Final Report

Manitowoc Road Stormwater Management

Prepared for:

CITY OF MENASHA

Menasha

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1.0 Executive Summary

The City of Menasha is taking a proactive role by addressing stormwater related issues in the planning phases of newly acquired land. The City of Menasha has purchased property in the northeast quadrant of Oneida Street and Manitowoc Road. This property may serve as a regional detention facility that could attenuate flood flows and improve stormwater quality after the area is developed. The regional detention facility could accomplish stormwater management goals instead of the City having to enforce an ordinance for each individual new developer on the land.

The study area is located approximately between STH 441 and STH 114 on the north and south sides, respectively. The western side of the watershed is along the USH 10 (Oneida Street) corridor and extends east to about Deerhaven Drive (Figure 2-1). The goal of this study was to analyze a 330 acre watershed and estimate the size and location of facilities that will detain and treat stormwater for two subwatersheds that are proposed development areas. The "north" subwatershed is north of Manitowoc Road as described in the opening paragraph. The "south" subwatershed is between Manitowoc Road and Natures Way where a commercial duplex/single-family residential subdivision is being planned.

The entire watershed drains primarily south and is serviced by storm sewer in urbanized areas. The Manitowoc Road storm sewer intercepts drainage from the north (north subwatershed) and discharges into the Oneida Street system. Stormwater then flows south into a concrete lined ditch along Oneida Street and eventually into Lake Winnebago. The area south of Manitowoc Road (south subwatershed) flows into a wetland south of Natures Way which discharges west to the concrete lined ditch along Oneida Street.

The hydrology and hydraulics were analyzed with the numerical stormwater computer program SWMM (Storm Water Management Model). This model worked well for this study because it can simulate rainfall events and route excess runoff through a complex network of storm sewer pipes and open channels. SWMM better simulates flow through pipes than many hydrologic routing methods that cannot simulate storage within the drainage network. The sophistication of SWMM was not required for this analysis but future studies may benefit from this detailed analysis.

Existing and proposed SWMM models were developed to estimate sizes of detention ponds. The 100-year storm event was used for analysis purposes to match existing and proposed discharge rates. Alternatives were considered for storage options and for alternative discharge points. Recommendations from this study include the following:

> New 8.7 ac-ft wet detention basin northwest of Manitowoc Road and Fieldview Drive. This basin will service new developments to the north and take the place of the small existing pond in the same location. The pond may discharge to the Manitowoc Road system while matching existing discharge rates for the 100-year event.
>
> New 1.8 ac-ft wet detention basin south of Natures Way. This basin will service the new residential development between Manitowoc Road and Natures Way including the adjacent areas that drain through the new development. The detention basin may need to be moved north of Natures Way dependent upon wetland limits and hydrologic conditions south of the roadway.

Both of these recommendations provide stormwater detention and treatment in accordance with the Wisconsin Administrative Code NR 216. The stormwater modeling in this study should be used as a planning tool and should not replace the design phase of the detention basins. This study will hopefully provide discussion topics and possibly be used for extended analysis within the watershed.

2.0 Project Information

The City of Menasha recently purchased open land (undeveloped) north of Manitowoc Road and east of Oneida Street in Calumet County. Development undoubtedly includes increased impervious areas that will increase peak runoff and degrade water quality. A regional look at the drainage system determined future stormwater management requirements for the City of Menasha. A proposed commercial duplex/single-family subdivision between Manitowoc Road and Natures Way is also a concern of the City to ensure proper stormwater management practices.

2.1 Project Description

The project area is an approximate 330 acre watershed along the eastern side of the City of Menasha in Calumet County. The study area is located approximately between STH 441 and STH 114 on the north and south sides. The western side of the watershed is along the USH 10 (Oneida Street) corridor and extends east to about Deerhaven Drive (Figure 2-1).

The watershed drains in a southerly direction towards Manitowoc Road. The portion of the watershed south of Manitowoc Road drains primarily south into the large wetland area south of Natures Way (Figure 2-2). The hydrologic soil group is classified as a "C" for this area and it has a significant influence from the Lake Winnebago water levels that often back up into roadside ditches. The lack of proper drainage at the lower end of this watershed, closer to Lake Winnebago, increases the sensitivity to urbanization in the watershed.

The majority of the development north of Manitowoc Road is residential with increasing institutional land use closer to the Oneida Street corridor. There is only marginal development south of Manitowoc Road consisting of commercial, light industrial, and residential land use. About 27% of the entire watershed has yet to reach a full development state (not including the Natures Way wetland). The mass of undeveloped area is northeast of Oneida Street and Manitowoc Road. There is also undeveloped land along the future Fieldview Drive extension, south of Manitowoc Road. These two areas are the focus of this study. The undeveloped areas will only aggravate flooding as they become developed unless water control devices are built to detain the increase in runoff volume.

The studied watershed discharges directly to Lake Winnebago via a concrete lined channel along Oneida Street. All of the developed areas of the watershed are drained via storm sewers. The secondary drainage system consists of overland flow although there are several areas that do not support positive drainage because of the topography has low spots (no secondary drainage system). There are not widespread drainage problems in the upper watershed; instead flooding problems are most prevalent along Oneida Street. Many of these problems appear to be a reflection of the tailwater created from Lake Winnebago that extends north along the Oneida Street conveyance channel.

There are two existing detention facilities just north of Manitowoc Road that were built as part of the residential subdivisions (see System Map, Appendix E). Specific geometry data was not available but the size and reported operation of the facilities do not have a significant impact on peak flow reduction for large storm events. The general drainage system for this watershed would be classified as adequate for the current land use of the watershed. The only exception would be areas which do not support overland flow (low spots) and rely solely upon the primary storm sewer system. These areas are susceptible to flooding and property damage during large storm events.

Future development will further exasperate the storm sewer system but will not have a direct or significant effect on the low areas upstream of future development. Urbanization north of Manitowoc Road will require a larger conveyance system downstream, or the acceptance of street flooding on

Project Location

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FIGURE 2-1
PROJECT LOCATION

City of Menasha *Wisconsin*

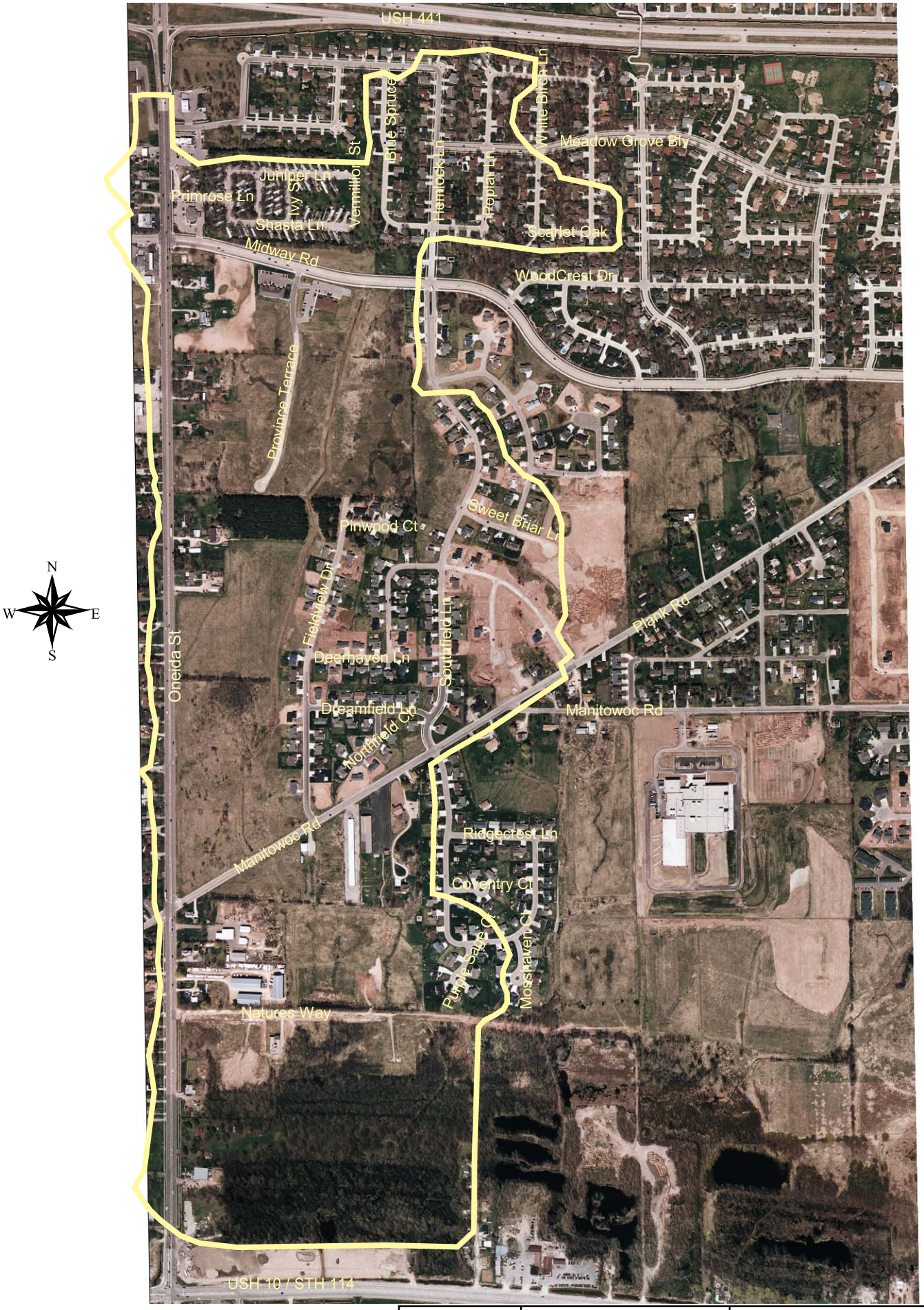

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FIGURE 2-2
WATERSHED AERIAL

City of Menasha *Wisconsin*

Manitowoc Road and Oneida Street. Furthermore, the Phase II Regulations of the Clean Water Act (legal binding for NR 216 Phase 2 in the State of Wisconsin) has water quantity and quality restrictions that would prohibit unmanaged stormwater entering waters of the state (Lake Winnebago). Development south of Manitowoc Road discharges towards the Natures Way wetland before it enters the Oneida Street ditch. NR 216 would apply to future development and require stormwater detention and treatment before water enters the wetlands.

2.2 Project Understanding

The focus of the project is on the newly acquired property in the northeast quadrant of Oneida Street and Manitowoc Road. This property may serve as a regional detention facility that could attenuate flood flows and improve stormwater quality after the area is developed. The goal of this study was to analyze the drainage system and estimate the size and location of facilities that will detain and treat stormwater in the future.

The intended purpose of this analysis is to support administrative decisions for reserving land and reviewing new developments in the drainage basin. The study will aid in any future grading and detention design in order to preserve the regional drainage plan. This study is a regional system evaluation with recommendations for maintaining the amount and quality of stormwater runoff from the study area.

A portion of this study also includes analysis of the commercial/duplex and single family home developments between Manitowoc Road and Natures Way (north of the wetlands). Proposed land use conditions will provide the City of Menasha and the developer with land area requirements to adequately manage stormwater.

3.0 Modeling Methodology

The watershed was analyzed with the numerical computer program PCSWMM 2002. PCSWMM is produced by Computation Hydraulics Int. (CHI) and provides a graphical user interface for the USEPA SWMM (Storm Water Management Model) program (PCSWMM 2002 GIS). The SWMM program was used because of the combination of both storm sewers and open channels in the watershed.

SWMM is a fully dynamic unsteady hydrologic and hydraulic model that can simulate rainfall events and route excess runoff through a complex network of storm sewer pipes, basins, and open channels. The sophistication of SWMM was not required for this analysis but future studies may be integrated with this model to study a larger portion of the surrounding area. The SWMM approach also allowed an analysis of the existing system to identify potential problem areas during larger storm events. The complexity of SWMM better simulates flow through pipes than many hydrologic routing methods that cannot simulate storage within the drainage network.

3.1 SWMM Criteria

The SWMM model was built with two of the modules within the SWMM program: RUNOFF and EXTRAN. RUNOFF is the hydrologic model that develops hydrographs at specific points within the drainage network. EXTRAN is the hydraulic model that routes the RUNOFF hydrographs through the pipe or open channel network.

RUNOFF uses four attributes (area, width, slope, percent impervious) from individual subbasins to generate hydrographs based upon precipitation, infiltration, and routing. These attributes will be discussed in the next section. Huff, 1st quartile, and SCS Type II (24-hour) rainfall distributions were tested with the completed SWMM model. A sensitivity analysis with the Huff distribution showed that the critical storm duration was less than 6 hours. The critical storm was defined as the rain event that produced the highest peak flow at the downstream end of the drainage system. Huff rainfall distributions and depths are based on a statistical study of Midwest rain gages and are considered a better representation of "actual" storm events.

Calumet County has a stormwater ordinance that specifies a 100-year SCS Type II distribution for detention pond sizing. For consistency with Calumet County it was decided that the Type II design storm should be used for this study. The SCS Type II storm is also considered a good estimate for pond sizing because it typically will produce a larger, more conservative, volume of runoff compared to other distributions during hydrograph generation. The chart below shows the Type II distribution and Table 3-1 shows the frequency distribution depths that are reported in Technical Paper 40.

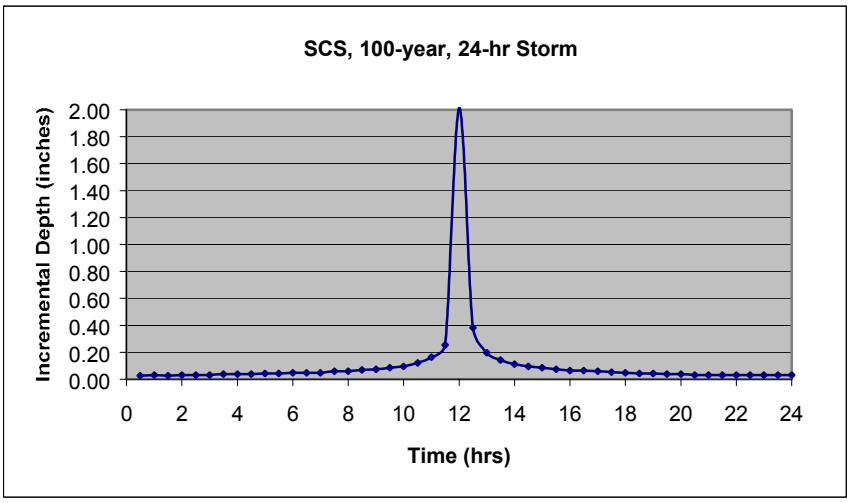


Table 3-1. NRCS Type II Rainfall Depths

Storm (frequency, duration)	Rainfall Depth (inches)
$P_{2,24}$	2.5
$P_{5,24}$	3.3
$P_{10,24}$	3.8
$P_{25,24}$	4.4
$P_{50,24}$	4.9
$P_{100,24}$	5.3

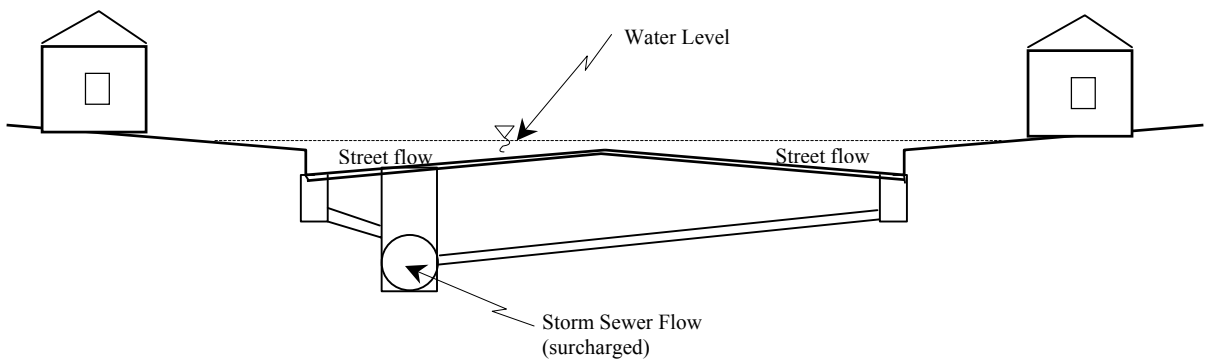
The Horton infiltration equation was used to model infiltration in pervious areas of the subbasins. Based upon the hydrologic soil conditions (HSG = C) the following equation variables were used in the model:

Max (initial) infiltration rate (f_o) : 2.5 in/hr
Min (ultimate) infiltration rate (f_α) : 0.15 in/hr
Decay coefficient (α) : 0.00115 1/sec

The global settings for hydrograph generation in RUNOFF consisted of using roughness values of 0.014 and 0.20 for impervious and pervious overland routing, respectively.

The EXTRAN model consisted of a pipe network, open channels, and storage areas to route hydrographs to the downstream discharge point. The SWMM network was created based upon modeling 15-inch or larger sewer pipes, although pipes as small as 12-inch were occasionally modeled if they drained a low point of the watershed (sag in roadway). Storage volume was defined at low points in the network where there was not positive drainage (overland flow). This was done for mass conservation in the numerical model and to represent ponding above an inlet.

Open channels were defined in the EXTRAN model to represent actual ditches, but to also simulate overland flow between inlets in the storm sewer system. Many times overland flow is not modeled in SWMM because of the additional input data required and the difficulty in balancing the numerical model, however, this study modeled both conveyance systems because a 100-year storm is likely to surcharge the sewer system and cause street (overland) flow. Also, inclusion of overland flow generates better runoff volume conservation within the SWMM model. The figure below illustrates a street cross section during extreme storm events.



3.2 SWMM Input Data

The subbasin attributes in RUNOFF were defined by the following guidelines and data sources:

Drainage Area
The drainage area of each individual subbasin was determined based on topography, land use, and inflow locations to the physical sewer/drainage network. Contour mapping from Calumet County (4-foot contour data), sewer system maps from the City of Menasha and the City of Appleton, and aerial photographs provided drainage path information that delineated the subbasins shown in Figure 3-1. Field reconnaissance and interviews with city personnel provided additional information to verify areas that could not be delineated from the contour maps.

Slope:
Contour information and spot elevations from system plans provided data needed to approximate the general slope of each subbasin.

Width:
The width was initially approximated based on the drainage area divided by the longest flow path. However, there are many instances where this is not prudent to use because of the spatial symmetry of the flow paths or the number of inlets and sewer pipes serving the basin.

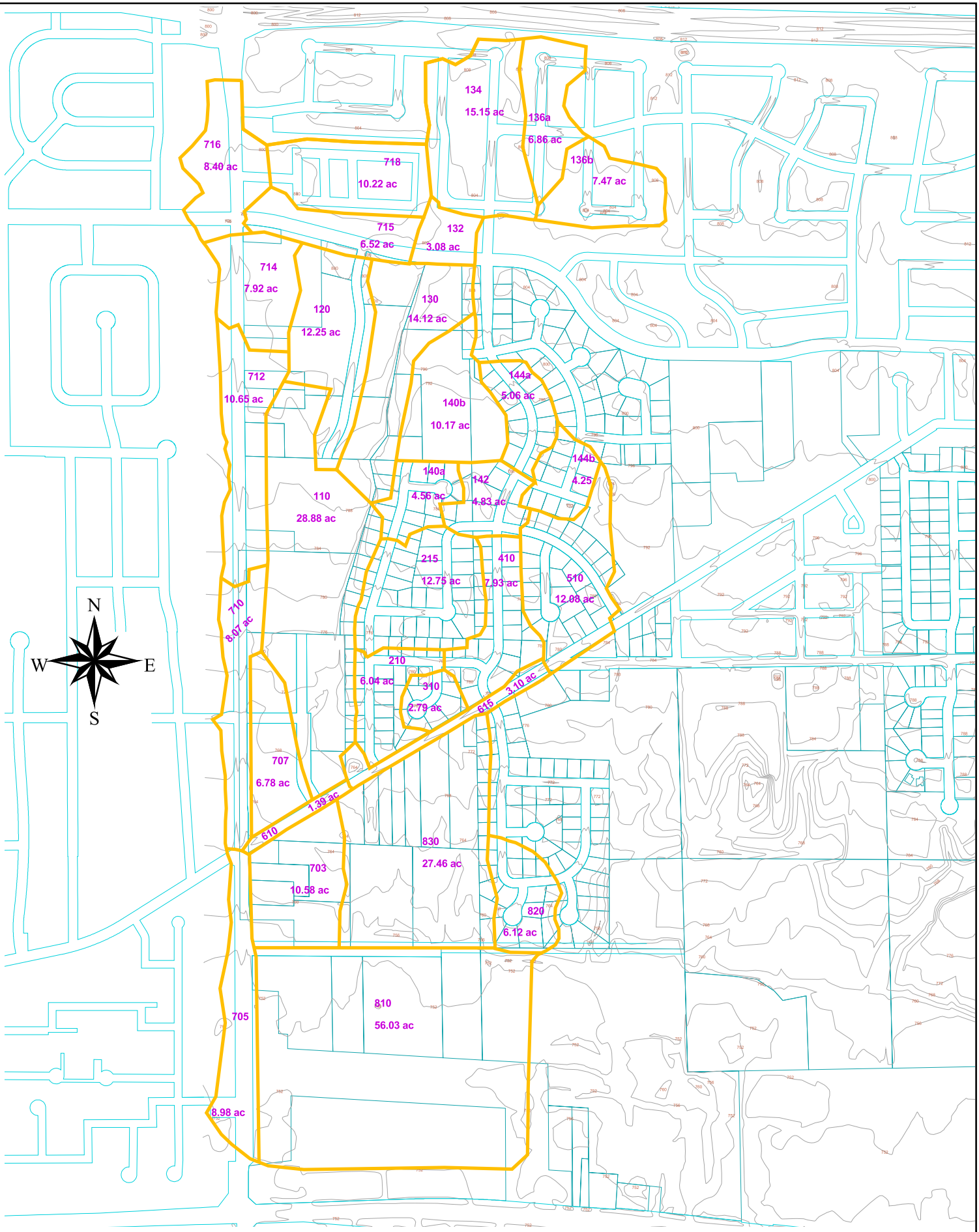


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FIGURE 3-1
SWMM Drainage Basins

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Impervious Area:
Aerial photos were used to classify each basin according to its land use. Each land use was assigned a "percent impervious" that was validated based upon sample measurements made from the aerial photos.

Table 3-2 shows the subbasin attributes that correspond to Figure 3-1. This study reviewed future conditions of the watershed by increasing the impervious area of eight subbasins. The developed conditions determined imperviousness based upon anticipated land uses (Figure 3-2).

Table 3-2. Subbasin Attributes used in SWMM

Basin Number	SWMM Basin	Area (acres)	Width (feet)	Slope (ft/ft)	Impervious (%), Existing	Impervious (%), Prop. Change
136b	3091	7.47	370	0.011	35	---
136a	3111	6.86	260	0.005	35	---
134	3131	15.15	610	0.006	35	---
132	3151	3.08	350	0.02	35	---
130	3171	14.12	360	0.0125	2	30
120	3191	12.25	650	0.007	20	50
144b	3201	4.25	310	0.02	35	---
144a	3211	5.06	300	0.012	35	---
142	3231	4.83	350	0.01	25	---
140b	3241b	10.17	530	0.015	2	35
140a	3241a	4.56	500	0.006	35	---
110	3181	28.88	575	0.016	2	85

215	3291	12.75	500	0.015	35	---
210	3271	6.04	270	0.01	35	---
310	3311	2.79	270	0.017	35	---
410	3251	7.93	370	0.01	35	---
510	3081	12.08	530	0.015	35	---
615	3051	3.10	700	0.01	90	---
610	3071	1.39	370	0.01	90	---

718	3331b	10.22	450	0.003	35	---
716	3331a	8.40	420	0.01	35	---
715	3341	6.52	280	0.005	50	---
714	3361	7.92	470	0.006	50	---
712	3421	10.65	800	0.006	50	85
710	3481	8.07	830	0.012	50	85

707	3321	6.78	275	0.013	2	85
705	3521	8.98	950	0.006	50	---
703	3501	10.58	590	0.017	80	---

830	3551	27.46	820	0.013	10	35
820	3531	6.12	370	0.012	35	---
810	3561	56.03	1700	0.005	2	---
TOTAL		**330.5**				

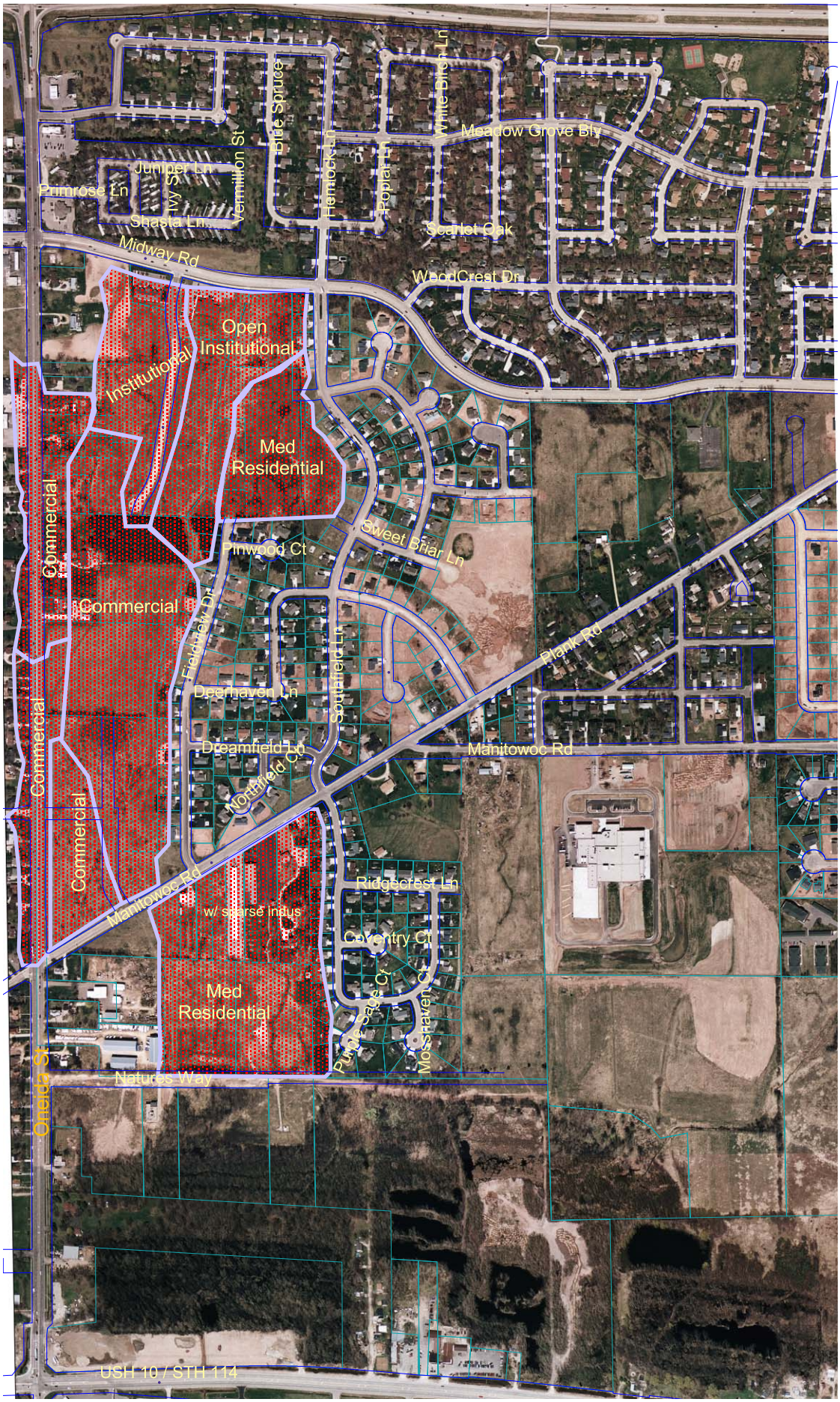

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FIGURE 3-2
Proposed Land Use Changes

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The EXTRAN module modeled the physical sewer and ditch system, including street flow between inlets. Input data was entered for the pipe inverts at each manhole as well as the rim elevation. Depending on the availability of street flow from an overtopped manhole, either a secondary conveyance system was constructed that represented overland flow or storage on the street was allowed. Storage, or ponding, on the street was modeled by roughly estimated the storage volume at a particular manhole location. Appendix B and D show the SWMM plan view schematics for existing and proposed conditions.

A free flow tailwater condition for the system was modeled at the outlet of the SWMM model. City officials reported a normal lake elevation of 747 feet which is just below the invert of the concrete lined channel at the SWMM outlet. Thus, increased lake levels, or storm surge, may limit the conveyance capacity of the concrete lined channel along Oneida Street, i.e. free flow condition may not always be valid.

4.0 Modeling Results

The purpose of this study was to estimate detention options for a regional detention facility based upon development northeast of Manitowoc Road / Oneida Street and south of Manitowoc Road (residential subdivision). The SWMM models were set up to model various frequency storms, but the controlling criteria for detention estimates was based on matching the 100-year post-developed flow rate to the 100-year-existing flow rate. The modeling results from existing and proposed conditions helped make estimates of detention storage which were verified within the SWMM model.

4.1 Street Flooding

Descriptions of the storm sewer operations are given below. A detailed frequency/capacity comparison was not completed for this project. However, various frequency storms were executed to "balance" the SWMM model and this output provided good insight to the hydraulic response of the drainage system. The majority of the observations below are based upon the 100-year design storm.

Oneida Street System
The Oneida Street storm sewer appears to have capacity to handle design storm events in the northern end of the line. Large storm events surcharge the sewer system and excess water floods the street and flows south. Near the intersection with Manitowoc Road the system is overwhelmed mainly because of the lack of capacity downstream of this junction. The pipe size upstream and downstream of the Manitowoc Road junction is a 43"x68" elliptical pipe (54" equivalent round). The sewer pipe coming into the junction from Manitowoc Road is also a 54-inch pipe.

The concrete lined channel that collects water from the Oneida Street storm sewer, as well as the wetland south of Natures Way, showed full flow conditions during extreme events. Based on the downstream boundary conditions used in the SWMM model (free flow conditions), flooding on Oneida Street would be expected if there were backwater in the channel. Backwater will likely affect the channel as a result of increased lake levels since the normal lake elevation (747 feet) is very close to the channel's invert elevation. Another possibility causing backwater may be from the cross culverts under Oneida Street (north of STH 114).

Manitowoc Road System
The Manitowoc Road storm sewer appears to have adequate capacity during frequent design storms. The capacity is compromised during large storm events where excess water is collected from Southfield

Drive, Northfield Court, and Fieldview Drive. A separate storm sewer system serves these streets but street flooding will flow into Manitowoc Road during large storm events. Street flooding on Manitowoc Road will flow east towards Oneida Street.

Fieldview Drive System
A low point between Deerhaven Drive and Dreamfield Lane is expected to flood during extreme rain events. Depending on the existence of overland flow paths, there may be property at risk from flood damage during heavy rain events. The topographic mapping from this study cannot conclude the extent of this low point. The storm sewer is expected to handle design flows and extreme events will overtop inlets and flow into the Manitowoc Road corridor. Street flooding near Manitowoc Road would likely be a result of highwater in the small detention facility. This detention facility collects water from both the Fieldview storm sewer and a minor sewer system paralleling Manitowoc Road. This minor system collects water from Northfield Court and Southfield Drive.

Scarlet Oak System
The City of Appleton has storm sewer that runs under Scarlet Oak and discharges to the drainage ditch just south of Midway Road. This sewer system is surcharged during the 100-year event with street flooding on Scarlet Drive. Runoff from this neighborhood, however, is assumed to only use the sewer system before discharging to the drainage ditch instead of overflowing Midway Drive.

Deerhaven Drive System
This system includes the storm sewer that discharges from Province Terrace into the drainage ditch, and also the sewer that drains into the ditch from under Deerhaven Drive. The storm sewer from Province Terrace is capable of handling large storm events (100-year), although this system will become surcharged after development progresses along the roadway for similarly large storm events.

The primary line of the Deerhaven Drive system is storm sewer that drains Sweetbriar Drive and a portion of Deerhaven Drive before discharging into the drainage ditch west of Fieldview Drive. Street flooding is evident during the 100-year storm. There appears to be a positive overland flow path that can discharge to the drainage ditch during large events like the 100-year event. There is a sag at the east end of Sweetbriar Drive that will pond and will likely have deeper flood depths than the rest of this system.

South of Manitowoc Road
This area contains limited storm sewer that discharges from Purple Sage Court into the wetland area. It appears that Purple Sage Court may flood severely before a secondary overland flow path is found during a 100-year storm. Additional topographic detail would need to be gathered to confirm this finding, although excessive peak flow rates into the wetland are not expected from this neighborhood because of the small drainage area. The storm sewer acts as a restrictor that attenuates peak flows.

The above problem areas were not quantified to determine the frequency of street flooding because of the scope of this study. However, SWMM results provided good flow estimates because this hydraulic model considered attenuation (storage) within the drainage system for the 100-year storm event. A frequency/capacity analysis could provide a priority list of areas that are more susceptible to flooding and help make sewer improvement decisions.

4.2 Flow and Volume from Proposed Developments

The two proposed areas of development flow to different locations (Figure 4-1). Each of these discharge points is what was used to compare existing and proposed discharge rates. Both of these locations ultimately drain into the Oneida Street ditch before flowing into Lake Winnebago.

North Manitowoc Road
The outlet location used for the 100-year comparison criteria was at the 48-inch inlet pipe just north of Manitowoc Road. This inlet pipe drains about 117 acres from the existing drainage ditch; this subwatershed contains most of the undeveloped areas of the study area.

South Manitowoc Road
The undeveloped area south of Manitowoc Road (proposed residential subdivision) is contained within one 27 acres subbasin modeled in SWMM (basin 830). The hydrologic runoff from existing and proposed conditions was used for comparison purposes.

Table 4-1 shows the existing and proposed 100-year discharge rates, and the proposed runoff volume, for both of the areas described above. The estimated storage volume was calculated based on NRCS storage volume estimate procedures.

Table 4-1. Estimated Storage Required After Development

	North Manitowoc Road	South Manitowoc Road (residential development)
Existing Flow (100-year)	171 cfs	40 cfs
Proposed Flow (100-year)	273 cfs	66 cfs
Proposed Runoff Volume	36 ac-ft	7.6 ac-ft
Estimated Storage Volume	**8.3 ac-ft**	**1.8 ac-ft**

The storage volume estimates will likely change during design of a specific facility. However, these estimates give guidance for planning purposes and discussions in the Alternatives Section.

5.0 Alternatives

The two areas proposed for development in the near future were shown in Figures 3-2 and 4-1. Alternatives for each of these areas are discussed below based upon modeling results, storage estimates, discussions with the City of Menasha, and the Wisconsin Department of Natural Resources.

5.1 North Manitowoc Road

Three alternatives (N1, N2, and N3) for storage locations were reviewed based upon topography and land availability.

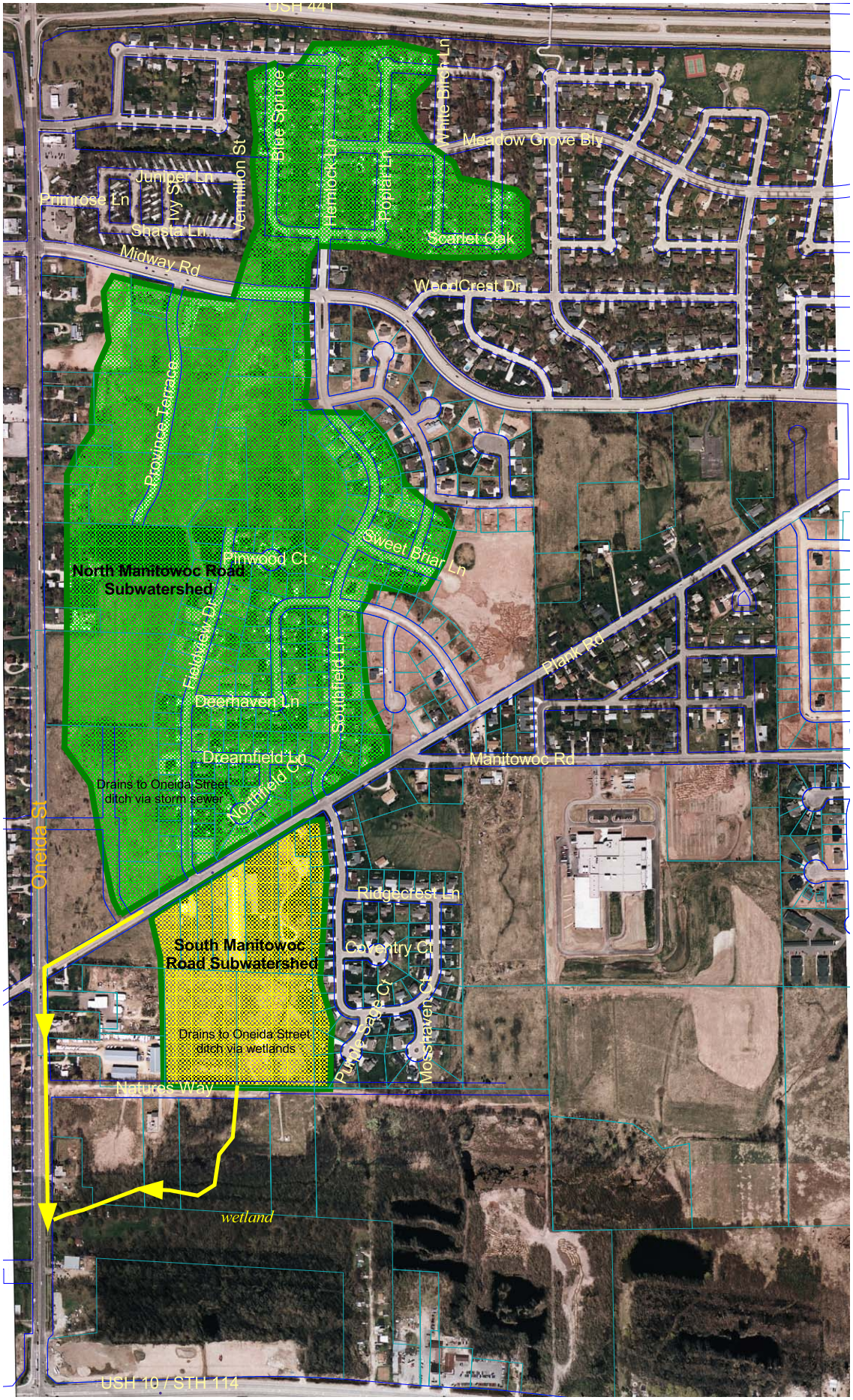

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FIGURE 4-1
Subwatersheds
(North Manitowoc Rd / South Manitowoc Rd)

City of Menasha *Wisconsin*

5.1.1 Reroute south to Natures Way wetland (Alternate N1)

An option to route stormflows into the wetland south of Natures Way was considered because this would reduce inflow to the Manitowoc Road storm sewer system (Figure 5-1). This option would take undetained flows and convey them to a detention facility south of Natures Way; attenuated flows from the detention basin would then flow into the wetland and ultimately drain into the Oneida Street ditch.

This alternative would require a cross culvert under Manitowoc Road and a drainage swale that would flow south into the detention facility between Natures Way and the wetland (a storm sewered system is also a consideration from north of Manitowoc Road to south of Natures Way). The detention facility would need a wet pond of approximately 8.3 ac-ft in size. Groundwater levels would need to be determined and considered in any design process to properly size the facility. A clay liner 6 to 12 inches thick may also be required dependent upon water levels or possible contamination concerns.

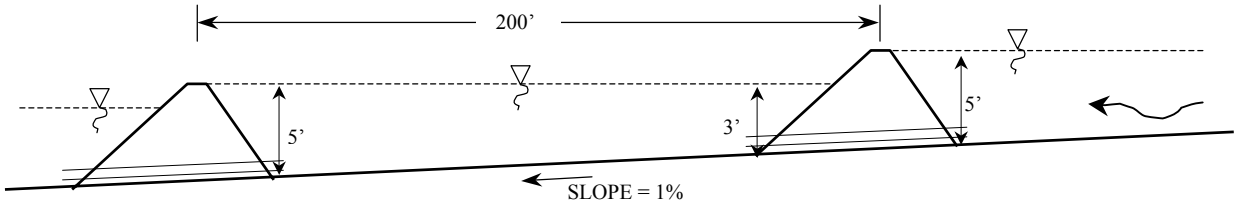
The WDNR would allow this option, although the increased volume of water entering the wetland would need to be quantified with respect to 1.) potential adverse impacts to adjacent property owners and 2.) adverse effects to the plant life. This wetland contains woodland that could be converted to cattails if there is too much additional water introduced.

The existing wetlands will be delineated during the spring of 2003 to determine if there is sufficient room to construct a detention facility outside of the wetland limits. It is anticipated that there will not be enough space for detention basin construction between Natures Way and the wetland which would eliminate this option from consideration.

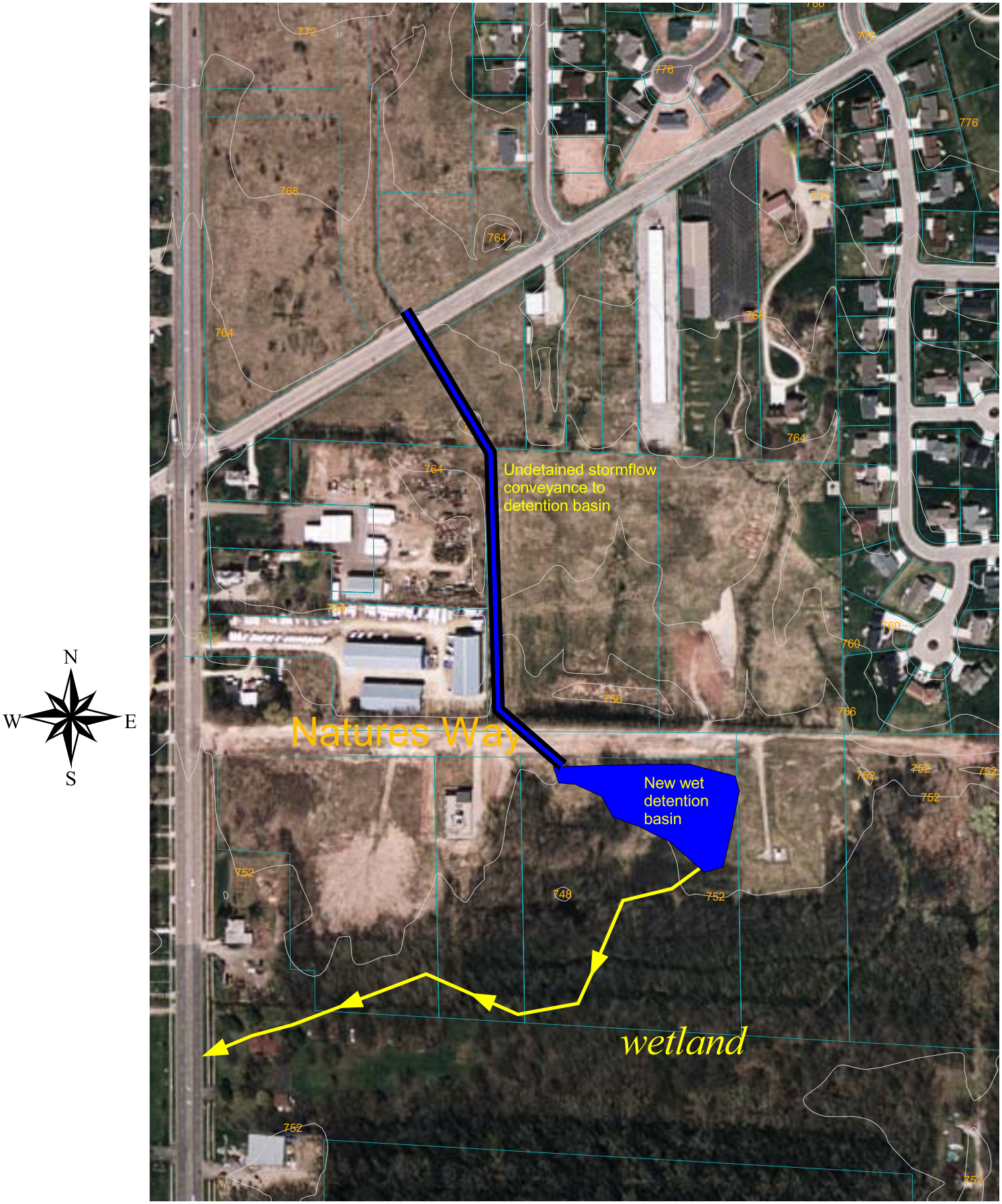
5.1.2 Linear Detention (Alternate N2)

A linear detention facility upstream of Manitowoc Road was considered along the existing drainage. This option would also include a wet detention pond just north of Manitowoc Road (Figure 5-2).

The existing drainage ditch is contained in a 60-foot corridor. The ditch has an average longitudinal slope of 1% and 4:1 sideslopes. Constructing a series of 13 check dams in the existing ditch could detain about 4.1 ac-ft of water. The dams would have a maximum head of 5 feet at each dam and would hold back an impoundment for 200 feet upstream (water depth upstream would be about 3 feet). This conceptual plan was based upon the maximum stage overflowing the dam and still allowing some freeboard along the sideslopes to protect adjacent property owners. The diagram below shows the conceptual layout of one of the dam segments.



The 13 linear dams would have a sum length of 2,600 feet and could hold back 4.1 ac-ft of the estimated 8.3 total detention volume. A wet pond with a storage volume of 4.2 ac-ft would also be required for the additional volume requirement and for water quality considerations. This option could be constructed in phases to coincide with development. That is, the wet pond could be constructed at first with additional dams built later.



300 0 300 Feet

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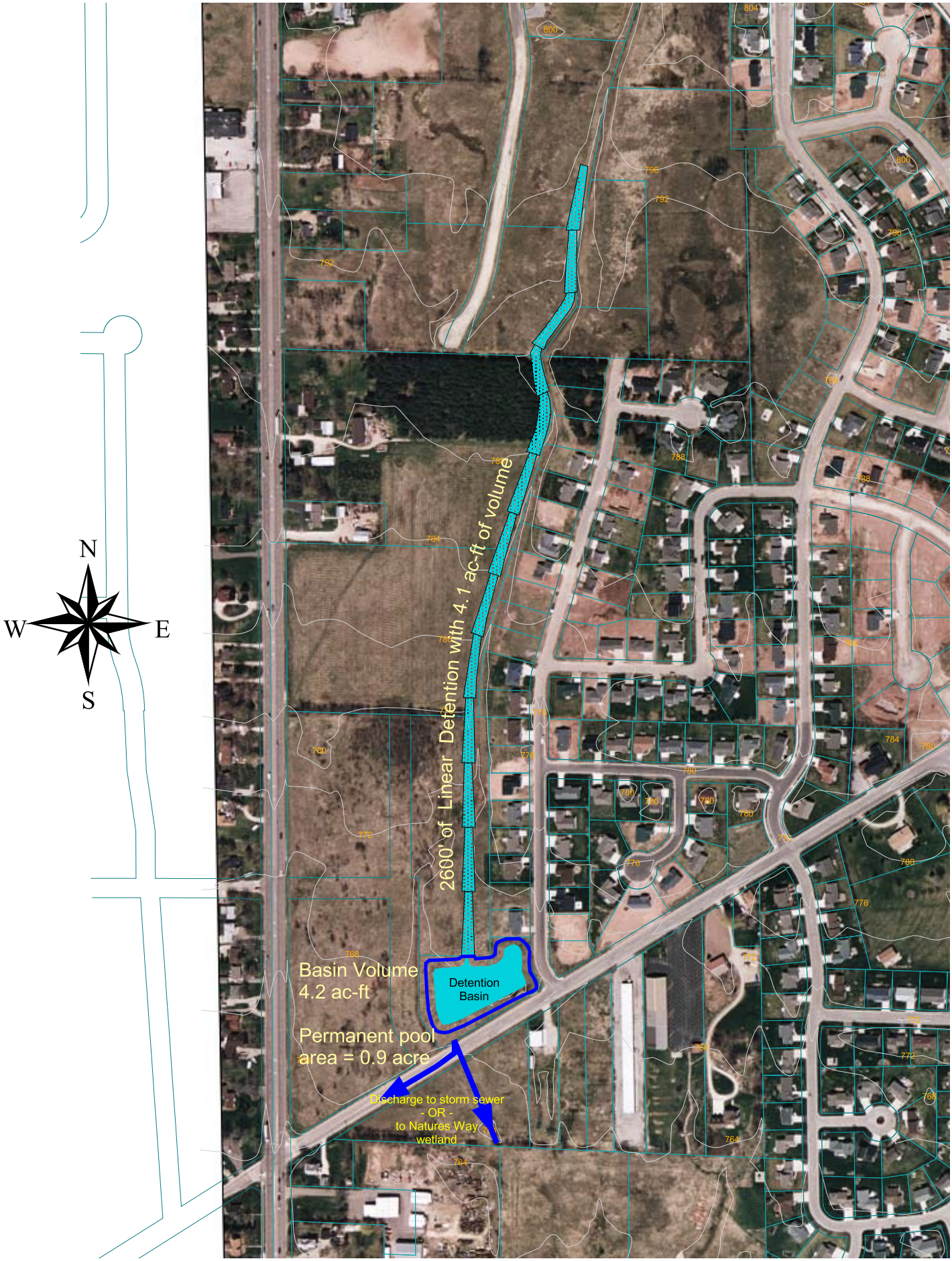
FIGURE 5-1
Alternate N1
Reroute towards Natures Way
City of Menasha *Wisconsin*



200 0 200 400 Feet

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FIGURE 5-2
Alternate N2
Linear Detention

City of Menasha *Wisconsin*

5.1.3 Single Detention Basin (Alternate N3)

A single detention basin could be constructed north of Manitowoc Road upstream of the existing 48-inch sewer pipe. This wet detention basin may also consume the existing small detention pond built northwest of Manitowoc Road / Fieldview Drive.

Incorporating the existing small pond in the design will require an estimated 0.2 to 0.4 ac-ft of detention volume (the existing pond was estimated to have about 0.2 ac-ft of available storage). The proposed wet detention basin would therefore need about 8.7 ac-ft of detention based upon the 100-year storm event. Figure 5-3 shows the approximate location of this alternative.

This alternative would accept water not only from the north (new developed areas) but also the 21-inch sewer pipe discharging from Fieldview Drive (21-inch pipe currently drains into small detention pond). A sediment forebay and low flow berms within the pond will increase the flow paths and increase the amount of suspended solids settling in the bottom of the facility.

5.1.3 Optional discharge points Manitowoc Road Detention

Sections 5.1.2 and 5.1.3 discuss detention options upstream of Manitowoc Road. These facilities were conceptually sized for discharge into the Manitowoc Road storm sewer system (same discharge point as existing drainage swale through this area). An alternative to this discharge point would be to pipe the water into the wetland south of Natures Way. The same concerns regarding increased water to the wetland, discussed in Section 5.1.1, should be addressed before starting any design. The benefit of rerouting the attenuated flood flows to the wetland is that it would relieve the storm sewer junction at Oneida Street and Manitowoc Road.

5.2 South Manitowoc Road

Two alternatives (S1 and S2) for stormwater detention were considered for post-developed conditions between Manitowoc Road and Natures Way. The 27 acre subbasin considered for full medium residential housing includes a portion southwest of Manitowoc Road / Southfield Drive that is already developed. The proposed residential housing development is only about 12 acres, however, topographic maps show this area is within a cumulative 27 acre watershed that drains south into the wetland, i.e. detention volume estimates assume stormwater management for the full 27 acre subbasin.

5.2.1 Detention North of Natures Way (Alternate S1)

This alternative assumes a wet detention pond with 1.8 ac-ft of available detention north of Natures Way on private property (Figure 5-4).

5.2.2 Detention South of Natures Way (Alternate S2)

This alternative assumes a wet detention pond with 1.8 ac-ft of available detention between the wetland and Natures Way (Figure 5-4). A wetland delineation that will be conducted in the spring of 2003 will determine if this is a viable alternative.

Both of these alternatives could have many different geometric pond designs and may change the storage requirement depending on the specific land use and grading considerations. If detention storage is required on the north side of Natures Way, then the developer should reserve at least one full-sized lot for stormwater purposes.

N
W E
S

100 0 100 200 Feet

Menasha

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FIGURE 5-3
Alternate N3
Single Detention Basin

City of Menasha *Wisconsin*

100 0 100 200 Feet

FIGURE 5-4
Alternates S1 and S2
Detention Basin Options for Residential Development
City of Menasha *Wisconsin*

6.0 Recommendations

The recommendations from this study include designing a single wet detention pond north of Manitowoc Road (Alternate N3) to manage stormwater in this area. Alternate S2 (new pond south of Natures Way) is recommended for the residential development south of Manitowoc Road.

6.1 North Manitowoc Road

The main reasoning for recommending Alternate N3 (single pond) north of Manitowoc Road is because water quality goals will be more obtainable with this option. Wisconsin Administrative Code NR 216 under the Wisconsin Pollution Discharge Elimination System (WPDES) outlines an 80% sediment reduction on an average annual basis. A wet pond prescribed according to WDNR's Wet Detention Basin design is a suggested approach that will meet NR 216 guidelines. Based on guidelines for calculating the surface area of a wet detention basin, the recommended permanent pool surface area should be about 1.5 acres. Alternate N3 has about the same permanent pool surface area. Thus, water quality goals could be more difficult to meet if the linear storage alternate (Alternate N2) is considered for design because it has a smaller wet pond surface area.

It does not appear that there will be enough space to construct a large pond south of Natures Way to facilitate Alternate N1 which would convey undetained flows just upstream of the wetland. Also, routing any additional water into the wetland from north of Manitowoc Road will require an environment study of the wetland to determine the effect of the additional water to the plant life of the wetland. The risk of property damage from additional water flowing into the wetland would need to be quantified from modeling results and a detailed field survey. However, mitigating property damage risk is likely easier than preserving the plant habitat.

Pond storage data was entered into the SWMM model for proposed runoff conditions. SWMM estimated the 100-year max stage of the pond at 5.1 feet (Elevation 766.1 feet) with a discharge of 144 cfs (existing discharge estimated at 171 cfs). The SWMM model included the inflow from the north but also from the 21-inch pipe that drains into the existing detention pond. These results confirm the initial detention volume estimate of 8.7 ac-ft.

The conceptual layout of the pond assumed a bottom elevation of 756 feet and a permanent pool elevation of 761 feet. A 3-foot minimum permanent pool depth is recommended for water quality purposes and 2 additional feet are needed for sediment storage. A 6 to 12 inch clay liner on the bottom and sideslopes may be needed to retain the permanent pool depending on soil conditions. A forebay and berms are recommended (Figure 5-3) to extend the residence time and increase settling of suspended solids in the basin during water quality events (1 to 2-year storm frequency).

6.2 South Manitowoc Road

If there is sufficient space to construct a wet detention pond according to NR216 guidelines south of Natures Way and outside of the wetland limits, then the owner of the proposed residential development may consider purchasing this land to save space for housing units north of Natures Way.

If a pond is feasible south of Natures Way then groundwater and lake elevations should be considered in the hydraulic sizing of the pond. A high backwater condition from the wetland may play a role in the available storage in the pond.

7.0 Conclusion

The purpose of this study was to support administrative decisions for reserving land and reviewing new developments in the drainage basin. The stormwater modeling in this study should be used as a planning tool and should not replace the design phase of the detention basins. This study will hopefully provide discussion topics and possibly be used for extended analysis within the watershed.

The City of Menasha is approaching development challenges in a proactive way by planning stormwater management facilities before options become limited. Regional stormwater management is beneficial because the municipality has control and insurance that the facility will be constructed properly and meet water quantity and quality standards. It will also minimize the review time of drainage plans for new developments in this area and make a higher percentage of the lot space available for development.

The northeast quadrant of Manitowoc Road and Oneida Street has a portion of land approximately 7 acres that currently drains towards Oneida Street according to topographic mapping. This area will need to have stormwater management restrictions for new developments if they discharge to the Oneida Street storm sewer. It may be beneficial to incorporate this area into the recommended detention pond west of Fieldview Drive if this is possible.

The results of the study extend beyond defining storage requirements for the watershed. The data currently contained in the SWMM model may be used to address conveyance and flooding problems elsewhere in the watershed. The SWMM model may also be incorporated with adjacent watersheds to rank problem areas and generate feasible solutions.