Section 7
Drainage Criteria Review

7.1 Introduction

The purpose of this section is to review stormwater standards for the City relating to future urban land use and, where appropriate, make recommendations relating to future rural residential development.

The following studies, design criteria and ordinances were reviewed:

CITY OF LINCOLN

- The Drainage Criteria Manual, City of Lincoln Public Works and Utilities Department and the Lower Platte South Natural Resources District, February 22, 2000, Revised May 10, 2004
- City of Lincoln Design Standards, Chapter 2.05 STORMWATER DRAINAGE DESIGN STANDARDS
- Lincoln Municipal Code Subdivision Ordinance Chapter 26.24 Flood Regulations For Existing Urban Area
- Lincoln Municipal Code Subdivision Ordinance Chapter 26.25 Flood Regulations for New Growth Area
- Lincoln Municipal Code Zoning Ordinance Chapter 27.52 Flood Regulations For Existing Urban Area
- Lincoln Municipal Code Zoning Ordinance Chapter 27.53 Flood Regulation For New Growth Area
- Lincoln Municipal Code Stormwater Quality and Erosion and Sediment Control Chapter 28.01 Regulations for Construction Site Discharges
- Lincoln Municipal Code Stormwater Quality and Erosion and Sediment Control Chapter 28.02 Regulations for Illicit Discharges
- Stevens Creek Masterplan, Section 7, Drainage Criteria Manual Review
- Alternative Stormwater Best Management Practices Guidelines, April 2006, City of Lincoln and Lower Platte South NRD.

LANCASTER COUNTY

- Nebraska Department of Roads-Roadway Design Manual, Chapter 10: Miscellaneous Design Issues, 2.E.2 Stream Crossings
- Lancaster County Land Subdivision Regulations, CHAPTER 4 Design Standards
- Lancaster County Land Subdivision Regulations, CHAPTER 6 Subdivision within Floodplain
- Lancaster County Zoning Regulations, ARTICLE 11 FLOOD PLAIN DISTRICT (Resolution No. 3665, January 26, 1982)

The guidelines and ordinances review for the Little Salt Creek Watershed, in general, focuses on characteristics unique to the watershed as follows:

- Dispersive soils
- Saline wetlands and seeps
- Endangered species, including the Salt Creek Tiger Beetle and Saltwort Plant
- Rural watershed, primarily agricultural
- The lower 10% of the watershed is projected to develop from a rural to urban density by the year 2030.
- The upper 90% of the watershed is projected to remain rural through the year 2030.

The recommendations described in the following subsections address the following topics:

1. Stormwater BMPs
2. Dispersive soils
3. Conservation culvert or crossing
4. Revised floodprone area adopted as best available information

7.2 Stormwater BMPs

In the Little Salt Creek Watershed, the highly erodible nature of the soils cause the main channel and tributaries to be very susceptible to erosion resulting from changes in runoff volumes and rates for storms which are more frequent than the 2-year event. The key to preserving water quality, maintaining long-term stream stability, and providing flood control benefits is to install stormwater facilities that control the full range of hydrologic conditions, including the smaller rain events in addition to the 2-, 10-, and 100-year storm events. Site-specific structural and non-structural best management practices (BMPs) are recommended to control the smaller rain events, with detention basins being used to control the larger rain events (2-, 10-, and 100-year design storms). Two approaches to manage both the larger storm events and smaller more frequent storm events and meeting the water quality goals are 1) Integrated Detention Facility, and 2) Alternative Site Design.

These two approaches are possible alternatives to achieve the same objective of helping preserve water quality and long-term stream stability within the Little Salt Creek Watershed and are explained in more detail below. This recommended guideline is for the City of Lincoln only.

7.2.1 Integrated Detention Facility

The integrated detention facility approach involves designing detention ponds to control the smaller more frequent storm events, as well as the 2-, 10-, and 100-year events. This will require changing the City's current stormwater BMP program from a voluntary to a mandatory program for site-specific structural BMPs as outlined in the Stevens Creek Watershed Master Plan. The implementation of integrated detention facilities approach will help preserve water quality and long-term stream stability.

7.2.2 Alternative Site Design

The alternative site design approach involves using site-specific structural and non-structural BMPs separate from the detention ponds. The BMPs can include, but are not limited to

grass-lined swales, bio-retention cells, and constructed wetlands. Being separate from the detention ponds allows them to be incorporated into the site as landscape features, park amenities, and passive recreation amenities. The alternative site design method will require changing the City's current stormwater BMP program from a voluntary to mandatory program for conservation site design and structural BMPs as outlined in the Stevens Creek Watershed Master Plan. The implementation of the alternative site design approach will help preserve water quality and long-term stream stability.

7.3 Dispersive Soils

The Salmo soils are potentially dispersive and highly erodible. Salmo soils are generally located in the lower part of the Little Salt Creek watershed along the main stem, downstream of the NW 12th Street and Branched Oak Road and the entire watershed south of Waverly Road. Stormwater structures constructed in dispersive and highly erodible soils are susceptible to piping and flanking. Headcuts in stream channels can propagate easily through these soils which can result in perched and threatened drainage structures. Consideration should be given to soil erodability when designing stormwater structures (culverts, bridges, grade controls, energy dissipation structures, etc.) within the watershed. The project geotechnical exploration should include testing for dispersive soils for use by design engineers. If soils are found to be highly erodible and dispersive, stormwater structures shall be designed and constructed of material that will not allow piping or degradation of the structure.

The following recommendations are for both the City of Lincoln and Lancaster County in areas containing Salmo soils:

- Dispersive soils test should be included as part of the geotechnical testing on each project.
- Geotechnical reports should include a section on erodibility.
- A Certified Professional in Erosion and Sediment Control (CPESC), a geotechnical engineer or similarly qualified professional should professionally seal or certify interventions that may result in accelerated erosion.

7.4 Conservation Culvert or Crossing

The design of new culverts or stream crossings should incorporate the natural channel configuration of the stream at the location of the new culvert or crossing. Most streams have a two-stage channel configuration consisting of a low-flow channel where the frequent flows are contained and then a flood-flow channel. Through conventional culvert design, streams are over-widened at the culvert. Over-widened streams will revert back to their natural channel shape over time by depositing sediment in the culvert barrel(s) to develop the low-flow channel. This deposition through the culvert causes maintenance problems and reduces the efficiency of the culvert during the flood-flows. Moreover, by inducing upstream incision and potentially bank failures, over-widening of streams at culverts is responsible for accelerated erosion and sediment delivery to the stream system with subsequent degradation of water quality and critical habitat.

Figure 7-1: Conservation culvert example

A conservation culvert is designed and configured to match the natural two-stage channel shape for each stream. The low-flow barrel should be sized to maintain the stream-forming flow depth through the culvert. The hatched area in Figure 7-1 shows the low-flow channel. The stream-forming flow may be derived using the Manning parameters including channel width, bed slope, hydraulic roughness and the depth at stream forming flow. This depth is sometimes determined from field indicators such as bar height and lower limit of woody vegetation, elevation of internal floodplains or persistent scour lines among others. Potential stream-forming flow indicators are plotted against the bed elevation; if the best fit line for the indicator plots parallel to the channel bed, the vertical difference between the two may be assumed to be a reasonable estimate of the depth of the stream forming flow. The indicators mentioned above are important but may be difficult to discern or altogether absent in heavily disturbed streams. Other valid methods for estimating the stream forming flow include methods described in Hydraulic Design of Stream Restoration Projects[1]. Once the low-flow barrel is sized, the other barrels and configuration are sized to handle the capacity of the flood-flow design storm. The most important point of this exercise is that flood capacity is obtained above the depth of the stream forming flow.

[1] US Army Corps of Engineers ERDC/CHL TR – 01-28.

The location of the low flow channel should be consistent with the natural plan-form of a stream. Channel plan form should not be altered. The low-flow channel should be on the outside of bends and more toward the center in transition segments between bends.

At bridge crossings, the same goal can be accomplished by maintaining a low-flow channel under the bridge. The channel cross section under the bridge should closely match that of the channel upstream of the bridge.

While applying this conservation culvert and crossing design concept, the requirements and design criteria outlined in Chapter 4 of the City's Drainage Criteria Manual revised May 10, 2004, should be followed.

These Conservation Culvert or Crossing guidelines are for both the City of Lincoln and Lancaster County.

7.5 Adopt Revised Floodprone Area as Best Available Information

It is recommended that the updated floodprone area and floodway boundaries be adopted as best available information to be used for regulatory purposes, in accordance with the existing City Flood Regulations. Accurate floodplain and floodway boundaries alert present homeowners and businesses of flood hazards as well as provide guidance for future growth and development within the watershed. The current FEMA floodplain boundaries were based on a study completed in 1981. They are considered FEMA Zone A (i.e. no detail analyses were performed) with limited coverage in the watershed. The updated floodprone area and floodway boundaries are delineated using more accurate contour data, allowing them to be considered FEMA Zone AE (i.e. a detail analyses was performed). The updated boundaries also include reaches that were not previously mapped.

The Little Salt Creek floodplain maps resulting from the present study will be submitted to FEMA for preliminary review and comment. The FEMA review process could take several months to more than a year following the final submittal, and will include a public comment period hosted by FEMA. In the interim, the City anticipates adopting these newly mapped floodplains for the purposes of regulating the updated floodplain and floodway boundaries (i.e. floodprone areas). Because such a large portion of the watershed having updated floodplain information is within the County's jurisdiction, it is also recommended that the County use the updated information for the purpose of administering the County floodplain regulations.

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