Section 9
Recommended Storm Water Management Plan

9.1 Option Selection

Section 8 of this Storm Water Management Master Plan presents several options to improve the storm water drainage and storm water quality for the City of New Berlin. The options considered and described present a range of effectiveness, as well as a range of cost. The recommended storm water management plan includes the options which are selected for implementation.

The recommended storm water management plan consists of three major elements;

- storm water drainage and flood control,
- water quality improvement, and
- urban land development.

A variety of structural and non-structural measures have been selected for implementation which will effectively and efficiently meet the goals and objectives of this plan, reduce flooding and drainage problems, and improve the quality of storm water runoff. The plan requires an effective operation and maintenance plan and a drainage concern response strategy. The selected storm water management plan is also based on the adoption and enforcement of a comprehensive storm water ordinance. Lack of the enforcement of the storm water ordinance or lack of implementation of the operation and maintenance plan will greatly reduce the effectiveness of the recommended plan and its ability to meet the stated and accepted goals and objectives presented in Section 2. The recommended plan is described in the following sections of this report and is shown on Plate 2 in Appendix A.

9.2 Storm Water Drainage and Flood Control Plan

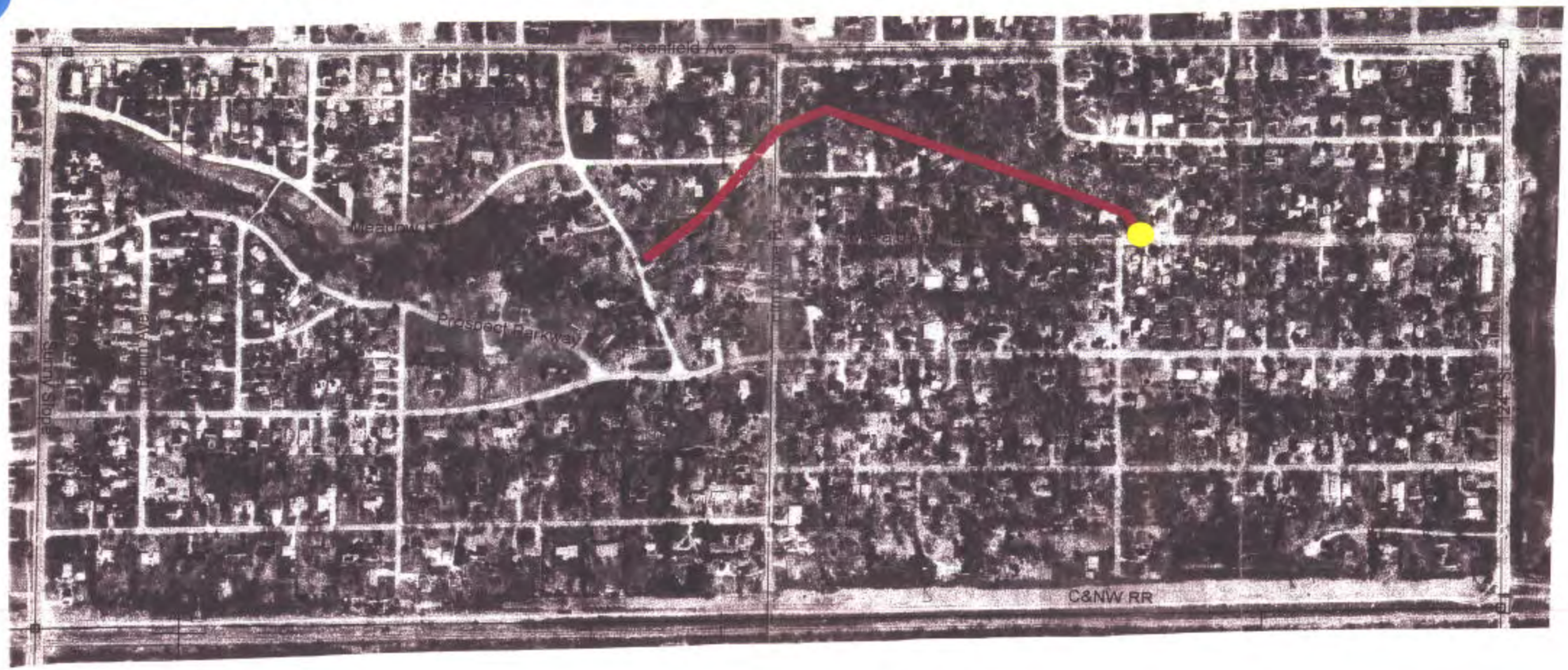
9.2.1 Primary Flooding Problems

The storm water drainage and flood control options evaluated include detention/storage measures or hydraulic system improvements which mitigate storm water drainage and flooding problems. The selected storm water drainage and flood control plan will provide a balance between protection against structural flooding in the 100-year storm event and public expenditure of funds.

The recommended flood control projects are presented in Table 9-1. The recommended flood control projects, including detention basin and channel improvement locations, are shown on Figures 9-1 through 9-7.

Figure 9-1
PROBLEM AREA UNDERWOOD 1 & 2a:
Underwood Creek at Meadow Lane &
Underwood Creek near Elm Grove Road

STORAGE FACILITY IN BROOKFIELD
IMPLEMENTED IN UNDERWOOD 2a OPTION



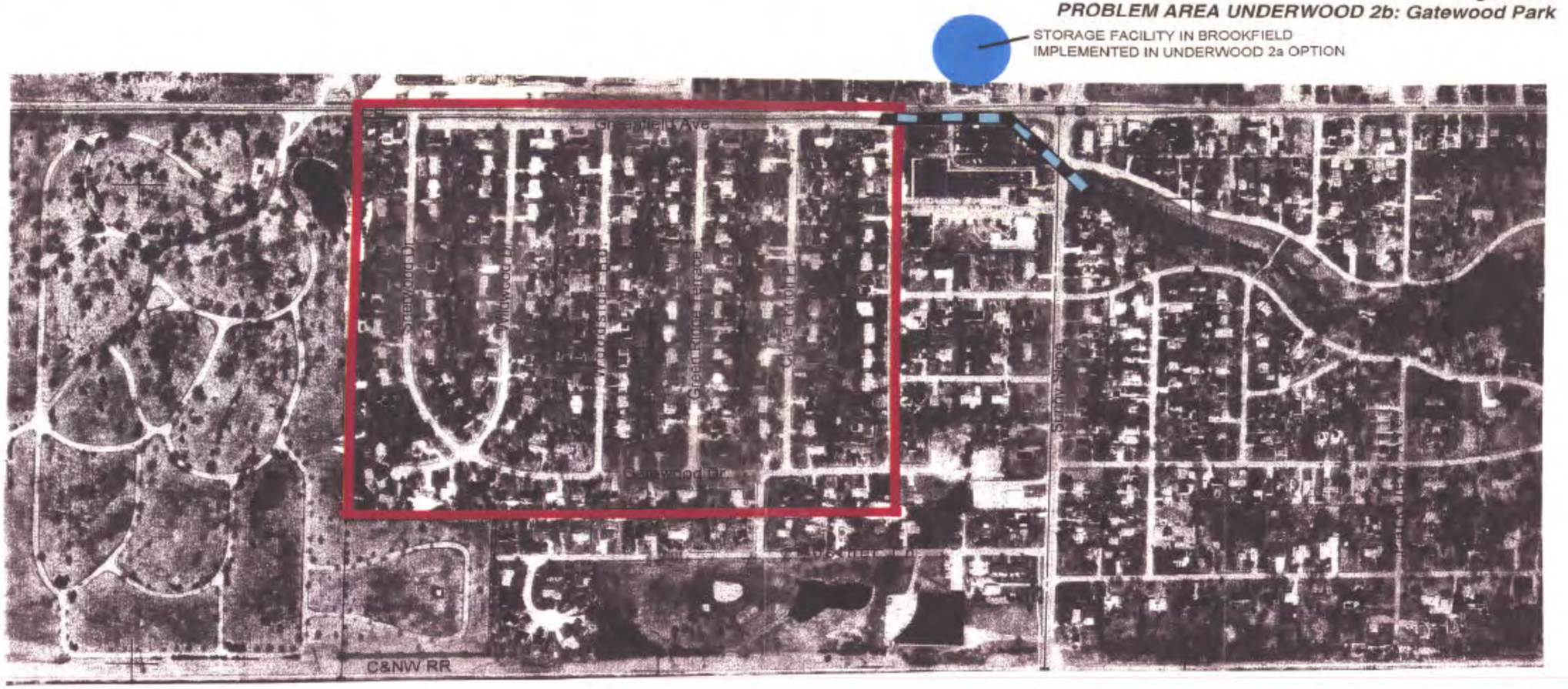
AREA OF CONCERN NOTED BY THE CITY OF NEW BERLIN	
STORM SEWER ENTRANCE IMPROVEMENTS	
STORAGE FACILITY IN BROOKFIELD	

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST, SECTION 1
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

SCALE 1" = 400'
NORTH
0 200 400

Figure 9-2

PROBLEM AREA UNDERWOOD 2b: Gatewood Park



REGION OF CONCERN NOTED BY THE CITY OF NEW BERLIN	
NEW STORM SEWER ADDITION	
STORAGE FACILITY IN BROOKFIELD	

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST SECTIONS 1&2
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

SCALE 1" = 400'

NORTH

0 200 400

Figure 9-3
PROBLEM AREA ROOT 1: Upper Root River - 130th Block of Park Avenue

NEW CULVERT INSTALLATION	●
CHANNEL EXPANSION	▬

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST SECTION 1
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

SCALE 1" = 400'

NORTH

0 200 400

Figure 9-4
PROBLEM AREA ROOT 2: Upper Root River - 132nd Street to Lagoon Road along Cleveland Avenue

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST, SECTION 12
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

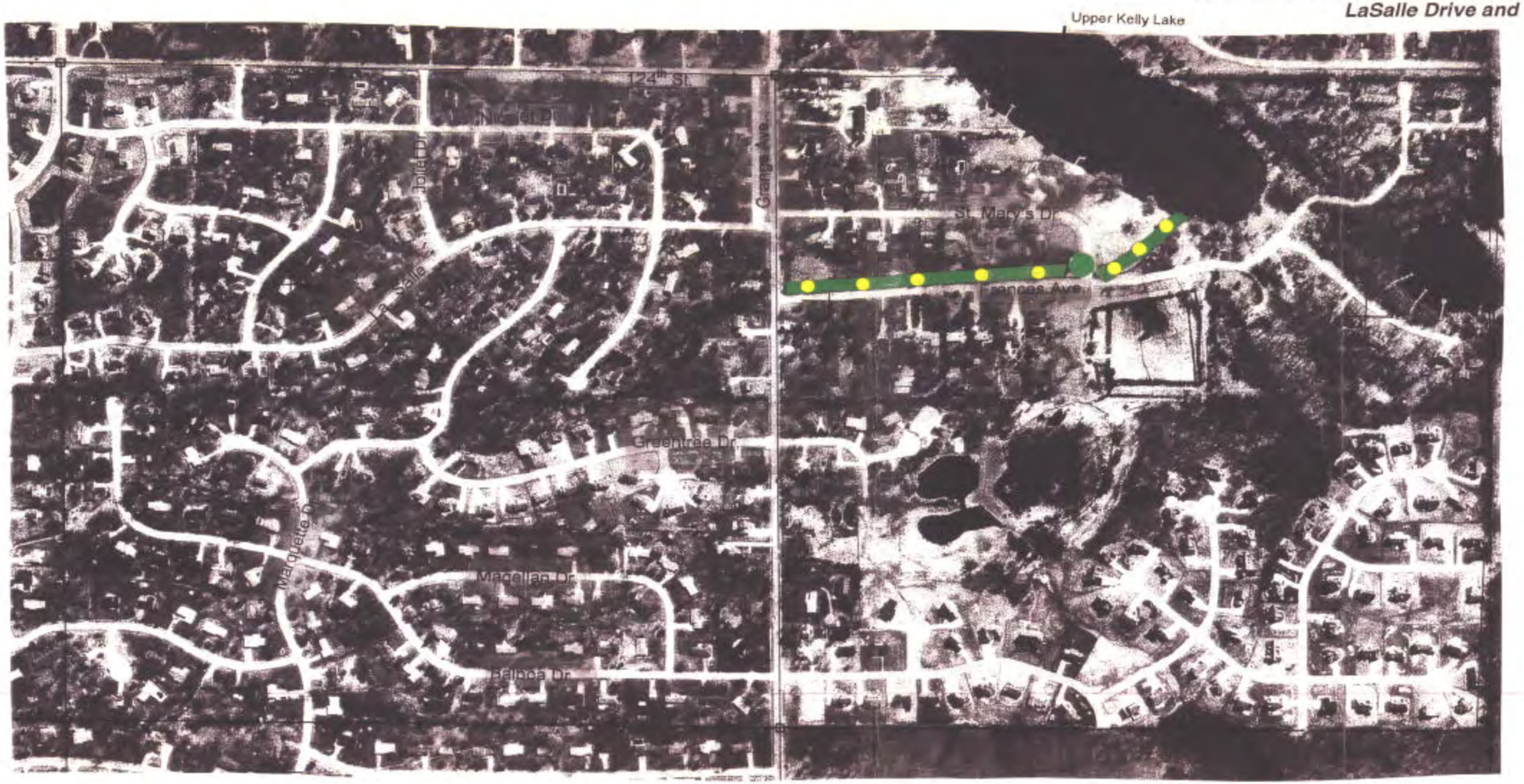
FLOODING STREAMBANK	
ON-LINE DETENTION STORAGE	
FLOOD PLAIN LOWERING	

SCALE 1" = 400'

NORTH

0 200 400

Figure 9-5
PROBLEM AREA ROOT 3: Upper Root River - LaSalle Drive and Grange Ave.



1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST, SECTIONS 25 & 36
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

NEW CULVERT INSTALLATION	
FLOOD PLAIN LOWERING	

SCALE 1" = 400'

NORTH

0 200 400

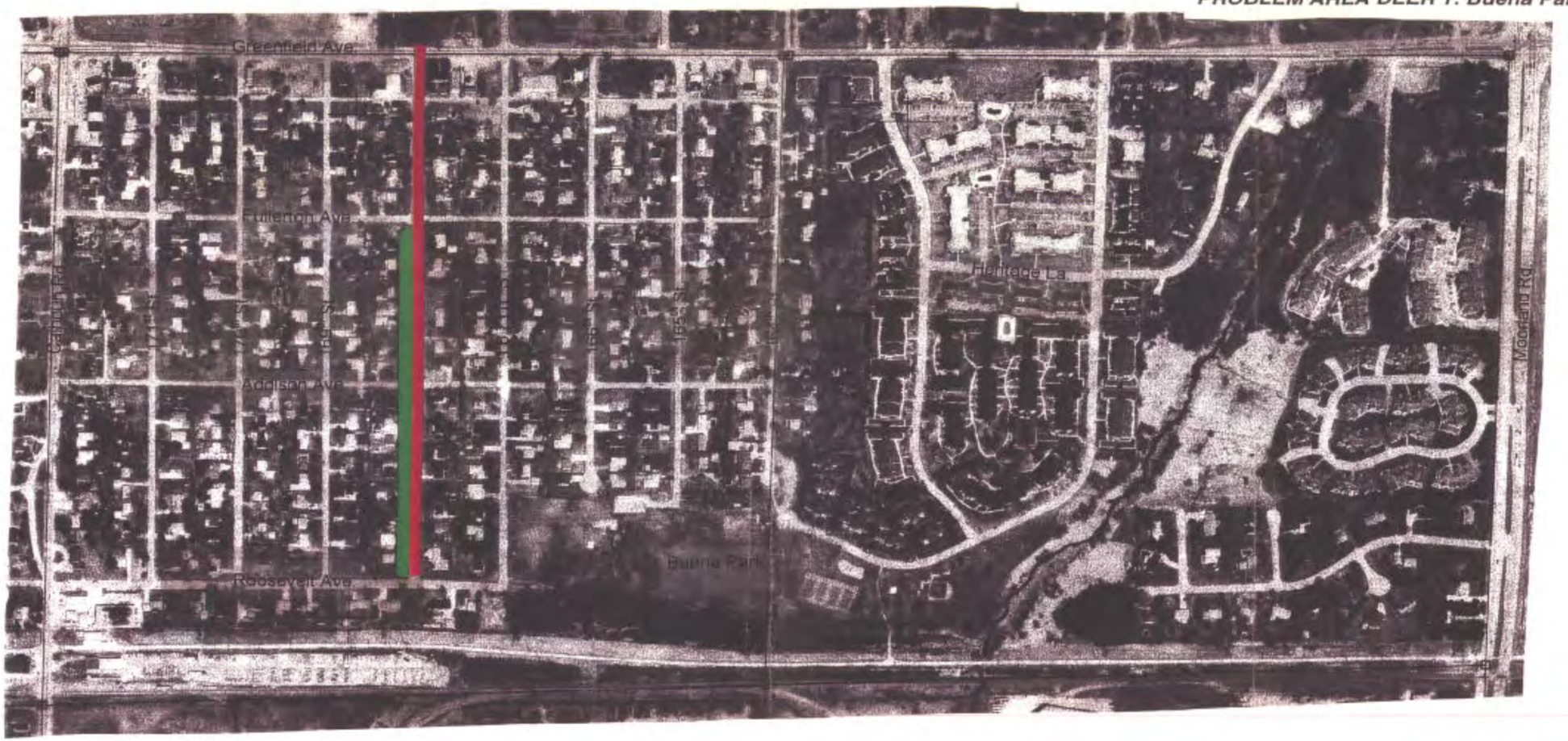
Figure 9-6
PROBLEM AREA ROOT 4: Upper Root River - Honey Lane

YARD FLOODING	
DITCH REGRADING	

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST SECTIONS 1&2
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

SCALE 1" = 400'
NORTH
0 200 400

Figure 9-7
PROBLEM AREA DEER 1: Buena Park



AREA OF CONCERN NOTED BY THE CITY OF NEW BERLIN	
DITCH RECONSTRUCTION	

1995 ORTHOGRAPH OF
TOWNSHIP 6 NORTH, RANGE 20 EAST, SECTION 3
STORM WATER MANAGEMENT MASTER PLAN
CITY OF NEW BERLIN, WAUKESHA COUNTY

SCALE 1" = 400'

NORTH

0 200 400

The selected alternatives generally meet Objective No. 2 by providing storm water drainage and flood control facilities which prevent flood damages to property, prevent health and safety hazards, and prevent drainage -related nuisance and inconvenience at the most effective cost. The selected alternatives will provide a level of protection against the 100-year storm in most of the problem areas identified.

Table 9-1: Selected Drainage and Flood Control Plan

Problem Number	Problem Summary	Selected Alternative	Level of Protection
UNDERWOOD 1 *(see Figure 9-1)*	Along Meadow Lane between 128th and 124th Sts. The South Branch of Underwood Creek is enclosed in a storm sewer. Overflow of the box culvert entrance at 124th St. and Meadow Land floods basements and backyards. There are numerous reports of house yard and street flooding associated with this enclosed channel.	Reduce flow with upstream storage recommended as part of UNDERWOOD 2a, increase conveyance capacity of the storm sewer entrance, including a sloped trash rack which is less susceptible to debris clogging.	100 year
UNDERWOOD 2a *(see Figure 9-1)*	Overbank flooding of yards and homes along the South Branch of Underwood Creek beginning about 500 feet upstream of Arcadian Drive. Flooding southwest of the intersection of Elm Grove and Meadow Lanes.	30 acre-foot storage facility located north of Greenfield Avenue in the City of Brookfield. Also provides necessary storage for Problem UNDERWOOD 1.	100 year
UNDERWOOD 2B *(see Figure 9-2)*	Yard, street, and basement flooding in the Gatewood Park neighborhood.	Additional 60-inch storm sewer to serve Gatewood Park area. Lower floodplain south of Grange Avenue.	25 year[1]
ROOT 1 *(see Figure 9-3)*	One residence experiences flooding along Park Avenue near Elm Grove Road. Yard flooding and erosion in backyards on the north side of Park Avenue.	Installation of new culvert at Graham St. and channel expansion between Graham St. and Elm Grove Road.	25 year[1]
ROOT 2 *(see Figure 9-4)*	15 homes are within the floodplain in the area bounded by Cleveland avenue, national avenue, 124th Street, and 132nd Street. Road flooding on Lagoon Road north of Cleveland Avenue. Washout of private bridge at 128th Street and Cleveland Ave.	Online detention storage at four locations in the area and floodplain lowering.	100 year
ROOT 3 *(see Figure 9-5)*	House flooding upstream of Grange Avenue near Francis Avenue.	Replace culverts at St. Mary=s Drive and lower floodplain south of Grange Avenue.	100 year
ROOT 4 *(see Figure 9-6)*	Yard flooding and erosion near Honey Lane and Elm Grove Road. Flooding of one residence and several yards east of the intersection at Elm Grove and Honey Lane.	Regrade roadside and railroad ditches in the area.	10 year[1]
DEER 1	Six residence experience structural flooding along 168th St. in the Buena Park	Reconstruct ditches with some segments of storm sewer from Fullerton	10 year[1]

Problem Number	Problem Summary	Selected Alternative	Level of Protection
(see Figure 9-7)	neighborhood south of Greenfield Avenue. The flooding is caused by inadequate drainage. Sump pumps discharge to the drainage ditch and lawn clipping and yard waste contribute to culvert blockage.	to Roosevelt. Also redirect sump pumps to lawn areas rather than direct discharge to the drainage ditches. Clean debris from ditches and culverts	

Notes:[1] an alternative to achieve 100-year level of protection was not considered economically feasible.

9.2.2 Culvert Replacement Program

In order to reduce localized flooding problems, culverts which are considered undersized are selected for replacement. The culvert replacement program includes 32 primary culverts which either cause road overtopping in excess of 6-inches in the 100-year storm; cause overtopping of a main arterial in the 100-year storm; or which do not provide sufficient capacity for the 100-year storm. The culvert replacement program also includes 83 secondary culverts which do not have sufficient capacity for the 10-year recurrence interval storm event. The culverts in the primary and secondary storm water management system that are designated for replacement are listed in Table 7-2 and 7-3, respectively.

9.2.3 Drainage Ditch Improvements

In order to improve the efficiency of the drainage ditch system, the drainage ditch problem areas identified in Section 7.4, listed in Table 7-4, should be repaired. Repair of the ditch areas will include erosion protection, restabilization, clearing of sedimentation, and collection of accumulated debris.

9.3 Storm Water Quality Improvement Plan

The storm water quality alternatives evaluated include pollution source control measures and pollution treatment measures. A combination of treatment and source control measures are selected to meet the objectives and criteria presented in Section 2. The selected source control and treatment control measures are presented in Table 9-2.

Table 9-2: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments
Source Control Measures			
Develop in Accordance with	The change from existing to future land use, based on the zoning map.	sediment 12% phosphorous 6%	As new areas are developed the land use will transform from agricultural to

Table 9-2: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments
the Zoning Map		lead -34%	urban land uses. Sediment and phosphorous loading will be reduced. However, due to the more urban land use, the metals loading is expected to increase.
Adopt and enforce storm water ordinance	The draft storm water ordinance requires new development to provide storm water quality improvement.	sediment 9% phosphorous 5% lead 14%	The storage and water quality requirements will be essential in eliminating new flooding or water quality problems caused be urban development.
Industrial Best Management Practices	Industries regulated by NR216 are required to implement best management practices. Additionally industries which are potential significant pollutant contributors should implement applicable suggested best management practices.	sediment 4% phosphorous 0.3% lead 3%	To ensure we achieve the estimated pollutant reduction, routine monitoring/reporting may be necessary.
Roadway Pavement Sweeping	Arterials and Industrial Park Area: Seasonal sweeping program (weekly from April through May, bi-weekly June through August, monthly from September through November and during March)	sediment 1% phosphorous 0.5% lead 3%	--
Ice Management Practices	implement improved salt distribution methods, train personnel involved with salt distribution	variable	Ice management should involve a policy decision on the part of the common council regarding the frequency, level, extent of deicing.
Catch Basin Cleaning / Retrofit	Clean catch basins twice per year / install catch basins in new development or redeveloping areas which will be serviced by storm sewer.	sediment 0.04 tons/acre drained lead 0.05 lbs./ acre drained	--
Landscape	Implement environmentally friendly landscape practices in institutional	sediment 0.4% phosphorous 2%	Examples of environmentally friendly practices include increased turf

Table 9-2: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments
Practices	yards, park areas, school yards, city building yards, and vegetated median strips.	lead 2%	height, reduced week control, replacement of turf with low maintenance ground cover or perennials, and reduced fertilized application.
Snow Storage Practices	Locate snow storage areas in a well vegetated area at least 200 feet from a drainage way or storm sewer inlet	variable	Implementation of this practice provides the snow melt an opportunity to filter though the vegetated area which will remove a portion of the pollutant loading.
Erosion Control Ordinance	Increase the construction site inspection program, and train inspectors on erosion control techniques.	Variable	--
Agricultural Practices	Encourage use of Agricultural BMPs such as conservation tillage and adopt a shoreline management ordinance.	sediment 6.5% phosphorous 7% lead 0.1%	County may be primarily responsible for implementation of agricultural practices.
Streambank Stabilization	Stabilize key streambanks as identified in Section 7	variable	streambank stabilization measures may include: vegetation, erosion protection, and debris removal is designated areas.
Public Education and Information Program	Provide information to the general public and industries on the Storm Water Management Plan	variable	Topics may include: Lawn care, pet waste handling, other best management practices, as well as the NR216 requirements. May utilize newsletters, newspaper articles, school programs, cable TV and use of preprinted materials and videos.
Treatment Measures			
Water Quality Detention Basin	Construct a water quality detention basin west of Kelly Lake	sediment 2% phosphorous 1.5% lead 3%	--
Retrofit Wetland	Retrofit three prior converted wetlands into storm water treatment wetlands	sediment 2% phosphorous 3%	

Table 9-2: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments
	for highway runoff. Locations: north of I-43 west of Calhoun, north of I-43 west of Moorland, south of I-43 east of Moorland	lead 15%	
Retrofit Wetland	Retrofit one prior converted wetland within Basin 5A020 south of National Avenue east of Moorland	sediment 1% phosphorous 1% lead 0.5%	Will collect runoff from agricultural and residential land use areas.
Retrofit Wetland	Retrofit one prior converted wetland within Basin 3A060 north of College west of Sunny Slope east of Small	sediment 0.2% phosphorous 0.1% lead 0.9%	Will collect runoff from commercial land use area.

The recommended options will result in the following approximate reductions in the existing total annual pollutant loadings from the study area: sediment 37 percent, phosphorous 26 percent, and lead 7 percent. Additional pollutant reductions will be provided for storm water management controls with variable pollutant reduction levels such as public information and education and increased erosion control inspections.

The selected plan will result in a significant reduction in pollutant loadings to the Root, Upper Fox, and Menomonee Rivers and Muskego - Wind Lakes. However, the reduction criteria presented in the Non-point Source Control Plan for the Priority Watersheds will not be met. The recommended level of pollutant reduction in the Non-point Source Control Plans is 50 to 75 percent for sediment, 30 to 70 percent for nutrients, and 40 to 53 percent for toxics, such as lead. The pollutant reduction goal is very difficult to achieve.

9.4 Regional Storage Opportunities

The regional storage options evaluated should be considered to mitigate the cumulative impacts of the existing and future development is an area. Impediments to implementation of regional storage include acquisition of land and the costs of construction and maintenance. Four regional detention areas, located in the Tess Corners Creek and Poplar Creek subwatersheds, were evaluated as part of this plan. Three of the sites are considered practical for implementation based on cost and effectiveness in flow reduction. The fourth site, (RD-2) served a relatively small drainage area and the site contained significant large wetland areas. It was determined that site RD-2 would not be an effective regional detention site and would be very costly to develop. The practical sites are listed below:

- RD-1, 40 acre site in the Tess Corners Creek watershed near Sunny Slope and College.
- RD-3, 200 acre site near Coffee Road and Calhoun Road.
- RD-4, 236 acre site located South of the Industrial Park South of Cleveland Avenue along Calhoun Road.

Additional information related to the regional detention sites is presented in Table 9-3.

Implementation of these regional storage areas should be evaluated on a case-by-case basis as development is anticipated to occur in the drainage areas. Each of these sites contains some wetland and floodplain areas which may affect their feasibility and development cost. The impact of these and other regulatory issues including endangered species and archaeological resources has not been investigated.

Regional storage areas recommended in the *Stormwater Management Plan for the Deer Creek Watershed* (Bonestroo Rosene Anderlik & Associates, 1993) and in the *Westridge Stormwater Management Plan* (Ruekert/Mielke 1995) should also be considered for implementation. Information related to the regional storage sites recommended in these storm water management plans is presented in Table 9-3. The location of the ponds is shown on the maps presented in Appendix J. The related storm water management plan should be referred to for more detailed information.

Table 9-3: Regional Detention Areas

Site Identification	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost	Annual Operations and Maintenance Cost
RD-1	Northeast side of Tess Corners Creek, west of Sunny Slope Rd.	1,570	260	$2,651,000 [1]	
RD-3	West side of Poplar Creek, south of Coffee Rd.	2,150	200	$8,430,030 [1]	
RD-4	East of Calhoun Rd., north of Coffee Rd.	2,520	236	$13,504,870 [1]	
Regional ponds recommended in the Stormwater Management Plan for the Deer Creek Subwatershed prepared by Bonestroo Rosene Anderlick & Associates [2]					
NP-1	NW & NE1/4 of Section 3	not available	1,64.3	$971,000	not available
CP-1	NW1/4 of Section 11	not available	0.3	not available	not available
CP-2	NW1/4 of Section 11	not available	11.9	not available	not available
CP-3	NE1/4 of Section 10	not available	24.1	not available	not available
CP-4	SW1/4 of Section 3	not available	9.9	$244,000	not available
CP-5	SW1/4 of Section 3	not available	10.3	$171,000	not available
CP-6	SW1/4 of Section 3	not available	45.8	$180,000	not available
CP-7	SE1/4 of Section 3	not available	50.5	not available	not available
CR-2		not available	not available	$10,000	not available
CR-3		not available	not available	$26,000	not available
SCP-1	SW1/4 of Section 11	not available	0.4	$74,000	not available
SCP-2	SW1/4 of Section 11	not available	2.2	$24,000	not available
SCP-3	SW1/4 of Section 11	not available	1.2	$37,000	not available

Table 9-3: Regional Detention Areas

Site Identification	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost	Annual Operations and Maintenance Cost
SCP-4	SW1/4 of Section 11	not available	5.3	$144,000	not available
SCP-5	SW1/4 of Section 11	not available	4.8	not available	not available
SCP-6	SW1/4 of Section 11	not available	34.9	$466,000	not available
SCP-7	SE1/4 of Section 10	not available	5.4	$32,000	not available
SCP-8	SE1/4 of Section 10	not available	8.8	$50,000	not available
CR-1	SE1/4 of Section 10	not available	25.1	$10,000	not available
SP-1	SW1/4 of Section 23	not available	11.2	$4,000	not available
SP-2	N1/2 of Section 23 & S1/2 of Section 14	not available	90.9	$516,000	not available
SP-3	SW1/4 of Section 14	not available	10.3	$41,000	not available
SP-4	SE1/4 of Section 14	not available	13	$54,000	not available
SP-5	SW1/4 of Section 14	not available	4.4	$535,000	not available
CR-4	Section 11,14,&23	not available	7.5	$26,000	not available
Regional ponds recommended in the Westridge Stormwater Management Plan prepared by Ruekert/Mielke [2]					
G3	NE1/4 of Section 34	not available	18.5	not available	not available
H1/2	SW1/4 of Section 23	58.5	3.61	not available	not available
H1/4	NW1/4 of Section 26	68	6.92	not available	not available
	NW1/4 of Section 26	90.4	3.34	not available	not available

Table 9-3: Regional Detention Areas

Site Identification	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost	Annual Operations and Maintenance Cost
H1/5					
H1/6	NE1/4 of Section 27	27.9	3.54	not available	not available
H2/1	SE1/4 of Section 27	87.6	5.01	not available	not available
H2/3	SW1/4 of Section 26	not available	3.00	not available	not available
H3/2	NE1/4 of Section 27	not available	7.08	not available	not available
H3/3	SW1/4 of Section 27	not available	13.32	not available	not available
H3/4	NE1/4 of Section 27	not available	3.10	not available	not available

Notes:
1 - These costs are for planning purposes only and do not include land acquisition, construction site erosion control, unknown environmental constraints, legal fees, or utility relocation costs which may be associated with the plan.

2- The recommendations presented in reports prepared by others were analyzed as part of this plan. The costs listed in this table have not been updated. The plans should be referred to far additional information.

9.5 Urban Land Development Guidelines

The stream corridor is a measure of the health of a watershed. Highly urbanized areas impact the stream with major changes in the way storm water runoff functions. Peak discharge becomes higher and faster and low flow becomes lower and more erosive. Bridges and culverts create backwater effects and leave sedimentation blockage at the upstream side. Water quality and habitat are extensively degraded. Figure 9-8 shows the effect of urbanization. Guidelines for development are necessary to reclaim or prevent stream impacts.

Imperviousness is directly related to both quantity and quality of storm water runoff. A very low percent increase in roads, parking lots, and rooftops has been shown to effect streams - even as low as 10 to 20%. The challenge is to effectively plan the gradual development process at the local level. New Berlin is located at the high points of five watersheds. The smallest network of the watershed begins at the high point. The headwater streams at this local level have a regional impact. The following guidelines are described to mitigate the impacts of urban growth expected in the City of New Berlin and protect the headwater streams.

- Establishing site grading requirements and zoning restrictions
- Requiring buffer zones or green spaces along streams
- Establishing building setbacks distances from streams
- Defining allowable peak rates and volumes of discharge
- Protecting wetlands and other sensitive areas
- Providing water quality improvement
- Implement operations and maintenance activities

All of the guidelines are essential to minimize the creation of new flooding problems or further degradation of water quality because of new development. Under separate cover, a land development guideline manual has been developed to serve as a companion document to the storm water ordinance, as well as this plan. The manual is tailored to each subwatershed. The document is intended to be a tool a developer and the City will use as the City of New Berlin develops.

9.6 Cost Estimate for the Recommended Plan

The total capital cost for the recommended Plan is estimated to be $4,681,000. A summary of the estimated costs for the selected plan elements is presented in Table 9-4. The costs associated with the storm water management ordinance compliance will be paid by developers, not by the City of New Berlin or the WDNR. Also, the costs associated with industrial BMP=s will be incurred by industry.

Urbanization Impacts on Streams

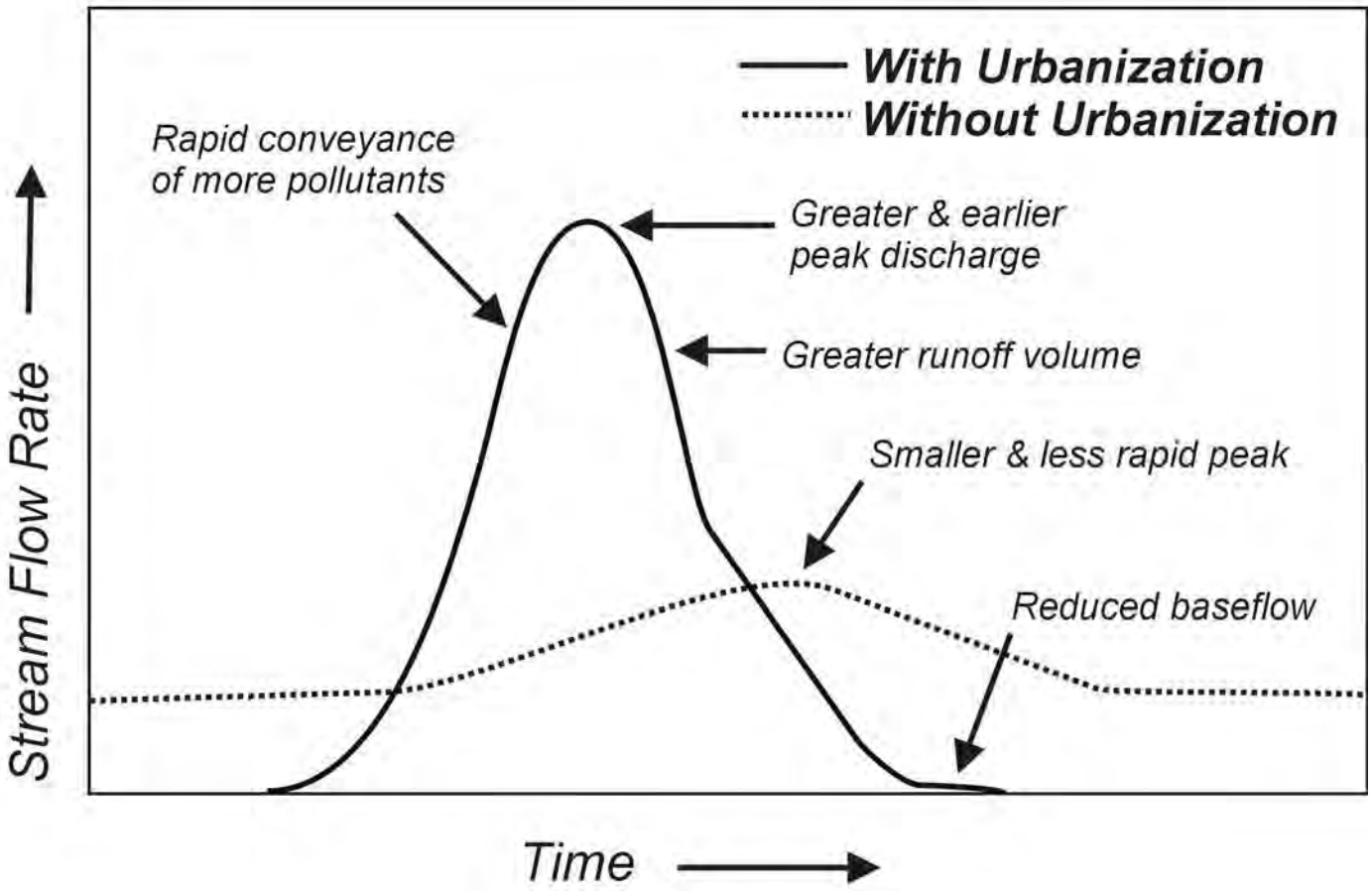


Figure 9-8

Table 9-4: Recommended Plan and Estimated Costs

Plan Component	City of New Berlin		Developers or Other		Total	
	Capital	Annual O& M	Capital	Annual O& M	Capital	Annual O& M
Drainage / Flood Control Plan						
UNDERWOOD 1: increased conveyance capacity at storm sewer entrance	$50,000-100,000	$8,000	--	--	$50,000-$100,000	$8,000
UNDERWOOD 2a: 30 acre-foot storage facility North of Greenfield in the City of Brookfield.	$790,000	$10,000	--	--	$790,000	$10,000
UNDERWOOD 2b: Additional 60-inch storm sewer to serve Gatewood Park area	$400,000	$1,000			$400,000	$1,000
ROOT 1: Installation of new culvert at Graham St. and channel expansion between Graham and Elm Grove Road.	$101,000	$1,000	--	--	$101,000	$1,000
ROOT 2: Online detention storage at four locations	$2,500,000	$10,000	--	--	$2,500,000	$10,000
ROOT 3: Replace culverts at St. Mary s Drive and lower floodplain south of Grange Ave.	$350,000	$1,000	--	--	$350,000	$1,000
ROOT 4: Regrade roadside and railroad ditches	$30,000	--	--	--	$30,000	--
DEER 1: Reconstruct ditches with segments of storm sewer from Fullerton to Roosevelt and redirect sump pump discharge to lawn areas.	$180,000	$2,000	Cost to home owners for redirection of sump pumps	--	$180,000	$2,000
Minor System Flooding Problems	To Be Determined	--	--	--	To Be Determined	--

Table 9-4: Recommended Plan and Estimated Costs

Plan Component	City of New Berlin		Developers or Other		Total	
	Capital	**Annual O& M**	**Capital**	**Annual O& M**	**Capital**	**Annual O& M**
Culvert Replacement and Ditch Repair Program (no water quality benefits)						
Replace/repair culverts	--	$50,000/yr	--	--	--	$50,000/yr
Repair Ditch	--	$25,000/yr	--	--	--	$25,000/yr
Water Quality Improvement Plan						
Implement Zoning Plan	--	--	--	--	--	--
Implement and enforce storm water ordinance / erosion control ordinance / shoreland ordinance	--	$10,000/yr	--	--	--	$10,000/yr
Industrial Best Management Practices and Extractive Land Use BMP's	--	--	cost will vary by industry/ cost paid by industry	cost will vary by industry/ cost paid by industry	--	--
Roadway Pavement Sweeping	--	$125,000/yr	--	--	--	$125,000/yr
Ice Management Practices	Variable		--	--	Variable	
Catch Basin Cleaning	$5,000 per new catch basin installed	$70/yr./catch basin cleaned *(assumed 200 basins cleaned/yr. for cost*	--	--	$5,000 per new catch basin installed	$70/yr./catch basin cleaned *(assumed 200 basins cleaned/yr. for cost estimate)*

Table 9-4: Recommended Plan and Estimated Costs

Plan Component	City of New Berlin		Developers or Other		Total	
	Capital	**Annual O& M**	**Capital**	**Annual O& M**	**Capital**	**Annual O& M**
		estimate)				
Landscape Practices	Variable		--	--	Variable	
Snow Storage Practices	Variable		--	--	Variable	
Agricultural Practices	Variable				Variable	
Streambank Stabilization	--	$250,000/yr	--	--	--	$250,000/yr
Public Education and Information Program	Variable		--	--	Variable	
Wet Detention Pond (Upper Kelly Lake)	to be determined	to be determined	--	--	to be determined	to be determined
Retrofit prior converted wetlands along I-43 (4.5 acre-feet)	$75,000	$10,000	possible cost share opportunity with WDOT	--	$75,000	$10,000
Retrofit prior converted wetland in basin 5A020 south of Grange Avenue, west of Sunny Slope Road (11 acre-feet)	$165,000	$10,000	--	--	$165,000	$10,000
Retrofit prior convert wetland in basin 3A060 east of Moorland Road, south of National Avenue (1 acre-foot)	$15,000	$10,000	--	--	$15,000	$10,000
Regulatory/Ordinance Program						
Compliance with the new ordinance*	--	--	costs will be incurred by	--	--	--

Table 9-4: Recommended Plan and Estimated Costs

Plan Component	City of New Berlin		Developers or Other		Total	
	Capital	Annual O& M	Capital	Annual O& M	Capital	Annual O& M
			developers			
Drainage/ Flood Control Plan	*$4,426,000*	*$108,000/yr*	--	--	*$4,426,000*	*$108,000/yr*
Culvert Replacement with Ditch Repair Program	--	*$200,000/yr*	--	--	--	*$200,000/yr*
Water Quality Improvement Plan	*$255,000**	*$429,000/yr*	--	--	*$255,000*	*$429,000/yr*
Regulatory / Ordinance Plan	--	--	--	--	--	--
TOTAL	*$4,681,000*	*$537,000/yr*	--	--	*$4,681,000*	*$537,000/yr*

Notes: These costs are for planning purposes only and do not include land acquisition, construction site erosion control unknown environmental constraints, legal fees, or utility relocation costs which may be associated with the plan. The cost of regional facilities is not included.

** the cost for new catch basins not included in the capital cost.*

9.7 Operations and Maintenance Program

The operations and maintenance (O&M) plan will provide the City with a means of addressing both the short and long term maintenance needs of its open channels, culverts, and detention facilities. Specifically, the program will identify needed maintenance activities and procedures, establish a schedule for maintaining individual system components, and define program management needs including costs and staffing. The prioritization of O&M activities for this project are divided into three levels of service based upon corrective, preventative, and aesthetic maintenance. The O&M activities are in Appendix H. A brief description of the O&M for each of these types of prioritization's is provided below:

9.7.1 Corrective Maintenance

Corrective Maintenance is performed on an emergency or as-needed basis when the integrity of a storm water drainage system is compromised. The focus of this type of maintenance is to protect the public health by repairing damages which threaten existing infrastructure or damage species and habitat. Corrective maintenance program for the City=s open channels, culverts, and detention facilities is provided in Appendix H.

9.7.2 Preventative Maintenance

Preventative maintenance is performed on a routine basis in order to ensure the proper operation of the Storm water drainage system. The intent of this type of maintenance is to continually retain the flow carrying capability of the Storm water drainage system. Preventative maintenance program for the City=s open channels, culverts, and detention facilities is provided in Appendix H.

9.7.3 Aesthetic Maintenance

Aesthetic maintenance is performed on a routine basis to enhance the appearance and appeal of the storm water drainage system. The goal of this type of maintenance is to provide the public with storm water facilities and components that enhance the community atmosphere. Aesthetic maintenance program for the City=s open channels, culverts, and detention facilities is provided in Appendix H.

9.7.4 Monitoring and Training Program

The adoption of a monitoring program is vital for insuring that the existing Storm water drainage system operates efficiently. As part of the monitoring program, a series of inspection forms can be used to identify areas within the drainage system to be monitored during each site visit. The benefit of utilizing such forms allows the City to compile a historical record of the Storm water drainage system, ensure a consistent means of gathering needed information, provide verification that the inspection was done routinely and proficiently, and identify areas where maintenance activities are needed and establish a schedule for their completion. A copy of inspection forms for stream evaluation, drainage swale inventory, storm water management ponds, storm water culverts, storm water open channels, storm water

drainage swales, and storm water infiltration facilities forms are provided in Appendix H.

The frequency for performing the inspections is between 1-2 times per year and after the occurrence of major storm events. A program could be set up by section as the City is conveniently located primarily within one township and range. One full time staff inspector is necessary to monitor approximately 1400 culverts (non-driveway), 34 miles of streams, and an extensive open channel ditch system.

To reduce the potential for improper inspection and maintenance, an inspector training and certification program should be implemented along with the monitoring program. By initializing such programs, the City benefits in two ways. First, by sending inspectors through the program, they become aware of the components, functions, and safety issues concerning each type of storm water drainage system. Second, by educating the inspectors about what to look for, they are able to identify potential problems before they escalate into more serious issues.

9.7.5 Drainage Concern Response Strategy

Resident complaints and concerns about drainage or pollution problems are important. A drainage investigation form has been developed to assist in establishing a reasonable response strategy. The first section is documented by clerical staff as the problem is called in. The second section is completed by the inspection staff which compiles the inventory needed to make decisions. The drainage problem type can be a prioritization mechanism for the maintenance action. The drainage investigation form is located in Appendix I.

9.7.6 Regulatory and Permit Issues

The WDNR provides regulatory review and permit approval on streams and creeks deemed navigable. Prior to any maintenance activity on navigable streams, proper regulatory approvals must be obtained. The WDNR has committed to identifying all navigable streams within the City of New Berlin by the end of 1999. (Greg Breese - WDNR; 229-0821) This will assist the corrective and preventative maintenance activities by knowing when regulatory permits are necessary.

9.7.7 Overall Maintenance Costs

For wet and dry detention ponds, the estimate of the annual maintenance costs (estimated at 3 times the surface area of the pond) range between $600-$1000 per maintained acre which includes the pond and surrounding buffer. Several ways to reduce costs include the management of the buffer zone as a meadow rather than a lawn, provide (if possible) on-site disposal, and provide a maintained access way to the facility at a minimum width of 10 feet.

A review of several wet pond dredging operations estimated a range in cost between $6.25 to $22.40 per cubic yard and an average dredging cost of $14 per cubic yard. This cost is based upon factors including size, accessibility, proximity to disposal site, and the method used to remove and transport the sediment. Costs associated for

smaller ponds (<100,000 cf) range between $5 and $10 per cubic yard. If hauling or landfilling is required the costs climb even higher by $5 to $10 per cubic yard and $15 to $20 per cubic yard respectively.

For dry detention ponds, the removal cost for cleaning will be lower than that of wet ponds. Actual costs for dry detention ponds range between $5 and $10 per cubic yard (1987 dollars). This is due to the elimination of dewatering, drag-line, and hydraulic dredging techniques needed for wet pond clean up. If hauling or landfilling is needed, the same unit costs apply as those found from wet detention ponds.

For open channels, the following costs are associated with operations and maintenance. Labor rates were estimated at $17 per hour; equipment costs at $200 per day; overhead and administrative costs at 3x raw labor; streambank repair and erosion control at $75 per linear foot; and plant replacement at $15 per plant.

For detention basins, the following costs as above for open channels with the addition of slope repair which was estimated at a lump sum of between $1,000 and $3,000 per year.

9.8 Storm Water Management Ordinance

The storm water management goals and objectives outlined in Section 2 require preventative actions be taken during land development activities. New development of land has a significant impact on storm water runoff and on storm water quality. A regulatory tool that can minimize that impact is a storm water ordinance. The intent of an ordinance would be to maintain, as nearly as possible, the pre-developed runoff characteristics, and to reduce storm water pollution. The ordinance would prevent new flooding and reduce stream erosion, siltation, and sedimentation. The WDNR has prepared a model storm water ordinance for voluntary local adoption. The Waukesha County Board adopted a revision of the model ordinance on March 24, 1998. The Waukesha County Stormwater Management Ordinance was developed by a Stormwater Advisory Committee and applies to unincorporated land in Waukesha County - not the City of New Berlin. Revisions to the current WDNR model storm water management ordinance are recommended and have been compared to the Waukesha County ordinance. Muskego, Menomonee Falls, and Germantown all have a similar over-detention water quantity policy. The recommended ordinance revisions include the following:

- The administering authority shall be the City of New Berlin Engineer.
- The applicability criteria shall apply to all land development activities greater then one acre.
- Other acceptable hydrologic and hydraulic design methods may include US EPA SWMM, US Army Corps HEC-1, or other approved methods.
- The maintenance of the storm water practices shall be the responsibility of the City of New Berlin.

- The 100-year, 24 hour peak rate of runoff after the proposed activities may not exceed the peak rate of runoff which would have resulted from the 10-year, 24 hour event occurring over the site with the land in pre-settlement state, with the pre-settlement state curve number being not greater than 77 for hydrologic soil group D, not greater than 70 for hydrologic soil group C, not greater than 55 for hydrologic soil group B, and not greater than 30 for hydrologic soil group A.

- Where on site detention is required for runoff control, the detention facilities shall safely contain and/or safely pass the runoff of a 100-year storm event of any duration through a v-notch weir control structure as practicable.

- An active storage volume equal to the runoff volume under developed condition from the 1-year, 24 hour event shall be created unless other storm water treatment practices are used. The active storage volume shall be discharged over the first 24 hours of the storm event or greater and that discharge control structure shall be submerged.

Design and specification shall be based on established and accepted procedures, and/or must conform to the standards set forth by the City Engineer. Any deviation from accepted procedures must be approved.