Hey and Associates, Inc.

Northeast and Northwest Delafield - Stormwater Management Plan

Prepared for

City of Delafield

September 2004

Northeast and Northwest Delafield - Stormwater Management Plan

Prepared for

City of Delafield
Waukesha County, Wisconsin

September 2004

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CHAPTER 1
INTRODUCTION

At the request of the City of Delafield, Hey and Associates, Inc. prepared this Stormwater Management Plan for the northeast and northwest portions of the City. The project is funded in part through a grant from the Wisconsin Department of Natural Resources.

The intent of the project is to identify locations for regional stormwater management facilities to improve the water quality before it enters Lake Nagawicka. The goals of the City of Delafield Stormwater Management Plan are as follows:

1. Protect public and private property from potential damage caused by stormwater runoff.
2. Protect the water quality of Lake Nagawicka and groundwater.
3. Protect environmentally sensitive areas such as wetlands, fish and wildlife habitat, and environmental corridors.

The plan objectives are to find solutions to better manage the quantity and quality of stormwater in the study area in a coordinated and balanced manner and to identify implementation mechanisms.

The study area, as shown on Figure 1-1 includes the northeast and northwest portions of the City of Delafield. The study area consists of residential, agricultural, and commercial land uses and local streets, as well as state and interstate highways, and railroads. Approximately 9 percent of the watershed is in residential land use and 73 percent is agricultural or open space. The remaining 18 percent is used for commercial and institutional purposes. This study assumes that much of the agricultural land will ultimately be developed.

The stormwater system is a combination of storm sewers, roadside ditches, channels, and culverts. Overland drainage is generally towards Lake Nagawicka or the Bark River, however some areas are internally drained through natural depressions. Since 1980, the City has required stormwater detention facilities to be constructed in conjunction with commercial land development in the vicinity. The northeast and northwest portions of the City currently do not contain much commercial development, but may contain more under future conditions.

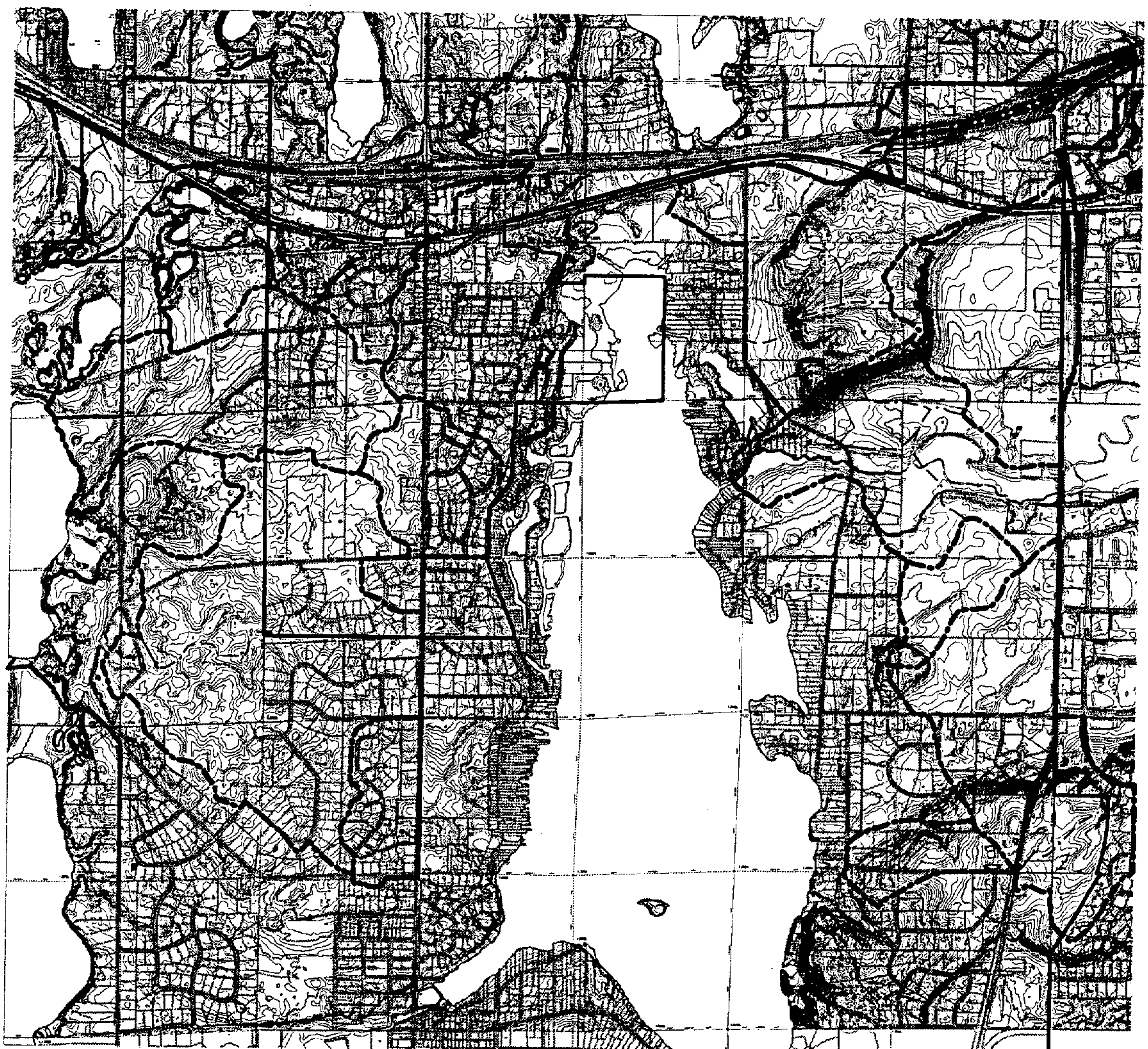


FIGURE 1-1

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

STUDY AREA

CORPORATE LIMITS

SUBBASIN BOUNDARIES

WATERSHED BOUNDARIES

SCALE: 1" = 3200'

N

ORGANIZATION OF THE PLAN

The following plan discusses an overview of the study area, the need for stormwater management, alternatives for stormwater management, and a recommended plan of action. The report is laid out in the following format:

Chapter 1	Introduction
Chapter 2	Overview of the Project Area
Chapter 3	Project Goals and Objectives
Chapter 4	Hydrologic Analysis
Chapter 5	Recommended Management Plan

PLANNING PROCESS

Hey and Associates, Inc. developed the City of Delafield Stormwater Management Plan with the assistance of the City of Delafield staff.

RELATIONSHIP TO OTHER PLANS

This Stormwater Management Plan provides information that supplements existing water resource plans addressing the study area. The related plans include:

- A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report (SEWRPC, Memorandum Report No. 93, 1995)
- A Lake and Watershed Inventory for Lake Nagawicka, Waukesha County, Wisconsin (SEWRPC, Memorandum Report No. 130, 1999)
- IH 94 & STH 83 Interchange Stormwater Management Plan (Hey and Associates, 2001)

CHAPTER 2
OVERVIEW OF STUDY AREA

INTRODUCTION

The City of Delafield has had a long history of concern for environmental protection of the local natural resources, especially Lake Nagawicka. As part of the concern for the protection of the environment, the City has funded a stormwater management study of the northeast and northwest portions of the City of Delafield. The study area is shown in further detail on Figures 2-1 and 2-2. The following chapter provides an overview of the physical features of the study area, including land use, drainage facilities, climate, soils, groundwater resources, wetland resources, and stream classifications.

DRAINAGE FACILITIES

The east and west portions of the study area have been divided into 21 and 11 subbasins, respectively, based on available topographic mapping and visual observations during field reconnaissance. Subbasin divides were chosen according to the topography and junctions in the drainage system. Subbasin identification numbers and boundaries are shown on Figures 2-1 and 2-2. Subbasins were named based on where they drain. DFD designates subbasins that have their runoff contained internally. BKR designates subbasins that drain to the Bark River, and NGE and NGW indicate subbasins draining to the east and west sides of Lake Nagawicka, and UNH designates subbasins which drain to Upper Nashotah Lake.

Stormwater runoff drainage facilities in the study area are a mixture of storm sewers, open grass swales, channels, and culverts. Numerous natural depressions exist which control stormwater runoff from developed and undeveloped sites. The locations of the depressional storage are shown in Figures 2-1 and 2-2. These depressional areas provide water quality and quantity benefits. Existing depressional storage within the study area has been analyzed as part of the hydrologic analysis as discussed in Chapter 4.

Much of the area west of Lake Nagawicka drains internally, or has engineered stormwater detention facilities. For this reason a detailed hydrologic analysis was not performed for the northwest portion of the City.

LAND USE

Current land use was delineated based on field reconnaissance and 2000 aerial photographs obtained from the Southeastern Wisconsin Regional Planning Commission (SEWRPC). Future land use was delineated from the Zoning Map contained within the City's Comprehensive Plan. From existing to future conditions there are several large agricultural plots which will be converted to residential, public, or retail use. Figure 2-3 illustrates the future land use in the east half of the study area.

The land use within the study area is predominantly single family residential with lot sizes ranging from 1/3-acre to several acre estates. Future development within the City will primarily occur west of STH 83 between HWY 16 and CTH KE. Table 2-1 outlines the existing and future land use breakdown in the east half of the study area.

Table 2-1
Land Use for East Study Area

Land Use	Existing Development		Future Development	
	Acres	Percent	Acres	Percent
Residential: Low Density	99	7.6	784	60.1
Residential: High Density	24	1.8	40	3.1
Agricultural	696	53.4	0	0.0
Retail	39	3.0	133	10.2
Institutional	189	14.5	205	15.7
Open space	257	19.7	142	10.9
Total	1304	100%	1304	100%

Source: Hey and Associates, Inc.

HISTORICAL SITES

Within the City of Delafield there are five historic sites on the National Register of Historic Places (SEWRPC, 1996). Table 2-2 has a complete listing of these sites and the land survey section each is located in.

Table 2-2
Historic Sites

Name	U.S. Public Land Survey Town, Range, and Section
Hawks Inn	T7N, R18E, Section 19
St. John Chrysostom Church	T7N, R18E, Section 18
St. John's Military Academy Historic District	T7N, R18E, Section 18
Delafield Fish Hatchery	T7N, R18E, Section 19
Bishopstead	T7N, R18E, Section 18

Source: Southeastern Wisconsin Regional Planning Commission, 1996

FIGURE 2-1

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

WEST STUDY AREA

SUBBASIN BOUNDARIES AND NATURAL STORAGE AREAS

CORPORATE LIMITS

SUBBASIN BOUNDARIES

WATERSHED BOUNDARIES

DFD - 40
SUBBASIN IDENTIFICATION

NATURAL DEPRESSIONS

2000 AERIAL PHOTOGRAPH

SCALE:
1" = 2000'

N

FIGURE 2-2

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

EAST STUDY AREA

SUBBASIN BOUNDARIES AND NATURAL STORAGE AREAS

CORPORATE LIMITS

SUBBASIN BOUNDARIES

WATERSHED BOUNDARIES

DFD - 40
SUBBASIN IDENTIFICATION

NATURAL DEPRESSIONS

2000 AERIAL PHOTOGRAPH
SCALE:
1" = 2000'

N

FIGURE 2-3

DELAFIELD STORMWATER MANAGEMENT PLAN

EAST STUDY AREA LAND USE

2000 AERIAL PHOTOGRAPH

SCALE:
1" = 1800'

INDUSTRIES IN THE CITY OF DELAFIELD

Table 2-3 lists the industries located within the City of Delafield. Their Standard Industry Code (SIC) and regulatory status under Wisconsin Administrative Code NR 216 are also listed.

Table 2-3
Manufacturing Industries in the City of Delafield

Company and Address	Standard Industry Code (SIC)
Lang Color Press 711 Wells Street	2796
Lieblang Leather 607 Main Street	2386
New Age Chemical 3765 Kettle Court East	2899
Ormson Corp. 3582 Kettle Court East	3589
Wheel Spray Corporation 215 Cushing Park Road	3523

Source: Wisconsin Association of Manufacturers, 2002

WASTE DISPOSAL SITES

When siting stormwater facilities such as detention basins or infiltration systems, waste disposal sites should be avoided to prevent the potential for groundwater contamination or expensive environmental clean up cost. Table 2-4 lists the three disposal sites located within the City of Delafield. The source used for this research was the Registry of Waste Disposal Sites in Wisconsin, SW-108-93 (WDNR, 1993).

Table 2-4
Waste Disposal Sites

Name	U.S. Public Land Survey Town, Range, and Section
Condura Construction	T7N, R18E, Section 6
Sanitary Trans & LF-Delafield	T7N, R18E, Section 22
St. John's Military Academy Historic District	T7N, R18E, Section 18

Source: Registry of Waste Disposal Sites in Wisconsin, SW-108-93 (WDNR, 1993)

CLIMATE

The frequency, duration and amount of precipitation influences surface and groundwater quality and quantity, soil moisture content, runoff characteristics, and the physical condition of surface waters. Precipitation events throughout the area are most frequently moderate in duration and quantity. An event is defined as a distinct period when precipitation is equal to or greater than 0.1 inch. Approximately 50 events per year occur in the area.

Table 2-5 summarizes the average annual temperature and precipitation from National Weather Service station at Carroll College in the City of Waukesha. Table 2-6 summarizes the nominal frost depth in Southeastern Wisconsin for November through April.

Table 2-5
Average Temperature and Precipitation in the City of Waukesha

Month	Temperature			Precipitation	
	Average Daily Maximum (°F)	Average Daily Minimum (°F)	Mean (°F)	Average Total Precipitation (in)	Average Snow and Sleet (in)
January	26.6	10.7	18.7	1.49	11.3
February	31.1	15.2	23.2	1.16	7.1
March	40.6	23.5	32.1	2.38	9.6
April	55.9	35.2	45.6	3.10	1.6
May	67.5	45.4	56.5	3.28	0.2
June	78.1	55.2	66.7	3.70	0.0
July	83.1	60.5	71.8	3.51	0.0
August	80.8	59.3	70.1	3.64	0.0
September	73.0	51.3	62.2	3.31	0.0
October	62.2	40.8	51.5	2.30	0.0
November	45.0	29.0	37.0	2.33	2.9
December	32.1	17.2	24.7	1.83	8.6
Average/Total	56.3	36.9	46.6	32.03	41.3

Source: SEWRPC, 1992 (Averages for 1940 – 1987)

Table 2-6
Average Frost depth in Southeastern Wisconsin: November to April

Month and Day	Nominal Frost Depth (inches)
November 30	1
December 15	3
December 31	4
January 15	9
January 31	12
February 15	14
February 28	15
March 15	13
March 31	7
April 7	3

Source: Wisconsin Agricultural Reporting Service, Snow and Frost in Wisconsin, October 1978 (Based on 1961 – 1977)

SOILS

The most common soil association occurring in the study area is the Fox (Fs). Fox are soils made up of silt loam soils that have subsoils of silty clay loam over clay loam and underlain by sand and gravel. (USDA, 1998) The soil of this association is well drained and facilitates good infiltration of runoff. These soils fall into the hydrologic soil group (HSG) of B. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate. The soils range from Group A, which has high permeability in well-drained soil with less runoff produced, to Group D which has low permeability and more anticipated runoff. Other similar soils found in the study area include Casco (Ce), Casco Rodman (Cr), and St. Charles (Se).

As shown on Figure 2-4, the majority of the soils in the study area are classified as HSG B, except along the Bark River and adjacent to Lake Nagawicka where much of the soils are classified in HSG D.

WETLANDS

Within the City of Delafield wetlands primarily exist along the Bark River and Lake Nagawicka. Wetlands as indicated in the Wisconsin Department of Natural Resources Wetlands Inventory map are shown on Figures 2-5 and 2-6.

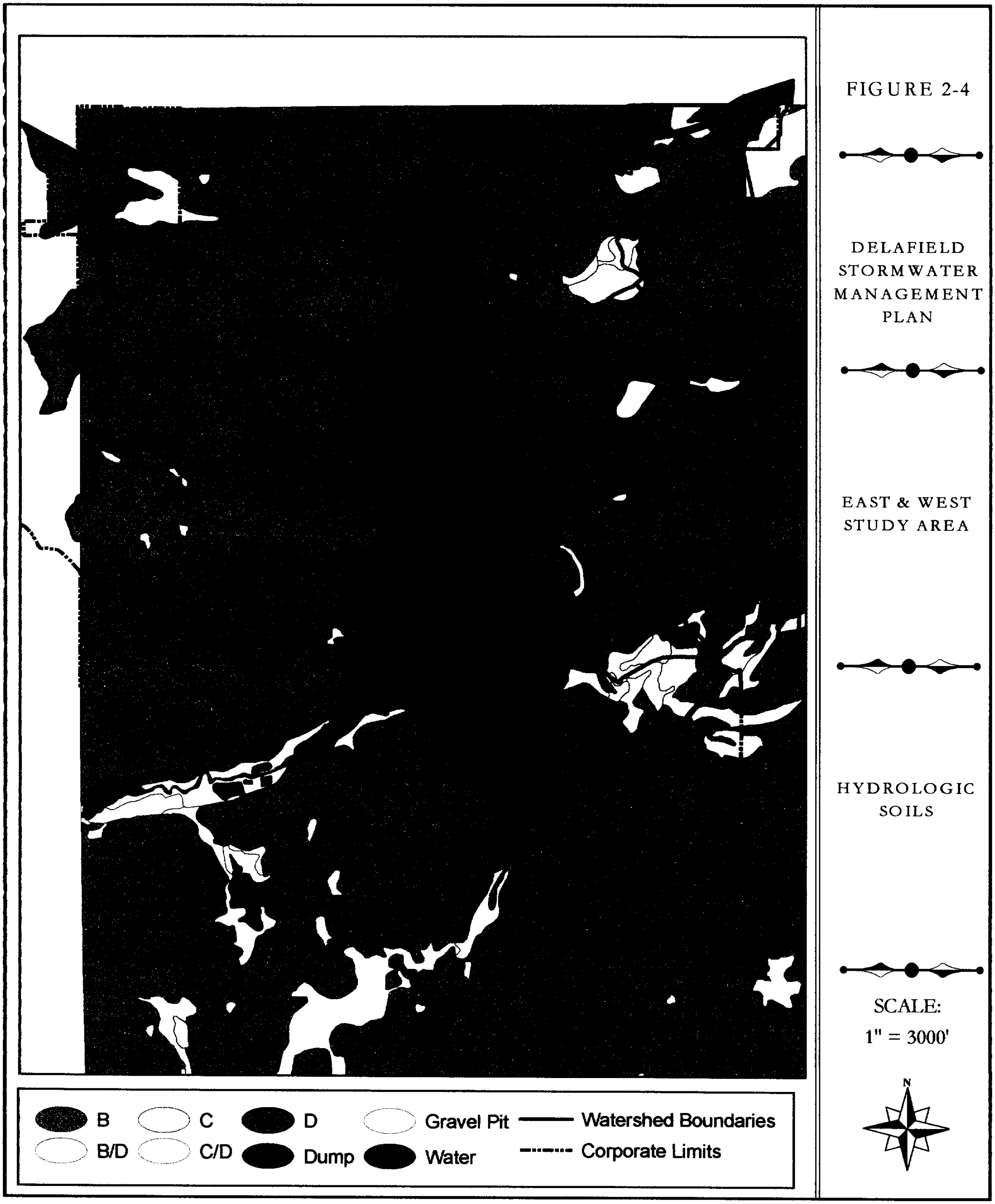


FIGURE 2-4
DELAFIELD STORMWATER MANAGEMENT PLAN
EAST & WEST STUDY AREA
HYDROLOGIC SOILS
SCALE:
1" = 3000'
N
B
C
D
Gravel Pit
Watershed Boundaries
B/D
C/D
Dump
Water
Corporate Limits

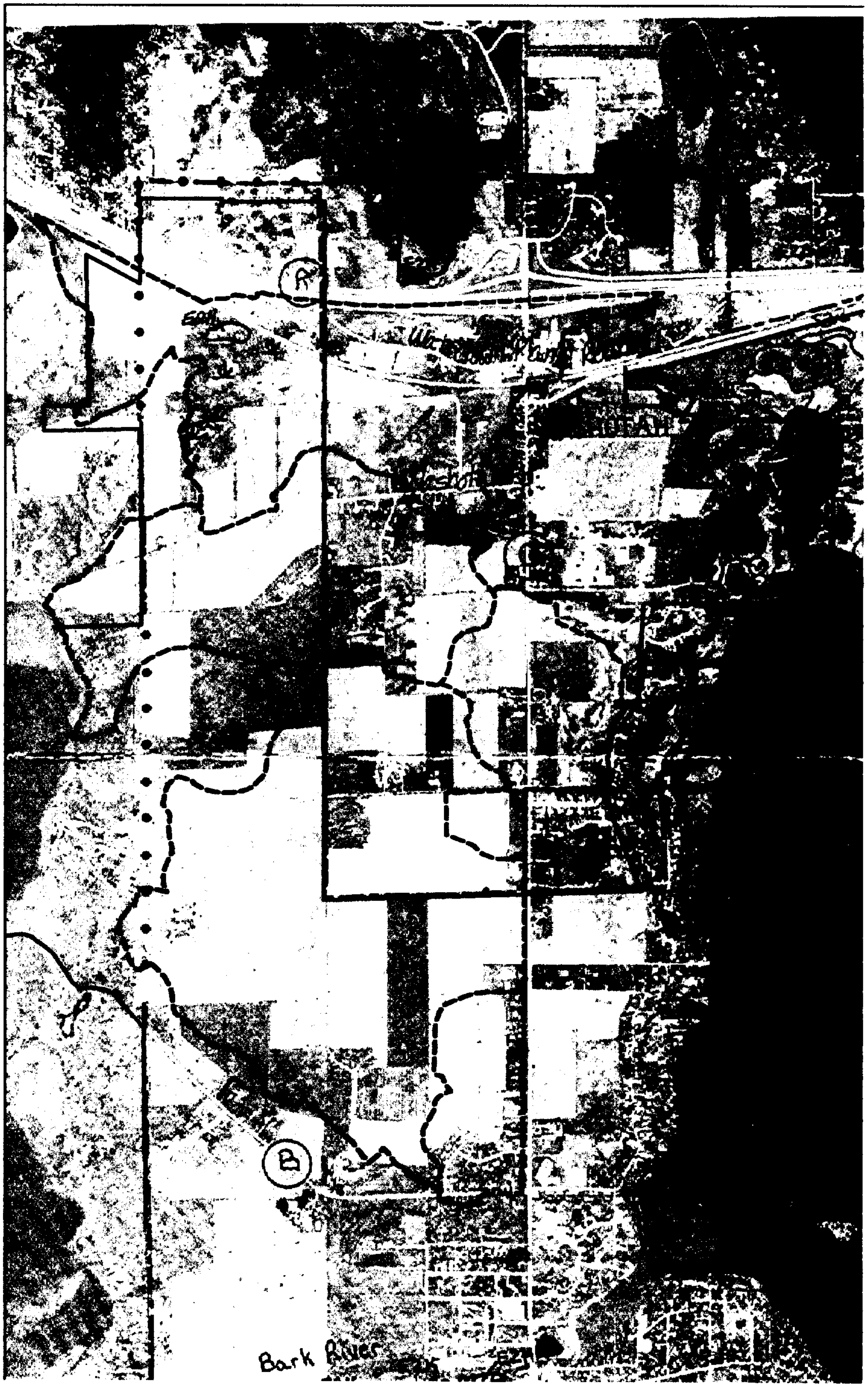


FIGURE 2-5

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

WEST STUDY AREA

WISCONSIN WETLANDS INVENTORY MAP

1980 AERIAL PHOTOGRAPH

CORPORATE LIMITS

WATERSHED BOUNDARIES

SCALE:
1" = 2000'

N

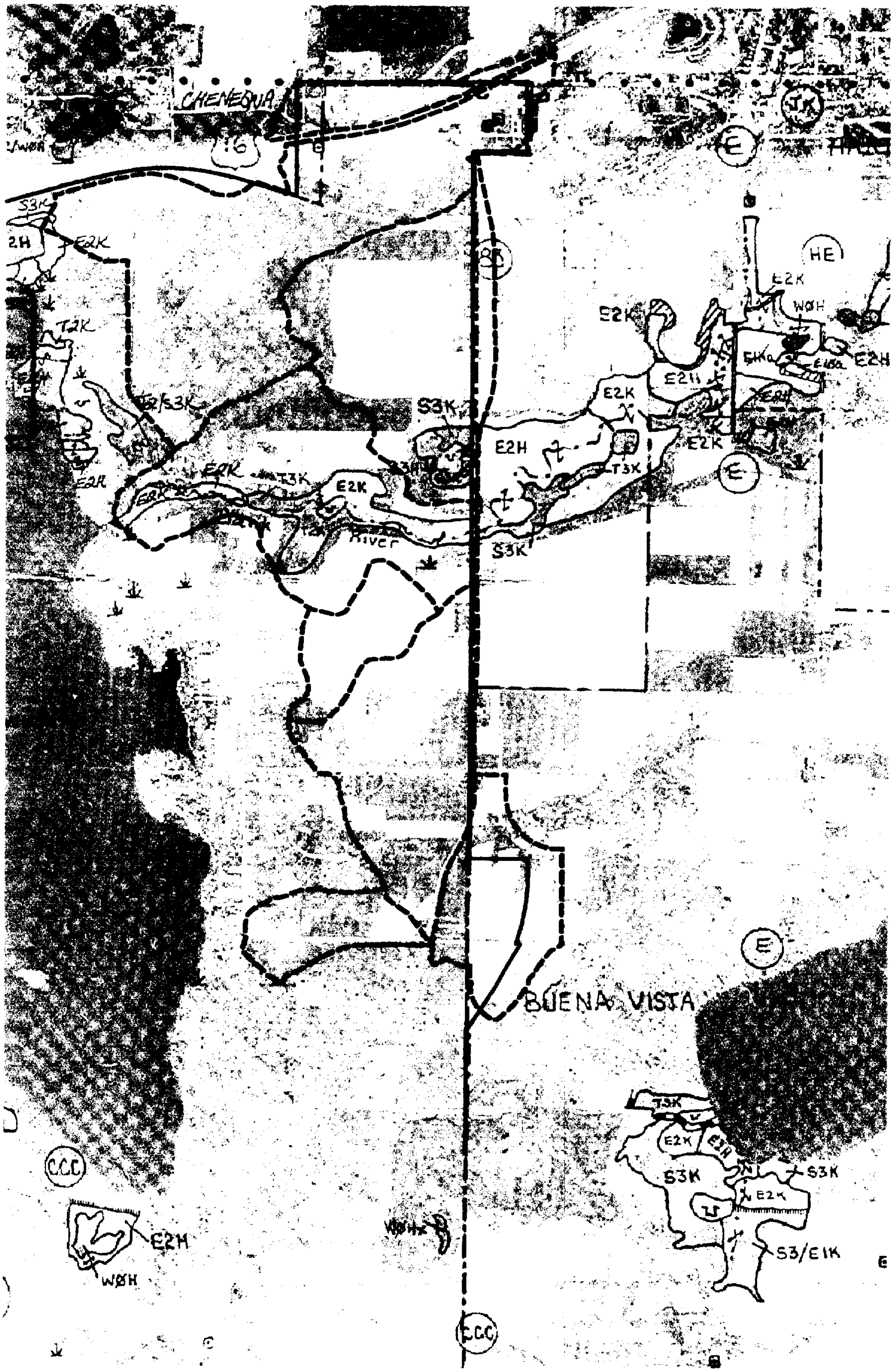


FIGURE 2-6

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

EAST STUDY AREA

WISCONSIN WETLANDS INVENTORY MAP

1980 AERIAL PHOTOGRAPH

CORPORATE LIMITS

WATERSHED BOUNDARIES

SCALE:
1" = 2000'

N

Groundwater and Geological Resources

Potable water supplies in the City of Delafield are obtained from private wells constructed into groundwater. The sources of groundwater are, in general order of depth below land surface, the sand and gravel, the Niagara Dolomite, and the St. Peter sandstone aquifers (USGS, 1980). Most of the potable water supply for the City of Delafield is pumped from the sand and gravel aquifer.

The sand and gravel aquifer consists of unconsolidated sand and gravel deposits of outwash, glacial-lake deposits, or alluvium. Groundwater occurs and moves in the void spaces among the grains of sand and gravel. The potential for contamination of this aquifer is high because of the shallow depth to groundwater. In the study area the sand and gravel aquifer is moving to the north towards Nagawicka and Pewaukee Lakes (USGS, 1979).

The Niagara aquifer includes the entire Silurian and Devonian dolomite section overlying the Maquoketa Shale and is not restricted to rocks of Middle Silurian (Niagaran age). Dolomite is a brittle rock similar to limestone, which contains groundwater in interconnected cracks. The potential for contamination of this aquifer is moderate to low.

The sandstone aquifer includes all Ordovician and Cambrian rocks older than the Maquoketa Shale and lies on relatively impermeable Precambrian rocks. The Maquoketa Shale separates the Niagara and sandstone aquifers. Because of its low permeability, the shale restricts the vertical movement of water and confines water in the sandstone aquifer. The potential for contamination in the sandstone aquifer is low.

Environmental Corridors

Environmental corridors are defined by SEWRPC as linear areas in the landscape containing concentrations of natural resource and resource-related amenities. These corridors generally lie along the major stream valleys, around major lakes, and in the Kettle Moraine area of Southeastern Wisconsin. Almost all of the remaining high-value wetlands, woodlands, wildlife habitat areas, major bodies of surface water, and delineated floodlands and shorelands are contained within these corridors. In addition, significant groundwater recharge and discharge areas, many of the most important recreational and scenic areas, and the best remaining potential park sites are located within the environmental corridors. Such environmental corridors are, in effect, a composite of the most important individual elements of the natural resource base in Southeastern Wisconsin and have immeasurable environmental, ecological, and recreational value (SEWRPC, 1992). SEWRPC has divided environmental corridors into primary and secondary categories based on their size and significance.

As shown on Figure 2-7, within the City, there are isolated natural areas and primary environmental corridor lands. They are generally located along the Bark River, and around Lake Nagawicka. As a general policy, stormwater management facilities should only be located in primary environmental corridors after other alternatives have been shown not to be feasible and careful site conditions have been considered.

FIGURE 2-7

DELAFIELD
STORMWATER
MANAGEMENT
PLAN

EAST & WEST
STUDY AREA

ENVIRONMENTAL
CORRIDOR

SCALE:
1" = 3000'

N

CHAPTER 3
PROJECT GOALS AND OBJECTIVES

INTRODUCTION

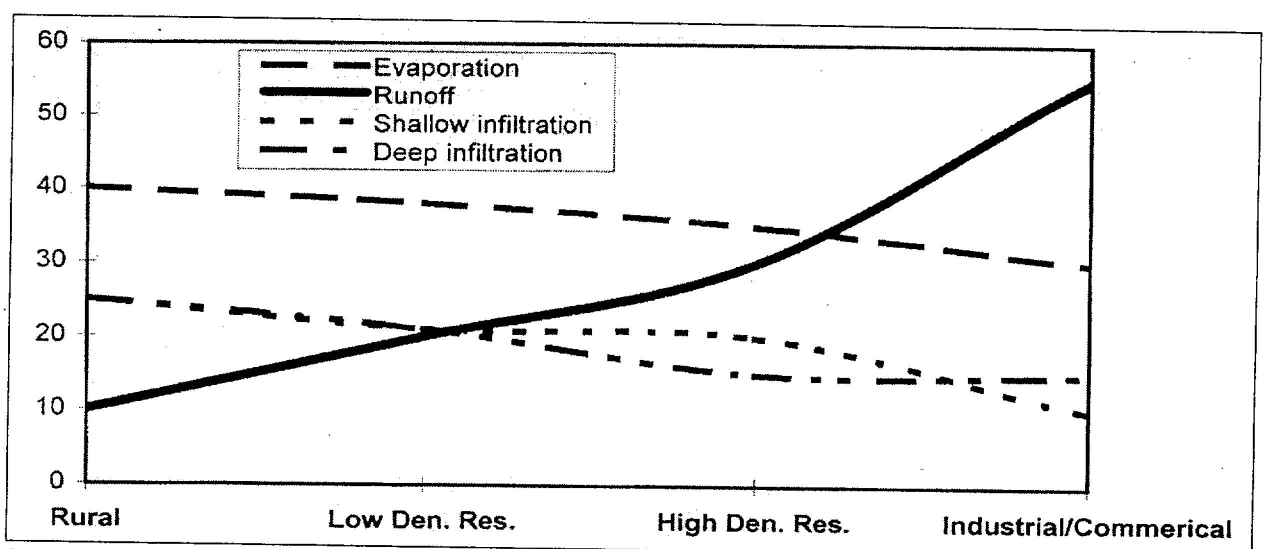
The following chapter outlines the goals and objectives that will act as the basis for planning decisions made in this report. Prior to outlining the goals and objectives, the chapter provides an overview of water quality and drainage concerns associated with urbanization that the plan needs to address.

WATER QUALITY CONCERNS

Water quality issues in the study area fall into four categories; changes to stream flow, increases in stream temperature, loss of stream habitat, and nonpoint source pollution.

When the study area was converted from forest, prairie, and wetland to urban and rural land use, the surface of the landscape was changed. In the past, greater amounts of water infiltrated into the ground and remained in wetland storage. Historically, stormwater reached the stream courses over long periods of time. Today, as the landscape continues to be developed, the associated increase in impervious surfaces, from parking lots, roads, driveways, and roofs, will allow more of the rainfall to be intercepted and become surface runoff. As the landscape continues to develop the impacts to water quality will become more significant. These changes all affect the hydrologic budget of the drainage area. A hydrologic budget is a quantitative statement of the hydrologic cycle used to equate the components of precipitation, evaporation, runoff, and infiltration. Figure 3-1 illustrates the changes that urbanization can have on the hydrologic budget.

FIGURE 3-1
Effects of Urbanization on Surface Water Runoff

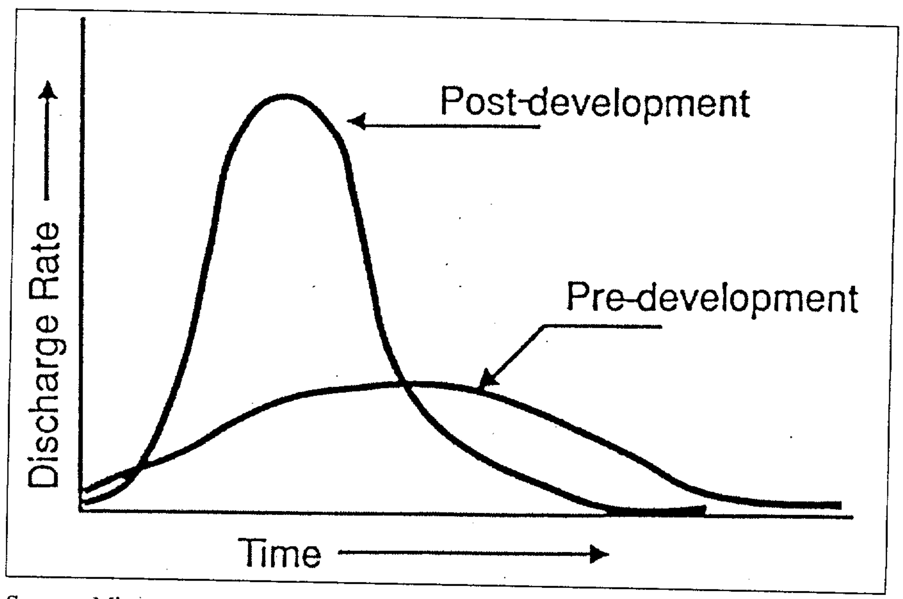


Source: Minnesota Pollution Control Agency

As shown in Figure 3-1, as urbanization takes place and more of the land surface is paved over with rooftops, driveways, parking lots, and streets, infiltration rates decrease and less water goes into groundwater storage. As groundwater storage decreases, the groundwater seepage that contributes flow to local streams during dry periods also decreases. The result is lower stream base flow and longer periods in which the intermittent channels are dry or stagnant during non-rain events. The end result is less fish and wildlife habitat in the local streams.

With less water being held in groundwater and wetland storage, more water is running off the land surface. As shown in Figure 3-1, as the density of urbanization increases, the rate of runoff increases. In the past, it took water days or weeks to reach the stream. As the land is developed, larger volumes of surface runoff reach the stream in hours, instead of days. The result is higher stream flows and velocities during rain events. Figure 3-2 illustrates typical pre- and post-development stream hydrographs. Only the most tolerant aquatic organisms can survive in the extreme high and low flow conditions of urbanized streams.

FIGURE 3 - 2
Pre- and Post-Development Hydrographs



Source: Minnesota Pollution Control Agency

Urbanization increases the amount of pollution in surface water runoff. This pollution, called nonpoint source pollution, is the result of man's activities on the land surface. There are two main reasons why urbanization increases pollutant loads in runoff. First of all, the volume and rate of runoff are increased as an area is developed, providing a larger capacity to transport pollutants. The second reason is that more materials are made available for movement by the runoff as the intensity of the land use increases.

No sampling of the runoff from the study area has taken place. Monitoring of 20 major cities as part of the National Urban Runoff Program (NURP) study has shown that the runoff from various land uses are similar regardless where they are located in the country. The NURP monitoring has shown that sampling of individual communities is not necessary to document a potential source of pollution. The NURP study concluded that mapping of the urban land covers and using developed land surface pollutant relationships could identify pollutant sources. Monitoring in Milwaukee and Madison have shown problem pollutants in urban surface water runoff to include sediment, nutrients, chlorides, bacteria, oil and grease, heavy metals, pesticides, and volatile organic compounds (VOCs). The major sources of these pollutants are outlined in Table 3-1.

TABLE 3-1
Major Sources of Urban Surface Water Pollutants

Pollutant	Major Source
Sediment	Construction sites, agricultural runoff
Nutrients (Nitrogen and Phosphorus)	Fertilizers, soil erosion
Chlorides	Road salt
Bacteria	Pet waste, wildlife
Oil and grease	Automobile
Heavy metals	Automobile
Pesticides	Lawn care, agriculture
VOCs	Automobile, home heating

Source: Novotny and Olem, 1994

The amount of pollutants that come off the land surface is a factor of land use, the amount of imperviousness, and automobile traffic. Pollutant loadings have not been determined for the study area. However, pollutants from the study area may be contributing to water quality problems in Lake Nagawicka.

DRAINAGE CONCERNS

Storm sewers, culverts, and open channels provide drainage within the study area. Storm sewers that exist in the study area were installed within the last 15 years, and were designed and installed to the City of Delafield's engineering standards in place at the time of original construction. Within the study area, there are no known flooding problems. As the area develops it is important that the release rates from future development meet the standards specified in City of Delafield Construction Site Erosion Control and Stormwater Management Regulations. The hydrology of the study area is discussed in more detail in Chapters 4 &5.

GOALS AND OBJECTIVES

The goals of the City of Delafield Stormwater Management Plan fall into the following three areas:

1. **Protect public and private property from potential damage caused by stormwater runoff.**
2. **Protect the water quality of Lake Nagawicka and groundwater.**
3. **Protect environmentally sensitive areas such as wetlands, fish and wildlife habitat, and environmental corridors.**

To meet the above goals the following objectives and policies have been developed.

Goal I. - Protect public and private property from potential damage caused by stormwater runoff.

The purpose of this goal is to protect life and property from damage and inconvenience caused by flooding and drainage problems. The drainage system includes both major and minor components. The minor system is made up of storm sewers and roadside ditches, designed to carry small storms typically 10-year or smaller in frequency. The major drainage system includes stream channels and overland flow paths that can carry the flows of larger flood events. To protect properties from damage by stormwater runoff, the following plan objectives and policies are suggested:

1. Design and maintain major and minor stormwater drainage systems that will convey stormwater in a manner that reduces the public's exposure to drainage related inconveniences, and protects public and private property from runoff related damages.

   a. Stormwater drainage systems should utilize the natural drainage and storage capabilities of the site to the fullest extent possible. New stormwater drainage systems should be designed to provide an economical gravity flow drainage system.

   b. Stormwater drainage systems should be designed and maintained to utilize the collector and land access streets as open runoff channels during major storm events without flooding adjoining building sites. The streets will be supplementary to the minor stormwater drainage system of storm sewers and roadside ditches.

   c. The minor drainage system, made up of storm sewers and roadside drainage ditches, should be designed to convey the 10-year critical duration storm on new developments and redevelopment.

   d. In order to provide an acceptable level of access to property and traffic service, the drainage system should be designed and maintained to provide two clear lanes of moving traffic on arterial streets and one 10-foot lane for moving traffic on collector and land access streets during the 10-year critical duration storm.

e. The major drainage system, made up of open channels and overland flow routes, should be designed and maintained to convey the runoff from the 100-year storm without causing safety hazards or damage to public or private property.

f. Drainage easements for open channels across private property should be wide enough to convey the 10-year critical duration storm for the minor drainage system, and the 100-year storm for the major drainage system.

g. The City of Delafield will cooperate with adjacent communities on the regional management of stormwater runoff.

2. Maintenance of a stormwater management system that prevents any adverse impacts from increases in flood elevations, and protects and preserves floodplain storage.

a. To prevent significant property damage and safety hazards, the major streams in the City should be maintained to accommodate runoff from the storm with a 1% chance of occurrence in any year (100-year interval storm event).

b. All new and replacement culverts and bridges over waterways should be designed so as to accommodate, according to the categories listed below, the designated flood event without overtopping the related roadway or railway track:

(1). Minor and collector streets used or intended to be used primarily for access to abutting properties: a 10-year recurrence interval flood discharge.

(2). Arterial streets and highways, other than freeways and expressways, used or intended to be used primarily to carry heavy volumes of traffic: a 50-year recurrence flood discharge.

(3). Freeway and expressway: a 100-year recurrence interval flood discharge.

(4). Railways: a 100-year recurrence interval flood discharge.

The depth of flow over the top of minor, collector, and arterial streets and highways should not exceed 6 inches during the 100-year recurrence interval flood.

d. The waterway opening of all new and replacement bridges should be designed so as to readily facilitate the passage of ice flows and other floating debris, and thereby avoid blockages. In locations where accumulation of floating ice or debris may cause significant backwater effects with attendant danger to life, public health or safety, or attendant serious damage to homes, industrial and commercial buildings, and important public utilities, the designer should evaluate the impact of any blockage and provide necessary freeboard between the peak stage and the low concrete or steel in the bridge to prevent increases in flood profiles.

e. Dikes and floodwalls should not be used to facilitate new development in the floodplain. New development in floodplains should only be on engineered fill.

f. New or altered stormwater facilities should be designed to prevent any increase in downstream velocities, over existing conditions, for the 2-year, 10-year, and 100-year recurrence interval flood discharge.

g. The existing floodwater storage provided in wetlands and floodplains in the City of Delafield should be maintained. Any loss of flood storage from the floodway and flood fringe due to filling should be compensated at a ratio of 1 to 1.2. The additional compensation is a safety factor to prevent downstream flooding problems. All compensatory storage must be hydraulically equivalent for the 10-year and 100-year recurrence interval flood discharges.

h. Reduced regulatory flood protection elevations and accompanying reduced floodway or floodplain areas resulting from any storage ponds or channel modifications should not become effective for the purposes of land use regulation until the storage facilities or channel changes are actually constructed and operative.

3. Implement a stormwater management system that favors stormwater storage versus stormwater conveyance.

a. To prevent increases in the extent of the existing regulatory floodplain, stormwater storage should be integrated into the design of new development and redevelopment.

b. Regional stormwater storage is preferred over individual on-site storage to reduce the potential of overlapping storm hydrographs, which may produce higher flood elevations. Regional stormwater storage facilities provide greater opportunities for the integration of other amenities such as wildlife habitat, aesthetics and recreation.

c. In areas where a regional stormwater facility exists, on-site storage requirements may be waived in lieu of a contribution to the development of the regional facility.

4. To maintain stream baseflow and replenish groundwater, the first portion of each storm should be infiltrated into the ground. The portion of each storm to be infiltrated, based on hydrologic soil type, is outlined in Table 3-2.

Table 3-2
Inches of Runoff to be Infiltrated by Design Per Runoff Event

Hydrologic Soil Group	1 & 2 Family Residential Land Use	Land Uses Other Than 1 & 2 Family Residential
A	0.26	0.40
B	0.23	0.30
C	0.12	0.14

Source: WDNR, Wisconsin Administrative Code NR 151

Note: The levels given in Table 3-2 are based on a site with 42% connected imperviousness for 1 and 2 family residential land use and 90% connected imperviousness for all other land uses. The table was developed assuming infiltration devices with an infiltration rate of no more than 0.4 inches/hour for A soils, 0.2 inches/hour for B soils, and 0.05 inches/hour for C soils; a maximum depth of 6 inches for the temporary pool behind the control structure; a draw down time of 30 hours; and a limitation on the area of the development dedicated to infiltration not to exceed 4% for residential development and 8% for non-residential development. Conservative infiltration rates, as identified here, were selected for the design of the infiltration facility to ensure continued infiltration throughout the life of the facility or until the facility undergoes maintenance.

The volume of runoff to be infiltrated is calculated using the values from Table 3-2 multiplied by the total area of the site. Infiltration devices and practices include, but are not limited to: decreasing the amount of impervious surface; directing runoff from rooftops and parking areas to natural pervious areas such as grassed lawns or swales; or, where space is limited for natural infiltration, directing runoff to infiltration devices such as basins or trenches.

5. Maintain a stormwater management system that is equitable and fair, and effectively meets all of the other stated objectives while considering all benefits in light of cost.

   a. To minimize new costs, maximum feasibility should be made of all existing stormwater system components, as well as natural stormwater storage.

   b. To the maximum extent possible, the location and alignment of new storm sewers and engineered channels and storage facilities should coincide with existing public rights-of-way to minimize land acquisition or easement costs.

   c. Stormwater storage facilities—consisting of both regional and on-site detention basins—should be used, where hydraulically and economically feasible, to reduce the size and resultant cost of the required stormwater conveyance system downstream of the storage site.

   d. Financing of publicly owned stormwater facilities should be based on a formula of volume of runoff, not property tax. Publicly owned or maintained stormwater facilities should be financed through user fees and special assessments.

6. Maintain a stormwater management system that requires minimum maintenance and has maintenance requirements that can be implemented by available organizations or units of government.

   a. New developments, redevelopments, and streets should be designed and graded to provide overland gravity flow routes to major drainageways so that drainage will not be affected in the event of failure of the local storm sewer network.

   b. Stormwater storage pond outlets should be designed to minimize clogging and downstream erosion and to protect public safety.

   c. Where feasible, streambanks and edges of detention ponds should be landscaped with native vegetation to prevent bank erosion and to discourage nuisance populations of Canadian Geese. Example species include river bulrush, iris, sweet flagg, and bur reed.

   d. The City of Delafield should establish a routine inspection program of public stormwater facilities. The purpose of the inspection program is to facilitate implementation of a program of minor repairs, with the intent of reducing the need for more extensive major maintenance.

7. Maintain a stormwater management system that complies with existing federal, state, regional and local regulations, and adopted management plans.

   a. Prior to the design of major projects sponsored by the City that require regulatory permits, the City Engineer will contact the affected regulatory agencies to identify any regulatory constraints.

   b. Any projects involving the modification of navigable waters will include in-kind replacement of the stream functional values. Functional values include such items as fish and wildlife habitat, recreational opportunities, and aesthetic values.

   c. All stormwater detention facilities shall be designed in accordance with the City of Delafield Construction Site Erosion Control and Stormwater Management Regulations.

Goal II. - Protect the water quality of Lake Nagawicka and groundwater.

1. Reduce the discharge of pollutants from land surfaces in the northeast and northwest portions of the City of Delafield.

   Beginning in September 2002, the Wisconsin Department of Natural Resources in the Wisconsin Administration Code, Chapter Natural Resources 151requires 80% reduction of total suspended solids that would normally come off the site for new development. A 40% reduction is required for redevelopment. To achieve the above pollutant reductions the we recommend the following actions:

- Enforcement of construction site erosion control ordinances. (The City currently does this)

- Development of a program of urban "housekeeping practices" including public education on dumping of pollutants down storm drains, adoption of ordinances to regulate pet waste, street sweeping, and increased leaf collection on streets.

- Adoption and enforcement of a new stormwater management ordinance. (The City currently has this)

- Development and implementation of a detailed stormwater management plan. (This study represents a step toward overall City stormwater management)

2. Prevent the discharge of hazardous waste into the stormwater drainage system.

   a. Conduct a public education program to inform local residents that storm sewers and local ditches drain to local streams and lakes. Improper use of lawn care products, solvents, and oil may damage local wildlife and may contaminate the groundwater.

   b. Develop and enforce a local ordinance that prohibits and fines individuals for purposely discharging pollutants into the City's drainage system.

3. Conduct a public education program on what local residents and businesses can do to control pollution.

   a. Conduct an annual program on proper use of lawn care products.

   b. Conduct an annual program on the proper disposal of hazardous waste.

   c. Conduct an annual program on the proper storage of industrial materials.

   d. Distribute educational materials on proper construction site erosion control through the Building Inspector's and City Engineer's office.

Goal III. - Protect environmentally sensitive areas such as wetlands, fish and wildlife habitat, and environmental corridors.

1. Where feasible, drainage and flood control facilities should be designed to protect the existing stream and downstream lake habitats

2. Where feasible, avoid the siting of stormwater facilities, such as detention basins and infiltration systems, in primary and secondary environmental corridors identified by the Southeastern Wisconsin Regional Planning Commission (SEWRPC).

3. Design and build stormwater facilities in an aesthetically pleasing manner, not just what works from a hydrological perspective.

CHAPTER 4
HYDROLOGIC ANALYSIS

INTRODUCTION

The hydrologic analysis for this study estimated the stormwater runoff that occurs in the northeast portion of the city. Rainfall events were analyzed in conjunction with the characteristics of the drainage areas to determine the volume and rate of runoff. The hydrologic analysis in this stormwater management plan was intended to identify and evaluate existing depressional storage in the drainage area. The analysis also evaluated proposed storage under future conditions consistent with the City of Delafield's Construction Site Erosion Control and Stormwater Management Regulations.

HYDROLOGIC METHODS

Because no gaging stations or flood records were available for the study area, computer simulation was used to develop rainfall/runoff relationships. The rainfall/runoff relationships for all subbasins were developed using the U.S. Army Corps of Engineers (ACOE) hydrologic computer program HEC-HMS (Hydraulic Engineering Center – Hydrologic Modeling System). HEC-HMS supersedes the ACOE HEC-1 Flood Hydrograph Package.

The primary function of the HEC-HMS model is to develop surface runoff hydrographs for each subbasin and route the runoff through the drainage system to produce peak discharge values at various locations within the watershed. The computer program accounts for storage capabilities and potential reduction in peak runoff. Flow hydrographs for storm events with recurrence intervals of 2-, 10-, 25-, and 100-years were computed for each subbasin. HEC-HMS was used to simulate flows at the outlet of each subbasin. Stage-area-discharge rating curves define depressional storage. Flow hydrographs were routed through depressional storage facilities for peak flow reduction in HEC-HMS.

Hydrologic Parameters

The data needed to perform the runoff analysis include precipitation, subbasin size, soil type and land use, and the timing associated with the precipitation reaching the stream system as surface runoff. A summary of the input data necessary for the analysis is described below. The Soil Conservation Service (SCS) has been renamed the Natural Resource Conservation Service. References to the SCS were retained in the following descriptions.

- Precipitation - Rainfall depths were obtained from the Southeastern Wisconsin Regional Planning Commission's Rainfall Frequency in the Southeastern Wisconsin Region, Technical Report 40. This publication is dated April 2000 and is more recent and provides more accurate information than the U.S. Weather Bureau Technical Paper No. 40 (TP40) or the Illinois State Water Survey Bulletins 70 and 71. To determine the proper storm duration for the analysis, a sensitivity analysis was conducted. Storm durations ranging from 1 hour to 24 hours were simulated. The 2-hour rainfall was found to produce the largest peak discharges. Based on this evaluation, the hydrologic analysis used the 2-, 10-, 25-, and 100-year recurrence interval storm events with 2-hour rainfall amounts of 1.54, 2.23, 2.73, and 3.64 inches, respectively.

- Subbasin Area - The east and west portions of the study area have been divided into 21 and 11 subbasins, respectively based on available topographic mapping and visual observations during field reconnaissance. Subbasin divides were chosen according to the topography and junctions in the drainage system. Subbasin identification numbers and boundaries are shown on Figures 2-1 and 2-2. Subbasins were named based on where they drain. DFD designates subbasins that have their runoff contained internally. BKR designates subbasins that drain to the Bark River, and NGE and NGW indicate subbasins draining to the east and west sides of Lake Nagawicka, and UNH designates subbasins which drain to Upper Nashotah Lake.

- Soil Types - The hydrologic soil groups (HSG) for the study area were determined using the U. S. Department of Agriculture Soil Survey of Waukesha and Milwaukee Counties, Wisconsin (USDA, 1998). Soils are classified into four HSGs (A, B, C, and D) according to their minimum infiltration rate. The soils range from Group A, which has high permeability in well-drained soil with less runoff produced, to Group D which has low permeability and more anticipated runoff. The soils for the study area are shown in Figure 2-4.

- Land Cover Runoff Curve Number (RCN) – Area-weighted composite RCN values were computed for each of the subbasins based on land use and hydrologic soil groups. The existing land use was determined from aerial photographs and visual reconnaissance. The proposed land use was determined from the Recommended Zoning Map in the City's Comprehensive Plan. Curve numbers were taken from the City's Construction Site Erosion Control and Stormwater Management Regulations and from Urban Hydrology for Small Watersheds (USDA, 1986).

- Time of Concentration and Lag Time – The Time of Concentration (T_c) is defined as the time it takes for the surface water runoff to travel from the hydraulically most distant point of the subbasin to the discharge location. The T_c was generally calculated based on a combination of sheet flow, shallow concentrated flow, and open channel flow, with travel paths determined from available topographic mapping.

  HEC-HMS uses Lag Time in the Soil Conservation Service (SCS) Dimensionless Unit Hydrograph Method to account for the delay in time between when the rainfall occurs and when the runoff occurs. The lag time is equal to the time (in minutes) between the center of mass of the rainfall hyetograph and the peak of the unit runoff hydrograph. Lag times were computed as 0.6 times the Time of Concentration.

  Due to a lack of detailed future conditions mapping, the same lag times computed for existing conditions were used for future conditions.

These parameters were developed for each subbasin. Table 4-1 summarizes the subbasin parameter values used in the hydrologic analyses.

Table 4-1
Subbasin Parameters

Subbasin	Area (sqmi)	Curve Number		Lag Time (min)
		Existing	Proposed	
DFD 4	0.0970	70	71	19.8
DFD 6	0.0697	68	71	14.4
DFD 8	0.2938	67	66	40.2
DFD 20	0.3697	67	67	27.6
BKR 2	0.0689	74	72	25.2
BKR 4	0.0553	70	68	22.2
BKR 6	0.0491	66	66	16.2
BKR 8	0.0625	63	64	25.8
BKR 9	0.0169	70	72	16.8
BKR 10	0.0723	73	71	26.4
BKR 12	0.0280	70	70	8.4
BKR 14	0.0377	73	72	18.0
NGE 4	0.0891	68	69	15.6
NGE 10	0.0958	68	65	37.8
NGE 40	0.1022	67	69	23.4
NGE 55	0.1433	61	61	25.8
NGE 60	0.1033	64	64	28.8
NGE 65	0.0431	64	65	22.2
NGE 80	0.0886	67	89	29.4
NGE 85	0.0852	77	89	21.6
NGE 90	0.0667	68	91	25.2
Total Area	**2.0380**			

Source: Hey and Associates, Inc.

Detention Storage Routing

In addition to determining flood hydrographs and peak discharges for each subbasin, the hydrographs were also combined and routed through the conveyance system to simulate the flood wave movement through the watershed. This hydrograph routing process determined the peak flows in downstream locations and accounted for storage in low areas. The Muskingum channel routing and Level Pool reservoir routing methods were used in the HEC-HMS model.

Hydrologically significant natural storage was accounted for in the model. Using available existing topography, areas of depressional storage were identified. The depressional storage areas represented in the hydrologic model are detailed in Table 4-2 and shown on Figures 2-1 and 2-2. The stage-area-discharge relationship for the areas are included in Appendix A. Discharge from the storage areas represents infiltration initially and weir overflow secondarily. Infiltration rates were taken from the 1998 USDA Soil Survey.

Table 4-2
Subbasins with Existing Depressional Storage

Subbasin	Maximum Depth (ft)	Storage Volume (ac-ft)
In DFD 8	13	128.45
In DFD 20	3	10.23
In NGE 65	3	0.55
In NGE 80	5	4.63
West of NGE 90	13	25.11

Source: Hey and Associates, Inc.

RESULTS OF HYDROLOGIC ANALYSIS

The 2-, 10-, 25-, and 100-year flows in all subbasins were determined using HEC-HMS. Flows under existing and future land use conditions were modeled. Future land use conditions are consistent with the Recommended Zoning in the City's Comprehensive Plan. Output from the HEC-HMS model is included in Appendix B.

In keeping with the City of Delafield's Construction Site Erosion Control and Stormwater Management Regulations the existing depressional storage should be maintained and proposed detention should be created to control 10-year post-development flow rates to no more than 2-year pre-development rates, and 100-year post-development flow rates to no more than 10-year pre-development rates.

The hydrologic analysis indicates that as the study area develops, there is sufficient open space available to maintain or create stormwater detention facilities that meet the City's regulations. Table 4-3 indicates the subbasins where stormwater facilities are recommended, and the approximate areas that need to be set aside for stormwater detention facilities. These locations and the drainage areas tributary to them are shown on Figure 4-1.

Table 4-3
Parcel Areas Required for Proposed Stormwater Storage

Subbasin	Land Stormwater Management (ac)
NGE 4	2
DFD 8	3.5
DFD 20	9
NGE 10	1.5

Source: Hey and Associates, Inc.

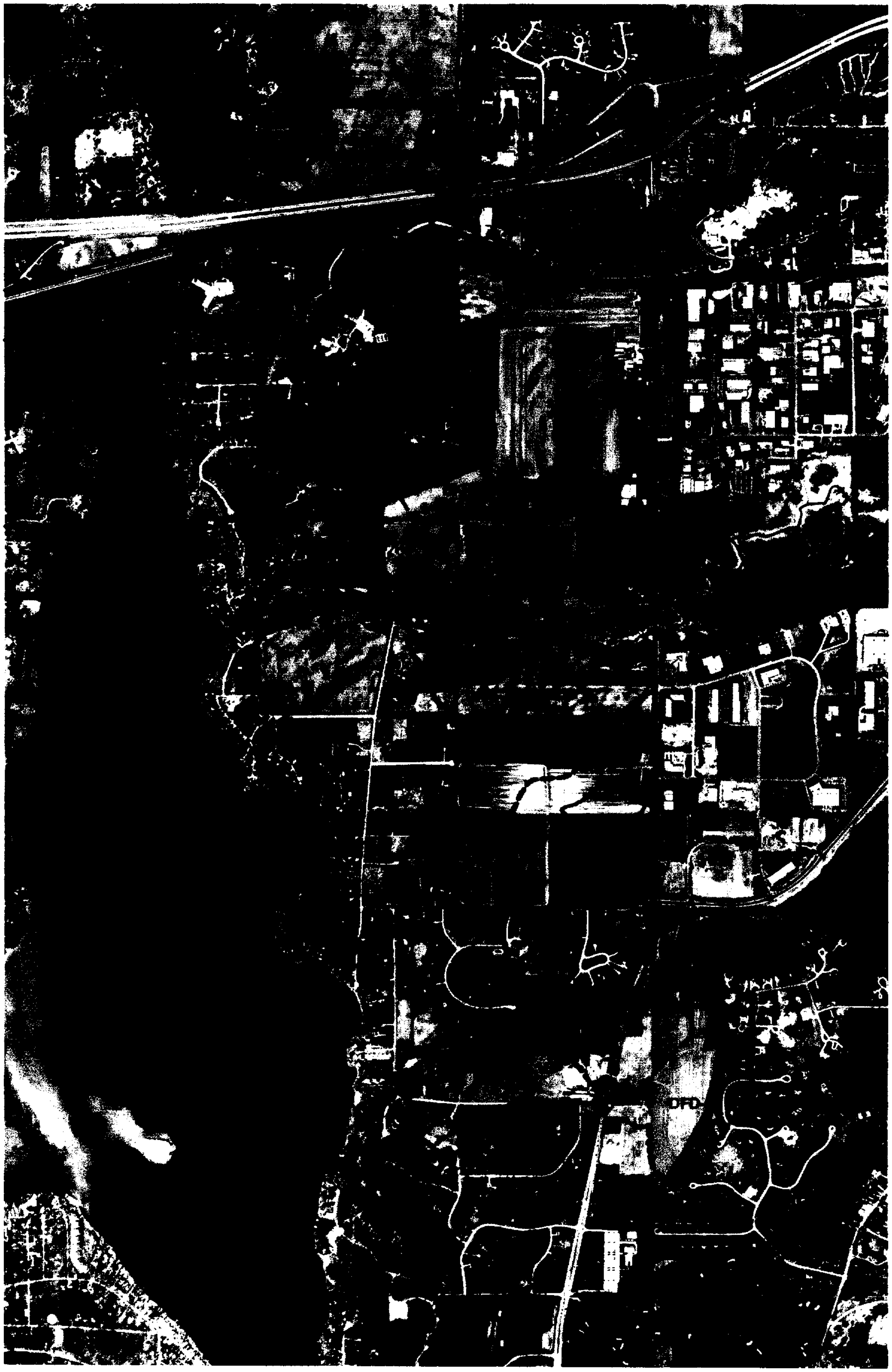


FIGURE 4-1

CITY OF DELAFIELD STORMWATER MANAGEMENT PLAN

EAST STUDY AREA

PROPOSED DETENTION SITES

CORPORATE LIMITS

SUBBASIN BOUNDARIES

WATERSHED BOUNDARIES

DFD - 40 SUBBASIN IDENTIFICATION

NATURAL DEPRESSIONS

PROPOSED DETENTION SITES

2000 AERIAL PHOTOGRAPH

SCALE: 1" = 2000'

N

CHAPTER 5
RECOMMENDED MANAGEMENT PLAN

INTRODUCTION

At the request of the City of Delafield, Hey and Associates, Inc. prepared this Stormwater Management Plan for the northeast and northwest portions of the City. The project is funded in part through a grant from the Wisconsin Department of Natural Resources.

The study area drains to Lake Nagawicka, Upper Nashotah Lake, the Bark River, and some subbasins are internally drained.

The goals of the City of Delafield Stormwater Management Plan are as follows:

1. Protect public and private property from potential damages caused by stormwater runoff.
2. Protect the water quality of Lake Nagawicka and groundwater.
3. Protect environmentally sensitive areas such as wetlands, fish and wildlife habitat, and environmental corridors.

The objectives of this plan are to suggest proposed locations of regional detention facilities in the northeast and northwest portions of the City in order to better manage the quantity and quality of stormwater runoff in the study area, and to identify implementation mechanisms.

RECOMMENDATIONS

Erosion Control

The City of Delafield should continue to control the amount of sediment contained in stormwater runoff through Chapter 23, Construction Site Erosion Control and Stormwater Management Regulations, of the Code of Ordinances.

Detention

Wet Basins

Parcels not tributary to the regional facilities identified in this report, should be developed in accordance with the City of Delafield's Stormwater Management Regulations. On site detention facilities should be sized, designed, and constructed following the regulations.

As shown in Figure 4-1 wet basins are recommended in four subbasins in the northeast portion of the City. Wet basins were selected as the recommended management practice because they address both stormwater quality and quantity concerns. Wet basins effectively trap sediment related pollutants and reduce the rate of outflow from the tributary areas. The proposed basins will serve as regional detention facilities, collecting runoff from multiple tributary properties. The proposed basins will discharge to natural infiltration areas or will be routed to Lake

Nagawicka or the Bark River. The land use at the locations of the proposed detention is currently undeveloped.

Table 5-1 contains information about these facilities and the tributary areas. The maps in Appendix A include proposed detention locations and land owners for the large undeveloped parcels within the study area. Land owners and developers should share the construction costs of these facilities. Wet basin sizing methodology has been developed by the State of Wisconsin, and is outlined in the Wisconsin Stormwater Manual, Part Two: Technical Design Guidelines for BMP's (WDNR, 2000), and should be followed when designing the facilities.

Table 5-1

Proposed Detention Facilities

Subbasin	Property Tax Key	Property Owner	Tributary Area (acres)	Approximate Facility Area (acres)
NGE 4	DELC0783016	Terry & Joyce Giles	57	2
DFD 8	DELC0756996002	Kettle Moraine Evangelical	188	3.5
DFD 20	DELC0736988	David and Madeline Morris	237	9
NGE 10	DELC0756997	Jerry Morris	61	1.5

Source: Hey and Associates, Inc.

The proposed wet basin located in NGE 4 will collect and treat runoff from the developing residential areas within the subbasin. Outflow from this wet basin will be routed through the existing culvert under Nagawicka Road. It is important to control the rate of runoff from this subbasin in order to protect downstream land owners. In addition, the City of Delafield is investigating realigning the intersection of Nagawicka Road and Weber Court. Any roadwork should be coordinated and integrated with the design and construction of the wet basin.

The proposed wet basin located in DFD 8 will treat runoff from the proposed Kettle Moraine Evangelical Church, the proposed City park, and low density residential land uses. Outflow from this basin will be routed to natural storage areas within the subbasin. Thus, the basin will serve to pretreat the runoff before it enters these areas. Pretreating the runoff will reduce the sediment entering the natural areas, effectively preserving their ability to store and infiltrate stormwater runoff. The proposed wet basin should be constructed in conjunction with tributary land development.

The land tributary to the proposed wet basin located in subbasin DFD 20 is expected to be developed as low density residential. This wet basin will discharge into the natural storage area within the subbasin. This natural storage area is designated as environmental corridor, and therefore should be preserved. The proposed wet basin in DFD 20 will serve to pretreat the runoff before it enters the environmental corridor. The proposed wet basin should be constructed as the surrounding land develops.

The proposed wet basin located in NGE 10 will collect and treat runoff from the tributary residential areas, and from the northwest portion of the City park. Outflow from the proposed wet basin in NGE 10 will be routed through the existing residential development on the west before it discharges to Lake Nagawicka. It is important to control the rate of runoff from this land as it develops to protect downstream land owners. The construction of the proposed wet basin should be coordinated with surrounding development.

Routine maintenance of the wet basins includes lawn care, basin inspections, debris removal, erosion control, and nuisance plant control. Periodic maintenance tasks include inlet and outlet repairs and sediment removal.

Natural Depressional Areas

As shown in Figures 2-1 and 2-2, many of the subbasins within the study area contain natural depressional areas. These areas serve as infiltration basins and provide for groundwater recharge, reduced volumes of runoff, and reduced peak discharges. As stormwater is allowed to infiltrate through the bottom and sides of the basin, pollutants are removed by the filtering action of the soil. Therefore, as the surrounding land is developed, the natural depressional areas within the subbasins should be preserved to maintain the stormwater storage and water quality benefits.

Table 5-2 contains information about the land containing these areas and the tributary areas. As summarized in the table, most of the natural storage is located on private property, thus, preservation is the responsibility of the individual land owners and developers.

The natural storage areas can also be used to meet the infiltration requirements under Chapter Natural Resources 151 of the Wisconsin Administration Code (NR 151). According to the Code, 90% of the pre-development infiltration must be maintained for residential land use. Alternatively, 25% of the post-development runoff from the 2-year, 24 hour rain can be infiltrated. For non-residential land uses (commercial, industrial, institutional), 60% of the pre-development infiltration must be maintained. Alternatively, 10% of the post-development runoff from the 2-year, 24 hour rain can be infiltrated. Residential sites may not be required to dedicate more than 1% of the site to meeting infiltration requirements. For non-residential sites no more than 2% of the site can be required. The rule identifies those situations where infiltration is optional. In other situations, the rule prohibits infiltration in order to protect ground water.

Table 5-2

Natural Infiltration Areas

Subbasin	Property Tax Key	Property Owner	Tributary Area (acres)
DFD 8	DELC0756996002, DELC0756997, DELC0756996001, DELC0781995001	Kettle Moraine Evangelical, Jerry Morris, City of Delafield, Scott & Carol Matton	188
DFD 20	DELC0753999, DELC0736993001, DELC0736992, DELC0753998	Harry & Leah Wolcott, Allan Jahneke, Ralph & Mary Gerber, Wee Know School, Inc.	237
DFD 30	DELC0790999011, DELC0746999	Robert & Carol Loepke, Nashotah House	314
DFD 32	DELC0746999	Nashotah House	197
DFD 36	DELC0742982, DELC0742990	William Knoff, Bradley Binkowski & Mary Slepekis	278
DFD 40	DELC0577980	Bradley Binkowski & Mary Slepekis	34
DFD 42	DELC0742990	Bradley Binkowski & Mary Slepekis	12
DFD 44	OCLV0577960	William G. Schuett	12
NGE 65	DELC0737995001	Lake Country School District	28
NGE 80	DELC0733993003, DELC0733993001	Sandy Bottom Nature Center LLC, Debra M. Daniels	57
West of NGE 90	CHQV0734989	Patricia Treiber	43

Source: Hey and Associates, Inc.

The volume of natural storage that should be preserved to control runoff from a 100-year storm event with proposed land use conditions was determined from the hydrologic modeling of the northeast portion of the City. The areas and volumes to be preserved are summarized in Table 5-3. If there is not sufficient storage volume to contain the runoff generated under a 100-year storm event, this has also been noted.

Table 5-3

Natural Storage to Preserve

Subbasin	Existing Area (acres)	Preserved Area (acres)	Preserved Volume (ac-ft)	Sufficient Storage
West of NGE 90	6.2	4.9	9.0	Yes
NGE 80	2.5	2.5	4.5	No
NGE 65	0.6	0.6	0.6	No
DFD 20	20.5	20.5	10.2	No
DFD 8	44.4	5.4	12.5	Yes

Source: Hey and Associates, Inc.

The land tributary to natural storage area west of subbasin NGE 90 is anticipated to have retail development. Runoff from retail development has been found to contain large quantities of sediment and oil. For this reason runoff from subbasins NGE 90 may need to pass through a grassed filter strip or similar stormwater treatment device before discharging to the natural storage areas. The degree of pretreatment necessary is dependent upon the density and type of retail development. The natural storage area west of NGE 90 has enough volume to contain runoff from a 100-year event, and should be preserved.

Under proposed development conditions, the land use in subbasin NGE 65 is converted from public land to low density residential, and the land in subbasin NGE 80 is anticipated to have retail development. As previously discussed, the runoff from NGE 80 may need to pass through a pretreatment device before it is discharged to the natural storage areas. Based on the hydrologic analysis, the natural storage in NGE 80 and NGE 65 do not have the capacity to contain all of the runoff generated under a 100-year event with proposed land use. However, during smaller storms the natural storage in these subbasins can effectively detain and treat stormwater runoff. Therefore, storage volumes in NGE 80 and NGE 65 should be preserved.

The natural storage areas located in DFD 8 and DFD 20 will receive outflow from the proposed wet basins located in these subbasins. The wet basins will pretreat the runoff, and reduce the suspended solids that enter the natural storage areas, effectively preserving their ability to store and infiltrate stormwater runoff. The natural storage area in subbasin DFD 20 is located in an environmental corridor, and should be preserved. Although it does not have enough volume to contain the runoff from a 100-year event, stormwater storage and treatment is still provided for smaller storm events. The natural storage area in subbasin DFD 8 has sufficient volume to contain all of the runoff generated under a 100-year event. The areas and volume contained in Table 5-3 are the minimum required to contain the 100-year event runoff and if possible more of the existing storage should be preserved.

Natural storage is also present in the northwest portion of the City. Further modeling of this area is required to determine the volume that should be preserved as the surrounding land is developed. In comparison to the natural storage areas in the northeast portion of the City, the storage areas in the northwest are tributary to larger parcels of undeveloped land. As land development occurs in northwest region, natural storage should be maintained.

In addition to the areas of natural storage, subbasin DFD 6 contains an existing low area engineered for infiltration. This area should be maintained to preserve its infiltration capabilities and benefits.

Maintenance needs for the natural storage areas include inspections annually and after large storm events, mowing at least twice a year, debris removal, erosion control, and control of nuisance odor and/or mosquito problems. Deep tilling may be required at 5-to 10-year intervals to break up a clogged surface layer. If deep tilling is necessary, the tilled surface would also need to be graded and re-vegetated. In some cases, an underdrain pipe may be needed to maintain adequate drawdown conditions. Accumulated sediments may also have to be removed by light equipment.

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APPENDIX A

SUBBASIN MAPS

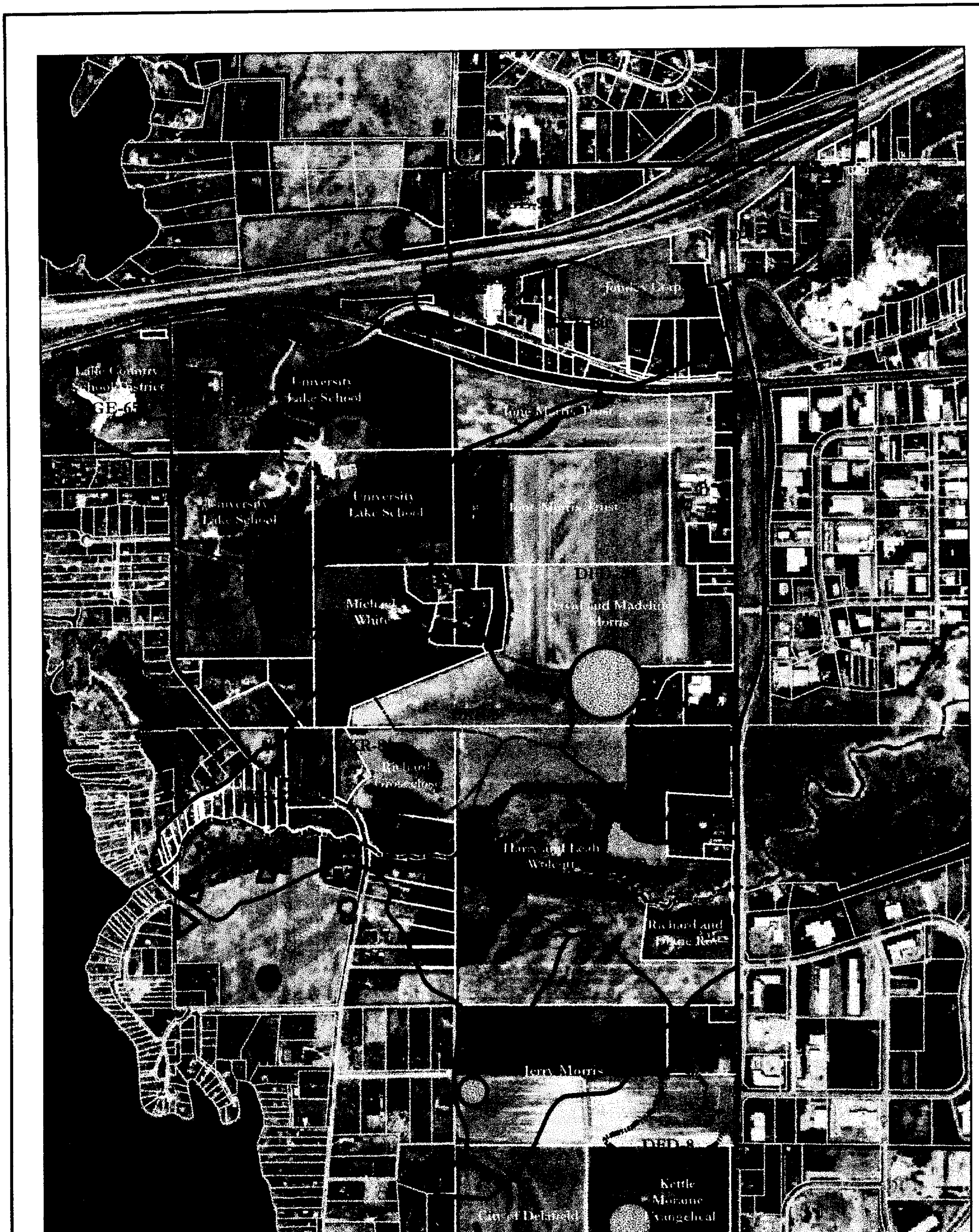
APPENDIX A

DELAFIELD
STORMWATER
MANAGEMENT
PLAN

WEST STUDY
AREA

SUBBASIN
BOUNDARIES
AND
DEPRESSIONAL
STORAGE AREAS

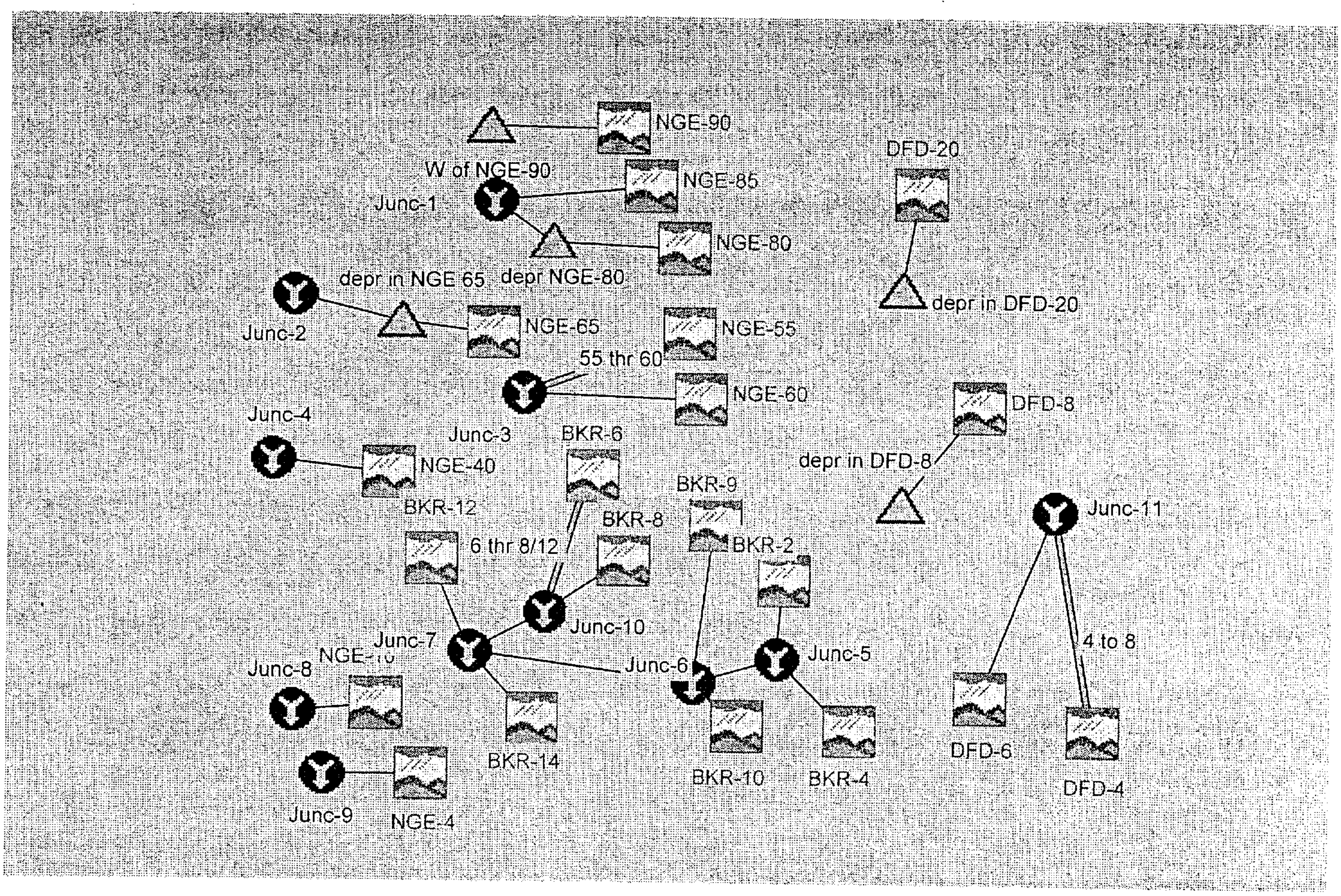

William and
Barbara Knoff
William and
Barbara Knoff
Nashotah House


University
Lake School
University
Lake School
Michael
White
Harry and Leah
Wolcott
Jerry Morris
DED-8
Kettle
Moraine
Evangelical

APPENDIX B

HYDROLOGIC MODELING RESULTS

Existing Land Use with Existing Detention


NGE-90
W of NGE-90
Junc-1
NGE-85
NGE-80
DFD-20
depr in NGE 65
depr NGE-80
depr in DFD-20
Junc-2
NGE-65
NGE-55
55 thr 60
NGE-60
Junc-4
Junc-3
BKR-6
DFD-8
NGE-40
depr in DFD-8
BKR-12
BKR-9
Junc-11
BKR-8
6 thr 8/12
BKR-2
Junc-10
Junc-7
4 to 8
Junc-6
Junc-5
Junc-8
BKR-14
BKR-10
BKR-4
DFD-6
DFD-4
Junc-9
NGE-4

HMS * Summary of Results

Project : Delafield Reg Det CD Run Name : 2-yr, 2-hr Exst

Start of Run : 01Jan99 0000 Basin Model : Delafield-infil Exst
End of Run : 01Jan99 0800 Met. Model : 2Hr-2Yr-Sew2000
Execution Time : 06Jun04 1752 Control Specs : 2-yr 2hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	4.4716	01 Jan 99 0216	0.24047	0.067
W of NGE-90	0.27431	01 Jan 99 0308	0.12410	0.067
NGE-80	4.4544	01 Jan 99 0220	0.26552	0.089
depr NGE-80	0.52968	01 Jan 99 0308	0.21044	0.089
NGE-85	17.679	01 Jan 99 0210	1.0274	0.085
Junc-1	17.886	01 Jan 99 0210	1.2378	0.174
NGE-65	1.4304	01 Jan 99 0216	0.065544	0.043
depr in NGE 65	0.082918	01 Jan 99 0302	0.032132	0.043
Junc-2	0.082918	01 Jan 99 0302	0.032132	0.043
NGE-55	1.5385	01 Jan 99 0222	0.078421	0.143
55 thr 60	1.4340	01 Jan 99 0228	0.078421	0.143
NGE-60	2.7203	01 Jan 99 0222	0.15709	0.103
Junc-3	4.0676	01 Jan 99 0224	0.23551	0.247
DFD-20	19.099	01 Jan 99 0220	1.1079	0.370
depr in DFD-20	0.62750	01 Jan 99 0328	0.26836	0.370
NGE-40	6.1486	01 Jan 99 0214	0.30628	0.102
Junc-4	6.1486	01 Jan 99 0214	0.30628	0.102
BKR-6	3.1466	01 Jan 99 0208	0.12017	0.049
6 thr 8/12	2.5305	01 Jan 99 0226	0.12017	0.049
BKR-8	1.3733	01 Jan 99 0220	0.071340	0.063
Junc-10	3.8280	01 Jan 99 0224	0.19151	0.112
BKR-2	9.9982	01 Jan 99 0214	0.59212	0.069
BKR-4	5.4304	01 Jan 99 0212	0.27679	0.055
Junc-5	15.390	01 Jan 99 0214	0.86891	0.124
BKR-9	1.9292	01 Jan 99 0208	0.084589	0.017
BKR-10	9.1794	01 Jan 99 0214	0.54892	0.072
Junc-6	26.260	01 Jan 99 0214	1.5024	0.213
BKR-12	4.1849	01 Jan 99 0202	0.14015	0.028
BKR-14	5.9019	01 Jan 99 0208	0.28623	0.038
Junc-7	35.734	01 Jan 99 0212	2.1203	0.391
NGE-10	4.5652	01 Jan 99 0228	0.34538	0.096
Junc-8	4.5652	01 Jan 99 0228	0.34538	0.096
NGE-4	7.9812	01 Jan 99 0208	0.32123	0.089
Junc-9	7.9812	01 Jan 99 0208	0.32123	0.089
DFD-8	11.190	01 Jan 99 0230	0.88047	0.294
depr in DFD-8	1.2014	01 Jan 99 0338	0.45581	0.294
DFD-4	10.093	01 Jan 99 0210	0.48551	0.097
4 to 6	9.7781	01 Jan 99 0214	0.48551	0.097
DFD-6	6.6880	01 Jan 99 0206	0.25129	0.070
Junc-11	15.379	01 Jan 99 0210	0.73680	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 10-yr, 2-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst
End of Run : 01Jan99 1200   Met. Model : 2Hr-10Yr-Sew2000
Execution Time : 06Jun04 1752   Control Specs : 10-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	16.227	01 Jan 99 0214	0.98570	0.067
W of NGE-90	0.62517	01 Jan 99 0314	0.44279	0.067
NGE-80	18.050	01 Jan 99 0216	1.1869	0.089
depr NGE-80	1.2464	01 Jan 99 0316	0.81750	0.089
NGE-85	40.454	01 Jan 99 0208	2.6217	0.085
Junc-1	41.071	01 Jan 99 0208	3.4392	0.174
NGE-65	7.8766	01 Jan 99 0212	0.41705	0.043
depr in NGE 65	0.22377	01 Jan 99 0310	0.16689	0.043
Junc-2	0.22377	01 Jan 99 0310	0.16689	0.043
NGE-55	16.661	01 Jan 99 0216	0.94170	0.143
55 thr 60	15.667	01 Jan 99 0224	0.94170	0.143
NGE-60	15.754	01 Jan 99 0218	0.99956	0.103
Junc-3	31.018	01 Jan 99 0220	1.9413	0.247
DFD-20	77.146	01 Jan 99 0216	4.9525	0.370
depr in DFD-20	2.8018	01 Jan 99 0324	1.8927	0.370
NGE-40	24.032	01 Jan 99 0212	1.3691	0.102
Junc-4	24.032	01 Jan 99 0212	1.3691	0.102
BKR-6	12.659	01 Jan 99 0206	0.59343	0.049
6 thr 8/12	10.906	01 Jan 99 0222	0.59343	0.049
BKR-8	9.2257	01 Jan 99 0216	0.53589	0.063
Junc-10	19.605	01 Jan 99 0220	1.1293	0.112
BKR-2	25.830	01 Jan 99 0212	1.7005	0.069
BKR-4	16.854	01 Jan 99 0210	0.98235	0.055
Junc-5	42.564	01 Jan 99 0210	2.6828	0.124
BKR-9	5.7704	01 Jan 99 0206	0.30021	0.017
BKR-10	24.871	01 Jan 99 0212	1.6504	0.072
Junc-6	72.672	01 Jan 99 0210	4.6334	0.213
BKR-12	11.431	01 Jan 99 0200	0.49739	0.028
BKR-14	15.328	01 Jan 99 0206	0.86059	0.038
Junc-7	109.08	01 Jan 99 0210	7.1207	0.391
NGE-10	17.585	01 Jan 99 0224	1.4157	0.096
Junc-8	17.585	01 Jan 99 0224	1.4157	0.096
NGE-4	26.942	01 Jan 99 0206	1.3167	0.089
Junc-9	26.942	01 Jan 99 0206	1.3167	0.089
DFD-8	47.325	01 Jan 99 0226	3.9358	0.294
depr in DFD-8	2.9495	01 Jan 99 0348	2.0221	0.294
DFD-4	30.924	01 Jan 99 0208	1.7231	0.097
4 to 6	30.245	01 Jan 99 0212	1.7231	0.097
DFD-6	22.087	01 Jan 99 0204	1.0300	0.070
Junc-11	49.991	01 Jan 99 0208	2.7531	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 25-yr, 2-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst
End of Run : 01Jan99 0500   Met. Model : 2Hr-25Yr-Sew2000
Execution Time : 06Jun04 1753   Control Specs : 25-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	27.270	01 Jan 99 0212	1.7527	0.067
W of NGE-90	0.98730	01 Jan 99 0314	0.23341	0.067
NGE-80	31.216	01 Jan 99 0216	2.1570	0.089
depr NGE-80	1.9013	01 Jan 99 0318	0.43941	0.089
NGE-85	59.280	01 Jan 99 0208	4.0366	0.085
Junc-1	60.221	01 Jan 99 0208	4.4760	0.174
NGE-65	14.372	01 Jan 99 0210	0.81901	0.043
depr in NGE 65	5.0181	01 Jan 99 0234	0.33517	0.043
Junc-2	5.0181	01 Jan 99 0234	0.33517	0.043
NGE-55	34.072	01 Jan 99 0214	2.0520	0.143
55 thr 60	32.326	01 Jan 99 0222	2.0520	0.143
NGE-60	29.353	01 Jan 99 0216	1.9630	0.103
Junc-3	60.967	01 Jan 99 0220	4.0150	0.247
DFD-20	132.88	01 Jan 99 0214	9.0003	0.370
depr in DFD-20	10.386	01 Jan 99 0310	1.8214	0.370
NGE-40	40.893	01 Jan 99 0210	2.4880	0.102
Junc-4	40.893	01 Jan 99 0210	2.4880	0.102
BKR-6	21.519	01 Jan 99 0206	1.1042	0.049
6 thr 8/12	18.959	01 Jan 99 0222	1.1042	0.049
BKR-8	17.588	01 Jan 99 0214	1.0856	0.063
Junc-10	35.646	01 Jan 99 0218	2.1898	0.112
BKR-2	39.366	01 Jan 99 0210	2.7257	0.069
BKR-4	27.063	01 Jan 99 0210	1.6798	0.055
Junc-5	66.429	01 Jan 99 0210	4.4055	0.124
BKR-9	9.1509	01 Jan 99 0206	0.51335	0.017
BKR-10	38.549	01 Jan 99 0212	2.6849	0.072
Junc-6	113.43	01 Jan 99 0210	7.6038	0.213
BKR-12	17.593	01 Jan 99 0200	0.85052	0.028
BKR-14	23.368	01 Jan 99 0206	1.4000	0.038
Junc-7	176.57	01 Jan 99 0208	12.044	0.391
NGE-10	30.186	01 Jan 99 0224	2.5172	0.096
Junc-8	30.186	01 Jan 99 0224	2.5172	0.096
NGE-4	43.962	01 Jan 99 0206	2.3413	0.089
Junc-9	43.962	01 Jan 99 0206	2.3413	0.089
DFD-8	83.278	01 Jan 99 0226	7.1503	0.294
depr in DFD-8	4.6384	01 Jan 99 0350	1.0018	0.294
DFD-4	49.498	01 Jan 99 0208	2.9465	0.097
4 to 6	48.531	01 Jan 99 0212	2.9465	0.097
DFD-6	35.879	01 Jan 99 0204	1.8315	0.070
Junc-11	81.054	01 Jan 99 0206	4.7780	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr, 1-hr, Exst

Start of Run	: 01Jan99 0000	Basin Model	:	Delafield-infil Exst
End of Run	: 01Jan99 0300	Met. Model	:	1Hr-100Yr-Sew2000
Execution Time	: 06Jun04 1750	Control Specs	:	100-yr 1-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	36.370	01 Jan 99 0116	1.9069	0.067
W of NGE-90	1.0634	01 Jan 99 0220	0.15123	0.067
NGE-80	39.936	01 Jan 99 0120	2.3491	0.089
depr NGE-80	2.0417	01 Jan 99 0224	0.28260	0.089
NGE-85	85.753	01 Jan 99 0112	4.3088	0.085
Junc-1	86.546	01 Jan 99 0112	4.5914	0.174
NGE-65	19.432	01 Jan 99 0114	0.90220	0.043
depr in NGE 65	6.4296	01 Jan 99 0136	0.39438	0.043
Junc-2	6.4296	01 Jan 99 0136	0.39438	0.043
NGE-55	43.592	01 Jan 99 0120	2.2874	0.143
55 thr 60	40.768	01 Jan 99 0126	2.2852	0.143
NGE-60	37.127	01 Jan 99 0122	2.1581	0.103
Junc-3	76.993	01 Jan 99 0124	4.4434	0.247
DFD-20	171.86	01 Jan 99 0120	9.8086	0.370
depr in DFD-20	13.353	01 Jan 99 0214	1.4825	0.370
NGE-40	55.559	01 Jan 99 0116	2.7147	0.102
Junc-4	55.559	01 Jan 99 0116	2.7147	0.102
BKR-6	32.143	01 Jan 99 0110	1.2084	0.049
6 thr 8/12	25.700	01 Jan 99 0126	1.2084	0.049
BKR-8	22.679	01 Jan 99 0118	1.1999	0.063
Junc-10	46.736	01 Jan 99 0124	2.4083	0.112
BKR-2	54.247	01 Jan 99 0116	2.9254	0.069
BKR-4	37.887	01 Jan 99 0114	1.8185	0.055
Junc-5	91.606	01 Jan 99 0114	4.7439	0.124
BKR-9	13.782	01 Jan 99 0110	0.55575	0.017
BKR-10	52.113	01 Jan 99 0118	2.8869	0.072
Junc-6	155.20	01 Jan 99 0114	8.1865	0.213
BKR-12	32.501	01 Jan 99 0102	0.92077	0.028
BKR-14	35.203	01 Jan 99 0110	1.5057	0.038
Junc-7	232.58	01 Jan 99 0114	13.021	0.391
NGE-10	36.645	01 Jan 99 0130	2.7002	0.096
Junc-8	36.645	01 Jan 99 0130	2.7002	0.096
NGE-4	66.676	01 Jan 99 0108	2.5475	0.089
Junc-9	66.676	01 Jan 99 0108	2.5475	0.089
DFD-8	99.906	01 Jan 99 0132	7.6565	0.294
depr in DFD-8	4.9907	01 Jan 99 0258	0.60321	0.294
DFD-4	71.150	01 Jan 99 0112	3.1898	0.097
4 to 6	68.540	01 Jan 99 0116	3.1898	0.097
DFD-6	56.410	01 Jan 99 0108	1.9928	0.070
Junc-11	113.42	01 Jan 99 0110	5.1826	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr, 2-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst

End of Run : 01Jan99 0500   Met. Model : 2Hr-100Yr-Sew2000

Execution Time : 06Jun04 1750   Control Specs : 100-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	50.587	01 Jan 99 0210	3.4992	0.067
W of NGE-90	1.8122	01 Jan 99 0314	0.42970	0.067
NGE-80	59.635	01 Jan 99 0214	4.3939	0.089
depr NGE-80	3.4078	01 Jan 99 0318	0.79032	0.089
NGE-85	96.039	01 Jan 99 0206	6.9765	0.085
Junc-1	97.661	01 Jan 99 0208	7.7668	0.174
NGE-65	28.642	01 Jan 99 0210	1.7862	0.043
depr in NGE 65	18.560	01 Jan 99 0224	1.2968	0.043
Junc-2	18.560	01 Jan 99 0224	1.2968	0.043
NGE-55	74.389	01 Jan 99 0212	4.8675	0.143
55 thr 60	71.311	01 Jan 99 0220	4.8675	0.143
NGE-60	59.733	01 Jan 99 0214	4.2811	0.103
Junc-3	129.99	01 Jan 99 0218	9.1486	0.247
DFD-20	253.37	01 Jan 99 0214	18.334	0.370
depr in DFD-20	42.718	01 Jan 99 0256	7.6859	0.370
NGE-40	76.959	01 Jan 99 0210	5.0684	0.102
Junc-4	76.959	01 Jan 99 0210	5.0684	0.102
BKR-6	40.329	01 Jan 99 0204	2.2979	0.049
6 thr 8/12	36.363	01 Jan 99 0220	2.2979	0.049
BKR-8	36.370	01 Jan 99 0212	2.4298	0.063
Junc-10	71.054	01 Jan 99 0216	4.7277	0.112
BKR-2	66.756	01 Jan 99 0210	4.9147	0.069
BKR-4	48.292	01 Jan 99 0208	3.2313	0.055
Junc-5	114.77	01 Jan 99 0210	8.1460	0.124
BKR-9	16.097	01 Jan 99 0204	0.98750	0.017
BKR-10	66.282	01 Jan 99 0210	4.9152	0.072
Junc-6	196.06	01 Jan 99 0208	14.049	0.213
BKR-12	30.053	01 Jan 99 0158	1.6361	0.028
BKR-14	39.480	01 Jan 99 0204	2.5630	0.038
Junc-7	317.23	01 Jan 99 0206	22.975	0.391
NGE-10	57.585	01 Jan 99 0222	5.0255	0.096
Junc-8	57.585	01 Jan 99 0222	5.0255	0.096
NGE-4	79.706	01 Jan 99 0204	4.6743	0.089
Junc-9	79.706	01 Jan 99 0204	4.6743	0.089
DFD-8	162.44	01 Jan 99 0224	14.566	0.294
depr in DFD-8	8.6059	01 Jan 99 0350	1.8606	0.294
DFD-4	87.712	01 Jan 99 0206	5.6679	0.097
4 to 6	86.297	01 Jan 99 0210	5.6679	0.097
DFD-6	64.409	01 Jan 99 0202	3.6566	0.070
Junc-11	146.07	01 Jan 99 0206	9.3244	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr, 3-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst

End of Run : 01Jan99 0600   Met. Model : 3Hr-100Yr-Sew2000

Execution Time : 06Jun04 1751   Control Specs : 100-yr 3-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	44.731	01 Jan 99 0306	4.0410	0.067
W of NGE-90	2.0585	01 Jan 99 0408	0.52281	0.067
NGE-80	54.546	01 Jan 99 0310	5.0924	0.089
depr NGE-80	11.142	01 Jan 99 0352	1.0966	0.089
NGE-85	79.060	01 Jan 99 0302	7.8448	0.085
Junc-1	81.158	01 Jan 99 0304	8.9414	0.174
NGE-65	25.413	01 Jan 99 0306	2.0946	0.043
depr in NGE 65	19.885	01 Jan 99 0318	1.6061	0.043
Junc-2	19.885	01 Jan 99 0318	1.6061	0.043
NGE-55	69.842	01 Jan 99 0308	5.7875	0.143
55 thr 60	68.098	01 Jan 99 0316	5.7875	0.143
NGE-60	55.886	01 Jan 99 0310	5.0203	0.103
Junc-3	123.26	01 Jan 99 0314	10.808	0.247
DFD-20	230.15	01 Jan 99 0308	21.249	0.370
depr in DFD-20	51.860	01 Jan 99 0348	9.8352	0.370
NGE-40	67.401	01 Jan 99 0306	5.8741	0.102
Junc-4	67.401	01 Jan 99 0306	5.8741	0.102
BKR-6	33.372	01 Jan 99 0302	2.6731	0.049
6 thr 8/12	31.788	01 Jan 99 0316	2.6731	0.049
BKR-8	33.564	01 Jan 99 0308	2.8618	0.063
Junc-10	64.420	01 Jan 99 0312	5.5349	0.112
BKR-2	56.938	01 Jan 99 0306	5.5710	0.069
BKR-4	41.202	01 Jan 99 0304	3.7068	0.055
Junc-5	98.088	01 Jan 99 0304	9.2779	0.124
BKR-9	13.148	01 Jan 99 0300	1.1328	0.017
BKR-10	57.310	01 Jan 99 0306	5.5874	0.072
Junc-6	168.19	01 Jan 99 0304	15.998	0.213
BKR-12	22.927	01 Jan 99 0254	1.8769	0.028
BKR-14	32.059	01 Jan 99 0302	2.9135	0.038
Junc-7	281.07	01 Jan 99 0304	26.323	0.391
NGE-10	55.131	01 Jan 99 0316	5.8039	0.096
Junc-8	55.131	01 Jan 99 0316	5.8039	0.096
NGE-4	65.215	01 Jan 99 0300	5.3982	0.089
Junc-9	65.215	01 Jan 99 0300	5.3982	0.089
DFD-8	158.16	01 Jan 99 0318	16.884	0.294
depr in DFD-8	9.8325	01 Jan 99 0444	2.2852	0.294
DFD-4	73.617	01 Jan 99 0302	6.5020	0.097
4 to 6	73.016	01 Jan 99 0306	6.5020	0.097
DFD-6	51.745	01 Jan 99 0300	4.2228	0.070
Junc-11	123.12	01 Jan 99 0302	10.725	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr, 6-hr Exst

Start of Run   : 01Jan99 0000   Basin Model   : Delafield-infil Exst
End of Run   : 01Jan99 1200   Met. Model   : 6Hr-100Yr-Sew2000
Execution Time   : 06Jun04 1751   Control Specs : 100-yr 6-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	34.415	01 Jan 99 0554	5.9377	0.067
W of NGE-90	2.5398	01 Jan 99 0700	1.4141	0.067
NGE-80	43.910	01 Jan 99 0557	7.5475	0.089
depr NGE-80	43.362	01 Jan 99 0606	4.3469	0.089
NGE-85	55.151	01 Jan 99 0545	10.788	0.085
Junc-1	95.744	01 Jan 99 0603	15.135	0.174
NGE-65	19.863	01 Jan 99 0551	3.1933	0.043
depr in NGE 65	18.947	01 Jan 99 0606	2.7668	0.043
Junc-2	18.947	01 Jan 99 0606	2.7668	0.043
NGE-55	58.916	01 Jan 99 0557	9.1149	0.143
55 thr 60	58.608	01 Jan 99 0603	9.1149	0.143
NGE-60	46.652	01 Jan 99 0600	7.6536	0.103
Junc-3	105.10	01 Jan 99 0603	16.768	0.247
DFD-20	183.79	01 Jan 99 0557	31.493	0.370
depr in DFD-20	77.575	01 Jan 99 0636	23.153	0.370
NGE-40	51.503	01 Jan 99 0551	8.7060	0.102
Junc-4	51.503	01 Jan 99 0551	8.7060	0.102
BKR-6	24.416	01 Jan 99 0548	3.9977	0.049
6 thr 8/12	24.180	01 Jan 99 0603	3.9977	0.049
BKR-8	27.556	01 Jan 99 0557	4.4080	0.063
Junc-10	51.679	01 Jan 99 0600	8.4057	0.112
BKR-2	41.489	01 Jan 99 0551	7.8174	0.069
BKR-4	30.353	01 Jan 99 0551	5.3582	0.055
Junc-5	71.842	01 Jan 99 0551	13.176	0.124
BKR-9	9.3650	01 Jan 99 0545	1.6375	0.017
BKR-10	42.416	01 Jan 99 0551	7.8962	0.072
Junc-6	123.58	01 Jan 99 0551	22.709	0.213
BKR-12	15.676	01 Jan 99 0542	2.7130	0.028
BKR-14	22.467	01 Jan 99 0545	4.1174	0.038
Junc-7	212.01	01 Jan 99 0548	37.945	0.391
NGE-10	47.409	01 Jan 99 0603	8.5282	0.096
Junc-8	47.409	01 Jan 99 0603	8.5282	0.096
NGE-4	46.881	01 Jan 99 0545	7.9317	0.089
Junc-9	46.881	01 Jan 99 0545	7.9317	0.089
DFD-8	139.88	01 Jan 99 0606	25.028	0.294
depr in DFD-8	13.998	01 Jan 99 0727	7.0605	0.294
DFD-4	53.480	01 Jan 99 0548	9.3986	0.097
4 to 6	53.397	01 Jan 99 0551	9.3986	0.097
DFD-6	36.799	01 Jan 99 0545	6.2047	0.070
Junc-11	90.035	01 Jan 99 0548	15.603	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr 12-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst

End of Run : 01Jan99 2400   Met. Model : 12Hr-100Yr-Sew2000

Execution Time : 06Jun04 1751   Control Specs : 100-yr 12-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	20.967	01 Jan 99 1127	7.3264	0.067
W of NGE-90	2.7782	01 Jan 99 1248	3.1035	0.067
NGE-80	27.130	01 Jan 99 1130	9.3525	0.089
depr NGE-80	27.120	01 Jan 99 1133	7.3556	0.089
NGE-85	32.529	01 Jan 99 1100	12.875	0.085
Junc-1	59.246	01 Jan 99 1109	20.231	0.174
NGE-65	12.265	01 Jan 99 1130	4.0116	0.043
depr in NGE 65	12.138	01 Jan 99 1139	3.6955	0.043
Junc-2	12.138	01 Jan 99 1139	3.6955	0.043
NGE-55	37.272	01 Jan 99 1133	11.629	0.143
55 thr 60	37.209	01 Jan 99 1139	11.629	0.143
NGE-60	29.235	01 Jan 99 1133	9.6148	0.103
Junc-3	66.406	01 Jan 99 1136	21.244	0.247
DFD-20	113.27	01 Jan 99 1130	39.025	0.370
depr in DFD-20	77.152	01 Jan 99 1224	33.321	0.370
NGE-40	31.390	01 Jan 99 1130	10.788	0.102
Junc-4	31.390	01 Jan 99 1130	10.788	0.102
BKR-6	14.784	01 Jan 99 1127	4.9756	0.049
6 thr 8/12	14.725	01 Jan 99 1139	4.9756	0.049
BKR-8	17.240	01 Jan 99 1133	5.5650	0.063
Junc-10	31.938	01 Jan 99 1133	10.541	0.112
BKR-2	24.760	01 Jan 99 1103	9.4264	0.069
BKR-4	18.237	01 Jan 99 1103	6.5580	0.055
Junc-5	42.997	01 Jan 99 1103	15.984	0.124
BKR-9	5.5963	01 Jan 99 1057	2.0042	0.017
BKR-10	25.425	01 Jan 99 1106	9.5556	0.072
Junc-6	73.997	01 Jan 99 1103	27.544	0.213
BKR-12	9.3553	01 Jan 99 1051	3.3205	0.028
BKR-14	13.337	01 Jan 99 1057	4.9827	0.038
Junc-7	128.15	01 Jan 99 1124	46.388	0.391
NGE-10	29.866	01 Jan 99 1133	10.523	0.096
Junc-8	29.866	01 Jan 99 1133	10.523	0.096
NGE-4	28.138	01 Jan 99 1127	9.7868	0.089
Junc-9	28.138	01 Jan 99 1127	9.7868	0.089
DFD-8	89.159	01 Jan 99 1136	31.013	0.294
depr in DFD-8	16.938	01 Jan 99 1309	15.796	0.294
DFD-4	32.039	01 Jan 99 1100	11.503	0.097
4 to 6	32.021	01 Jan 99 1106	11.503	0.097
DFD-6	22.044	01 Jan 99 1057	7.6559	0.070
Junc-11	53.983	01 Jan 99 1127	19.159	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr 24-hr Exst

Start of Run : 01Jan99 0000   Basin Model : Delafield-infil Exst
End of Run : 02Jan99 2400   Met. Model : 24Hr-100Yr-Sew2000
Execution Time : 06Jun04 1752   Control Specs : 100-yr 24-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	12.545	01 Jan 99 2148	8.9967	0.067
W of NGE-90	2.9668	02 Jan 99 0040	6.1630	0.067
NGE-80	16.266	01 Jan 99 2152	11.529	0.089
depr NGE-80	16.261	01 Jan 99 2156	10.915	0.089
NGE-85	18.969	01 Jan 99 2144	15.334	0.085
Junc-1	35.187	01 Jan 99 2148	26.249	0.174
NGE-65	7.4060	01 Jan 99 2252	5.0070	0.043
depr in NGE 65	7.3662	01 Jan 99 2256	4.8628	0.043
Junc-2	7.3662	01 Jan 99 2256	4.8628	0.043
NGE-55	22.828	01 Jan 99 2252	14.717	0.143
55 thr 60	22.798	01 Jan 99 2300	14.717	0.143
NGE-60	17.688	01 Jan 99 2252	12.001	0.103
Junc-3	40.472	01 Jan 99 2256	26.718	0.247
DFD-20	67.902	01 Jan 99 2152	48.108	0.370
depr in DFD-20	59.661	01 Jan 99 2348	45.096	0.370
NGE-40	18.815	01 Jan 99 2148	13.299	0.102
Junc-4	18.815	01 Jan 99 2148	13.299	0.102
BKR-6	8.8671	01 Jan 99 2144	6.1582	0.049
6 thr 8/12	8.8384	01 Jan 99 2200	6.1582	0.049
BKR-8	10.467	01 Jan 99 2252	6.9767	0.063
Junc-10	19.258	01 Jan 99 2256	13.135	0.112
BKR-2	14.584	01 Jan 99 2144	11.333	0.069
BKR-4	10.863	01 Jan 99 2144	7.9936	0.055
Junc-5	25.447	01 Jan 99 2144	19.327	0.124
BKR-9	3.3277	01 Jan 99 2144	2.4429	0.017
BKR-10	15.028	01 Jan 99 2148	11.527	0.072
Junc-6	43.799	01 Jan 99 2144	33.297	0.213
BKR-12	5.5427	01 Jan 99 2136	4.0474	0.028
BKR-14	7.8585	01 Jan 99 2144	6.0105	0.038
Junc-7	76.323	01 Jan 99 2144	56.490	0.391
NGE-10	17.920	01 Jan 99 2200	12.922	0.096
Junc-8	17.920	01 Jan 99 2200	12.922	0.096
NGE-4	16.832	01 Jan 99 2144	12.018	0.089
Junc-9	16.832	01 Jan 99 2144	12.018	0.089
DFD-8	53.679	01 Jan 99 2204	38.231	0.294
depr in DFD-8	19.125	02 Jan 99 0052	29.661	0.294
DFD-4	19.074	01 Jan 99 2144	14.021	0.097
4 to 6	19.065	01 Jan 99 2148	14.021	0.097
DFD-6	13.181	01 Jan 99 2140	9.4013	0.070
Junc-11	32.227	01 Jan 99 2144	23.423	0.167

Proposed Land Use with Existing Detention

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 2-yr,2-hr Prop Cond

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 0800   Met. Model : 2Hr-2Yr-Sew2000
Execution Time : 06Jun04 1757   Control Specs : 2-yr 2hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	34.592	01 Jan 99 0208	2.7490	0.067
W of NGE-90	1.4536	01 Jan 99 0310	0.67776	0.067
NGE-80	38.444	01 Jan 99 0212	3.1231	0.089
depr NGE-80	2.5426	01 Jan 99 0314	1.1411	0.089
NGE-85	41.164	01 Jan 99 0206	3.0033	0.085
Junc-1	42.603	01 Jan 99 0208	4.1444	0.174
NGE-65	1.8097	01 Jan 99 0214	0.084294	0.043
depr in NGE 65	0.10504	01 Jan 99 0302	0.040760	0.043
Junc-2	0.10504	01 Jan 99 0302	0.040760	0.043
NGE-55	1.5385	01 Jan 99 0222	0.078421	0.143
55 thr 60	1.4340	01 Jan 99 0228	0.078421	0.143
NGE-60	2.7203	01 Jan 99 0222	0.15709	0.103
Junc-3	4.0676	01 Jan 99 0224	0.23551	0.247
DFD-20	19.099	01 Jan 99 0220	1.1079	0.370
depr in DFD-20	0.62750	01 Jan 99 0328	0.26836	0.370
NGE-40	8.4764	01 Jan 99 0214	0.43682	0.102
Junc-4	8.4764	01 Jan 99 0214	0.43682	0.102
BKR-6	3.1466	01 Jan 99 0208	0.12017	0.049
6 thr 8/12	2.5305	01 Jan 99 0226	0.12017	0.049
BKR-8	1.8058	01 Jan 99 0220	0.095047	0.063
Junc-10	4.2227	01 Jan 99 0224	0.21522	0.112
BKR-2	8.0093	01 Jan 99 0214	0.45901	0.069
BKR-4	4.0549	01 Jan 99 0214	0.19937	0.055
Junc-5	12.064	01 Jan 99 0214	0.65838	0.124
BKR-9	2.4423	01 Jan 99 0208	0.11259	0.017
BKR-10	7.2368	01 Jan 99 0216	0.41938	0.072
Junc-6	21.368	01 Jan 99 0214	1.1903	0.213
BKR-12	4.1849	01 Jan 99 0202	0.14015	0.028
BKR-14	5.2967	01 Jan 99 0208	0.25116	0.038
Junc-7	30.631	01 Jan 99 0212	1.7969	0.391
NGE-10	2.5265	01 Jan 99 0230	0.18736	0.096
Junc-8	2.5265	01 Jan 99 0230	0.18736	0.096
NGE-4	9.2026	01 Jan 99 0208	0.38083	0.089
Junc-9	9.2026	01 Jan 99 0208	0.38083	0.089
DFD-8	9.1950	01 Jan 99 0232	0.71906	0.294
depr in DFD-8	0.99107	01 Jan 99 0338	0.37568	0.294
DFD-4	11.466	01 Jan 99 0210	0.56265	0.097
4 to 6	11.126	01 Jan 99 0214	0.56265	0.097
DFD-6	9.8208	01 Jan 99 0206	0.40429	0.070
Junc-11	19.449	01 Jan 99 0210	0.96694	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 10-yr, 2-hr Prop

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 1200   Met. Model : 2Hr-10Yr-Sew2000
Execution Time : 06Jun04 1756   Control Specs : 10-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	57.664	01 Jan 99 0208	4.8627	0.067
W of NGE-90	2.3250	01 Jan 99 0310	1.7456	0.067
NGE-80	66.993	01 Jan 99 0212	5.7717	0.089
depr NGE-80	31.950	01 Jan 99 0238	3.3737	0.089
NGE-85	71.017	01 Jan 99 0206	5.5502	0.085
Junc-1	73.344	01 Jan 99 0206	8.9239	0.174
NGE-65	8.6793	01 Jan 99 0212	0.46749	0.043
depr in NGE 65	0.23904	01 Jan 99 0310	0.17847	0.043
Junc-2	0.23904	01 Jan 99 0310	0.17847	0.043
NGE-55	16.661	01 Jan 99 0216	0.94170	0.143
55 thr 60	15.667	01 Jan 99 0224	0.94170	0.143
NGE-60	15.754	01 Jan 99 0218	0.99956	0.103
Junc-3	31.018	01 Jan 99 0220	1.9413	0.247
DFD-20	77.146	01 Jan 99 0216	4.9525	0.370
depr in DFD-20	2.8018	01 Jan 99 0324	1.8927	0.370
NGE-40	28.218	01 Jan 99 0212	1.6591	0.102
Junc-4	28.218	01 Jan 99 0212	1.6591	0.102
BKR-6	12.659	01 Jan 99 0206	0.59343	0.049
6 thr 8/12	10.906	01 Jan 99 0222	0.59343	0.049
BKR-8	10.261	01 Jan 99 0216	0.60477	0.063
Junc-10	20.549	01 Jan 99 0220	1.1982	0.112
BKR-2	22.647	01 Jan 99 0212	1.4510	0.069
BKR-4	14.453	01 Jan 99 0210	0.81723	0.055
Junc-5	37.051	01 Jan 99 0212	2.2682	0.124
BKR-9	6.5909	01 Jan 99 0206	0.35589	0.017
BKR-10	21.660	01 Jan 99 0214	1.4006	0.072
Junc-6	64.559	01 Jan 99 0212	4.0247	0.213
BKR-12	11.431	01 Jan 99 0200	0.49739	0.028
BKR-14	14.383	01 Jan 99 0206	0.79392	0.038
Junc-7	101.09	01 Jan 99 0210	6.5142	0.391
NGE-10	13.215	01 Jan 99 0226	1.0391	0.096
Junc-8	13.215	01 Jan 99 0226	1.0391	0.096
NGE-4	28.993	01 Jan 99 0206	1.4464	0.089
Junc-9	28.993	01 Jan 99 0206	1.4464	0.089
DFD-8	42.995	01 Jan 99 0228	3.5509	0.294
depr in DFD-8	2.7401	01 Jan 99 0348	1.8771	0.294
DFD-4	33.182	01 Jan 99 0208	1.8791	0.097
4 to 6	32.475	01 Jan 99 0212	1.8791	0.097
DFD-6	27.145	01 Jan 99 0204	1.3502	0.070
Junc-11	56.802	01 Jan 99 0208	3.2293	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 25-yr,2-hr Prop Cond

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 0500   Met. Model : 2Hr-25Yr-Sew2000
Execution Time : 06Jun04 1757   Control Specs : 25-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	74.554	01 Jan 99 0208	6.4778	0.067
W of NGE-90	2.6933	01 Jan 99 0312	0.69843	0.067
NGE-80	88.366	01 Jan 99 0210	7.8329	0.089
depr NGE-80	75.888	01 Jan 99 0222	3.7973	0.089
NGE-85	93.102	01 Jan 99 0206	7.5323	0.085
Junc-1	140.41	01 Jan 99 0220	11.330	0.174
NGE-65	15.442	01 Jan 99 0210	0.89255	0.043
depr in NGE 65	6.1676	01 Jan 99 0232	0.40800	0.043
Junc-2	6.1676	01 Jan 99 0232	0.40800	0.043
NGE-55	34.072	01 Jan 99 0214	2.0520	0.143
55 thr 60	32.326	01 Jan 99 0222	2.0520	0.143
NGE-60	29.353	01 Jan 99 0216	1.9630	0.103
Junc-3	60.967	01 Jan 99 0220	4.0150	0.247
DFD-20	132.88	01 Jan 99 0214	9.0003	0.370
depr in DFD-20	10.386	01 Jan 99 0310	1.8214	0.370
NGE-40	46.291	01 Jan 99 0210	2.8909	0.102
Junc-4	46.291	01 Jan 99 0210	2.8909	0.102
BKR-6	21.519	01 Jan 99 0206	1.1042	0.049
6 thr 8/12	18.959	01 Jan 99 0222	1.1042	0.049
BKR-8	19.002	01 Jan 99 0214	1.1877	0.063
Junc-10	36.953	01 Jan 99 0218	2.2919	0.112
BKR-2	35.478	01 Jan 99 0212	2.3976	0.069
BKR-4	24.088	01 Jan 99 0210	1.4531	0.055
Junc-5	59.513	01 Jan 99 0210	3.8507	0.124
BKR-9	10.139	01 Jan 99 0206	0.58810	0.017
BKR-10	34.586	01 Jan 99 0212	2.3531	0.072
Junc-6	103.36	01 Jan 99 0210	6.7919	0.213
BKR-12	17.593	01 Jan 99 0200	0.85052	0.028
BKR-14	22.240	01 Jan 99 0206	1.3119	0.038
Junc-7	166.74	01 Jan 99 0208	11.246	0.391
NGE-10	24.363	01 Jan 99 0224	1.9838	0.096
Junc-8	24.363	01 Jan 99 0224	1.9838	0.096
NGE-4	46.547	01 Jan 99 0204	2.5203	0.089
Junc-9	46.547	01 Jan 99 0204	2.5203	0.089
DFD-8	77.510	01 Jan 99 0226	6.6052	0.294
depr in DFD-8	4.3530	01 Jan 99 0350	0.93857	0.294
DFD-4	52.250	01 Jan 99 0208	3.1569	0.097
4 to 6	51.254	01 Jan 99 0212	3.1569	0.097
DFD-6	41.992	01 Jan 99 0204	2.2684	0.070
Junc-11	89.728	01 Jan 99 0206	5.4254	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD Run Name : 100-yr, 1-hr infil

Start of Run : 01Jan99 0000 Basin Model : Delafield inflt Prop
End of Run : 01Jan99 0300 Met. Model : 1Hr-100Yr-Sew2000
Execution Time : 06Jun04 1754 Control Specs : 100-yr 1-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	112.24	01 Jan 99 0114	6.7730	0.067
W of NGE-90	2.7699	01 Jan 99 0222	0.42494	0.067
NGE-80	125.70	01 Jan 99 0116	8.2021	0.089
depr NGE-80	95.054	01 Jan 99 0130	3.8344	0.089
NGE-85	143.44	01 Jan 99 0112	7.8971	0.085
Junc-1	166.38	01 Jan 99 0128	11.732	0.174
NGE-65	21.004	01 Jan 99 0114	0.97985	0.043
depr in NGE 65	7.6834	01 Jan 99 0136	0.47133	0.043
Junc-2	7.6834	01 Jan 99 0136	0.47133	0.043
NGE-55	43.592	01 Jan 99 0120	2.2874	0.143
55 thr 60	40.768	01 Jan 99 0126	2.2852	0.143
NGE-60	37.127	01 Jan 99 0122	2.1581	0.103
Junc-3	76.993	01 Jan 99 0124	4.4434	0.247
DFD-20	171.86	01 Jan 99 0120	9.8086	0.370
depr in DFD-20	13.353	01 Jan 99 0214	1.4825	0.370
NGE-40	63.472	01 Jan 99 0114	3.1374	0.102
Junc-4	63.472	01 Jan 99 0114	3.1374	0.102
BKR-6	32.143	01 Jan 99 0110	1.2084	0.049
6 thr 8/12	25.700	01 Jan 99 0126	1.2084	0.049
BKR-8	24.634	01 Jan 99 0118	1.3079	0.063
Junc-10	48.454	01 Jan 99 0124	2.5163	0.112
BKR-2	48.408	01 Jan 99 0116	2.5838	0.069
BKR-4	33.343	01 Jan 99 0114	1.5811	0.055
Junc-5	81.352	01 Jan 99 0116	4.1649	0.124
BKR-9	15.426	01 Jan 99 0110	0.63380	0.017
BKR-10	46.373	01 Jan 99 0118	2.5409	0.072
Junc-6	140.26	01 Jan 99 0116	7.3396	0.213
BKR-12	32.501	01 Jan 99 0102	0.92077	0.028
BKR-14	33.325	01 Jan 99 0110	1.4139	0.038
Junc-7	217.83	01 Jan 99 0114	12.190	0.391
NGE-10	29.343	01 Jan 99 0130	2.1462	0.096
Junc-8	29.343	01 Jan 99 0130	2.1462	0.096
NGE-4	71.007	01 Jan 99 0108	2.7352	0.089
Junc-9	71.007	01 Jan 99 0108	2.7352	0.089
DFD-8	92.764	01 Jan 99 0132	7.0926	0.294
depr in DFD-8	4.6894	01 Jan 99 0258	0.56689	0.294
DFD-4	75.522	01 Jan 99 0112	3.4098	0.097
4 to 6	72.804	01 Jan 99 0116	3.4098	0.097
DFD-6	67.296	01 Jan 99 0106	2.4501	0.070
Junc-11	127.34	01 Jan 99 0110	5.8599	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr,2-hr infil

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 0500   Met. Model : 2Hr-100Yr-Sew2000
Execution Time : 06Jun04 1754   Control Specs : 100-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	105.45	01 Jan 99 0206	9.5120	0.067
W of NGE-90	3.8706	01 Jan 99 0312	0.97733	0.067
NGE-80	127.73	01 Jan 99 0210	11.751	0.089
depr NGE-80	125.89	01 Jan 99 0214	7.6887	0.089
NGE-85	133.56	01 Jan 99 0204	11.300	0.085
Junc-1	252.67	01 Jan 99 0210	18.989	0.174
NGE-65	30.079	01 Jan 99 0210	1.9000	0.043
depr in NGE 65	19.954	01 Jan 99 0224	1.4103	0.043
Junc-2	19.954	01 Jan 99 0224	1.4103	0.043
NGE-55	74.389	01 Jan 99 0212	4.8675	0.143
55 thr 60	71.311	01 Jan 99 0220	4.8675	0.143
NGE-60	59.733	01 Jan 99 0214	4.2811	0.103
Junc-3	129.99	01 Jan 99 0218	9.1486	0.247
DFD-20	253.37	01 Jan 99 0214	18.334	0.370
depr in DFD-20	42.718	01 Jan 99 0256	7.6859	0.370
NGE-40	83.971	01 Jan 99 0210	5.6626	0.102
Junc-4	83.971	01 Jan 99 0210	5.6626	0.102
BKR-6	40.329	01 Jan 99 0204	2.2979	0.049
6 thr 8/12	36.363	01 Jan 99 0220	2.2979	0.049
BKR-8	38.368	01 Jan 99 0212	2.5902	0.063
Junc-10	72.921	01 Jan 99 0216	4.8881	0.112
BKR-2	61.858	01 Jan 99 0210	4.4591	0.069
BKR-4	44.368	01 Jan 99 0208	2.9011	0.055
Junc-5	106.06	01 Jan 99 0210	7.3602	0.124
BKR-9	17.361	01 Jan 99 0204	1.0937	0.017
BKR-10	61.206	01 Jan 99 0212	4.4490	0.072
Junc-6	183.27	01 Jan 99 0210	12.903	0.213
BKR-12	30.053	01 Jan 99 0158	1.6361	0.028
BKR-14	38.057	01 Jan 99 0204	2.4399	0.038
Junc-7	304.93	01 Jan 99 0208	21.867	0.391
NGE-10	49.431	01 Jan 99 0222	4.2230	0.096
Junc-8	49.431	01 Jan 99 0222	4.2230	0.096
NGE-4	82.990	01 Jan 99 0204	4.9368	0.089
Junc-9	82.990	01 Jan 99 0204	4.9368	0.089
DFD-8	154.34	01 Jan 99 0224	13.746	0.294
depr in DFD-8	8.1582	01 Jan 99 0350	1.7611	0.294
DFD-4	91.268	01 Jan 99 0206	5.9689	0.097
4 to 6	89.824	01 Jan 99 0210	5.9689	0.097
DFD-6	72.285	01 Jan 99 0202	4.2890	0.070
Junc-11	156.92	01 Jan 99 0206	10.258	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr,3-hr infil

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop

End of Run : 01Jan99 0600   Met. Model : 3Hr-100Yr-Sew2000

Execution Time : 06Jun04 1755   Control Specs : 100-yr 3-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	82.887	01 Jan 99 0302	10.359	0.067
W of NGE-90	4.2840	01 Jan 99 0404	1.1826	0.067
NGE-80	103.66	01 Jan 99 0304	12.853	0.089
depr NGE-80	103.19	01 Jan 99 0308	8.8150	0.089
NGE-85	104.04	01 Jan 99 0300	12.360	0.085
Junc-1	205.67	01 Jan 99 0304	21.174	0.174
NGE-65	26.504	01 Jan 99 0306	2.2190	0.043
depr in NGE 65	21.046	01 Jan 99 0318	1.7302	0.043
Junc-2	21.046	01 Jan 99 0318	1.7302	0.043
NGE-55	69.842	01 Jan 99 0308	5.7875	0.143
55 thr 60	68.098	01 Jan 99 0316	5.7875	0.143
NGE-60	55.886	01 Jan 99 0310	5.0203	0.103
Junc-3	123.26	01 Jan 99 0314	10.808	0.247
DFD-20	230.15	01 Jan 99 0308	21.249	0.370
depr in DFD-20	51.860	01 Jan 99 0348	9.8352	0.370
NGE-40	72.665	01 Jan 99 0304	6.5173	0.102
Junc-4	72.665	01 Jan 99 0304	6.5173	0.102
BKR-6	33.372	01 Jan 99 0302	2.6731	0.049
6 thr 8/12	31.788	01 Jan 99 0316	2.6731	0.049
BKR-8	35.127	01 Jan 99 0308	3.0374	0.063
Junc-10	65.903	01 Jan 99 0312	5.7106	0.112
BKR-2	53.359	01 Jan 99 0306	5.0838	0.069
BKR-4	38.313	01 Jan 99 0304	3.3504	0.055
Junc-5	91.586	01 Jan 99 0306	8.4342	0.124
BKR-9	14.038	01 Jan 99 0300	1.2470	0.017
BKR-10	53.535	01 Jan 99 0306	5.0877	0.072
Junc-6	158.67	01 Jan 99 0306	14.769	0.213
BKR-12	22.927	01 Jan 99 0254	1.8769	0.028
BKR-14	31.083	01 Jan 99 0302	2.7817	0.038
Junc-7	272.19	01 Jan 99 0304	25.138	0.391
NGE-10	48.324	01 Jan 99 0318	4.9320	0.096
Junc-8	48.324	01 Jan 99 0318	4.9320	0.096
NGE-4	67.550	01 Jan 99 0300	5.6819	0.089
Junc-9	67.550	01 Jan 99 0300	5.6819	0.089
DFD-8	151.30	01 Jan 99 0318	15.992	0.294
depr in DFD-8	9.3490	01 Jan 99 0444	2.1668	0.294
DFD-4	76.177	01 Jan 99 0302	6.8258	0.097
4 to 6	75.568	01 Jan 99 0306	6.8258	0.097
DFD-6	57.172	01 Jan 99 0258	4.9047	0.070
Junc-11	130.97	01 Jan 99 0302	11.731	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr,6hr infil

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 1200   Met. Model : 6Hr-100Yr-Sew2000
Execution Time : 06Jun04 1755   Control Specs : 100-yr 6-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	53.887	01 Jan 99 0539	13.131	0.067
W of NGE-90	5.5738	01 Jan 99 0654	3.1139	0.067
NGE-80	69.459	01 Jan 99 0545	16.470	0.089
depr NGE-80	69.405	01 Jan 99 0548	13.243	0.089
NGE-85	67.550	01 Jan 99 0536	15.838	0.085
Junc-1	136.61	01 Jan 99 0542	29.081	0.174
NGE-65	20.505	01 Jan 99 0551	3.3498	0.043
depr in NGE 65	19.592	01 Jan 99 0606	2.9231	0.043
Junc-2	19.592	01 Jan 99 0606	2.9231	0.043
NGE-55	58.916	01 Jan 99 0557	9.1149	0.143
55 thr 60	58.608	01 Jan 99 0603	9.1149	0.143
NGE-60	46.652	01 Jan 99 0600	7.6536	0.103
Junc-3	105.10	01 Jan 99 0603	16.768	0.247
DFD-20	183.79	01 Jan 99 0557	31.493	0.370
depr in DFD-20	77.575	01 Jan 99 0636	23.153	0.370
NGE-40	54.500	01 Jan 99 0551	9.4967	0.102
Junc-4	54.500	01 Jan 99 0551	9.4967	0.102
BKR-6	24.416	01 Jan 99 0548	3.9977	0.049
6 thr 8/12	24.180	01 Jan 99 0603	3.9977	0.049
BKR-8	28.480	01 Jan 99 0557	4.6307	0.063
Junc-10	52.586	01 Jan 99 0600	8.6284	0.112
BKR-2	39.539	01 Jan 99 0551	7.2372	0.069
BKR-4	28.754	01 Jan 99 0551	4.9228	0.055
Junc-5	68.293	01 Jan 99 0551	12.160	0.124
BKR-9	9.8462	01 Jan 99 0545	1.7752	0.017
BKR-10	40.344	01 Jan 99 0554	7.2974	0.072
Junc-6	118.41	01 Jan 99 0551	21.233	0.213
BKR-12	15.676	01 Jan 99 0542	2.7130	0.028
BKR-14	21.935	01 Jan 99 0545	3.9600	0.038
Junc-7	207.20	01 Jan 99 0548	36.534	0.391
NGE-10	43.157	01 Jan 99 0606	7.4457	0.096
Junc-8	43.157	01 Jan 99 0606	7.4457	0.096
NGE-4	48.172	01 Jan 99 0545	8.2794	0.089
Junc-9	48.172	01 Jan 99 0545	8.2794	0.089
DFD-8	135.56	01 Jan 99 0606	23.921	0.294
depr in DFD-8	13.414	01 Jan 99 0730	6.7472	0.294
DFD-4	54.871	01 Jan 99 0548	9.7904	0.097
4 to 6	54.798	01 Jan 99 0551	9.7904	0.097
DFD-6	39.759	01 Jan 99 0545	7.0349	0.070
Junc-11	94.361	01 Jan 99 0548	16.825	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr 12-hr

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 01Jan99 2400   Met. Model : 12Hr-100Yr-Sew2000
Execution Time : 06Jun04 1755   Control Specs : 100-yr 12-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	30.881	01 Jan 99 1033	15.030	0.067
W of NGE-90	6.1165	01 Jan 99 1242	6.4129	0.067
NGE-80	40.120	01 Jan 99 1051	18.957	0.089
depr NGE-80	40.115	01 Jan 99 1054	16.945	0.089
NGE-85	38.726	01 Jan 99 1030	18.229	0.085
Junc-1	78.752	01 Jan 99 1051	35.174	0.174
NGE-65	12.595	01 Jan 99 1130	4.1883	0.043
depr in NGE 65	12.477	01 Jan 99 1136	3.8720	0.043
Junc-2	12.477	01 Jan 99 1136	3.8720	0.043
NGE-55	37.272	01 Jan 99 1133	11.629	0.143
55 thr 60	37.209	01 Jan 99 1139	11.629	0.143
NGE-60	29.235	01 Jan 99 1133	9.6148	0.103
Junc-3	66.406	01 Jan 99 1136	21.244	0.247
DFD-20	113.27	01 Jan 99 1130	39.025	0.370
depr in DFD-20	77.152	01 Jan 99 1224	33.321	0.370
NGE-40	32.910	01 Jan 99 1127	11.670	0.102
Junc-4	32.910	01 Jan 99 1127	11.670	0.102
BKR-6	14.784	01 Jan 99 1127	4.9756	0.049
6 thr 8/12	14.725	01 Jan 99 1139	4.9756	0.049
BKR-8	17.729	01 Jan 99 1130	5.8173	0.063
Junc-10	32.423	01 Jan 99 1133	10.793	0.112
BKR-2	23.728	01 Jan 99 1106	8.7902	0.069
BKR-4	17.407	01 Jan 99 1127	6.0742	0.055
Junc-5	41.100	01 Jan 99 1106	14.864	0.124
BKR-9	5.8563	01 Jan 99 1057	2.1561	0.017
BKR-10	24.331	01 Jan 99 1109	8.8968	0.072
Junc-6	71.251	01 Jan 99 1106	25.917	0.213
BKR-12	9.3553	01 Jan 99 1051	3.3205	0.028
BKR-14	13.053	01 Jan 99 1057	4.8098	0.038
Junc-7	125.81	01 Jan 99 1124	44.841	0.391
NGE-10	27.635	01 Jan 99 1136	9.3094	0.096
Junc-8	27.635	01 Jan 99 1136	9.3094	0.096
NGE-4	28.836	01 Jan 99 1057	10.174	0.089
Junc-9	28.836	01 Jan 99 1057	10.174	0.089
DFD-8	86.869	01 Jan 99 1139	29.773	0.294
depr in DFD-8	16.087	01 Jan 99 1309	15.133	0.294
DFD-4	32.791	01 Jan 99 1100	11.936	0.097
4 to 6	32.769	01 Jan 99 1106	11.936	0.097
DFD-6	23.678	01 Jan 99 1054	8.5769	0.070
Junc-11	56.334	01 Jan 99 1100	20.513	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr 24-hr

Start of Run : 01Jan99 0000   Basin Model : Delafield inflt Prop
End of Run : 02Jan99 2400   Met. Model : 24Hr-100Yr-Sew2000
Execution Time : 06Jun04 1756   Control Specs : 100-yr 24-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	17.610	01 Jan 99 2032	17.217	0.067
W of NGE-90	6.2348	02 Jan 99 0032	11.494	0.067
NGE-80	22.957	01 Jan 99 2040	21.827	0.089
depr NGE-80	22.953	01 Jan 99 2044	21.207	0.089
NGE-85	22.125	01 Jan 99 2032	20.990	0.085
Junc-1	45.063	01 Jan 99 2036	42.197	0.174
NGE-65	7.5750	01 Jan 99 2252	5.2052	0.043
depr in NGE 65	7.5382	01 Jan 99 2256	5.0609	0.043
Junc-2	7.5382	01 Jan 99 2256	5.0609	0.043
NGE-55	22.828	01 Jan 99 2252	14.717	0.143
55 thr 60	22.798	01 Jan 99 2300	14.717	0.143
NGE-60	17.688	01 Jan 99 2252	12.001	0.103
Junc-3	40.472	01 Jan 99 2256	26.718	0.247
DFD-20	67.902	01 Jan 99 2152	48.108	0.370
depr in DFD-20	59.661	01 Jan 99 2348	45.096	0.370
NGE-40	19.657	01 Jan 99 2148	14.276	0.102
Junc-4	19.657	01 Jan 99 2148	14.276	0.102
BKR-6	8.8671	01 Jan 99 2144	6.1582	0.049
6 thr 8/12	8.8384	01 Jan 99 2200	6.1582	0.049
BKR-8	10.717	01 Jan 99 2252	7.2608	0.063
Junc-10	19.517	01 Jan 99 2156	13.419	0.112
BKR-2	14.062	01 Jan 99 2148	10.640	0.069
BKR-4	10.414	01 Jan 99 2148	7.4590	0.055
Junc-5	24.476	01 Jan 99 2148	18.099	0.124
BKR-9	3.4596	01 Jan 99 2144	2.6097	0.017
BKR-10	14.468	01 Jan 99 2148	10.806	0.072
Junc-6	42.395	01 Jan 99 2148	31.514	0.213
BKR-12	5.5427	01 Jan 99 2136	4.0474	0.028
BKR-14	7.7154	01 Jan 99 2144	5.8216	0.038
Junc-7	75.050	01 Jan 99 2144	54.802	0.391
NGE-10	16.736	01 Jan 99 2256	11.570	0.096
Junc-8	16.736	01 Jan 99 2256	11.570	0.096
NGE-4	17.194	01 Jan 99 2144	12.446	0.089
Junc-9	17.194	01 Jan 99 2144	12.446	0.089
DFD-8	52.455	01 Jan 99 2256	36.849	0.294
depr in DFD-8	18.329	02 Jan 99 0052	28.564	0.294
DFD-4	19.458	01 Jan 99 2144	14.498	0.097
4 to 6	19.449	01 Jan 99 2148	14.498	0.097
DFD-6	14.019	01 Jan 99 2140	10.417	0.070
Junc-11	33.446	01 Jan 99 2144	24.915	0.167

Proposed Land Use with Proposed Detention

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 2-yr,2-hr Prop det

Start of Run : 01Jan99 0000   Basin Model : Dlfid inflt Prop det
End of Run : 01Jan99 0800   Met. Model : 2Hr-2Yr-Sew2000
Execution Time : 06Jun04 1913   Control Specs : 2-yr 2hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	34.592	01 Jan 99 0208	2.7490	0.067
W of NGE-90	1.4536	01 Jan 99 0310	0.67776	0.067
NGE-80	38.444	01 Jan 99 0212	3.1231	0.089
depr NGE-80	2.5426	01 Jan 99 0314	1.1411	0.089
NGE-85	41.164	01 Jan 99 0206	3.0033	0.085
Junc-1	42.603	01 Jan 99 0208	4.1444	0.174
NGE-65	1.8097	01 Jan 99 0214	0.084294	0.043
depr in NGE 65	0.10504	01 Jan 99 0302	0.040760	0.043
Junc-2	0.10504	01 Jan 99 0302	0.040760	0.043
NGE-55	1.5385	01 Jan 99 0222	0.078421	0.143
55 thr 60	1.4340	01 Jan 99 0228	0.078421	0.143
NGE-60	2.7203	01 Jan 99 0222	0.15709	0.103
Junc-3	4.0676	01 Jan 99 0224	0.23551	0.247
DFD-20	19.099	01 Jan 99 0220	1.1079	0.370
prop depr 20	0.20790	01 Jan 99 0348	0.093673	0.370
NGE-40	8.4764	01 Jan 99 0214	0.43682	0.102
Junc-4	8.4764	01 Jan 99 0214	0.43682	0.102
BKR-6	3.1466	01 Jan 99 0208	0.12017	0.049
6 thr 8/12	2.5305	01 Jan 99 0226	0.12017	0.049
BKR-8	1.8058	01 Jan 99 0220	0.095047	0.063
Junc-10	4.2227	01 Jan 99 0224	0.21522	0.112
Prop Det 6 & 8	0.0010000	01 Jan 99 0158	0.00050516	0.112
BKR-2	8.0093	01 Jan 99 0214	0.45901	0.069
BKR-4	4.0549	01 Jan 99 0214	0.19937	0.055
Junc-5	12.064	01 Jan 99 0214	0.65838	0.124
BKR-9	2.4423	01 Jan 99 0208	0.11259	0.017
BKR-10	7.2368	01 Jan 99 0216	0.41938	0.072
Junc-6	21.368	01 Jan 99 0214	1.1903	0.213
BKR-12	4.1849	01 Jan 99 0202	0.14015	0.028
BKR-14	5.2967	01 Jan 99 0208	0.25116	0.038
Junc-7	28.027	01 Jan 99 0210	1.5822	0.391
NGE-10	2.5265	01 Jan 99 0230	0.18736	0.096
Prop Det 10	0.74304	01 Jan 99 0310	0.17320	0.096
NGE-4	9.2026	01 Jan 99 0208	0.38083	0.089
prop Det 4	1.9255	01 Jan 99 0230	0.36461	0.089
DFD-8	9.1950	01 Jan 99 0232	0.71906	0.294
prop det 8	0.19519	01 Jan 99 0418	0.083887	0.294
DFD-4	11.466	01 Jan 99 0210	0.56265	0.097
4 to 6	11.126	01 Jan 99 0214	0.56265	0.097
DFD-6	9.8208	01 Jan 99 0206	0.40429	0.070
Junc-11	19.449	01 Jan 99 0210	0.96694	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 10-yr,2-hr prop det

Start of Run	: 01Jan99 0000	Basin Model	: Dlfid inflt Prop det
End of Run	: 01Jan99 1200	Met. Model	: 2Hr-10Yr-Sew2000
Execution Time	: 06Jun04 1913	Control Specs	: 10-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	57.664	01 Jan 99 0208	4.8627	0.067
W of NGE-90	2.3250	01 Jan 99 0310	1.7456	0.067
NGE-80	66.993	01 Jan 99 0212	5.7717	0.089
depr NGE-80	31.950	01 Jan 99 0238	3.3737	0.089
NGE-85	71.017	01 Jan 99 0206	5.5502	0.085
Junc-1	73.344	01 Jan 99 0206	8.9239	0.174
NGE-65	8.6793	01 Jan 99 0212	0.46749	0.043
depr in NGE 65	0.23904	01 Jan 99 0310	0.17847	0.043
Junc-2	0.23904	01 Jan 99 0310	0.17847	0.043
NGE-55	16.661	01 Jan 99 0216	0.94170	0.143
55 thr 60	15.667	01 Jan 99 0224	0.94170	0.143
NGE-60	15.754	01 Jan 99 0218	0.99956	0.103
Junc-3	31.018	01 Jan 99 0220	1.9413	0.247
DFD-20	77.146	01 Jan 99 0216	4.9525	0.370
prop depr 20	0.70000	01 Jan 99 0232	0.56760	0.370
NGE-40	28.218	01 Jan 99 0212	1.6591	0.102
Junc-4	28.218	01 Jan 99 0212	1.6591	0.102
BKR-6	12.659	01 Jan 99 0206	0.59343	0.049
6 thr 8/12	10.906	01 Jan 99 0222	0.59343	0.049
BKR-8	10.261	01 Jan 99 0216	0.60477	0.063
Junc-10	20.549	01 Jan 99 0220	1.1982	0.112
Prop Det 6 & 8	2.5092	01 Jan 99 0258	0.45955	0.112
BKR-2	22.647	01 Jan 99 0212	1.4510	0.069
BKR-4	14.453	01 Jan 99 0210	0.81723	0.055
Junc-5	37.051	01 Jan 99 0212	2.2682	0.124
BKR-9	6.5909	01 Jan 99 0206	0.35589	0.017
BKR-10	21.660	01 Jan 99 0214	1.4006	0.072
Junc-6	64.559	01 Jan 99 0212	4.0247	0.213
BKR-12	11.431	01 Jan 99 0200	0.49739	0.028
BKR-14	14.383	01 Jan 99 0206	0.79392	0.038
Junc-7	84.846	01 Jan 99 0208	5.7755	0.391
NGE-10	13.215	01 Jan 99 0226	1.0391	0.096
Prop Det 10	4.1419	01 Jan 99 0304	1.0289	0.096
NGE-4	28.993	01 Jan 99 0206	1.4464	0.089
prop Det 4	7.8276	01 Jan 99 0226	1.4394	0.089
DFD-8	42.995	01 Jan 99 0228	3.5509	0.294
prop det 8	1.0968	01 Jan 99 0412	0.77956	0.294
DFD-4	33.182	01 Jan 99 0208	1.8791	0.097
4 to 6	32.475	01 Jan 99 0212	1.8791	0.097
DFD-6	27.145	01 Jan 99 0204	1.3502	0.070
Junc-11	56.802	01 Jan 99 0208	3.2293	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 25-yr,2-hr Prop det

Start of Run : 01Jan99 0000   Basin Model : Dlfid inflt Prop det

End of Run : 01Jan99 0500   Met. Model : 2Hr-25Yr-Sew2000

Execution Time : 06Jun04 1913   Control Specs : 25-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	74.554	01 Jan 99 0208	6.4778	0.067
W of NGE-90	2.6933	01 Jan 99 0312	0.69843	0.067
NGE-80	88.366	01 Jan 99 0210	7.8329	0.089
depr NGE-80	75.888	01 Jan 99 0222	3.7973	0.089
NGE-85	93.102	01 Jan 99 0206	7.5323	0.085
Junc-1	140.41	01 Jan 99 0220	11.330	0.174
NGE-65	15.442	01 Jan 99 0210	0.89255	0.043
depr in NGE 65	6.1676	01 Jan 99 0232	0.40800	0.043
Junc-2	6.1676	01 Jan 99 0232	0.40800	0.043
NGE-55	34.072	01 Jan 99 0214	2.0520	0.143
55 thr 60	32.326	01 Jan 99 0222	2.0520	0.143
NGE-60	29.353	01 Jan 99 0216	1.9630	0.103
Junc-3	60.967	01 Jan 99 0220	4.0150	0.247
DFD-20	132.88	01 Jan 99 0214	9.0003	0.370
prop depr 20	0.70000	01 Jan 99 0214	0.17475	0.370
NGE-40	46.291	01 Jan 99 0210	2.8909	0.102
Junc-4	46.291	01 Jan 99 0210	2.8909	0.102
BKR-6	21.519	01 Jan 99 0206	1.1042	0.049
6 thr 8/12	18.959	01 Jan 99 0222	1.1042	0.049
BKR-8	19.002	01 Jan 99 0214	1.1877	0.063
Junc-10	36.953	01 Jan 99 0218	2.2919	0.112
Prop Det 6 & 8	8.2776	01 Jan 99 0250	1.2239	0.112
BKR-2	35.478	01 Jan 99 0212	2.3976	0.069
BKR-4	24.088	01 Jan 99 0210	1.4531	0.055
Junc-5	59.513	01 Jan 99 0210	3.8507	0.124
BKR-9	10.139	01 Jan 99 0206	0.58810	0.017
BKR-10	34.586	01 Jan 99 0212	2.3531	0.072
Junc-6	103.36	01 Jan 99 0210	6.7919	0.213
BKR-12	17.593	01 Jan 99 0200	0.85052	0.028
BKR-14	22.240	01 Jan 99 0206	1.3119	0.038
Junc-7	136.07	01 Jan 99 0206	10.178	0.391
NGE-10	24.363	01 Jan 99 0224	1.9838	0.096
Prop Det 10	8.8412	01 Jan 99 0300	1.4528	0.096
NGE-4	46.547	01 Jan 99 0204	2.5203	0.089
prop Det 4	14.227	01 Jan 99 0226	2.0884	0.089
DFD-8	77.510	01 Jan 99 0226	6.6052	0.294
prop det 8	1.6055	01 Jan 99 0416	0.33809	0.294
DFD-4	52.250	01 Jan 99 0208	3.1569	0.097
4 to 6	51.254	01 Jan 99 0212	3.1569	0.097
DFD-6	41.992	01 Jan 99 0204	2.2684	0.070
Junc-11	89.728	01 Jan 99 0206	5.4254	0.167

HMS * Summary of Results

Project : Delafield Reg Det CD   Run Name : 100-yr,2-hr prop det

Start of Run : 01Jan99 0000   Basin Model : Dlfid inflt Prop det
End of Run : 01Jan99 0500   Met. Model : 2Hr-100Yr-Sew2000
Execution Time : 06Jun04 1912   Control Specs : 100-yr 2-hr event

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
NGE-90	105.45	01 Jan 99 0206	9.5120	0.067
W of NGE-90	3.8706	01 Jan 99 0312	0.97733	0.067
NGE-80	127.73	01 Jan 99 0210	11.751	0.089
depr NGE-80	125.89	01 Jan 99 0214	7.6887	0.089
NGE-85	133.56	01 Jan 99 0204	11.300	0.085
Junc-1	252.67	01 Jan 99 0210	18.989	0.174
NGE-65	30.079	01 Jan 99 0210	1.9000	0.043
depr in NGE 65	19.954	01 Jan 99 0224	1.4103	0.043
Junc-2	19.954	01 Jan 99 0224	1.4103	0.043
NGE-55	74.389	01 Jan 99 0212	4.8675	0.143
55 thr 60	71.311	01 Jan 99 0220	4.8675	0.143
NGE-60	59.733	01 Jan 99 0214	4.2811	0.103
Junc-3	129.99	01 Jan 99 0218	9.1486	0.247
DFD-20	253.37	01 Jan 99 0214	18.334	0.370
prop depr 20	2.6684	01 Jan 99 0344	0.57926	0.370
NGE-40	83.971	01 Jan 99 0210	5.6626	0.102
Junc-4	83.971	01 Jan 99 0210	5.6626	0.102
BKR-6	40.329	01 Jan 99 0204	2.2979	0.049
6 thr 8/12	36.363	01 Jan 99 0220	2.2979	0.049
BKR-8	38.368	01 Jan 99 0212	2.5902	0.063
Junc-10	72.921	01 Jan 99 0216	4.8881	0.112
Prop Det 6 & 8	18.059	01 Jan 99 0248	3.1692	0.112
BKR-2	61.858	01 Jan 99 0210	4.4591	0.069
BKR-4	44.368	01 Jan 99 0208	2.9011	0.055
Junc-5	106.06	01 Jan 99 0210	7.3602	0.124
BKR-9	17.361	01 Jan 99 0204	1.0937	0.017
BKR-10	61.206	01 Jan 99 0212	4.4490	0.072
Junc-6	183.27	01 Jan 99 0210	12.903	0.213
BKR-12	30.053	01 Jan 99 0158	1.6361	0.028
BKR-14	38.057	01 Jan 99 0204	2.4399	0.038
Junc-7	247.03	01 Jan 99 0206	20.148	0.391
NGE-10	49.431	01 Jan 99 0222	4.2230	0.096
Prop Det 10	17.250	01 Jan 99 0300	3.1981	0.096
NGE-4	82.990	01 Jan 99 0204	4.9368	0.089
prop Det 4	23.712	01 Jan 99 0226	4.1303	0.089
DFD-8	154.34	01 Jan 99 0224	13.746	0.294
prop det 8	2.8399	01 Jan 99 0418	0.61145	0.294
DFD-4	91.268	01 Jan 99 0206	5.9689	0.097
4 to 6	89.824	01 Jan 99 0210	5.9689	0.097
DFD-6	72.285	01 Jan 99 0202	4.2890	0.070
Junc-11	156.92	01 Jan 99 0206	10.258	0.167