CHAPTER 1 DESIGN MANUAL OVERVIEW

1.1 INTRODUCTION

The response of an urbanized watershed to precipitation is significantly different from the response of a natural watershed. The relationship between the amount of impervious surfaces in a watershed and the effect on the hydrology and water quality has been well documented. Post-developed peak runoff is expected to exceed pre-developed runoff from a similar storm event. This is most commonly the result of reduced infiltration and decreased travel time, which significantly increases peak discharge rates and runoff volumes. Factors influencing the amount (volume) of runoff include precipitation depth, the infiltrative capacity of soils, soil moisture, vegetative cover type, the amount of impervious surfaces, and surface retention. Travel time is determined primarily by slope, length of flow path, depth of flow, and roughness of flow surfaces.

Land modifications such as grading, paving of streets, driveways, parking lots, and the construction of buildings and other facilities characteristic of urban development reduce both the infiltration rate of the soil and the soil storage capacity by eliminating pervious surfaces and reducing vegetation. As the runoff moves over these impervious surfaces pollutants are picked up and carried to the receiving waterbody. A variety of inorganic, organic, and bacteriological pollutants are transported in surface runoff as it moves across the urban landscape. The majority of the annual pollutant loading is added to local streams from the smaller, high frequency (< 1-year) storms. Increases in the overall volume of runoff can destabilize stream bank material and increase downstream erosion.

To accommodate the higher discharge rates and volumes of stormwater runoff in suburban and higher-density urban development, storm sewer conveyance systems are installed to provide safe and efficient drainage of the landscape. Additional protection is provided through storage facilities which control release rates to downstream systems. Traditional design considerations have focused on the prevention of damage to the development site, drainageways, streets, public and private property from flooding. Recently, focus has been added to the reduction of soil erosion and pollutant discharge. With the implementation of the stormwater NPDES Phase II regulations, the improvement of stormwater runoff quality is now an additional stormwater management goal for the City.

1.2 PURPOSE

The purpose of this manual is to present planning and design guidelines for the management of stormwater quality *and* quantity in the suburban and urban environment. This manual establishes standard methods and principals for the design of stormwater collection systems, stormwater detention and retention facilities, stormwater treatment and construction site best management practices (BMPs).

The design factors, formulae, graphs, and procedures are intended for use as engineering guides for determination of quantity, rate of flow, method of collection, storage, conveyance, and discharge of storm water. The Engineer is encouraged to use cost-

effective designs that are hydrologically and hydraulically appropriate through the use of good engineering judgment. The material in this manual includes the hydrologic design and implementation of stormwater quality BMPs and traditional analysis and design of stormwater runoff conveyance for larger storm events to prevent flooding. Additional guidance is provided on improved site planning, construction site runoff control and the protection of environmentally sensitive areas. While this manual includes most of the commonly-used stormwater BMPs, it is not a comprehensive list. Additional design guidance from other technical documents is referenced as applicable.

1.2 BACKGROUND

A driving factor behind the development of this manual is the need to comply with the National Pollution Discharge Elimination System (NPDES) Phase II requirements. The City of Holts Summit has developed this manual based on a review of the City of Columbia's Stormwater Management and Water Quality Manual, City of Springfield's Stormwater Design Criteria Manual, Mid-America Regional Council and the Kansas City Chapter of the American Public Works Association's Section 5600 and Best Management Practices for Water Quality Manual. However, an effort has been made to customize the policies and procedures to more closely fit the types of development expected in the City of Holts Summit. Users of this manual may also want to utilize as a reference, the Missouri Department of Natural Resource's "Protecting Water Quality" manual that is available for download from their web site.

1.3 GOALS

The overall goals of this manual and the related ordinances are to:

- minimize the long term cost of operation and maintenance of stormwater management facilities for both the City and private property owners
- provide guidance to local developers, engineers and construction personnel that will assist in complying with the NPDES permit for state and federal regulations
- reduce the environmental impact of increased stormwater runoff due to development both during construction and in the long term
- control flooding to provide protection of both private and public infrastructure
- minimize nonpoint source pollution to streams in and near the City of Holts Summit
- protect the public's health, safety and welfare
- provide additional protection for environmentally sensitive areas

1.4 CHAPTER SUMMARIES

A. Chapter 1: General Information

This chapter serves as an executive summary of the design manual. It summarizes the manual's purpose, background, goals and provides chapter

descriptions. It also provides information about additional permitting issues related to the construction of stormwater management facilities beyond the requirements of the City.

B. Chapter 2: Plan Requirements

This chapter provides an overview of the various development processes and the required information for plan and permit submittals. This includes the expectations for each type of plan sheet or calculation required for the approval of stormwater management facilities and associated pollution prevention in subdivisions, planned developments and commercial site development. Plan review checklists corresponding to these requirements can be found in Appendix B.

C. Chapter 3: Hydrology and Hydraulics

This chapter provides a brief review of the hydrologic and hydraulic calculations and formulas for determining runoff quantities, velocities and system capacities. This chapter is not intended as a substitute for formal hydrology and hydraulics training and may also be supplemented by extensive information available in industry accepted computer software for hydrologic and hydraulic modeling. Various charts and figures to assist with these calculations are included at the end of the chapter.

Information on determining water quality and channel protection volumes is also included in this chapter. However, specific design guidance for sizing individual post-construction best management practices can be found in the most recent Mid-America Regional Council's (MARC) Manual for Best Management Practices for Stormwater Quality.

D. Chapter 4: Enclosed Systems

This chapter provides specific design criteria for the locations and sizing of storm sewer systems. This includes protection from flooding for various classifications of streets. Energy dissipation at the outlet of an enclosed system is discussed both here and in Chapter 8 – Erosion and Sediment Control. The chapter also includes guidance for reviewing the overflow from the enclosed system. Various charts and figures to assist with these calculations are included at the end of the chapter.

E. Chapter 5: Open Channels

This chapter provides guidance in natural stream protection and design criteria for the locations and sizing of engineered open channel stormwater conveyance systems. Natural stream protection is partially addressed in the zoning code through the stream buffer regulations. However, it is

recognized that occasionally it is necessary to enter the streamside zone or the stream for utility and road crossings. This chapter provides guidance for limited stream assessments to minimize the impacts of the construction activities and the location of stormwater outfalls. Various charts and figures to assist with these calculations are included at the end of the chapter.

F. Chapter 6: Stormwater Quantity and Quality Management

The traditional stormwater management goals for quantity management have centered on storing peak volumes of runoff from large rainfall events and discharging it at a slower (typically pre-development) rate. While traditional storage practices can reduce the peak runoff flows from urban development and provide some level of flood protection, the increase in runoff volume and frequency of peak flows is not reduced and very little improvement in stormwater quality is accomplished unless the water is retained in the basin for more than six (6) months. This chapter provides design criteria for the design of facilities to address quantity management. Design methodologies for sizing these facilities may be supplemented by Hydrologic and Hydraulic information found in Chapter 3. This chapter also discusses a wider variety of alternatives to traditional pond storage. Discussion of operation and maintenance plans is also presented.

Although management of the quantity of stormwater runoff reduces impacts to natural channel systems, it does not sufficiently address treatment of pollutants introduced in the developed environment. This chapter further discusses typical pollutants generated by different types of land treatments and the BMPs that can address these pollutants. Stormwater management plans, as required by the Stormwater Management Ordinance, will address both the quantity and quality of the stormwater runoff from developments.

G. Chapter 7: Environmentally Sensitive Areas

This chapter highlights the additional issues presented by the development of land near environmentally sensitive areas such as Karst sinkholes, caves, springs, losing streams, wetlands, and outstanding state resource waters. Per the Stormwater Management Ordinance, developments near these areas will require additional measures be taken to reduce the risk of any surface or groundwater contamination. Additional information related to the identification of these areas is provided in Appendix C.

H. Chapter 8: Erosion and Sediment Control

This chapter provides a menu of various construction site related best management practices for erosion control, stormwater runoff management,

sediment control, tracking control and general good housekeeping for pollution prevention. Both the erosion and sediment control plan sheets and narrative (Stormwater Pollution Prevention Plan – SWPPP) should utilize options within this chapter to describe how the contractor will attempt to prevent the discharge of pollutants during construction activities.

As noted in this chapter, this is not intended as an exhaustive list of BMPs and specifically did not attempt to address the growing variety of proprietary products on the market for these purposes. The City encourages the introduction of various alternatives to the plans if the ultimate objective of pollution prevention can be achieved.

This chapter is significantly based on guidance developed by the City of Springfield. We appreciate their sharing of their draft erosion prevention and sediment control guidelines.

I. Appendix A: Checklists

This appendix provides the user copies of the plan review checklists that will be utilized in the review and approval of all plans and reports required by the Stormwater Management Ordinance and further detailed within this manual. It is recommended that the developer's engineers utilize these checklists to minimize the comments received from staff and expedite the approval and permitting process. These checklists correspond to plan requirements in Chapter 2.

1.5 REQUIREMENTS OF OTHER AGENCIES

Rules and regulations of other agencies also pertain to stormwater management systems, which may or may not compliment these criteria. When conflicts are encountered, the more stringent criteria shall govern. The following agencies have jurisdiction over streams and/or discharges from stormwater collection systems and may require additional permits. Other regulations, permits and requirements may not be limited to these agencies.

- Federal Emergency Management Agency (FEMA)
- U S. Army Corps of Engineers
- Missouri Department of Natural Resources
- Environmental Protection Agency