SECTION 9 – RECOMMENDATIONS CITY-WIDE

9.1. Introduction

Water quality lessons learned and key recommendations from the Basin Plan can be utilized throughout other watersheds in the City, especially those which are already fully developed.

Water quality lessons learned and key recommendations from the Basin Plan can be utilized throughout other watersheds in the City, especially those which are already fully developed. These lessons can also be applied to future growth areas, future comprehensive watershed master plans which focus on flooding, and used to justify policy decisions that can benefit water quality and the environment in Lincoln. Recommendations in this section support the goals and strategies of the Lincoln and Lancaster County Comprehensive Plan, known as LPlan 2040, detailed in the Vision, Environmental Resources, and Energy and Utilities – Watershed Management Section, which support integration of natural resources features into future planning activities. In this case, natural features are recommended to improve water quality, increase community aesthetics, and provide flood control as a secondary benefit.

Once formally adopted by the LPSNRD Board and Lincoln City Council, the Basin Plan will be considered a 'subarea' plan in LPlan 2040. Subarea plans usually focus more on specific issues; in this case water quality in the Antelope Creek watershed. Each of the watershed master plans previously adopted are included in LPlan 2040 as subarea plans.

Recommendations in this Basin Plan should be considered for incorporation into other planning documents, including consideration for post-construction BMPs into private developments and public projects city-wide. In addition, water quality elements of this Basin Plan should be considered by groups such as the Mayor's Clean Water Task Force.

9.2. City-wide Recommendation Overview

In 2010, the City of Lincoln completed an update of the LPlan 2040. This plan serves as the community's future growth. In order to facilitate a sustainable growth pattern, LPlan 2040 has designated Growth Tiers with Priority Areas for the community's growth over the next 50 years. These Growth Tiers represent anticipated areas of development, including new development and in-fill development. The future Growth Tier map can be found in Figure 9-1.

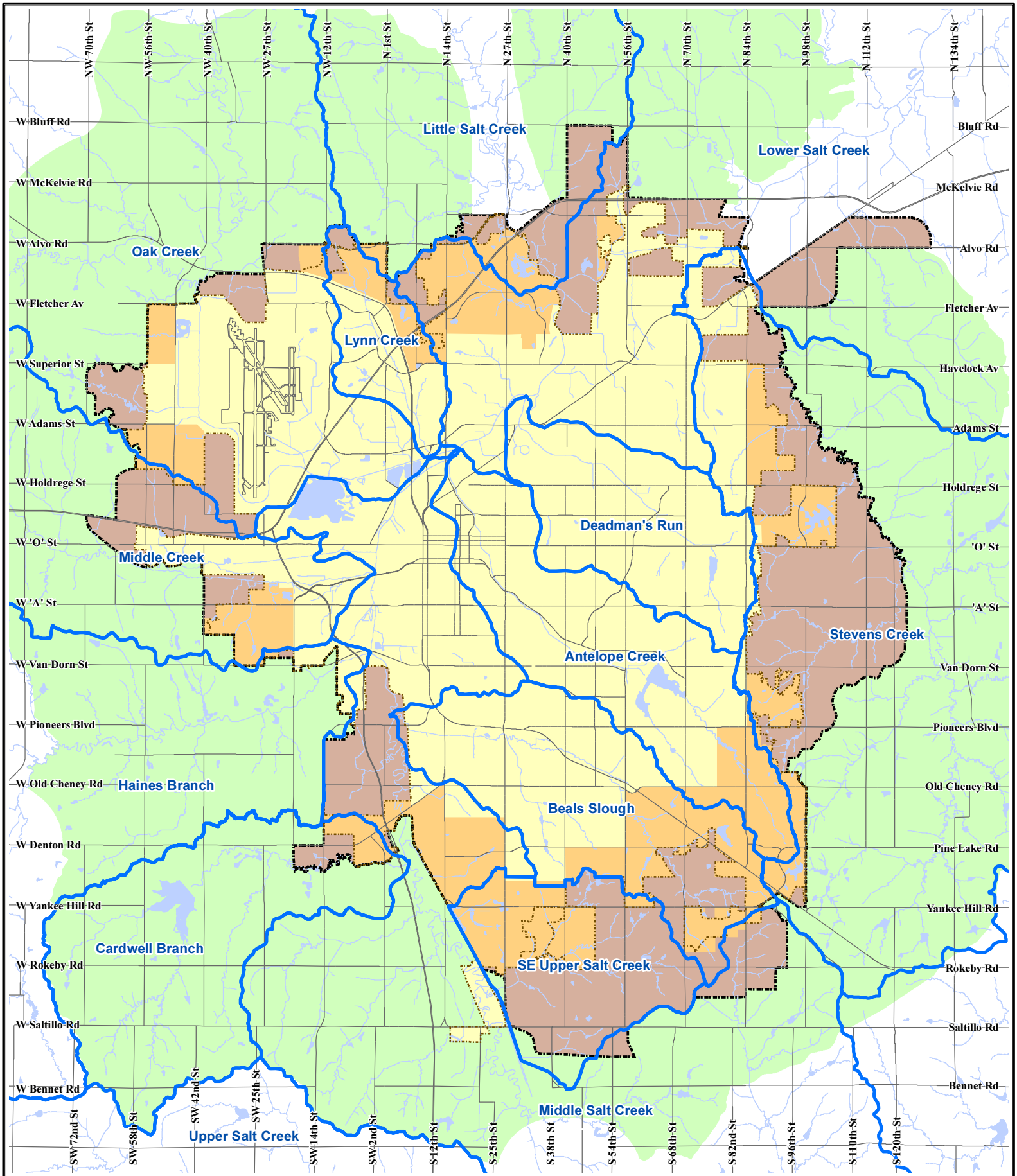
Tier I describes the future service limit, the area anticipated to be served with urban services by the year 2040. Tier I is further broken down into three subareas:

- Tier IA which is either currently within the city limits or has some sort of approved preliminary plan, is considered the "developing" area.
- Tier IB is the area that is anticipated to begin developing by 2025
- Tier IC is the area that is anticipated to begin developing after 2025 but before 2040.

Tier II is the area that is anticipated to begin developing after 2040 but before 2060. Tier III will likely not begin developing until after 2060.

Separate from the comprehensive planning process, Public Works and Utilities has delineated the City into 13 total sub-basins. Each has been grouped into either the developed watershed category, or undeveloped watershed category as part of the ongoing Comprehensive Watershed Master Planning Process as seen in Figure 9-1. As the City and LPSNRD consider water quality improvements, it is important to recognize which projects best fit into areas of the City that are developed, or are being developed for the first time.

The Antelope Creek watershed is nearly 85% urbanized and is located in the heart of the City. The Basin Plan only includes that portion of the basin below Holmes Lake and that portion of the basin is fully (100%) developed. The remainder of the Antelope Creek basin is developing. The portion of the Antelope Creek stream in the Basin Plan area has been significantly improved with hard armor to stabilize the stream banks and widening to improve flood control. Overall, stream bank degradation is no longer a significant concern for Antelope Creek, hence the focus on water quality through development of this Basin Plan. Although no other watershed is identical to Antelope Creek's, several share similar characteristics in land use and pollutant sources. Table 9-1 shows the watersheds broken down by growth tiers as listed above on Figure 9-1. Growth tiers are developed through the comprehensive planning process and Tier I in particular is used as a guideline for directing development of the City over the next 30 years. Table 9-2 shows the same table with breakdowns by percentages.



LINCOLN WATERSHEDS

Figure 9-1: Lincoln Future Growth Tier Map

- Watershed Boundary
- Lincoln Corporate Limits
- Future Service Limit

- Existing City (Not in Tier I)
- Developing (Tier IA)
- Future Development (Tiers IB & IC)
- Beyond 2040 (Tiers II & III)

LINCOLN - LANCASTER COUNTY PLANNING DEPARTMENT
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Table 9-1. Existing Basin Growth Patterns (acres)

BASIN	TOTAL	(1) URBANIZED	(2) DEVELOPING	(3) FUTURE	(4) BEYOND 2040	OUTSIDE TIER III	INSIDE F.S.L.	INSIDE CITY LIMITS
Antelope Creek	8,623	7,293	1,330	0	0	0	8,623	8,623
Beal Slough	8,835	5,251	2,383	1,182	19	0	8,816	7,546
Cardwell Branch	10,450	0	325	272	9,774	79	597	325
Deadmans Run	6,017	6,017	0	0	0	0	6,017	6,017
Haines Branch	43,745	384	34	21	10,287	33,019	439	417
Little Salt Creek	29,345	0	599	1,193	9,870	17,683	1,792	599
Lower Salt Creek	69,151	6,645	1,741	3,295	12,527	44,943	11,681	8,210
Lynn Creek	2,640	1,778	637	219	6	0	2,634	2,395
Middle Creek	64,153	1,971	888	1,566	8,860	50,868	4,425	2,850
Middle Salt Creek	67,054	6,243	1,416	2,477	14,871	42,047	10,136	7,627
Oak Creek	162,603	6,765	1,021	1,627	15,714	137,476	9,413	7,707
SE Upper Salt Creek	5,751	21	1,929	3,425	376	0	5,375	1,667
Stevens Creek	33,048	1,975	2,154	6,475	22,289	155	10,604	4,146
TOTAL	**511,415**	**44,343**	**14,457**	**21,752**	**104,593**	**326,270**	**80,552**	**58,129**

Source: Provided by the City of Lincoln Planning Department
Notes: (1) Inside city but not in Tier I. (2) Tier 1 A. (3) Tiers 1 B and I C. (4) Tiers II and III. F.S.L = Future Service Limit (Jan. 19, 2012)

Table 9-2. Existing Basin Growth Patterns (percentage)

BASIN	TOTAL (ACRES)	(1) URBANIZED	(2) DEVELOPING	(3) FUTURE	(4) BEYOND 2040	OUTSIDE TIER III	INSIDE F.S.L.	INSIDE CITY LIMITS
Antelope Creek	8,623	84.6	15.4	0.0	0.0	0.0	100	100
Beal Slough	8,835	59.4	27.0	13.4	0.2	0.0	100	85
Cardwell Branch	10,450	0.0	3.1	2.6	93.5	0.8	6	3
Deadmans Run	6,017	100.0	0.0	0.0	0.0	0.0	100	100
Haines Branch	43,745	0.9	0.1	0.0	23.5	75.5	1	1
Little Salt Creek	29,345	0.0	2.0	4.1	33.6	60.3	6	2
Lower Salt Creek	69,151	9.6	2.5	4.8	18.1	65.0	17	12
Lynn Creek	2,640	67.3	24.1	8.3	0.2	0.0	100	91
Middle Creek	64,153	3.1	1.4	2.4	13.8	79.3	7	4
Middle Salt Creek	67,054	9.3	2.1	3.7	22.2	62.7	15	11
Oak Creek	162,603	4.2	0.6	1.0	9.7	84.5	6	5
SE Upper Salt Creek	5,751	0.4	33.5	59.6	6.5	0.0	93	29
Stevens Creek	33,048	6.0	6.5	19.6	67.4	0.5	32	13
TOTAL	**511,415**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Source: Provided by the City of Lincoln Planning Department
Notes: (1) Inside city but not in Tier I. (2) Tier 1 A. (3) Tiers 1 B and I C. (4) Tiers II and III. F.S.L = Future Service Limit (Jan. 19, 2012)

While land use characteristics within the Antelope Creek watershed are unique, the impairments within the stream are not. Antelope Creek is one of six stream segments in the Lincoln area that are part of a TMDL determination that addresses the Lower Platte River Basin, and of the six, four of them address *E. coli.* TMDL designations for

other Lincoln area water bodies are shown below in Table 9-3. Holmes Lake is also currently listed as impaired, but could be removed from the 303(d) list as water quality improves in the lake following renovation in 2004.

Table 9-3. Water Bodies with TMDL Determinations in Lincoln/Lancaster County

Water Body	Segment ID	Impairment
Salt Creek	LP2-20000	*E. coli*
Oak Creek	LP2-20500	*E. coli*
Deadmans Run	LP2-20400	*E. coli*
Middle Creek	LP2-21000	Atrazine
Salt Creek	LP2-30000	*E. coli*
Holmes Lake	LP2-0040	Sediment and Phosphorous

Source: NDEQ IR, 2010

The Source Loading and Management Model for Windows (WinSLAMM) was developed on the specific layout of the Antelope Creek watershed using lot sizes, age of housing, street size, parking, and estimate of impervious surfaces. Applying results from WinSLAMM for Antelope Creek may not accurately represent differing watersheds City-wide. One similarity is the rainfall estimates used for WinSLAMM; which were based upon actual recorded rainfall in Lincoln. WinSLAMM can be used to give a general idea of what might be expected, but for purposes of stormwater management planning in other watersheds, the model should be developed for that specific area.

In general, newer developments have fewer directly connected downspouts, which can help to reduce the amount of stormwater runoff. The overall lot sizes may also differ in newer developments. For larger lots, Low/No-phosphorus fertilizers may be a more effective source control than disconnections. These differences have not been specifically analyzed as part of this Section.

Non-structural programs focus on management of pollutants at their source by minimizing exposure to runoff, rather than treating runoff in structural BMPs.

Non-structural programs focus on management of pollutants at their source by minimizing exposure to runoff, rather than treating runoff in structural BMPs. Although non-structural programs removal efficiencies vary depending on the pollutant of concern, in general they are a cost effective strategy. According to Table 9-3, it appears that the main constituent of concern in streams in Lincoln is *E. coli*. Due to overall similar stream impairments, and the effectiveness and low-cost of implementing non-structural BMPs, the remainder of this section focuses mostly on how non-structural BMPs can be applied City-wide. While structural BMPs are still a viable solution to treating pollutants in stormwater, details regarding the use or placement of structural alternatives will not be detailed in other basins. The remainder of this section discusses how recommendations for the Antelope Creek watershed can be applied to other watersheds across the city. Recommendations have been divided into three separate categories:

- City-wide recommendations – strategies that can be applied in both urban and developing watersheds
- Developed watershed recommendations – strategies that can be applied to urbanized watersheds
- Undeveloped watershed recommendations – strategies that can be applied to developing watersheds

Generalized structural stormwater BMP recommendations are also included for all watersheds City-wide.

9.3. City-wide Recommendations

City-wide recommendations include structural and non-structural BMPs and considerations such as policy changes or incorporation into planning principles that would encourage activities to limit future pollutant loading to water bodies in the City and future development areas. These actions would be effective regardless of the land use and other characteristics within a specific watershed. The following City-wide strategies are recommended:

- Water quality monitoring
- Overlay districts
- Low/No-phosphorus Fertilizer Ordinance
- Outreach to lawn care providers
- Snow and ice management strategies

- LPSNRD Cost-share Program
- Update Drainage Manual
- Bridge retrofits
- Establishment of native plant species into Capital Improvement Projects
- Regional Water Quality Management Plans
- Incorporation of water quality elements into future Watershed Master Plans
- Water quality partnerships
- Urban wildlife management
- Post Construction Standards
- Pet Waste Ordinances / Disposal Cans
- Long term public education

Picture 37: The City has several existing City-wide actions aimed at improving water quality

Water Quality Monitoring

Sampling at the confluence of each watershed will provide an overall look at the water quality within the watershed as water quality strategies are implemented. This location is the ultimate compliance location for water quality sampling and established TMDL determination. Sampling data from the confluences can be compared to the water quality sampling completed in the past as well as information in relation to an established TMDL determination. Sampling at these locations will not help the City and LPSNRD to understand pollutant load reductions from individual BMPs or load reductions from individual sub-basins. Sampling at the confluences will determine the total percent reduction basin-wide and if goals listed in the TMDL document are being met.

Overlay Districts

The City of Lincoln currently uses several overlay districts – historic districts, capital environs, airport noise and height districts. In these areas, development must meet higher design standards and often has a special review board. The City also uses neighborhood design standards (setbacks, garage placement, pitch of roof, etc.) for neighborhoods that were within the city limits in 1949.

Conservation overlay districts have also been used to address environmentally related land use activities such as restrictions for agricultural producers in a wellhead protection area. These types of overlay districts could be used to regulate land use activities potentially harmful to water quality. Examples might include requirements for disconnection of rooftop runoff to impervious areas, use of Low/No-phosphorus fertilizers, or others.

Low/No-Phosphorus Fertilizer Ordinance

To support efforts of improving water quality city-wide, consider the use of an ordinance to ban or restrict phosphorus fertilizers. Restrictions could apply across the entire city, or be focused in more environmentally sensitive areas such neighborhoods above lakes or within a set distance from waterways.

Outreach to Lawn Care Providers

To support city-wide efforts to increase use of Low/No-phosphorus fertilizer, consider offering education and outreach or incentives to lawn care providers to use or offer Low/No-phosphorus fertilizer and to promote soil testing as an option to customers. Provide flyers and other information to lawn care providers to share with their customers that explain the benefits of Low/No-phosphorus fertilizer on the health of their watershed.

Snow and Ice Management Strategies

The City's snow removal management strategies could implement practices as recommended in Section 8.3.1: Expansion of Existing Programs.

Update Drainage Manual

The City of Lincoln is responsible for providing adequate drainage in urban areas as a necessary component in maintaining the overall health, welfare, and economic wellbeing of the City. The last update of the stormwater chapter in the City's Urban Drainage Criteria Manual was 2004. Stormwater management strategies have evolved substantially since 2004, therefore, it is recommended that the City update the stormwater chapter of the criteria manual.

Bridge Retrofits

Retrofitting bridges to control wildlife was discussed as a recommendation for Antelope Creek in Section 8.3.2: New Programs. Consider expanding activities to control bird activity near waterways City-wide.

Establishment of Native Plant Species into Capital Improvement Projects

Plants are a basic environmental building block, provide habitat and food for animals, as well as aid in sustaining the vegetation that holds the soil and protects water quality. Maintaining a diverse range of plants ultimately supports a healthier environment for all plants and animals. Natural areas provide soil treatment opportunities from enhanced infiltration and other natural processes and should result in decreased bacteria export in stormwater. Long grass vegetation also discourages some waterfowl. To improve stormwater quality City-wide, consider the use of native grass species in areas of existing long-grass, as part of flood control and water quality projects. Prairie plants have the following benefits:

- Control invasive weeds
- Filter carbon dioxide
- Reduce flooding by promoting infiltration
- Feed birds and wildlife
- Reduce maintenance cost
- Are aesthetically pleasing
- Adapted to the local climate

Regional Watershed Management Plans

NDEQ and EPA emphasize watershed management plans that address water quality issues in 303(d) listed waters with a developed TMDL. One option for the development of watershed management plan is to establish a larger-scale plan that encompasses several watersheds. Multi-basin plans are written more generally than a Basin Plan covering one impaired water segment. For example, LPSNRD could cover the entire District with two watershed plans, the Upper Salt Creek Water Quality Management Plan and Lower Salt Creek Water Quality Management Plan. Within each plan several projects would be identified. Once the project sponsor intends to implement a project listed in the regional watershed plan a specific project management plan would then be developed for that individual project.

Water Quality Partnerships

As opportunities arise City-wide the City and LPSNRD could consider working with public/private partnerships to incorporate water quality projects into private development.

Incorporation of Water Quality Elements into Future Watershed Master Plans

To support continued water quality improvements, consider including water quality as either a primary or secondary focus of all future Comprehensive Watershed Master Plans. If an existing plan is updated or amended, consider addressing water quality planning elements.

Urban Wildlife Management

Urban wildlife management is discussed in Section 8.3.2 and could be expanded to other areas of concern across the city.

Post Construction Standards

Incorporate post-construction BMPs for new development and redevelopment projects that aim to address both the increased pollutant loads to local waterway as a result of urbanization as well as the increased quantity of water delivered to a water body during a rainfall event. Take into consideration business, environmental, and neighborhood interest recognizing the need to sustain long-term economic and development opportunities in the City and future growth areas.

Pet Waste Ordinances / Disposal Cans

The use of pet waste ordinances and disposal cans is discussed in Section 8.3.1 and could be expanded to other areas of concern across the city, especially those watersheds with an *E. coli* impairment listed in Table 9-3.

Long Term Public Education

Establish a long term education program. This program will focus on education the public on the benefits of improving water quality, and its effects on the environment.

9.4. Developed Watershed Recommendations

According to the City Planning Department, developed watersheds include those that are fully urbanized, within the City limits, and can only support in-fill development. As the City grows and expands, other watersheds may become fully urbanized, and be considered developed. According to Table 9-2, Deadmans Run is the only 100% urbanized watershed in Lincoln, with Antelope Creek 85% urbanized. Other significantly urbanized watersheds include Lynn Creek (67.3%) and Beal Slough (59.4%).

Non-structural programs focus on management of pollutants at their source by minimizing exposure to runoff, rather than treating runoff in structural BMPs. Although non-structural programs removal efficiencies vary depending on the pollutant of concern, in general they are a cost effective strategy. Due to overall similar stream impairments in Lincoln, and the effectiveness and low-cost of implementing non-structural BMPs, an emphasis on non-structural BMPs across the city is recommended. Non-structural strategies that are specific to developed watersheds are listed below:

- Sanitary Sewer Line Inspection Program
- Dry weather storm drainage screening program
- Pet waste ordinance/enforcement
- Long grass maintenance area expansion
- Flood control structure retrofits
- Rooftop runoff disconnections
- LID strategies
- Urban soil quality restoration

9.4.1 Non-structural Recommendations

Sanitary Sewer Line Inspection Program

A sanitary sewer line inspection program as discussed in Section 8.3.1 should be implemented.

Dry Weather Storm Drainage Screening Program

A sampling program as discussed in Section 8.3.1 is recommended.

Pet Waste Ordinance Enforcement

Pet waste ordinance enforcement as discussed in Section 8.3.1 is recommended.

Long Grass Maintenance Area Expansion

Long grass maintenance area expansion as discussed in Section 8.3.1 is recommended.

Flood Control Structure Retrofits

Retrofitting of existing flood control structures throughout the City to enhance water quality benefits could be a large scale, cost effective treatment option. Currently, many residential neighborhoods and large commercial/industrial

sites have dry detention basins to manage runoff during rainfall events. The dry cells are typically designed to temporarily detain stormwater and allow outflow at a specified rate that will not cause flooding downstream. The cells are usually designed to manage up to a 1% chance rainfall event (100-year).

Existing dry cells can be retrofitted with amended soils and outlet structure modifications to capture and infiltrate the 90% rainfall event (1.25 inches). Retrofit of these cells could have a significant effect on pollutant loads in a watershed, by reducing total runoff volumes and the pollutant load it carries, and trapping sediment from stormwater. Demonstration project AC-P10: Extended Detention Cell Near 60th and South in SECTION 8 - MANAGEMENT PRACTICES–RECOMMENDED PROJECTS/PROGRAMS details a potential retrofit of an existing dry cell into an extended detention cell. This project serves as one approach that could be used throughout the City.

Disconnections of Roof Runoff/Parking Lots

As described in Section 8.3.2, disconnections of rooftop runoff and surface water runoff from impervious surfaces such as parking lots can have a considerable benefit to stormwater runoff at a relatively low cost. It is recommended that an incentive program for property owners to disconnect downspouts and roof drains from spilling onto impervious surfaces be established. Support the program with a considerable educational campaign using bill stuffers, billboards, press releases, social media, news articles, information on the City and LPSNRD's website, and other means.

It is also recommended that locations be identified in the Basin Plan area where parking lot drainage to storm drain inlets could be disconnected. Directing flow of stormwater from parking lots onto vegetated surfaces, swales, rain gardens, or other BMPs, could have a considerable positive impact on water quality and on reducing wet weather peak flows in the streams, with associated BMPs. A process should be established to work with property owners to encourage disconnection of parking lots and other large impervious surfaces from the storm drain system.

Disconnections of rooftop runoff and surface water runoff from impervious surfaces such as parking lots can have a considerable benefit to stormwater runoff at a relatively low cost.

Urban Soil Quality Restoration

Urban soil quality restoration is discussed in Section 8.3.2. During re-development activities, City-wide care should be given to ensure soil remains undisturbed during construction activities. This could be accomplished through required fencing of sensitive areas to limit compaction or restore the soil quality after construction.

9.4.2 Structural Recommendations

According to Pitt's April 2011 WinSLAMM report, structural source controls will help reduce pollutant loading and improve water quality, but can be more costly to implement that the non-structural BMPs listed above. As mentioned previously, structural stormwater controls are more efficient when they are stacked, or used in a combination, to provide treatment to one area. Below are a number of effective stormwater controls modeled in WinSLAMM for runoff volume controls for urbanized areas with characteristics similar to those within the Antelope Creek watershed.

- Strip mall and shopping center areas
    - Porous pavement (in half of the parking areas)
    - Curb-cut biofilters (along 80% of the curbs) for strip malls or biofilters in parking areas (10% of the source area) for shopping centers
    - Biofilters in parking areas (10% of the source area) and curb-cut biofilters (along 40% of the curbs)
- Light industrial areas
    - Curb-cut biofilters (along 40% of the curbs)
    - Roofs and parking areas half or all disconnected
- School, church, and hospital institutional areas
    - Small rain tanks (0.10 cubic feet storage/square foot roof area) for schools and churches; rain tanks (0.25 cubic feet storage/square foot roof area) for hospitals
    - Roofs and parking areas half or all disconnected
- Low and medium density residential areas
    - Curb-cut biofilters

9.5. Undeveloped Watershed Recommendations

Undeveloped watersheds include those that are not fully urbanized, have areas that are located outside current City limits, and can support future expansion as shown in Figure 9-1. As the City grows and expands, these watersheds may become fully urbanized and be considered developed. As these watersheds become more developed, the recommendations for each should be updated to reflect their status. The following list includes the currently significantly undeveloped watersheds within the City by percent urbanized (City Planning Department, 2011):

- Cardwell Branch (0.0%)
- Haines Branch (0.9%)
- Little Salt Creek (0.0%)
- Lower Salt Creek (9.6%)
- Middle Creek (3.1%)
- Middle Salt Creek (9.3%)
- Oak Creek (4.2%)
- SE Upper Salt Creek (0.4%)
- Stevens Creek (6.0%)

9.5.1 Non-structural Recommendations

A proactive approach to stormwater management by the City and LPSNRD within developing watersheds would support sustainability regarding water quality. Planning for water quality improvements should begin ahead of new development. Below are two recommendations for non-structural activities ahead of future development in Lincoln's non-developed basins.

Post-Construction Stormwater Management

An effective stormwater quality management approach for developing or redeveloping areas would be Low Impact Development (LID) strategies. LID strategies include the use of structural and non-structural BMPs as part of a planned development to manage stormwater, versus the traditional method which includes moving large amounts of stormwater offsite as quickly as possible. Post-construction BMPs would include those that are used in the layout and construction of new development and redevelopment areas; both public and private. If the natural hydrologic and hydraulic functions of a watershed can be maintained, it will be easier to manage water quality in those areas. Some of the strategies that should be considered are:

- Maintain natural drainage ways and flow patterns
- Maintain as much natural grasslands and existing tree areas during construction as possible
- Consider right-of-way areas along all existing streams and creeks which provide a minimum of 200 foot total buffer width.
- Onsite capture and treatment of stormwater for each parcel to return the volume and peak flow during rainfall events to predevelopment levels
- Use of pervious pavement in residential areas and parking lots
- Using grassed swales and bio-infiltration areas to convey stormwater in lieu of conventional curb and gutter and closed conduit systems.
- Green roofs
- Planter boxes
- Rooftop disconnection requirements for new developments

Disconnection Requirements for New Developments

As described in Section 8.3.2, disconnections of rooftop runoff and surface water runoff from impervious surfaces such as parking lots can have a considerable benefit to stormwater runoff at a relatively low cost. For developing areas, consider requirements that would route rooftop and impervious surface runoff onto pervious surfaces.

9.5.2 Structural Recommendations

Structural BMPs which help reduce pollutant loading and improve water quality are not as economical as the non-structural BMPs listed above. The two most effective water quality BMPs at controlling *E. coli,* TSS, and nutrients are infiltration BMPs and wet ponds. In most of the City it is more feasible to retrofit the infiltration BMPs into project sites. However, in new development areas the City should consider the use of wet ponds to manage stormwater.