Section 8
Capital Improvement Projects

8.1 Introduction
The results of the hydrologic, hydraulic, geomorphic, and water quality 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 CIP.

8.2 Problem Identification
The process for identifying flooding and erosion problems was focused on areas along Deadmans Run main channel that pose a serious public safety concern with respect to potential building flooding, street flooding, or stream instabilities. Drainage problems related to the enclosed pipeline systems that discharge to the main channel was not part of this study evaluation.

Hydraulic deficiencies including undersized bridges and culverts, as well as channel overbank flooding, were identified along the main channel. Table 8-1 lists street flooding at major roadway stream crossings. The overbank flooding is illustrated by the extent of the 100-year existing conditions floodplain, as shown on Figure 8-1. Approximately 982 buildings are located within the Deadmans Run existing conditions floodplain.

<table>
<thead>
<tr>
<th>Location</th>
<th>2 Year Storm Event Overtopping (Feet)</th>
<th>10 Year Storm Event Overtopping (Feet)</th>
<th>50 Year Storm Event Overtopping (Feet)</th>
<th>100 Year Storm Event Overtopping (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52nd Street</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>56th Street</td>
<td>0.0</td>
<td>0.8</td>
<td>1.8</td>
<td>2.1</td>
</tr>
<tr>
<td>66th Street</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.0</td>
</tr>
<tr>
<td>“O” Street</td>
<td>0.5</td>
<td>1.8</td>
<td>2.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

The geomorphic evaluation discussed in Section 7 was used to identify stream instability problems. In addition to flooding and stream erosion projects, the study evaluated structural BMPs that focus on improving the water quality throughout the watershed.
8.3 Evaluation Approach

Potential improvement projects were evaluated based on design considerations, economic feasibility, and overall efficiency. This evaluation approach varied based on the intent of the project, including flood mitigation, stream stability measures, and water quality improvements. Projects that were determined to provide measurable benefits are included as recommended projects in Section 8.4. Projects that were considered but were not included as part of CIP did not meet the evaluation criteria and are summarized in Section 8.7.

8.3.1 Flooding Evaluation

The majority of the Deadmans Run main channel has been channelized using a variety of hard armoring components to increase channel conveyance and mitigate erosion problems. In addition, a limited amount of open space exists adjacent to the channel which makes it difficult to identify suitable locations for flood control projects. However, all of the evaluated alternatives utilize existing open space where available with the goal of minimizing stakeholder disruption.

The main goal of the flooding evaluation approach was to develop flood improvement projects that reduce future flood damages based on the 10-, 50-, and 100-year storm events. The flooding evaluation approach identified channel, bridge, and culvert conveyance improvements that effectively reduce the floodplain width in the respective area. Conveyance improvements that reduce overbank flooding also increase peak flows along...
the main channel. Therefore, the project team evaluated multiple combinations of detention projects to avoid an increase in downstream flood water surface elevations. Finally, the improvement projects integrated water quality and stream stability features. While investigating bridge constrictions, the bridge ratings were reviewed to determine if the stream crossing was structurally sufficient to remain in service. Table 8-2 provides the summary of bridge ratings and their respective status.

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornhusker Highway</td>
<td>86.8</td>
<td>Not Deficient</td>
</tr>
<tr>
<td>33rd Street and Baldwin Street</td>
<td>97.0</td>
<td>Not Deficient</td>
</tr>
<tr>
<td>Huntington Boulevard near 33rd Street</td>
<td>86.2</td>
<td>Not Deficient</td>
</tr>
<tr>
<td>48th Street near Leighton Street</td>
<td>75.1</td>
<td>Functionally obsolete because of roadway width</td>
</tr>
<tr>
<td>52nd Street and Francis</td>
<td>96.9</td>
<td>Not Deficient</td>
</tr>
<tr>
<td>56th Street and Holdrege Street</td>
<td>96.2</td>
<td>Not Deficient</td>
</tr>
</tbody>
</table>

Table 8-2 denotes the 48th Street Bridge status as functionally obsolete. A functionally obsolete bridge has older design features and, while it is not unsafe for all vehicles, it cannot safely accommodate current traffic volumes and vehicle sizes. The priority for improving a functionally obsolete bridge may be higher than bridges that are not deficient. Therefore, an opportunity exists to coordinate the recommended improvement for 48th Street conveyance (Section 8.4.1.3) with future transportation improvements.

In summary, an iterative process was used to balance the design and overall efficiency of the flood improvement projects with the economic considerations. The economic feasibility is further discussed in Section 9.

8.3.2 Stream Erosion/Water Quality Evaluation

The improvement projects to address stream erosion in the watershed focused on resolving critical stream stability issues that have the potential to adversely impact buildings and infrastructure. Improvement projects to improve water quality in the watershed included the consideration of new structural BMPs, retrofitting existing detention basins with water quality features, and end of pipe treatments (Section 6). The new structural BMPs were identified based on available open space in the watershed. Existing detention facilities eligible for retrofit included wet and dry detention ponds located in the proper location with opportunities for enhancements.
8.4 Recommended Improvement Projects

Like many watersheds throughout the country, the Deadmans Run watershed is fully urbanized and contains a limited amount of open green space. As a result, the process of developing solutions to mitigate flooding was very challenging because of the physical limitations that significantly reduce the number of suitable locations for flood control projects. However, the improvement alternatives analysis used for this study focused on utilizing existing open space where available with the goal of minimizing stakeholder disruption.

The evaluation process resulted in 13 total conceptual level improvement projects. The general location of each project is shown on Figure 8-2. The total conceptual level cost estimate for the 13 CIPs is approximately $50 million. Detailed cost information for each project is presented in Appendix F. All costs are in 2007 dollars. The cost estimates do not include costs for easements or land rights, hazardous waste remediation, utility relocation, or rehabilitation. The costs also do not include potential cost-sharing opportunities with NRD’s Antelope Valley or other City street improvement projects within the area.

The 13 CIPs are grouped into stormwater conveyance improvements, dry detention basins, local flood control, or water quality projects based on their main function. The projects are discussed on the following pages.

8.4.1 Stormwater Conveyance Projects

The stormwater conveyance projects extend from the Salt Creek confluence to 56th Street. The channel improvements were organized into four projects based on their geographic location. All four project improvements were evaluated using the HEC-RAS computer model which provided the ability to modify the hydraulic conveyance properties of the drainage system to determine the net effect on flood elevations.
8.4.1.1 Project 1: Downstream Conveyance System

Project 1 was divided into three locations, two along the main channel and one along the Deadmans Run West Tributary. Location 1 includes flooding improvements and geomorphic interventions to alleviate erosion problems downstream of Cornhusker Highway. Location 2 includes a portion of the downstream section of Deadmans Run West Tributary. Location 3 includes the portion of the main channel that extends from Cornhusker Highway to Huntington Street.

Project 1, Location 1: Main Channel, Station 0+00 to 23+66

Problem Description: The Salt Creek levee system ties into existing grade using the right and left bank of Deadmans Run. The levee isolates conveyance of the Deadmans Run main channel to a width of approximately 200 feet. Although the channel has adequate capacity to convey the 100-year storm flow, the area creates a constriction that increases water surface elevations upstream of Cornhusker Highway. This stream segment has undergone straightening but has not been improved with hard armoring, which has made this segment susceptible to erosion.

Further contributing to erosion in this area are several storm sewer outfalls that are acting as turning vanes which direct flow of the main channel to the bank opposite the storm sewer outfall. This mechanism has caused accelerated widening and meander migration throughout this unlined reach, especially along the upstream half of the reach and along the left (west) bank. The storm sewer outfall pictured to the right has been flanked which caused a collapse and is directing flow to the opposite bank and causing erosion. The exposed soils along the left bank are silty and sandy. These soils are easily eroded once flows scour under the root zones of bank vegetation. Side and channel bars are present in the channel which indicate that the channel bottom is stable downstream of the sheet pile and scour pool, which have abated the headcut from migrating upstream.

The erosion and bank instability along the left bank will continue, if left unattended. In turn, the failing banks could expose and endanger the sanitary sewer that runs parallel to the channel along the west side. Continued bank failure could endanger the commercial properties farther to the west. Continued scouring and erosion of the banks will generate significant sediment and, to a lesser extent, woody debris. This generation of sediment and woody debris could affect the stability of Salt Creek, particularly at the confluence with Deadmans Run, where the material would initially accumulate downstream of Deadmans Run.

Recommended Improvements: The constriction of flow will be alleviated by increasing the width of the stream channel. Widening the channel by shifting the right levee tie-in approximately 80 feet to the east allows space for a two-stage channel in which the smaller stream forming flow will meander within the larger flood channel, as depicted on Figure 8-3. The low-flow channel is designed to handle flows up to bankfull discharge. The purpose of
the two-stage channel is to honor this channel geometry found in naturally formed creeks. The regularly occurring storms are transported by the low-flow channel, while the larger flood events are handled with the expanded portion of the channel. The channel modifications will involve shifting the left bank to the east. The channel widening will also move the right bank farther to the east to facilitate the meander within the 110-foot wide channel at the base, while containing a smaller 25-foot low-flow channel. The banks will be sloped at 2 horizontal to 1 vertical.

As shown on Figure 8-4, the low-flow channel will consist of toe stone along its banks up to the bankfull shelf. The bankfull shelf, which forms the base for the majority of the channel, will be covered with a bioengineered system design of erosion fabric and plants. The banks, which extend up to the crest, will be covered with a combination of composite revetment and fabric and plants, depending upon the depth and frequency of inundation and tractive shear. To replace the sheet pile and scour pool, a series of grade controls will be placed along the channel to facilitate a stable grade change from the sheet pile wall to the confluence with Salt Creek. The grade controls should be Newbury-type rock structures with gently sloping tailwater ramps. The grade controls should extend through the low-flow channel and bankfull shelf and tie into the composite revetment along the banks.

*Estimated Project Cost:* $8,304,000
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Figure 8-3
Project 1, Location 1 Channel Improvements

Figure 8-4
Project 1, Location 1 Typical Channel Cross Section
Project 1, Location 2: Deadmans Run West Tributary, Station 0+00 to 13+44

Problem Description: The West Tributary receives approximately 1 square mile of upstream drainage as well as overbank flooding from the main channel. During the 100-year storm event, the railroad culverts and bridges constrict flood flows causing flooding upstream. Downstream of the railroad crossings, the channel conveyance is undersized which causes overbank flooding across State Fair Park Drive to the west. In addition, the twin 6-foot diameter CMPs just upstream of the confluence with the main channel, do not have adequate capacity which creates backwater effects and upstream flooding.

Recommended Improvements: The Deadmans Run main channel floodplain in this area is controlled by Salt Creek; therefore, improvements along the West Tributary will not significantly reduce the extent of the floodplain. However, the flooding caused by Deadmans Run West Tributary can be greatly reduced by focusing on reducing backwater and increasing channel capacity. To avoid adversely impacting stakeholders, no buildings in this area are proposed to be removed.

The recommended improvements include utilizing open space to widen the channel. In areas that have been encroached by development and widening is not possible, an increase in channel conveyance can be achieved by flood benching (Figure 8-5). To further promote increased capacity, the tributary invert should be gradually lowered to achieve a constant slope over the project extents. The constriction in flow at the confluence with the main channel will be eliminated by replacing the twin 6-foot CMPs with a 24-foot span, 12-foot rise, ConSpan culvert.

Estimated Project Cost: $1,207,000
Project 1, Location 3: Main Channel, Station 23+66 to 58+00

Problem Description: The main channel from the railroad crossings to downstream of Cornhusker Highway conveys the 100-year storm event. However, the channel creates a constriction that increases water surface elevations upstream of the railroad crossings. In addition, the railroad bridges, 33rd Street culvert, and the Huntington Street bridge openings are too small to accommodate the design flood flows, resulting in overbank flooding throughout this channel segment.

Recommended Improvements: The stream crossings in this location are undersized and require increased capacity. Figure 8-6 provides the recommended modifications to the drainage structures as well as construction limits for channel widening. A typical flood bench channel (Figure 8-7), including a low-flow natural channel, will balance aquatic habitat and water quality with a flood conveyance channel for larger storm events. The existing lined channel will be removed and replaced with a rock grade control base to encourage aquatic habitat, limit hydraulic movement of the surface, and provide a stable lining for the creek streambed. The rock lining is necessary to protect the native soils from erosion during stream forming flow. The widened flood channel bottom ties into gradual side slopes to complete the hydraulic section. The proposed channel must be widened by 100 feet on the right bank to accommodate the flood bench. As a result, one building and various roads and parking lots will be permanently removed.

Estimated Project Cost: $15,723,000
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Figure 8-6
Project 1, Location 3 Channel Improvements

Figure 8-7
Project 1, Location 3 Typical Channel Cross Section
8.4.1.2 Project 2: University of Nebraska – East Campus

Project 2 is divided into two locations based on the physical characteristics of each stream segment (Figure 8-8). Location 1, outlined in orange, includes the engineered, lined section of channel, which is bordered by several buildings owned and operated by the University of Nebraska. Location 2, shown in yellow, spans the natural channel section upstream of 38th Street to downstream of 48th Street.

**Project 2, Location 1: Main Channel, Station 58+00 to 81+78**

**Problem Description:** The channel does not have adequate capacity for larger storm events. During the 100-year storm event, the channel capacity is exceeded resulting in overbank flooding.

**Recommended Improvements:** The University buildings to the south and research fields to the north limit design alternatives to improve the capacity of the channel in this area. The channel conveyance will be increased by implementing a terraced section, as depicted on Figure 8-9. The channel accommodates stream forming flows in the low-flow channel and limits erosion with a grade control base made of natural stone. Native plantings on the horizontal terraces will promote infiltration and improve wildlife habitat. Structural retaining walls increase channel capacity without widening the channel, which is needed in this stream segment to avoid impacting adjacent buildings or the research fields. The retaining walls could be constructed using various materials. For the purpose of this study, a retaining wall system was assumed.

**Project 2, Location 2: Main Channel, Station 81+78 to 107+80**

**Problem Description:** The steep banks and a narrow channel characteristic of this segment constrict flow during larger storm events. During the 100-year storm event, the channel capacity is exceeded, resulting in overbank flooding to the north. The University’s research fields to the north limit the amount of channel widening in this area.

**Recommended Improvements:** Using available open space to reshape the channel banks back at a more gradual side slope will limit bank sloughing and also increase the flow capacity of the channel. The City and NRD recently performed stream stabilization improvements at multiple locations along this segment. Therefore, the recommendation is to continue with similar stream improvements in areas that were not addressed previously, using a typical cross section as depicted on Figure 8-10. A grade control base should be used to minimize erosion during stream forming flows. Velocities on the flood portion of the section are low enough to use native plantings, which will further promote water quality and improve wildlife habitat. The channel banks are tied back into existing grade, resulting in approximately 30 to 40 feet of widening to the south and up to 20 feet of widening to the north. Widening the channel will provide opportunity for stream meanders and riffles and pools, which will stabilize the stream channel.

**Estimated Project Cost:** $9,198,000
Figure 8-8
Project 2 Improvement Locations

Figure 8-9
Project 2, Location 1 Typical Channel Cross Section

Figure 8-10
Project 2, Location 2 Typical Channel Cross Section
8.4.1.3  Project 3: University Place Park, Main Channel, Station 107+80 to 124+40

Problem Description: The narrow channel constricts flow during larger storm events, causing overbank flooding to the south. In addition, the 48th Street culvert and the pedestrian bridge near the park are undersized to convey the 100-year storm event.

Recommended Improvements: The recommended improvement consists of widening the channel using flood benches to reduce the overbank flooding, as well as replacing the pedestrian crossing and the bridge that extends beneath 48th Street. Figure 8-11 depicts the channel widening and project construction limit extents. Flood benching the channel by an average of 50 feet to the south, with the process shown on Figure 8-12 will provide an opportunity to replace the existing main channel with stream meanders, riffles, and pools. Flood bench terraces will be vegetated with native grasses similar to the vegetation found in the park. Trees that are impacted during channel widening will be mitigated by replanting riparian trees adjacent to the stream corridor.

Estimated Project Cost: $2,474,000
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Figure 8-11
Project 3 Channel Improvements

Figure 8-12
Project 3 Typical Channel Cross Section
8.4.1.4 Project 4: 52nd Street to 56th Street, Main Channel, Station 124+40 to 143+90

**Problem Description:** Through previous channelization projects, this section of the creek has been improved using hard armoring components. The channel consists of a Fabriform mattress liner with gabion basket retaining walls to support vertical banks. In addition, a limited amount of open space exists near the channel because of the close proximity of residential homes. The narrow channel does not have adequate capacity to support larger storm events, causing overbank flooding to the south. The culverts at 52nd Street and 56th Street are undersized for the 100-year storm event, which causes backwater flooding immediately upstream of the area.

**Recommended Improvements:** The recommended improvements include widening the channel by approximately 20 feet on each side of the banks as shown on Figure 8-13. To maximize the capacity of the channel without impacting the backyards of the adjacent residential homes, vertical structural retaining walls using a terraced approach is recommended, as depicted on Figure 8-14. Native planting the terraces will provide water quality benefits and improve wildlife habitat.

The 60-foot-wide bridge at 52nd Street should be modified to incorporate vertical walls rather than sloping abutments. The existing sloping abutments of the bridge are causing the bottleneck of flows as well as reported debris jams. The 56th Street culvert should be replaced with an 80-foot span bridge to adequately convey the upstream flood flows.

**Estimated Project Cost:** $7,764,000
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Figure 8-13
Project 4 Channel Improvements

Figure 8-14
Project 4 Typical Channel Cross Section

Existing: 60' span bridge with sloping abutments
Replace with: 60' span bridge with vertical abutments

Existing: 28' x 15' RCP
Replace with: 80' span bridge

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8.4.2 Stormwater Detention Projects

Multiple stormwater detention project locations were evaluated with the goal of reducing flood flows along Deadmans Run main channel. A detailed hydrologic model was developed for each alternative to determine the effectiveness of the proposed sites. Based on the detailed evaluation, two dry detention projects are recommended. The first dry detention basin is located upstream of 56th Street and Holdrege Street along the main channel, while the second basin is located within Taylor Park.

8.4.2.1 Project 5: Offline Dry Detention Upstream of 56th Street, Main Channel, Station 152+93 to 159+78

Problem Description: Projects 1 through 4 include channel improvement projects that lower the floodplain elevation by increasing conveyance in the channel. This process eliminates existing flood storage in the overbanks and results in higher flood flows. To mitigate this increase in flow and potential adverse impacts downstream, stormwater detention basins must be constructed upstream of the channel conveyance projects.

Recommended Improvements: The goal of stormwater detention projects is to reduce flood flows by temporarily storing flood waters during severe rain storms and then slowly releasing the stormwater back into the channel after the storm has ended. Multiple alternatives were evaluated in this area, including variations of in-line storage with a wet bottom and variations of off-line storage with a dry bottom. The offline dry detention option was selected based on its efficiency of reducing flood flows for a given volume and project cost. The risk of adversely impacting adjacent buildings is also greatly reduced with the offline storage facility.

Available open space was targeted for the offline storage facility based on the size and geographic location within the watershed. The configuration of the basin consists of two cells, as depicted on Figure 8-15. Cell A encompasses land owned by an apartment complex and is designated as open space on their Community Unit Plan, which was approved by the City of Lincoln’s Planning Department. The apartment complex has built a trail on the north side of the area that provides a connection from the west apartments to the leasing office and recreational facilities approximately a half mile to the east. The area south of the trail includes varying topography, mature trees, and a maintenance road currently used as a disposal site for construction fill and debris. Cell B encompasses land owned by a private school. The school has recently improved the area by regrading and seeding the field to create improved recreational playing surfaces.

The construction of Cell A will involve excavating approximately 16 feet of soil material using gradual 4:1 side slopes. The construction of Cell B will involve excavating approximately 13 feet of soil material using the same side slopes. A side channel weir will be constructed along the left bank of Deadmans Run main channel. The left bank and weir will separate the excavated storage facility from the channel. The weir elevation will be positioned at approximately the 5-year design storm stage. When the Deadmans Run main channel water level reaches the crest elevation of the weir, stormwater will be diverted into Cell A. As the main channel continues to rise, the bottom of Cell A will fill. During approximately the 10-year design storm, Cell B will begin to inundate, storing stormwater...
for larger, less frequent storms. After the storms end, the storage facilities will drain water back into the main channel within a 24-hour period.

Other supplemental features of Cell A will include environmental enhancement by replanting with native grasses and trees. In addition, the connection trail can be replaced along the existing alignment, or through the detention facility providing access to passive recreation activities. Cell B will include a sand bed, underdrain system, and turf grass that can be used for recreational purposes. The area will gravity drain to Cell A and be available for recreational use within 24 hours of the storm subsiding.

**Estimated Project Cost:** $2,932,000
8.4.2.2 Project 6: Taylor Park Dry Detention

Problem Description: Projects 1 through 4 include channel improvement projects that lower the floodplain elevation by increasing conveyance in the channel. This process eliminates existing flood storage in the overbanks and results in higher flood flows. To mitigate this increase in flow and potential adverse impacts downstream, stormwater detention basins must be constructed upstream of the channel conveyance projects.

Recommended Improvements: Taylor Park, located near 66th Street and Taylor Park Drive (Figure 8-16), is a good candidate to implement stormwater detention. The south end of the park receives over 300 acres of upstream drainage which contributes to overbank flooding along Deadmans Run main channel. Available open space at the south end of the park includes a large hill to the west of the channel. The hill will be excavated almost 30 feet starting at the City’s property line and using 4:1 side slopes. An earthen berm, approximately 12 feet in height, would be constructed across the channel and tie into existing grade. The berm would back up water into the basin during larger storm events, temporarily storing the water and releasing over an extended time.

Similar to Project 5, the existing functionality of the park will be enhanced as part of the project. The excavated portion of the basin would be replanted with native grasses and trees. In addition, the area is an excellent candidate for a walking trail system that would meander within the basin footprint. Planting additional trees to provide shade for the trail will also enhance the function of the park, which is currently a designated arboretum. The project will be integrated with the channel stabilization effort currently being constructed and managed through the City’s Parks and Recreation Department. The construction includes stabilization measures located along the stream channel throughout Taylor Park.

Estimated Project Cost: $1,440,000
8.4.3 Local Flood Control

Local flood control projects are designed to prevent flood waters from impacting habitable buildings by redirecting existing drainage patterns. One local flood control project is recommended and discussed below.

**Project 7: Seacrest Park Berm**

**Problem Description:** Flooding at the north end of Seacrest Park has been reported to cause damages to the habitable buildings near Englewood Drive and Hazelwood Drive. An existing berm on the north end of the park becomes overtopped and does not provide adequate protection.

**Recommended Improvements:** The proposed recommended improvements include raising the existing earth berm height by approximately 2 feet. The improved berm would tie into existing grade further to the east. Project construction limits are indicated on Figure 8-17.

**Estimated Project Cost:** $19,000

![Figure 8-17](Project 7 Construction Limits)
8.4.4 Water Quality Projects

Five water quality projects are recommended. The projects utilized open space where available and are strategically located to maximize pollutant removal efficiencies in Deadmans Run main channel (Figure 8-18). Improvement projects to address water quality in the watershed include new structural BMPs, retrofitting existing detention basins with water quality features, end of pipe treatments, and stream stabilization measures.
8.4.4.1 Project 8: Wyuka Cemetery Existing Detention Pond Retrofit

**Problem Description:** The Wyuka Cemetery detention pond located near Vine Street and 45th Street was designed as a flood-control facility to reduce peak runoff rates. The basin is not appropriately configured to maximize the available storage to treat the water quality control volume. The existing outlet and sediment forebay is not efficiently flushing the system as indicated in the photo to the right.

**Recommended Improvements:** The proposed recommended improvements for the detention pond include using a portion of the storage volume to treat runoff entering the facility as indicated on Figure 8-19. This would be accomplished by modifying the outlet of the facility to extend the drawdown time during smaller storm events. The basin has sufficient capacity to treat 100 percent of the water quality volume without adversely impacting flood control benefits. In addition to the outlet modifications, the existing sediment forebay volume can be increased by adding berm height to the existing grade that separates the basin from the forebay.

**Estimated Project Cost:** $47,000
8.4.4.2 Project 9: Bethany Park New Water Quality BMP

**Problem Description:** The residential development located upstream of Bethany park (250 acres) is drained by a network of enclosed pipelines and concrete-lined channels. This type of traditional drainage system provides no water quality treatment benefits.

**Recommended Improvements:** The proposed recommended improvements include converting a portion of the west end of the park into a water quality feature that will treat the Vine Street tributary flow. The west end of the park will be excavated approximately 1 to 6 feet within the construction limits shown on Figure 8-20. A small culvert installed in the low-flow channel of the existing concrete-lined Vine Street tributary will divert the water quality storm flows and allow larger flood flows to continue to the main channel. The proposed grading would allow treatment of 45 percent of the WQCV.

**Estimated Project Cost:** $113,000
8.4.4.3 Project 10: Russwood Dry Detention Pond Retrofit

Problem Description: The commercial development upstream of two existing dry detention basins is drained by a traditional drainage system that provides limited water quality benefits. The existing basin outlet structures are designed for flood control, which allows low flows to exit the facility without proper water quality treatment, as shown in the picture to the right.

Recommended Improvements: The proposed recommended improvements, as shown in Figure 8-21, include modifying each basin’s outlet to achieve an appropriate drawdown of the water quality volume. The basins have adequate capacity to treat the entire water quality volume. In addition to the outlet modification, the construction of sediment forebays at the two east inlet locations is recommended to provide pretreatment measures.

Estimated Project Cost: $35,000

8.4.4.4 Project 11: Trendwood Park Water Quality BMP

Problem Description: Trendwood Park is located at the outlet of a 270-acre drainage area consisting primarily of residential development. The drainage area contributes large amounts of trash, sediment, and other urban pollutants.

Recommended Improvements: The proposed recommended improvements include the construction of a water quality feature near “A” Street along the Deadmans Run main channel as shown on Figure 8-22. The area immediately upstream of “A” Street would be excavated approximately 6 feet with gradual side slopes. Over-excavating the area to create a wet pond, if desired, is suitable in this area as baseflow will continually flush the basin avoiding stagnant water. The culvert at “A” Street would be retrofitted with a concrete box weir with a water quality orifice. The weir would back water into the BMP during small storm events and achieve a sufficient drawdown to treat approximately 20 percent of the water quality volume. During significant storm events, the weir is sized appropriately to overtop and not constrict larger flow volumes, effectively avoiding any adverse flooding impacts.

Estimated Project Cost: $142,000
8.4.4.5 Project 12: Cotner Boulevard Storm Pipe

**Problem Description:** Significant amounts of trash and debris have been reported by City maintenance crews who maintain the main channel near Cotner Boulevard and Vine Street.

**Recommended Improvements:** The proposed recommended improvements include the implementation of a hydrodynamic separator. The separator would be installed within the existing 60-inch storm pipe located at the intersection of Vine Street and Cotner Street (Figure 8-23). Small storm events are diverted from the existing pipe into the hydrodynamic separator, which uses a vortex to settle out particulate matter. The separator allows larger flow volumes to bypass the treatment.

**Estimated Project Cost:** $237,000

![Figure 8-23](Project 12 Location of Hydrodynamic Separator)

8.4.4.6 Project 13: Herbert Park Stream Stabilization

**Problem Description:** As part of a study completed by Intuition & Logic for the City of Lincoln Parks and Recreation Department, stream stability issues were identified in Herbert Park. This problem description, recommended improvements, and cost estimate are based on Intuition & Logic’s preliminary stream stability assessment report submitted to the City of Lincoln in December 2003. This tributary segment to Deadmans Run main channel receives approximately 180 acres drainage and is actively undergoing erosion, causing widening with minor right-descending bank scour and major left-descending bank scour endangering adjacent property.

**Recommended Improvements:** The recommended improvements include constructing grade controls near the pedestrian bridge, grade controls along the tributary length and within the concrete channels to manage energy, a riprap stilling basin by the second pedestrian bridge, a composite revetment downstream of the bridge, and

![Figure 8-24](Project 13 Location of Stream Stabilization Measures)
installing vegetated riprap by the concrete junctions. The cost estimate below has been calculated based on Intuition & Logic’s 2003 estimate and adjusted to present value dollars using McGraw-Hill Construction’s Engineering News Record cost index.

**Estimated Project Cost:** $211,000

### 8.5 Watershed Solution

The projects recommended in Section 8.4 accomplish the goals of reducing the potential for future flood damages, achieving stream stabilization, and improving water quality. The local flood control project (project 7) and water quality projects (projects 8 through 12) can be constructed independent of the other recommended projects. However, projects 1 through 6 are dependent on each other to ensure the net benefit of flood reduction is realized throughout the project area and that no adverse impacts occur downstream. Therefore, projects 1 through 6 are considered a watershed-based solution, which will require an implementation plan using construction sequencing. The implementation of the recommended projects is further discussed in Section 10.

### 8.6 Prioritization

The prioritization of Deadman’s Run CIPs was completed according to the prioritization system that was developed for the City and NRD by a peer review committee to set priorities for the implementation of watershed master planning projects. The peer review committee consisted of local consultants along with City, state, and NRD staff who provided input and suggestions regarding the prioritization criteria and appropriate weighting of the selected criteria. The prioritization system was specifically developed for CIPs that are part of the ongoing watershed master planning efforts.

The prioritization system contains five major categories as summarized below:

- **Flooding Impacts** – This category identifies the impact of flood water 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 10-year storm event. Projects primarily intended to address structural or nonstructural 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 basic visual observation, not strictly using a 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 flood water. A safety factor is generally associated with projects addressing structural or nonstructural 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.

Ranking worksheets were used to assign 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 G provides a copy of each ranking worksheet. Because projects 1 through 6 are dependent on each other, one ranking was provided for all six flood reduction projects. Table 8-3 lists the results of the ranking scores for the eight CIPs within the Deadmans Run study area. For projects with the same overall score, engineering judgment was used to finalize the ranking.

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Overall Score</th>
<th>Project Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>450</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>150</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>330</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>330</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>255</td>
<td>4</td>
</tr>
</tbody>
</table>

As implementation begins on the Deadmans Run CIPs, the priority of these projects will need to be reviewed and weighted against other projects included in adopted watershed master plans.
8.7 Summary

Table 8-4 provides a summary of the recommended improvement projects and the associated project costs.

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Name</th>
<th>Project Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Downstream Conveyance Components</td>
<td>$ 25,234,000</td>
</tr>
<tr>
<td>2</td>
<td>University of Nebraska - East Campus Channel Conveyance</td>
<td>$ 9,198,000</td>
</tr>
<tr>
<td>3</td>
<td>University Place Park</td>
<td>$ 2,474,000</td>
</tr>
<tr>
<td>4</td>
<td>52nd Street to 56th Street</td>
<td>$ 7,764,000</td>
</tr>
<tr>
<td>5</td>
<td>Chateau Apartments/Lincoln Lutheran Schools</td>
<td>$ 2,932,000</td>
</tr>
<tr>
<td>6</td>
<td>Taylor Park</td>
<td>$ 1,440,000</td>
</tr>
<tr>
<td>7</td>
<td>Seacrest Park</td>
<td>$ 19,000</td>
</tr>
<tr>
<td>8</td>
<td>Wyuka Cemetery Existing Detention Pond Retrofit</td>
<td>$ 47,000</td>
</tr>
<tr>
<td>9</td>
<td>Bethany Park New Water Quality BMP</td>
<td>$ 113,000</td>
</tr>
<tr>
<td>10</td>
<td>Russwood Dry Detention Pond Retrofits</td>
<td>$ 35,000</td>
</tr>
<tr>
<td>11</td>
<td>Trendwood Park New Water Quality BMP</td>
<td>$ 142,000</td>
</tr>
<tr>
<td>12</td>
<td>Cotner Boulevard Storm Pipe</td>
<td>$ 237,000</td>
</tr>
<tr>
<td>13</td>
<td>Herbert Park Stream Stabilization Project</td>
<td>$ 211,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$ 49,846,000</strong></td>
</tr>
</tbody>
</table>

As shown in the table above, approximately 99 percent of the total CIP costs can be attributed to projects 1 through 6. Due to the magnitude of these projects, an economic evaluation was conducted using a benefit-cost approach to justify the feasibility of these improvements (Section 9).

Figure 8-24 compares the Master Plan existing conditions 100-year floodplain with the 100-year floodplain after implementation of the recommended watershed solution. The number of total buildings within the Deadmans Run existing 100-year floodplain will be reduced from 982 buildings to 58 total buildings after implementation of the recommended watershed alternative. Due to the Salt Creek backwater, the total number of buildings within the mapped FEMA floodplain would be reduced from 982 to 175 total buildings.

In the portion of the watershed where the majority of the buildings are located within the floodplain, Figure 8-25 compares the study 100-year floodplain (existing conditions) with the potential 100-year floodplain after implementing projects 1 through 6. The total number of buildings taken out of the FEMA floodplain is 807 buildings, and another 175 buildings receive flood protection benefits.
8.8 Other Projects Evaluated

Potential improvements that were not recommended but were thoroughly evaluated are depicted as “Other Projects Evaluated” and are shown on Figure 8-25. These projects were not included in the CIP because of the physical constraints, design issues, economic feasibility, or overall efficiency in reducing flooding or improving water quality. A summary of these projects is listed below.

Figure 8-26
Other Projects Evaluated
8.8.1 Other Stormwater Conveyance Projects

Two additional channel projects were considered during the improvement project evaluation process. Both projects address street flooding and are discussed below.

8.8.1.1 Project 14: 66th Street Flooding

**Problem Description:** During the 100-year storm event, it is anticipated 2.6 feet of overtopping will be observed at the 66th Street stream crossing.

**Evaluated Improvements:** Extensive flood benching of the channel upstream and downstream of the crossing, as well as expanding the length of the bridge by 60 feet would be necessary to reduce flooding across 66th Street to ½ foot of overtopping.

**Issues:** The project was not economically feasible based on the benefit-cost outlined in Section 9.

8.8.1.2 Project 15: “O” Street Flooding

**Problem Description:** During the 100-year storm event, it is anticipated “O” Street near the MoPac Trail overpass will encounter 3.1 feet of street flooding.

**Evaluated Improvements:** Lowering the existing trail to make room for flood benching of the channel, 70th Street crossing expansion, adding culverts to the MoPac Trail crossing, and lowering the invert adjacent to “O” Street would be necessary to eliminate flooding across “O” Street.

**Issues:** The project was not economically feasible based on the benefit-cost outlined in Section 9.

8.8.2 Other Stormwater Detention Projects

Additional stormwater detention was considered during the improvement project evaluation process, as discussed below. The problem description for each of these projects is similar to the previously recommended dry detention facilities, which minimize flows by temporarily storing stormwater and reduce the flooding potential in the downstream reaches of Deadmans Run watershed.

**Project 16: Bethany Park Dry Detention**

**Evaluated Improvements:** The park’s playground, permanent air conditioned shelter, and open air shelter currently are used throughout the year. To minimize stakeholder impacts, a terraced detention facility was evaluated. Excavation to the west half of the park would provide flood storage volume. The playground was relocated within the 50-year flood storage to the east portion of the detention facility. The shelters were moved to the east, completely out of the detention facility.

**Issues:** The weir structure adjacent to the main channel is too short to efficiently divert flood flows. In addition, the topography of the site makes it difficult to maximize the available flood storage before submerging the weir. The project was not efficient at reducing flood flows.
Project 17: Russwood Dry Detention

**Evaluated Improvements:** Excavation between the north and south existing dry detention facilities at the Russwood development area would provide additional flood storage volume.

**Issues:** The drainage areas into the basins do not significantly contribute to flood flows. The expanded basin is not efficient in decreasing flood flows.

Project 18: Fusion Dry Detention

**Evaluated Improvements:** Demolish the buildings within the existing shopping area between 66th Street and the MoPac Trail and excavate the area to provide flood storage volume. Twin 10-feet by 15-feet box culverts would constrict flow and attenuate flood waters.

**Issues:** The cost of the improvement project was not justified based on the efficiency of the system at reducing flood flows.

Project 19: Trendwood Park Dry Detention

**Evaluated Improvements:** An earthen berm would be constructed across the channel and tie into existing grade. The berm would back up water into the basin during larger storm events, temporarily storing the water and releasing over an extended time.

**Issues:** The topography of the area was not suitable for efficiently reducing flood flows.

8.8.3 Other Water Quality Projects

Additional water quality projects were considered during the improvement project evaluation process, as discussed below.

8.8.3.1 Project 20: Wyuka Cemetery Swan Pond Retrofit

**Problem Description:** Approximately 240 acres drains to the Wyuka Cemetery through a culvert under “O” Street. The stormwater in the area may include urban pollutants. The pond is currently used by the cemetery visitors to view the wildlife in a calm setting.

**Evaluated Improvements:** Construct a berm across the outlet and tie into existing grade to the east and west of existing pond. Modify the outlet to obtain a longer drawdown and achieve approximately 25 percent of the water quality treatment. Construct a sediment forebay at the inlet to the pond.

**Issues:** The improvements would drastically change the aesthetics of the pond. In addition, the berm would be large enough to increase risk of flooding at “O” Street and the cemetery’s offices to the east.

8.8.3.2 Project 21: Wyuka Cemetery New Water Quality BMP at Vine Street

**Problem Description:** Approximately 500 acres drains to the Vine Street Culvert near 36th Street. The stormwater in the area may include urban pollutants. The area currently has some open space available adjacent to the cemetery plots.
**Evaluated Improvements:** Construct a V-notch weir that would back water up into an excavated area to the east and west of the tributary flow. The project would treat 60 percent of the water quality volume in the area.

**Issues:** Drainage issues were brought to the attention of the project team during stakeholder meetings. When further investigated, the project was removed from consideration based on design concerns and the ability to achieve positive drainage.

### 8.8.3.3 Project 22: Carriage Hill Pond Retrofits

**Problem Description:** The Carriage Hill existing ponds were designed for flood control. Two ponds in sequence provide the desired flood attenuation for this area. The residential development may be impacting the water quality.

**Evaluated Improvements:** Redesign the facility with a sediment forebay and modified outlet. The berm separating the two facilities would be moved to the north to achieve the required detention volume.

**Issues:** Design issues and concern of increasing flood potential in the area caused the project team to remove this retrofit from consideration.

### 8.8.3.4 Project 23: Leighton Tributary Wetland

**Problem Description:** Approximately 100 acres drains via a storm pipe network into a tributary adjacent to Leighton Street. The tributary is located in the middle of the University’s research fields and outlets to the main channel upstream of 38th Street. The urbanization of upstream drainage may contribute to adverse water quality in this area.

**Evaluated Improvements:** Construct an earthen flow spreader in available open space to slow velocities and settle particulates. Available open space would be excavated to maximize available treatment volumes. In-line structures that would backup the tributary flow were not feasible based on the surrounding topography.

**Issues:** Based on the flow velocities of the upstream pipe network, the tributary would reform the natural channel and bypass any water quality treatment. The conceptual design was removed from consideration based on the efficiency of the system.

### 8.8.3.5 Project 24: Taylor Park Water Quality Features

**Problem Description:** Over 400 acres drains via overland flow and storm pipe networks from residential neighborhoods into a tributary through Taylor Park. The urbanization of upstream drainage may contribute to adverse water quality in this area.

**Evaluated Improvements:** Construct multiple micro pools with small berms approximately 5 feet high to slow velocities, settle particulates, and allow plants to treat the water.

**Issues:** The current stream stabilization measures being constructed by the City’s Parks and Recreation Department include similar water quality measures.
8.8.3.6 Project 25: Stream Stability Measures along Tributary Upstream of Sycamore Drive Extension to Skyway Road

**Problem Description:** Current practices of mowing the shallow-rooted grass as close as possible to the waters edge (including rushes) and close to the ground have seriously reduced the potential of filtering surface water before it reaches the channel and of the roots reinforcing the banks. Several areas of the banks were scalped to bare ground, thus eliminating the potential for the turf grasses to reinforce the near surface and provide a stormwater buffer. The combination of shallow-rooted grasses along the banks and the current mowing practice may have initiated the bank instabilities.

**Evaluated Improvements:** Enhancements to the stability of the channel can be achieved by planting deeper-rooted woody and mesic prairie vegetation along the banks and placing several grade controls to maintain the channel slope.

**Issues:** The stream segment is encountering localized issues that should be addressed during routine maintenance activities.

8.8.3.7 Project 26: Stream Stability Measures Along Main Channel from Wedgewood Lake to Corporate Drive

**Problem Description:** The main limiting factor for this portion of the reach is the narrow vegetative buffers along either side of the tributary. Algae and duckweed were of limited presence, but the potential for both species thriving following the loading of nutrient-rich surface waters flowing to the channel was apparent.

**Evaluated Improvements:** Establishing a wider vegetative buffer downstream of the pedestrian bridge will provide stormwater quality filtering.

**Issues:** The severities of these issues are not critical and do not warrant inclusion in the recommended Master Plan improvement projects. However, the stream segment is encountering localized issues that should be addressed during routine maintenance activities.