3 REVIEW OF WATERSHED MANAGEMENT ACTIVITIES

As part of the Plan, the City desired to review certain watershed management activities to identify how they are meeting the objectives of supporting watershed management and CIP identification and implementation. The review included consideration of potential updates to these activities and recommendations, as applicable. A summary of existing related watershed management activities is provided below:

1. Minimum Flood Corridor (MFC) - Section 10.3 of the City's DCM adopted in May of 2004 includes the requirements related to preserving the MFC for channels that drain greater than 150 acres OR have a defined bed and bank within the New Growth Areas of the City at the time. The minimum corridor at these locations is defined as the channel width, plus six times the channel depth, plus 60 feet.
2. Stream Restoration, Including Grade Control – The City's DCM includes guidance with respect to channel design and erosion and grade control. Currently, there are no broad regulatory requirements for stream restoration or grade controls to be applied. However, the City has completed a number of stream restoration and grade control projects on their own and as a part of developments.
3. NFIP Community Rating System (CRS) - The City has been a long-time participant of the NFIP's CRS program, which offers flood insurance discounts to flood insurance policy holders city-wide in exchange for the City completing certain floodplain and stormwater management activities. Program participants receive a 5% discount for each Class, starting with 5% at Class 9. Currently the City is a Class 5 CRS community, meaning flood insurance policies are discounted 25%. Based on 2021 City-wide flood insurance coverage, each 5% increment of flood insurance cost reduction is worth approximately $75,000 per year in savings to flood insurance policy holders in the City.

The following sections describe additional evaluations completed as part of this plan.

3.1 Minimum Flood Corridor Mapping

The "defined bed and bank" criteria included in the current MFC policy has created implementation challenges due to potential subjectivity in its interpretation. To help better define these criteria and reduce ambiguity, the North Salt Creek Watershed Master Plan (Intuition & Logic, 2018) included a literature review and analysis to further clarify these requirements. While the literature review indicated there were no simple or industry standard definitions of "bed and

bank", and guidelines related to minimum corridors were limited, 40 acres appeared to be a common average between various sources. Various desktop analyses and field visits were completed to evaluate the defined bed and bank as well as drainage area criteria. The conclusion was that, based on a number of test sites, a defined bed and bank begins to occur on average at approximately 40 acres of contributing drainage area or greater. Proposed MFC buffer widths were developed for various contributing drainage areas, as reported in Table 3. Based on these recommendations, the City is in the process of adopting updated MFC requirements as part of a proposed revision of the DCM.

Table 3 - Proposed Minimum Flood Corridor Standards

Contributing Drainage Area (DA) in	Buffer Width
DA<100 Acres	90 foot buffer width centered on channel
100 Ac<DA<100 Ac	100 foot buffer width centered on channel
200 Ac<DA<300 Ac	120 foot buffer width centered on channel
300 Ac<DA	Buffer width = channel width plus six times depth of channel plus 60 feet

As part of the development of the Plan, JEO was tasked with developing the geospatial minimum corridors within the Tier 1 Future Growth Areas defined by the City's comprehensive plan. Development of these corridors includes both mapping the estimated corridor using widely available terrain data in GIS, while also evaluating the proposed standards when compared to calculated values across the City.

The proposed updated minimum corridor standards and policy are based off the findings outlined in the North Salt Creek Watershed Master Plan detailed above. However, all these observations used to develop the recommendations were within North Salt tributary. As part of the Plan, JEO conducted additional geospatial analysis throughout the Stevens Creek, Antelope Creek, and Southeast Upper Salt Creek watersheds to assess if this 40-acre threshold is potentially appropriate for application of City-wide MFC standards. In total, 34 sites were examined as part of the analysis.

Based on these results a defined bed and bank appears to begin on average somewhere between 37.5 and 53.6 acres, with a grand mean of 46.7 acres among all the sub-basins evaluated. When combined with the data set forth in the North Salt Creek Watershed Master Plan, a target of 40-acres remains within the expanded dataset and still appears valid to simplify the lower bounds for requiring MFC standards.

Like the definition of defined bed and bank, the buffer widths set forth in the proposed MFC standards are based on data collected as part of the North Salt Creek Watershed Master Plan. The findings of that report recommended a standard buffer width of 90

The literature review completed in the North Salt Creek Watershed Master Plan (Intuition & Logic, 2018) found that a clear, consistent definition of a defined channel bed and bank is not available. Following are some summary findings from the literature review:

Literature Reviewed	Recommendation
The North Carolina Division of Water Quality, Methodology for Identification of Intermittent and Perennial Streams and Their Origins	None of these detailed methodologies identify a consistent, easy to implement set of criteria for stream identification.
Perennial Stream Field Identification Protocol of Fairfax County, Virginia	
Unified Development Code of Ordinances, definition of defined channel bed, Snohomish County, Washington	
Kansas City Metropolitan Chapter of the American Public Works Association Design Guidance Document Section 5600, February 2011 (APWA 5600)	Recommend stream buffers begin at the 40 acre contributing drainage area.
City of Gardner, Kansas (Development Criteria Manual Chapter 14.10)	Requires stream buffers for drainage areas starting at 40 acres, but also requires stream buffers for sites less than 40 acres where the existing stream network is not planned to be enclosed in a pipe network.
City of Groveport, Ohio (Stream Corridor Protection Zone Delineation and Mitigation Technical Guideline Manual, 2013)	Requires a Stream Corridor Protection Zone for all channels based on the contributing drainage area, with a minimum setback width of 50 ft and the maximum set as the wider of the calculated setback or the FEMA designated floodway.
Platte County, Missouri (Platte County Subdivision Regulations of 1992 Article IV, Section 405.225)	Requires stream corridors for all channels starting at a 25 acre contributing drainage area.
General Summary	Although the simplified defined bed and bank approach did not yield consistent results for identifying channels, it was observed that where the defined bed and bank criteria becomes subjective centers around the 40 acre contributing drainage area.

feet for contributing drainage areas between 40 and 100 acres as defined in Table 3. These buffer widths were initially determined based on field data from five tributaries within the North Salt Creek watershed.

JEO completed further analysis to assess buffer width recommendations. In total, 292 sites were examined for contributing areas between 40 and 100 acres. The analysis indicates that on average, the calculated buffer (channel width, plus six times the channel depth, plus 60 feet) for drainage areas between 40 and 100 acres is 86 feet. This suggests that the City proposed standard width of 90 feet for this range of drainage areas aligns with the draft MFC standards.

Finally, as part of the Plan, minimum corridors for all Tier 1 Future Growth Areas were mapped using the proposed minimum flood corridor standards. Full details of all evaluations and recommendations can be found in the Technical Work Summary in Appendix B.

3.2 Stream Restoration and Grade Control

The City and NRD support proactive protection of the streams and open channels within the City's jurisdiction. As development increases the length of streams impacted, there is a need to better understand the potential proactive considerations to protect the channels' benefits, as well as public and private infrastructure. Streams are impacted through development and human disturbance in several ways creating the need to restore streams and/or mitigate for these impacts. In the broader context, stream restoration is any activity that seeks to restore dynamic equilibrium to a stream system, which ultimately reduces the amount of erosion or channel head cutting occurring in the system. There are many techniques that can be used to restore streams including the use of riparian buffers, bank stabilization, full channel reconstruction of dimension/pattern/profile, the use of grade control, etc. While all techniques of restoring streams can be beneficial, protecting streams through the use of grade control can particularly be beneficial by reducing the likelihood of channel head cutting, which in turn can trigger other channel disturbances including streambank erosion, over-widening, and channel migration.

Example of Grade Control Practices

Through the Plan effort, the project team was tasked with investigating potential mechanisms that the City of Lincoln could explore toward establishing stream grade control criteria and creating incentives/requirements for future developments to implement grade control as part of their project. The detailed technical memo for this effort in the Technical Work Summary (Appendix B) is intended to serve as a summary of:

1. The “Literature Reviewed”,
2. “Lessons Learned from Other Municipalities” and how they are addressing similar issues,
3. Conditions that warrant grade control consideration on an urban watershed scale,
4. “Types of Grade Control” that could be considered,
5. Temporal topographic change detection GIS desktop analysis, and
6. “Recommendations and Next Steps”, outlining approaches to developing regionally specific incentives for grade control implementation.

Channel instabilities and the need for grade control are a very common occurrence in developed/developing urban watersheds having altered hydrology. Developing proactive approaches to establishing minimum flood corridors and to encourage, incentivize, or require stream stabilization in conjunction with development will enable the City to effectively address problems and promote cost-effectiveness. While there are many examples of differing protocols used by other municipalities, all require a regionally specific approach tailored to their specific watershed conditions and their specific administrative culture. There is no single solution that can be universally applied across regions, but an approach that works for the City of Lincoln can be further investigated by considering some of the recommendations laid out below.

3.2.1 Recommendation 1 - Field Verification of Priority Areas

A geospatial data change detection analysis was conducted to assess if mapping exercises could help identify problem areas without the need for extensive field visits. By comparing the elevational change between 2010 to 2016 LiDAR data, several areas of potential concern were identified. These areas exhibiting significant changes between the data sets require field verification to validate the analysis. The analysis could be prone to some interpretive error due to local environmental conditions and the relatively coarse resolution of the 2010 elevation dataset.

It is recommended that the areas be field visited to help calibrate the analysis for validation. If these areas are indeed exhibiting significant instabilities, they should be further prioritized for stabilization and grade control implementation prior to further development of the watershed. Identifying and proactively addressing problem areas that exist under the current conditions will be more beneficial and cost effective to the City rather than allowing for further degradation that can be expected following the development and alteration of the watershed’s hydrologic regime.

3.2.2 Recommendation 2 - Investigate Incentive Strategies

The three potential incentives structures that have been identified for consideration by the City are water quality based, development of a streamlined regional general permit, and maintenance obligation. Future total maximum daily load (TMDL) mandates are a possibility in these watersheds. Establishing a program to get ahead of potential largescale channel degradation would be more cost effective in the long run. Lessons learned from other municipalities have shown that it is cheaper to be proactive rather than reactive.

One way that the City could develop an incentive program is by developing a protocol for existing conditions assessment through geomorphic parameters, such as measuring channel incision through bank height ratio measurements, quantifying the sediment loading contribution via the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS) method, and quantifying other factors.

More comprehensive geomorphic assessments could be done to determine the state of the existing channels and predict future changes, should watershed development occur. This would identify most at-risk areas. These assessments could utilize simple criteria metrics that don't require significant analysis.

1. Low Bank Height Ratio (BHR)
    a. BHR < 1.2 Functioning
    b. 1.2 <= BHR <=1.5 Functioning at Risk
    c. BHR > 1.5 Non Functioning
2. Sediment Loading/Bank Erosion
    a. Tied to TSS TMDLs
    b. BANCs model (**Functioning, Functioning at Risk, Non Functioning**)
    c. EPA Stormwater BMP model
3. Treatment acre size
    a. Credit for stormwater treatment that goes beyond minimum requirements
4. Future % Impervious area

Verification of the priority areas identified in the change detection analysis, would allow for ground-truthing of the assessment and provides additional validity to the approach. Additionally, incorporation of aerial drone assessments could provide rapid data collection in difficult to access areas.

3.2.3 Recommendation 3 - Streamlined Permitting Process – Regional General Permit

Through conversations with the City, it is understood that the current Section 404 permitting process through the USACE Omaha District is both cumbersome and time consuming for in-channel work. This has been identified as an obstacle for the City and developers alike. A potential solution to this issue that the City could pursue is working with the USACE to develop a Regional General Permit for specific grade control and channel improvement projects. The Mile High Flood District around Denver, Colorado (along with other watershed groups in Colorado) and USACE (part of the Omaha District), developed RGP 37 with the specific purpose for authorizing stream bed and bank stabilization activities in Colorado that meet certain criteria. A recommended focus is to work with the USACE to identify potential tools to simplify stream restoration and grade control permitting, so it can be more efficiently, and cost effectively integrated into development and restoration plans.

In particular, the adoption of this type of permit would provide a time and cost saving incentive to encourage planning for channel buffer corridors and grade control. This is a non-tax based, non-fee based, method to create an incentive. Additionally, there is already some coordination occurring for developing this type of RGP in the USACE Omaha District and the City of Omaha, Douglas and Sarpy Counties, and the Papio-Missouri River NRD are already in the process of meeting with USACE to start these discussions. The City of Lincoln should consider joining or following these negotiations and come up with a list of objectives to be achieved by the intent of the permit.

3.2.4 Recommendation 4 - Development of Design Criteria and Methodologies

Establishing design criteria that is specific to the City of Lincoln and Lower Platte South NRD Region, is a critical step to creating scientifically defensible guidance and/or ordinance on requiring grade control. The groundwork for some of this work has already been started with the various master plans completed by the City. Some of the most important criteria to be evaluated and determined are listed below. In addition, the City should consider developing regional curves of bankfull properties versus drainage area.

1. Longitudinal equilibrium slope
2. Maximum allowable 100-year velocity
3. Maximum allowable 5-year velocity
4. Maximum allowable 100-year shear stress

5. Bankfull Channel Capacity
6. Multi-stage Channel requirements

Overall, it is recommended that a focus be placed on stream corridor management, enhancement, and restoration. Focusing on stream restoration and treating the stream corridors as amenities will promote alignment with regulatory agencies as well as a higher potential for successful pursuits of funding opportunities. It will also promote increased community value, which will translate into higher property values. The focus for individual streams may vary based on developed, developing, or undeveloped status of the watershed. Full details of all evaluations and recommendations can be found in the technical memo provided in the Technical Work Summary (Appendix B).

Example of Installed Grade Control

3.3 NFIP Community Rating System (CRS)

The City is currently credited for multiple floodplain and stormwater management activities that are being completed as part of the watershed management programs of the City and NRD. JEO completed a review of the activities receiving credit and where there may be opportunities to receive additional credit, with a focus on Activity 450 – Stormwater Management. JEO also reviewed the potential for the City to move to Class 4 within the CRS program.

Class 4 carries multiple defined pre-requisites. Many of the pre-requisites align with activities the City is currently not receiving full credit for, and in some cases receives no credit for. An overview summary is provided below. Note this includes only the key pre-requisites impacting eligibility for

a Class change; other pre-requisites are activities the City is currently completing. Full details can be found in the 2017 CRS Manual starting on page 210-4. To move to Class 4, the City needs to meet the pre-requisites and obtain approximately 300-400 additional points (depending on Community Growth Adjustment applied to the final points).

1. Activity 450 - WMP 1 and WMP 2 for Watershed Master Planning.

    a. WMP 1 – covers adopted Watershed Master Plans. The community must receive 90 points before impact adjustment as a pre-requisite for Class 4. While the City has a substantial baseline of Watershed Master Planning activities supporting this requirement, there are some possible issues with readily obtaining credit, including:
        i. Periodic plan evaluation.
        ii. Future conditions runoff evaluation.
        iii. Requirement that plans manage the 25-year flood event.
    b. WMP 2 – covers runoff impact management such as detention requirements. The community must receive 30 points before impact adjustment as a pre-requisite for Class 4. The City has substantial runoff management regulations; however, the standard requirement for this credit includes:
        i. Runoff management for all storms, including the 25-year and 50-year (currently not covered by City requirements).
        ii. Community wide coverage. Certain differences between the developed vs. developing regions of the community may impact credit.
    c. Recommendation – the City should pursue a review of current practices, as well as updates to the project prioritization and CIP, by the Insurance Services Office (ISO). ISO acts on behalf of the CRS program to review credit eligibility for these activities. A determination of eligibility of existing programs for credit will be beneficial for this activity. Based on the language of the CRS manual, it appears the City currently does not meet all criteria to get enough credit for this activity for CRS Class 4. Because meeting these criteria requires possible regulatory changes, it would be preferable to get guidance from the ISO CRS specialist before proceeding. It is also possible for the City to request consideration of City specific requirements for this activity relative to the prescribed pre-requisites; it is recommended that ISO be asked to potentially consider this given the substantial watershed master planning efforts completed.

2. Activity 510 – Floodplain Management Planning – the City appears to have enough credit in this activity to qualify for Class 4; however, through the ongoing Flood Mitigation Master Plan the City should qualify to obtain additional credit which would support the additional points needed for a class change.

    a. Anticipated potential points: approximately 150-300.
    b. Recommendation – ensure the Flood Mitigation Master Plan development process considers the CRS credit requirements.

3. Activity 540 – Drainage System Maintenance – the City previously obtained credit for this activity as recently as 2015. However, the City no longer receives points for this activity. It is unclear from documentation why the points are no longer credited to the City.

    a. Anticipated potential points: approximately 150-250.
    b. Recommendation – coordinate with the ISO CRS specialist to determine why previously credited points are no longer credited.

4. Activity 610 – Flood Warning and Response – the City must receive some credit for this activity to move to Class 4, and currently doesn't receive any credit. Based on existing City and NRD activities, it appears that the City should receive credit for the subcategories Flood Threat Recognition System and Emergency Warning Dissemination.

    a. Anticipated potential points: approximately 30-50.
    b. Recommendation – coordinate with the ISO CRS specialist to determine the process to review potential credit. Full credit documentation may require coordination with Lancaster County Emergency Management and that National Weather Service.

Based on JEO's review, the City appears to have the potential to obtain in the range of 300-400 additional points minimum if appropriate credit is given for these activities. However, a key activity is the watershed master planning subcategory of Activity 450 – Stormwater Management. Currently it does not appear the City meets the criteria for WMP 1 or WMP 2 and therefore does not appear to meet the Class 4 prerequisites. Coordination with ISO on this specific category will be key to moving to Class 4, if desired by the City.

3.4 Hydrologic and Hydraulic Modeling

Certain plans have included detailed hydrology and hydraulic analyses and therefore have been leveraged for development of floodplain mapping updates on the Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Map (DFIRM) for the City, while others have focused almost exclusively on stream stability and water quality. For H&H data, the best available H&H model data sets were compiled and reviewed in coordination with the City and NRD as part of the Plan. Since the majority of the effective H&H updates occurred between 2005 – 2009, the analyses tended to use older data and modeling approaches than are currently used. Examples of general considerations include but are not limited to outdated hydrology that needs to be updated to NOAA Atlas 14 precipitation data, outdated LiDAR, potentially outdated stream crossing structure data, and use of one dimensional (1D) modeling rather than two-dimensional (2D) modeling which is typically more accurate regarding flood extents and potential velocity impact areas.

Based on the H&H data review findings, JEO recommends the City consider comprehensive flood modeling updates. A focus on comprehensive models using best available terrain and precipitation data and producing consistent GIS deliverables will have value to guide CIP development and decision making. This will especially benefit stream stability and flood risk reduction projects by using best available data to better define the potential impacts. Additionally, improved flood data accuracy will support public buy-in regarding the need for and effectiveness of related CIP projects. Finally, updated flood modeling can be used to refine effective floodplain mapping to match best available technical data and terrain.

These updates would support overall model data quality and consistency and could also leverage 2D modeling tools as well as recent flood data for calibration such as the May 2015 flood event. A minimum recommendation is to consider updates to Beal Slough flood modeling for the purposes of a consistent flood model product for use for floodplain management and development purposes.