PART II - GENERAL INFORMATION

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A. AUTHORIZATION AND SCOPE

This study and report were authorized by agreement between the City of Manhattan, Kansas and BG Consultants, Inc. of Manhattan with Burns & McDonnell Engineers of Kansas City, Missouri on March 9, 1993. Specific services authorized were:

- Review of existing maps, records, reports, ordinances, criteria and floodplain studies to organize and collate information pertinent to the study.

- A public meeting at the beginning of the study to gather information about existing problems and public perception and opinions; public meetings at the end of the study to present findings and recommendations; and a meeting with local developers and design professionals to present recommended updated design criteria.

- A field investigation of the City's existing major drainage structures and hydrologic land use parameters to measure and record data for use in computer modeling of the system, operation and maintenance studies, and cost and priority studies.

- Preparation of system maps at a scale of 1"= 400' using U.S.G.S. topographic mapping as a base and identification thereon of:
  - Watershed and subwatershed boundaries.
  - Existing major drainage system structures.
  - Computer model identification nomenclature.

- Evaluation of the performance capability and deficiencies of the existing drainage system by use of the Corps of Engineers' HEC-1 and HEC-2 computer models for return periods ranging from two years to 100 years.

- Development of a master facility plan for the City considering the optimum combination of structural and nonstructural components capable of providing an acceptable level of drainage service under future complete development in accordance with the City's Comprehensive Land Use Plan. Use of the computer models to develop and validate the recommended system's performance.

- Preparation of capital and annual operation and maintenance cost estimates for the City's drainage system and for recommended improvement projects using the SYCOST computer model.

- Development of recommended priorities for implementing specific structural and nonstructural improvement projects using the PRIOR computer model.

- Preparation of a recommended plan for operating and maintaining the drainage system.

- Preparation of a financial plan with recommendations for funding improvements to and continuing management of the drainage system.

- Preparation of an updated storm drainage system design criteria document.

- Preparation of a written report with supplementary graphic exhibits presenting the information and recommendations developed by the study.

- Preliminary design of recommended CICO channel improvements based on results of system analysis and alternatives developed and presented to area residents.

B. DEFINITION OF TERMS

Various technical terms are used throughout this report. They are defined as follows.

1. Detention Facility - Any structure, device or combination thereof that functions to accept inflow from surface runoff and discharge it at a controlled rate less than the peak inflow rate.

2. Developer - Any person or corporation engaged in the process of changing the use of land.

3. Development - Any activity that alters the surface of the land to create additional impervious surfaces including, but not limited to, pavement, buildings and structures.

4. Enclosed Drainage System - A drainage system consisting of essentially continuous pipes and/or culverts below the ground surface.

5. Erosion - The removal of soil particles by the action of flowing water.

6. Freeboard - The vertical difference in elevation between the hydraulic gradient and a referenced point. Examples are the difference between the maximum water surface level behind a dam and the top of a dam, or the difference in elevation between the water surface at a culvert beneath the roadway and the surface of the roadway.

7. Hydraulic Gradient - The elevation of the surface of the water in the drainage system at any point.

8. Impervious Surface - Any surface that does not readily permit water to enter. Examples are roofs and concrete or asphalt-paved surfaces.

9. Improved Channel - Any channel whose characteristics are changed by either grading or construction of lining materials.

10. Level of Service - The return period for which a drainage system, or an individual element of that system has adequate hydraulic capacity.

11. Natural Channel - An existing channel that has not been appreciably altered by lining or changing its course.

12. Open System - A drainage system consisting of open channels, either natural or improved, with only comparatively short lengths enclosed by pipes or culverts.

13. Pervious Surfaces - Surfaces that absorb water such as yards and other unpaved areas.

14. Reach - A specific length of the storm drainage system between two points. For example, a reach may consist of a single culvert or may consist of several connected pipes or channel sections. The term "line" may also be used synonymously within the report.

15. Return Period - A statistical term for the average frequency that a given event may be expected to occur although it does not imply that the event will occur regularly at even intervals. It can also be defined as the reciprocal of the probability of an event. For example, a storm having a 10-year return period statistically can be expected to occur once in a period of 10 years, an annual probability of occurrence of 0.10, or 10%. However, the event may happen at any time and two such events may actually occur on successive days.

16. Sediment - Soil particles eroded by flowing water either in suspension in that water or as deposited.

17. Storm Drainage System - All of the natural and constructed facilities and appurtenances, such as ditches, natural channels, pipes, culverts, bridges, improved channels, street gutters, inlets and detention facilities, that serve to collect and convey surface drainage within the City.

18. Watershed - All land draining to the storm drainage system at any given point. This term is used synonymously with the terms tributary area, drainage area, drainage basin and catchment area.

C. STORM DRAINAGE SYSTEMS

There are two storm drainage systems in the City, the "major system" and the "minor system." Each must perform its function adequately to provide an acceptable level of drainage service. However, the consequences of poor performance by each system differ greatly.

The major system may be considered analogous to the City's arterial streets that serve to carry large volumes of traffic through the City. The minor system may be considered similar to the City's residential streets that serve to collect traffic from each driveway and carry it to the major streets for passage through the City.

Substandard performance by the major system is usually associated with significant consequences. When it fails to perform, comparatively large volumes of water overflow streets and property and may cause real damage by both erosion and flooding of buildings. The failure of the Minor System to perform is characterized by lower volume, shorter duration overflows that may, on occasion, be a nuisance to traffic or cause objectionable quantities of water to flow across property although real damage is seldom experienced.

There is no clear line of demarcation between the major and minor systems. In general, the major system is considered to begin at the point at which approximately 40 acres become tributary to the system. This study and report are directed to the major system although some minor system elements have been included for continuity of the analysis.

D. AREA INFORMATION

The City of Manhattan is located near the southeast corner of Riley County with a relatively small portion of the east side of the city within Pottawatomie County. The confluence of the Big Blue and Kansas Rivers and Wildcat Creek is near the southeast corner of the city. Fort Riley Military

Reservation is located to the west and Tuttle Creek Reservoir approximately three miles to the north. Major highways through the area include U.S. Highway 24 and State Highways 18, 113 and 177. The Kansas State University campus is located in the north central part of the city and much of the land along the northern edge of the city is owned by the university.

For this study the city and adjacent areas tributary to the municipal drainage system are divided into 13 main watersheds covering a total area of 27.8 square miles. Each area is generally associated with a stream tributary to one of the three major waterways. These include Little Kitten Creek, the CICO Tributary, Rolling Hills Tributary, the Virginia-Nevada Tributary and Eureka Valley Tributary.

Soils in the area generally are fine-grained with moderately pervious surface soils and less pervious subsoils. They are classified according to the Unified Classification system primarily as silt loams and silty-clay loams with some sandy loams in the floodplain areas. They typically are classified as hydrologic Class B or C soils according to the Soil Conservation Service (SCS) system.

Surface slopes range from nearly level in the floodplains along the east and south edges of the city to approximately 10 percent on the west side. Elevations range from approximately 1,000 feet (305 meters) at the eastern edge of the corporate limits near the river confluence, to 1,360 feet (415 meters) in the upper reaches of the Little Kitten Creek basin, northwest of the city.

Average annual precipitation in the area is 32.9 inches with the Gulf of Mexico being the primary source of moisture for the area. Heaviest rainfall is expected during the spring and summer months with 75 percent of the total precipitation falling in the period from April to September. The driest period occurs from November to March. Rainfall events that place the most frequent demands on the drainage system occur as convective thunderstorms having intense, short duration rainfall. On average, thunderstorms occur on about 55 days each year in Riley County.

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