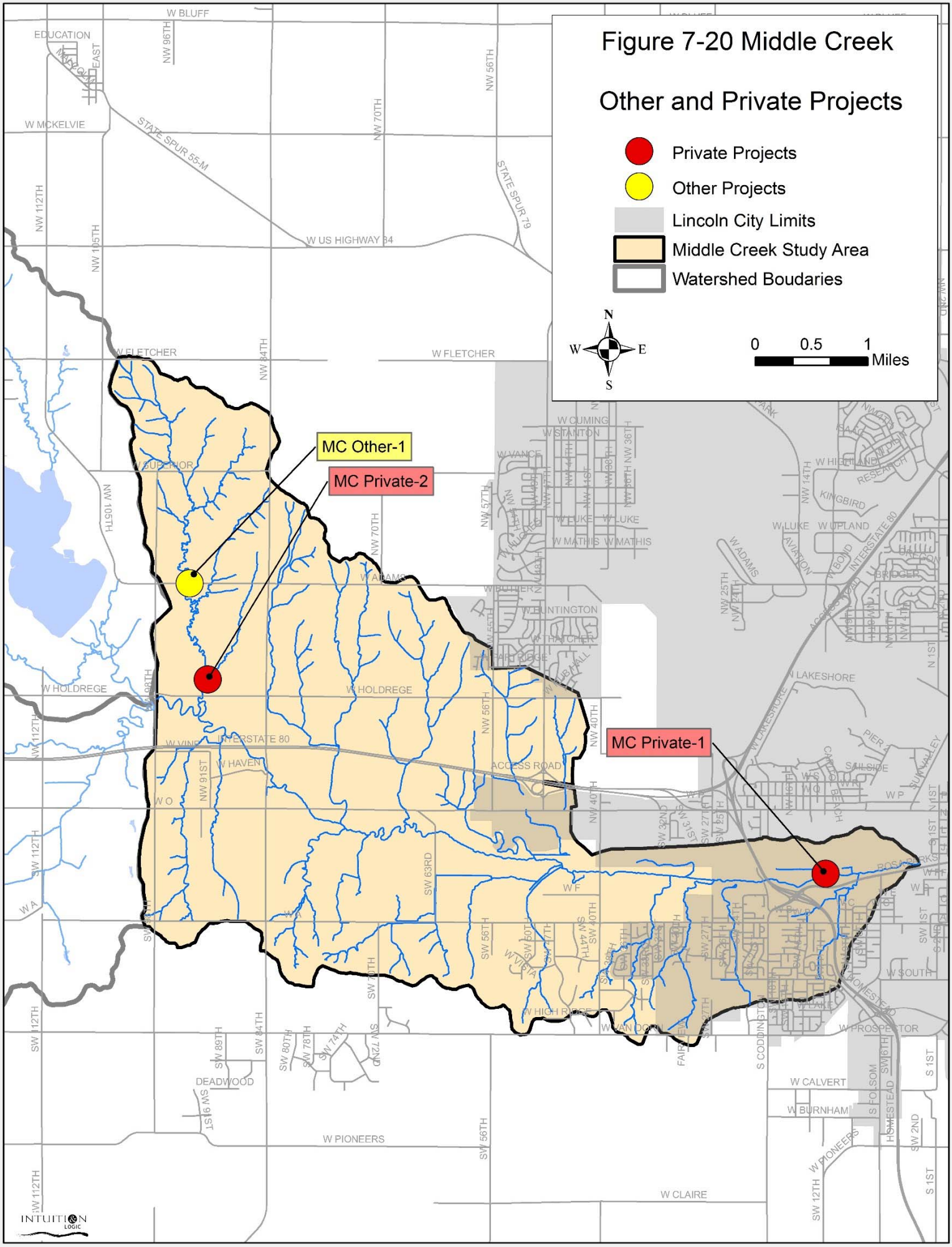
Figure 7-20 Middle Creek
Other and Private Projects
Private Projects
Other Projects
Lincoln City Limits
Middle Creek Study Area
Watershed Boudaries
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Miles
MC Other-1
MC Private-2
MC Private-1
W BLUFF
EDUCATION
W MCKELVIE
STATE SPUR 55-M
W US HIGHWAY 34
STATE SPUR 79
W FLETCHER
W CUMING
W STANTON
W VANCE
W SUPERIOR
W ADAMS
W HUNTINGTON
W HOLDREGE
W VINE
INTERSTATE 80
W HAVEN
ACCESS ROAD
W LAKESHORE
SAILSIDE
SUNNYBRAE
W SOUTH
W HIGH RIDGE
W PROSPECTOR
W CALVERT
W BURNHAM
W PIONEERS
W CLAIRE
DEADWOOD
KINGBIRD
W LUKE
W UPLAND
W MATHIS
W BOND
BRIDGEPORT
HOMESTEAD
INTUITION LOGIC

7.6.1 Project MC Other-1: W Adams St Culvert (County Structure M-105) at Tributary Reach Numbers MC075R015 and MC070R020

Problem description: Hydraulic analysis completed based upon available hydrologic and as-built data, indicates that roadway overtopping will occur during a 100-year flow event at this road crossing for tributaries MC075R015 and MC070R020. Roadway overtopping at this location could be eliminated if the culvert capacity is increased. The channel capacity at this location is sufficient to convey flood flow without overtopping the roadway.

Figure 7-21 – W Adams St culvert

Recommendation: Conduct further evaluation of the culvert crossing to augment prioritization for culvert replacment.

Impact to Special Areas and Water Quality: NONE

Figure 7-22: Project MC Other-1 Location

7.6.2 Project MC Private-1: Incising Tributary MC010R005 on left Descending Bank of the Middle Creek Main Stem MCR010.

Problem description: Tributary MC010R005 is incised between its confluence with the Middle Creek main stem MCR010 and the railroad tracks. Incision is beginning to threaten the railroad utility road. The incised reach is about 150 feet long and located 3,000 feet downstream of Homestead and 600 feet north of Rosa Parks Way. Additionally, the erosion control measures are failing causing construction sediment to be discharged.

Figure 7-23: Incising tributary

Recommendation: Place grade control in the tributary to stop incision.

Impact to Special Areas and Water Quality: NONE

Figure 7-24: Project MC Private-1 Location

7.6.3 Project MC Private-2: Barn Near Top of Bank of Tributary MC075R005 Upstream of W Holdrege St

Problem description: At this location on tributary MC075R005 a barn is located at the top of the channel adjacent to a 1:1 bank slope and is susceptible to bank erosion. Project is located 1,000 feet upstream of W Holdrege St between NW 98th St and NW 84th St. Potentially affected parcels are private property.

Figure 7-25: Barn Near Top of bank

Recommendation: Recommend constructing bank stabilization in the vicinity of the barn with associated grade controls.

Impact to Special Areas and Water Quality:
Project is located in a woodland corridor. Consideration during design and construction should be provided to minimize disturbance to special areas and reduce impacts to water quality to the greatest extent practical.

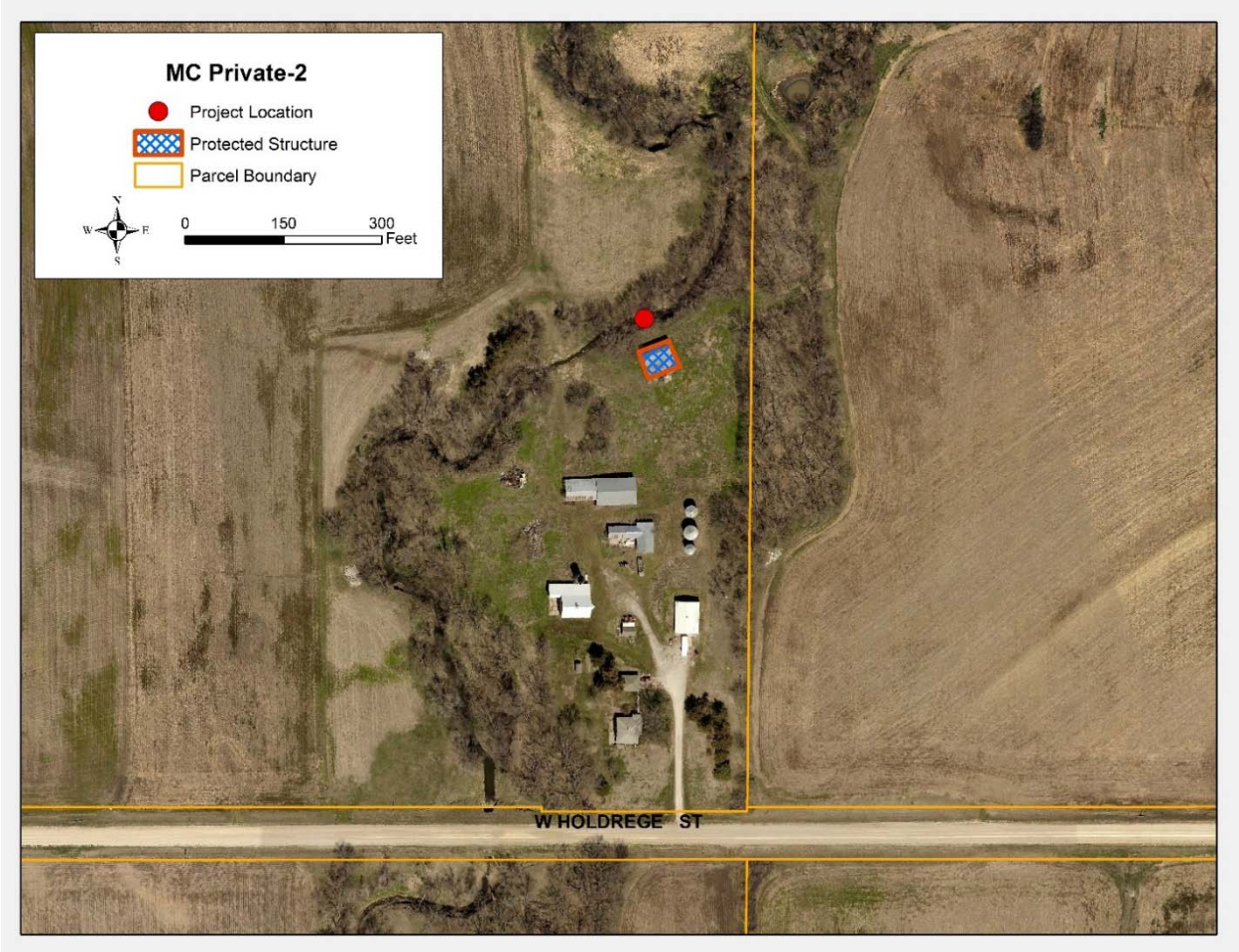

Figure 7-26: Project MC Private-2 Location

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